Illinois Power Resource Generating, LLC
1500 Eastport Plaza Dr.
Collinsville, IL 62234

January 28, 2022

Illinois Environmental Protection Agency
DWPC – Permits MC #15
Attn: Part 845 Coal Combustion Residual Rule Submittal
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

Re: Duck Creek Power Plant GMF Pond; IEPA ID # W0578010001-04

Dear Mr. LeCrone:

In accordance with 35 I.A.C. § 845.200, Illinois Power Resource Generating, LLC (IPRG) is submitting a construction permit application for the Duck Creek Power Plant GMF Pond (IEPA ID # W0578010001-04). One hardcopy is provided with this submittal.

The permit application was prepared in accordance with 35 I.A.C. § 845.220 (a) and (d). This submittal includes the completed permit forms as required by § 845.210.

Sincerely,

Cynthia Vodopivec
SVP-Environmental Health and Safety

Enclosures

Form CCR 1	Illinois Environmental Protection Agency CCR Surface Impoundment Permit Application Form CCR 1 – General Provisions

Bureau of Water ID Number:
W0578010001

CCR Permit Number:
Initial Permit

Facility Name:
Duck Creek Power Plant

For IEPA Use Only

SECTION 1: FACILITY, OPERATOR, AND OWNER INFORMATION (35 Ill. Adm. Code 845.210(b))

Facility, Operator, and Owner Information

1.1	Facility Name		
	Illinois Power Resources Generating, LLC - Duck Creek Power Plant		
1.2	Illinois EPA CCR Permit Number (if applicable)		
	Initial Permit		
1.3	Facility Contact Information		
	Name (first and last) Phil Morris	Title Senior Director - Environmental	Phone Number 618-343-7794
	Email address phil.morris@vistracorp.com		
1.4	Facility Mailing Address		
	Street or P.O. box 1500 Eastport Plaza Dr		
	City or town Collinsville	State IL	Zip Code 62234
1.5	Facility Location		
	Street, route number, or other specific identifier 17751 North CILCO Road		
	County name Fulton	County code (if known)	
	City or town Canton	State IL	Zip Code 61520
1.6	Name of Owner/Operator		
	Illinois Power Resources Generating, LLC		

Facility, Operator, and Owner Info				
	1.7	Owner/Operator Contact Information		
		Name (first and last) Phil Morris	Title Senior Director - Environmental	Phone Number 618-343-7794
		Email address phil.morris@vistracorp.com		
	1.8	Owner/Operator Mailing Address		
		Street or P.O. box 1500 Eastport Plaza Dr		
		City or town Collinsville	State IL	Zip Code 62234

SECTION 2: LEGAL DESCRIPTION (35 Ill. Adm. Code 845.210(c))

Legal Description		
	2.1	Legal Description of the facility boundary
		See Attachment A.

SECTION 3: PUBLICLY ACCESSIBLE INTERNET SITE REQUIREMENTS (35 Ill. Adm. Code 845.810)

Internet Site					
	3.1	Web Address(es) to publicly accessible internet site(s) (CCR website)			
		www.luminant.com/illinois-ccr/			
	3.2	Is/are the website(s) titled “Illinois CCR Rule Compliance Data and Information”			
		☑	Yes	☐	No

SECTION 4: IMPOUNDMENT IDENTIFICATION

Impoundment Identification				
	4.1	List all the impoundment identification numbers for your facility and check the corresponding box to indicate that you have attached a written description for each impoundment.		
		W0578010001-04 (see Attachment A)	☑	Attached written description
			☐	Attached written description
			☐	Attached written description
			☐	Attached written description
			☐	Attached written description
			☐	Attached written description

		☐	Attached written description
		☐	Attached written description
		☐	Attached written description
		☐	Attached written description

SECTION 5: CHECKLIST AND CERTIFICATION STATEMENT

Checklist and Certification Statement

5.1 In Column 1 below, mark the sections of Form 1 that you have completed and are submitting with your application. For each section, specify in Column 2 any attachments that you are enclosing.

Column 1		Column 2	
Section 1: Facility, Operator, and Owner Information	☑	w/attachments	☐
Section 2: Legal Description	☑	w/attachments	☑
Section 3: Publicly Accessible Internet Site Requirement	☑	w/attachments	☐
Section 4: Impoundment Identification	☑	w/attachments	☑

5.2 **Certification Statement**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name (print or type first and last name) of Owner/Operator	Official Title
Cynthia Vodopivec	SVP - Environmental
Signature: Cynthia S. Vodopivec	Date Signed: 1/27/2022

Form 2CC	Illinois Environmental Protection Agency CCR Surface Impoundment Permit Application Form CCR 2CC – Closure Construction

Bureau of Water ID Number: W0578010001 **CCR Permit Number:** Initial Permit **Facility Name:** Duck Creek Power Plant	For IEPA Use Only

SECTION 1: DESIGN AND CONSTRUCTION PLANS (35 Ill. Adm. Code 845.220)

Design and Construction Plans (Construction History)	1.1	CCR surface impoundment name.
		GMF Pond and GMF Recycle Pond
	1.2	Identification number of the CCR surface impoundment (if one has been assigned by the Agency).
		W0578010001-04
	1.3	Describe the boundaries of the CCR surface impoundment (35 Ill. Adm. Code 845.210 (c)).
		See Attachment A.
	1.4	State the purpose for which the CCR surface impoundment is being used.
		See Attachment B.
	1.5	How long has the CCR surface impoundment been in operation?
		See Attachment B.
	1.6	List the types of CCR that have been placed in the CCR surface impoundment.
		See Attachment B.

Design and Construction Plans (Continued)	1.7	List the name of the watershed within which the CCR surface impoundment is located.	
		See Attachment B.	
	1.8	What is the size in acres of the watershed within which the CCR surface impoundment is located?	
		See Attachment B.	
	1.9	Check the corresponding boxes to indicate that you have attached the following:	
		☑	A description of the physical and engineering properties of the foundation and abutment materials on which the CCR surface impoundment is constructed.
		☑	A statement of the type, size, range, and physical and engineering properties of the materials used in constructing each zone or stage of the CCR surface impoundment.
		☑	A statement of the method of site preparation and construction of each zone of the CCR surface impoundment.
		☑	A statement of the approximate dates of construction of each successive stage of construction of the CCR surface impoundment.
		☑	Drawings satisfying the requirements of 35 Ill. Adm. Code 845.220(a)(1)(F).
		☑	A description of the type, purpose, and location of existing instrumentation.
		☑	Area capacity curves for the CCR impoundment.
		☑	A description of each spillway and diversion design features and capacities and provide the calculations used in their determination.
		☑	The construction specifications and provisions for surveillance, maintenance, and repair of the CCR surface impoundment.
	1.10.1	Is there any record or knowledge of structural instability of the CCR surface impoundment?	
		☐ Yes	☑ No
	1.10.2	If you answered yes to Item 1.10.1, provide detailed explanation of the structural instability.	

SECTION 2: NARRATIVE DESCRIPTION OF THE FACILITY (35 Ill. Adm. Code 845.220)

Narrative Description

2.1	List the types of CCR expected in the CCR surface impoundments.			
	See Attachment B.			
2.2	Have you attached a chemical analysis of each type of expected CCR?			
	☑	Yes		
2.3	Estimate of the maximum capacity of the surface impoundment in gallons or cubic yards.			
	See Attachment B.			
2.4	The rate at which CCR and non-CCR waste streams currently enter the CCR impoundment in gallons per day and dry tons.			
	0	GPD	0	dTn
2.5	Estimate length of time the CCR surface impoundment will receive CCR and non-CCR waste streams.			
	NA			
2.6	Have you attached an on-site transportation plan that includes all existing and planned roads in the facility that will be used during the operation of the CCR surface impoundment?			
	☑	Yes		

SECTION 3: MAPS (35 Ill. Adm. Code 845.220)

Maps

3.1	Check the corresponding boxes to indicate that you have attached the following maps:	
	☑	A site location map on the most recent United Sates Geological Survey (USGS) quadrangle of the area from the 7 ½ minute series (topographic) or on another map whose scale clearly shows the information required in 35 Ill. Adm. Code 845.220(a)(3).
	☑	Site plans maps satisfying the requirements of 35 Ill. Adm. Code 845.220(a)(4).

SECTION 4: ATTACHMENTS

Attachments

4.1	Check the corresponding boxes to indicate that you have attached the following:	
	☑	A narrative description of the proposed construction of, or modification to, a CCR surface impoundment and any projected changes in the volume or nature of the CCR or non-CCR waste streams.
	☑	Plans and specifications fully describing the design, nature, function, and interrelationship of each individual component of the facility.
	☑	The signature and seal of a qualified professional engineer.
	☑	Certification that the owner or operator of the CCR surface impoundment completed the public notification and public meetings required under 35 Ill. Adm. Code 845.240.

Attachments (Continued)		✔	A summary of the issues raised by the public during the public notification and public meetings.
		✔	A summary of any revisions, determinations, or other considerations made in response to those issues raised by the public during the public notification and public meetings.
		✔	A list of interested persons in attendance who would like to be added to the Agency's listserv for the facility.
		✔	Certification that all contractors, subcontractors, and installers utilized to construct, install, modify, or close a CCR surface impoundment are participants in a training program that is approved by and registered with the U.S. Department of Labor's Employment and Training Administration and that includes instruction in erosion control and environmental remediation.
		✔	Certification that all contractors, subcontractors, and installers utilized to construct, install, modify, or close a CCR surface impoundment are participants in a training program that is approved by and registered with the U.S. Department of Labor's Employment and Training Administration and that includes instruction in the operation of heavy equipment and excavation.
SECTION 5: GROUNDWATER MONITORING PROGRAM			
Groundwater Monitoring	5.1	Indicate that you have attached the following components of a new groundwater monitoring program or any modifications to an existing groundwater monitoring program by checking the corresponding boxes:	
		✔	A hydrogeologic site investigation meeting the requirements of 35 Ill. Adm. Code 845.620, if applicable.
		✔	Design and construction plans of a groundwater monitoring system meeting the requirements of 35 Ill. Adm. Code 845.630.
		✔	A proposed groundwater sampling and analysis program that includes selection of the statistical procedures to be used for evaluating groundwater monitoring data as required by 35 Ill. Adm. Code 845.640 and 845.650.
SECTION 6: CLOSURE (35 Ill. Adm. Code 845.220(d))			
Closure	6.1	What is the closure prioritization category under 35 Ill. Adm. Code 845.700(g), if applicable?	
		Category 3	
	6.2	Indicate that you have attached the following by checking the corresponding boxes:	
		✔	The final closure plan, as specified in 35 Ill. Adm. Code 845.720(b), which includes the closure alternatives analysis required by 35 Ill. Adm. Code 845.710.
		✔	Proposed schedule to complete closure.
		✔	Post-closure care plan as specified in 35 Ill. Adm. Code 845.780(d).
SECTION 7: GROUNDWATER MODELING (35 Ill. Adm. Code 845.220(d)(3))			
Groundwater	7.1	Indicate that you have attached the following by checking the corresponding boxes:	
		✔	The results of groundwater contaminant transport modeling and calculations showing how the closure will achieve compliance with the applicable groundwater standards.
		✔	All modeling inputs and assumptions.
		✔	Description of the fate and transport of contaminants with the selected corrective action over time.

		☑	Capture zone modeling, if applicable.
		☑	Any necessary licenses and software needed to review and access both the model and the data contained within the model.

GOLDER
MEMBER OF WSP

PERMIT APPLICATION

Part 845 Construction Permit Application for the Gypsum Management Facility Pond

Duck Creek Power Plant

Submitted to:

Illinois Environmental Protection Agency

1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276

Submitted by:

Illinois Power Resources Generating, LLC

1500 Eastport Plaza Drive
Collinsville, Illinois 62234

Compiled by:

Golder Associates USA Inc.

701 Emerson Road, Suite 250
Creve Coeur, Missouri 63141

21454861-7-R-1

January 25, 2022

Executive Summary

Introduction

Illinois Power Resources Generating, LLC (IPRG) owns and operates the Gypsum Management Facility (GMF) Pond at the Duck Creek Power Plant in Fulton County, Illinois. The GMF Pond is a coal combustion residuals (CCR) surface impoundment that was used to manage gypsum produced at the Duck Creek Power Plant from the time construction of the GMF Pond was completed in early 2009 until the power plant was retired in December 2019. Since the retirement of the Duck Creek Power Plant, the GMF Pond has no longer received CCR or any other waste stream. IPRG is submitting this Part 845 Construction Permit Application for the GMF Pond to provide the Illinois Environmental Protection Agency (IEPA) with the information required under 35 Illinois Administrative Code (I.A.C.) 845, Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments (Part 845) for closure of the GMF Pond.

Closure Method Selection

As required under 35 I.A.C. § 845.710, a closure alternatives analysis has been completed to identify the most appropriate closure method for the GMF Pond. The following closure alternatives were evaluated:

- closure by removal of CCR with disposal in an on-site landfill
- closure by removal of CCR with disposal in an off-site landfill
- closure with a final cover system constructed over the CCR

Based on the findings of the closure alternatives analysis, the GMF Pond will be closed with a final cover system (i.e., closure in place). The closed GMF Pond will contain approximately 400,000 cubic yards of CCR. Closure in place will be completed in accordance with 35 I.A.C. § 845.750.

Closure Method Description

The GMF Pond has a dual composite liner system with a leachate collection and removal system. These systems will remain in place below the closure footprint to minimize the release of CCR or leachate to groundwater or the atmosphere. Closure of the GMF Pond will begin with the removal of supernatant water contained in the GMF Pond. Water removed from the GMF Pond will be managed in accordance with the National Pollutant Discharge Elimination System (NPDES) permit for the Duck Creek Power Plant. The gypsum currently contained within an approximate 15-acre area in the northern portion of the GMF Pond will remain in place. The upper gypsum layer in this northern portion will be dewatered as necessary to allow mobile equipment traffic across the surface using a series of trenches and sumps, and free liquids will be eliminated by removing liquid wastes or solidifying the remaining wastes and waste residues. Water flowing to the sumps will be pumped out and managed in accordance with the NPDES permit for the Duck Creek Power Plant. An earthen containment berm will be constructed across the southern limit of the 15-acre area to enhance the structural stability of the closed GMF Pond and reduce the closure footprint. A composite liner system will be installed on the upstream face of the containment berm and tied into the existing liner system. Gypsum currently situated south of the containment berm will be loaded, hauled, and placed atop the existing gypsum north of the containment berm (i.e., within the closure footprint) to establish closure grades. After closure grades have been established, a final cover system meeting the requirements of 35 I.A.C. § 845.750 will be constructed over the gypsum to minimize the post-closure

infiltration of liquids into the waste. The liner system and the cover system will provide complete encapsulation of gypsum in the GMF Pond, physically isolating it from contact with surrounding soils, groundwater, surface water, and the atmosphere.

In portions of the GMF Pond that are outside of (i.e., generally south of) the closure footprint, the primary composite liner system, the leachate collection and removal system, and the geosynthetic components of the secondary composite liner system will be removed and disposed in the closure footprint or the existing permitted on-site landfill. Up to 1 foot of additional subsoil may also be removed. The existing permitted on-site landfill has sufficient capacity to accept the removed materials. The subsoils will be visually observed for signs of CCR staining. If subsoils with CCR staining are observed, they will be removed and disposed. A surface water channel will be excavated south of the GMF Pond to route stormwater flows away from the GMF Pond. Groundwater modeling indicates that the closure method described is expected to maintain compliance with the groundwater protection standards.

Document Organization

IEPA Application Form CCR 1 and IEPA Application Form CCR 2CC precede this Executive Summary. A checklist identifying the required elements of the Part 845 Construction Permit Application and the location in this document where each element can be found follows this Executive Summary. Supplemental information required under Part 845 is organized in a set of appendices that follow the checklist:

- Appendix A (History of Construction) provides general information about the GMF Pond and describes its design and construction.
- Appendix B (Narrative Description) describes the types and generation rates of CCR managed in the GMF Pond.
- Appendix C (Map Package) includes a Site Location Map and a Site Plan Map depicting important site features and information.
- Appendix D (Hydrogeologic Site Characterization) describes hydrogeologic conditions in the vicinity of the GMF Pond.
- Appendix E (Evaluation of Potential Exceedances of Groundwater Protection Standards) summarizes the potential exceedances of groundwater protection standards that have been detected at the GMF Pond and identifies the alternative sources that have caused them.
- Appendix F (Closure Priority Categorization) identifies the closure priority category assigned to the GMF Pond.
- Appendix G (Groundwater Modeling) describes the results of groundwater modeling that has been conducted to assess the expected fate and transport of chemical constituents following closure of the GMF Pond (a link to access the groundwater model files will be transmitted to the IEPA separately).
- Appendix H (Final Closure Plan) provides design information for closure of the GMF Pond, as well as the results of a closure alternatives analysis that has been conducted to determine the most effective approach for closure of the GMF Pond.
- Appendix I (Groundwater Monitoring Plan) describes the monitoring locations and procedures that will be used to assess groundwater quality after closure of the GMF Pond.

- Appendix J (Post-closure Care Plan) describes the procedures that will be followed to maintain the closed GMF Pond during the post-closure care period.
- Appendix K (Legal Description) provides the land description of the GMF Pond facility boundary.
- Appendix L (Public Meetings Information) provides the information pertaining to the public notification and public meetings required under Part 845.
- Appendix M (Training Program Statement) certifies that personnel utilized to construct, install, modify, or close the GMF Pond will participate in required training programs.

Signature Page

Golder Associates USA Inc.

I, Mark Haddock, being a registered professional engineer in good standing in the State of Illinois, certify to the best of my knowledge that the information contained in this construction permit application has been prepared in accordance with recognized and generally accepted engineering practices.

Mark Haddock, PE
Principal

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https://golderassociates.sharepoint.com/sites/141778/project files/6 deliverables/reports/7-r-gmf_permit_app/7-r-1/21454861-7-r-1-gypsum_management_facility_permit_application_25jan22.docx

Regulation	Requirement	Location in Permit Application
Section 845.220 - Construction Permits		
a)	All construction permit applications must contain the following information and documents.	
1)	Design and Construction Plans (Construction History)	Appendix A
A)	Identifying information	Appendix A
i)	The name and address of the person or persons owning or operating the CCR surface impoundment;	Appendix A
ii)	The name associated with the CCR surface impoundment;	Appendix A
iii)	The identification number of the CCR surface impoundment if one has been assigned by the Agency.	Appendix A
B)	A statement of the purpose for which the CCR surface impoundment is being used, how long the CCR surface impoundment has been in operation, and the types of CCR that have been placed in the CCR surface impoundment.	Appendix A
C)	The name and size in acres of the watershed within which the CCR surface impoundment is located.	Appendix A
D)	A description of the physical and engineering properties of the foundation and abutment materials on which the CCR surface impoundment is constructed.	Appendix A
E)	A statement of the type, size, range, and physical and engineering properties of the materials used in constructing each zone or stage of the CCR surface impoundment; the method of site preparation and construction of each zone of the CCR surface impoundment; and the approximate dates of construction of each successive stage of construction of the CCR surface impoundment.	Appendix A
F)	At a scale that details engineering structures and appurtenances relevant to the design, construction, operation, and maintenance of the CCR surface impoundment, detailed dimensional drawings of the CCR surface impoundment, including a plan view and cross-sections of the length and width of the CCR surface impoundment, showing all zones, foundation improvements, drainage provisions, spillways, diversion ditches, outlets, instrument locations, and slope protection, in addition to the normal operating pool surface elevation and the maximum pool surface elevation following peak discharge from the inflow design flood, the expected maximum depth of CCR within the CCR surface impoundment, and any identifiable natural or manmade features that could adversely affect operation of the CCR surface impoundment due to malfunction or mis-operation.	Appendix A
G)	A description of the type, purpose, and location of existing instrumentation.	Appendix A
H)	Area-capacity curves for the CCR surface impoundment.	Appendix A
I)	A description of each spillway and diversion design features and capacities and calculations used in their determination.	Appendix A
J)	The construction specifications and provisions for surveillance, maintenance, and repair of the CCR surface impoundment.	Appendix A
K)	Any record or knowledge of structural instability of the CCR surface impoundment.	Appendix A
2)	Narrative Description of the Facility. The permit application must contain a written description of the facility with supporting documentation describing the procedures and plans that will be used at the facility to comply with the requirements of this Part. The descriptions must include, but are not limited to, the following information:	Appendix B, Appendix H
A)	The types of CCR expected in the CCR surface impoundment, including a chemical analysis of each type of expected CCR;	Appendix B
B)	An estimate of the maximum capacity of each surface impoundment in gallons or cubic yards;	Appendix B
C)	The rate at which CCR and non-CCR waste streams currently enter the CCR surface impoundment in gallons per day and dry tons;	Appendix B
D)	The estimated length of time the CCR surface impoundment will receive CCR and non-CCR waste streams; and	Appendix B
E)	An on-site transportation plan that includes all existing and planned roads in the facility that will be used during the operation of the CCR surface impoundment.	Appendix B
3)	Site Location Map. All permit applications must contain a site location map on the most recent United States Geological Survey (USGS) quadrangle of the area from the 7½ minute series (topographic), or on such other map whose scale clearly shows the following information:	Appendix C
A)	The facility boundaries and all adjacent property, extending at least 1000 meters (3280 feet) beyond the boundary of the facility;	Appendix C
B)	All surface waters;	Appendix C
C)	The prevailing wind direction;	Appendix C
D)	The limits of all 100-year floodplains;	Appendix C
E)	All natural areas designated as a Dedicated Illinois Nature Preserve under the Illinois Natural Areas Preservation Act [525 ILCS 30];	Appendix C
F)	All historic and archaeological sites designated by the National Historic Preservation Act (16 USC 470 et seq.) and the Illinois Historic Sites Advisory Council Act [20 ILCS 3410]; and	Appendix C
G)	All areas identified as critical habitat under the Endangered Species Act of 1973 (16 USC 1531 et seq.) and the Illinois Endangered Species Protection Act [520 ILCS 10].	Appendix C
4)	Site Plan Map. The application must contain maps, including cross-sectional maps of the site boundaries, showing the location of the facility. The following information must be shown:	Appendix C
A)	The entire facility, including any proposed and all existing CCR surface impoundment locations;	Appendix C
B)	The boundaries, both above and below ground level, of the facility and all CCR surface impoundments or landfills containing CCR included in the facility;	Appendix C
C)	All existing and proposed groundwater monitoring wells; and	Appendix C
D)	All main service corridors, transportation routes, and access roads to the facility.	Appendix C
5)	A narrative description of the proposed construction of, or modification to, a CCR surface impoundment and any projected changes in the volume or nature of the CCR or non-CCR waste streams.	Appendix H
6)	Plans and specifications fully describing the design, nature, function and interrelationship of each individual component of the facility.	Appendix A, Appendix H
7)	A new groundwater monitoring program or any modification to an existing groundwater monitoring program that includes but is not limited to the following information:	
A)	A hydrogeologic site investigation meeting the requirements of Section 845.620, if applicable;	Appendix D
B)	Design and construction plans of a groundwater monitoring system meeting the requirements of Section 845.630; and	Appendix I

Regulation	Requirement	Location in Permit Application
Section 845.220 - Construction Permits (Continued)		
C)	A proposed groundwater sampling and analysis program that includes selection of the statistical procedures to be used for evaluating groundwater monitoring data, as required by Sections 845.640 and 845.650.	Appendix I
8)	The signature and seal of a qualified professional engineer	Executive Summary
9)	Certification that the owner or operator of the CCR surface impoundment completed the public notification and public meetings required under Section 845.240, a summary of the issues raised by the public, a summary of any revisions, determinations, or other considerations made in response to those issues, and a list of interested persons in attendance who would like to be added to the Agency's listserv for the facility.	Appendix L
b)	New Construction. In addition to the requirements in subsection (a), all construction permit applications to build a new CCR surface impoundment, lateral expansion of a CCR surface impoundment, or retrofit of an existing CCR surface impoundment must also contain the following information and documents:	Not applicable - not new construction, lateral expansion, or retrofit
1)	Plans and specifications that demostrate the proposed CCR surface impoundment will meet the location standards in the following sections:	
A)	Section 845.300 (Placement Above the Uppermost Aquifer);	
B)	Section 845.310 (Wetlands);	
C)	Section 845.320 (Fault Areas);	
D)	Section 845.330 (Seismic Impact Zones); and	
E)	Section 845.340 (Unstable Areas and Floodplains).	
2)	Plans and specifications demonstrate the proposed CCR surface impoundment will meet the following design criteria:	
A)	The CCR surface impoundment will have a liner meeting the liner requirements of Section 845.400(b) or (c);	
B)	The CCR surface impoundment will have a leachate collection system meeting the requirements of Section 845.420; and	
C)	The CCR surface impoundment, if not incised, will be constructed with slope protection, as required by Section 845.430.	
3)	CCR fugitive dust control plan (see Section 845.500(b)).	
4)	Preliminary written closure plan (see Section 845.720(a)).	
5)	Initial written post-closure care plan, if applicable (see Section 845.780(d)).	
c)	Corrective Action Construction. In addition to the requirements in subsection (a), all construction permit applications that include any corrective action performed under Subpart F must also contain the following information and documents:	Not applicable - no corrective action included
1)	Corrective action plan (see Section 845.670);	
2)	Groundwater modeling, including:	
A)	The results of groundwater contaminant transport modeling and calculations showing how the closure will achieve compliance with the applicable groundwater standards;	
B)	All modeling inputs and assumptions;	
C)	Description of the fate and transport of contaminants, with the selected closure over time; and	
D)	Capture zone modeling, if applicable.	
3)	Any necessary licenses and software needed to review and access both the models and the data contained within the models required by subsection (c)(2);	
4)	Corrective action groundwater monitoring program, including identification of revisions to the groundwater monitoring system for corrective action; and	
5)	Any interim measures necessary to reduce the contaminants leaching from the CCR surface impoundment, and/or potential exposures to human or ecological receptors, including an analysis of the factors specified in Section 845.680(a)(3).	
d)	Closure Construction. In addition to the requirements in subsection (a), all construction permit applications for closure of the CCR surface impoundment under Subpart G must contain the following information and documents:	
1)	Closure prioritization category under Section 845.700(g), if applicable;	Appendix F
2)	Final closure plan, as specified in Section 845.720(b), which includes the closure alternatives analysis required by Section 845.710;	Appendix H
3)	Groundwater modeling, including:	Appendix G
A)	The results of groundwater contaminant transport modeling and calculations showing how the closure will achieve compliance with the applicable groundwater standards;	Appendix G
B)	All modeling inputs and assumptions;	Appendix G
C)	Description of the fate and transport of contaminants, with the selected closure over time;	Appendix G
D)	Capture zone modeling, if applicable; and	Not applicable
E)	Any necessary licenses and software needed to review and access both the model and the data contained within the model.	Provided separately if applicable
4)	Proposed schedule to complete closure; and	Appendix H
5)	Post-closure care plan as specified in Section 845.780(d), if applicable.	Appendix J
e)	*Owners or operators of CCR surface impoundments who submitted a closure plan to the agency before May 1, 2019, and who complete closure before July 30, 2021, shall not be required to obtain a construction permit for closure under subsection (d).* [415 ILCS 5/22.58(e)]	Not applicable - closure not completed before July 31, 2021
f)	A single construction permit application may be submitted for new construction, corrective action, and closure if the construction is related to the same multiphased project. The permit application for a project with multiple phases must contain all information required by subsections (a), (b), (c) and (d), as applicable.	Not applicable - not a multiphased project
g)	Duration of Construction Permits	
1)	For any construction permit that is not for the closure or retrofit of the CCR surface impoundment, the construction permit must be issued for fixed terms not to exceed 3 years.	Not applicable - permit application is for closure
2)	For any construction permit for the closure or retrofit of a CCR surface impoundment, the construction permit must be issued for an initial fixed term expiring within the timeframe approved by the Agency in the construction permit or five years, whichever is less. The Agency may renew a construction permit for closure or retrofit in two-year increments under Section 845.760(b).	Acknowledged

Regulation	Requirement	Location in Permit Application
Section 845.620 - Hydrogeologic Site Characterization		
a)	The owner or operator of the CCR surface impoundment must design and implement a hydrogeologic site characterization.	Appendix D
b)	The hydrogeologic site characterization must include, but is not limited to, the following:	
1)	Geologic well logs/boring logs;	Appendix D
2)	Climatic aspects of the site, including seasonal and temporal fluctuations in groundwater flow;	Appendix D
3)	Identification of nearby surface water bodies and drinking water intakes;	Appendix D
4)	Identification of nearby pumping wells and associated uses of the groundwater;	Appendix D
5)	Identification of nearby dedicated nature preserves;	Appendix D
6)	Geologic setting;	Appendix D
7)	Structural characteristics;	Appendix D
8)	Geologic cross-sections;	Appendix D
9)	Soil characteristics;	Appendix D
10)	Identification of confining layers;	Appendix D
11)	Identification of potential migration pathways;	Appendix D
12)	Groundwater quality data;	Appendix D
13)	Vertical and horizontal extent of the geologic layers to a minimum depth of 100 feet below land surface, including lithology and stratigraphy;	Appendix D
14)	A map displaying any known underground mines beneath a CCR surface impoundment;	Appendix D
15)	Chemical and physical properties of the geologic layers to a minimum depth of 100 feet below land surface;	Appendix D
16)	Hydraulic characteristics of the geologic layers identified as migration pathways and geologic layers that limit migration, including:	Appendix D
A)	Water table depth;	Appendix D
B)	Hydraulic conductivities;	Appendix D
C)	Effective and total porosities;	Appendix D
D)	Direction and velocity of groundwater flow; and	Appendix D
E)	Map of the potentiometric surface;	Appendix D
17)	Groundwater classification under 35 Ill. Adm. Code 620; and	Appendix D
18)	Any other information requested by the Agency that is relevant to the hydrogeologic site characterization.	Appendix D
Section 845.630 - Groundwater Monitoring Systems (excerpts providing requirements for the construction permit application)		
g)	The owner or operator must obtain a certification from a qualified professional engineer stating that the groundwater monitoring system has been designed and constructed to meet the requirements of this Section. If the groundwater monitoring system includes the minimum number of monitoring wells specified in subsection (c)(1), the certification must document the basis supporting this determination. The certification must be submitted to the Agency with the appropriate permit application.	Appendix I
Section 845.640 - Groundwater Sampling and Analysis Requirements (excerpts providing requirements for the construction permit application)		
a)	The groundwater monitoring program must include consistent sampling and analysis procedures that are designed to ensure monitoring results that provide an accurate representation of groundwater quality at the background and downgradient wells required by Section 845.630. The owner or operator of the CCR surface impoundment must develop a sampling and analysis program that includes procedures and techniques for:	Appendix I
b)	The groundwater monitoring program must include sampling and analysis methods that are appropriate for groundwater sampling and that accurately measure constituents and other monitoring parameters in groundwater samples.	Appendix I
1)	Sample collection;	Appendix I
2)	Sample preservation and shipment;	Appendix I
3)	Analytical procedures;	Appendix I
4)	Chain of custody control; and	Appendix I
5)	Quality assurance and quality control.	Appendix I
f)	Statistical Methods	Appendix I
1)	The owner or operator of the CCR surface impoundment must select one of the statistical methods specified in subsection (f)(1) to be used in evaluating groundwater monitoring data for each specified constituent. The statistical test chosen must be conducted separately for each constituent in each monitoring well.	Appendix I
2)	The owner or operator of the CCR surface impoundment must obtain a certification from a qualified professional engineer stating that the selected statistical method is appropriate for evaluating the groundwater monitoring data for the CCR surface impoundment. The certification must include a narrative description of the statistical method selected to evaluate the groundwater monitoring data. The certification must be submitted to the Agency with the appropriate permit application.	Appendix I
Section 845.710 - Closure Alternatives (excerpts providing requirements for the construction permit application)		
b)	Before selecting a closure method, the owner or operator of each CCR surface impoundment must complete a closure alternatives analysis. The closure alternatives analysis must examine the following for each closure alternative:	Appendix H
1)	The long- and short-term effectiveness and protectiveness of the closure method, including identification and analyses of the following factors:	Appendix H
A)	The magnitude of reduction of existing risks;	Appendix H
B)	The magnitude of residual risks in terms of likelihood of future releases of CCR;	Appendix H
C)	The the type and degree of long-term management required, including monitoring, operation, and maintenance;	Appendix H
D)	The short-term risks that might be posed to the community or the environment during implementation of such a closure, including potential threats to human health and the environment associated with excavation, transportation, and re-disposal of contaminants;	Appendix H
E)	The time until closure and post-closure care or the completion of groundwater monitoring under Section 845.740(b) is completed;	Appendix H
F)	The 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, containment or changes in groundwater flow;	Appendix H
G)	The long-term reliability of the engineering and institutional controls, including an analysis of any off-site, nearby destabilizing activities; and	Appendix H
H)	Potential need for future corrective action of the closure alternative.	Appendix H

Regulation	Requirement	Location in Permit Application
Section 845.710 - Closure Alternatives (excerpts providing requirements for the construction permit application) (Continued)		
2)	The effectiveness of the closure method in controlling future releases based on analyses of the following factors:	Appendix H
A)	The extent to which containment practices will reduce further releases; and	Appendix H
B)	The extent to which treatment technologies may be used.	Appendix H
3)	The ease or difficulty of implementing a potential closure method based on analyses of the following types of factors:	Appendix H
A)	Degree of difficulty associated with constructing the technology;	Appendix H
B)	Expected operational reliability of the technologies;	Appendix H
C)	Need to coordinate with and obtain necessary approvals and permits from other agencies;	Appendix H
D)	Availability of necessary equipment and specialists; and	Appendix H
E)	Available capacity and location of needed treatment, storage, and disposal services.	Appendix H
4)	The degree to which the concerns of the residents living within communities where the CCR will be handled, transported and disposed are addressed by the closure method.	Appendix H
c)	In the closure alternative analysis, the owner or operator of the CCR surface impoundment must:	Appendix H
1)	Analyze complete removal of the CCR as one closure alternative, along with the modes for transporting the removed CCR, including by rail, barge, low-polluting trucks, or a combination of these transportation modes;	Appendix H
2)	Identify whether the facility has an onsite landfill with remaining capacity that can legally accept CCR, and, if not, whether constructing an onsite landfill is possible; and	Appendix H
3)	Include any other closure method in the alternatives analysis if requested by the Agency.	Appendix H
d)	The analysis for each alternative completed under this Section must:	Appendix H
1)	Meet or exceed a class 4 estimate under the AACE Classification Standard, incorporated by reference in Section 845.150, or a comparable classification practice as provided in the AACE Classification Standard;	Appendix H
2)	Contain the results of groundwater contaminant transport modeling and calculations showing how the closure alternative will achieve compliance with the applicable groundwater protection standards;	Appendix H
3)	Include a description of the fate and transport of contaminants with the closure alternative over time including consideration of seasonal variations; and	Appendix H
4)	Assess impacts to waters in the state.	Appendix H
e)	At least 30 days before submission of a construction permit application for closure, the owner or operator of the CCR surface impoundment must discuss the results of the closure alternatives analysis in a public meeting with interested and affected parties as required by Section 845.240.	Appendix L
f)	After completion of the public meeting under subsection (e), the owner or operator of a CCR surface impoundment must select a closure method and submit a final closure plan to the Agency under Section 845.720(b). All materials demonstrating completion of the closure alternatives analysis specified in this Section must be submitted with the final closure plan.	Appendix H
Section 845.720 - Closure Plan (excerpts providing requirements for the construction permit application)		
b)	Final Closure Plan	Appendix H
1)	The owner or operator of a CCR surface impoundment must submit to the Agency, as a part of a construction permit application for closure, a final closure plan. The plan must be submitted before the installation of a final cover system or removal of CCR from the surface impoundment for the purpose of closure.	Appendix H
3)	The final closure plan must identify the proposed selected closure method, and must include the information required in subsection (a)(1) and the closure alternatives analysis as specified in Section 845.710.	Appendix H
5)	The owner or operator of the CCR surface impoundment must obtain and submit with its construction permit application for closure a written certification from a qualified professional engineer that the final written closure plan meets the requirements of this Part.	Appendix H
Section 845.750 - Closure with a Final Cover System (excerpts providing requirements for the construction permit application)		
c)	Final Cover System. If a CCR surface impoundment is closed by leaving CCR in place, the owner or operator must install a final cover system that is designed to minimize infiltration and erosion, and, at a minimum, meets the requirements of this subsection (c). The final cover system must consist of a low permeability layer and a final protective layer. The design of the final cover system must be included in the preliminary and final written closure plans required by Section 845.720 and the construction permit application for closure submitted to the agency.	Appendix H
Section 845.780 - Post-Closure Care Requirements (excerpts providing requirements for the construction permit application)		
d)	Written Post-Closure Care Plan	Appendix J
1)	Content of the Plan. The owner or operator of a CCR surface impoundment must prepare a written post-closure care plan that includes, at a minimum, the information specified in this subsection (d)(1).	Appendix J
A)	A description of the monitoring and maintenance activities required in subsection (b) for the CCR surface impoundment and the frequency at which these activities will be performed;	Appendix J
B)	The name, address, telephone number, and email address of the person or office to contact about the facility during the post-closure care period; and	Appendix J
C)	A description of the planned uses of the property during the post- closure care period. Post-closure use of the property must not disturb the integrity of the final cover, liners, or any other component of the containment system, or the function of the monitoring systems unless necessary to comply with the requirements in this Part. Any other disturbance is allowed if the owner or operator of the CCR surface impoundment demonstrates that disturbance of the final cover, liner, or other component of the containment system, including any removal of CCR, will not increase the potential threat to human health or the environment. The demonstration must be certified by a qualified professional engineer and must be submitted to the Agency.	Appendix J
4)	The owner or operator of the CCR surface impoundment must obtain a written certification from a qualified professional engineer that the initial, and any amendment of the, written post-closure care plan meets the requirements of this Section.	Appendix J

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History of Construction

October 2016

Illinois Power Resources Generating, LLC
17751 North Cilco Road
Canton, IL 61520

RE: History of Construction
USEPA Final CCR Rule, 40 CFR § 257.73(c)
Duck Creek Power Station
Canton, Illinois

On behalf of Illinois Power Resources Generating, LLC, AECOM has prepared the following history of construction for the Ash Pond No. 1, Ash Pond No. 2, and GMF Pond at the Duck Creek Power Station in accordance with 40 CFR § 257.73(c). The Bottom Ash Basin is an incised pond with a storage volume of less than 20 acre-feet. A history of construction is not required for the Bottom Ash Basin as specified in § 257.73(b).

BACKGROUND

40 CFR § 257.73(c)(1) requires the owner or operator of an existing coal combustion residual (CCR) surface impoundment that either (1) has a height of five feet or more and a storage volume of 20 acre-feet or more, or (2) has a height of 20 feet or more to compile a history of construction by October 17, 2016 that contains, to the extent feasible, the information specified in 40 CFR § 257.73(c)(1)(i)–(xii).

The history of construction presented herein was compiled based on existing documentation, as reasonably and readily available (see 80 Fed. Reg. 21302, 21380 [April 17, 2015]), AECOM's site experience, and discussion with plant engineers. AECOM's document review included construction drawings, geotechnical investigations, observation reports, etc. for the Ash Pond No. 1, Ash Pond No. 2, and GMF Pond at the Duck Creek Power Station.

HISTORY OF CONSTRUCTION

§ 257.73(c)(1)(i): The name and address of the person(s) owning or operating the CCR unit; the name associated with the CCR unit; and the identification number of the CCR unit if one has been assigned by the state.

Owner: Illinois Power Resources Generating, LLC

Address: 1500 Eastport Plaza Drive
Collinsville, IL 62234

CCR Units: Ash Pond No. 1
Ash Pond No. 2, IDNR Dam ID No. IL50014
GMF Pond, IDNR Dam ID No. IL50573

Ash Pond No. 1 does not have a state assigned identification number.

§ 257.73(c)(1)(ii): The location of the CCR unit identified on the most recent USGS $7^1/_2$ or 15 minute topographic quadrangle map or a topographic map of equivalent scale if a USGS map is not available.

The locations of the Ash Pond No. 1, Ash Pond No. 2, and the GMF Pond have been identified on an USGS 7-1/2 minute topographic quadrangle map in **Appendix A**.

§ 257.73(c)(1)(iii): A statement of the purpose for which the CCR unit is being used.

The following captures the purpose of each CCR unit:

- The Ash Pond No. 1 (inactive) was used to store and dispose of fly ash and bottom ash.
- The Ash Pond No. 2 (inactive) was used to store and dispose of fly ash and bottom ash and to clarify CCR contact stormwater prior to discharge in accordance with the station's Water Pollution Control Permit (#2015-EO-59369).
- The GMF Pond is being used to store and dispose of gypsum and to clarify recycled process water for plant operations.

Notice of intent to close Ash Pond No. 1 and Ash Pond No. 2 was provided in November, 2015.[1]

[1] This history of construction report was prepared on a facility-wide basis for CCR surface impoundments at the Duck Creek Power Station. The inclusion of Ash Pond No. 1 and Ash Pond No. 2 in this history of construction report does not concede and should not be construed to concede that Ash Pond No. 1 and Ash Pond No. 2 are subject to the Design Criteria or all Operating Criteria in the CCR Rule.

§ 257.73(c)(1)(iv): The name and size in acres of the watershed where the CCR unit is located.

Ash Pond No. 1, Ash Pond No. 2, and the GMF Pond are located at the western edge of the Rice Lake-Illinois River Watershed with a 12-digit Hydrologic Unit Code (HUC) of 071300030603 and a drainage area of 21,203 acres (USGS, 2016).

§ 257.73(c)(1)(v): A description of the physical and engineering properties of the foundation and abutment materials on which the CCR unit is constructed.

Physical properties of the foundation materials for Ash Pond No. 1 and Ash Pond No. 2 are primarily strip-mine spoils with variable thickness overlying shale bedrock. The mine spoils consist of a mixtures of native loess and glacial till and, to a lesser extent, the underlying (primarily shale) bedrock. The loess is classified as silty low plastic clay, with a zone of high plastic clay identified in the upper few feet of the stratum. The glacial till is classified as medium stiff to stiff, silty low plastic clay with trace sand and gravel.

Physical properties of the foundation materials for the GMF Pond are (from top to bottom) native loess, glacial till, and bedrock (primarily shale). The loess is classified as silty low plastic clay, with a zone of high plastic clay identified in the upper few feet of the stratum. The glacial till is classified as medium stiff to stiff, silty low plastic clay with trace sand and gravel.

An available summary of foundation material engineering properties for Ash Pond No.1, Ash Pond No. 2, and the GMF Pond is presented in **Table 1** below. The foundation material engineering properties are based on previous geotechnical explorations and laboratory testing.

Table 1. Summary of Foundation Material Engineering Properties

Material	Unit Weight (pcf)	Effective (drained) Shear Strength Parameters		Total (undrained) Shear Strength Parameters	
		c' (psf)	Φ' (°)	c (psf)	Φ (°)
Loess	116	100	32	1,250	0
Glacial Till	125	200	30	1,900	0
Mine Spoils	120	100	30	250	15
Shale Bedrock	130	300	26	600	13

Ash Pond No.1, Ash Pond No. 2, and the GMF Pond are enclosed impoundments with embankments and do not have abutments.

§ 257.73(c)(1)(vi): A statement of the type, size, range, and physical and engineering properties of the materials used in constructing each zone or stage of the CCR unit; the method of site preparation and construction of each zone of the CCR unit; and the approximate dates of construction of each successive stage of construction of the CCR unit.

The embankments of the Ash Pond No. 1 and Ash Pond No. 2 were constructed with mine spoils excavated from within the center of the existing pond footprints. The mine spoils consist of a mixtures of native loess and glacial till and, to a lesser extent, the underlying (primarily shale) bedrock. The loess is classified as silty low plastic clay, with a zone of high plastic clay identified in the upper few feet of the stratum. The glacial till is classified as medium stiff to stiff, silty low plastic clay with trace sand and gravel.

The embankments of the GMF Pond generally consists of silty, low plastic clay and generally had a stiff to very stiff consistency and appeared to be well-compacted material. The liner system within the GMF Pond consists of (from top to bottom) a 60-mil textured high density polyethylene (HDPE) geomembrane, 1-foot-thick layer of “cushion dirt”, 4-ounce geotechnical filter fabric, 1-foot-thick drainage layer, 10-ounce geotextile cushion, 60-mil textured HDPE geomembrane, a Bentomat SDN reinforced geosynthetic clay liner (GCL), and 3-foot-thick layer of compacted clay. A typical cross section profile of the liner system is shown on drawing C180-C102-8 presented in **Appendix B**.

An available summary of construction material engineering properties is presented in **Table 2** below. The construction material engineering properties are based on previous geotechnical investigations and laboratory testing.

Table 2. Summary of Construction Material Engineering Properties

Material	Unit Weight (pcf)	Effective (drained) Shear Strength Parameters		Total (undrained) Shear Strength Parameters	
		c’ (psf)	Φ’ (°)	c (psf)	Φ (°)
Liner-Cushion Material	116	0	38	660	0
Liner-Granular Drainage Layer	120	0	33	0	33
Liner-Geotextile /Geomembrane	75	100	25	100	25
Embankment Fill	116	150	32	2,150	0

The methods used for preparation and construction of Ash Pond No. 1 and Ash Pond No. 2 are not reasonably and readily available.

The site preparation work for the GMF Pond included stripping and stockpiling the topsoil. The subsoil was then excavated to approximately 5.4 feet above the proposed foundation grade and stockpiled. Temporary and permanent erosion control measures were also installed. The site was later excavated to the proposed subgrade and proof rolled to inspect for unsuitable soils. Any unsuitable soils were either removed or reworked. A sheepsfoot roller was used to compact suitable backfill material placed in 8-inch lifts. Compaction testing was performed using a nuclear density gauge at a minimum rate of one test per 10,000 cubic yards (minimum one test per lift). Backfill was compacted to at least 95% of standard proctor maximum dry density and with a moisture content of -2% to +2% of optimum. Embankment

construction was performed using similar compacting and testing techniques as for the subgrade preparation.

Prior to constructing the clay liner for the GMF Pond, two test pad liners were constructed using separate borrow material. Testing of both liners indicated that the construction practice and material used were acceptable. The full scale clay liner was constructed with fill placed in 8-inch lifts and compacted with a sheepsfoot roller. Placed fill was compacted to at least 95% of standard proctor maximum dry density and with a moisture content of optimum to +5%. Compaction testing was performed using a nuclear density gauge at a minimum rate of one test per 1,000 cubic yards (minimum one test per lift). After the minimum clay liner thickness was achieved, the surface was smooth rolled in preparation of the GCL. The GCL and lower geomembrane were then placed sequentially followed by the 10-ounce geotextile cushion. A leak detection/leachate collection and recovery system (LD/LCRS) was then installed which includes a 1-foot-thick sand drainage layer and collection pipes. The sand was graded to minimum thickness using a dozer. The LD/LCRS was completed by placing a 4-ounce geotechnical filter fabric on top of the sand. A 1-foot-thick “cushion dirt” layer was then placed using a dozer to spread general fill. The liner was completed by placing the upper geomembrane on top.

The approximate dates of each successive event stage of construction of Ash Pond No. 1, Ash Pond No. 2, and the GMF Pond are provided in **Table 3** below.

Table 3. Approximate dates of construction of each successive stage of construction.

Date	Event
1976	Ash Pond No. 1 was commissioned
1986	Ash Pond No. 2 was commissioned
2007	Surface preparation for GMF Pond began
2008-2009	Construction of GMF Pond

§ 257.73(c)(1)(vii): At a scale that details engineering structures and appurtenances relevant to the design, construction, operation, and maintenance of the CCR unit, detailed dimensional drawings of the CCR unit, including a plan view and cross sections of the length and width of the CCR unit, showing all zones, foundation improvements, drainage provisions, spillways, diversion ditches, outlets, instrument locations, and slope protection, in addition to the normal operating pool surface elevation and the maximum pool surface elevation following peak discharge from the inflow design flood, the expected maximum depth of CCR within the CCR surface impoundment, and any identifiable natural or manmade features that could adversely affect operation of the CCR unit due to malfunction or mis-operation.

Drawings that contain items pertaining to the requested information for Ash Pond No. 1, Ash Pond No. 2, and the GMF Pond are listed in **Table 4** below. Items marked as "Not Available" are items not found during review of reasonably and readily available record documentation

Table 4. List of drawings containing items pertaining to the information requested in § 257.73(c)(1)(vii).

	Ash Pond No. 1	Ash Pond No. 2	GMF Pond
Dimensional plan view (all zones)	C180-G1916-3	C180-G1916-4, C180-G1916-6	C180-C102-8 thru -11
Dimensional cross sections	C180-G1916-3	C180-G1916-7	C180-C102-12 thru -14
Foundation Improvements	C180-G1916-3	C180-G1916-7	Not Applicable
Drainage Provisions	Not Applicable	C180-G1916-9 thru -11, M-1001	C180-C102-12 thru -14 C180-C102-30 thru -31
Spillways and Outlets	C180-G1916-3	C180-G1916-8	C180-C102-15, C180-C102-29
Diversion Ditches	Not Applicable	Not Applicable	Not Applicable
Instrument Locations	Figure in Appendix C, Plate 2	Figure in Appendix C, Plate 2	Not Applicable
Slope Protection	C180-G1916-3	Not Available	C180-C102-12
Normal Operating Pool Elevation	Not Available	Not Available	Not Available
Maximum Pool Elevation	C180-G1916	C180-G1916-7	Not Available
Approximate Maximum Depth of CCR in 2016	68 feet	59 feet	25 feet

All drawings referenced in the table above can be found in **Appendix B** and **Appendix C**.

Based on the review of the drawings listed above, no natural or manmade features that could adversely affect operation of these CCR units due to malfunction or mis-operation were identified.

§ 257.73(c)(1)(viii): A description of the type, purpose, and location of existing instrumentation.

Existing instrumentation at Ash Pond No. 1 and Ash Pond No. 2 consists of open-standpipe piezometers. The purpose of the piezometers is to measure the pore water pressures within and around the CCR units. Two (2) piezometers (B-2 and B-5) were installed in 2010 and the locations are presented on Plate 2 in **Appendix C**. Five (5) additional piezometers were installed in 2010 and the locations are presented in **Appendix C**.

The GMF Pond does not contain existing instrumentation used for monitoring the operation of the CCR unit.

§ 257.73(c)(1)(ix): Area-capacity curves for the CCR unit.

Area-capacity curves for the Ash Pond No. 1 and Ash Pond No. 2 are not reasonably and readily available. The area-capacity curve for the GMF Pond is presented in **Figure 1** below. "Area-capacity curves", as defined by 40 CFR § 257.53, "means graphic curves which readily show the reservoir water surface area, in acres, at different elevations from the bottom of the reservoir to the maximum water surface, and the capacity or volume, in acre-feet, of the water contained in the reservoir at various elevations."

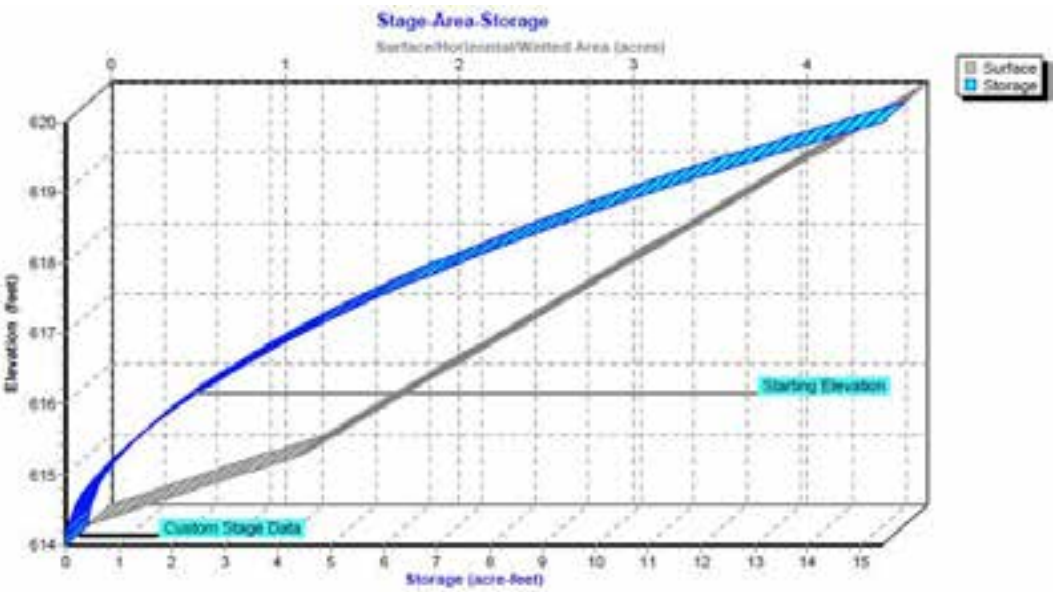


Figure 1. Area-capacity curve for GMF Pond prepared in 2016

§ 257.73(c)(1)(x): A description of each spillway and diversion design features and capacities and calculations used in their determination.

Ash Pond No. 1 does not contain an active spillway or diversion feature. Stormwater collected in Ash Pond No. 1 is manually pumped to Ash Pond No. 2 at the judgement of plant personnel. Current discharge capacity and calculation information for Ash Pond No. 1 is not reasonably and readily available.

Stormwater collected in Ash Pond No. 2 is drained via a 36-inch diameter (dia.) steel morning glory spillway, formed by 2-foot tall stacked sections, located in the northeast corner of the pond. The spillway transitions to a 36-inch dia. reinforced concrete pipe (RCP) and drains towards the return water pumphouse and discharges in accordance with the station's Water Pollution Control Permit. Current discharge capacity and calculation information for Ash Pond No. 2 is not reasonably and readily available.

The GMF Pond contains a transfer channel that discharges clear water into the GMF Recycle Pond. The transfer channel is trapezoidal in shape with 3H:1V side slopes. The channel transitions from a 16-foot bottom width at an invert elevation of 616 feet at the upstream end to a 35-foot bottom width at an invert elevation of 609 feet at the downstream end. In 2016 the discharge capacity of the GMF Pond was evaluated using HydroCAD 8.50 software modeling a 1,000-year, 24-hour rainfall event. The results of the HydroCAD 8.50 analysis are presented below in **Table 5**.

Table 5. Results of HydroCAD 8.50 analyses

	GMF Pond
Approximate Minimum Berm Elevation[1] (ft)	620.0
Approximate Emergency Spillway Elevation[1] (ft)	616.0
Starting Pool Elevation[1] (ft)	616.0
Peak Elevation[1] (ft)	618.3
Time to Peak (hr)	12.0
Surface Area (ac)	3.5
Storage[2] (ac-ft)	8.3

Notes: 1. Elevations are based on NAVD88 datum.
2. Storage given is from Starting Pool Elevation to Peak Elevation

§ 257.73(c)(1)(xi): The construction specifications and provisions for surveillance, maintenance, and repair of the CCR unit.

The construction specification for Ash Pond No. 1 is located in Technical Specification Section 21, however the construction specification is not reasonably and readily available. The construction specification for the Ash Pond No. 2 is not reasonably and readily available. The construction specification for the GMF Pond is located in *Project Manual; Specification No's.: C180-C102* (presented in **Appendix D**).

The provisions for surveillance, general maintenance, and repair of the GMF Pond are presented in **Appendix E**.

The operations and maintenance plans for Ash Pond No. 1, Ash Pond No. 2, and GMF Pond are currently either being generated or being revised by Illinois Power Resources Generating,

LLC. This section will be updated when the new operations and maintenance plans are available.

§ 257.73(c)(1)(xii): Any record or knowledge of structural instability of the CCR unit.

There is no record or knowledge of structural instability of Ash Pond No. 1, Ash Pond No. 2, and the GMF Pond at Duck Creek Power Station.

LIMITATIONS

The signature of AECOM's authorized representative on this document represents that to the best of AECOM's knowledge, information and belief in the exercise of its professional judgment, it is AECOM's professional opinion that the aforementioned information is accurate as of the date of such signature. Any recommendation, opinion or decisions by AECOM are made on the basis of AECOM's experience, qualifications and professional judgment and are not to be construed as warranties or guaranties. In addition, opinions relating to environmental, geologic, and geotechnical conditions or other estimates are based on available data and that actual conditions may vary from those encountered at the times and locations where data are obtained, despite the use of due care.

Sincerely,

Claudia Prado
Project Manager

Victor Modeer, P.E., D.GE
Senior Project Manager

REFERENCES

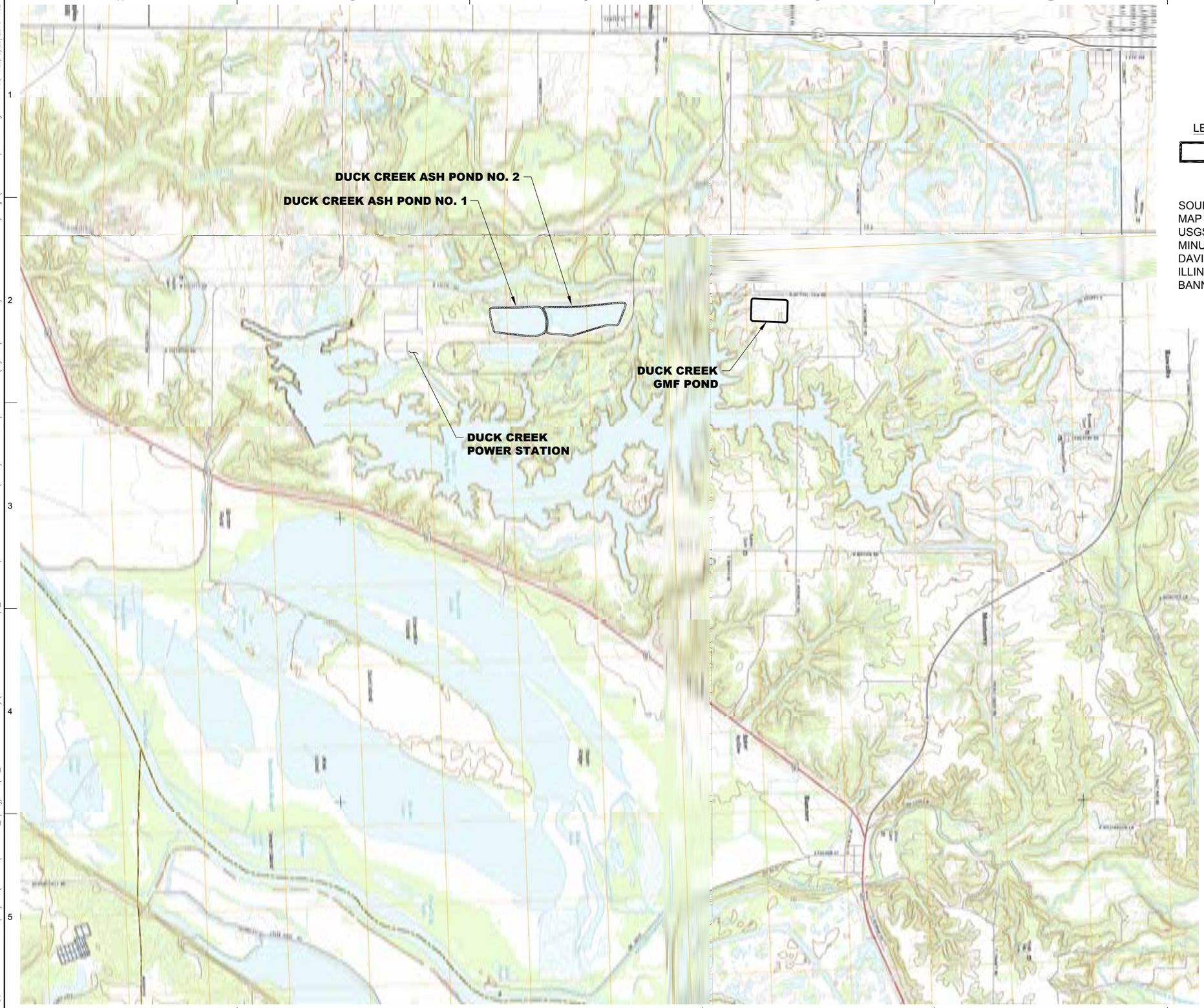
United States Environmental Protection Agency (USEPA). (2015). *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule.* 40 CFR Parts 257 and 261, 80 Fed. Reg. 21302, 21380 April 17, 2015.

United States Geological Survey (USGS). (2016). The National Map Viewer. http://viewer.nationalmap.gov/viewer/. USGS data first accessed in March of 2016.

APPENDICES

Appendix A: History of Construction Vicinity Map
Appendix B: Duck Creek Power Station Drawings
Appendix C: Duck Creek Power Station Boring and Piezometer Locations
Appendix D: Project Manual; Specification No's.: C180-C102 (excerpt)
Appendix E: Operation and Maintenance Manual, Duck Creek Energy Center, Gypsum Management Facility

Appendix A: History of Construction Vicinity Map



LEGEND

CCR UNITS

SOURCE:
MAP PROVIDED FROM ELECTRONIC USGS DIGITAL RASTER GRAPHIC 7.5 MINUTE TOPOGRAPHIC MAP OF SAINT DAVID ILLINOIS, DUCK CREEK ISLAND ILLINOIS, CANTON ILLINOIS AND BANNOR ILLINOIS, REVISED 2015.

QUADRANGLE LOCATION

0 2000 4000 6000
SCALE IN FEET

AECOM
1001 Highlands Plaza Drive, Suite 300
St. Louis, Mo. 63110
314 429-0100 (phone)
314-429-0462 (fax)

ILLINOIS POWER RESOURCES GENERATING, LLC
17751 North CILCO Rd.,
Canton, IL 61520

HISTORY OF CONSTRUCTION

DUCK CREEK POWER STATION
CANTON, ILLINOIS

ISSUED FOR BIDDING — DATE BY

ISSUED FOR CONSTRUCTION — DATE BY

REVISIONS

NO.	DESCRIPTION	DATE
△		
△		
△		
△		
△		

AECOM PROJECT NO:	60489731
DRAWN BY:	DJD
DESIGNED BY:	DJD
CHECKED BY:	MN
DATE CREATED:	2016-04-13
PLOT DATE:	
SCALE:	1" = 2000'
ACAD VER:	2014

SHEET TITLE

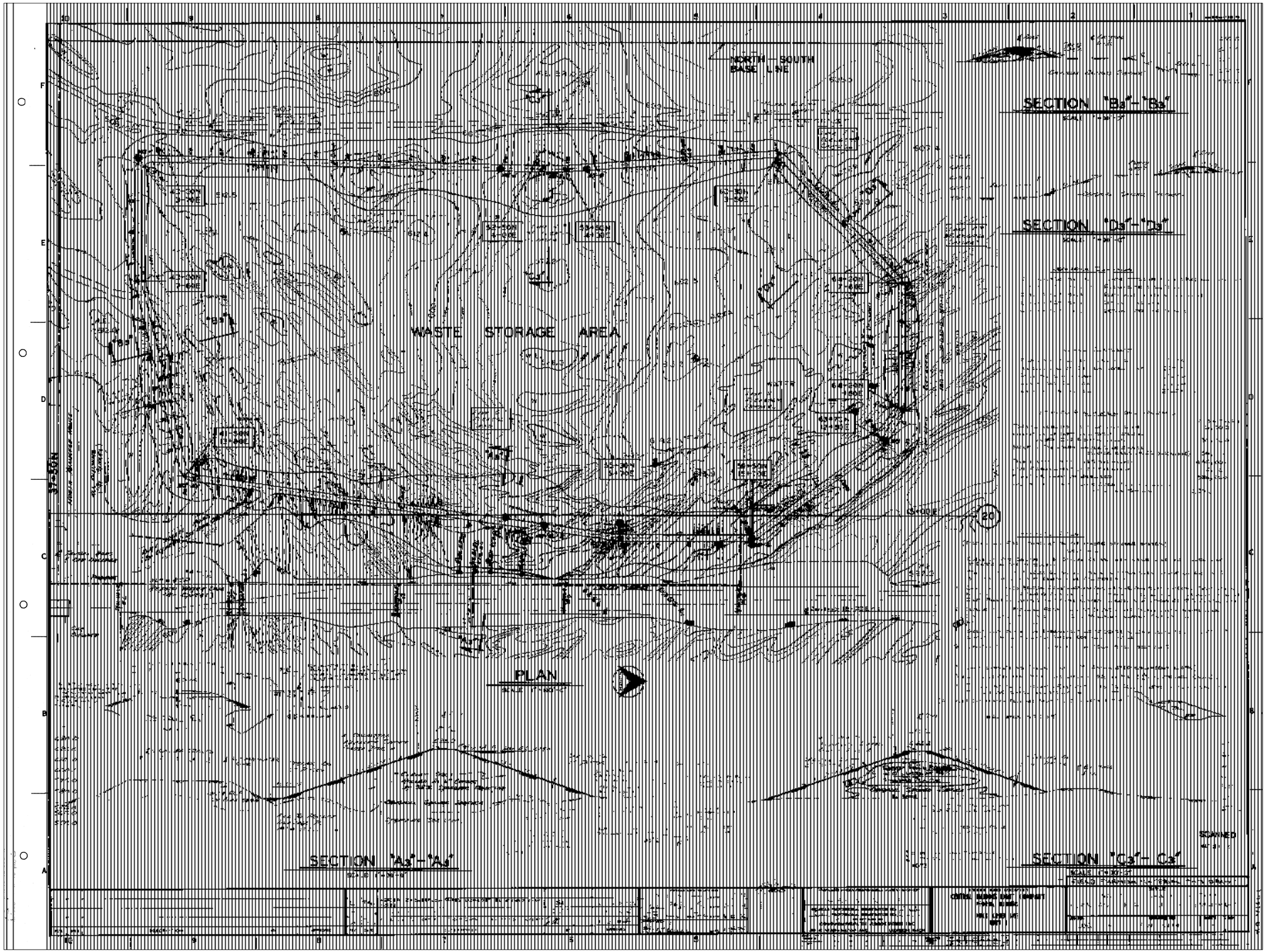
HISTORY OF CONSTRUCTION VICINITY MAP

01

AECOM DRAWING PATH: P:\Projects\Geotech\60428794_DynegyCCR\13_Construction History\04 Technical Production\2_Duck Creek\Reference Documents\Vicinity Location Map References\Figures\C-01 History of Construction Vicinity Map (Duck Creek) -MUN.dwg NANAK, MATT, 8/23/2016 4:02 PM

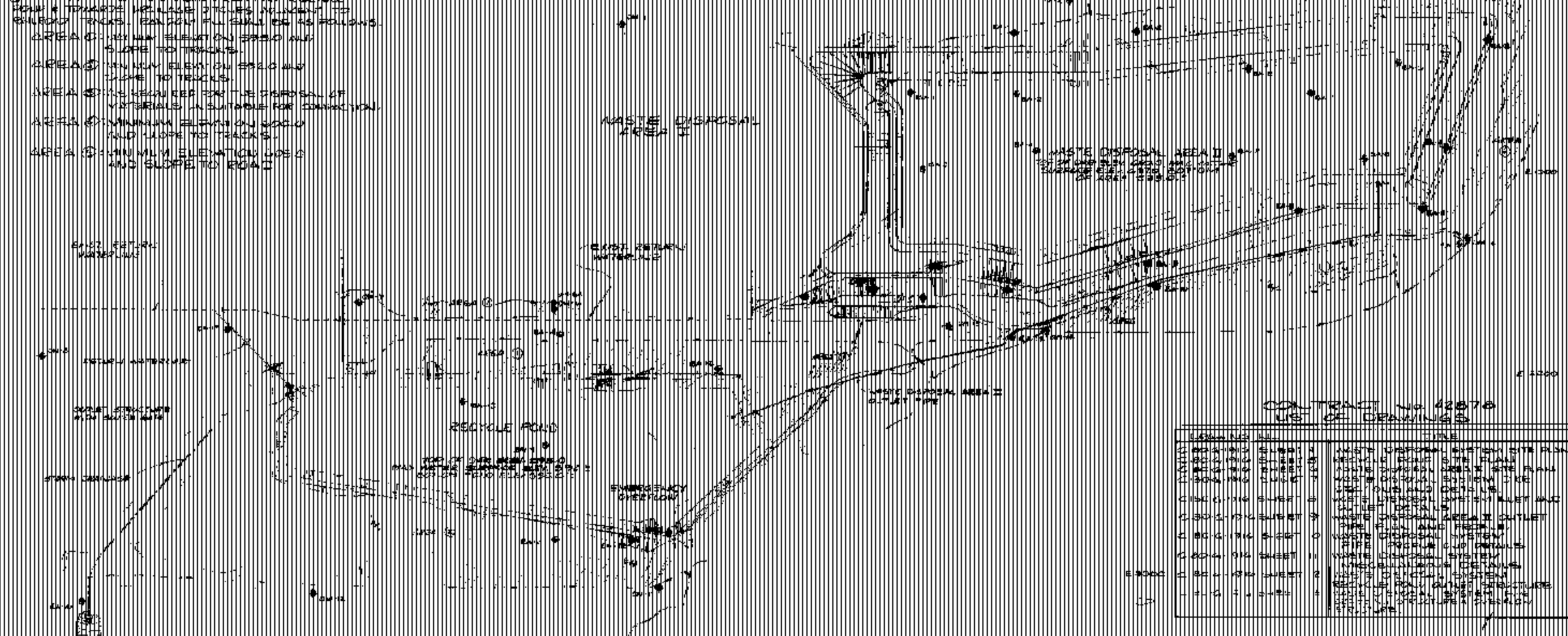
Appendix B: Duck Creek Power Station Drawings

1. "Waste Storage System, Plan and Details of Dike Embankment", Drawing No. C180-G1916-3, Revision D, 13 February, 1975, Commonwealth Associates Inc.
2. "Waste Disposal System, Site Plan", Drawing No. C180-G1916-4, Revision C, 16 October, 1984, Commonwealth Associates Inc.
3. "Waste Disposal Area II, Site Plan", Drawing No. C180-G1916-6, Revision G, 16 October, 1984, Commonwealth Associates Inc.
4. "Waste Disposal System, Dike Sections and Details", Drawing No. C180-G1916-7, Revision D, 16 October, 1984, Commonwealth Associates Inc.
5. "Waste Disposal System, Inlet and Outlet Details", Drawing No. C180-G1916-8, Revision E, 16 October, 1984, Commonwealth Associates Inc.
6. "Waste Disposal Area II, Outlet Pipe Plan & Profile", Drawing No. C180-G1916-9, Revision E, 11 October, 1984, Commonwealth Associates Inc.
7. "Waste Disposal System, Pipe Profile and Details", Drawing No. C180-G1916-10, Revision E, 10 October, 1984, Commonwealth Associates Inc.
8. "Waste Disposal System, Miscellaneous Details", Drawing No. C180-G1916-11, Revision E, 10 October, 1984, Commonwealth Associates Inc.
9. "Pipe Plan & Profile, Recycle Pond Bypass", Drawing No. M-1001, Revision 0, 30 July, 2004, Sargent & Lundy LLC.
10. "Gypsum Stack – Foundation Grade", Drawing No. C180-C102-8, Revision 6, 5 March, 2009, Hanson Professional Services, Inc.
11. "Gypsum Stack – Clay Layer Grade", Drawing No. C180-C102-9, Revision 4, 5 March, 2009, Hanson Professional Services, Inc.
12. "Gypsum Stack – LD/LCRS Drainage Layer Grade", Drawing No. C180-C102-10, Revision 6, 5 March, 2009, Hanson Professional Services, Inc.
13. "PWRS-Ring Drain System Cushion Dirt Layer Grade", Drawing No. C180-C102-11, Revision 6, 5 March, 2009, Hanson Professional Services, Inc.
14. "PWRS-Ring Drain Details", Drawing No. C180-C102-12, Revision 5, 5 March, 2009, Hanson Professional Services, Inc.
15. "PWRS-Ring Drain Details", Drawing No. C180-C102-13, Revision 2, 5 March, 2009, Hanson Professional Services, Inc.
16. "LD/LCRS Sections & Details", Drawing No. C180-C102-14, Revision 3, 5 March, 2009, Hanson Professional Services, Inc.
17. "Recycle Pond Plan", Drawing No. C180-C102-15, Revision 5, 5 March, 2009, Hanson Professional Services, Inc.
18. "Miscellaneous Details", Drawing No. C180-C102-29, Revision 2, 5 March, 2009, Hanson Professional Services, Inc.
19. "LD/LCRS Underdrain Dewatering System-Seep 1", Drawing No. C180-C102-30, Revision 2, 5 March, 2009, Hanson Professional Services, Inc.
20. "LD/LCRS Underdrain Dewatering System-Seep 2", Drawing No. C180-C102-31, Revision 2, 5 March, 2009, Hanson Professional Services, Inc.


NORTH - SOUTH
BASE LINE
SECTION "B3"- "B3"
SECTION "D3"- "D3"
WASTE STORAGE AREA
PLAN
SECTION "A3"- "A3"
SECTION "C3"- C3"
SCANNED

GENERAL NOTES

1) SITE SURVEY FROM ABRAMS AERIAL SURVEY MADE UP ON OCTOBER 1974 ([illegible]).
2) THE AREA WITHIN WASTE DISPOSAL AREA 1, RECYCLE ROAD, ALL DIKE FOUNDATIONS, FILL AREAS, BORROW AREAS AND DRAIN EXCAVATIONS SHALL BE CLEARED PRIOR TO ANY SUBSEQUENT WORK.
3) ALL SUBGRADES SHALL BE APPROVED BY THE OWNER'S REPRESENTATIVE PRIOR TO THE PLACEMENT OF ANY FILL.
4) ALL DIKE EMBANKMENTS SHALL BE COMPACTED TO 95% OF MAXIMUM DENSITY AS OBTAINED BY ASTM D 698.
5) ALL RANDOM FILL AREAS SHALL BE COMPACTED TO 85% OF MAXIMUM DENSITY AS OBTAINED BY ASTM D 698. RANDOM FILL SHALL BE SLOPED AWAY FROM DISPOSAL AREA AND RECYCLE POND & TOWARDS DRAINAGE DITCHES ADJACENT TO RAILROAD TRACKS. RANDOM FILL SHALL BE AS FOLLOWS:
   - AREA ①: MINIMUM ELEVATION [illegible] AND SLOPE TO TRACKS.
   - AREA ②: MINIMUM ELEVATION [illegible] AND SLOPE TO TRACKS.
   - AREA ③: IS RESERVED FOR THE DISPOSAL OF MATERIALS UNSUITABLE FOR COMPACTION.
   - AREA ④: MINIMUM ELEVATION [illegible] AND SLOPE TO TRACKS.
   - AREA ⑤: MINIMUM ELEVATION [illegible] AND SLOPE TO ROAD.



CONTRACT No. 42878
LIST OF DRAWINGS

DRAWING NO.		TITLE
[illegible]	SHEET 4	WASTE DISPOSAL SYSTEM SITE PLAN
[illegible]	SHEET 5	RECYCLE POND SITE PLAN
[illegible]	SHEET 6	WASTE DISPOSAL AREA II SITE PLAN
[illegible]	SHEET 7	WASTE DISPOSAL SYSTEM DIKE SECTIONS AND DETAILS
[illegible]	SHEET 8	WASTE DISPOSAL SYSTEM INLET AND OUTLET DETAILS
[illegible]	SHEET 9	WASTE DISPOSAL AREA II OUTLET PIPE PLAN AND PROFILE
[illegible]	SHEET 10	WASTE DISPOSAL SYSTEM PIPE PROFILE AND DETAILS
[illegible]	SHEET 11	WASTE DISPOSAL SYSTEM MISCELLANEOUS DETAILS
[illegible]	SHEET 12	WASTE DISPOSAL SYSTEM RECYCLE POND OUTLET STRUCTURE
[illegible]	SHEET [illegible]	WASTE DISPOSAL SYSTEM [illegible] STRUCTURE & OVERFLOW STRUCTURE

LEGEND

- INDICATES FINAL DISPOSAL AREA AND RECYCLE POND SLOPES.
- INDICATES RANDOM FILL AREAS.
- INDICATES DITCHES, DRAINAGE
- MONITORING WELL
- EMBANKMENT AREA OR DIKE BORING
- BORROW AREA BORING

PLAN

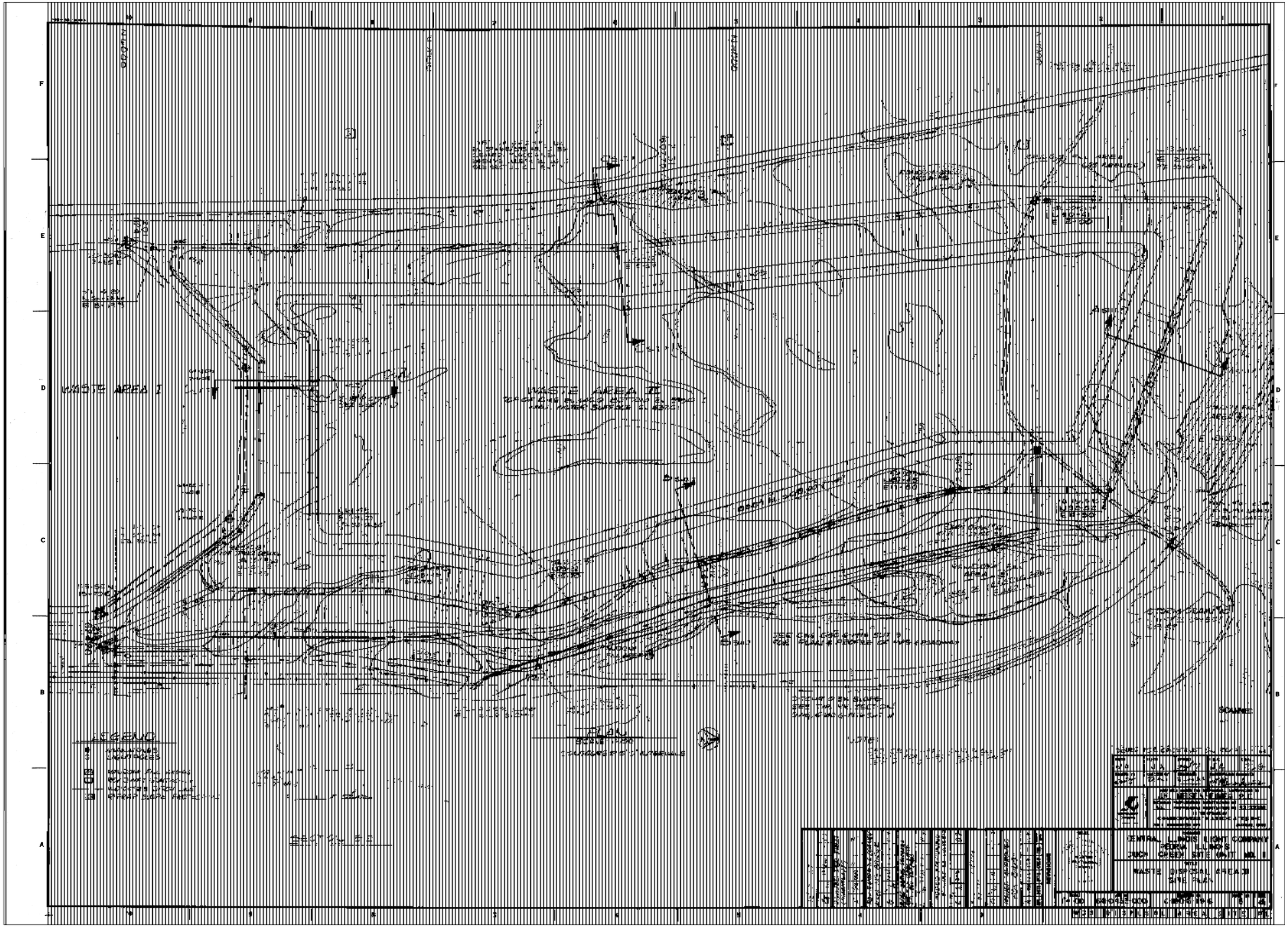
SCALE 1" = [illegible]
CONTOURS AT 2' INTERVALS

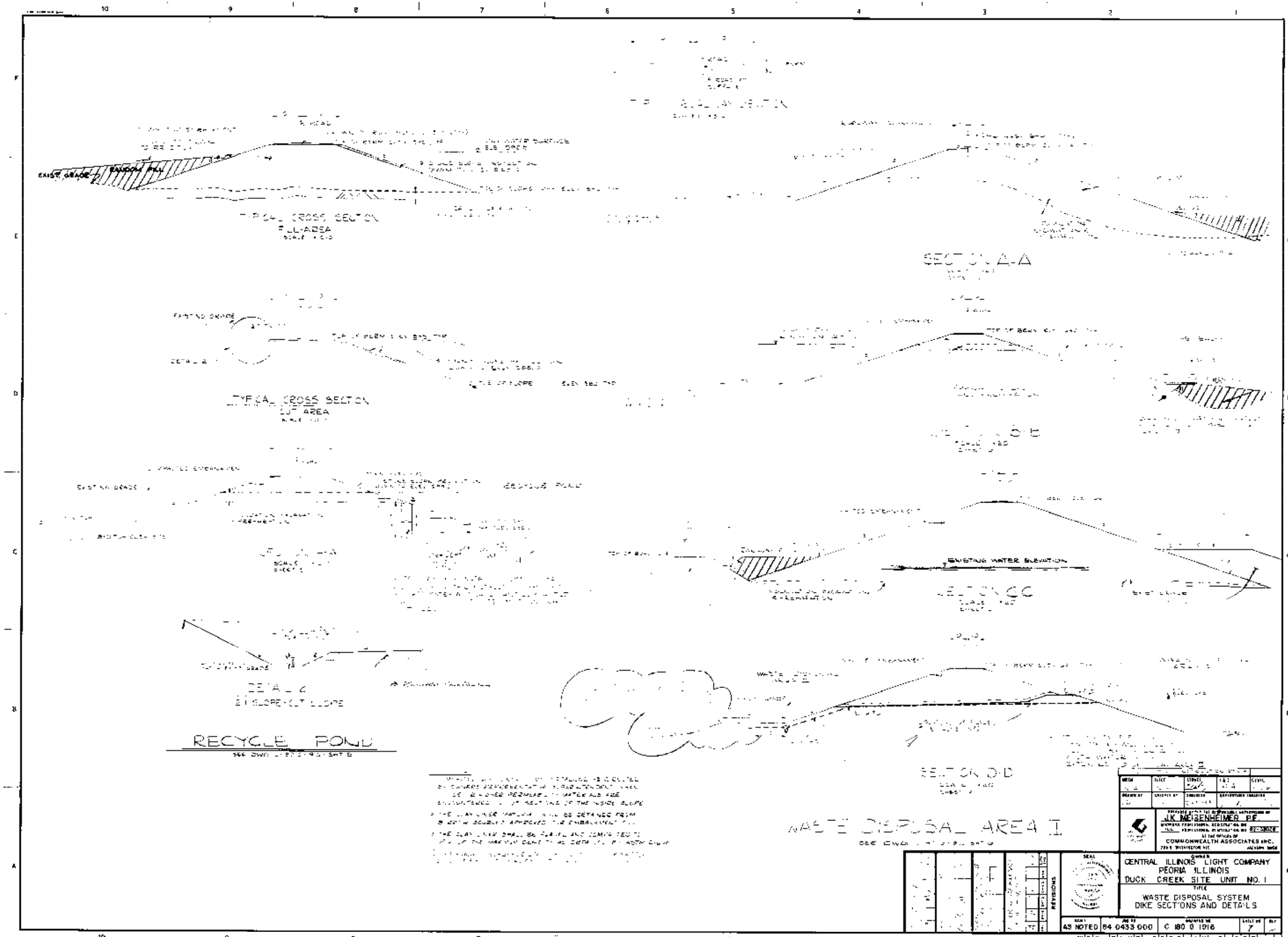
ISSUED FOR CONSTRUCTION

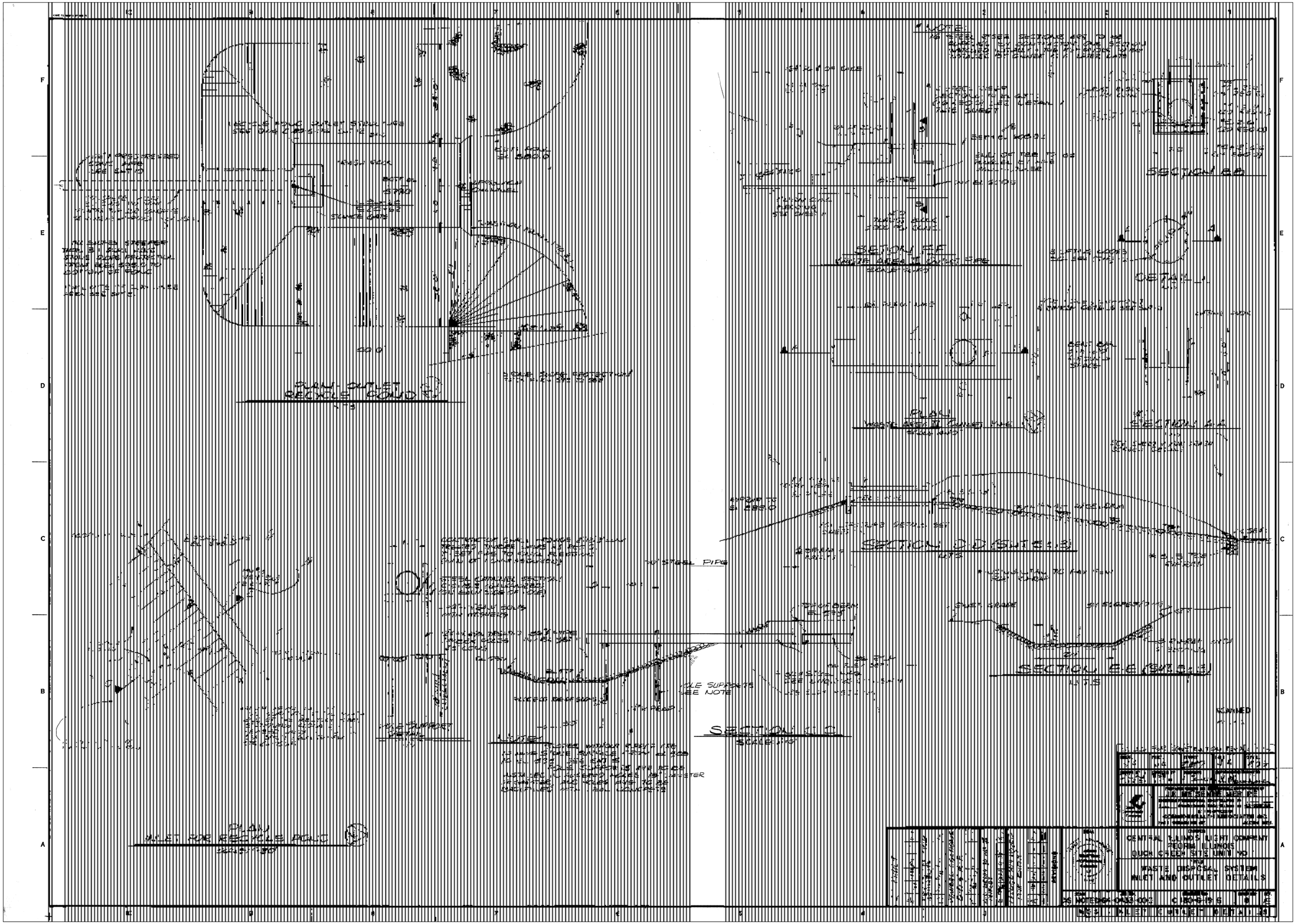
CENTRAL ILLINOIS LIGHT COMPANY
PEORIA, ILLINOIS
DUCK CREEK SITE - UNIT NO. 1

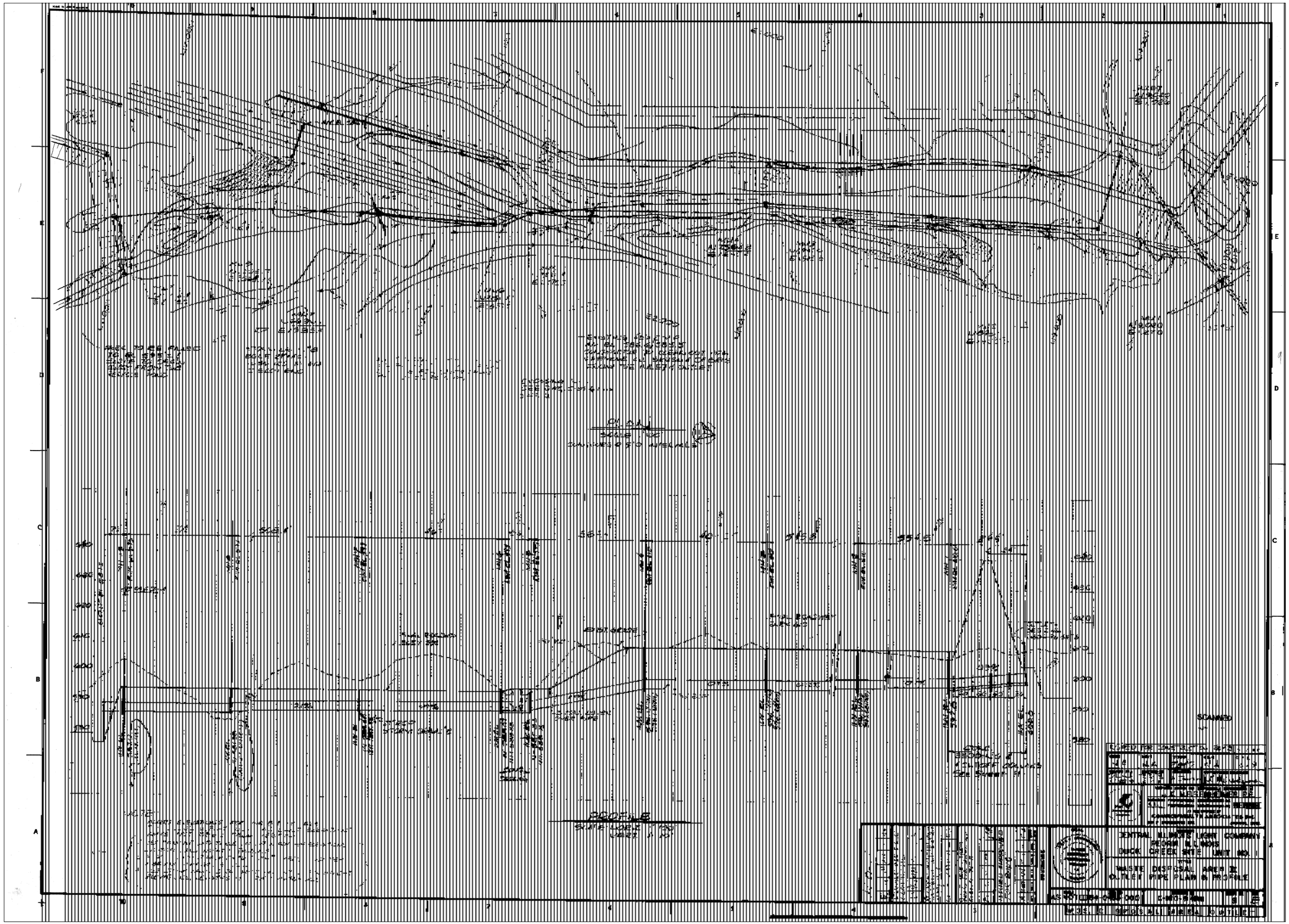
WASTE DISPOSAL SYSTEM
SITE PLAN

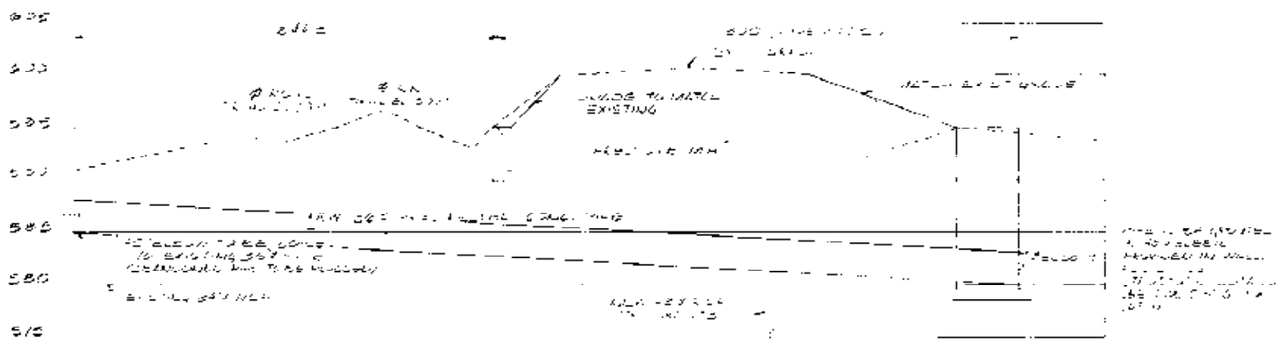
11-200 | 69-0433-000 | C180-3-1916


WASTE AREA I
WASTE AREA II
LEGEND
PLAN
SECTION B-B
CENTRAL ILLINOIS LIGHT COMPANY
PEORIA ILLINOIS
DUCK CREEK SITE UNIT NO. 1
WASTE DISPOSAL AREA
SITE PLAN

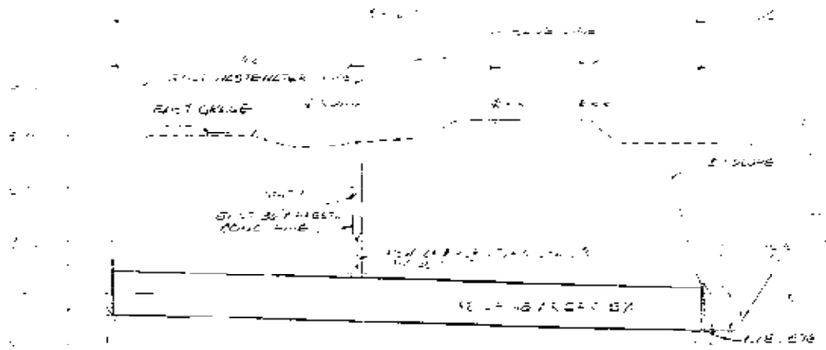

EXIST GRADE
TYPICAL CROSS SECTION
FILL AREA
TYPICAL CROSS SECTION
CUT AREA
DETAIL C
RECYCLE POND
SECTION A-A
SECTION B-B
EXISTING WATER ELEVATION
SECTION C-C
SECTION D-D
WASTE DISPOSAL AREA I
REVISIONS
SEAL
JK MEISENHEIMER P.E.
COMMONWEALTH ASSOCIATES INC.
OWNER
CENTRAL ILLINOIS LIGHT COMPANY
PEORIA ILLINOIS
DUCK CREEK SITE UNIT NO. 1
TITLE
WASTE DISPOSAL SYSTEM
DIKE SECTIONS AND DETAILS
AS NOTED
84 0433 000
C 180 0 1916
7
WDS DIKE SECTIONS & DETAILS


PLAN OUTLET RECYCLE POND
SECTION F-F
SECTION B-B
DETAIL
PLAN
SECTION A-A
SECTION D-D
SECTION E-E
SECTION C-C
PLAN INLET FOR RECYCLE POND
CENTRAL ILLINOIS LIGHT COMPANY
PEORIA ILLINOIS
DUCK CREEK SITE UNIT NO.
WASTE DISPOSAL SYSTEM
INLET AND OUTLET DETAILS

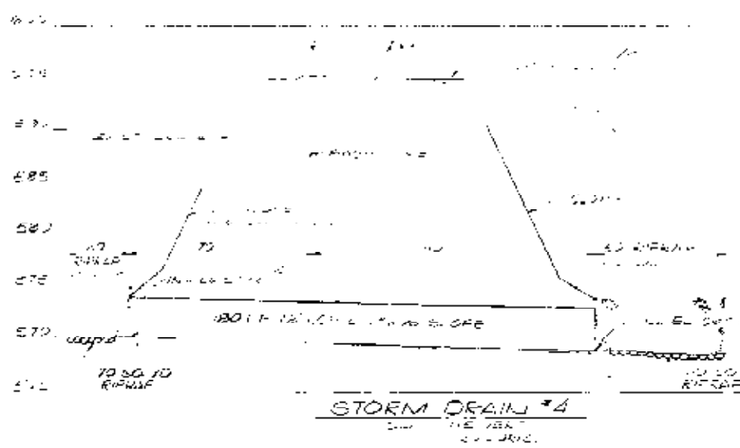

PROFILE
SCANNED
CENTRAL ILLINOIS LIGHT COMPANY
PEORIA ILLINOIS
DUCK CREEK SITE UNIT NO. 1
WASTE DISPOSAL AREA II
OUTLET PIPE PLAN & PROFILE



RECALL POND RETAINING WALL PROFILE



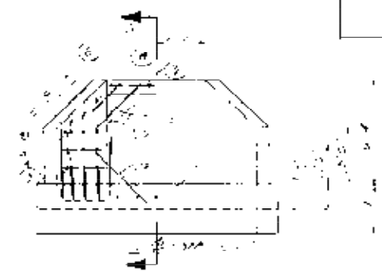
STORM DRAIN #2



STORM DRAIN #4

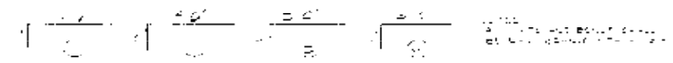
STORM DRAIN DATA

PLAN



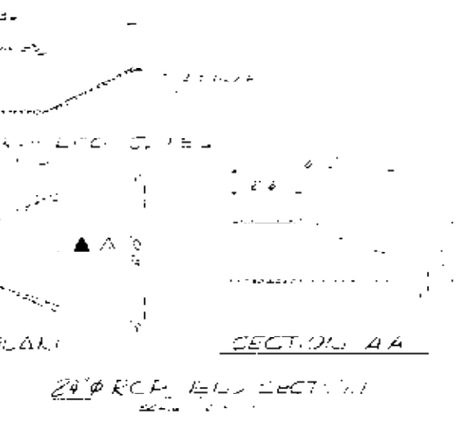
SECTION AA

TYPICAL HEADWALL DETAILS



BELL CAP DETAILS

BAR SCHEDULE



PLAN

SECTION AA

24" ϕ RCP HELD SECTION

REVISIONS

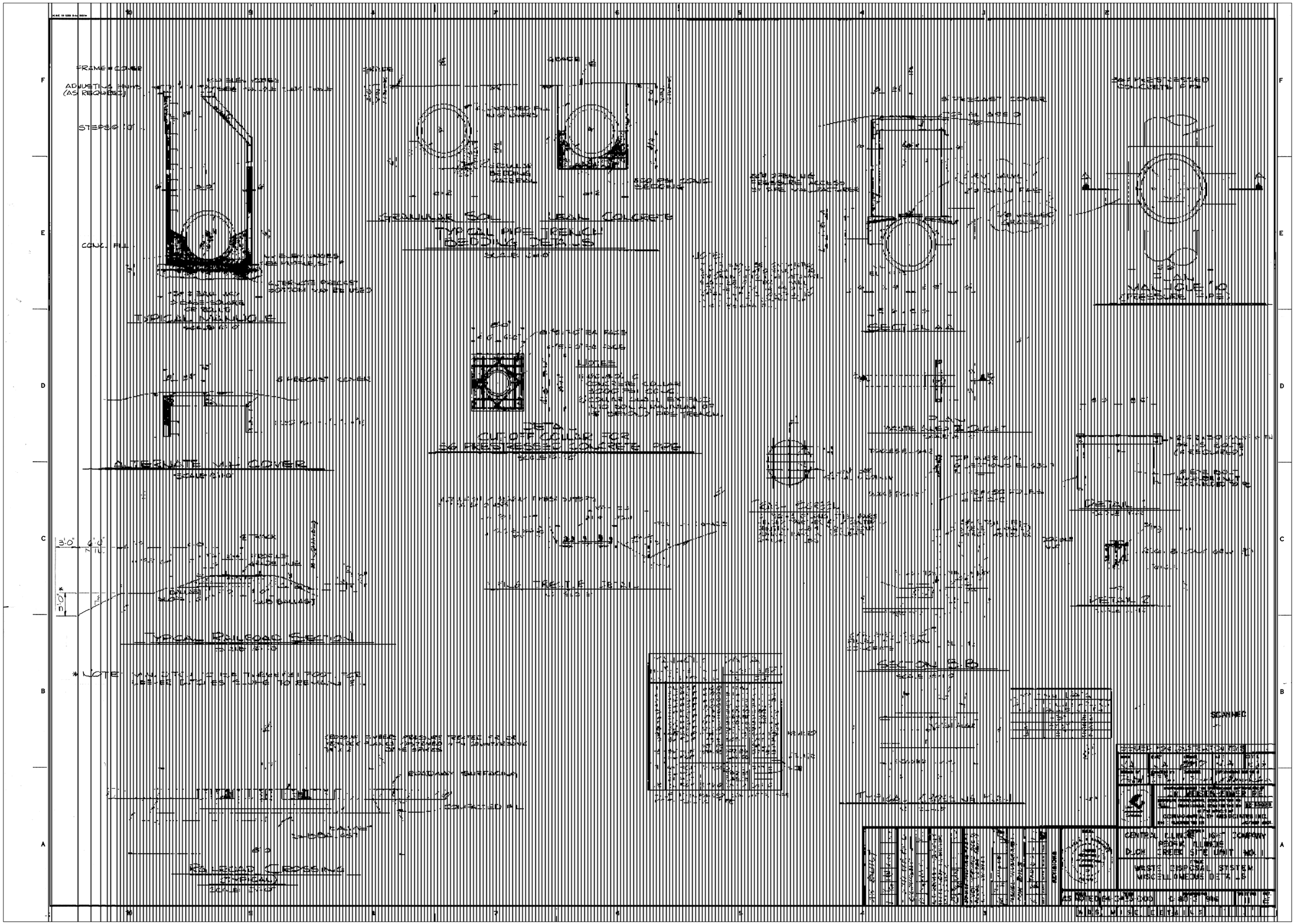
PROFESSIONAL ENGINEER (IN RESPONSIBLE CHARGE OF) J.K. NEISENHEMER P.E.
REGISTRATION NO. 62-33026
COMMONWEALTH ASSOCIATES INC.

CENTRAL ILLINOIS LIGHT COMPANY
PEORIA ILLINOIS
DUCK CREEK SITE UNIT NO. 1

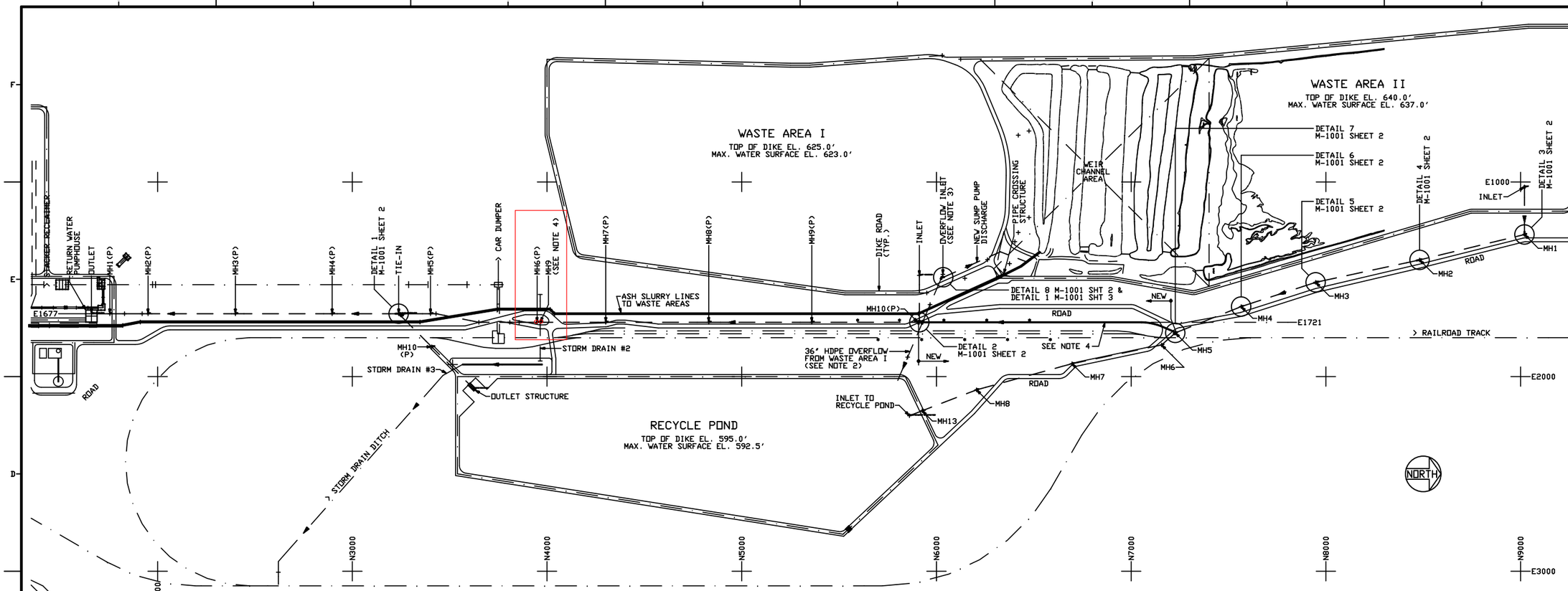
WASTE DISPOSAL SYSTEM
PIPE PROFILE AND DETAILS

SCALE	JOB NO	DRAWING NO	SHEET NO	REV
AS NOTED	64 0433-000	C 180 S 1016	10	E

WDS PIPE PROFILES (8) DETAIL



TYPICAL MANHOLE
GRANULAR SOIL
LEAN CONCRETE
TYPICAL PIPE TRENCH BEDDING DETAILS
SECTION A-A
MANHOLE #10
ALTERNATE M.H. COVER
DETAIL
CUT-OFF COLLAR FOR 36 PRESTRESSED CONCRETE PIPE
DETAIL 1
DETAIL 2
TYPICAL RAILROAD SECTION
SECTION B-B
RAILROAD CROSSING
TYPICAL CROSSING PLAN
SCANNED
CENTRAL ILLINOIS LIGHT COMPANY
PEORIA ILLINOIS
DUCK CREEK SITE UNIT NO. 1
WASTE DISPOSAL SYSTEM
MISCELLANEOUS DETAILS



PLAN

REFERENCE DRAWINGS:

1. EXISTING PIPE ROUTE FROM WASTE AREA I INLET TO RETURN WATER PUMPHOUSE PER DRAWING C180-G1929 SHEET 1 AND 'INTERPACE' PIPE LAYING SCHEDULE SB-74-26.

2. EXISTING PIPE ROUTE FROM RECYCLE POND OUTLET STRUCTURE TO TIE-IN POINT TO ORIGINAL RETURN LINE AND FROM WASTE AREA II INLET TO RECYCLE POND PER DRAWING C180-G-1916 SHEETS 5 AND 9 RESPECTIVELY.

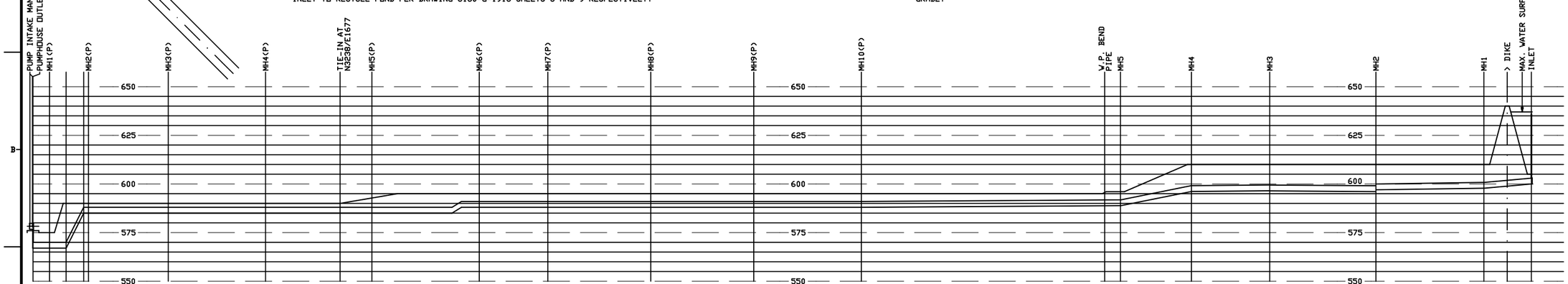
NOTES:

1. MANHOLES (MH) WITH PRESSURE ACCESS HATCHES INDICATED WITH A (P).

2. EXISTING OVERFLOW PIPE TO BE ABANDONED AS PART OF THE RETIREMENT OF WASTE AREA I. PIPE SECTION TO BE CUT OUT TO ALLOW FOR THE INSTALLATION OF THE WASTE WATER RETURN LINE FROM WASTE AREA II; BOTH ENDS IN THE EXCAVATION TO BE CAPPED.

3. OVERFLOW OUTLET REUSED BY CUTTING INTO THE OVERFLOW PIPE INSIDE OF THE DIKE ROAD AND INSTALLING A NEW HDPE SUMP. DISCHARGE FROM SUMP PUMP ROUTED TO PIPE CROSSING STRUCTURE AT WASTE AREA II.

4. HDPE PIPE ALTERNATE MAY TRANSITION FROM UNDERGROUND CONNECTION AND MAY BE ROUTED ON GRADE; ROAD CROSSINGS SHALL BE BELOW GRADE.



PROFILE

SCALES: HORIZONTAL 1'= 200' / VERTICAL 1'= 20'

ANY MODIFICATION OR ADDITION TO THIS DRAWING BY AN ORGANIZATION OTHER THAN SARGENT & LUNDY IS NOT THE RESPONSIBILITY OF SARGENT & LUNDY

FILE I.D.: M1001 01.DGN

DRAWING RELEASE RECORD

REV.	DATE REL'D.	PREPARED	REVIEWED	APPROVED	PURPOSE	FILM

DRAWING RELEASE RECORD

REV.	DATE REL'D.	PREPARED	REVIEWED	APPROVED	PURPOSE	FILM
0	07/30/04	J.ALCANTARA	M.MAZZAFERRO		FOR RECORD/SENT TO CLIENT	

SCALE: 1'=200'

PROJECT NUMBER: 11478-006

PIPE PLAN & PROFILE RECYCLE POND BYPASS

DUCK CREEK SITE
UNIT 1
CANTON, ILLINOIS
AMEREN CILCO

Sargent & Lundy

DRAWING NO. M-1001 REV. 0

SHEET 1 OF

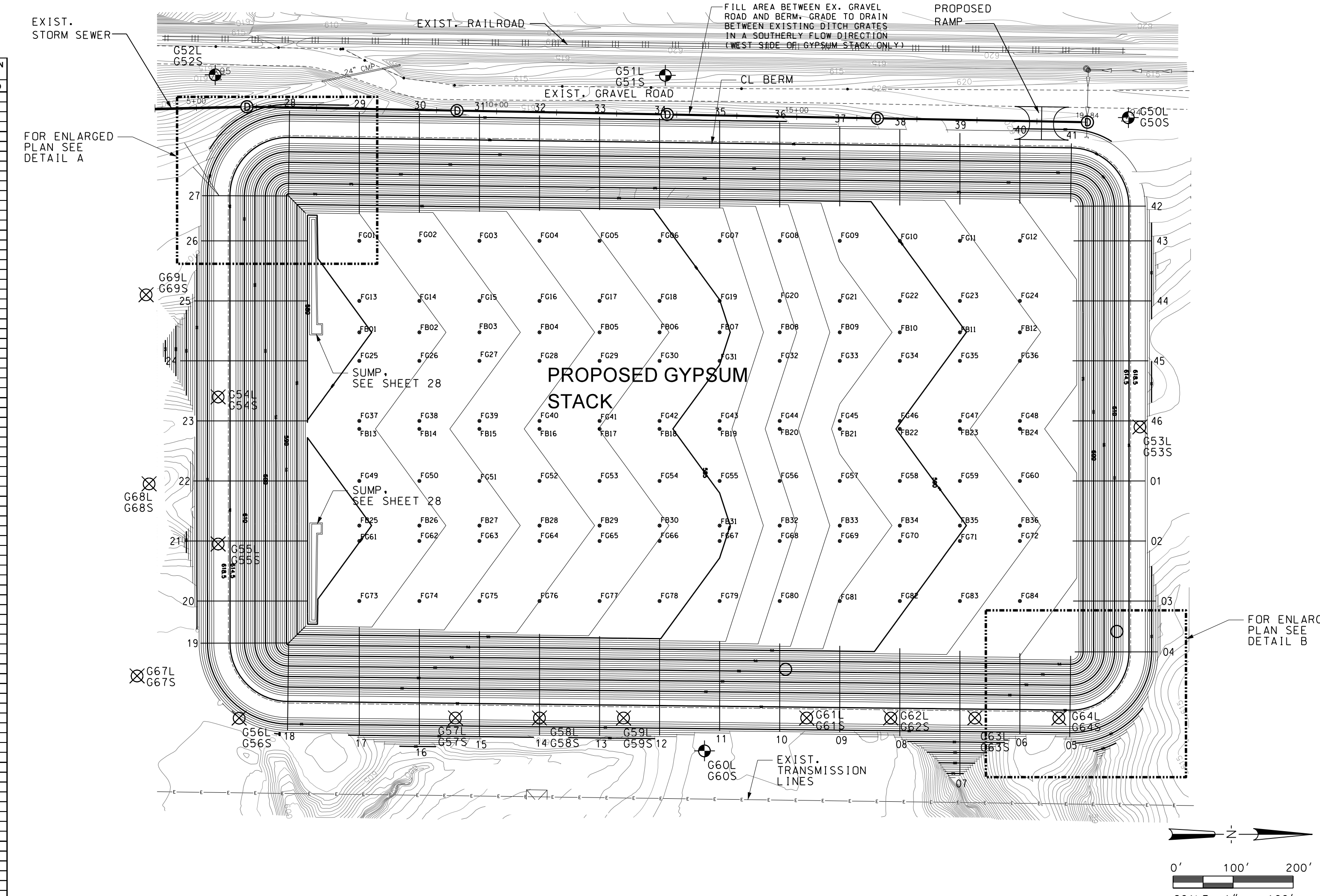
CONTROL POINT NUMBER	GRID COORDINATES NORTHING	GRID COORDINATES EASTING	TOP OF FOUNDATION ELEVATION DESIGN	TOP OF FOUNDATION ELEVATION RECORD
F0101	16094.44	600.00	591.92	591.92
F0102	16129.48	600.00	601.93	601.72
F0103	16171.72	600.00	614.00	613.76
F0104	16181.80	600.00	614.00	613.93
F0105	16181.80	600.00	618.50	618.41
F0106	16207.05	600.00	618.50	618.41
F0107	16212.92	599.97	616.81	617.46
F0201	16093.44	700.00	591.63	591.43
F0202	16128.99	700.00	601.78	601.57
F0203	16171.75	700.00	614.00	613.66
F0204	16181.83	700.00	614.00	613.83
F0205	16181.83	700.00	618.50	618.45
F0206	16207.08	700.00	618.50	618.39
F0207	16214.65	699.99	616.33	616.08
F0301	16095.59	800.00	592.23	592.10
F0302	16130.09	800.00	602.09	601.78
F0303	16171.78	800.00	614.00	613.92
F0304	16181.86	800.00	614.00	613.80
F0305	16181.86	800.00	618.50	618.40
F0306	16207.11	800.00	618.50	618.36
F0307	16231.93	800.00	611.41	613.77
F0401	16097.41	884.70	592.75	592.62
F0402	16131.01	884.69	602.34	601.96
F0403	16171.81	884.68	614.00	613.88
F0404	16181.89	884.67	614.00	613.95
F0405	16181.89	884.67	618.50	618.46
F0406	16207.14	884.67	618.50	618.49
F0407	16233.79	884.62	610.88	611.16
F0501	16084.47	897.40	592.72	592.61
F0502	16084.09	931.08	602.34	601.98
F0503	16083.63	971.90	614.00	613.82
F0504	16083.52	981.98	614.00	613.99
F0505	16083.52	981.98	618.50	618.42
F0506	16083.24	1007.23	618.50	618.27
F0507	16082.98	1032.66	611.24	612.16
F0601	16000.00	894.01	592.01	591.89
F0602	16000.00	928.91	601.99	601.71
F0603	16000.00	970.96	614.00	613.85
F0604	16000.00	981.05	614.00	613.91
F0605	16000.00	981.05	618.50	618.35
F0606	16000.00	1006.30	618.50	618.19
F0607	15999.99	1027.93	612.32	614.31
F0701	15900.00	889.98	591.18	591.13
F0702	15900.00	926.34	601.57	601.53
F0703	15900.00	969.85	614.00	613.72
F0704	15900.00	979.93	614.00	613.97
F0705	15900.00	979.93	618.50	618.32
F0706	15900.00	1005.18	618.50	618.28
F0707	15900.00	1090.84	594.03	610.36
F0801	15800.00	885.96	590.35	590.35
F0802	15800.00	923.77	601.15	601.09
F0803	15800.00	968.73	614.00	613.77
F0804	15800.00	978.81	614.00	613.82
F0805	15800.00	978.81	618.50	618.32
F0806	15800.00	1004.06	618.50	618.35
F0807	15799.99	1029.78	611.15	611.95
F0901	15700.00	881.93	589.52	589.33
F0902	15700.00	921.20	600.74	600.58
F0903	15700.00	967.62	614.00	613.65
F0904	15700.00	977.70	614.00	613.93
F0905	15700.00	977.70	618.50	618.36
F0906	15700.00	1002.95	618.50	618.42
F0907	15700.00	1023.57	612.61	613.54
F1001	15600.00	874.33	587.67	587.28
F1002	15600.00	918.63	600.32	600.30
F1003	15600.00	966.50	614.00	613.79
F1004	15600.00	976.58	614.00	613.81
F1005	15600.00	976.58	618.50	618.43
F1006	15600.00	1001.83	618.50	618.42
F1007	15600.00	1020.54	613.15	613.94
F1101	15500.00	866.73	585.81	585.69
F1102	15500.00	916.06	599.91	599.75
F1103	15500.00	965.38	614.00	613.70
F1104	15500.00	975.46	614.00	613.81
F1105	15500.00	975.46	618.50	618.40
F1106	15500.00	1000.72	618.50	618.37
F1107	15500.02	1020.41	612.87	613.37
F1201	15400.00	862.70	584.98	584.93
F1202	15400.00	913.48	599.49	599.29
F1203	15400.00	964.27	614.00	613.73
F1204	15400.00	974.35	614.00	613.78
F1205	15400.00	974.35	618.50	618.32
F1206	15400.00	999.60	618.50	618.32
F1207	15399.98	1028.62	610.20	611.46
F1301	15300.00	858.67	584.15	583.89
F1302	15300.00	910.91	599.08	598.88
F1303	15300.00	963.15	614.00	613.76
F1304	15300.00	973.23	614.00	613.83
F1305	15300.00	973.23	618.50	618.38
F1306	15300.00	998.48	618.50	618.12
F1307	15300.00	1032.07	608.91	610.62
F1401	15200.00	854.65	583.32	583.20
F1402	15200.00	908.34	598.66	598.57
F1403	15200.00	962.03	614.00	613.76
F1404	15200.00	972.12	614.00	613.80
F1405	15200.00	972.12	618.50	618.27
F1406	15200.00	997.37	618.50	618.45
F1407	15199.99	1026.69	610.12	611.00
F1501	15100.00	850.62	582.49	582.35
F1502	15100.00	905.77	598.24	598.08
F1503	15100.00	960.92	614.00	613.65
F1504	15100.00	971.00	614.00	613.79
F1505	15100.00	971.00	618.50	618.43
F1506	15100.00	996.25	618.50	618.33
F1507	15099.99	1029.67	608.96	611.29
F1601	15000.00	846.59	581.66	581.56
F1602	15000.00	903.20	597.83	597.75
F1603	15000.00	959.80	614.00	613.69
F1604	15000.00	969.88	614.00	613.88
F1605	15000.00	969.88	618.50	618.37
F1606	15000.00	995.13	618.50	618.28
F1607	15000.03	1043.53	604.67	611.24
F1701	14900.00	842.57	580.83	580.78
F1702	14900.00	900.63	597.41	597.33
F1703	14900.00	958.69	614.00	613.84
F1704	14900.00	968.77	614.00	613.82
F1705	14900.00	968.77	618.50	618.39

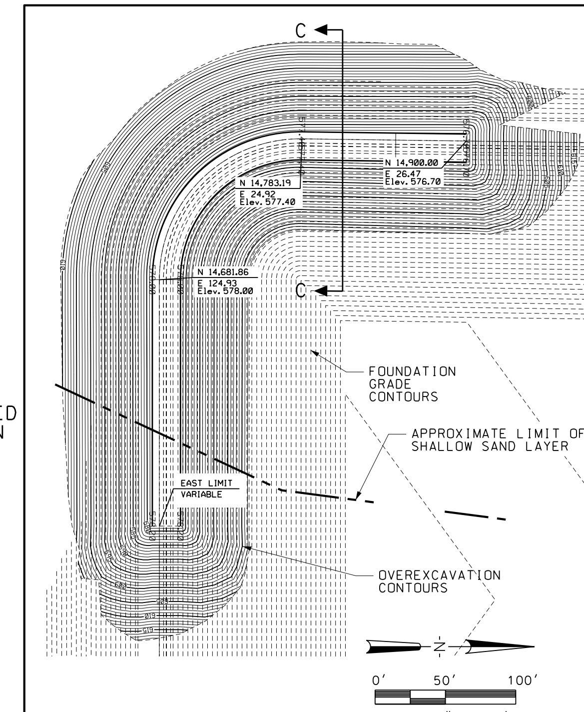
CONTROL POINT NUMBER	GRID COORDINATES NORTHING	GRID COORDINATES EASTING	TOP OF FOUNDATION ELEVATION DESIGN	TOP OF FOUNDATION ELEVATION RECORD
F1706	14900.00	994.02	618.50	618.33
F1707	14900.00	1028.15	608.75	611.74
F1801	14813.44	839.08	580.21	579.97
F1802	14782.32	869.87	589.00	588.95
F1803	14781.16	957.36	614.00	613.89
F1804	14781.02	967.44	614.00	613.98
F1805	14781.02	967.44	618.50	618.33
F1806	14780.69	992.69	618.50	618.30
F1807	14780.28	1021.66	610.22	612.15
F1901	14813.44	839.08	580.21	579.95
F1902	14782.32	869.87	589.00	588.94
F1903	14694.82	870.06	614.00	613.79
F1904	14684.74	870.09	614.00	613.82
F1905	14684.74	870.09	618.50	618.35
F1906	14659.49	870.14	618.50	618.28
F1907	14631.04	870.23	610.37	618.75
F2001	14814.22	800.00	579.88	579.87
F2002	14754.51	800.00	596.94	596.83
F2003	14694.80	800.00	614.00	613.87
F2004	14684.72	800.00	614.00	613.81
F2005	14684.72	800.00	618.50	618.21
F2006	14659.47	800.00	618.50	618.43
F2007	14625.16	799.98	608.69	617.10
F2101	14816.20	700.00	579.31	579.28
F2102	14755.49	700.00	596.65	596.51
F2103	14694.78	700.00	614.00	613.87
F2104	14684.70	700.00	614.00	613.87
F2105	14684.70	700.00	618.50	618.46
F2106	14659.45	700.00	618.50	618.31
F2107	14604.09	699.98	602.68	617.45
F2201	14815.21	600.00	579.59	579.48
F2202	14754.98	600.00	596.79	596.47
F2203	14694.76	600.00	614.00	613.77
F2204	14684.68	600.00	614.00	613.90
F2205	14684.68	600.00	618.50	618.48
F2206	14659.43	600.00	618.50	618.47
F2207	14616.86	600.00	606.34	617.52
F2301	14813.75	500.00	580.00	579.84
F2302	14754.25	500.00	597.00	596.67
F2303	14694.74	500.00	614.00	613.66
F2304	14684.66	500.00	614.00	613.68
F2305	14684.66	500.00	618.50	618.35
F2306	14659.41	500.00	618.50	618.47
F2307	14628.55	499.97	609.69	617.85
F2401	14815.70	400.00	579.43	579.29
F2402	14755.21	400.00	596.72	596.41
F2403	14694.72	400.00	614.00	613.71
F2404	14684.64	400.00	614.00	613.74
F2405	14684.64	400.00	618.50	618.37
F2406	14659.39	400.00	618.50	618.39
F2407	14575.59	399.99	594.55	611.78
F2501	14815.59	300.00	579.46	579.37
F2502	14755.14	300.00	596.73	596.50
F2503	14694.70	300.00	614.00	613.66
F2504	14684.62	300.00	614.00	613.78
F2505	14684.62	300.00	618.50	618.43
F2506	14659.37	300.00	618.50	618.19
F2507	14620.64	299.98	607.44	616.64
F2601	14813.56	200.00	580.03	579.89
F2602	14754.12	200.00	597.02	596.76
F2603	14694.68	200.00	614.00	613.71
F2604	14684.60	200.00	614.00	613.92
F2605	14684.60	200.00	618.50	618.35
F2606	14659.35	200.00	618.50	618.27
F2607	14631.96	199.98	610.68	617.40
F2701	14812.67	156.13	580.28	580.17
F2702	14782.16	125.21	589.00	588.97
F2703	14694.66	125.04	614.00	613.87
F2704	14684.58	125.02	614.00	613.79
F2705	14684.58	125.02	618.50	618.43
F2706	14659.33	124.97	618.50	618.20
F2707	14635.10	124.92	611.57	614.44
F2801	14812.67	156.13	580.28	580.21
F2802	14782.16	125.21	589.00	588.96
F2803	14783.14	37.72	614.00	613.81
F2804	14783.25	27.64	614.00	613.79
F2805	14783.25	27.64	618.50	618.42
F2806	14783.53	2.39	618.50	618.22
F2807	14783.96	-34.35	608.00	610.18
F2901	14900.00	154.79	581.00	581.00
F2902	14900.00	97.03	597.50	597.36
F2903	14900.00	39.27	614.00	613.93
F2904	14900.00	29.19	614.00	613.98
F2905	14900.00	29.19	618.50	618.11
F2906	14900.00	3.94	618.50	618.45
F2907	14900.00	-23.80	610.57	613.06
F3001	15000.00	153.27	581.81	581.73
F3002	15000.00	96.94	597.91	597.64
F3003	15000.00	40.61	614.00	613.86
F3004	15000.00	30.53	614.00	613.95
F3005	15000.00	30.53	618.50	618.43
F3006	15000.00	5.28	618.50	618.36
F3007	14999.97	-14.01	613.00	614.78
F3101	15100.00	151.74	582.63	582.56
F3102	15100.00	96.84	598.32	598.32
F3103	15100.00	41.94	614.00	613.93
F3104	15100.00	31.86	614.00	613.87
F3105	15100.00	31.86	618.50	618.29
F3106	15100.00	6.61	618.50	618.15
F3107	15100.02	-8.95	614.06	614.92
F3201	15200.00	150.22	583.45	583.22
F3202	15200.00	96.75	598.72	598.64
F3203	15200.00	43.28	614.00	613.96
F3204	15200.00	33.19	614.00	613.93
F3205	15200.00	33.19	618.50	618.39
F3206	15200.00	7.94	618.50	618.30
F3207	15199.98	-7.68	614.03	615.32
F3301	15300.00	148.69	584.26	584.18
F3302	15300.00	96.65	599.13	599.11
F3303	15300.00	44.61	614.00	613.96
F3304	15300.00	34.53	614.00	613.96
F3305	15300.00	34.53	618.50	618.32
F3306	15300.00	9.28	618.50	618.15
F3307	15300.02	-5.09	614.39	615.54
F3401	15400.00	147.17	585.08	584.94
F3402	15400.00	96.55	599.54	599.46
F3403	15400.00	45.94	614.00	613.92

CONTROL POINT NUMBER	GRID COORDINATES NORTHING	GRID COORDINATES EASTING	TOP OF FOUNDATION ELEVATION DESIGN	TOP OF FOUNDATION ELEVATION RECORD
F3404	15400.00	35.86	614.00	613.89
F3405	15400.00	35.86	618.50	618.35
F3406	15400.00	10.61	618.50	618.30
F3407	15299.99	-4.81	614.10	615.48
F3501	15500.00	145.64	585.90	585.79
F3502	15500.00	96.46	599.95	599.88
F3503	15500.00	47.28	614.00	613.88
F3504	15500.00	37.19	614.00	613.95
F3505	15500.00	37.19	618.50	618.35
F3506	15500.00	11.94	618.50	618.28
F3507	15399.98	-3.03	614.22	616.45
F3601	15600.00	140.54	587.74	587.67
F3602	15600.00	96.36	600.36	600.28
F3603	15600.00	48.61	614.00	613.87
F3604	15600.00	38.53	614.00	613.95
F3605	15600.00	38.53	618.50	618.43
F3606	15600.00	13.28	618.50	618.13
F3607	15600.01	0.68	614.90	617.26
F3701	15700.00	135.44	589.57	589.38
F3702	15700.00	96.27	600.77	600.75
F3703	15700.00	49.94	614.00	613.94
F3704	15700.00	39.86	614.00	613.84
F3705	15700.00	39.86	618.50	618.31
F3706	15700.00	14.61	618.50	618.16
F3707	15699.99	6.05	616.06	618.25
F3801	15800.00	133.92	590.39	590.28
F3802	15800.00	96.17	601.17	600.92
F3803	15800.00	51.28	614.00	613.73
F3804	15800.00	41.20	614.00	613.78
F3805	15800.00	41.20	618.50	618.39
F3806	15800.00	15.94	618.50	618.48
F3807	15799.99	13.41	617.77	619.70
F3901	15900.00	132.39	591.21	591.17
F3902	15900.00	96.07	601.58	601.40
F3903	15900.00	52.61	614.00	613.83
F3904	15900.00	42.53	614.00	613.99
F3905	15900.00	42.53	618.50	618.41
F3906	15900.00	17.28	618.50	618.27
F3907	15899.97	14.63	619.26	620.26
F4001	16000.00	130.87	592.02	591.82
F4002	16000.00	95.98	601.99	601.75
F4003	16000.00	53.94	614.00	613.93
F4004	16000.00	43.86	614.00	613.91
F4005	16000.00	43.86	618.50	618.37
F4006	16000.00	18.61	618.50	618.28
F4007	15999.98	13.17	620.06	620.37
F4101	16084.55	129.59	592.71	592.70
F4102	16085.00	95.91	602.34	602.23
F4103	16085.54	55.08	614.00	613.89
F4104	16085.68	45.00	614.00	613.91
F4105	16085.68	45.00	618.50	618.34
F4106	16086.02	19.76	618.50	618.11
F4107	16086.08	13.77	620.21	620.54
F4201	16097.17	142.27	592.74	592.52
F4202	16130.77	142.26	602.34	602.02
F4203	16171.58	142.25	614.00	613.64
F4204	16181.66	142.25	614.00	613.89
F4205	16181.66	142.25	618.50	618.49
F4206	16206.91	142.24	618.50	618.30
F4207	16214.67	142.24	616.28	619.55
F4301	16095.97	200.00	592.39	592.38
F4302	16130.18	200.00	602.17	601.94
F4303	16171.60	200.00	614.00	613.94
F4304	16181.68	200.00	614.00	613.93
F4305	16181.68	200.00	618.50	618.31
F4306	16206.93	200.00	618.50	618.44
F4307	16223.64	199.97	613.72	618.76
F4401	16093.88	300.00	591.79	591.57
F4402	16129.15	300.00	601.86	601.47
F4403	16171.63	300.00	614.00	613.88
F4404	16181.71	300.00	614.00	613.82
F4405	16181.71	300.00	618.50	618.42
F4406	16206.96	300.00	618.50	618.45
F4407	16223.86	300.00	613.66	618.51
F4501	16093.81	400.00	591.76	591.75
F4502	16129.13	400.00	601.85	601.64
F4503	16171.66	400.00	614.00	613.61
F4504	16181.74	400.00	614.00	613.62
F4505	16181.74	400.00	618.50	618.41
F4506	16206.99	400.00	618.50	618.48
F4507	16219.15	400.02	615.01	618.75
F4601	16095.96	500.00	592.36	592.32
F4602	16130.22	500.00	602.15	601.93
F4603	16171.69	500.00	614.00	613.80
F4604	16181.77	500.00	614.00	613.86
F4605	16181.77	500.00	618.50	618.39
F4606	16207.02	500.00	618.50	618.42
F4607	16214.87	500.01	616.27	617.97
FB01	14900.00	352.42	579.83	579.50
FB02	15000.00	352.42	580.64	580.45
FB03	15100.00	352.42	581.45	581.24
FB04	15200.00	352.42	582.26	582.22
FB05	15300.00	352.42	583.06	582.98
FB06	15400.00	352.42	583.87	583.69
FB07	15500.00	352.42	584.68	584.44
FB08	15600.00	352.42	586.49	586.24
FB09	15700.00	352.42	588.30	588.08
FB10	15800.00	352.42	589.10	588.95
FB11	15900.00	352.42	589.91	589.89
FB12	16000.00	352.42	590.72	590.64
FB13	14900.00	513.35	580.78	580.38
FB14	15000.00	513.35	581.59	581.25
FB15	15100.00	513.35	582.40	582.32
FB16	15200.00	513.35	583.21	583.08
FB17	15300.00	513.35	584.01	584.00
FB18	15400.00	513.35	584.82	584.74
FB19	15500.00	513.35	585.63	585.53
FB20	15600.00	513.35	587.44	587.26
FB21	15700.00	513.35	589.24	589.05
FB22	15800.00	513.35	590.05	589.78
FB23	15900.00	513.35	590.86	590.62
FB24	16000.00	513.35	591.67	591.39
FB25	14900.00	674.29	579.83	579.69
FB26	15000.00	674.29	580.64	580.47
FB27	15100.00	674.29	581.45	581.42
FB28	15200.00	674.29	582.26	582.06
FB29	15300.00	674.29	583.07	582.93

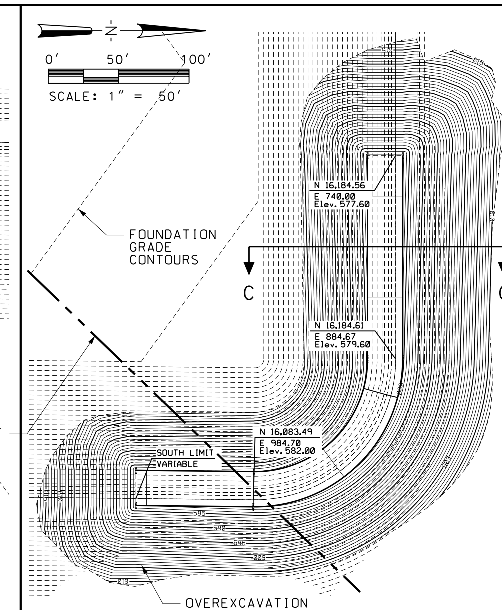
CONTROL POINT NUMBER	GRID COORDINATES NORTHING	GRID COORDINATES EASTING	TOP OF FOUNDATION ELEVATION DESIGN	TOP OF FOUNDATION ELEVATION RECORD
FB30	15400.00	674.29	583.87	583.66
FB31	15500.00	674.29	584.68	584.50
FB32	15600.00	674.29	586.49	586.28
FB33	15700.00	674.29	588.30	588.21
FB34	15800.00	674.29	589.10	588.95
FB35	15900.00	674.29	589.91	589.81
FB36	16000.00	674.29	590.72	590.51
FG01	14900.00	200.00	580.73	580.50
FG02	15000.00	200.00	581.54	581.17
FG03	15100.00	200.00	582.35	582.15
FG04	15200.00	200.00	583.15	583.01
FG05	15300.00	200.00	583.96	583.91
FG06	15400.00	200.00	584.77	584.43
FG07	15500.00	200.00	585.58	585.40
FG08	15600.00	200.00	587.39	587.18
FG09	15700.00	200.00	589.19	589.14
FG10	15800.00	200.00	590.00	589.85
FG11	15900.00	200.00	590.81	590.59
FG12	16000.00	200.00	591.62	591.40
FG13	14900.00	300.00	580.14	580.01
FG14	15000.00	300.00	580.95	580.68
FG15	15100.00	300.00	581.76	581.61
FG16	15200.00	300.00	582.57	582.52
FG17	15300.00	300.00	583.37	583.29
FG18	15400.00	300.00	584.18	584.10
FG19	15500.00	300.00	584.99	584.80
FG20	15600.00	300.00	586.80	586.62
FG21	15700.00	300.00	588.60	588.48
FG22	15800.00	300.00	589.41	589.33
FG23	15900.00	300.00	590.22	590.13
FG24	16000.00	300.00	591.03	591.03
FG25	14900.00	400.00	580.11	580.11
FG26	15000.00	400.00	580.92	580.78
FG27	15100.00	400.00	581.73	581.55
FG28	15200.00	400.00	582.54	582.42
FG29	15300.00	400.00	583.34	583.21
FG30	15400.00	400.00	584.15	584.05
FG31	15500.00	400.00	584.96	584.74
FG32	15600.00	400.00	586.77	586.65
FG33	15700.00	400.00	588.58	588.49
FG34	15800.00	400.00	589.38	589.32
FG35	15900.00	400.00	590.19	590.14
FG36	16000.00	400.00	591.00	590.87
FG37	14900.00	500.00	580.70	580.46
FG38	15000.00	500.00	581.51	581.30
FG39	15100.00	500.00	582.32	582.10
FG40	15200.00	500.00	583.13	583.07
FG41	15300.00	500.00	583.93	583.81
FG42	15400.00	500.00	584.74	584.39
FG43	15500.00	500.00	585.55	585.47
FG44	15600.00	500.00	587.36	587.35
FG45	15700.00	500.00	589.17	588.77
FG46	15800.00	500.00	589.97	589.84
FG47	15900.00	500.00	590.78	590.72
FG48	16000.00	500.00	591.59	591.28
FG49	14900.00	600.00	580.27	580.18
FG50	15000.00	600.00	581.08	580.89
FG51	15100.00	600.00	581.89	581.71
FG52	15200.00	600.00	582.70	582.56
FG53	15300.00	600.00	583.50	583.45
FG54	15400.00	600.00	584.31	584.25
FG55	15500.00	600.00	585.12	584.75
FG56	15600.00	600.00	586.93	586.75
FG57	15700.00	600.00	588.73	588.52
FG58	15800.00	600.00	589.54	589.41
FG59	15900.00	600.00	590.35	590.21
FG60	16000.00	600.00	591.16	590.91
FG61	14900.00	700.00	579.99	579.83
FG62	15000.00	700.00	580.79	580.44
FG63	15100.00	700.00	581.60	581.34
FG64	15200.00	700.00	582.41	582.31
FG65	15300.00	700.00	583.22	583.05
FG66	15400.00	700.00	584.02	583.64
FG67	15500.00	700.00	584.83	584.58
FG68	15600.00	700.00	586.64	586.37
FG69	15700.00	700.00	588.45	588.13
FG70	15800.00	700.00	589.26	588.99
FG71	15900.00	700.00	590.06	589.98
FG72	16000.00	700.00	590.87	590.75
FG73	14900.00	800.00	580.57	580.46
FG74	15000.00	800.00	581.38	581.22
FG75	15100.00	800.00	582.19	582.05
FG76	15200.00	800.00	583.00	582.86
FG77	15300.00	800.00	583.81	583.66
FG78	15400.00	800.00	584.61	584.46
FG79	15500.00	800.00	585.42	585.34
FG80	15600.00	800.00	587.23	587.14
FG81	15700.00	800.00	589.04	588.70
FG82	15800.00	800.00	589.84	589.50
FG83	15900.00	800.00	590.65	590.50
FG84	16000.00	800.00	591.46	591.42

NOTE: RECORD ELEVATIONS AND LAYER THICKNESSES BASED ON A COMPILATION OF RECORD SURVEY DATA PROVIDED BY MAURER-STUTZ, INC. THIS RECORD SURVEY PROVIDED BY MAURER-STUTZ, INC., IS CONTAINED ELSEWHERE IN THIS ACCEPTANCE REPORT.

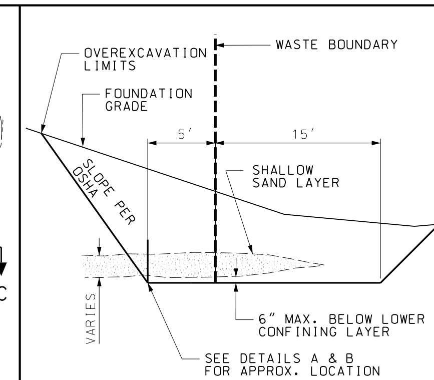




DETAIL A



DETAIL B



DETAIL C

NOTES:

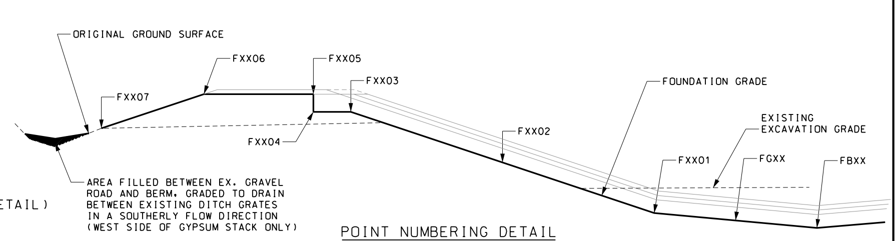
1. GRADES ARE APPROXIMATE BASED ON AVAILABLE GEOTECHNICAL DATA. ACTUAL GRADE TO FULLY EXCAVATE THE SHALLOW SAND LAYER SHALL BE APPROX. 6" BELOW THE LAYER AS SHOWN ABOVE.
2. CONTRACTOR SHALL EXCAVATE TO THE LATERAL LIMITS OF THE SHALLOW SAND LAYER. GRADE LOCATIONS MAY CHANGE BASED UPON THE ACTUAL EXCAVATION REQUIRED TO CUT OFF THE LAYER AS SHOWN ON THE DETAIL ABOVE.

TYPICAL POINT NUMBER LOCATION

FB 00
- GRID POINT NUMBER
- FOUNDATION GRADE (BREAK POINT)

FG 00
- GRID POINT NUMBER
- FOUNDATION GRADE

F 00 00
- POINT NUMBER (SEE POINT NUMBERING DETAIL)
- CONTROL LINE NUMBER
- FOUNDATION GRADE



POINT NUMBERING DETAIL

AEG CAD GENERATED
DO NOT REVISE MANUALLY

REFER TO OTHER PLAN SHEETS FOR STANDARD LEGEND

Brans00939
09\4\2009
I:\03 Jobs\03s5010\Gypsum Stack\CADD\Sheets\C180-C102-08.dgn

LAYOUT	SMB	05/08/07
DRAWN	SKB	02-21-08
REVIEWED		

DRAWING RECORD

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
0	02-22-08	SKB	SMB	SMB	ISSUED FOR BIDDING - NOT FOR CONSTRUCTION
1	03-05-08	SKB	SMB	SMB	CORRECTIONS TO TABLE - ISSUED FOR BIDDING - NOT FOR CONSTRUCTION
2	04-11-08	SKB	SMB	SMB	ISSUED FOR CONSTRUCTION
3	04-18-08	SKB	SMB	SMB	REVISED OVER EXCAVATION LIMITS
4	07-17-08	SKB	SMB	SMB	REVISED ELEVATION FOR POINT F0304 TO BE 614.0
5	07-25-08	DBH	SMB	SMB	RAISED FOUNDATION FLOOR ELEV. TWO FEET AT ALL POINTS NORTH OF N15500
					INCLUDE REVISED CONTOURS AND POINT TABLE
6	03-05-09	SKB	ADC	SMB	ISSUED FOR RECORD DRAWING

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
-	-	-	-	-	

RECORD DRAWING

FILE NO. -C180-C102-08.dgn

HANSON
Hanson Professional Services Inc.
1525 South Sixth Street
Springfield, Illinois 62703-2886
Phone: (217)788-2450 Fax: (217) 788-2503
Illinois Licensed Professional Service Corporation #184-001084
© Copyright Hanson Professional Services Inc. 2009

SCALE -
DRAFTER -
DATE 03-26-09

DRAWING TITLE

GYPSUM STACK-FOUNDATION GRADE

GYPSUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS
DUCK CREEK POWER STATION UNIT NO. -

Ameren Energy Resources Generating

DRAWING NUMBER C180-C102 REV. 6

30x42

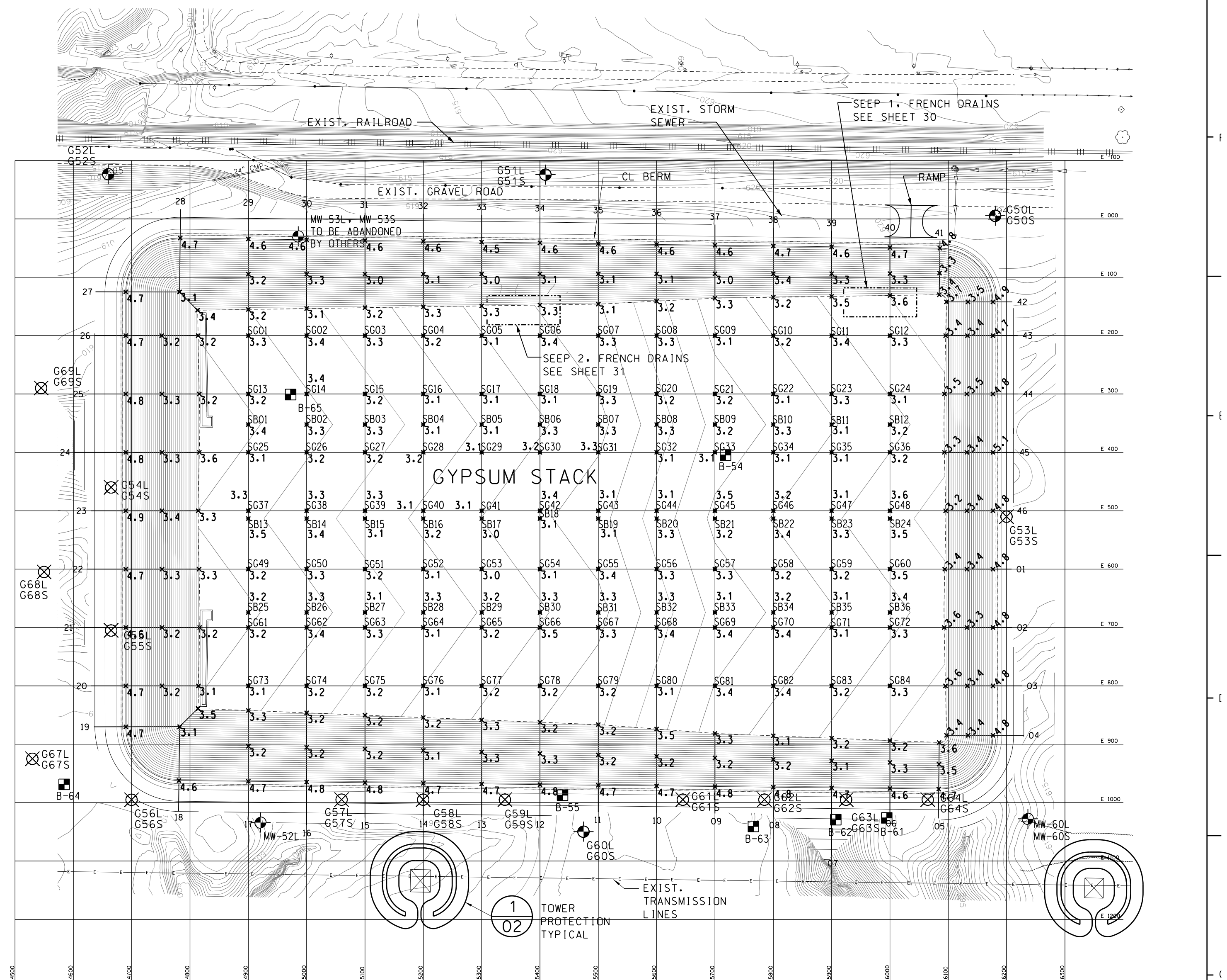
C180-C102
PAGE NO. - 09

CONTROL POINT NUMBER	GRID COORDINATES NORTHING	GRID COORDINATES EASTING	TOP OF CLAY LAYER DESIGN	TOP OF CLAY LAYER RECORD	CLAY LAYER THICKNESS
S0101	16094.01	600.00	594.92	595.29	3.4
S0102	16131.93	600.00	605.75	605.94	3.4
S0103	16176.55	600.00	618.50	618.66	4.8
S0201	16093.01	700.00	594.62	595.01	3.6
S0202	16131.96	700.00	605.75	605.83	3.3
S0203	16176.58	700.00	618.50	618.59	4.8
S0301	16095.16	800.00	595.23	595.72	3.6
S0302	16132.64	800.00	605.94	606.02	3.4
S0303	16176.61	800.00	618.50	618.68	4.8
S0401	16096.98	884.70	595.74	596.05	3.4
S0402	16133.97	884.69	606.31	606.33	3.4
S0403	16176.64	884.68	618.50	618.70	4.8
S0501	16084.47	896.97	595.71	596.24	3.6
S0502	16084.06	934.06	606.31	606.41	3.5
S0503	16083.58	976.73	618.50	618.65	4.7
S0601	16000.00	893.58	595.01	595.08	3.2
S0602	16000.00	931.11	605.73	605.74	3.3
S0603	16000.00	975.79	618.50	618.51	4.6
S0701	15900.00	889.55	594.18	594.28	3.2
S0702	15900.00	928.54	605.32	605.41	3.1
S0703	15900.00	974.68	618.50	618.50	4.7
S0801	15800.00	885.53	593.35	593.44	3.1
S0802	15800.00	925.97	604.90	604.98	3.2
S0803	15800.00	973.56	618.50	618.55	4.8
S0901	15700.00	881.50	592.52	592.61	3.3
S0902	15700.00	923.40	604.49	604.57	3.2
S0903	15700.00	972.45	618.50	618.57	4.8
S1001	15600.00	873.90	590.66	590.75	3.5
S1002	15600.00	920.83	604.07	604.16	3.2
S1003	15600.00	971.33	618.50	618.51	4.7
S1101	15500.00	866.30	588.81	588.90	3.2
S1102	15500.00	918.26	603.66	603.72	3.2
S1103	15500.00	970.21	618.50	618.50	4.7
S1201	15400.00	862.27	587.98	588.08	3.2
S1202	15400.00	915.68	603.24	603.30	3.3
S1203	15400.00	969.10	618.50	618.51	4.8
S1301	15300.00	858.25	587.15	587.19	3.3
S1302	15300.00	913.11	602.82	602.89	3.3
S1303	15300.00	967.98	618.50	618.51	4.7
S1401	15200.00	854.22	586.32	586.41	3.2
S1402	15200.00	910.54	602.41	602.41	3.1
S1403	15200.00	966.87	618.50	618.51	4.7
S1501	15100.00	850.19	585.49	585.59	3.2
S1502	15100.00	907.97	601.99	602.01	3.2
S1503	15100.00	965.75	618.50	618.52	4.8
S1601	15000.00	846.17	584.65	584.73	3.2
S1602	15000.00	905.40	601.58	601.65	3.2
S1603	15000.00	964.63	618.50	618.57	4.8
S1701	14900.00	842.14	583.82	584.08	3.3
S1702	14900.00	903.35	601.31	601.39	3.2
S1703	14900.00	963.52	618.50	618.50	4.7
S1801	14813.86	838.67	583.11	583.51	3.5
S1802	14782.32	869.87	592.12	592.18	3.1
S1803	14781.09	962.19	618.50	618.54	4.6
S1901	14813.86	838.67	583.11	583.51	3.5
S1902	14782.32	869.87	592.12	592.16	3.1
S1903	14689.99	870.07	618.50	618.52	4.7
S2001	14814.62	800.00	582.89	582.98	3.1
S2002	14752.10	800.00	600.75	600.82	3.2
S2003	14689.97	800.00	618.50	618.58	4.7
S2101	14816.61	700.00	582.31	582.51	3.2
S2102	14752.08	700.00	600.75	600.80	3.2
S2103	14689.95	700.00	618.50	618.50	4.6
S2201	14815.61	600.00	582.59	582.75	3.3
S2202	14752.06	600.00	600.75	600.76	3.3
S2203	14689.93	600.00	618.50	618.50	4.7
S2301	14814.16	500.00	583.00	583.15	3.3
S2302	14752.03	500.00	600.75	600.78	3.4
S2303	14689.91	500.00	618.50	618.52	4.9
S2401	14816.11	400.00	582.44	582.87	3.6
S2402	14752.01	400.00	600.75	600.77	3.3
S2403	14689.89	400.00	618.50	618.51	4.8
S2501	14815.99	300.00	582.46	582.58	3.2
S2502	14751.99	300.00	600.75	600.78	3.3
S2503	14689.87	300.00	618.50	618.52	4.8
S2601	14813.97	200.00	583.04	583.13	3.2
S2602	14751.57	200.00	600.86	600.86	3.2
S2603	14689.85	200.00	618.50	618.53	4.7
S2701	14813.09	156.55	583.29	583.56	3.4
S2702	14782.16	125.21	592.12	592.22	3.1
S2703	14689.83	125.03	618.50	618.52	4.7
S2801	14813.09	156.55	583.29	583.54	3.4
S2802	14782.16	125.21	592.12	592.20	3.1
S2803	14783.19	32.89	618.50	618.51	4.7
S2901	14900.00	155.22	583.99	584.23	3.2
S2902	14900.00	94.62	601.31	601.36	3.2
S2903	14900.00	34.44	618.50	618.51	4.6
S3001	15000.00	153.70	584.81	584.85	3.1
S3002	15000.00	94.74	601.66	601.72	3.3
S3003	15000.00	35.78	618.50	618.55	4.6
S3101	15100.00	152.17	585.63	585.72	3.2
S3102	15100.00	94.64	602.06	602.09	3.0
S3103	15100.00	37.11	618.50	618.51	4.6
S3201	15200.00	150.65	586.45	586.54	3.3
S3202	15200.00	94.55	602.47	602.47	3.1
S3203	15200.00	38.44	618.50	618.57	4.6
S3301	15300.00	149.12	587.26	587.46	3.3
S3302	15300.00	94.45	602.88	602.93	3.0
S3303	15300.00	39.78	618.50	618.51	4.5
S3401	15400.00	147.60	588.08	588.26	3.3
S3402	15400.00	94.35	603.29	603.37	3.1
S3403	15400.00	41.11	618.50	618.51	4.6
S3501	15500.00	146.07	588.90	588.93	3.1
S3502	15500.00	94.26	603.70	603.69	3.1
S3503	15500.00	42.45	618.50	618.49	4.6
S3601	15600.00	140.97	590.73	590.85	3.2
S3602	15600.00	94.16	604.11	604.16	3.1
S3603	15600.00	43.78	618.50	618.50	4.6
S3701	15700.00	135.87	592.57	592.65	3.3
S3702	15700.00	94.07	604.51	604.53	3.0
S3703	15700.00	45.11	618.50	618.49	4.6
S3801	15800.00	134.35	593.39	593.44	3.2
S3802	15800.00	93.97	604.92	604.99	3.4
S3803	15800.00	46.45	618.50	618.50	4.7
S3901	15900.00	132.82	594.20	594.71	3.5
S3902	15900.00	93.87	605.33	605.43	3.3
S3903	15900.00	47.78	618.50	618.54	4.6

CONTROL POINT NUMBER	GRID COORDINATES NORTHING	GRID COORDINATES EASTING	TOP OF CLAY LAYER DESIGN	TOP OF CLAY LAYER RECORD	CLAY LAYER THICKNESS
S4001	16000.00	131.30	595.02	595.38	3.6
S4002	16000.00	93.78	605.74	605.83	3.3
S4003	16000.00	49.11	618.50	618.58	4.7
S4101	16084.55	130.01	595.71	596.11	3.4
S4102	16085.04	92.92	606.31	606.49	3.3
S4103	16085.61	50.25	618.50	618.66	4.8
S4201	16096.74	142.27	595.74	596.24	3.7
S4202	16133.75	142.26	606.31	606.47	3.5
S4203	16176.41	142.25	618.50	618.70	4.9
S4301	16095.54	200.00	595.39	595.74	3.4
S4302	16132.87	200.00	606.05	606.20	3.4
S4303	16176.43	200.00	618.50	618.61	4.7
S4401	16093.45	300.00	594.78	595.08	3.5
S4402	16131.83	300.00	605.75	605.94	3.5
S4403	16176.46	300.00	618.50	618.64	4.8
S4501	16093.38	400.00	594.75	595.01	3.3
S4502	16131.87	400.00	605.75	605.91	3.4
S4503	16176.49	400.00	618.50	618.68	5.1
S4601	16095.53	500.00	595.36	595.55	3.2
S4602	16131.90	500.00	605.75	605.92	3.4
S4603	16176.52	500.00	618.50	618.59	4.8
SB01	14900.00	352.42	582.83	582.85	3.4
SB02	15000.00	352.42	583.64	583.71	3.3
SB03	15100.00	352.42	584.45	584.49	3.3
SB04	15200.00	352.42	585.26	585.32	3.1
SB05	15300.00	352.42	586.06	586.06	3.1
SB06	15400.00	352.42	586.87	586.97	3.3
SB07	15500.00	352.42	587.68	587.76	3.3
SB08	15600.00	352.42	589.49	589.54	3.3
SB09	15700.00	352.42	591.30	591.31	3.2
SB10	15800.00	352.42	592.10	592.20	3.3
SB11	15900.00	352.42	592.91	593.03	3.1
SB12	16000.00	352.42	593.72	593.88	3.2
SB13	14900.00	513.35	583.78	583.86	3.5
SB14	15000.00	513.35	584.59	584.66	3.4
SB15	15100.00	513.35	585.40	585.41	3.1
SB16	15200.00	513.35	586.21	586.26	3.2
SB17	15300.00	513.35	587.01	587.04	3.0
SB18	15400.00	513.35	587.82	587.86	3.1
SB19	15500.00	513.35	588.63	588.65	3.1
SB20	15600.00	513.35	590.44	590.55	3.3
SB21	15700.00	513.35	592.24	592.26	3.2
SB22	15800.00	513.35	593.05	593.14	3.4
SB23	15900.00	513.35	593.86	593.91	3.3
SB24	16000.00	513.35	594.67	594.85	3.5
SB25	14900.00	674.29	582.83	582.91	3.2
SB26	15000.00	674.29	583.64	583.72	3.3
SB27	15100.00	674.29	584.45	584.47	3.1
SB28	15200.00	674.29	585.26	585.35	3.3
SB29	15300.00	674.29	586.07	586.09	3.2
SB30	15400.00	674.29	586.87	586.95	3.3
SB31	15500.00	674.29	587.68	587.75	3.3
SB32	15600.00	674.29	589.49	589.59	3.3
SB33	15700.00	674.29	591.30	591.34	3.1
SB34	15800.00	674.29	592.10	592.19	3.2
SB35	15900.00	674.29	592.91	592.92	3.1
SB36	16000.00	674.29	593.72	593.94	3.4
SG01	14900.00	200.00	583.73	583.84	3.3
SG02	15000.00	200.00	584.54	584.56	3.4
SG03	15100.00	200.00	585.35	585.42	3.3
SG04	15200.00	200.00	586.15	586.21	3.2
SG05	15300.00	200.00	586.96	587.04	3.1
SG06	15400.00	200.00	587.77	587.81	3.4
SG07	15500.00	200.00	588.58	588.66	3.3
SG08	15600.00	200.00	590.39	590.43	3.3
SG09	15700.00	200.00	592.19	592.26	3.1
SG10	15800.00	200.00	593.00	593.07	3.2
SG11	15900.00	200.00	593.81	594.03	3.4
SG12	16000.00	200.00	594.62	594.69	3.3
SG13	14900.00	300.00	583.14	583.21	3.2
SG14	15000.00	300.00	583.95	584.05	3.4
SG15	15100.00	300.00	584.76	584.77	3.2
SG16	15200.00	300.00	585.57	585.67	3.1
SG17	15300.00	300.00	586.37	586.41	3.1
SG18	15400.00	300.00	587.18	587.22	3.1
SG19	15500.00	300.00	587.99	588.09	3.3
SG20	15600.00	300.00	589.80	589.81	3.2
SG21	15700.00	300.00	591.60	591.65	3.2
SG22	15800.00	300.00	592.41	592.45	3.1
SG23	15900.00	300.00	593.22	593.41	3.3
SG24	16000.00	300.00	594.03	594.10	3.1
SG25	14900.00	400.00	583.11	583.23	3.1
SG26	15000.00	400.00	583.92	584.00	3.2
SG27	15100.00	400.00	584.73	584.75	3.2
SG28	15200.00	400.00	585.54	585.61	3.2
SG29	15300.00	400.00	586.34	586.35	3.1
SG30	15400.00	400.00	587.15	587.23	3.2
SG31	15500.00	400.00	587.96	588.05	3.3
SG32	15600.00	400.00	589.77	589.80	3.1
SG33	15700.00	400.00	591.58	591.64	3.1
SG34	15800.00	400.00	592.38	592.45	3.1
SG35	15900.00	400.00	593.19	593.26	3.1
SG36	16000.00	400.00	594.00	594.07	3.2
SG37	14900.00	500.00	583.70	583.77	3.3
SG38	15000.00	500.00	584.51	584.58	3.3
SG39	15100.00	500.00	585.32	585.36	3.3
SG40	15200.00	500.00	586.13	586.19	3.1
SG41	15300.00	500.00	586.93	586.95	3.1
SG42	15400.00	500.00	587.74	587.82	3.4
SG43	15500.00	500.00	588.55	588.60	3.1
SG44	15600.00	500.00	590.36	590.43	3.1
SG45	15700.00	500.00	592.17	592.23	3.5
SG46	15800.00	500.00	592.97	593.05	3.2
SG47	15900.00	500.00	593.78	593.79	3.1
SG48	16000.00	500.00	594.59	594.83	3.6
SG49	14900.00	600.00	583.27	583.37	3.2
SG50	15000.00	600.00	584.08	584.17	3.3
SG51	15100.00	600.00	584.89	584.95	3.2
SG52	15200.00	600.00	585.70	585.70	3.1
SG53	15300.00	600.00	586.50	586.50	3.0
SG54	15400.00	600.00	587.31	587.39	3.1
SG55	15500.00	600.00	588.12	588.18	3.4
SG56	15600.00	600.00	589.93	590.03	3.3
SG57	15700.00	600.00	591.73	591.81	3.3
SG58	15800.00	600.00	592.54	592.57	3.2
SG59	15900.00	600.00	593.35	593.44	3.2
SG60	16000.00	600.00	594.16	594.43	3.5

CONTROL POINT NUMBER	GRID COORDINATES NORTHING	GRID COORDINATES EASTING	TOP OF CLAY LAYER DESIGN	TOP OF CLAY LAYER RECORD	CLAY LAYER THICKNESS
SG61	14900.00	700.00	582.99	582.99	3.2
SG62	15000.00	700.00	583.79	583.88	3.4
SG63	15100.00	700.00	584.60	584.62	3.3
SG64	15200.00	700.00	585.41	585.45	3.1
SG65	15300.00	700.00	586.22	586.24	3.2
SG66	15400.00	700.00	587.02	587.09	3.5
SG67	15500.00	700.00	587.83	587.92	3.3
SG68	15600.00	700.00	589.64	589.73	3.4
SG69	15700.00	700.00	591.45	591.50	3.4
SG70	15800.00	700.00	592.26	592.34	3.4
SG71	15900.00	700.00	593.06	593.07	3.1
SG72	16000.00	700.00	593.87	594.03	3.3
SG73	14900.00	800.00	583.57	583.57	3.1
SG74	15000.00	800.00	584.38	584.45	3.2
SG75	15100.00	800.00	585.19	585.20	3.2
SG76	15200.00	800.00	586.00	586.00	3.1
SG77	15300.00	800.00	586.81	586.82	3.2
SG78	15400.00	800.00	587.61	587.70	3.2
SG79	15500.00	800.00	588.42	588.52	3.2
SG80	15600.00	800.00	590.23	590.29	3.1
SG81	15700.00	800.00	592.04	592.13	3.4
SG82	15800.00	800.00	592.84	592.90	3.4
SG83	15900.00	800.00	593.65	593.69	3.2
SG84	16000.00	800.00	594.46	594.76	3.3

NOTE: RECORD ELEVATIONS AND LAYER THICKNESSES BASED ON A COMPILATION OF RECORD SURVEY DATA PROVIDED BY MAURER-STUTZ, INC. THIS RECORD SURVEY PROVIDED BY MAURER-STUTZ, INC., IS CONTAINED ELSEWHERE IN THIS ACCEPTANCE REPORT.



STANDARD LEGEND

(ALL SYMBOLS MAY NOT BE USED ON EACH PLAN)

- ORIGINAL CONTOURS
- FENCELINE
- TRANSMISSION TOWER
- OVERHEAD ELECTRIC
- LIMITS OF VEGETATION
- GRAVEL ROAD
- RAILROAD
- STORM SEWER
- CONTROL POINT
- NEW CONTOURS
- LD/LCRS COLLECTION PIPE
- GEONET
- MW-53L MONITORING WELL
- B-55 BORING
- G69L FUTURE GROUNDWATER MONITORING WELL
- 4" DIA. PERFORATED DRAINAGE PIPING
- 6" DIA. OUTFALL PIPING
- 3.1 CLAY LAYER THICKNESS (IN FEET)

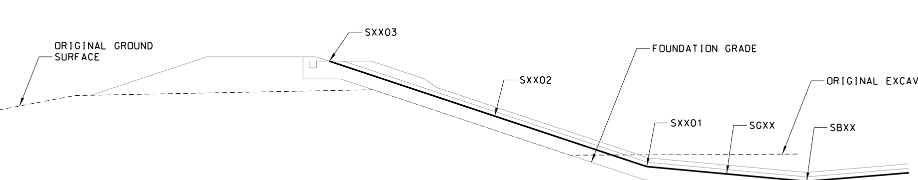
0' 100' 200'
SCALE: 1" = 100'

TYPICAL POINT NUMBER LOCATION

SB 00 — GRID POINT NUMBER; CLAY LAYER GRADE (BREAK POINT)

SG 00 — GRID POINT NUMBER; CLAY LAYER GRADE

S 00 00 — POINT NUMBER (SEE POINT NUMBERING DETAIL); CONTROL LINE NUMBER; CLAY LAYER GRADE



POINT NUMBERING DETAIL

AEG CAD GENERATED
DO NOT REVISE MANUALLY

Brans00939
09\4\2009
I:\03 Jobs\03s5010\Gypsum Stack\CADD\Sheets\C180-C102-09.dgn

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
0	02-21-08	SKB	SMB	SMB	ISSUED FOR BIDDING - NOT FOR CONSTRUCTION
1	03-05-08	SKB	SMB	SMB	REVISED POINT NO. DETAIL - ISSUED FOR BIDDING - NOT FOR CONSTRUCTION
2	04-11-08	SKB	SMB	SMB	ISSUED FOR CONSTRUCTION
3	08-29-08	DBH	SMB	SMB	RAISE BOTTOM ELEV. OF NORTH 400' OF CELL-UPDATE CONTOURS & POINT TABLE
4	03-05-09	SKB	ADC	SMB	ISSUED FOR RECORD DRAWING

LAYOUT SMB 05/08/07; DRAWN SKB 03-05-08; REVIEWED

RECORD DRAWING

FILE NO. -C180-C102-09.dgn

HANSON
Hanson Professional Services Inc.
1525 South Sixth Street
Springfield, Illinois 62703-2886
Phone: (217)788-2450 Fax: (217) 788-2503
Illinois Licensed Professional Service Corporation #184-001084
© Copyright Hanson Professional Services Inc. 2009

SCALE -
DRAFTER -
DATE 03-26-09

DRAWING TITLE
GYPSUM STACK - CLAY LAYER GRADE

GYPSUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS
DUCK CREEK POWER STATION UNIT NO. -

Ameren Energy Resources Generating

DRAWING NUMBER C180-C102 REV. 4
SHEET NO. 09 OF 33

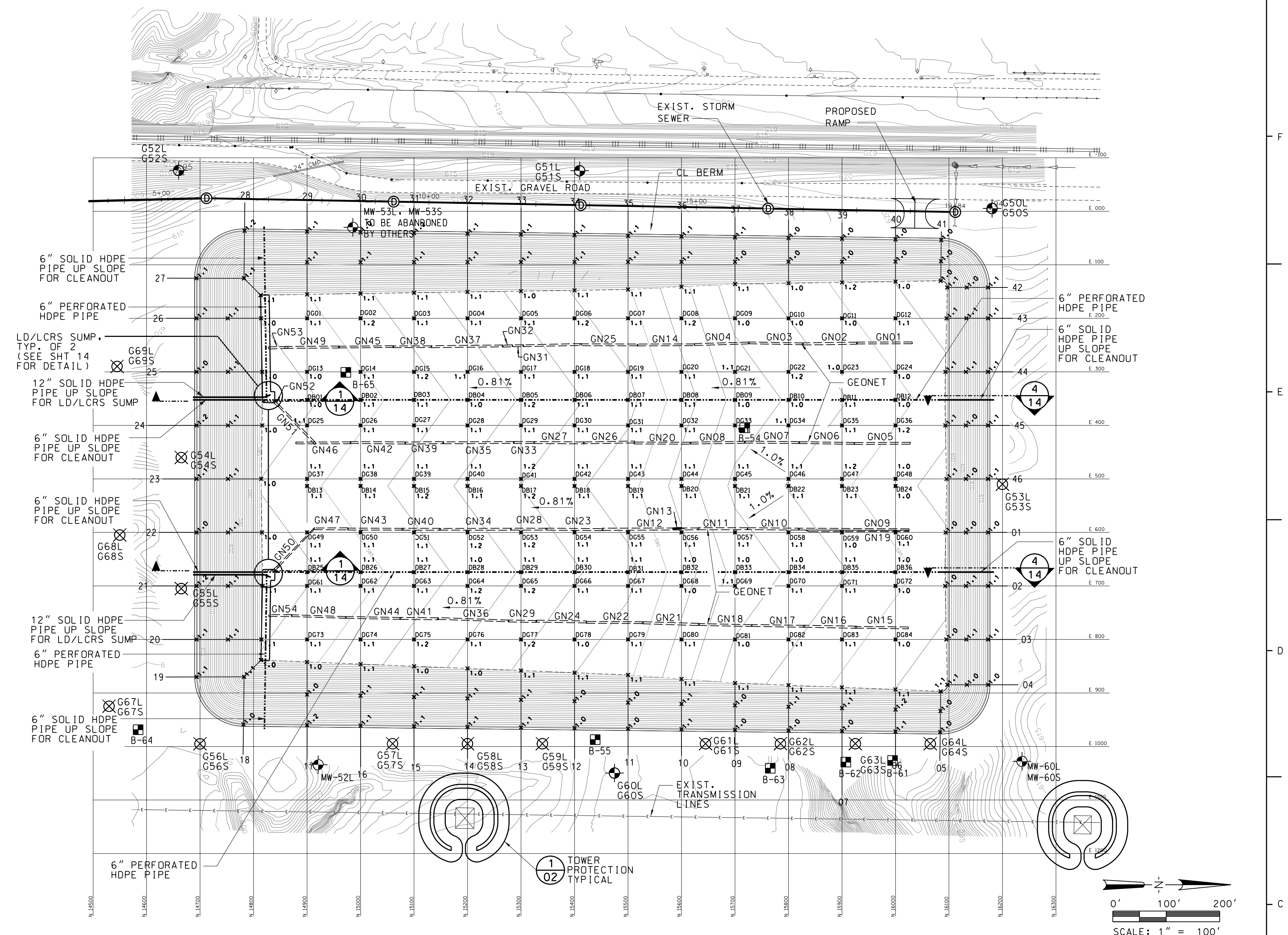
30x42

CONTROL POINT NUMBER	GRID COORDINATES NORTHING	GRID COORDINATES EASTING	TOP OF DRAINAGE DESIGN	TOP OF DRAINAGE RECORD	DRAINAGE LAYER THICKNESS
D0101	16093.86	600.00	595.92	596.32	1.0
D0102	16131.65	600.00	606.71	606.92	0.9
D0103	16172.91	600.00	618.50	618.67	1.0
D0201	16092.87	700.00	595.62	596.04	1.0
D0202	16131.68	700.00	606.71	606.88	1.1
D0203	16172.94	700.00	618.50	618.70	1.1
D0301	16095.02	800.00	596.23	596.74	1.0
D0302	16132.36	800.00	606.90	607.10	1.1
D0303	16172.97	800.00	618.50	618.71	1.1
D0401	16096.83	884.70	596.74	597.14	1.1
D0402	16133.70	884.69	607.27	607.31	1.0
D0403	16173.00	884.68	618.50	618.72	1.0
D0501	16084.47	896.82	596.71	597.34	1.1
D0502	16084.06	933.79	607.27	607.40	1.0
D0503	16083.62	973.09	618.50	618.69	1.0
D0601	16000.00	893.44	596.01	596.18	1.1
D0602	16000.00	930.84	606.70	606.89	1.2
D0603	16000.00	972.15	618.50	618.58	1.1
D0701	15900.00	889.41	595.18	595.38	1.1
D0702	15900.00	928.27	606.28	606.46	1.1
D0703	15900.00	971.04	618.50	618.56	1.0
D0801	15800.00	885.38	594.35	594.55	1.1
D0802	15800.00	925.70	605.86	606.04	1.1
D0803	15800.00	969.92	618.50	618.56	1.0
D0901	15700.00	881.36	593.52	593.70	1.1
D0902	15700.00	923.12	605.45	605.55	1.0
D0903	15700.00	968.81	618.50	618.61	1.0
D1001	15600.00	873.76	591.66	591.85	1.1
D1002	15600.00	920.55	605.03	605.16	1.1
D1003	15600.00	967.69	618.50	618.67	1.1
D1101	15500.00	866.16	589.81	589.95	1.1
D1102	15500.00	917.98	604.62	604.70	1.0
D1103	15500.00	966.57	618.50	618.50	1.0
D1201	15400.00	862.13	588.98	589.17	1.1
D1202	15400.00	915.41	604.20	604.28	1.0
D1203	15400.00	965.46	618.50	618.53	1.0
D1301	15300.00	858.10	588.15	588.33	1.1
D1302	15300.00	912.84	603.79	603.94	1.1
D1303	15300.00	964.34	618.50	618.62	1.1
D1401	15200.00	854.08	587.32	587.44	1.0
D1402	15200.00	910.27	603.37	603.53	1.1
D1403	15200.00	963.22	618.50	618.61	1.1
D1501	15100.00	850.05	586.49	586.59	1.0
D1502	15100.00	907.70	602.95	603.09	1.1
D1503	15100.00	962.11	618.50	618.58	1.1
D1601	15000.00	846.02	585.65	585.79	1.1
D1602	15000.00	905.12	602.54	602.69	1.1
D1603	15000.00	960.99	618.50	618.61	1.1
D1701	14900.00	842.00	584.82	585.04	1.0
D1702	14900.00	903.07	602.27	602.39	1.0
D1703	14900.00	959.88	618.50	618.70	1.2
D1801	14814.00	838.53	584.11	584.50	1.0
D1802	14782.32	869.87	593.16	593.36	1.1
D1803	14781.03	958.55	618.50	618.58	1.0
D1901	14814.00	838.53	584.11	584.54	1.0
D1902	14782.32	869.87	593.16	593.36	1.1
D1903	14693.63	870.07	618.50	618.62	1.1
D2001	14814.76	800.00	583.89	584.06	1.1
D2002	14752.37	800.00	601.71	601.84	1.1
D2003	14693.61	800.00	618.50	618.65	1.1
D2101	14816.75	700.00	583.31	583.61	1.1
D2102	14752.35	700.00	601.71	601.84	1.1
D2103	14693.59	700.00	618.50	618.65	1.2
D2201	14815.75	600.00	583.59	583.79	1.0
D2202	14752.33	600.00	601.71	601.85	1.1
D2203	14693.57	600.00	618.50	618.52	1.0
D2301	14814.30	500.00	584.00	584.18	1.0
D2302	14752.31	500.00	601.71	601.82	1.1
D2303	14693.55	500.00	618.50	618.68	1.1
D2401	14816.25	400.00	583.44	583.86	1.0
D2402	14752.29	400.00	601.71	601.85	1.1
D2403	14693.53	400.00	618.50	618.68	1.2
D2501	14816.13	300.00	583.46	583.64	1.0
D2502	14752.27	300.00	601.71	601.90	1.1
D2503	14693.51	300.00	618.50	618.67	1.0
D2601	14814.10	200.00	584.04	584.16	1.0
D2602	14751.84	200.00	601.83	601.97	1.1
D2603	14693.49	200.00	618.50	618.67	1.1
D2701	14813.23	156.69	584.29	584.61	1.1
D2702	14782.16	125.21	593.16	593.32	1.1
D2703	14693.47	125.04	618.50	618.68	1.1
D2801	14813.23	156.69	584.29	584.61	1.1
D2802	14782.16	125.21	593.16	593.32	1.1
D2803	14783.15	36.53	618.50	618.67	1.2
D2901	14900.00	155.37	584.99	585.36	1.1
D2902	14900.00	94.89	602.27	602.46	1.1
D2903	14900.00	38.08	618.50	618.63	1.1
D3001	15000.00	153.84	585.81	585.95	1.1
D3002	15000.00	95.01	602.62	602.78	1.1
D3003	15000.00	39.42	618.50	618.61	1.0
D3101	15100.00	152.32	586.63	586.81	1.1
D3102	15100.00	94.92	603.03	603.16	1.1
D3103	15100.00	40.75	618.50	618.68	1.2
D3201	15200.00	150.79	587.44	587.64	1.1
D3202	15200.00	94.82	603.43	603.55	1.1
D3203	15200.00	42.09	618.50	618.70	1.1
D3301	15300.00	149.26	588.26	588.52	1.0
D3302	15300.00	94.72	603.84	603.97	1.1
D3303	15300.00	43.42	618.50	618.63	1.1
D3401	15400.00	147.74	589.08	589.38	1.1
D3402	15400.00	94.63	604.25	604.38	1.1
D3403	15400.00	44.75	618.50	618.66	1.1
D3501	15500.00	146.21	589.89	590.06	1.1
D3502	15500.00	94.53	604.66	604.75	1.1
D3503	15500.00	46.09	618.50	618.61	1.1
D3601	15600.00	141.11	591.73	591.95	1.1
D3602	15600.00	94.44	605.07	605.18	1.1
D3603	15600.00	47.42	618.50	618.64	1.1
D3701	15700.00	136.02	593.57	593.77	1.1
D3702	15700.00	94.34	605.48	605.53	1.0
D3703	15700.00	48.75	618.50	618.60	1.1
D3801	15800.00	134.49	594.39	594.47	1.0
D3802	15800.00	94.24	605.88	605.98	1.0
D3803	15800.00	50.09	618.50	618.58	1.0
D3901	15900.00	132.96	595.20	595.94	1.2
D3902	15900.00	94.15	606.29	606.39	1.0
D3903	15900.00	51.42	618.50	618.54	1.0

CONTROL POINT NUMBER	GRID COORDINATES NORTHING	GRID COORDINATES EASTING	TOP OF DRAINAGE DESIGN	TOP OF DRAINAGE RECORD	DRAINAGE LAYER THICKNESS
D4001	16000.00	131.44	596.02	596.39	1.0
D4002	16000.00	94.05	606.70	606.83	1.0
D4003	16000.00	52.75	618.50	618.59	1.0
D4101	16084.54	130.16	596.71	597.11	1.0
D4102	16085.04	93.19	607.27	607.46	1.0
D4103	16085.56	53.89	618.50	618.69	1.0
D4201	16096.59	142.27	596.74	597.31	1.1
D4202	16133.47	142.26	607.27	607.50	1.0
D4203	16172.77	142.25	618.50	618.78	1.1
D4301	16095.39	200.00	596.39	596.84	1.1
D4302	16132.59	200.00	607.02	607.27	1.1
D4303	16172.79	200.00	618.50	618.67	1.1
D4401	16093.30	300.00	595.78	596.21	1.1
D4402	16131.56	300.00	606.71	606.93	1.1
D4403	16172.82	300.00	618.50	618.73	1.1
D4501	16093.23	400.00	595.75	596.06	1.1
D4502	16131.59	400.00	606.71	606.88	1.0
D4503	16172.85	400.00	618.50	618.72	1.1
D4601	16095.39	500.00	596.36	596.65	1.1
D4602	16131.62	500.00	606.71	606.93	1.0
D4603	16172.88	500.00	618.50	618.65	1.1
DB01	14900.00	352.42	583.83	583.91	1.1
DB02	15000.00	352.42	584.64	584.81	1.1
DB03	15100.00	352.42	585.45	585.60	1.1
DB04	15200.00	352.42	586.26	586.37	1.0
DB05	15300.00	352.42	587.06	587.23	1.2
DB06	15400.00	352.42	587.87	588.05	1.1
DB07	15500.00	352.42	588.68	588.84	1.1
DB08	15600.00	352.42	590.49	590.65	1.1
DB09	15700.00	352.42	592.30	592.32	1.0
DB10	15800.00	352.42	593.10	593.22	1.0
DB11	15900.00	352.42	593.91	594.11	1.1
DB12	16000.00	352.42	594.72	594.92	1.0
DB13	14900.00	513.35	584.78	584.95	1.1
DB14	15000.00	513.35	585.59	585.76	1.1
DB15	15100.00	513.35	586.40	586.60	1.2
DB16	15200.00	513.35	587.21	587.41	1.1
DB17	15300.00	513.35	588.01	588.20	1.2
DB18	15400.00	513.35	588.82	588.97	1.1
DB19	15500.00	513.35	589.63	589.79	1.1
DB20	15600.00	513.35	591.44	591.61	1.1
DB21	15700.00	513.35	593.24	593.40	1.1
DB22	15800.00	513.35	594.05	594.21	1.1
DB23	15900.00	513.35	594.86	594.99	1.1
DB24	16000.00	513.35	595.67	595.85	1.0
DB25	14900.00	674.29	583.83	584.03	1.1
DB26	15000.00	674.29	584.64	584.80	1.1
DB27	15100.00	674.29	585.45	585.58	1.1
DB28	15200.00	674.29	586.26	586.38	1.0
DB29	15300.00	674.29	587.07	587.24	1.1
DB30	15400.00	674.29	587.87	588.04	1.1
DB31	15500.00	674.29	588.68	588.85	1.1
DB32	15600.00	674.29	590.49	590.62	1.0
DB33	15700.00	674.29	592.30	592.36	1.0
DB34	15800.00	674.29	593.10	593.24	1.0
DB35	15900.00	674.29	593.91	594.00	1.1
DB36	16000.00	674.29	594.72	594.96	1.0
DG01	14900.00	200.00	584.73	584.87	1.0
DG02	15000.00	200.00	585.54	585.71	1.2
DG03	15100.00	200.00	586.35	586.53	1.1
DG04	15200.00	200.00	587.15	587.33	1.1
DG05	15300.00	200.00	587.96	588.14	1.1
DG06	15400.00	200.00	588.77	588.97	1.2
DG07	15500.00	200.00	589.58	589.78	1.1
DG08	15600.00	200.00	591.39	591.58	1.2
DG09	15700.00	200.00	593.19	593.28	1.0
DG10	15800.00	200.00	594.00	594.10	1.0
DG11	15900.00	200.00	594.81	595.05	1.0
DG12	16000.00	200.00	595.62	595.76	1.1
DG13	14900.00	300.00	584.14	584.23	1.0
DG14	15000.00	300.00	584.95	585.15	1.1
DG15	15100.00	300.00	585.76	585.94	1.2
DG16	15200.00	300.00	586.57	586.77	1.1
DG17	15300.00	300.00	587.37	587.56	1.1
DG18	15400.00	300.00	588.18	588.35	1.1
DG19	15500.00	300.00	588.99	589.17	1.1
DG20	15600.00	300.00	590.80	590.90	1.1
DG21	15700.00	300.00	592.60	592.80	1.1
DG22	15800.00	300.00	593.41	593.62	1.2
DG23	15900.00	300.00	594.22	594.44	1.0
DG24	16000.00	300.00	595.03	595.14	1.0
DG25	14900.00	400.00	584.11	584.27	1.0
DG26	15000.00	400.00	584.92	585.08	1.1
DG27	15100.00	400.00	585.73	585.87	1.1
DG28	15200.00	400.00	586.54	586.69	1.1
DG29	15300.00	400.00	587.34	587.46	1.1
DG30	15400.00	400.00	588.15	588.32	1.1
DG31	15500.00	400.00	588.96	589.12	1.1
DG32	15600.00	400.00	590.77	590.89	1.1
DG33	15700.00	400.00	592.58	592.71	1.1
DG34	15800.00	400.00	593.38	593.57	1.1
DG35	15900.00	400.00	594.19	594.38	1.1
DG36	16000.00	400.00	595.00	595.25	1.2
DG37	14900.00	500.00	584.70	584.87	1.1
DG38	15000.00	500.00	585.51	585.65	1.1
DG39	15100.00	500.00	586.32	586.43	1.1
DG40	15200.00	500.00	587.13	587.31	1.1
DG41	15300.00	500.00	587.93	588.11	1.2
DG42	15400.00	500.00	588.74	588.89	1.1
DG43	15500.00	500.00	589.55	589.73	1.1
DG44	15600.00	500.00	591.36	591.49	1.1
DG45	15700.00	500.00	593.17	593.34	1.1
DG46	15800.00	500.00	593.97	594.11	1.1
DG47	15900.00	500.00	594.78	594.94	1.2
DG48	16000.00	500.00	595.59	595.85	1.0
DG49	14900.00	600.00	584.27	584.45	1.1
DG50	15000.00	600.00	585.08	585.24	1.1
DG51	15100.00	600.00	585.89	586.06	1.1
DG52	15200.00	600.00	586.70	586.86	1.2
DG53	15300.00	600.00	587.50	587.67	1.2
DG54	15400.00	600.00	588.31	588.47	1.1
DG55	15500.00	600.00	589.12	589.30	1.1
DG56	15600.00	600.00	590.93	591.09	1.1
DG57	15700.00	600.00	592.73	592.90	1.1
DG58	15800.00	600.00	593.54	593.66	1.1
DG59	15900.00	600.00	594.35	594.45	1.0
DG60	16000.00	600.00	595.16	595.52	1.1

CONTROL POINT NUMBER	GRID COORDINATES NORTHING	GRID COORDINATES EASTING	TOP OF DRAINAGE DESIGN	TOP OF DRAINAGE RECORD	DRAINAGE LAYER THICKNESS
DG61	14900.00	700.00	583.99	584.10	1.1
DG62	15000.00	700.00	584.79	584.95	1.1
DG63	15100.00	700.00	585.60	585.77	1.1
DG64	15200.00	700.00	586.41	586.61	1.2
DG65	15300.00	700.00	587.22	587.41	1.2
DG66	15400.00	700.00	588.02	588.19	1.1
DG67	15500.00	700.00	588.83	589.00	1.1
DG68	15600.00	700.00	590.64	590.73	1.0
DG69	15700.00	700.00	592.45	592.57	1.1
DG70	15800.00	700.00	593.26	593.42	1.1
DG71	15900.00	700.00	594.06	594.22	1.1
DG72	16000.00	700.00	594.87	595.07	1.0
DG73	14900.00	800.00	584.57	584.70	1.1
DG74	15000.00	800.00	585.38	585.57	1.1
DG75	15100.00	800.00	586.19	586.39	1.2
DG76	15200.00	800.00	587.00	587.08	1.1
DG77	15300.00	800.00	587.81	587.98	1.2
DG78	15400.00	800.00	588.61	588.73	1.0
DG79	15500.00	800.00	589.42	589.59	1.1
DG80	15600.00	800.00	591.23	591.41	1.1
DG81	15700.00	800.00	593.04	593.17	1.0
DG82	15800.00	800.00	593.84	594.02	1.1
DG83	15900.00	800.00	594.65	594.84	1.1
DG84	16000.00	800.00	595.46	595.81	1.0

NOTE: RECORD ELEVATIONS AND LAYER THICKNESSES BASED ON A COMPILATION OF RECORD SURVEY DATA PROVIDED BY MAURER-STUTZ, INC. THIS RECORD SURVEY PROVIDED BY MAURER-STUTZ, INC., IS CONTAINED ELSEWHERE IN THIS ACCEPTANCE REPORT.



GEONET COORDINATES (AS SURVEYED BY MAURER-STUTZ, INC. OCT. 16, 2008 THRU NOV. 09, 2008))

MSI Point #	Northing	Easting	Elevation
GN01 NE	16031.54	247.52	594.68
GN01 NW	16031.29	244.17	594.67
GN01 SE	15926.87	247.82	593.88
GN01 SW	15927.72	244.24	593.84
GN02 NE	15928.44	248.25	593.86
GN02 NW	15928.47	244.45	593.89
GN02 SE	15826.47	249.75	593.09
GN02 SW	15826.90	245.83	593.03
GN03 NE	15827.58	249.31	593.11
GN03 NW	15827.56	245.97	593.11
GN03 SE	15724.79	247.49	592.19
GN03 SW	15725.54	244.14	592.19
GN04 NE	15726.76	247.64	592.22
GN04 NW	15726.53	244.25	592.23
GN04 SE	15624.04	250.74	590.71
GN04 SW	15623.67	247.37	590.64
GN05 NE	16027.25	435.11	594.51
GN05 NW	16028.07	431.72	594.59
GN05 SE	15922.82	435.53	593.71
GN05 SW	15922.46	432.03	593.76
GN06 NE	15923.21	435.36	593.79
GN06 NW	15923.77	432.01	593.83
GN06 SE	15819.28	433.87	592.79
GN06 SW	15819.45	430.55	592.82
GN07 NE	15820.73	433.82	592.78
GN07 NW	15820.49	430.32	592.79
GN07 SE	15717.44	433.09	591.93
GN07 SW	15717.99	429.43	591.88
GN08 NE	15718.42	433.40	591.89
GN08 NW	15719.69	429.72	591.92
GN08 SE	15615.94	434.80	590.33
GN08 SW	15615.87	431.37	590.35
GN09 NE	16025.28	596.65	594.63
GN09 NW	16025.35	593.25	594.70
GN09 SE	15818.43	595.37	592.90
GN09 SW	15818.32	592.16	592.92
GN10 NE	15819.80	595.64	592.86

MSI Point #	Northing	Easting	Elevation
GN10 NW	15820.24	592.11	592.92
GN10 SE	15722.77	594.71	592.16
GN10 SW	15722.89	591.21	592.17
GN11 NE	15724.17	594.85	592.15
GN11 NW	15724.23	591.29	592.13
GN11 SE	15629.65	595.03	590.66
GN11 SW	15629.87	591.23	590.77
GN12 NE	15632.28	595.03	590.67
GN12 NW	15632.86	591.56	590.85
GN12 SE	15451.68	596.23	587.71
GN12 SW	15451.35	592.15	587.70
GN13 NE	15605.74	593.03	590.43
GN13 NW	15599.46	590.51	590.32
GN13 SE	15583.49	594.48	589.98
GN13 SW	15583.20	591.39	590.09
GN14 NE	15624.25	250.96	590.79
GN14 NW	15624.41	247.74	590.72
GN14 SE	15517.29	251.54	588.81
GN14 SW	15517.13	248.02	588.93
GN15 NE	16023.98	780.10	594.76
GN15 NW	16023.87	776.59	594.74
GN15 SE	15924.36	778.84	593.99
GN15 SW	15924.38	775.56	594.00
GN16 NE	15927.03	779.12	594.02
GN16 NW	15927.24	775.19	594.00
GN16 SE	15827.80	777.22	592.97
GN16 SW	15827.73	773.53	593.04
GN17 NE	15830.61	777.06	593.00
GN17 NW	15830.44	773.72	593.10
GN17 SE	15730.92	775.62	592.32
GN17 SW	15731.18	772.17	592.22
GN18 NE	15731.53	775.87	592.31
GN18 NW	15731.95	772.39	592.28
GN18 SE	15631.43	773.88	590.69
GN18 SW	15631.16	770.26	590.80
GN19 NE	16025.38	598.28	594.62
GN19 NW	16024.98	595.88	594.71

MSI Point #	Northing	Easting	Elevation
GN19 SE	15838.81	598.82	592.95
GN19 SW	15831.46	595.63	592.99
GN20 NE	15617.61	434.97	590.48
GN20 NW	15617.55	431.59	590.41
GN20 SE	15510.69	434.63	588.58
GN20 SW	15511.01	431.12	588.61
GN21 NE	15633.12	773.95	590.75
GN21 NW	15633.24	770.09	590.87
GN21 SE	15526.36	770.62	588.81
GN21 SW	15526.55	766.84	588.94
GN22 NE	15528.76	770.34	588.89
GN22 NW	15528.77	767.03	589.01
GN22 SE	15422.07	769.78	587.75
GN22 SW	15421.99	766.33	587.66
GN23 NW	15453.29	592.84	587.86
GN23 NE	15453.28	596.50	587.92
GN24 NW	15422.97	765.40	587.78
GN24 NE	15423.07	769.15	587.83
GN24 SE	15327.62	767.72	587.11
GN24 SW	15327.97	764.02	586.94
GN23 SE	15346.02	595.83	587.31
GN23 SW	15345.82	592.13	587.31
GN25 NW	15518.48	247.99	588.99
GN25 NE	15518.60	251.22	588.81
GN25 SW	15410.27	247.61	587.78
GN25 SE	15409.83	251.05	587.63
GN26 NW	15512.37	429.11	588.64
GN26 NE	15512.63	432.65	588.59
GN26 SE	15416.67	434.44	587.53
GN26 SW	15416.87	431.04	587.52
GN27 NE	15417.98	434.48	587.68
GN27 NW	15417.81	431.10	587.66
GN27 SE	15324.00	433.85	586.82
GN27 SW	15324.22	430.17	586.74
GN28 NE	15348.32	595.83	587.17
GN28 NW	15348.50	592.19	587.14
GN28 SE	15280.49	595.53	586.49

MSI Point #	Northing	Easting	Elevation
GN28 SW	15280.81	592.02	586.50
GN29 NE	15329.00	768.16	586.87
GN29 NW	15329.37	764.66	586.88
GN29 SE	15275.78	767.33	586.47
GN29 SW	15275.65	763.68	586.43
GN30 NE	15413.16	250.66	587.69
GN30 NW	15413.20	247.14	587.73
GN30 SE	15303.26	252.85	586.68
GN30 SW	15303.99	249.39	586.72
GN31 NE	15304.78	252.93	586.65
GN31 NW	15305.07	249.40	586.69
GN31 SE	15283.42	252.82	586.67
GN31 SW	15283.58	249.45	586.64
GN32 NE	15284.07	252.89	586.68
GN32 NW	15284.26	249.47	586.72
GN32 SE	15264.76	253.73	586.42
GN32 SW	15264.61	250.34	586.47
GN33 NE	15325.03	433.92	586.83
GN33 NW	15325.35	430.48	586.84
GN33 SE	15285.46	433.71	586.42
GN33 SW	15285.75	430.05	586.39
GN34 NE	15281.57	595.92	586.47
GN34 NW	15281.56	592.20	586.49
GN34 SE	15147.45	595.83	585.37
GN34 SW	15147.56	592.50	585.43
GN35 NE	15286.92	433.49	586.51
GN35 NW	15287.52	430.21	586.48
GN35 SE	15153.79	434.44	585.52
GN35 SW	15153.69	430.90	585.54
GN36 NE	15277.72	766.98	586.58
GN36 NW	15277.69	763.85	586.54
GN36 SE	15143.59	762.46	585.40
GN36 SW	15144.03	759.10	585.42
GN37 NE	15266.60	253.18	586.50
GN37 NW	15266.46	249.73	586.57
GN37 SE	15132.02	254.75	585.29
GN37 SW	15132.27	251.11	585.32

MSI Point #	Northing	Easting	Elevation
GN38 NE	15133.08	254.33	585.31
GN38 NW	15132.85	251.37	585.37
GN38 SE	15060.30	254.72	584.76
GN38 SW	15060.61	251.69	584.86
GN39 NE	15155.35	434.02	585.54
GN39 NW	15155.43	430.31	585.54
GN39 SE	15083.15	434.97	584.96
GN39 SW	15082.88	431.25	584.93
GN40 NE	15149.50	595.99	585.39
GN40 NW	15149.77	592.33	585.44
GN40 SE	15077.26	595.93	584.91
GN40 SW	15077.23	592.28	584.92
GN41 NE	15145.81	763.07	585.41
GN41 NW	15145.86	759.40	585.44
GN41 SE	15073.33	762.40	584.84
GN41 SW	15073.46	758.79	584.83
GN42 NE	15084.07	434.86	585.04
GN42 NW	15084.09	431.10	584.95
GN42 SE	14980.63	433.68	583.98
GN42 SW	14980.73	430.12	583.92
GN43 NE	15079.59	595.77	585.00
GN43 NW	15079.33	592.38	584.97
GN43 SE	14975.70	595.52	584.02
GN43 SW	14976.07	591.83	584.02
GN44 NE	15075.20	762.40	584.95
GN44 NW	15075.46	758.98	584.88
GN44 SE	14972.05	760.53	584.06
GN44 SW	14971.75	757.08	583.97
GN45 NE	15062.01	254.22	584.77
GN45 NW	15061.72	251.14	584.87
GN45 SE	14958.41	255.32	584.01
GN45 SW	14958.62	252.09	584.07
GN46 NE	14981.65	434.40	584.02
GN46 NW	14981.93	430.81	583.98
GN46 SE	14879.21	434.56	583.30
GN46 SW	14878.92	431.17	583.25
GN47 NE	14976.68	595.20	584.09

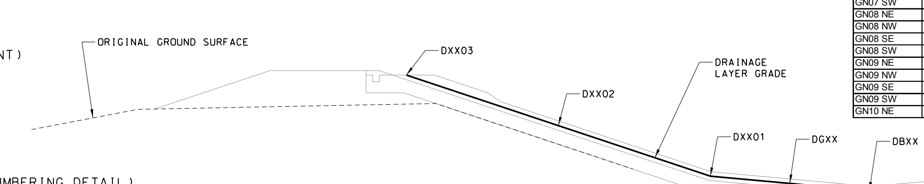
MSI Point #	Northing	Easting	Elevation
GN47 NW	14976.62	591.43	584.05
GN47 SE	14874.46	595.48	583.24
GN47 SW	14913.11	591.69	583.51
GN48 NE	14973.19	760.40	584.08
GN48 NW	14972.78	757.35	583.97
GN48 SE	14870.34	757.20	583.11
GN48 SW	14870.84	753.85	583.10
GN49 NE	14960.65	255.51	584.07
GN49 NW	14960.75	251.85	584.15
GN49 SE	14858.52	256.02	583.11
GN49 SW	14858.47	252.52	583.12
GN50 NE	14913.55	594.10	583.52
GN50 NW	14913.90	590.98	583.55
GN50 SE	14845.55	666.01	582.57
GN50 SW	14843.33	663.46	582.50
GN51 NE	14914.55	435.80	583.49
GN51 NW	14916.84	433.09	583.51
GN51 SE	14845.94	364.15	582.68
GN51 SW	14848.57	362.28	582.60
GN52 NE	14846.05	365.22	582.69
GN52 NW	14848.49	362.29	582.62
GN52 SE	14835.80	356.67	582.13
GN52 SW	14838.16	353.78	581.88
GN53 NE	14864.21	256.21	583.19
GN53 NW	14864.37	252.71	583.22
GN53 SE	14827.98	257.35	581.68
GN53 SW	14827.72	253.34	581.66
GN54 NE	14871.73	757.18	583.27
GN54 NW	14871.46	753.51	583.22
GN54 SE	14828.12	756.99	581.83
GN54 SW	14828.60	753.59	582.03
GN55 NE	14849.01	663.25	582.55
GN55 NW	14846.64	660.64	582.64
GN55 SE	14837.45	673.29	581.61
GN55 SW	14835.22	670.81	581.88

TYPICAL POINT NUMBER LOCATION

DB 00 — GRID POINT NUMBER; DRAINAGE LAYER GRADE (BREAK POINT)

DG 00 — GRID POINT NUMBER; DRAINAGE LAYER GRADE

D 00 00 — POINT NUMBER (SEE POINT NUMBERING DETAIL); CONTROL LINE NUMBER; DRAINAGE LAYER GRADE



POINT NUMBERING DETAIL

LEGEND

x 1.1 — DRAINAGE LAYER THICKNESS (IN FEET)

GN54 — GEONET

RECORD DRAWING

FILE NO. -C180-C102-10.dgn

AEG CAD GENERATED
DO NOT REVISE MANUALLY

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
0	02-22-08	SKB	SMB	SMB	ISSUED FOR BIDDING - NOT FOR CONSTRUCTION
1	03-05-08	SKB	SMB	SMB	REVISED POINT NO. DETAIL - ISSUED FOR BIDDING - NOT FOR CONSTRUCTION
2	04-11-08	SKB	SMB	SMB	ISSUED FOR CONSTRUCTION
3	10-10-08	TCJ	DBH	SMB	ADDITION OF GEOGRID AND SUMP MODIFICATIONS, REVISE GRADES DUE TO 2 FT. FOUNDATION RAISE
4	03-05-09	SKB	ADC	SMB	ISSUED FOR RECORD DRAWING

DRAWING RECORD

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
-	-	-	-	-	-

LAYOUT	DBH	05-10-07
DRAWN	SKB	03-05-08
REVIEWED	SMB	10-10-08

Brans00939
09\4\2009
I:\03 Jobs\03s5010\Gypsum Stack\CADD\Sheets\C180-C102-10.dgn

HANSON
Hanson Professional Services Inc.
1525 South Sixth Street
Springfield, Illinois 62703-2886
Phone: (217)788-2450 Fax: (217) 788-2503
Illinois Licensed Professional Service Corporation #184-001084
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SCALE -
DRAFTER -
DATE 03-26-09

DRAWING TITLE

GYPSUM STACK - LD/LCRS DRAINAGE LAYER GRADE

GYPSUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS
DUCK CREEK POWER STATION UNIT NO. -

Ameren Energy
Resources Generating

DRAWING NUMBER C180-C102 REV. 4

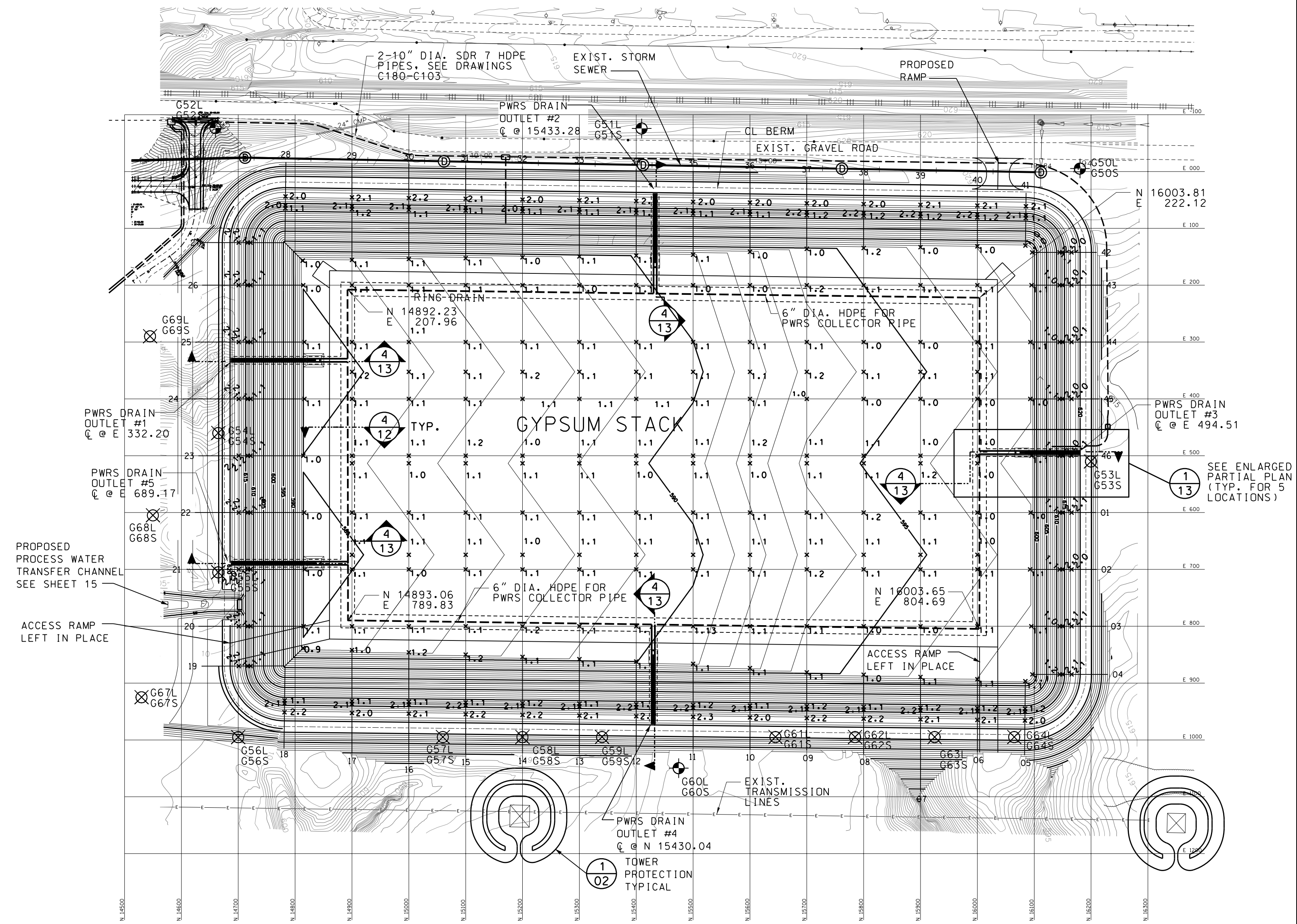
30x42

CONTROL POINT NUMBER	GRID COORDINATES NORTHING	GRID COORDINATES EASTING	TOP OF CUSHION DIRT DESIGN	TOP OF CUSHION DIRT RECORD	CUSHION DIRT
C0101	16093.72	600.00	596.91	597.36	1.0
C0102	16144.88	600.00	611.53	611.82	1.1
C0103	16149.88	600.00	614.00	614.30	2.1
C0104	16165.63	600.00	618.50	618.74	2.1
C0201	16092.72	700.00	596.62	597.10	1.1
C0202	16144.91	700.00	611.53	611.82	1.1
C0203	16149.91	700.00	614.00	614.24	2.0
C0204	16165.66	700.00	618.50	618.74	2.0
C0301	16094.87	800.00	597.23	597.82	1.1
C0302	16144.94	800.00	611.53	611.75	1.0
C0303	16149.94	800.00	614.00	614.29	2.1
C0304	16165.69	800.00	618.50	618.78	2.1
C0401	16096.68	884.70	597.74	598.24	1.1
C0402	16144.96	884.71	611.53	611.79	1.2
C0403	16149.96	884.70	614.00	614.23	2.1
C0404	16165.72	884.69	618.50	618.74	2.1
C0501	16084.47	896.68	597.71	598.41	1.1
C0502	16083.93	945.11	611.56	611.85	1.2
C0503	16083.88	950.06	614.00	614.25	2.1
C0504	16083.70	965.81	618.50	618.69	2.0
C0601	16000.00	893.29	597.01	597.27	1.1
C0602	16000.00	944.12	611.53	611.82	1.2
C0603	16000.00	949.12	614.00	614.24	2.1
C0604	16000.00	964.87	618.50	618.72	2.1
C0701	15900.00	889.27	596.18	596.47	1.1
C0702	15900.00	943.00	611.53	611.82	1.2
C0703	15900.00	948.01	614.00	614.29	2.2
C0704	15900.00	963.76	618.50	618.70	2.1
C0801	15800.00	885.24	595.35	595.60	1.0
C0802	15800.00	941.89	611.53	611.80	1.1
C0803	15800.00	946.89	614.00	614.26	2.1
C0804	15800.00	962.64	618.50	618.78	2.2
C0901	15700.00	881.21	594.52	594.81	1.1
C0902	15700.00	940.77	611.53	611.82	1.2
C0903	15700.00	945.77	614.00	614.26	2.1
C0904	15700.00	961.53	618.50	618.80	2.2
C1001	15600.00	873.61	592.66	592.94	1.1
C1002	15600.00	939.66	611.53	611.76	1.1
C1003	15600.00	944.66	614.00	614.25	2.1
C1004	15600.00	960.41	618.50	618.73	2.0
C1101	15500.00	866.01	590.81	591.07	1.1
C1102	15500.00	938.54	611.53	611.82	1.2
C1103	15500.00	943.54	614.00	614.26	2.2
C1104	15500.00	959.29	618.50	618.78	2.3
C1201	15400.00	861.99	589.98	590.25	1.1
C1202	15400.00	937.42	611.53	611.82	1.2
C1203	15400.00	942.42	614.00	614.29	2.2
C1204	15400.00	958.18	618.50	618.73	2.2
C1301	15300.00	857.96	589.15	589.38	1.1
C1302	15300.00	936.31	611.53	611.79	1.1
C1303	15300.00	941.31	614.00	614.23	2.1
C1304	15300.00	957.06	618.50	618.75	2.1
C1401	15200.00	853.93	588.32	588.57	1.1
C1402	15200.00	935.19	611.53	611.82	1.2
C1403	15200.00	940.19	614.00	614.25	2.1
C1404	15200.00	955.94	618.50	618.76	2.2
C1501	15100.00	849.91	587.48	587.77	1.2
C1502	15100.00	934.07	611.53	611.81	1.1
C1503	15100.00	939.07	614.00	614.27	2.2
C1504	15100.00	954.83	618.50	618.78	2.2
C1601	15000.00	845.88	586.65	586.96	1.2
C1602	15000.00	932.96	611.53	611.81	1.1
C1603	15000.00	937.96	614.00	614.26	2.1
C1604	15000.00	953.71	618.50	618.72	2.1
C1701	14900.00	841.85	585.82	586.02	1.0
C1702	14900.00	931.84	611.53	611.82	1.1
C1703	14900.00	936.84	614.00	614.29	2.1
C1704	14900.00	952.60	618.50	618.71	2.0
C1801	14814.14	838.40	585.11	585.38	0.9
C1802	14781.51	930.52	611.53	611.79	1.1
C1803	14781.45	935.52	614.00	614.20	2.1
C1804	14781.24	951.27	618.50	618.77	2.2
C1901	14814.14	838.40	585.11	585.40	0.9
C1902	14721.66	870.00	611.53	611.75	1.1
C1903	14716.66	870.01	614.00	614.25	2.1
C1904	14700.91	870.05	618.50	618.76	2.1
C2001	14814.90	800.00	584.89	585.18	1.1
C2002	14721.64	800.00	611.53	611.82	1.1
C2003	14716.64	800.00	614.00	614.25	2.1
C2004	14700.89	800.00	618.50	618.71	2.1
C2101	14816.88	700.00	584.31	584.59	1.0
C2102	14721.62	700.00	611.53	611.80	1.1
C2103	14716.62	700.00	614.00	614.21	2.1
C2104	14700.87	700.00	618.50	618.72	2.0
C2201	14815.89	600.00	584.59	584.83	1.0
C2202	14721.60	600.00	611.53	611.81	1.2
C2203	14716.60	600.00	614.00	614.20	2.1
C2204	14700.85	600.00	618.50	618.70	2.2
C2301	14814.43	500.00	585.00	585.22	1.0
C2302	14721.58	500.00	611.53	611.81	1.1
C2303	14716.58	500.00	614.00	614.29	2.2
C2304	14700.83	500.00	618.50	618.76	2.1
C2401	14816.38	400.00	584.44	584.96	1.1
C2402	14721.56	400.00	611.53	611.77	1.1
C2403	14716.56	400.00	614.00	614.23	2.1
C2404	14700.81	400.00	618.50	618.71	2.1
C2501	14816.27	300.00	584.47	584.76	1.1
C2502	14721.54	300.00	611.53	611.78	1.2
C2503	14716.54	300.00	614.00	614.23	2.1
C2504	14700.79	300.00	618.50	618.74	2.2
C2601	14814.24	200.00	585.04	585.25	1.0
C2602	14721.52	200.00	611.53	611.78	1.1
C2603	14716.52	200.00	614.00	614.25	2.1
C2604	14700.77	200.00	618.50	618.72	2.1
C2701	14813.37	156.83	585.29	585.66	1.0
C2702	14721.50	125.09	611.53	611.75	1.1
C2703	14716.50	125.09	614.00	614.24	2.1
C2704	14700.75	125.05	618.50	618.70	2.1
C2801	14813.37	156.83	585.29	585.68	1.0
C2802	14782.84	64.56	611.53	611.79	1.1
C2803	14782.89	59.56	614.00	614.21	2.0
C2804	14783.07	43.81	618.50	618.68	2.0
C2901	14900.00	155.51	585.99	586.42	1.1
C2902	14900.00	66.12	611.53	611.82	1.2
C2903	14900.00	61.12	614.00	614.23	2.1
C2904	14900.00	45.37	618.50	618.74	2.1
C3001	15000.00	153.98	586.81	587.08	1.1

CONTROL POINT NUMBER	GRID COORDINATES NORTHING	GRID COORDINATES EASTING	TOP OF CUSHION DIRT DESIGN	TOP OF CUSHION DIRT RECORD	CUSHION DIRT
C3002	15000.00	67.45	611.53	611.75	1.1
C3003	15000.00	62.45	614.00	614.23	2.1
C3004	15000.00	46.70	618.50	618.78	2.2
C3101	15100.00	152.46	587.63	587.91	1.1
C3102	15100.00	68.79	611.53	611.81	1.1
C3103	15100.00	63.79	614.00	614.25	2.1
C3104	15100.00	48.03	618.50	618.77	2.1
C3201	15200.00	150.93	588.44	588.66	1.0
C3202	15200.00	70.12	611.53	611.81	1.1
C3203	15200.00	65.12	614.00	614.23	2.0
C3204	15200.00	49.37	618.50	618.71	2.0
C3301	15300.00	149.41	589.26	589.61	1.1
C3302	15300.00	71.45	611.53	611.77	1.1
C3303	15300.00	66.45	614.00	614.25	2.1
C3304	15300.00	50.70	618.50	618.74	2.1
C3401	15400.00	147.88	590.08	590.46	1.1
C3402	15400.00	72.79	611.53	611.79	1.1
C3403	15400.00	67.79	614.00	614.22	2.1
C3404	15400.00	52.03	618.50	618.66	2.0
C3501	15500.00	146.36	590.89	591.14	1.1
C3502	15500.00	74.12	611.53	611.77	1.1
C3503	15500.00	69.12	614.00	614.24	2.1
C3504	15500.00	53.37	618.50	618.62	2.0
C3601	15600.00	141.26	592.73	592.98	1.0
C3602	15600.00	75.45	611.53	611.78	1.1
C3603	15600.00	70.45	614.00	614.25	2.1
C3604	15600.00	54.70	618.50	618.68	2.0
C3701	15700.00	136.16	594.57	594.81	1.0
C3702	15700.00	76.79	611.53	611.77	1.2
C3703	15700.00	71.79	614.00	614.27	2.2
C3704	15700.00	56.03	618.50	618.61	2.0
C3801	15800.00	134.63	595.39	595.65	1.2
C3802	15800.00	78.12	611.53	611.80	1.2
C3803	15800.00	73.12	614.00	614.26	2.2
C3804	15800.00	57.37	618.50	618.61	2.0
C3901	15900.00	133.11	596.20	596.94	1.0
C3902	15900.00	79.45	611.53	611.81	1.2
C3903	15900.00	74.45	614.00	614.25	2.2
C3904	15900.00	58.70	618.50	618.67	2.1
C4001	16000.00	131.58	597.02	597.43	1.0
C4002	16000.00	80.79	611.53	611.83	1.2
C4003	16000.00	75.79	614.00	614.30	2.2
C4004	16000.00	60.03	618.50	618.71	2.1
C4101	16084.54	130.31	597.71	598.14	1.0
C4102	16085.19	81.93	611.53	611.80	1.1
C4103	16085.25	76.93	614.00	614.24	2.1
C4104	16085.46	61.17	618.50	618.76	2.1
C4201	16096.44	142.27	597.74	598.33	1.0
C4202	16144.74	142.26	611.53	611.83	1.1
C4203	16149.74	142.26	614.00	614.26	2.0
C4204	16165.49	142.25	618.50	618.81	2.0
C4301	16095.25	200.00	597.39	597.91	1.1
C4302	16144.76	200.00	611.53	611.78	1.0
C4303	16149.76	200.00	614.00	614.26	2.0
C4304	16165.51	200.00	618.50	618.77	2.1
C4401	16093.16	300.00	596.78	597.28	1.1
C4402	16144.79	300.00	611.53	611.80	1.0
C4403	16149.79	300.00	614.00	614.21	2.0
C4404	16165.54	300.00	618.50	618.79	2.1
C4501	16093.09	400.00	596.75	597.07	1.0
C4502	16144.82	400.00	611.53	611.79	1.1
C4503	16149.82	400.00	614.00	614.25	2.0
C4504	16165.57	400.00	618.50	618.78	2.0
C4601	16095.24	500.00	597.36	597.71	1.1
C4602	16144.85	500.00	611.53	611.80	1.1
C4603	16149.85	500.00	614.00	614.22	2.0
C4604	16165.60	500.00	618.50	618.76	2.1
CB01	14900.00	352.42	584.83	585.07	1.2
CB02	15000.00	352.42	585.64	585.91	1.1
CB03	15100.00	352.42	586.45	586.72	1.1
CB04	15200.00	352.42	587.26	587.53	1.2
CB05	15300.00	352.42	588.06	588.29	1.1
CB06	15400.00	352.42	588.87	589.10	1.1
CB07	15500.00	352.42	589.68	589.97	1.1
CB08	15600.00	352.42	591.49	591.72	1.1
CB09	15700.00	352.42	593.30	593.51	1.2
CB10	15800.00	352.42	594.10	594.35	1.1
CB11	15900.00	352.42	594.91	595.17	1.1
CB12	16000.00	352.42	595.72	596.00	1.1
CB13	14900.00	513.35	585.78	586.01	1.1
CB14	15000.00	513.35	586.59	586.80	1.0
CB15	15100.00	513.35	587.40	587.68	1.1
CB16	15200.00	513.35	588.21	588.46	1.1
CB17	15300.00	513.35	589.01	589.30	1.1
CB18	15400.00	513.35	589.82	589.99	1.0
CB19	15500.00	513.35	590.63	590.92	1.1
CB20	15600.00	513.35	592.44	592.65	1.0
CB21	15700.00	513.35	594.24	594.54	1.1
CB22	15800.00	513.35	595.05	595.28	1.1
CB23	15900.00	513.35	595.86	596.16	1.2
CB24	16000.00	513.35	596.67	596.84	1.0
CB25	14900.00	674.29	584.83	585.12	1.1
CB26	15000.00	674.29	585.64	585.88	1.1
CB27	15100.00	674.29	586.45	586.73	1.1
CB28	15200.00	674.29	587.26	587.43	1.0
CB29	15300.00	674.29	588.07	588.35	1.1
CB30	15400.00	674.29	588.87	589.18	1.1
CB31	15500.00	674.29	589.68	589.93	1.1
CB32	15600.00	674.29	591.49	591.74	1.1
CB33	15700.00	674.29	593.30	593.51	1.1
CB34	15800.00	674.29	594.10	594.32	1.1
CB35	15900.00	674.29	594.91	595.15	1.1
CB36	16000.00	674.29	595.72	596.01	1.0
CG01	14900.00	200.00	585.73	585.97	1.1
CG02	15000.00	200.00	586.54	586.80	1.1
CG03	15100.00	200.00	587.35	587.59	1.1
CG04	15200.00	200.00	588.15	588.45	1.1
CG05	15300.00	200.00	588.96	589.15	1.0
CG06	15400.00	200.00	589.77	590.03	1.1
CG07	15500.00	200.00	590.58	590.79	1.0
CG08	15600.00	200.00	592.39	592.62	1.0
CG09	15700.00	200.00	594.19	594.49	1.2
CG10	15800.00	200.00	595.00	595.25	1.1
CG11	15900.00	200.00	595.81	596.13	1.1
CG12	16000.00	200.00	596.62	596.82	1.1
CG13	14900.00	300.00	585.14	585.35	1.1
CG14	15000.00	300.00	585.95	586.21	1.1

CONTROL POINT NUMBER	GRID COORDINATES NORTHING	GRID COORDINATES EASTING	TOP OF CUSHION DIRT DESIGN	TOP OF CUSHION DIRT RECORD	CUSHION DIRT
CG15	15100.00	300.00	586.76	587.03	1.1
CG16	15200.00	300.00	587.57	587.86	1.1
CG17	15300.00	300.00	588.37	588.67	1.1
CG18	15400.00	300.00	589.18	589.41	1.1
CG19	15500.00	300.00	589.99	590.25	1.1
CG20	15600.00	300.00	591.80	592.04	1.1
CG21	15700.00	300.00	593.60	593.86	1.1
CG22	15800.00	300.00	594.41	594.67	1.0
CG23	15900.00	300.00	595.22	595.45	1.0
CG24	16000.00	300.00	596.03	596.27	1.1
CG25	14900.00	400.00	585.11	585.36	1.1
CG26	15000.00	400.00	585.92	586.15	1.1
CG27	15100.00	400.00	586.73	587.01	1.1
CG28	15200.00	400.00	587.54	587.78	1.1
CG29	15300.00	400.00	588.34	588.58	1.1
CG30	15400.00	400.00	589.15	589.40	1.1
CG31	15500.00	400.00	589.96	590.20	1.1
CG32	15600.00	400.00	591.77	592.03	1.1
CG33	15700.00	400.00	593.58	593.74	1.0
CG34	15800.00	400.00	594.38	594.62	1.0
CG35	15900.00	400.00	595.19	595.41	1.0
CG36	16000.00	400.00	596.00	596.27	1.0
CG37	14900.00	500.00	585.70	586.00	1.1
CG38	15000.00	500.00	586.51	586.75	1.1
CG39	15100.00	500.00	587.32	587.59	1.2
CG40	15200.00	500.00	588.13	588.34	1.0
CG41	15300.00	500.00	588.93	589.21	1.1
CG42	15400.00	500.00	589.74	590.01	1.1
CG43	15500.00	500.00	590.55	590.81	1.1
CG44	15600.00	500.00	592.36	592.65	1.2.
CG45	15700.00	500.00	594.17	594.43	1.1
CG46	15800.00	500.00	594.97	595.22	1.1
CG47	15900.00	500.00	595.78	595.97	1.0
CG48	16000.00	500.00	596.59	596.89	1.0
CG49	14900.00	600.00	585.27	585.53	1.1
CG50	15000.00	600.00	586.08	586.34	1.1
CG51	15100.00	600.00	586.89	587.16	1.1
CG52	15200.00	600.00	587.70	587.97	1.1
CG53	15300.00	600.00	588.50	588.78	1.1
CG54	15400.00	600.00	589.31	589.59	1.1
CG55	15500.00	600.00	590.12	590.35	1.0
CG56	15600.00	600.00	591.93	592.23	1.0
CG57	15700.00	600.00	593.73	593.98	1.1
CG58	15800.00	600.00	594.54	594.82	1.2
CG59	15900.00	600.00	595.35	595.59	1.1
CG60	16000.00	600.00	596.16	596.52	1.0
CG61	14900.00	700.00	584.99	585.21	1.1
CG62	15000.00	700.00	585.79	585.98	1.0
CG63	15100.00	700.00	586.60	586.86	1.1
CG64	15200.00	700.00	587.41	587.68	1.1
CG65	15300.00	700.00	588.22	588.48	1.1
CG66	15400.00	700.00	589.02	589.30	1.1
CG67	15500.00	700.00	589.83	590.12	1.1
CG68	15600.00	700.00	591.64	591.85	1.1
CG69	15700.00	700.00	593.45	593.72	1.1
CG70	15800.00	700.00	594.26	594.52	1.1
CG71	15900.00	700.00	595.06	595.32	1.1
CG72	16000.00	700.00	595.87	596.17	1.1
CG73	14900.00	800.00	585.57	585.81	1.1
CG74	15000.00	800.00	586.38	586.66	1.1
CG75	15100.00	800.00	587.19	587.44	1.1
CG76	15200.00	800.00	588.00	588.27	1.2
CG77	15300.00	800.00	588.81	589.10	1.1
CG78	15400.00	800.00	589.61	589.80	1.1
CG79	15500.00	800.00	590.42	590.72	1.1
CG80	15600.00	800.00	592.23	592.52	1.1
CG81	15700.00	800.00	594.04	594.31	1.1
CG82	15800.00	800.00	594.84	595.06	1.0
CG83	15900.00	800.00	595.65	595.88	1.0
CG84	16000.00	800.00	596.46	596.87	1.1

NOTE: RECORD ELEVATIONS AND LAYER THICKNESSES BASED ON A COMPILATION OF RECORD SURVEY DATA PROVIDED BY MAURER-STUTZ, INC. THIS RECORD SURVEY PROVIDED BY MAURER-STUTZ, INC., IS CONTAINED ELSEWHERE IN THIS ACCEPTANCE REPORT.



STANDARD LEGEND

(ALL SYMBOLS MAY NOT BE USED ON EACH PLAN)

- ORIGINAL CONTOURS
- FENCELINE
- TRANSMISSION TOWER
- OVERHEAD ELECTRIC
- LIMITS OF VEGETATION
- GRAVEL ROAD
- RAILROAD
- STORM SEWER
- CONTROL POINT
- NEW CONTOURS
- LD/LCRS COLLECTION PIPE
- GEONET
- MW-53L MONITORING WELL
- B-55 BORING
- G69L FUTURE GROUNDWATER MONITORING WELL
- 4" DIA. PERFORATED DRAINAGE PIPING
- 6" DIA. OUTFALL PIPING
- 1.1 CUSHION DIRT LAYER THICKNESS (IN FEET)
- RING DRAIN SAND LIMITS
- CONSTRUCTION ROAD LIMITS

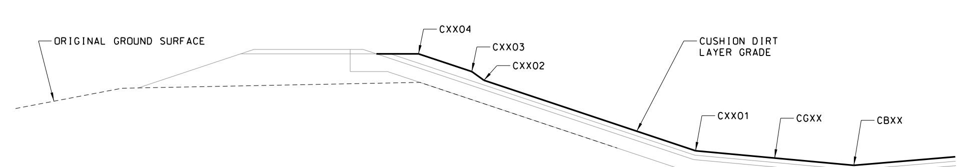
0' 100' 200'
SCALE: 1" = 100'

TYPICAL POINT NUMBER LOCATION

CB 00
- GRID POINT NUMBER
- CUSHION LAYER GRADE (BREAK POINT)

CG 00
- GRID POINT NUMBER
- CUSHION LAYER GRADE

C 00 00
- POINT NUMBER (SEE POINT NUMBERING DETAIL)
- CONTROL LINE NUMBER
- CUSHION LAYER GRADE



POINT NUMBERING DETAIL

Brans00939
09\4\2009
I:\03 Jobs\03s5010\Gypsum Stack\CADD\Sheets\C180-C102-II.dgn

AEG CAD GENERATED
DO NOT REVISE MANUALLY

LAYOUT	KNK	05/10/07
DRAWN	SKB	03-05-08
REVIEWED		

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
0	02-22-08	SKB	SMB	SMB	ISSUED FOR BIDDING - NOT FOR CONSTRUCTION
1	03-05-08	SKB	SMB	SMB	REVISED CONTOURS / TABLE - ISSUED FOR BIDDING - NOT FOR CONSTRUCTION
2	04-11-08	SKB	SMB	SMB	ISSUED FOR CONSTRUCTION
3	10-14-08	TJL	DBH	SMB	REVISED GRADING TABLE AND CONTOURS FOR 2 FT. FOUNDATION GRADE RAISE FOR THE NORTH 400' OF THE GYPSUM STACK FLOOR
4	11-17-08	DBH	DBH	SMB	ADDED CENTERLINE COORDINATES FOR PWRS DRAIN LOCATIONS
5	02-09-09	DBH	SKB	SMB	RELOCATE SOUTH RING DRAIN ALIGNMENT 30' NORTH
6	03-05-09	SKB	ADC	SMB	ISSUED FOR RECORD DRAWING

DRAWING RECORD

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
-	-	-	-	-	

30x42

RECORD DRAWING

FILE NO. -C180-C102-II.dgn

HANSON
Hanson Professional Services Inc.
1525 South Sixth Street
Springfield, Illinois 62703-2886
Phone: (217)788-2450 Fax: (217) 788-2503
Illinois Licensed Professional Service Corporation #184-001084
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SCALE -
DRAFTER -
DATE 03-26-09

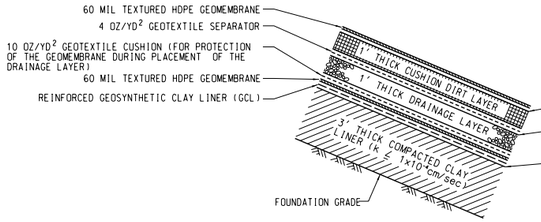
DRAWING TITLE

PWRS-RING DRAIN SYSTEM CUSHION DIRT LAYER GRADE

GYPSUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS
DUCK CREEK POWER STATION UNIT NO. -

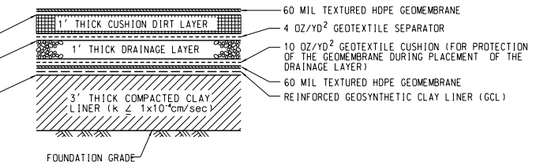
Ameren Energy Resources Generating

DRAWING NUMBER C180-C102 REV. 6



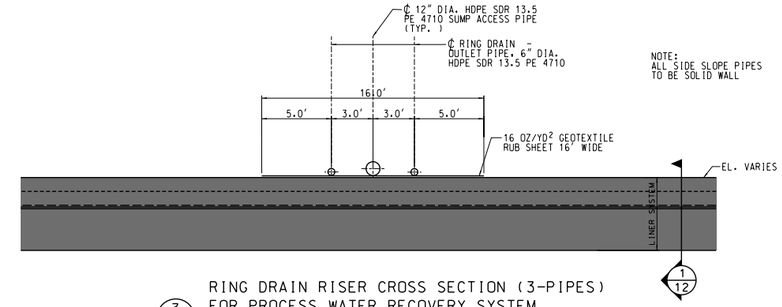
1/12 SIDE SLOPE LINER SYSTEM
NTS

NOTE: LEACHATE COLLECTION SYSTEM NOT SHOWN

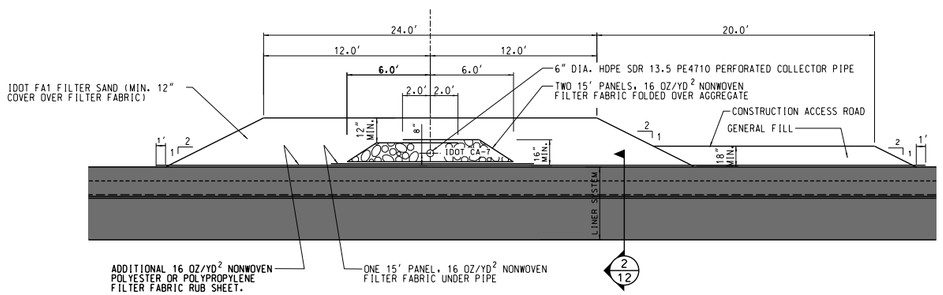


2/12 BOTTOM LINER SYSTEM
NTS

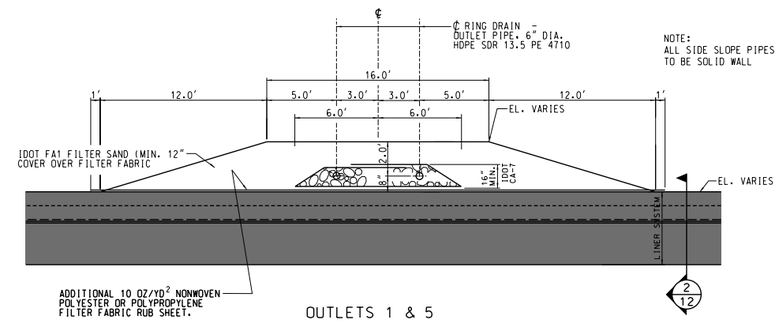
NOTE: LEACHATE COLLECTION SYSTEM NOT SHOWN



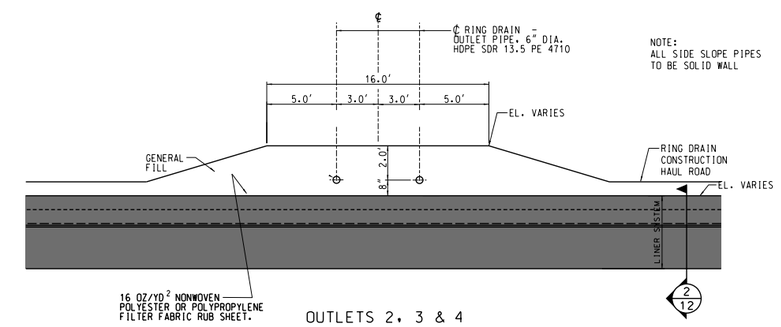
3/12 RING DRAIN RISER CROSS SECTION (3-PIPES) FOR PROCESS WATER RECOVERY SYSTEM
SCALE: 1" = 4'
NOTE: LEACHATE COLLECTION SYSTEM NOT SHOWN



4/12 RING DRAIN COLLECTOR CROSS SECTION FOR PROCESS WATER RECOVERY SYSTEM
SCALE: 1" = 4'
NOTE: LEACHATE COLLECTION SYSTEM NOT SHOWN

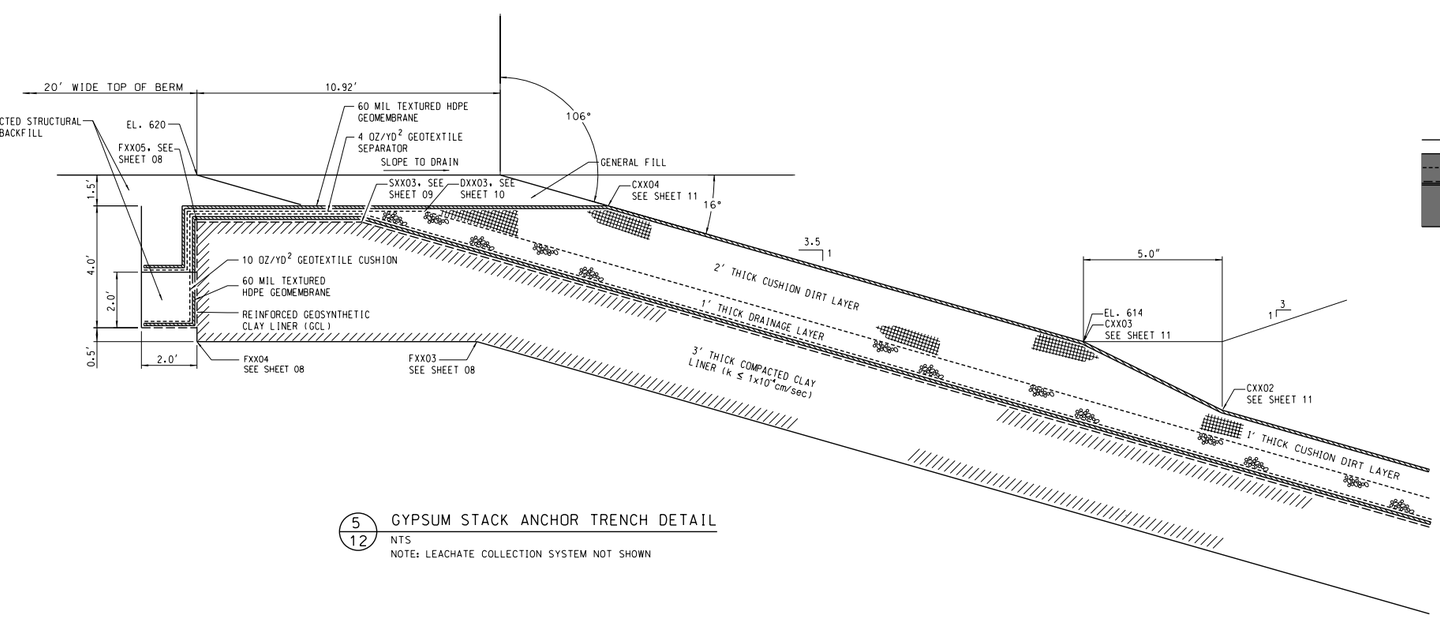


OUTLETS 1 & 5



OUTLETS 2, 3 & 4

6/12 PIPES BETWEEN RING DRAIN AND RISERS FOR PROCESS WATER RECOVERY SYSTEM
SCALE: 1" = 4'
NOTE: LEACHATE COLLECTION SYSTEM NOT SHOWN



5/12 GYPSUM STACK ANCHOR TRENCH DETAIL
NTS
NOTE: LEACHATE COLLECTION SYSTEM NOT SHOWN

AEG CAD GENERATED
DO NOT REVISE MANUALLY

DRAWING RECORD

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
0	02-22-08	SKB	SMB	SMB	ISSUED FOR BIDDING - NOT FOR CONSTRUCTION
1	03-05-08	SKB	SMB	SMB	REVISED DETAIL 5 - ISSUED FOR BIDDING - NOT FOR CONSTRUCTION
2	04-11-08	SKB	SMB	SMB	ISSUED FOR CONSTRUCTION
3	9-19-08	TCJ	RWH	RWH	ADDED LEACHATE COLLECTION NOTE TO ALL DETAILS
4	02-12-09	SKB	SMB	SMB	REVISED DETAIL 6
5	03-05-09	SKB	JMM	-	ISSUED FOR RECORD DRAWING BY HANSON

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
-	-	-	-	-	

LAYOUT	KNK	05-15-07
DRAWN	SKB	03-05-08
REVIEWED		

30x42

HANSON
Hanson Professional Services Inc.
1525 South Sixth Street
Springfield, Illinois 62703-2886
Phone: (217)788-2450 Fax: (217) 788-2503
Illinois Licensed Professional Service Corporation #184-001084
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SCALE -
DRAFTER -
DATE 03-26-09

RECORD DRAWING
FILE NO. -C180-C102-12.dgn

DRAWING TITLE
PWRS - RING DRAIN DETAILS

GYPSUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS
DUCK CREEK POWER STATION UNIT NO. -

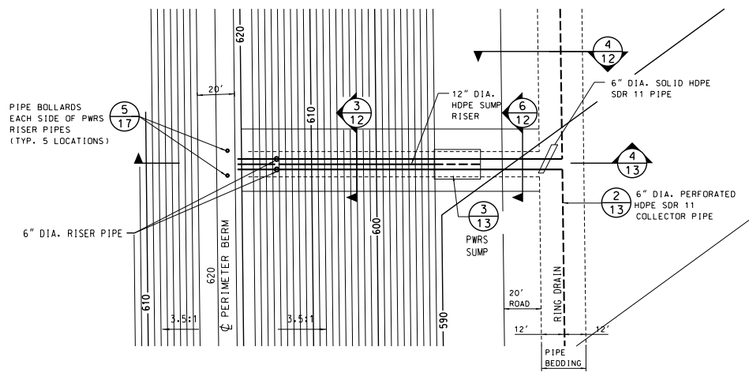
Ameren Energy. Resources Generating

DRAWING NUMBER C180-C102 REV. 5
SHEET NO. 12 OF 33

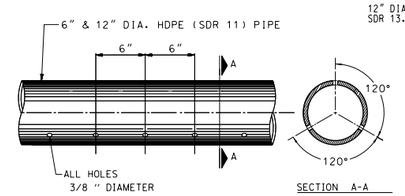
Brand09939
Date04/02/09
\\03jobs\03s500\Gypsum Stack\CADD\Sheets\C180-C102-12.dgn

PERFORATED PIPE

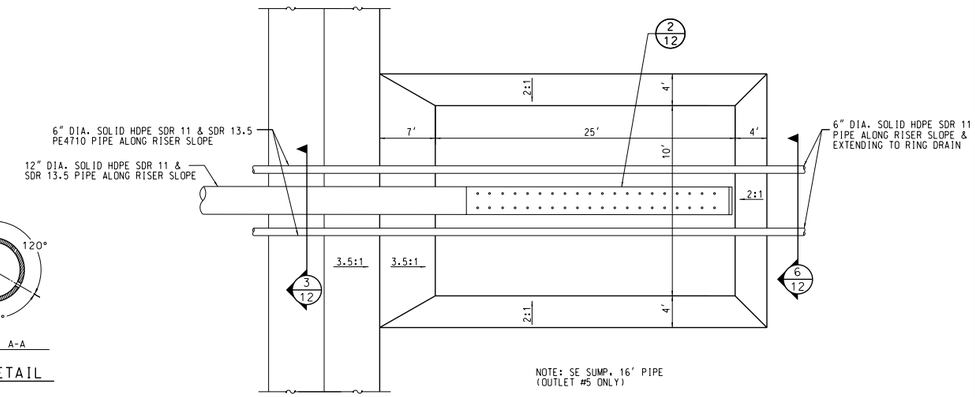
SOLID PIPE



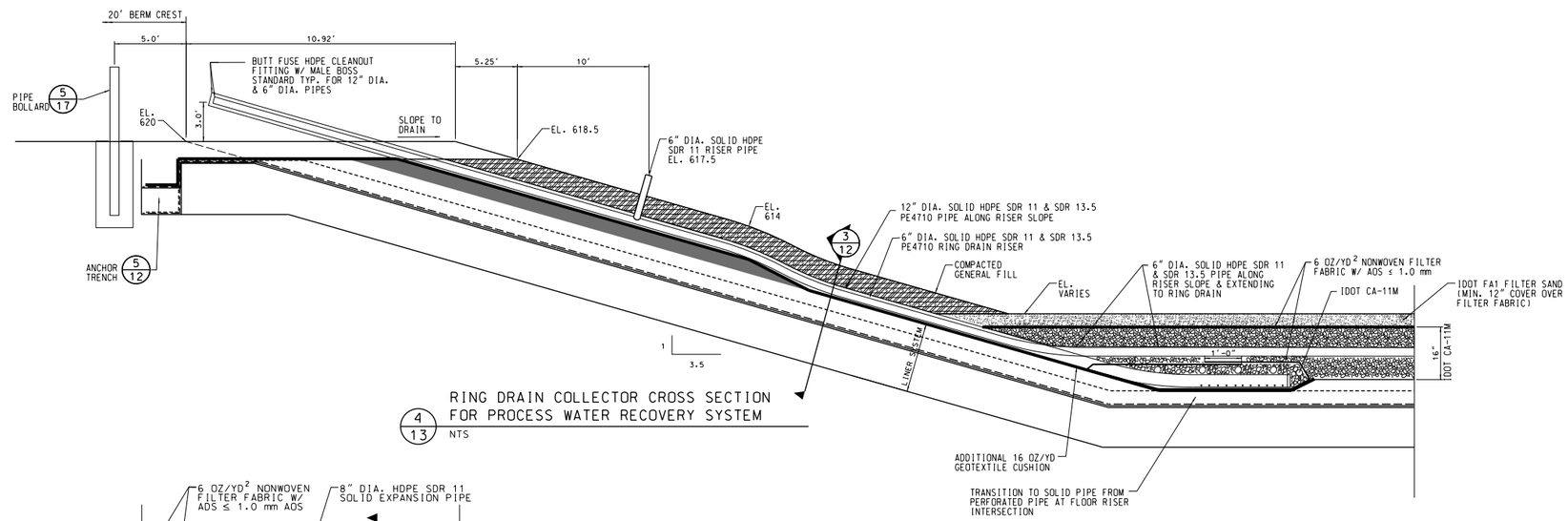
1/13 PROCESS WATER RECOVERY SYSTEM - PARTIAL PLAN (TYP. 5 LOCATIONS)
SCALE: 1"=30'



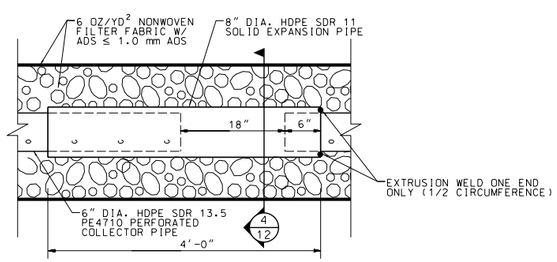
2/13 RING DRAIN COLLECTOR PIPE DETAIL
NTS



3/13 PWRS SUMP PLAN
NTS



4/13 RING DRAIN COLLECTOR CROSS SECTION FOR PROCESS WATER RECOVERY SYSTEM
NTS



5/13 RING DRAIN COLLECTOR PIPE EXPANSION UNION
NTS

NOTE:
INSTALL EXPANSION UNION EVERY 100 FT OF 6" DIA. PERFORATED COLLECTOR PIPE

NOTE:
RING DRAIN COLLECTOR PIPES ARE PERFORATED.
RING DRAIN RISER PIPES ARE NOT PERFORATED.

AEG CAD GENERATED
DO NOT REVISE MANUALLY

DRAWING RECORD

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
0	02-22-08	SKB	SMB	SMB	ISSUED FOR BIDDING - NOT FOR CONSTRUCTION
1	04-11-08	SKB	SMB	SMB	ISSUED FOR CONSTRUCTION
2	-	SKB	JDM	-	ISSUED FOR RECORD DRAWING

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
-	-	-	-	-	

LAYOUT 05/15/07
DRAWN SKB 04-15-09
REVIEWED

HANSON
Hanson Professional Services Inc.
1525 South Sixth Street
Springfield, Illinois 62703-2886
Phone: (217)789-2450 Fax: (217) 789-2503
Illinois Licensed Professional Service Corporation #184-001064
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RECORD DRAWING

FILE NO. C180-C102-13.dgn

DRAWING TITLE

PWRS - RING DRAIN DETAILS

GYPSUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS
DUCK CREEK POWER STATION UNIT NO. -

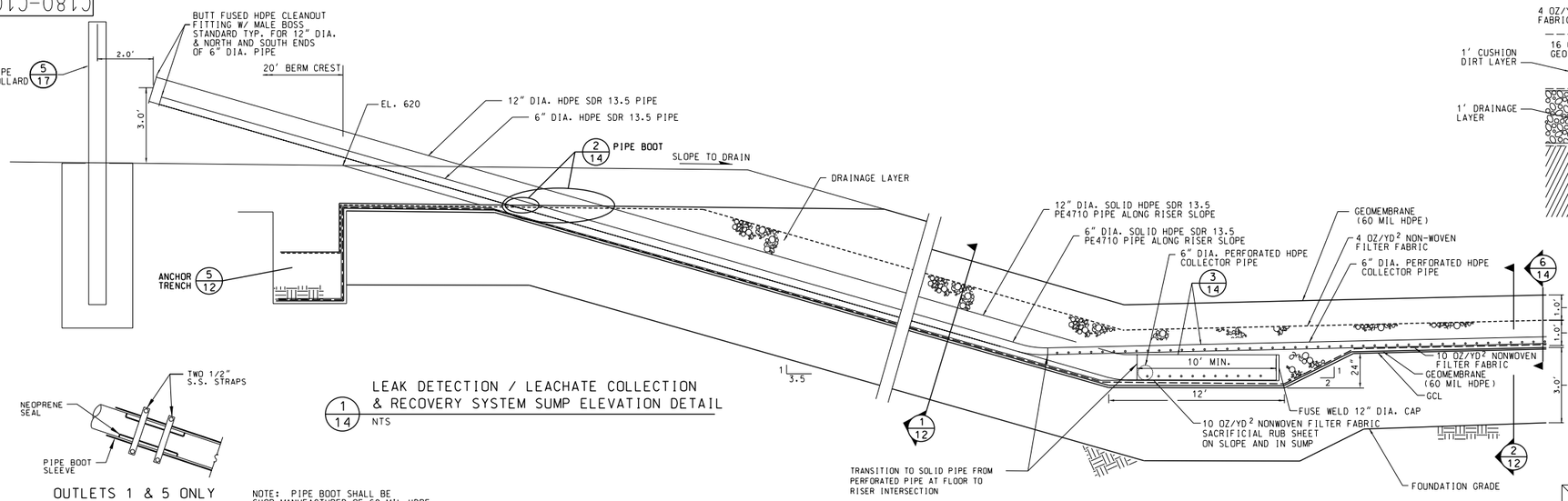
SCALE -
DRAFTER -
DATE 03-26-09

Ameren Energy. Resources Generating

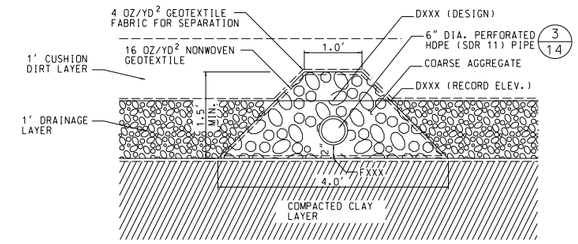
DRAWING NUMBER C180-C102
REV. 2
SHEET NO. 13 OF 33

30x42

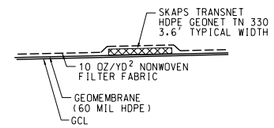
Brand0039
Brand0039
/V03/data/03x50/0/0/gydgm Stock\CADD\Sheets\C180-C102-13.dgn



1/14 LEAK DETECTION / LEACHATE COLLECTION & RECOVERY SYSTEM SUMP ELEVATION DETAIL
NTS



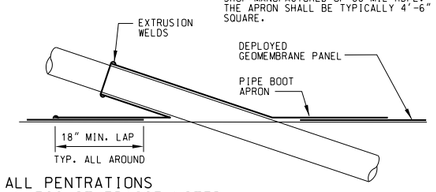
6/14 LD/LCRS COLLECTOR PIPE
NTS



7/14 STRIP DRAIN DETAIL
NTS

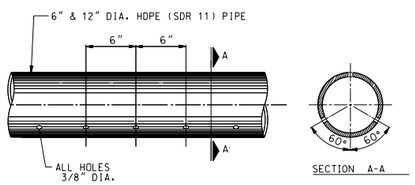
OUTLETS 1 & 5 ONLY

NOTE: PIPE BOOT SHALL BE SHOP-MANUFACTURED OF 60 MIL HDPE. THE APRON SHALL BE TYPICALLY 4'-6" SQUARE.

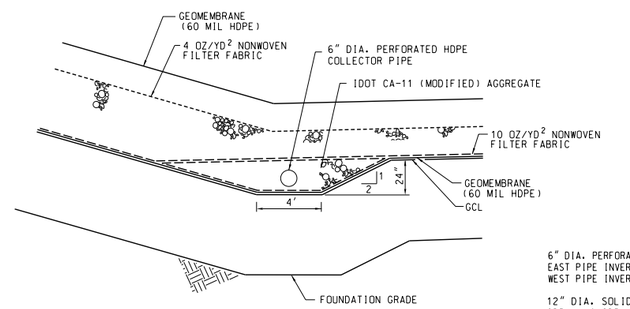


ALL PENTRATIONS UNLESS OTHERWISE NOTED

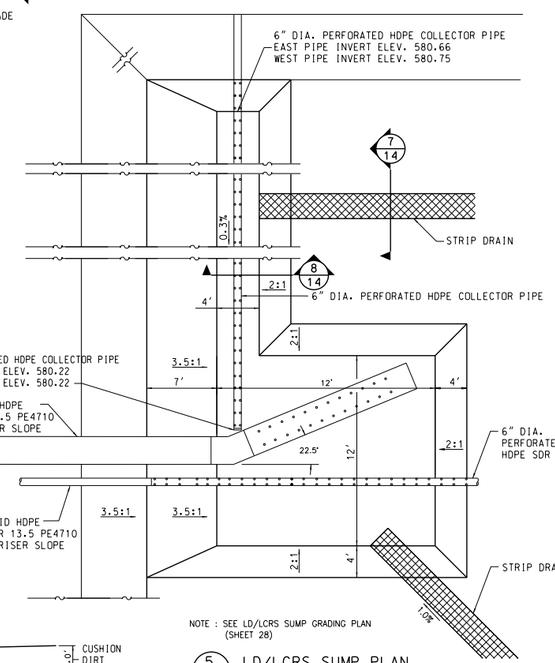
2/14 LINER PENETRATION DETAIL
NTS



3/14 PERFORATED LEACHATE COLLECTION PIPE
NTS

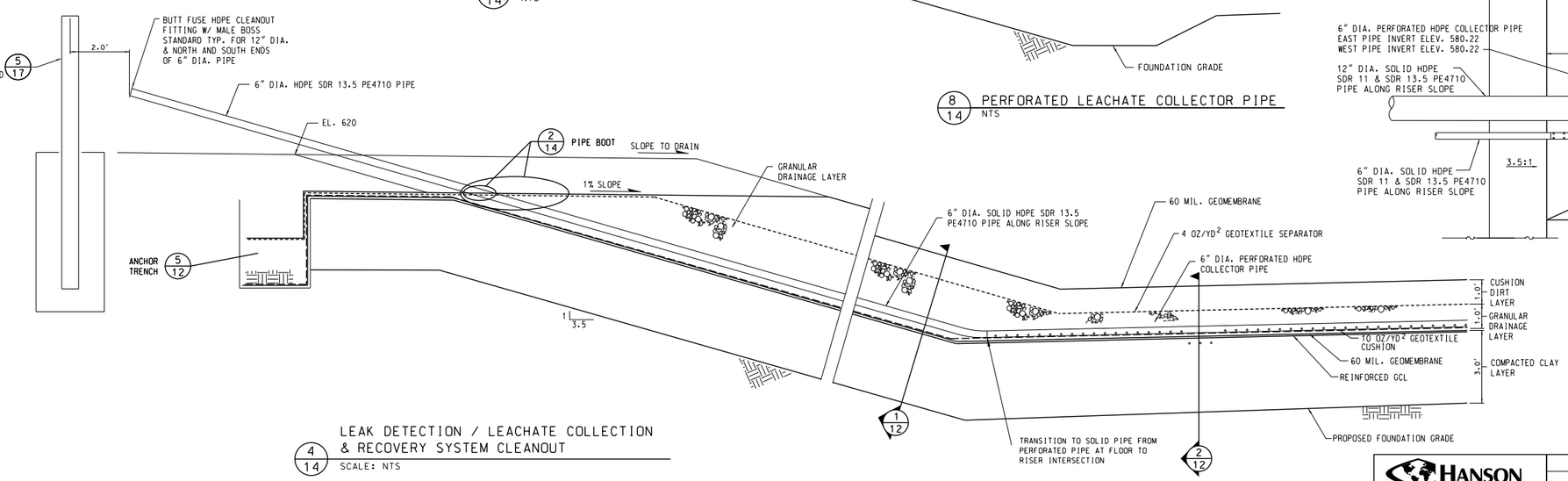


8/14 PERFORATED LEACHATE COLLECTOR PIPE
NTS



NOTE : SEE LD/LCRS SUMP GRADING PLAN (SHEET 28)

5/14 LD/LCRS SUMP PLAN
NTS



4/14 LEAK DETECTION / LEACHATE COLLECTION & RECOVERY SYSTEM CLEANOUT
SCALE: NTS

AEG CAD GENERATED
DO NOT REVISE MANUALLY

DRAWING RECORD

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
0	02-22-08	SKB	SMB	SMB	ISSUED FOR BIDDING - NOT FOR CONSTRUCTION
1	04-11-08	SKB	SMB	SMB	ISSUED FOR CONSTRUCTION
2	10-10-08	TCJ	DBH	SMB	MODIFIED LD/LCRS SUMP PLAN
3	03-05-09	SKB	JMM	-	ISSUED FOR RECORD DRAWING BY HANSON

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
-	-	-	-	-	-

LAYOUT		
DRAWN	SKB	04-16-09
REVIEWED	KNK	05-15-07

30x42

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SCALE -
DRAFTER -
DATE 03-26-09

RECORD DRAWING

FILE NO. -C180-C102-14.dgn

DRAWING TITLE

LD/LCRS SECTIONS & DETAILS

GYPSUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS
DUCK CREEK POWER STATION UNIT NO. -

Ameren Energy. Resources Generating

DRAWING NUMBER C180-C102 REV. 3

SHEET NO. 14 OF 33

Brand0039
Brand0039
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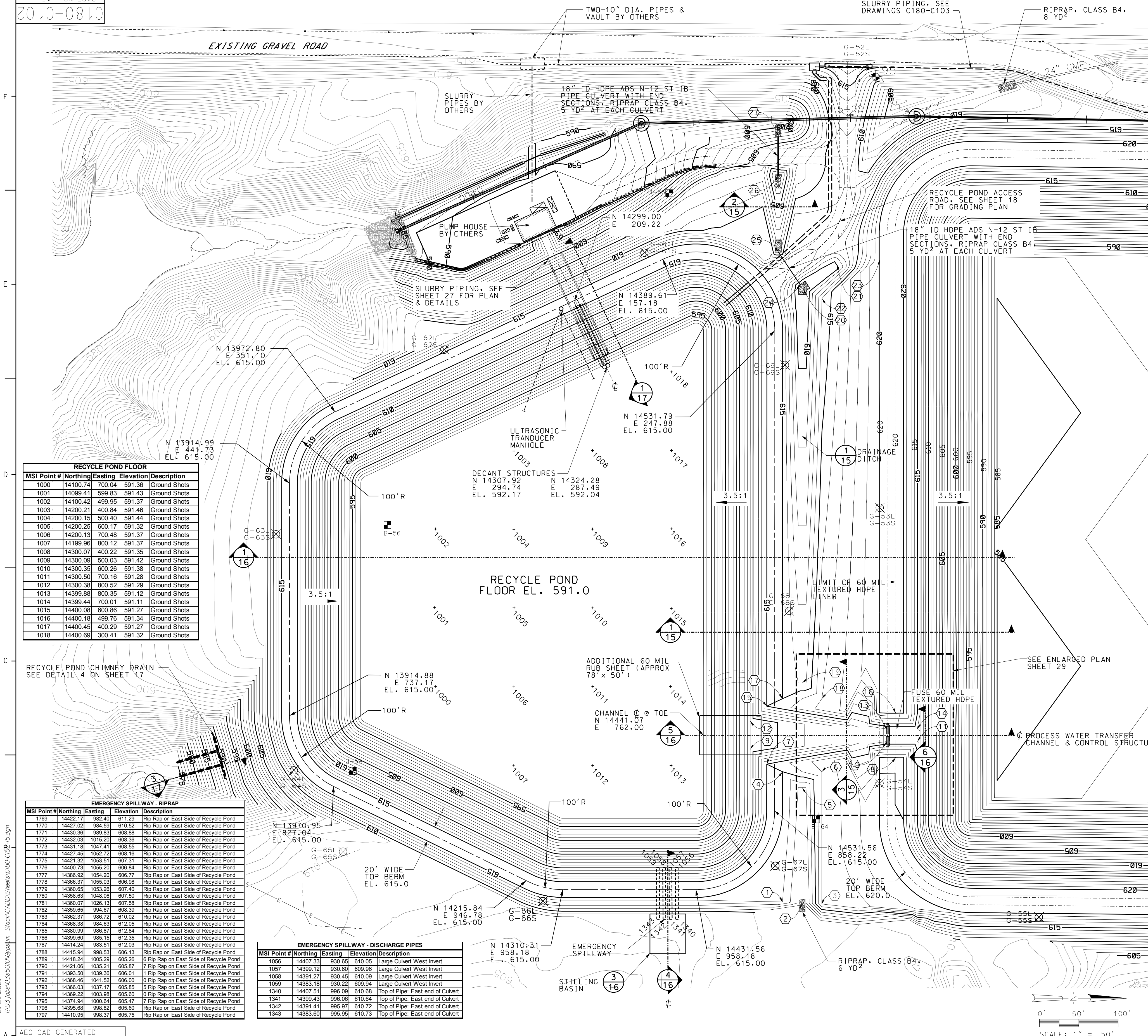


RECYCLE POND FLOOR

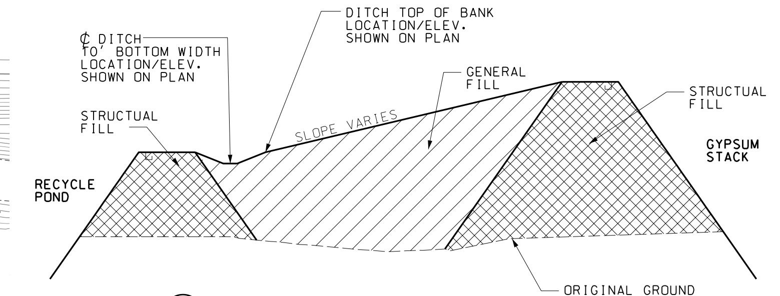
MSI Point #	Northing	Easting	Elevation	Description
1000	14100.74	700.04	591.36	Ground Shots
1001	14099.41	599.83	591.43	Ground Shots
1002	14100.42	499.95	591.37	Ground Shots
1003	14200.21	400.84	591.46	Ground Shots
1004	14200.15	500.40	591.44	Ground Shots
1005	14200.25	600.17	591.32	Ground Shots
1006	14200.13	700.48	591.37	Ground Shots
1007	14199.96	800.12	591.37	Ground Shots
1008	14300.07	400.22	591.35	Ground Shots
1009	14300.09	500.03	591.42	Ground Shots
1010	14300.35	600.26	591.38	Ground Shots
1011	14300.50	700.16	591.28	Ground Shots
1012	14300.38	800.52	591.29	Ground Shots
1013	14399.88	800.35	591.12	Ground Shots
1014	14399.44	700.01	591.11	Ground Shots
1015	14400.08	600.86	591.27	Ground Shots
1016	14400.18	499.76	591.34	Ground Shots
1017	14400.45	400.29	591.27	Ground Shots
1018	14400.69	300.41	591.32	Ground Shots

EMERGENCY SPILLWAY - RIPRAP

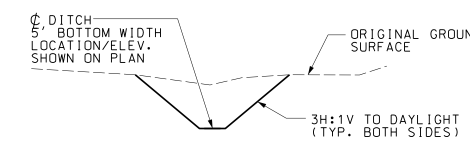
MSI Point #	Northing	Easting	Elevation	Description
1769	14422.17	982.40	611.29	Rip Rap on East Side of Recycle Pond
1770	14427.02	984.59	610.52	Rip Rap on East Side of Recycle Pond
1771	14430.36	989.83	608.88	Rip Rap on East Side of Recycle Pond
1772	14432.03	1015.20	608.36	Rip Rap on East Side of Recycle Pond
1773	14431.18	1047.41	608.55	Rip Rap on East Side of Recycle Pond
1774	14427.45	1052.72	608.16	Rip Rap on East Side of Recycle Pond
1775	14421.32	1053.51	607.31	Rip Rap on East Side of Recycle Pond
1776	14400.73	1055.20	606.84	Rip Rap on East Side of Recycle Pond
1777	14386.92	1054.20	606.77	Rip Rap on East Side of Recycle Pond
1778	14366.37	1055.03	606.98	Rip Rap on East Side of Recycle Pond
1779	14360.65	1053.26	607.40	Rip Rap on East Side of Recycle Pond
1780	14358.63	1048.06	607.50	Rip Rap on East Side of Recycle Pond
1781	14360.07	1026.13	607.58	Rip Rap on East Side of Recycle Pond
1782	14359.65	994.67	608.39	Rip Rap on East Side of Recycle Pond
1783	14362.37	986.72	610.02	Rip Rap on East Side of Recycle Pond
1784	14368.38	984.63	612.05	Rip Rap on East Side of Recycle Pond
1785	14380.99	986.87	612.84	Rip Rap on East Side of Recycle Pond
1786	14399.60	985.15	612.35	Rip Rap on East Side of Recycle Pond
1787	14414.24	983.51	612.03	Rip Rap on East Side of Recycle Pond
1788	14415.94	998.53	606.13	Rip Rap on East Side of Recycle Pond
1789	14418.24	1005.29	605.26	6 Rip Rap on East Side of Recycle Pond
1790	14421.06	1035.21	605.87	7 Rip Rap on East Side of Recycle Pond
1791	14393.50	1039.36	606.01	1 Rip Rap on East Side of Recycle Pond
1792	14368.46	1041.52	606.00	0 Rip Rap on East Side of Recycle Pond
1793	14366.03	1037.17	605.85	5 Rip Rap on East Side of Recycle Pond
1794	14369.22	1003.98	605.60	0 Rip Rap on East Side of Recycle Pond
1795	14374.94	1000.64	605.47	7 Rip Rap on East Side of Recycle Pond
1796	14395.68	998.82	605.60	Rip Rap on East Side of Recycle Pond
1797	14410.95	998.37	605.75	Rip Rap on East Side of Recycle Pond

EMERGENCY SPILLWAY - DISCHARGE PIPES

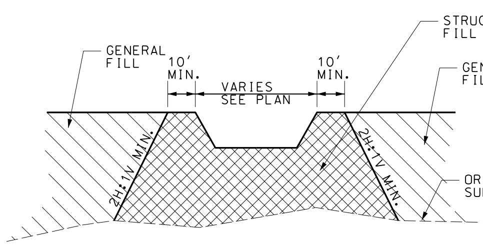
MSI Point #	Northing	Easting	Elevation	Description
1056	14407.33	930.65	610.05	Large Culvert West Invert
1057	14399.12	930.60	609.96	Large Culvert West Invert
1058	14391.27	930.45	610.09	Large Culvert West Invert
1059	14383.18	930.22	609.94	Large Culvert West Invert
1340	14407.51	996.09	610.68	Top of Pipe: East end of Culvert
1341	14399.43	996.06	610.64	Top of Pipe: East end of Culvert
1342	14391.41	995.97	610.72	Top of Pipe: East end of Culvert
1343	14383.60	995.95	610.73	Top of Pipe: East end of Culvert



1/15 SECTION THROUGH FILL AREA
NTS



2/15 SECTION THROUGH DITCH
NTS



3/15 SECTION THROUGH FILL AREA
NTS

STANDARD LEGEND

(ALL SYMBOLS MAY NOT BE USED ON EACH PLAN)

- 650 — ORIGINAL CONTOURS
- X—X—X—X — FENCELINE
- TRANSMISSION TOWER
- —E—E— OVERHEAD ELECTRIC
- LIMITS OF VEGETATION
- GRAVEL ROAD
- RAILROAD
- STORM SEWER
- CONTROL POINT
- 650 — NEW CONTOURS
- LD/LCRS COLLECTION PIPE
- GEONET
- MW-53L — MONITORING WELL
- B-55 — BORING
- G69L — FUTURE GROUNDWATER MONITORING WELL
- 4" DIA. PERFORATED DRAINAGE PIPING
- 6" DIA. OUTFALL PIPING
- +1001 — POINT SURVEYED BY MAUERER-STUTZ, INC.

GRADING TABLE

POINT NUMBER	DESCRIPTION	NORTHING	EASTING	ELEVATION OR INVERT
1	DITCH TOP OF BANK	14,541.49	973.94	614.00
2	CENTERLINE OF DITCH	14,566.49	975.25	612.00
3	DITCH TOP OF BANK	14,591.49	976.56	617.00
4	DITCH TOP OF BANK	14,541.55	808.45	615.00
5	CENTERLINE OF DITCH	14,566.54	828.46	613.00
6	DITCH TOP OF BANK	14,591.55	808.47	617.00
7	PWTC TOP OF BANK	14,521.55	798.85	615.00
8	PWTC TOP OF BANK	14,685.65	790.09	620.00
9	PWTC BOTTOM	14,500.57	780.02	609.00
10	PWTC BOTTOM	14,673.64	770.09	614.00
11	PWTC BOTTOM	14,712.97	770.10	614.00
12	PWTC BOTTOM	14,500.57	744.02	609.00
13	PWTC BOTTOM	14,673.64	754.09	614.00
14	PWTC BOTTOM	14,712.96	754.10	614.00
15	PWTC TOP OF BANK	14,521.58	725.21	615.00
16	PWTC TOP OF BANK	14,685.63	734.09	620.00
17	DITCH TOP OF BANK	14,541.59	715.67	615.00
18	DITCH TOP OF BANK	14,591.59	715.69	617.00
19	CENTERLINE OF DITCH	14,566.59	695.68	614.00
20	CENTERLINE OF DITCH	14,566.78	193.68	609.00
21	CENTERLINE OF DITCH	14,610.57	164.41	610.00
22	DITCH TOP OF BANK	14,591.78	207.04	614.00
23	DITCH TOP OF BANK	14,665.51	157.75	620.00
24	CENTERLINE OF CULVERT	14,564.00	189.52	609.00
25	CENTERLINE OF DITCH/CULVERT	14,536.22	147.95	608.90
26	CENTERLINE OF DITCH/CULVERT	14,536.22	51.05	602.50
27	CENTERLINE OF CULVERT	14,536.22	1.05	602.30

NOTE: PWTC = PROCESS WATER TRANSFER CHANNEL

NOTES:

1. CONTOURS SHOWN IN RECYCLE POND REPRESENT TOP OF LINER.
2. THE PROPERTY IS LOCATED IN SECTION 18, TOWNSHIP 6 NORTH, RANGE 5 EAST, 4TH P.M., FULTON COUNTY, ILLINOIS.

AEG CAD GENERATED
DO NOT REVISE MANUALLY

Brans00939
09\29\2009
I:\03Jobs\03S5010\Gypsum Stack\CADD\Sheets\C180-C102-15.dgn

DRAWING RECORD

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
0	02-22-08	SKB	SMB	SMB	ISSUED FOR BIDDING - NOT FOR CONSTRUCTION
1	03-05-08	SKB	SMB	SMB	ADDED SLURRY PIPIING - ISSUED FOR BIDDING - NOT FOR CONSTRUCTION
2	04-11-08	SKB	SMB	SMB	ISSUED FOR CONSTRUCTION
3	09-29-08	DBH	SMB	SMB	REVISED COORDINATES FOR PROCESS WATER CONTROL STRUCTURE
4	12-19-08	TCJ			REVISED CHIMNEY DRAIN
5	03-05-09	SKB	JMM	-	ISSUED FOR RECORD DRAWING BY HANSON

LAYOUT	SMB	05/08/07
DRAWN	SKB	04-16-09
REVIEWED		

30x42

RECORD DRAWING

FILE NO. -C180-C102-15.dgn

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Springfield, Illinois 62703-2886
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Illinois Licensed Professional Service Corporation #184-001084
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SCALE -
DRAFTER -
DATE 03-26-09

DRAWING TITLE

RECYCLE POND PLAN

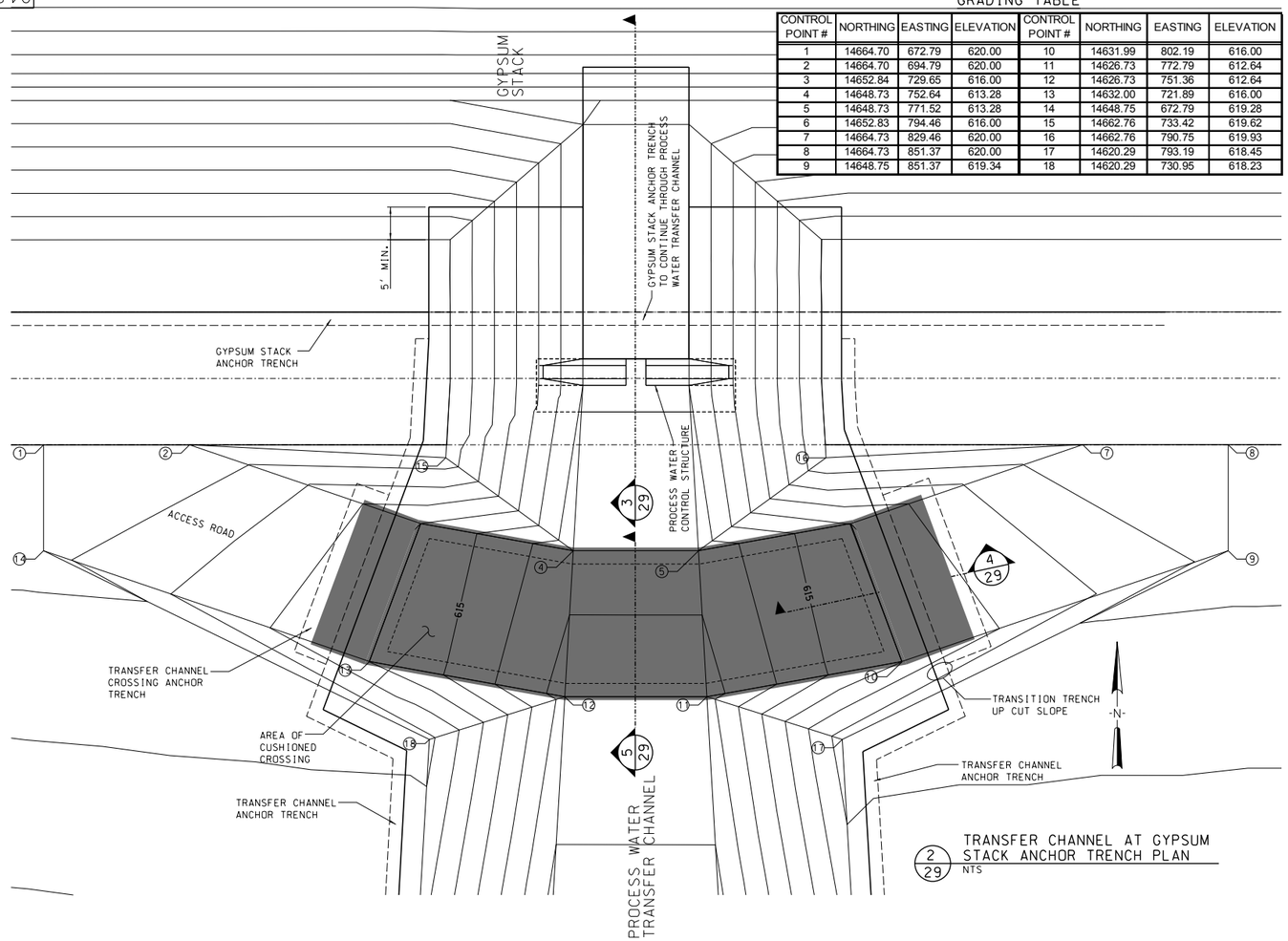
GYPSUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS
DUCK CREEK POWER STATION UNIT NO. -

Ameren Energy Resources Generating

DRAWING NUMBER: C180-C102 | REV. 5

GRADING TABLE

CONTROL POINT #	NORTHING	EASTING	ELEVATION	CONTROL POINT #	NORTHING	EASTING	ELEVATION
1	14664.70	672.79	620.00	10	14631.99	802.19	616.00
2	14664.70	694.79	620.00	11	14626.73	772.79	612.64
3	14652.84	729.65	616.00	12	14626.73	751.36	612.64
4	14648.73	752.64	613.28	13	14632.00	721.89	616.00
5	14648.73	771.52	613.28	14	14648.75	672.79	619.28
6	14652.83	794.46	616.00	15	14662.76	733.42	619.62
7	14664.73	829.46	620.00	16	14662.76	790.75	619.93
8	14664.73	851.37	620.00	17	14620.29	793.19	618.45
9	14648.75	851.37	619.34	18	14620.29	730.95	618.23

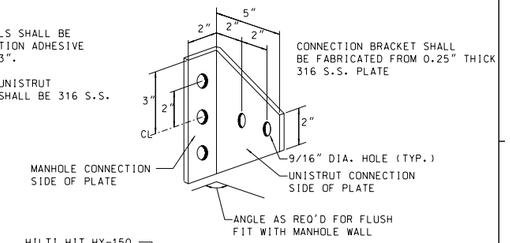


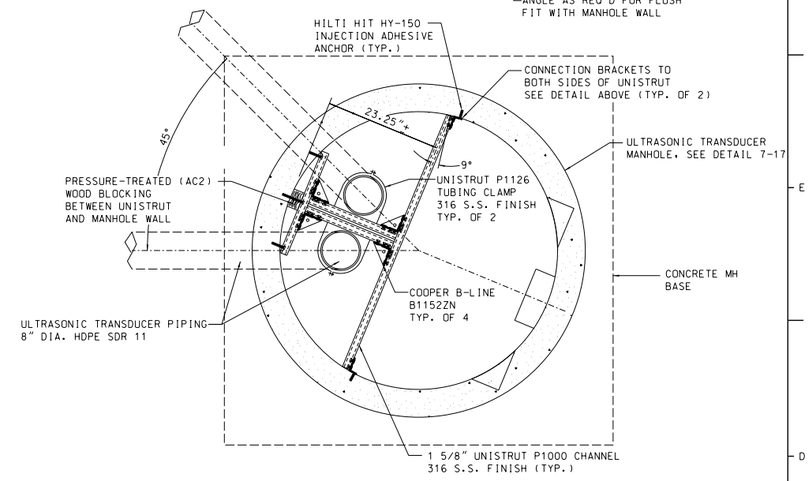
2/29 TRANSFER CHANNEL AT GYPSUM STACK ANCHOR TRENCH PLAN
NTS

NOTE:

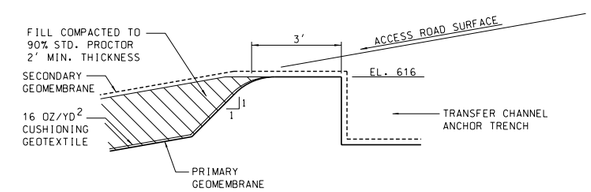
ALL ANCHORS IN MANHOLE WALLS SHALL BE HILTI HIT HY-150 MAX INJECTION ADHESIVE ANCHORS SET TO A DEPTH OF 3".

ALL FASTENER HARDWARE AND UNISTRUT CHANNEL NUTS (PART P1010) SHALL BE 316 S.S. WITH 1/2"x13 BOLT SIZE

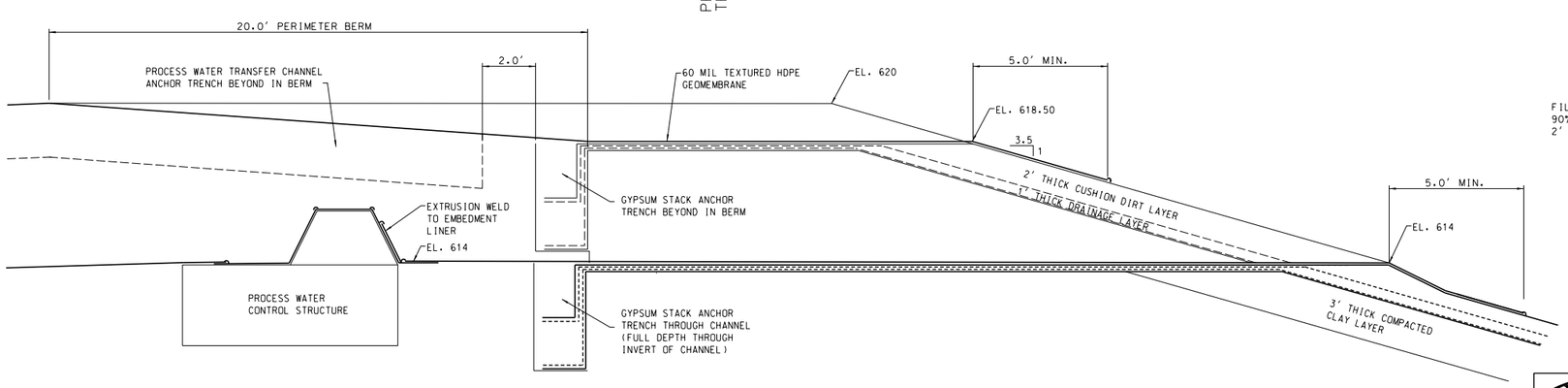




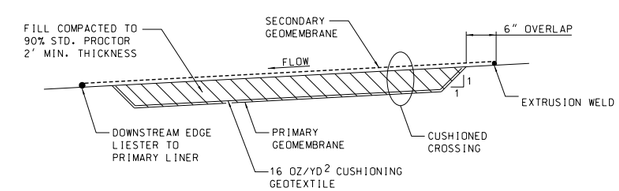
1/29 ULTRASONIC TRANSDUCER PIPE SUPPORT DETAIL
1"=1'



4/29 ACCESS ROAD AT TRANSFER CHANNEL TRENCH
NTS



3/29 TRANSFER CHANNEL AT GYPSUM STACK ANCHOR TRENCH SECTION
NTS



5/29 ACCESS ROAD THRU PROCESS WATER TRANSFER CHANNEL TRENCH
NTS

AEG CAD GENERATED
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DRAWING RECORD

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0	11-07-08	TCJ	DBH	SMB	ISSUED FOR CONSTRUCTION
1	01-08-09	TCJ	DBH	DBH	ADDED ACCESS ROAD CROSSING AND DETAILS
2	03-05-09	SKB	JMM	-	ISSUED FOR RECORD DRAWING

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
-					-

LAYOUT	TCJ	10-31-08
DRAWN	SKB	04-28-09
REVIEWED	-	- / - / -

30x42

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SCALE -
DRAFTER -
DATE 03-26-09

AWING
FILE NO. -C180-C102-29.dgn

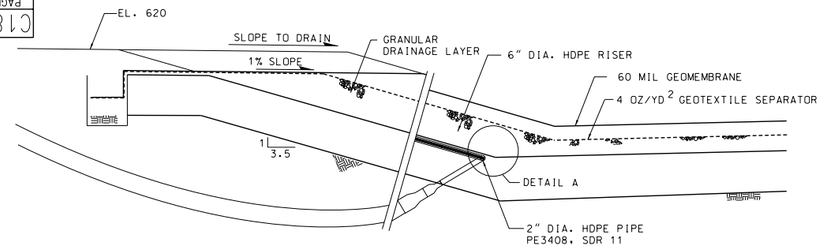
DRAWING TITLE
MISCELLANEOUS DETAILS

GYPSUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS
DUCK CREEK POWER STATION UNIT NO. -

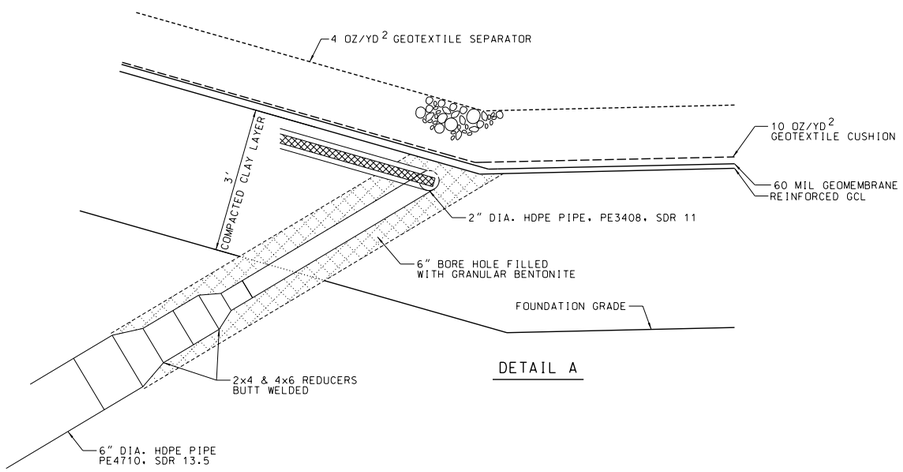
Ameren Energy. Resources Generating

DRAWING NUMBER C180-C102 REV. 2
SHEET NO. 29 OF 33

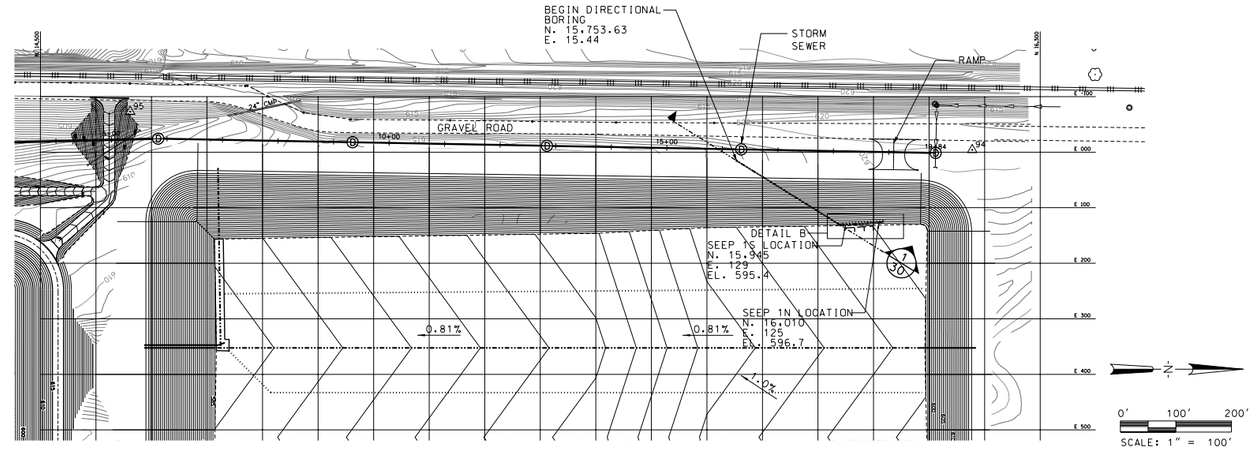
Brand09039
09PW50039
N:\Sjobs\03-3500\Gypsum Stack\CADD\Sheets\C180-C102-29.dgn

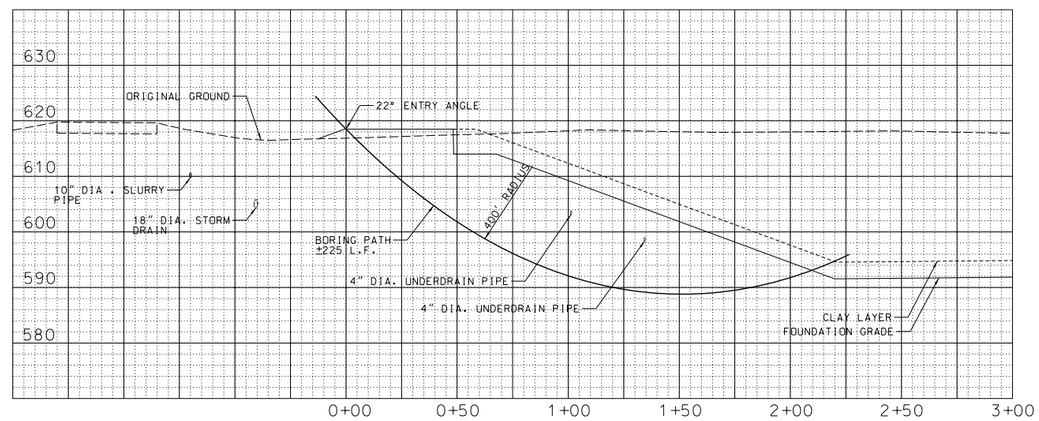


1/30 RISER DETAIL
SCALE: NTS



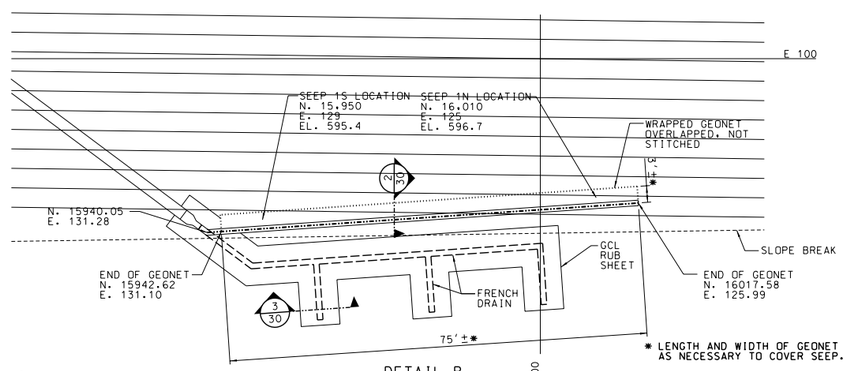
DETAIL A



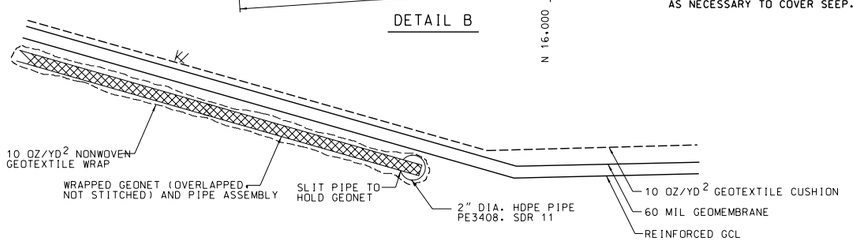


BORING PROFILE

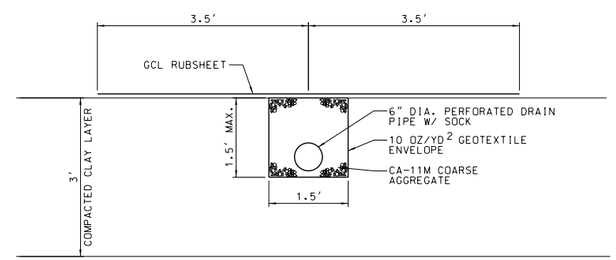
STATION	CLAY LAYER ELEVATION	BORING PATH ELEVATION
0+00	618.50	618.50
0+10	618.50	614.57
0+20	618.50	610.94
0+30	618.50	607.62
0+40	618.50	604.58
0+50	618.50	601.82
0+60	618.26	599.34
0+70	616.79	597.14
0+80	615.31	595.19
0+90	613.84	593.51
1+00	612.36	592.09
1+10	610.89	590.93
1+20	609.41	590.02
1+30	607.94	589.36
1+40	606.46	588.95
1+50	604.98	588.80
1+60	603.51	588.89
1+70	602.03	589.23
1+80	600.56	589.83
1+90	599.08	590.67
2+00	597.61	591.77
2+10	596.13	593.13
2+20	594.66	594.74



DETAIL B



2/30 GEONET DETAIL
SCALE: NTS



3/30 FRENCH DRAIN DETAIL
SCALE: NTS

NOTE:
SEE OTHER PLAN SHEETS FOR STANDARD LEGEND.

RECORD DRAWING

FILE NO. -C180-C102-30_SEEP1.dgn

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DRAWING TITLE
LD/LCRS UNDERDRAIN DEWATERING SYSTEM-SEEP 1
GYPSUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS
DUCK CREEK POWER STATION UNIT NO. -

Ameren Energy. Resources Generating

DRAWING NUMBER	REV.
C180-C102	2

SHEET NO. 30 OF 33

SCALE
DRAFTER
DATE 03-26-09

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DRAWING RECORD

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
0	11-07-08	TCJ	RWH	DBH	ISSUED FOR CONSTRUCTION
1	11-14-08	TCJ			REVISED BORING PATH AND ENTRY POINT - ISSUED FOR CONSTRUCTION
2	03-05-09	SKB	JMM		ISSUED FOR RECORD DRAWING BY HANSON

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
–	–	–	–	–	

LAYOUT	TCJ	11-03-08
DRAWN	SKB	04-28-09
REVIEWED	DBH	11-05-08

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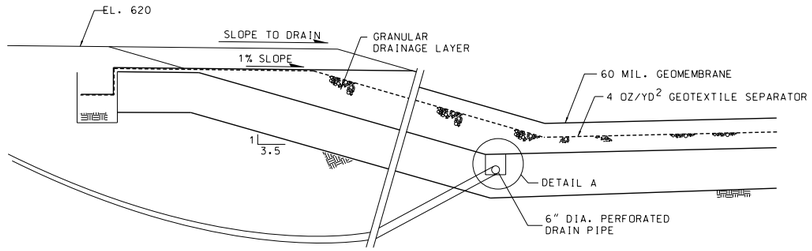
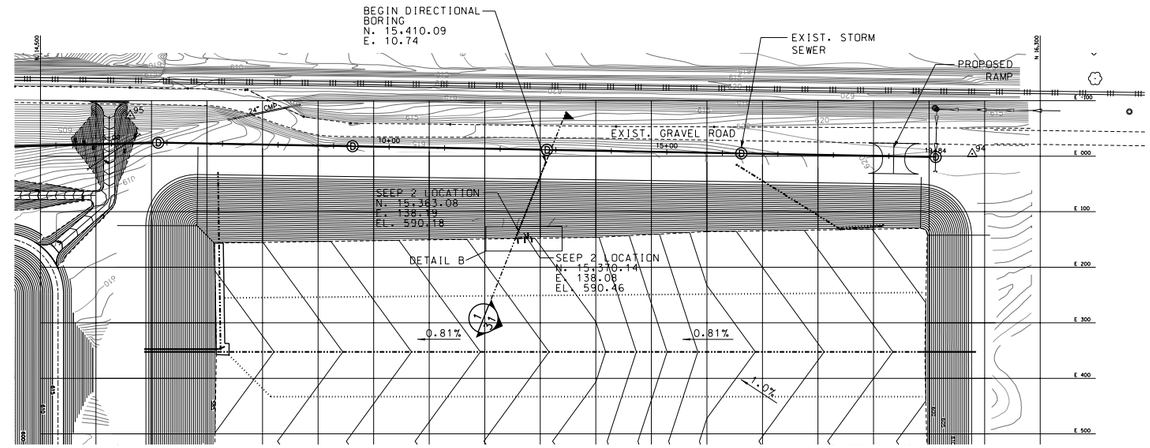
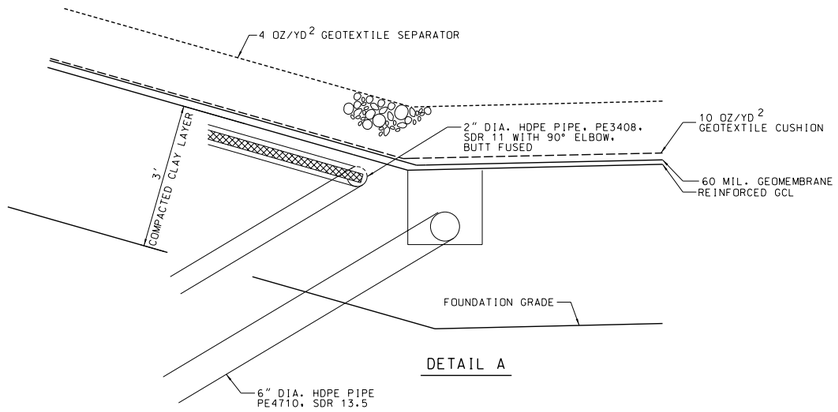
\\O3Jobs\O35500\Gypsum Stock\CADD\Sheets\C180-C102-30_SEEP1.dgn

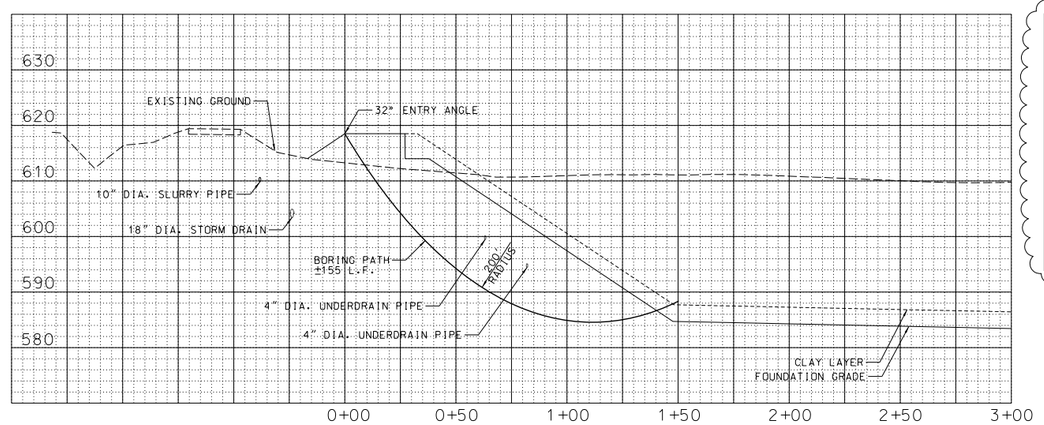


1/31 RISER DETAIL
SCALE: NTS





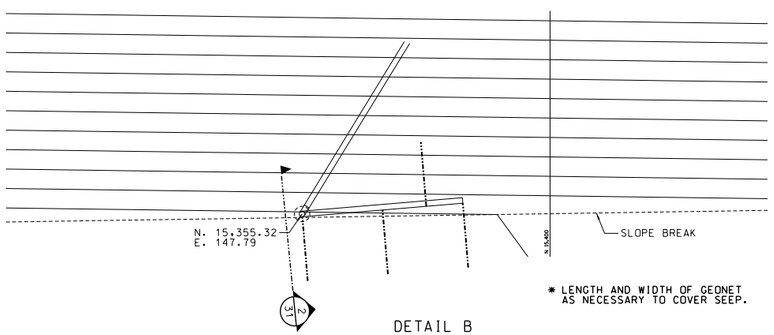
DETAIL A



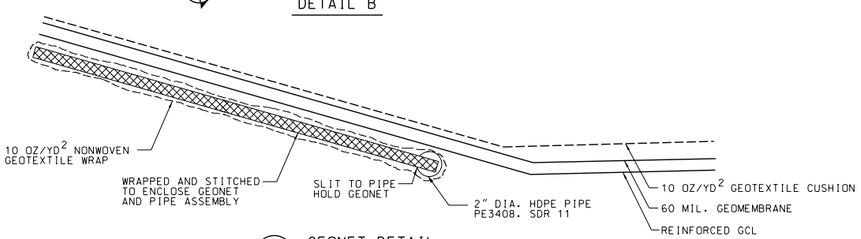
BORING PROFILE

1

STATION	CLAY LAYER ELEVATION	BORING PATH ELEVATION
0+00	618.50	618.50
0+10	618.50	612.21
0+20	618.50	606.70
0+30	618.50	601.90
0+40	616.55	597.77
0+50	613.88	594.24
0+60	611.21	591.30
0+70	608.55	588.91
0+80	605.88	587.05
0+90	603.21	585.72
1+00	600.54	584.89
1+10	597.88	584.57
1+20	595.21	584.75
1+30	592.54	585.43
1+40	589.88	586.61



DETAIL B



2/31 GEONET DETAIL
SCALE: NTS

STANDARD LEGEND

(ALL SYMBOLS MAY NOT BE USED ON EACH PLAN)

650	ORIGINAL CONTOURS	650	NEW CONTOURS
x—x—x—x	FENCELINE		LD/LCRS COLLECTION PIPE
	TRANSMISSION TOWER		GEONET
	OVERHEAD ELECTRIC	MW-53L	MONITORING WELL
	LIMITS OF VEGETATION	B-55	BORING
	GRAVEL ROAD	G69L	FUTURE GROUNDWATER MONITORING WELL
	RAILROAD		4" DIA. PERFORATED DRAINAGE PIPING
	STORM SEWER		6" DIA. OUTFALL PIPING
	CONTROL POINT		

N

0' 100' 200'
SCALE: 1" = 100'

RECORD DRAWING

FILE NO. -C180-C102-31_SEEP2.dgn

AEG CAD GENERATED
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DRAWING RECORD

REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION	REV.	DATE	PREPARED	REVIEWED	APPROVED	DESCRIPTION
0	11-19-08	TCJ	---	---	ISSUED FOR CONSTRUCTION	-	-	-	-	-	-
1	11-24-08	TCJ	RWH	DBH	ISSUED FOR CONSTRUCTION REVISED PENETRATION LOCATION						
2	03-05-09	TCJ	JMM	-	ISSUED FOR RECORD DRAWING BY HANSON						

LAYOUT	TCJ	11-03-08
DRAWN	TCJ	11-19-08
REVIEWED	DBH	-----

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SCALE -
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DATE 03-26-09

DRAWING TITLE

LD/LCRS UNDERDRAIN DEWATERING SYSTEM-SEEP 2

GYPSUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS
DUCK CREEK POWER STATION UNIT NO. -

Ameren Energy. Resources Generating

DRAWING NUMBER C180-C102 REV. 2
SHEET NO. 31 OF 33

30x42

Brandon0939
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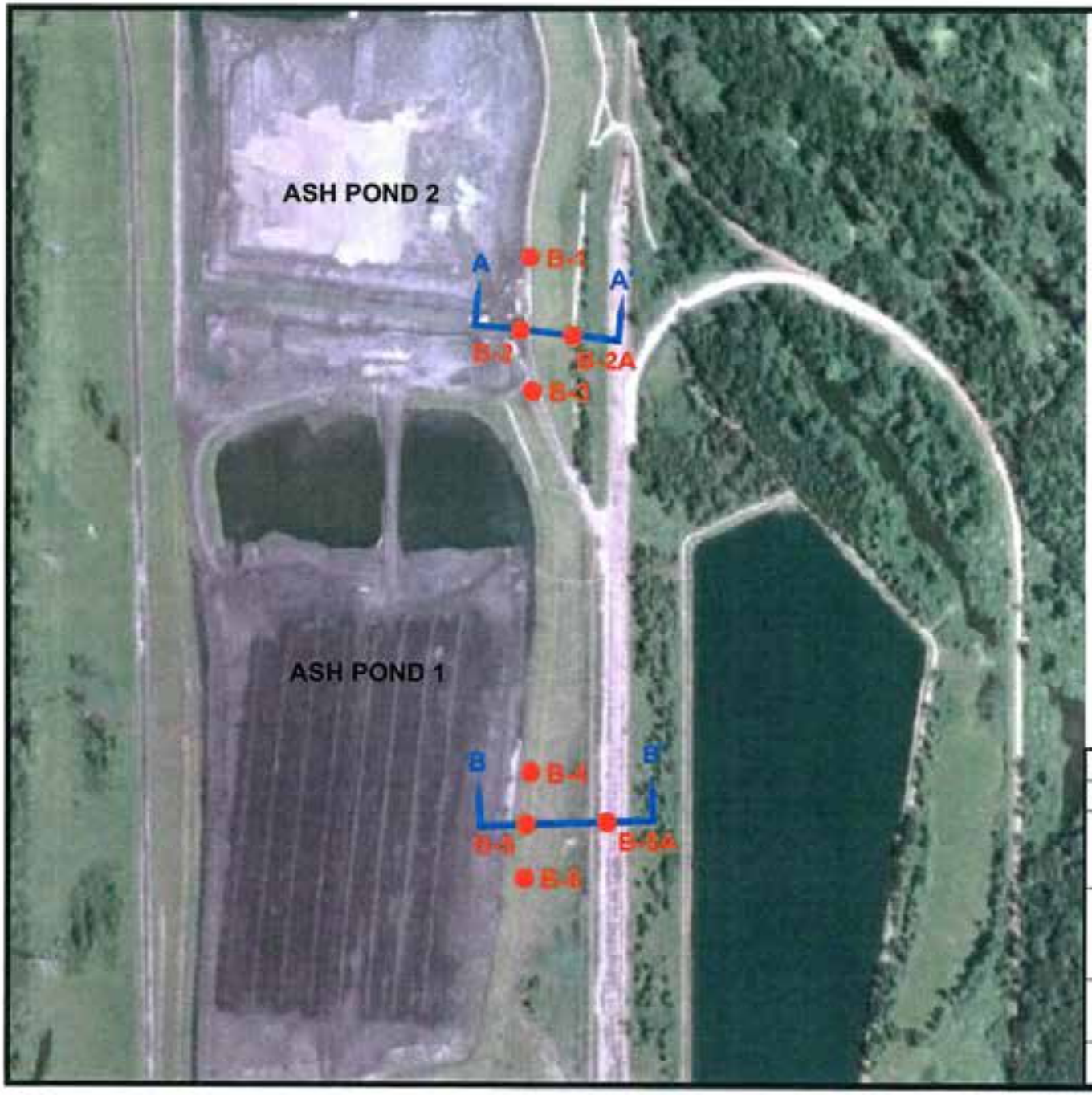
Appendix C: Duck Creek Power Station Boring and Piezometer Locations



NOTES

1. Plan adapted from an aerial photograph courtesy of Google Earth.

LEGEND

Boring Location

Slope Stablity Cross Section

N

0 500 1000

APPROXIMATE SCALE IN FEET

Drawn By: SLC	Ck'd By: S-C	App'vd By: DAN
Date: 11-03-10	Date: 12/14/10	Date: 1/4/11

GEOTECHNOLOGY INC
FROM THE GROUND UP

Duck Creek Power Station
Canton, Illinois

AERIAL PHOTOGRAPH OF SITE AND BORING LOCATIONS

Project Number
J017150.01

PLATE 2

Figure C.1. Piezometer locations for Ash Pond No. 1 and Ash Pond No. 2.

Appendix D: Project Manual; Specification No's.: C180-C102 (excerpt)

PROJECT MANUAL
GYPSUM STACK AND RECYCLE POND AND CCB LANDFILL CONSTRUCTION
GYPSUM MANAGEMENT FACILITY AND CCB LANDFILL
DUCK CREEK POWER STATION
FULTON COUNTY, ILLINOIS

SPECIFICATION NO'S.: C180-C102

Prepared For:

AMEREN ENERGY RESOURCES GENERATING COMPANY

Prepared By:

HANSON PROFESSIONAL SERVICES INC.
1525 South Sixth Street
Springfield, Illinois 62703

Specifications for Construction

April 11, 2008

BIDDING CLARIFICATIONS FOR AMEREN CONTRACT DOCUMENTS
AMEREN ENERGY RESOURCES GENERATING COMPANY
GYPSUM MANAGEMENT FACILITY AND CCB LANDFILL
PROJECT SPECIFICATIONS NO. C180-C102
ADDENDUM #2

Prepared March 24, 2008
By Hanson Professional Services, Inc.
Preparer: DBH

Hanson Professional Services is please to provide the following clarifications to outstanding questions regarding the contract documents:

1) *Please clarify again Bid Form page BF-A-5 the 146,740 cy is the amount excavated and stockpiled. In addition in that price we include 146,740 cy going back in place?*

   Answer: The Estimated Quantity of 146,740 C.Y. shown on Bid Forms A and B is our estimated TOTAL excavation needed for the Over-excavation of Soil and Sand from NE & SW Corners of Gypsum Stack Area. The excavation shall be backfilled with suitable structural backfill after the unsuitable sand lens material has been removed and stockpiled. Our estimate for unsuitable sand material is the 17,600 C.Y. shown in the same section of the Bid Forms.

2) *What is the status of design on slurry piping plan and details? Currently sheet C102-27 does not provide sufficient information.*

   Answer: An updated sheet will be issued with Addendum #2.

3) *Per sheet C102-05, "All under drain pipes installed under the excavation contract C180-C101 shall remain in place. Subsurface drainage piping shall be sealed with bentonite slurry in accordance with project specifications upon completion of the liner system". Please provide specifications.*

   Answer: Sealing of the subsurface drainage system is specified in Section 02141 - Surface Water Management, paragraph 3.06.

4) *Is dwg. format available with Landfill, Gypsum and Recycle Pond area merged to one drawing. We specifically need existing and proposed contours for both projects consolidated as one design and existing layer. The tins provided are for the Gypsum Pond only, would appreciate fill for Landfill if drawings can not be merged. Will Hanson be able to provide design contours for cushion dirt layer? Currently available drawings provide points only from sheet C102-11.*

   Answer: We will be issuing updated tin & dwg files for the Gypsum Stack Recycle Pond that reflects the work completed under Contract C180-C101 with Addendum #2. Tin & DWG files for the CCB Landfill will be issued later in the week, as it is currently being surveyed and verified.

5) *The granular materials for the drainage layer and seperation berm shall provide a minimum hydraulic conductivity (ASTM D2434) of 1 X 10-3. Is there a specific material anticipated for the completion of this work?*

   Answer: The granular materials required for the drainage layer and separation berm are adequately specified in the Project Specifications. The Contractor shall be responsible for determining availability and sourcing for these materials.

6) *Is a construction joint allowed in the Process Water Control Structure.*

Answer: A Bonded Construction Joint will be allowed for this structure, provided that it is constructed in accordance with article 503.09 of the Illinois Department of Transportation "Standard Specifications for Road and Bridge Construction" Adopted January 1. 2007.

7) *What if anything is required on the low water crossing on sheet 16 of the CCB Landfill?*

Answer: No special materials are required in this area, the invert of the existing spillway channel shall be maintained and crossed by the proposed haul road.

8) *Is the Coarse Aggregate for the Leachate collection pipe also the IDOT CA-7 Per Article 1004.1 of IDOT Specs.*

Answer: The Coarse Aggregate for the Leachate Collection Pipe shall be a gradation as required to provide a minimum hydraulic conductivity (ASTM D2434) of 1×10^{-3} cm/sec. We will issue a correction to the specifications with Addendum #2.

9) *Detail 7/17 for the Ultrasonic Transducer from your web site is different than your handout at the pre-bid meeting is the web site detail the one we are to provide?*

Answer: The latest detail on the web site is the latest one, however a revision to that detail will be issued with Addendum #2.

10) *Bid Form page A-3 Riprap Class B4, the unit of measure is LF, should that be TONS or S.Y.?*

Answer: The correct unit should be S.Y.

11) *In an effort to utilize local aggregate sources, can we use "Special Provision Rock" as specified by IDOT for Contracts 68206 & 68205 for the aggregate base and surface course?*

Answer: All aggregates shall be supplied as specified in Section 02315 Granular Materials.

12) *Can we substitute a butt fusion reducer in lieu of the 50% welded extrusion joints" as shown in detail 5/13?*

Answer: A butt fusion reducer would be acceptable in that location (Detail 5/13 - Plans C180-C102)

13) *Page 27, slurry piping- Is this the sluice piping from section 2640? There is no size listed on the plans. The plan shows dashed and solid lines, what do they represent. Section 2640 calls for valves in the sluice piping, are these the valves shown on sheet 27?*

Answer: A revised sheet C180-102-27 and a new sheet C180-102-28 are included in Addendum #2.

14) *The specs say all underdrain within lined areas of cell is to be grouted. Is the recycle pond lined?*

Answer: The subdrainage outfall piping beneath the recycle pond is to be grouted.

15) *We are trying to figure out what gradation of rock is required for detail 6/14 on the gypsum stack and also for detail 1/12 and 2/12 on the CCB Landfill. Section 2315 Part 2 does not have the gradation language we are used to looking at for the CCB Landfill Course Aggregate.*

Answer: The Coarse Aggregate material called out in these details is the same as is specified in Section 02315 - Part 2.01-B-2 for CCB Landfill Coarse Aggregate. A revised specification will be included in this Addendum.

BIDDING CLARIFICATIONS FOR AMEREN CONTRACT DOCUMENTS
AMEREN ENERGY RESOURCES GENERATING COMPANY
GYPSUM MANAGEMENT FACILITY AND CCB LANDFILL
PROJECT SPECIFICATIONS NO. C180-C102

ADDENDUM #3

Prepared March 27, 2008
By Hanson Professional Services, Inc.
Preparer: DBH

Hanson Professional Services is pleased to provide the following clarifications to outstanding questions regarding the contract documents:

Question: One GCL manufacturer produces a double nonwoven, needlepunch reinforced geosynthetic clay liner that will meet or exceed the project requirements and the GRI-GCL-3 specification, with only two clarifications:

Footnote #2 in Table 1 of the GRI-GCL-3 specification states that for nonwoven reinforced GCLs, one of the Geotextiles must contain a scrim component of mass > 2.9 oz/yd2 for dimensional stability. An exception to the scrim reinforcement requirement has been requested.

Table 1 of the GRI-GCL-3 specification states that nonwoven reinforced GCLs should be manufactured with minimum 5.9 and 5.8 oz/yd2 Geotextiles. Our product is manufactured with minimum 6.0 and 2.7 oz/yd2 nonwoven Geotextiles and it will still meet the peel and tensile strength requirements in the specifications. Accordingly, an exception to the minimum geotextile weights has been requested.

Answer: *We will allow these exceptions, provided that all of the other requirements of the specifications are met by the GCL being submitted for bid.*

Question: Aggregate suppliers cannot perform the testing required to qualify that their materials will meet the project specifications in the time allotted for bidding. What can the aggregate suppliers do to provide a reasonable quote for the aggregate materials within the Gypsum Stack and CCB Landfill footprints.

Answer: Adequate bidding time was allotted for relatively quick permeability and gradation testing, and these test results should be available. However, based on the time allotted for bidding and the turn-around time needed to complete the longer tests necessary to certify project specification compliance, we will allow aggregate suppliers to certify a unit price for these materials based on the contingency that they will meet the following required specifications:

ASTM D3042-03 Standard Test Method for Insoluble Residue in Carbonate Aggregates (15% loss Max.)

Na_2SO_4 Soundness 5 Cycle, Illinois Modified AASHTO T 104 (15% Loss Max.)
ASTM C 1260 Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method) (Less than 0.10% internal expansions at 16 days after casting)

Additional question related to the overexcavation and replacement of materials in the NE and SW corners of the gypsum stack area:
Please clarify "The excavation shall be backfilled with suitable structural backfill". How and where will that backfill be paid for?

Answer: Please note that the bid form section for additional items to be paid on a unit cost or time and material basis provides estimated quantities only. The bid form allows for separate pricing for unsuitable sand soils that will need to be excavated from the NE and SW corners of the gypsum stack areas and transported to stockpiles (estimated at 17,600 cy) and for excavation and recompaction of soil material suitable for reuse (estimated at 146,740 cy). Based on these ESTIMATED volumes, the total ESTIMATED volume to be over-excavated from the NE and SW corners of the gypsum stack excavation is 164,340 cy (17,600 cy of which is estimated to be unsuitable sand that needs to be transported out of the excavation and stockpiled). Note again that we will be removing an unknown amount of sand from the excavation. Shrinkage as a result of the compaction process may also be a factor. Any shortage of suitable backfill shall be obtained from the subsoil stockpiles. Backfilling the excavation with Structural Fill to be obtained from stockpiles will be paid for at Time and Material or by the unit cost included on the bid form for "Backfill w/Structural Fill from Stockpile."

Question: Can the test pad for the clay liner be constructed outside the footprint of the cell?

Answer: The test soil liner must be constructed within the footprint of the cell.

What end treatment is to be applied to the upstream ends of the 6" and 12" perforated laterals shown on Sheet C180-C110-09 and detailed on sheet C180-C110-12 for the CCB Landfill?

Answer: Cleanouts with threaded caps shall be installed at the termination points for the 6" and 12" perforated laterals. Revised drawing #C180-C110-09 is attached indicating this detail.

Question: The new details for vaults on the slurry lines show 8" RFP being bolted into 8" Valves, then a 10" HDPE pipes. The bolt patterns on the 10" pipe and 8" valve are not compatible. Please clarify.

Answer: An FRP spindle needs to be provided to go from the 8" valve to the 10" HDPE pipe. Revised drawing #C180-C102-28 is attached to show this configuration.

FINAL NOTE: THE BIDS ARE DUE MONDAY, 3/31/08. NO MORE QUESTIONS WILL BE ACCEPTED PRIOR TO BIDDING. PLEASE INCLUDE ANY ADDITIONAL ASSUMPTIONS AND CLARIFICATIONS WITH YOUR BIDS.

GYPSUM STACK AND RECYCLE POND AND CCB LANDFILL CONSTRUCTION
GYPSUM MANAGEMENT FACILITY AND CCB LANDFILL
DUCK CREEK POWER STATION
FULTON COUNTY, ILLINOIS

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02200 - Earthwork	02200-1 to 02200-13
02275 - Riprap	02275-1 to 02275-2
02315 - Granular Drainage Materials	02315-1 to 02315-9
02373 - Geotextiles	02373-1 to 02373-8
02376 - Geosynthetic Clay Liner	02376-1 to 02376-8
Attachment 1 – GRI-GCL3 Specification	End of Section
02640 - HDPE Piping	02640-1 to 02640-4
02700 – Storm Drainage	02700-1 to 02700-2

02800 - HDPE Geomembrane	02800-1 to 02800-15
Attachment 1 – GRI-GM13 Specification	End of Section
02936 – Topsoil Seeding and Mulching	02936-1 to 02936-3
03100 - Concrete Formwork	03100-1 to 03100-5
03200 – Concrete Reinforcement	03200-1 to 03200-3
03300 – Cast-In-Place Concrete	03300-1 to 03300-6
03400 – Concrete Embedment Liner	03400-1 to 03400-4

Appendix 1 – Field Change Order Process

Appendix 2 – Construction Quality Assurance (CQA) Plan

Appendix 3 – Geotechnical Data

~~Appendix 4 – Construction Field Office~~

PART 1. GENERAL

1.0 INTRODUCTION

A. Gypsum Management Facility

The intent of this contract is to provide the services of a General Contractor to construct Gypsum Management Facility, consisting of a lined Gypsum Stack and Recycle Pond for the disposal of gypsum at Ameren Energy Resources Generating Company (AERG) Duck Creek Power Station's Gypsum Management Facility located near Canton, Illinois.

Excavation to approximately 5.4 ft. above foundation grade, partial construction of Recycle Pond perimeter berm, installation of a temporary stormwater outlet ditch, a temporary subsurface drainage system and the Recycle Pond pump station pad with access road were completed under a prior contract as outlined in the plans. Excavated material was stockpiled north and east of the excavation for use in this contract.

B. CCB Landfill

The intent of this contract is to provide the services of a General Contractor to construct a CCB Landfill, consisting a base 3 ft. thick Compacted Clay Liner, Geosynthetic Clay Liner (GCL), High Density Polyethylene (HDPE) Geomembrane, Geotextile Cushion Fabric and Leachate Collection System for the permanent disposal of coal combustion by-products (CCB) at the Ameren Energy Resources Generating Company (AERG) Duck Creek Power Station CCB Landfill located near Canton, Illinois.

Excavation to approximately 6 in. above foundation grade, construction of perimeter berm, installation of a permanent berm ditch outlet structure and a temporary subsurface drainage system were completed under prior contract. Excavated material was visually segregated during excavation and stockpiled east of the excavation for use in this contract.

2.0 DESCRIPTION OF WORK

2.01 Gypsum Management Facility

The scope of work shall consist of furnishing all materials, equipment, tools, labor, and incidentals necessary to perform the work as described below:

A. Gypsum Stack - Foundation Preparation

1. Excavate areas indicated on the plans to remove areas of underground sand seams and backfill with structural soil backfill.
2. Locally excavate to the foundation grade as indicated on the plans and finish grade the portion of the cell to be covered by Compacted Clay Liner.
3. Proof roll to identify unsuitable foundation soil materials.
4. As directed by the Owner's Representative, Excavate and replace unsuitable foundation materials consisting of unknown pockets of peat, sand, muck or other unsuitable materials with suitable structural backfill. Installation of geotextile fabric for ground stabilization, as deemed necessary by the owner's Representative, will be installed on a time and materials basis.

B. Gypsum Stack - Compacted Clay Liner

1. Construct Test Soil Liner, as outlined Section 5.0 of the project Construction Quality Assurance (CQA) Plan, included in Appendix 2, to demonstrate construction procedures and equipment that will produce the specified permeability.
2. Obtain Foundation Grade Verification by Amerens Field Surveyor prior to constructing areas requiring Compacted Clay Liner, as outlined in Section 6.2.1a of the project Construction Quality Assurance Plan.
3. Install Compacted Clay Liner in accordance with the project specifications using the compactive means demonstrated by the Test Soil Liner.

C. Gypsum Stack - Excavation and Backfill of Anchor Trench

1. Excavate anchor trench.
2. Place initial trench backfill after installation of Geosynthetic Clay Liner (GCL) and High Density Polyethylene (HDPE) Geomembrane by geosynthetic liner Contractor.
3. Complete trench backfill after installation of separation geotextile.

D. Gypsum Stack - Geosynthetic Clay Liner (GCL)

1. The Geosynthetics Installer's Representative shall jointly inspect the surface of the Compacted Clay Liner with the Owner's Representative

before commencing daily work. The Geosynthetics Installer's Representative shall continuously observe the condition of the Compacted Clay Liner during GCL placement and submit a Certificate of Acceptance in the daily report that no GCL was placed over visibly defective Compacted Clay Liner.

2. Furnish and install GCL on accepted Compacted Clay Liner. Provide reinforced GCL on the sideslopes and bottom of Gypsum Stack. Protect GCL per the Manufacturer's recommendations until it is covered by HDPE Geomembrane

E. Gypsum Stack High Density Polyethylene (HDPE) Geomembrane (Lower Layer)

1. The Geosynthetics Installer's Representative shall jointly inspect the GCL with the Owner's Representative: continuously observe the condition of the GCL during HDPE Geomembrane placement; and submit a Certificate of Acceptance in the daily report that no HDPE Geomembrane was placed over visibly defective GCL.
2. Furnish and install HDPE geomemebrane on accepted GCL. Provide textured HDPE liner on the side slopes and bottom of the Gypsum Stack. Protect HDPE liner until it is covered by geotextile cushion fabric.
3. The Geosynthetics Installer shall perform non-destructive seam testing at frequencies specified in Section 6.3.2 of the Construction Quality Assurance Plan. Provide samples for destructive seam testing by the Owner's testing consultant, and repair sampled locations.

F. Gypsum Stack - Geotextile Cushion Fabric

1. The Geosynthetics Installer's Representative shall jointly inspect the HDPE Geomembrane with the Owner's Representative: continuously observe the condition of the HDPE Geomembrane during placement of the geotextile cushion fabric; and submit a Certificate of Acceptance in the daily report that no geotextile fabric was placed over visibly defective HDPE Geomembrane.
2. Furnish and install geotextile cushion on accepted Geomembrane.
3. Furnish and install drainage layer material for ballast.

G. Gypsum Stack - HDPE Leachate Collection Piping

1. Furnish and install geotextile fabric for coarse aggregate envelope.
2. Furnish and install initial lift of coarse agregate.
3. Furnish and install leachate collection piping as shown on the plans.
4. Furnish and install coarse aggregate along the pipe to provide lateral stability.
5. The piping installer shall obtain concurrance with the Owner's Representative that the piping installation meets the intended design

requirements before placing remainder of coarse aggregate and geotextile envelope.

H. Gypsum Stack - Drainage Layer

1. Furnish and install granular material for drainage layer in accordance with the project plans and specifications.
2. Obtain verification by the Owner's Field Surveyor that the minimum required Drainage Layer thickness has been achieved.

I. Gypsum Stack - Separation Fabric

1. The Geosynthetics Installer's Representative shall jointly inspect the Drainage Layer with the Owner's Representative; continuously observing the condition of the surface of the Drainage Layer during placement of the Geotextile Separation Fabric; and submit a Certificate of Acceptance in the daily report that no geotextile fabric was placed over visibly defective Drainage Layer surface.
2. Furnish and install geotextile fabric on accepted Drainage Layer and anchor geotextile fabric in anchor trench.

J. Gypsum Stack - Cushion Dirt

1. Place Cushion Dirt to facilitate installation of the second HDPE Geomembrane. The Contractor shall protect the underlaying Separation Fabric per the project specifications.
2. Obtain verification by the Owner's Field Surveyor that the minimum required Cushion Dirt thickness has been achieved.

K. Gypsum Stack High Density Polyethylene (HDPE) Geomembrane (Upper Layer)

1. The Geosynthetics Installer's Representative shall jointly inspect the surface of the Cushion Dirt with the Owner's Representative before commencing daily work. The Geosynthetics Installer's Representative shall continuously observe the condition of the Cushion Dirt during HDPE Geomembrane placement and submit a Certificate of Acceptance in the daily report that no HDPE Geomembrane was placed over visibly defective Cushion Dirt.
2. Furnish and install HDPE Geomembrane on approved Cushion Dirt. Provide textured HDPE Geomembrane on cell side slopes and bottom of cell. Protect HDPE Geomembrane until it is initially covered by gypsum waste material.
3. The Geosynthetics Installer shall perform non-destructive seam testing at frequencies specified in Section 6.3.2 of the Construction Quality Assurance Plan. Provide samples for destructive seam testing by the Owner's testing consultant, and repair sampled locations.

L. Gypsum Stack - HDPE Process Water Recovery System

1. Furnish and install HDPE Process Water Collection System, as shown on the plans.
2. The piping installer shall obtain concurrance with the Owner's Representative that the piping installation meets the intended design requirements before covering the piping with aggregate and filter fabric as shown on the plan.

M. Gypsum Stack - Miscellaneous Earthwork

1. Provide access ramp to perimeter berm of cell.

N. Gypsum Sluice Piping

1. Connect to existing piping and install new Gypsum Sluice Piping, fittings and valves for the Gypsum Stack.

O. Gypsum Stack - Subdrainage System

1. Abandon existing subdrainage system, and remove vent pipes, vertical drains and inlet structures as specified in Section 02140 – Surface Water Management.

P. Gypsum Stack - Erosion Control

2. Maintain previously installed temporary erosion control systems during the life of the contract.
3. Seed and mulch all exposed soil surfaces.

Q. Recycle Pond - Earthwork

1. Strip topsoil from areas of the proposed excavation and proposed compacted berms.
2. Excavate the recycle pond to the lines and grades shown on the plans.
3. Proof roll stripped/excavated areas to expose unsuitable materials.
4. Remove and replace unsuitable foundation material and/or install geotextile fabric for ground stabilization as directed by the Owner's Representative. Work required to correct unsuitable foundation material will be paid by the Owner on a Time and Materials Basis.
5. Construct Recycle Pond Embankments, Process Water Transfer Channel and Emergency Spillway to the line and grades shown on the plans.

R. Recycle Pond – Toe Drain

1. Furnish and install aggregate materials and filter fabric at the outside toe of the recycle pond dam as shown on the plans.

S. Recycle Pond - Excavation and Backfill of Anchor Trench

1. Excavate anchor trench.
2. Backfill trench after installation of High Density Polyethylene (HDPE) Geomembrane by Geosynthetics Installer.

T. Recycle Pond - HDPE Geomembrane

1. The Geosynthetics Installer's Representative shall jointly inspect the surface of the recycle pond foundation soils with the Owner's Representative before commencing daily work. The Geosynthetics Installer's Representative shall continuously observe the condition of the foundation soils during HDPE Geomembrance placement and submit a Certificate of Acceptance in the daily report that no HDPE Geomembrane was placed over visibly defective foundation soil.
2. Furnish and install HDPE Geomembrane on approved foundation soil. Provide textured HDPE Geomembrane on recycle pond side slopes and bottom. Anchor in the excavated anchor trench and backfill in accordance with the project specifications.
3. The Geosynthetics Installer shall perform non-destructive seam testing at frequencies specified in Section 6.3.2 of the Construction Quality Assurance Plan. Provide samples for destructive seam testing by the Owner's testing consultant, and repair sampled locations.

U. Recycle Pond - Water Transfer Structures

1. Furnish, fabricate, and install all materials and aggregate necessary to construct the Process Water Control Structure, Process Water Transfer Channel, Recycle Pond Emergency Spillway/Riprap Stilling Basin, and Side Slope Decant Pipe/Riprap Basin as shown on the plans.

~~V. Construction Field Office~~

~~The Contractor shall furnish and install a Construction Field Office for the Owner's use in accordance with the Specifications of Appendix 4 of these Specifications.~~

2.02 CCB Landfill

A. Foundation Preparation:

1. Remove top 6" of soil from the existing excavation and stockpile in an area designated on the Plans.
2. Finish grade the portion of the cell to be covered by Compacted Clay Liner.
3. Proof roll to expose any unsuitable foundation materials..
4. Remove and replace unsuitable foundation material and/or install geotextile fabric for ground stabilization as directed by the Owner's Representative.

B. Compacted Clay Liner

1. Construct Test Soil Liner, as outlined Section 5.0 of the project Construction Quality Assurance (CQA) Plan, included in Appendix 2, to demonstrate construction procedures and equipment that will produce the specified permeability.
2. Obtain Foundation Grade Verification by Amerens Field Surveyor prior to constructing areas requiring Compacted Clay Liner, as outlined in Section 6.2.1a of the project Construction Quality Assurance Plan.
3. Install Compacted Clay Liner in accordance with the project specifications using the compactive means demonstrated by the Test Soil Liner.

C. Excavation and Backfill of Anchor Trench:

1. Excavate anchor trench.
2. Place initial trench backfill after installation of GCL and HDPE geomembrane by geosynthetic liner contractor.
3. Complete trench backfill after installation of separation geotextile.

D. Geosynthetic Clay Liner (GCL)

1. The Geosynthetics Installer's Representative shall jointly inspect the surface of the Compacted Clay Liner with the Owner's Representative before commencing daily work. The Geosynthetics Installer's Representative shall continuously observe the condition of the Compacted Clay Liner during GCL placement and submit a Certificate of Acceptance in the daily report that no GCL was placed over visibly defective Compacted Clay Liner.
2. Furnish and install GCL on accepted Compacted Clay Liner. Provide re-inforced GCL on the sideslopes and bottom of the cell. Protect GCL per the Manufacturer's recommendations until it is covered by HDPE Geomembrane

E. High Density Polyethylene (HDPE) Geomembrane (Lower Layer)

1. The Geosynthetics Installer's Representative shall jointly inspect the GCL with the Owner's Representative; continuously observe the condition of the GCL during HDPE Geomembrane placement; and submit a Certificate of Acceptance in the daily report that no HDPE Geomembrane was placed over visibly defective GCL.
2. Furnish and install HDPE Geomemebrane on accepted GCL. Provide textured HDPE Geomembrane on cell side slopes and smooth HDPE Geomembrane on bottom of the cell. Protect HDPE liner until it is covered by geotextile cushion fabric.
3. The Geosynthetics Installer shall perform non-destructive seam testing at frequencies specified in Section 6.3.2 of the Construction Quality Assurance Plan. Provide samples for destructive seam testing by the Owner's testing consultant, and repair sampled locations.

F. Geotextile Cushion Fabric:

1. The Geosynthetics Installer's Representative shall jointly inspect the HDPE Geomembrane with the Owner's Representative; continuously observe the condition of the HDPE Geomembrane during placement of the geotextile cushion fabric; and submit a Certificate of Acceptance in the daily report that no geotextile fabric was placed over visibly defective HDPE Geomembrane.
2. Install geotextile cushion on accepted Geomembrane.
3. Install drainage layer material for ballast.

G. HDPE Leachate Collection Piping:

1. Place geotextile fabric for coarse aggregate envelope.
2. Place initial lift of Coarse Aggregate Bedding.
3. Furnish and install HDPE Leachate Collection Piping on Coarse Aggregate bedding.
4. Place coarse aggregate along the pipe to provide lateral stability.
5. The piping installer shall obtain concurrance with the Owner's Representative that the piping installation meets the intended design requirements before covering the piping with remainder of coarse aggregate and geotextile envelope as shown on the plans.

H. Drainage Layer and Separation Berm:

1. Place granular material for separation berm and drainage layer.

I. Separation Fabric:

1. Install geotextile fabric on accepted drainage layer and anchor geotextile fabric in anchor trench.

J. Haul Road

s

1. Funish materials and construct Haul Road to the top of the CCB Landfill.

K. Miscellaneous Earthwork:

1. Provide construction access ramp to bottom of cell.
2. Place general fill to form in-board side of berm ditch.

L. Construct and maintain temporary erosion control systems during the life of the contract. Remove and dispose of temporary erosion control items when no longer required. Seed and mulch all remaining disturbed soil surfaces.

3.0 OWNER AND MANUFACTURER'S DRAWINGS

3.1 Provided By Ameren Energy Resources Generating

A. Hard-Copy Drawings

The following drawings are intended to indicate the scope of the work to be done and details necessary for the installation of items set forth in this specification, and are part of this specification. These drawings in general are to scale, but dimensions shall always be followed and drawings are not to be scaled. In case of errors or discrepancies, the Owner's Representative shall be consulted for the adjustment of all complications arising therefrom. The Owner's Representative's decisions shall be final.

AERG DRAWING NO.	SHEET TITLE
C180-C102-01	Title & Index
C180-C102-02	General Notes
C180-C102-03	Site Plan
C180-C102-04	Existing Site Conditions
C180-C102-04A	Existing Subsurface Drainage Profiles
C180-C102-05	Existing Subsurface & Vertical Drain Details
C180-C102-06	Existing Subsurface Drainage Details
C180-C102-07	Existing Grading Plan
C180-C102-08	Gypsum Stack-Foundation Grade
C180-C102-09	Gypsum Stack-Top of Clay Layer
C180-C102-10	Gypsum Stack- Leak Detection/Leachate Collection

AERG DRAWING NO.	SHEET TITLE
	Recovery System (LD/LCRS) Drainage Layer Grade
C180-C102-11	Process Water Recovery System (PWRS) - Ring Drain System Cushion Dirt Layer Grade
C180-C102-12	PWRS-Ring Drain Details
C180-C102-13	PWRS-Ring Drain Details
C180-C102-14	LD/LCRS Sections & Details
C180-C102-15	Recycle Pond Plan
C180-C102-16	Recycle Pond Details
C180-C102-17	Recycle Pond Details
C180-C102-18	Access Road and Pump Station Site Plan
C180-C102-19	Access Road Vertical Alignments
C180-C102-20	Erosion Control Plan
C180-C102-21	Erosion Control Details
C180-C102-22	Groundwater Monitoring & Boring Plan
C180-C102-23	Geological Cross Sections
C180-C102-24	Geological Cross Sections
C180-C102-25	Geological Cross Sections
C180-C102-26	Geological Cross Sections

AERG DRAWING NO.	SHEET TITLE
C180-C110-01	Title and Index
C180-C110-02	General Notes
C180-C110-03	Site Plan
C180-C110-04	Foundation Grade Plan
C180-C110-05	Foundation Grade Control Data
C180-C110-06	Base Grade Plan
C180-C110-07	Base Grade Control Data
C180-C110-08	Geomembrane Panel Layout
C180-C110-09	Drainage Layer Grade Plan & Leachate Collection Piping
C180-C110-10	Drainage Grade Control Data
C180-C110-11	Typical Sections and Details
C180-C110-12	Leachate Collection Details
C180-C110-13	Typical Cross Sections
C180-C110-14	Separation Berm Details
C180-C110-15	Exist. Sub-Drain Plan & Details
C180-C110-16	~~Haul Road / Construction Water Access Road Plan~~ ***Landfill Haul Road***
~~C180-C110-17~~	~~Construction Water Access Road~~
C180-C110-17	Boring Well and Section Locations

AERG DRAWING NO.	SHEET TITLE
C180-C110-18	Geologic Cross Sections A and B
C180-C110-19	Geologic Cross Sections C, D, and E
C180-C110-20	Geologic Cross Sections F to K

B. Electronic Files

The following electronic files are provided solely for the convenience of the bidder and/or Contractor and are subject to the terms and conditions stipulated in the Disclaimer text included with the electronic files.

1. Drawings listed above in PDF format.
2. TIN files of the existing and proposed ground surfaces.
3. Bid Forms.
4. Disclaimer text.

In the event of a conflict between the hard-copy documents and the electronic files, the hard-copy documents shall govern.

3.2 Provided by the Contractor

The Contractor shall submit to the Owner's Representative, with such promptness as to cause no delay in the performance of the work, four copies of shop drawings, product data sheets, etc., as required by these specifications. No purchasing, fabrication, erection, processing, or shipping of the aforementioned materials may begin until the required documentation has been reviewed by the Owner.

Three copies of data required to be submitted to the Owner's Representative shall be forwarded to each of the following:

Ameren Energy Resources Generating
Dave Boyce
Duck Creek Power Station
17751 North CILCO Road
Canton, Illinois 61520

Hanson Professional Services Inc.
Steven Bishoff
1525 South Sixth Street
Springfield, Illinois 62703-2886

Data sheets and shop drawings shall be reviewed and returned to the Contractor within ten (10) working days after receipt. Approval is for general design features only and will not relieve the Contractor of responsibility for proper quantities, adequacy of details, and

coordination with other trades. Deviation from Contract Documents are not approved unless specifically requested in writing by the Contractor and approved in writing by the Owner.

Should field changes be required, such changes shall be promptly documented by the Contractor and submitted to the Owner in the form of as-built drawings. The field change order process is included in Appendix 1.

4.0 MATERIALS AND EQUIPMENT SUPPLIED BY THE OWNER

The materials and equipment that are to be furnished by the Owner are listed in the schedule below:

ITEM	SHIPPING DATE	LOCATION
~~Drainage Layer Material (Gypsum Stack & CCB Landfill)~~	~~Prior to Start of Construction~~	~~Stockpile~~
~~Coarse Aggregate Encasement for Ring Drain Piping (IDOT CA-7) (Gypsum Stack)~~	~~Prior to Start of Construction~~	~~Stockpile~~
~~Filter Sand for Protection of Ring Drain Piping (IDOT FA-1) (Gypsum Stack)~~	~~Prior to Start of Construction~~	~~Stockpile~~
~~Coarse Aggregate Coarse Encasement For Leachate Collection Piping (CCB Landfill)~~	~~Prior to Start of Construction~~	~~Stockpile~~

Note: Per Addendum #1, none of the above listed aggregates will be supplied by the owner

5.0 MATERIALS AND EQUIPMENT FURNISHED BY THE CONTRACTOR

All materials, equipment, tools, and any incidental items necessary to complete each portion of the work described herein and/or shown on the drawings shall be furnished by the Contractor.

6.0 UTILITIES, FACILITIES, AND MISCELLANEOUS

The following utilities, facilities, etc., shall be provided as indicated.

	Item	Provided By
A.	Telephone Service for Use of Construction Forces	Contractor
B.	Sanitary Facilities	Contractor
C.	Drinking Water	Contractor
D.	Construction Water	Contractor
E.	Electric Service for Contractor's Use	Contractor
F.	Construction Office and Storage Facilities for Contractor's Use	Contractor
G.	Construction of Gravel Haul Roads and Parking Area for Construction Forces	Contractor

Submit with the bid documents a general layout of temporary facilities required for the Contractor's operations, such as haul roads, parking areas, temporary drainage facilities, Contractor's construction field office and storage facilities, electric service, telephone service, staging and laydown areas, etc.

7.0 SCHEDULE

The Contractor shall be required to furnish the Owner's Representative with a complete schedule of the Work to be performed under this contract broken down by major activity.

The schedule shall include the Contractor's estimate of man-days required for each activity, and shall show precedent relationships between activities. The schedule shall be included as part of the bid package presented by the Contractor. The schedule shall comply with the dates and guidelines listed below:

A. The required start date of this contract is upon receipt of Purchase Order. The Purchase Order is expected to be issued within two (2) weeks of the bid due date.

B. The required finish date of this for the Gypsum Management Facility Contract is September 30, 2008. The required finish date for the CCB Landfill Contract is December 31, 2008 for the Scope of Work incuded in Bid Forms A & C.

C. The level of detail in each schedule shall be sufficient to permit the Owner to monitor the Contractor's performance relative to the specified guidelines. The required level of detail will be discussed at the pre-bid meeting.

D. The Contractor shall submit a daily construction report and shall furnish schedule status reports at weekly progress meetings until the work is completed. The schedule status reports shall indicate by activity the scheduled percent of completion as shown on the original schedule, the actual percent completion as of the date of the report, and the number of man-days expended on the project to date.

If at any time during this Contract, when the Contractor's actual progress, in the opinion of the Owner, is such that the completion dates of the work will not be met, the Contractor shall participate in a re-evaluation of the remaining work.

If, as a result of this re-evaluation of the remaining work, it is determined by the Owner that the completion date will not be met, the Owner retains the right to direct the Contractor to accelerate the construction program. It shall be the responsibility of the Contractor to initiate and comply with such corrective action as required or directed.

At the time of the award of this contract, scheduling requirements will be discussed in detail by all interested parties.

8.0 CONSTRUCTION QUALITY CONTROL ASSURANCE

A. Construction Quality Assurance Plan

A Construction Quality Assurance (CQA) Plan has been developed for this project to ensure compliance with the all applicable permit requirements. A copy of this plan is included in Appendix 2. The testing requirements and frequency of this plan will govern in instances which there may be discrepancies between the CQA Plan and these specifications.

B. Testing and Inspections:

1. The Contractor is responsible for construction quality control testing, sampling, and inspections to ensure that the materials and workmanship comply with the plans and specifications. The Contractor shall submit results of construction quality control testing. The Contractor shall visually inspect underlying surfaces on a continuous basis immediately ahead of placement of geosynthetics and geotextile and shall certify in the daily report that no material was placed over visibly defective substrate.
2. The Contractor is responsible for non-destructive testing of all Geomembrane seams and for providing samples for prequalification material testing and destructive seam testing as directed by the Owner's

Representative. The minimum sampling frequencies are specified in Appendix 2.

3. Except as specified above, Construction Quality Assurance (CQA) testing, sampling, and inspections to verify compliance with the plans and specifications are the responsibility of the Owner. The CQA sampling and testing requirements are summarized in Appendix 2. The Contractor shall coordinate and cooperate with the Owner's materials testing consultant to provide samples and accommodate testing activities at no additional cost to the Owner.

C. Construction Surveying

Construction surveying for layout and grading control shall be the responsibility of the Contractor. Finished grades will be surveyed by the Owner's surveyor to verify that the finished grade is within 0.1 ft. of plan grade.

D. CQA Surveys to certify material thickness, leachate piping and ditch grades are the responsibility of the Owner. CQA Surveying requirements are summarized in Appendix 2.

9.0 COORDINATION WITH OTHERS

This Contractor will work in close harmony with other Contractors or AERG personnel who may be employed at this site. In the event of differences of opinion regarding scheduling of work, the decision of the Owner will be final and binding.

The following construction activities are anticipated within the landfill facility boundary during this contract:

A. Loading and Hauling of coal combustion by-product to the site by AERG personnel or Contractor.

B. Loading and Hauling of water for dust contol operations on AERG property.

C. Loading and hauling stockpiled excavated material from the stockpile south of East McKinley Road by Fulton County Highway Department Contractor and by Ameren personnel or contractor.

D. Monitoring, removing, and disposing of leachate by Ameren's CCB disposal facility operator.

10.0 SAFETY AND SITE SECURITY

The Contractor will comply with safety and security requirements stipulated in the General Conditions and Supplemental General Conditions.

A. Although the Ameren Energy Resources Generating property is generally fenced and patrolled by Ameren Energy Resources Generating security, the site should not be considered secure.

   1. A Security Check-In Station will be provided by AERG for the duration of the construction project at the entrance on McKinley Road.

B. Contractor personnel will be required to attend a 2-hour site-specific safety orientation conducted by the Owner.

C. Contractor personnel will be required to submit to a ten (10) panel drug test to be performed and provided by AERG.

D. A copy of the Contractor's Field Construction Safety Program shall be submitted with the Contractor's bid package.

E. The Contractor shall have a designated Safety Supervisor on site whenever construction work is being performed.

11.0 DUST CONTROL

The Contractor shall be responsible for controlling dust and air-borne dirt generated by construction activities. Dust shall be controlled by applying water to exposed surfaces, particularly surfaces on which construction vehicles travel. Water from the Duck Creek Reservoir is unsuitable. A pond north and east of the proposed CCB Landfill is designated at the only water source available for use by the Contractor.

No chemical dust suppressants shall be permitted unless approved in writing by the Owner's Representative. Dust control measures shall be readily available for implementation whenever the Contractor or the Owner's Representative deems that that dust control is needed. The cost of dust control shall be included in the contract lump sum price.

PART 2. PRODUCTS

No products used.

PART 3. EXECUTION

1.0 The Contractor shall be responsible for inspecting the site to note any and all conditions that may affect the work under the contract. The Contractor shall satisfy himself as to the nature, extent and location of the work; the configuration of the ground; the equipment and facilities needed for construction; the general and local conditions of the area; and all other factors and conditions which can, in any way, affect the work under the contract. Any failure by the Contractor to do so will not relieve him from responsibility for successfully performing the work without additional expense to the Owner.

2.0 The Contractor is specifically advised of the presence of overhead power lines that traverse the project work area.

END OF SECTION 01010

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PART 1. GENERAL

1.01 DESCRIPTION

A. This section pertains to the construction and maintenance of existing and proposed temporary erosion control systems to control erosion and sediment damage to adjacent properties and water resources.

1.02 RELATED SECTIONS

The following sections contain items which are related to the work in this section:

02936 - Topsoil, Seeding, and Mulching.

1.03 REFERENCES

The following reference, or cited portions thereof, governs the work:

Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007.

1.04 SUBMITTALS

A. Submittals shall follow the provisions of Section 01010.

B. Preconstruction Submittals: A storm water best management practices (BMP) plan shall be submitted that includes the following items:

1. Inspection and record-keeping procedures; and
2. Maintenance procedures for erosion controls.

PART 2. PRODUCTS

2.01 EROSION CONTROL SYSTEMS

Materials for erosion control systems shall be in accordance with Article 280.02 of the IDOT Standard Specifications.

PART 3. EXECUTION

3.01 EXAMINATION

The site shall be examined to determine the condition existing temporary erosion controls systems installed under a prior contract and the extent of new work required.

3.02 PRECONSTRUCTION JOBSITE INSPECTION

A. The person who shall be at the jobsite during construction and who shall be responsible for insuring that erosion control work is completed in a timely manner shall be identified at the preconstruction meeting.

B. A jobsite inspection shall be conducted with the Owner's Representative to review and designate the locations and types of erosion protection to be placed. The inspection shall be scheduled at the preconstruction conference and carried out on the job site before beginning any work that will disturb existing drainage or potentially create erodible conditions.

3.03 CONSTRUCTION

A. Temporary erosion control systems shall be constructed in accordance with IDOT Standard 280001 and Article 280.04 of the Standard Specifications and as directed by the Owner's Representative. Erosion control devices shall be in place and approved by the Owner's Representative prior to beginning other work.

B. Incorporate permanent erosion control features into the project at the earliest practicable time to minimize the need for temporary erosion controls.

3.04 MAINTENANCE

A. Temporary erosion control systems shall be maintained in accordance with Article 280.05 of the Standard Specifications, except that measurement and payment provisions shall not apply.

B. Temporary erosion control systems for unprotected disturbed areas shall be cleaned of trapped sediment and repaired immediately prior to project close out.

C. Temporary seeding shall be applied to all disturbed areas except the gypsum stack excavation and the future fill and topsoil stockpiles.

3.05 REMOVAL AND DISPOSAL

All temporary erosion control system shall be left in place by the Contractor for future construction operations at both facilities.

END OF SECTION 01356

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PART 1. GENERAL

1.01 DESCRIPTION

Logs of borings and laboratory soil test data.

PART 2. PRODUCTS

No products used.

PART 3. EXECUTION

3.01 TEST BORINGS

A. Test borings were taken at the locations shown on the drawings. Copies of boring logs, along with soil test data on soil samples recovered from the borings are included in Appendix 3.

B. Data on indicated subsurface conditions are not intended as representations or warrants of continuity of such conditions between soil borings. It is expressly understood that the Owner will not be responsible for interpretations or conclusions drawn therefrom by the Contractor. Data are made available for the convenience of the Contractor.

C. Additional test borings and other exploratory operations may be made by the Contractor at no additional cost to the Owner, provided such operations are approved by the Owner's Representative.

3.02 SITE OBSERVATIONS

B. Gypsum Management Facility (Gypsum Stack & Recycle Pond)

1. The Gypsum Stack has been excavated to foundation grade on the sideslopes, and to within approximately 5.4 of foundation grade at the bottom of the cell. The remaining 5.4 feet of material will be utilized to construct the 3 foot thick clay layer. A drainage channel was cut from the southwest floor of the excavation to allow adequate surface water drainage. During the pre-bid meeting, Contractors will be given opportunity to view the excavation and resulting stockpiles, and to observe the in-situ conditions at the time of the meeting.

2. The earthwork for the recycle pond pump station pad and access road, as well as sections of the recycle pond perimeter berm have been constructed to finish grade. During the pre-bid meeting, Contractors will be given the opportunity to view the in-situ conditions at the time of the meeting.

A. CCB Landfill

1. The CCB Landfill has been excavated to within 6 in. of foundation grade. During the pre-bid meeting, Contractors will be given opportunity to view the excavation and observe the in-situ conditions near foundation grade at the time of the meeting.

END OF SECTION 02010

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PART 1. GENERAL

1.01 DESCRIPTION

This section pertains to stripping of topsoil and vegetation from areas of the site that are to be excavated.

1.02 RELATED SECTIONS

No related sections.

PART 2. PRODUCTS

No products used.

PART 3. EXECUTION

3.01 EXAMINATION

The Contractor shall examine the site to determine the extent of work required, as well as the extent of previously stripped topsoil completed under a previous contract.

3.02 SITE PREPARATION - STRIPPING

A. The Gypsum Stack and portions of the Recycle Pond grading limits have been previously stripped under a separate contract as shown on the plans. Any remaining vegetation and topsoil encountered within the Gypsum Stack and Recycle Pond grading limits required to complete the work in this contract shall be stripped. ~~Topsoil shall be kept clean and free of all foreign material, and stored in separate stockpiles from vegetation and common excavations. Stockpiles shall be located as indicated on the drawings or as directed by the Owner's Representative.~~ ***Topsoil removed by stripping shall not be stockpiled, and shall be deposited completely as described in section 3.02-C of this specification.***

B. The top 6" of the existing excavation area of the CCB Landfill-Cell 1 within the CCB Landfill shall be removed and stockpiled per Specification Section 02200 Earthwork.

C. Stripped Topsoil shall be used to fill depressions east of the Gypsum Management Facility as shown in the Plans.

3.03 DISPOSAL

A. All materials resulting from site preparation operations shall be stockpiled in the designated spoil area. Contractor shall obey all laws and regulations when disposing of the materials.

END OF SECTION 02100

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PART 1. GENERAL

1.01 DESCRIPTION OF WORK

Control of surface water caused by precipitation and abandonment of existing subsurface drainage facilities within the construction limits of the Gypsum Management CCB Landfill shall be considered as part of the work under this specification.

A. The work to be completed by the Contractor includes, but is not necessarily limited to, the following:

1. Maintenance of existing Erosion and Sedimentation Control Measures according to Section 01356; and
2. Dewatering excavations from water caused by precipitation.
3. Abandonment of the existing subdrainage systems.

B. The Contractor shall be responsible for providing all materials, equipment, labor, and services necessary for care of water and erosion control and abandonment of the existing subsurface dewatering systems at the end of the Contract.

1.02 EXISTING FACILITIES

A. Gypsum Management Facility

1. An existing ditch at the south end of the existing excavation provides gravity outlet for the excavation to 5.4 feet above the foundation grade.

2. An existing subdrainage system provides limited control of groundwater migration into the excavation. The subdrainage system outlets by gravity flow to an existing ditch approximately 0.3 mile south of the existing excavation.

B. CCB Landfill Facility

1. An existing ditch at the southeast corner of the existing excavation provides gravity outlet for the excavation to foundation grade.

2. An existing subdrainage system provides limited control of groundwater migration into the excavation. The subdrainage system outlets by gravity flow to an existing channel approximately 0.2 mile east of the existing excavation.

1.03 REQUIREMENTS

B. The General Contractor shall employ standard surface water management practices to prevent the ponding of stormwater runoff and/or erosion of existing and proposed earth surfaces, as required to complete the work.

1.04 RELATED SECTIONS

The following sections contain items which are related to the work in this section:

1. 01356 – Storm Water Pollution Prevention Measures
2. 02010 - Subsurface Investigation
3. 02200 - Earthwork

PART 2. PRODUCTS

2.01 MATERIALS

A. Materials and equipment for surface water management shall be reviewed by the Owner's Representative for compatibility with future construction and operation of the facility.

PART 3. EXECUTION

3.01 SURFACE WATER MANAGEMENT

A. The Contractor shall be responsible for providing all facilities required to divert, collect, control, and remove water caused by precipitation from all construction work areas and excavations.

B. Drainage features shall have sufficient capacity to avoid flooding of work areas.

C. Drainage features shall be so arranged and altered, as required to avoid degradation of the final excavated surface(s).

D. The Contractor shall utilize all necessary erosion and sediment control measures according to Section 01356 to avoid construction-related sedimentation of existing and proposed facilities.

3.02 WATER DISPOSAL

A. Dispose of water removed from the excavations in such a manner as:

1. Will not endanger portions of work under construction or completed.
2. Will cause no inconvenience to Owner or to others working near site.
3. Will comply with the stipulations of Section 01356.

4. Will control runoff. The Contractor shall be responsible for control of runoff in all work areas, including, but not limited to: excavations, access roads, parking areas, stockpile, laydown, and staging areas. The Contractor shall provide, operate, and maintain all ditches, basins, sumps, culverts, site grading, and pumping facilities to divert, collect, and remove all water from the work areas. All water shall be removed from the immediate work areas and shall be disposed of in accordance with Section 01356.

B. Existing site drainage features or proposed subdrainage system may be used for water disposal.

3.03 DAMAGES

A. Immediately repair damages to adjacent facilities caused by the surface water management facilities, as constructed by the Contractor.

3.04 REMOVAL OF STORMWATER MANAGEMENT SYSTEMS INSTALLED BY CONTRACTOR

A. Remove and backfill temporary sumps, ditches, trenches, etc. according to Section 02300, as required by the Owner.

3.05 CORRECTIVE ACTION

Work shall be performed as necessary for reinstatement of foundation soil and damaged structure resulting from such inadequacy or failure by Contractor to control surface water, at no additional cost to Owner.

3.06 ABANDONMENT OF EXISTING SUBDRAINAGE SYSTEMS

Concurrence shall be obtained from Owner before discontinuing operation of subdrainage system.

The General Contractor shall maintain the existing subdrainage systems during construction of the Gypsum Management and CCB Landfill Facilities.

Prior to construction of the Compacted Clay Liner at the Gypsum Management Facility, all vertical drains consisting of a geotextile fabric encased pea gravel envelope shall be removed. The pea gravel shall be stockpiled and the geotextile fabric shall be removed and disposed of in a legal manner. Subdrainage piping damaged during removal of the vertical drains shall be repaired with equal material incidental to the work. An existing drainage structure consisting of 24" diameter reinforced concrete pipes with a ditch grate shall be removed. The concrete pipes shall be disposed of in a legal manner and the ditch grate shall be salvaged per the direction of Owner's Representative

Upon completion of the construction of either facility, that facility's existing subdrainage system within the lined portion of the cell shall be abandoned as follows:

1. At each subdrainage vent pipe riser location, a mixture of high solids bentonite grout shall be pumped into the subdrainage piping to completely seal the system. The high solids bentonite grout shall be CETCO Volclay Grout or an approved equal that is NSF/ANSI Standard 60 certified. The grout shall be mixed according to the manufacturer's specifications for this application to provide a low permeability seal less than $1x10^{-7}$ cm/sec.
2. Cut the vent pipe risers 36 inches below with the ground surface. Fill the remaining vent piping with concrete as shown on the plans.
3. Remove completely the existing concrete inlet at the southeast quadrant of the gypsum stack excavation and dispose of in a legal manner. The grate will be salvaged and stored at the direction of the owner.
4. Remove completely the vent pipe protective bollards and dispose of in a legal manner.

END OF SECTION 02140

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PART 1. GENERAL

1.01 DESCRIPTION

This section pertains to excavation, fill, and backfill required for foundation preparation, construction of Compacted Clay Liners, anchor trench construction, miscellaneous site grading, berm construction.

1.02 RELATED SECTIONS

A. The following sections contain items which are related to the work in this section:

1. 01356 – Storm Water Pollution Prevention Measures
2. 02100 - Site Preparation
3. 02140 – Surface Water Management
4. 02373 – Geotextiles
3. 02936 - Topsoil, Seeding, and Mulching

1.03 REFERENCES

The following references, or cited portions thereof, govern the work:

1. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007
2. Department of Sustainable Natural Resources, Soil Survey Standard Test Method, Unified Soil Classification System: Field Method (USCS).

1.04 MEASUREMENT AND PAYMENT

A. The Contractor shall be responsible for estimating the extent of excavation and fill required to complete the work, including, but not limited to, excavation to required elevations; loading, transporting, placing, and compacting the Compacted Clay Liners; excavation and backfill of anchor trench; and miscellaneous site grading, including berm construction. The Contractor shall include the dollar amount associated with all earthwork in his Lump Sum Bid amount.

B. Removal and replacement of unsuitable foundation material (including underground sand channel materials) and subgrade stabilization measures directed by the Owner's Representative will be paid for on a time and material basis. Payment quantities will be based volume of excavation, determined from field surveys by the Owner's Field Surveyor.

1.05 EARTHWORK COMPLETED UNDER PRIOR CONTRACT

A. Gypsum Management Facility

1. The gypsum stack has been excavated to approximately 5.4 ft. above foundation grade across the bottom of the cell.

2. Excavated subsoil material was stockpiled north and east into short term and long term subsoil stockpiles as shown on the plans. Stripped Topsoil was stockpiled separately.

3. The ~~75,000 yard~~ subsoil stockpile east of the Gypsum Stack shall be completely depleted under this contract. Schedule and timing shall be determined by the Contractor.

B. CCB Landfill

1. The cell has been excavated to approximately 6 in. above foundation grade and the perimeter berm has been completed, except for an existing construction access ramp on the east side of the cell near Sta. 205+00.

2. Excavated material was stockpiled in locations east of the excavation. The intended use and location for each stockpile is shown on the plans

1.06 COORDINATION

Existing utilities or other plant facilities shall not be interrupted, except when permitted in writing by the Owner's Representative and then only after acceptable temporary services have been provided. A minimum 48-hour notice shall be provided prior to proceeding with an approved temporary interruption.

1.07 SURFACE WATER MANAGEMENT

Control of surface water caused by precipitation necessary for completion of the work under this contract according to Section 02140 is the responsibility of the Contractor and shall be included in the contract lump sum price.

1.08 SUBMITTALS

A. Materials Handling Plan.

A materials handling plan shall be submitted for construction and protection of the Compacted Clay Liner. The plan shall describe the following:

1. Processing and placement of the Compacted Clay Liner: type, model number, weight, and critical dimensions of equipment to be used for soil processing, compaction, scarification, and smooth rolling;

2. Method of protecting the Compacted Clay Liner from changes in moisture content and freezing after placement.

PART 2. PRODUCTS

2.01 MATERIALS

A. Earth Fill Material

Earth Fill Material shall consist of a mixture of clay, silt, sand, and gravel-sized particles obtained from previously constructed subsoil stockpiles. These materials can be used separately or mixed as required for best results. These materials shall be free of ice, snow, organic matter, rubbish, and debris. Coarse-grained particles shall be well dispersed to prevent the development of segregated pockets or zones with insufficient fine material to fill the interstices.

B. Compacted Clay Liners

1. Gypsum Management Facility

The Compacted Clay Liner for the Gypsum Management Facility shall be soil materials obtained from the approximately 5.4 ft. of material remaining above the foundation grade that was left in-place under the previous excavation contract. The material shall be free of ice, snow, organic matter, rubbish, and debris, and shall have a maximum clod size no greater than the length of the compactor foot for the compaction equipment proposed by the Contractor. When compacted, the material shall have a vertical hydraulic conductivity of less than 1×10^{-4} cm/sec.

2. CCB Landfill

The Compacted Clay Liner for the CCB Landfill shall be soil materials obtained from on-site excavations and materials stockpiled east of the cell. The material shall be free of ice, snow, organic matter, rubbish, and debris, and shall have a maximum clod size no greater than the length of the compactor foot for the compaction equipment proposed by the Contractor. When compacted, the material shall have a vertical hydraulic conductivity of less than 1×10^{-6} cm/sec.

C. Soil Stabilizers and Moisture Conditioning Agents

Additives to accelerate drying or to improve stability and workability of soil shall not be permitted unless approved in writing by the Owner's Representative.

2.02 EQUIPMENT

A. Compaction Equipment

1. Tamping foot rollers

Compaction equipment shall consist of tamping foot rollers which have a minimum weight of 40,000 pounds. At least one tamping foot shall be provided for each 110 square in. of drum surface. The length of each tamping foot, measured from the outside surface of the drum, shall be at least 1 in. longer than the loose lift thickness.

2. Steel-Wheeled Rollers

Equipment used to produce a smooth compacted surface shall be a smooth, non-vibratory steel wheeled roller weighing not less than 1,000 lb. per lineal ft.

B. Scarification Equipment

Discs, rotor tillers, or other equipment used to scarify the surface shall be capable of uniformly disturbing at least the upper 6 in. of surface to provide good bonding between lifts.

C. Mixing and Spreading Equipment

Discs, harrows, and motor graders or other similar equipment shall be available at the site for use in spreading, mixing, and drying Compacted Subsoil Stockpile Material.

PART 3. EXECUTION

3.01 PREPARATION

A. Control of Work

Benchmarks, monuments, and other reference points shall be maintained throughout the work area.

B. Utility Location

Before starting excavation, the location and extent of underground utilities in the work area shall be established.

3.02 EXCAVATION

A. General

Excavation consists of removal and redistribution of material encountered when establishing required grade and subgrade elevations. The Contractor shall be responsible for dewatering, protection, shoring, and disposal of excavated materials as necessary to complete the excavation.

B. Procedures

Excavation may be accomplished by any method and by use of any equipment that is suitable to the work, except that blasting will not be permitted. Based on previous construction experience at the site, it is recommended that excavation to the foundation grade be completed as far in advance of the Compacted Clay Liner placement as possible to allow the foundation surface to dry and form a "crust" capable of sustaining compactive effort.

C. Overexcavation

Overexcavation shall be performed to the lines and grades indicated on the plans. Additional overexcavation required to remove unsuitable materials as requested by the Owner's Representative shall be paid for by the Owner for at the Unit Price for Excavation. Any overexcavation or excess excavation not requested by the Owner's Representative shall be at the expense of the Contractor.

D. Disposal of Excavated Materials

Contractor shall stockpile excess excavated subsoil or topsoil materials in their corresponding stockpile for future use.

3.03 SUBGRADE PREPARATION

A. Areas to receive fill shall be proof rolled under the observation of the Owner's Representative. Soft, loose, weak, or wet materials shall be removed and replaced with compacted fill or stabilized with geotechnical fabric or geogrid as directed by the Owner's Representative and paid on a time and materials basis. Joints, fractures, and moisture seeps shall be repaired, and local sand deposits, if present at foundation grade, shall be removed and backfilled with compacted fill material as directed by the Owner's Representative.

B. The Owner's Representative may recommend additional drying time for soft, wet subgrade that has not been exposed long enough to permit "crust" formation. If approved by the Owner's Representative, the Contractor may install, at his own expense, geotechnical fabric to stabilize the wet subgrade and expedite construction.

C. Following the excavation for the Compacted Clay Liner, the CQA Officer shall direct the Owner's Field Surveyor to verify that actual depths and grades of the foundation are in accordance with the plans and specifications. Elevations shall be surveyed on a 100 ft. grid pattern for the bottom of the cell. The points surveyed for side slopes will be at the top, midpoint, and toe. In addition, all breaks in grade will be surveyed. Foundation excavation grading shall meet a control tolerance requirement of 0 ft to -0.4 ft. The measured depths and grades shall be documented on "as built" drawings furnished to the CQA Officer by the surveyor agency. The CQA Officer shall review the survey data for conformance to requirements and, if found in agreement with requirements, provide certification for the work in accordance with CQA Plan Procedures.

C. The Contractor shall not place fill until the subgrade has been examined jointly with the Owner's Representative and a certificate of approval for the subgrade has been submitted to the Owner's Representative.

3.04 STRUCTURAL FILL

A. Placement

1. Unless otherwise indicated on the plans, all Fill shall be composed of Earth Fill Material.
2. Fill materials used in embankment construction shall normally be placed in lanes parallel to the embankment axis and shall be placed in conformance with the lines, grades, and slopes as indicated on the plans. Placement of fill materials in lanes which are not parallel to the embankment will be allowed only where working room is too restricted for normal placement as determined by the Owner's Representative.
3. Fill shall be spread in approximately flat layers in such a manner as to obtain lifts of relatively uniform thickness without spaces between successively deposited loads. Segregation shall be prevented during placing and spreading. Hauling equipment shall be routed across the fill in such a way as to promote uniform compaction and to prevent the formation of ruts.
4. The maximum compacted thickness of each lift shall not exceed 8 in. where heavy compaction equipment will be used. The maximum compacted thickness shall not exceed 3 in. where power tampers or similar smaller equipment will be used. It may be necessary to reduce the thickness of lifts in order to obtain the required minimum density.
5. Where compacted Fill is to be placed against existing slopes, each lift shall be keyed into existing slope by removing existing slope material in steps as each new lift is placed.
6. The surface of the fill shall be kept reasonably smooth. The fill surface shall be sloped transverse to the axis of the embankments to allow drainage. If the compacted surface is, in the opinion of the Owner's Representative, too smooth or too dry to bond properly with the succeeding lift, it shall be roughened by scarifying, light discing, or other acceptable means, and it shall be sprinkled with water before the

succeeding lift is placed thereon. If the surface becomes rutted or uneven subsequent to compaction, it shall be flattened and leveled before placing the next lift. This extra work shall be at the Contractor's expense.

7. Fill operations shall be suspended during periods of extended wet weather. Upon resuming operations, all fill materials that are excessively wet or soft shall be reprocessed in place or removed and stockpiled for reprocessing. The removal of soft material shall be carried to such depth as is necessary to expose firm materials. Fill shall not be placed on frozen surfaces.
8. When filling operations at any section will be suspended for any period in excess of 12 hours or in wet weather, the surface of the fill shall be rolled smooth to seal it against excessive absorption of moisture and to facilitate runoff. Prior to resuming fill placement and compaction, the fill surface shall be scarified and/or disced and moisture conditioned as required.
9. The Contractor will receive no additional compensation for any removal, reprocessing, stockpiling, recompaction, wasting, or similar operation related to suspensions or conditions due to weather or other causes unless caused by the Owner.
10. Earth fill access ramps shall not be constructed within the limits of the compacted embankments without the approval of the Owner's Representative. When such ramps are approved, they shall be constructed of Compacted Clay Liner material (in-board of the perimeter berm) or compacted Fill (out-board of the perimeter berm).

B. Compaction -

1. Fill materials shall be compacted to a dry density equal to or greater than the following:

   a. The Gypsum Management Facility: 95 percent of the maximum dry density obtained from the Standard Proctor Test, ASTM D698.
   b. The CCB Landfill: 90 percent of the maximum dry density obtained from the Standard Proctor Test, ASTM D698.

   In order to insure uniform coverage and to facilitate construction inspection and control, the compaction of each layer shall proceed in a systematic, orderly, and continuous manner. Rolling shall be parallel to the embankment axis, except where there is insufficient working room for such operations.

2. The moisture content of all earth fill materials shall be as uniform as practicable throughout each lift. Fill shall be compacted at a moisture content that is no more than 2 percent below and no more than 2 percent above optimum moisture content.
3. Moisture conditioning of fill materials shall be performed by discing, harrowing, plowing, blading, or other suitable means prior to excavation. Moisture conditioning where the fill is placed shall be limited to minor adjustments prior to compaction. Addition of moisture shall be by using a

pressure spray bar mounted in front of or to one side of a water tanker so that water will not collect in the tracks of the truck.

4. Any materials that are placed but not compacted prior to drying out or becoming too wet shall be removed and replaced or reprocessed at the Contractor's expense.
5. No admixtures as drying agents or to improve the workability of the soil will be allowed.

3.05 GENERAL FILL

General Fill materials shall be placed to the specifications for Structural Fill, except it shall be compacted to a dry density equal to or greater than 92 percent of the maximum dry density obtained from the Standard Proctor Test, ASTM D698

3.06 COMPACTED CLAY LINERS

A. Sources

The Compacted Clay Liners for both the Gypsum Management Facility and the CCB Landfill shall be constructed from Compacted Clay Liner material as described in paragraph 2.01(B) above.

B. Test Soil Liner

A Test Soil Liner of the actual full scale liner shall be constructed in accordance with the following requirements:

1. Test liner will be constructed from the same soil material sources, to the same design specifications, and with similar equipment and procedures as are proposed for the full scale liner.
2. Test liner will be at least four times the width of the widest piece of equipment to be used.
3. Test liner will be no less than 100 ft long to allow equipment to reach normal operating speed before reaching a central 40-ft test area.
4. Test liner will be constructed with maximum 8-in. compacted lifts for a total liner thickness of 3 ft.
5. Test liner will be tested by the Owner's Testing Firm in accordance with the project Construction Quality Assurance (CQA) Plan, included in Appendix 2, summarized below for each of the following physical properties:

    a. Multiple two-stage Boutwell permeameter tests will be used on the test liner to determine the hydraulic conductivity. The two-stage field hydraulic conductivity test is a falling head infiltration test conducted in a cased borehole, typically 4 in. in diameter. The test is cited in the U.S. EPA Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities, September 1993 (EPA/600/R-93/182).

b. Undisturbed samples (Shelby tubes) will be tested in the laboratory for hydraulic conductivity to determine if there is a statistical correlation to the field testing results.

c. Other engineering parameters including, but not limited to, particle size analysis, liquid limits, plasticity, water content, and in-place density that are needed to evaluate the full scale liner will be determined.

6. Additional test fills will be constructed for each new soil type or for each change in equipment or procedures.

C. Full Scale Liner Construction:

1. Full scale liner construction shall not be commenced until the results of the in-place compaction testing and Boutwell permeameter tests on the test liner confirm that the construction procedures and specified compaction requirements produce in-situ hydraulic conductivities as specified in Section 2.01(B) above.

2. The liner shall be constructed according to the placement and compaction requirements for general fill, except the material shall be compacted to a density of no less than 95 percent of maximum dry density as determined by the Standard Proctor Test (ASTM D 698) at the following moisture contents:

   a. Gypsum Stack Compacted Clay Liner shall be compacted at a moisture content between 100 percent and 105 percent of optimum.

   b. CCB Landfill Compacted Clay Liner shall be compacted at a moisture content determined by the "acceptable zone" criteria as outlined in the project CQA Plan.

   The same compaction procedures, such as number of passes, speed, and compaction equipment used on construction of the test liner shall be used. Grade stakes shall not be driven into the clay liner.

3. Moisture/density, hydraulic conductivity, and strength testing of the Compacted Clay Liner shall be conducted by the soil testing agency under the requirements and frequencies specified in the project CQA Plan to verify that ongoing liner placement meets the criteria developed by the Test Soil Liner.

4. The completed liner shall be smooth rolled to limit moisture loss and promote run-off of surface water. Moisture content shall be maintained within the specified range and erosion or other damage that occurs in the soil liner shall be repaired as directed by the Owner's Representative until the geosynthetic liner is placed.

5. Voids created in the Compacted Clay Liner during construction (including, but not limited to, penetrations for test samples, and other penetrations necessary for construction) shall be repaired by removing material that does not meet the requirements for Compacted Clay Liner material, backfill with Compacted Clay Liner material, granular or pelletized bentonite, or a mixture of bentonite and Compacted Clay Liner material in lifts no thicker than 2 in. and tamping each lift with a steel rod. Each lift shall be tamped a minimum of 25 times altering the location of the rod within the void for each blow. Other ruts and depressions in the surface of the lifts shall be scarified, filled, and then compacted to grade.

3.07 CUSHION DIRT (Gypsum Management Facility Only)

Cushion Dirt to be placed beneath the upper High Density Polyethylene (HDPE) Geomembrane is to be placed to the specifications for General Fill in Section 3.04 above, except fill materials for Cushion Dirt shall be compacted to a dry density equal to or greater than 90 percent of the maximum dry density obtained from the Standard Proctor Test, ASTM D698.

3.08 ANCHOR TRENCH CONSTRUCTION

A. Gypsum Management Facility – Gypsum Stack

1. The anchor trench shall be excavated to the depth and width shown on the anchor trench details. The front edge of the trench shall be rounded to eliminate any sharp corners that could cause excessive stress to the geosynthetic liners. Loose soil shall be removed or compacted into the floor of the trench.

2. Subsequent to Geosynthetic Clay Liner (GCL), Bottom HDPE Geomembrane and Geotextile Cushion installation, the liners shall be placed in the trench to fully cover the entire trench floor, but do not extend up the back of the trench wall. After the liner installation, the trench shall be backfilled with 1 ft. of Compacted Clay Liner material. The backfill shall be deposited and compacted according to the requirements for general fill in such a manner as to prevent damage to the GCL and liner materials.

3. Subsequent to installation of separation geotextile on top of drainage layer, it shall be verified that the fabric extends across the top of the initial 1 ft layer of trench backfill, but does not extend up the back of the trench wall. After the separation geotextile has been installed in, the trench shall be backfilled with 2 ft of Compacted Clay Liner material. The backfill shall be deposited and compacted according to the requirements for general fill in such a manner as to prevent damage to the separation geotextile.

4. Subsequent to installation of the upper HDPE Geomembrane, the liner shall be installed into the trench and extend across the top of the initial 1 ft layer of trench backfill, but not extend up the back of the trench wall. After the liner installation in the trench has been inspected jointly with the Owner's Representative, and the Geosynthetics Installer's Representative has submitted a certificate of approval that the HDPE Geomembrane was installed in the anchor trench in accordance with the plans and specifications, the Contractor may backfill the remainder of the trench to the top of the Compacted Clay Liner. Deposit and compact the backfill according to the requirements for general fill in such a manner as to prevent damage to the HDPE Geomembrane.

B. Gypsum Management Facility – Recycle Pond

1. The anchor trench shall be excavated to the depth and width shown on the anchor trench details. The front edge of the trench shall be rounded to eliminate any sharp corners that could cause excessive stress to the geosynthetic liners. Loose soil shall be removed or compacted into the floor of the trench.

2. Subsequent to HDPE Geomembrane installation, it shall be verified that the liner covers the entire trench floor, but does not extend up the back of the trench wall. After the liner installation in the trench has been inspected jointly with the Owner's Representative, and the Geosynthetics Installer's Representative has submitted a certificate of approval that the HDPE Geomembrane was installed in the anchor trench in accordance with the plans and specifications, the Contractor may backfill the remainder of the trench to the top of the Recycle Pond berm. The backfill shall be deposited and compacted according to the requirements for general fill in such a manner as to prevent damage to the liner material.

C. CCB Landfill

1. Excavate a ledge at bottom of anchor trench elevation and place and compact Compacted Clay Liner material on the ledge as shown on the anchor trench details in the plans.

2. Excavate the anchor trench to the depth and width shown on the anchor trench details. Round the front edge of the trench to eliminate any sharp corners that could cause excessive stress to the geosynthetic liners. Remove loose soil or compact it into the floor of the trench.

3. Subsequent to GCL and HDPE geomembrane installation by the geosynthetic liner contractor, verify that the liners cover the entire trench floor, but do not extend up the back of the trench wall. After the liner installation in the trench has been inspected jointly with the Owner's Representative, and the Geosynthetics Installer's Representative has submitted a certificate of approval that the HDPE Geomembrane was

installed in the anchor trench in accordance with the plans and specifications, the Contractor may backfill the remainder of the trench to the top of the Compacted Clay Liner. Deposit and compact the backfill according to the requirements for general fill in such a manner as to prevent damage to the GCL and HDPE geomembrane.

4. Subsequent to installation of separation geotextile on top of drainage layer, verify that the fabric extends across the top of the initial 1 ft layer of trench backfill, but does not extend up the back of the trench wall. After the fabric installation in the trench has been inspected and approved by the Owner's Representative, backfill the remainder of the trench to the top of the Compacted Clay Liner. Deposit and compact the backfill according to the requirements for general fill in such a manner as to prevent damage to the geotextile fabric.

3.09 TESTING

A. Construction Quality Assurance (CQA) compaction and permeability tests will be made by the Owner's Testing Consultant during the progress of the work as indicated in the Construction Quality Assurance Plan, included in Appendix 2. The Contractor shall cooperate with the Testing Consultant and allow such tests to be performed.

B. If tests indicate that an area of fill or Compacted Clay Liner does not meet the specified requirements, additional tests shall be performed to determine the extent of non-compliance. The Contractor shall moisture condition and recompact that area until a passing test result is obtained.

C. Moisture/density testing by nuclear methods will be conducted by the Owner's Testing Firm at a minimum frequency as outlined in the Construction Quality Assurance (CQA) Plan. The range of moisture content will be determined in accordance with the "acceptable zone" method which is also outlined in the Project CQA Manual. A moisture test will be considered failed if the result indicates that the moisture content does not lie within the "acceptable zone." Material that fails will be dried or wetted until satisfactory moisture content is achieved. A density test will be considered failed if the result indicates a dry density outside the "acceptable zone." The material will be compacted until a passing test is achieved.

To ensure accuracy and reproducibility of testing of the soil liner for compaction and moisture content, all density gauges shall be certified by annual calibration.

3.10 FINISH GRADING

All excavated and filled areas shall be fine graded and leveled to provide a smooth finish free of debris, foreign matter, objectionable stones, clods, lumps, pockets, or high spots, properly drained and true to indicated elevations. Finish grading shall be only near completion of work or when requested. Any portions

of the berm damaged by construction shall be restored. The berm ditch shall be finished to design grade, and the ditch side slopes shaped and trimmed to provide a uniform ditch cross section.

3.11 CONSTRUCTION TOLERANCES

A. Elevations will be surveyed at breaks in slopes and on a 100 ft. grid pattern on the base before and after liner construction to verify liner thickness and to verify that proper drainage slopes to leachate collection piping are maintained. To verify material thickness, all horizontal survey coordinates will be the same for the bottom and the top of the material that is placed. Side slope thicknesses will be verified using crest (top), midpoint, and toe documentation points. A test will be considered failed if it does not meet the minimum design requirements. To obtain the specified design thickness, additional soil material will be placed and compacted in failing areas where the as-built thickness is less than the design thickness. Surveying required for verification of final construction tolerances will be performed by the Owner's Land Surveyor.

B. The minimum specified design thickness of all Compacted Clay Liners shall be 3.00 ft.

END OF SECTION 02200

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PART 1. GENERAL

1.01 DESCRIPTION

This section pertains to the placement of riprap for erosion control.

1.02 RELATED SECTIONS

The following section contains items which are related to the work in this section:

02200 - Earthwork

1.03 REFERENCES

Specified references or cited portions thereof, current at date of bidding documents unless otherwise specified, govern the work.

A. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007.

1.04 SUBMITTALS

Product Data: Provide quarry name and material type prior to delivery.

PART 2. PRODUCTS

2.01 MATERIALS

A. Stone Riprap and Bedding materials according to Article 1005.01 of the Illinois Standard Specifications for Road and Bridge Construction.

B. Filter Fabric material, where required by IDOT specifications for Stone Riprap, shall furnished according to Article 1080.03, with an AOS (Apparent Opening Size) as indicated on the plans.

C. Riprap Source shall be listed on the current IDOT Approved Aggregate Source List.

D. Gradation as indicated in the drawings. Quality shall be Class A.

PART 3. EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. Stone Riprap and Bedding shall be installed in accordance with Section 281 of the Illinois Standard Specifications for Road and Bridge Construction for the placement of Stone Riprap. Measurement and payment provisions of Section 281 shall not apply.

B. Filter Fabric for Stone Riprap shall be installed in accordance with Section 282 of the Illinois Standard Specifications for Road and Bridge Construction.

C. The Owner's Representative shall be allowed to visually inspect Riprap for compliance with specifications prior to placement.

END OF SECTION 02275

PART 1. GENERAL

1.01 DESCRIPTION

A. Gypsum Management Facility

This section pertains to the following:

1. Furnishing and placing granular drainage materials for the drainage layer and Leachate Collection System piping.
2. Furnishing and placing coarse aggregate for encasement of the Process Water Recovery System piping.
3. Furnishing and installing Filter Sand for the protection of the Process Water Recovery System piping.
4. Furnishing and installing materials for roadbed construction related to the Gypsum Management Facility access roads.
5. Recycle Pond Drain.
6. Furnishing and installing materials for roadbed construction related to maintaining McKinley Road on AERG property.
7. ***Furnishing and installing materials for roadbed construction related to the Landfill Haul Road.***

B. CCB Landfill

This section pertains to the following:

1. Placing granular material for Drainage Layer.
2. Placing granular material for Separation Berm.
3. Placing Coarse Aggregate for encasement of leachate collection piping.
4. Furnishing and installing materials for roadbed construction related to the landfill access road.

1.02 RELATED SECTIONS

The following sections contain items which are related to the work in this section:

1. 02300 - Earthwork
2. 02373 – Geotextiles
3. 02640 - Leachate Collection Piping

1.03 REFERENCES

The following references, or cited portions thereof, govern the work:

1. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007.
2. American Society for Testing and Materials (ASTM):

    a. ASTM D 75 (2003) Practice for Sampling Aggregates.
    b. ASTM D 422 (1963; R 2002) Test Method for Particle-Size Analysis of Soils.
    c. ASTM D 2434 (1968, R 2000) Test Method for Permeability of Granular Soils (Constant Head).
    d. ASTM D 3042 (2003) Test Method for Insoluble Residue in Carbonate Aggregates.
    e. ASTM C 1260 (2005) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).

3. American Geological Institute (AGI). Geoscience Handbook AGI Data Sheets, 4th Edition.

1.04 MEASUREMENT AND PAYMENT

The Contractor shall be responsible for estimating the extent of granular materials required to complete the work including, but not limited to, construction of drainage layer, encasement of leachate collection piping, and road-bed construction. The Contractor shall include the dollar amount associated with furnishing and placing all granular materials in his Lump Sum Bid amount.

1.05 COORDINATION

A. The geosynthetic liner shall be covered with granular materials as soon as practicable after a section of liner has been approved by the Owner's Representative.

1.06 SUBMITTALS

A. Product Data:

1. Aggregate source list: Submit a list of proposed aggregate sources.

2. Shipping Tickets: Submit shipping tickets for the granular materials delivered to the site. Shipping tickets shall be according to paragraph 1004.01f of the IDOT Standard Specifications.

B. Test Reports.

1. Submit results of grain size analysis (ASTM D422) and hydraulic conductivity testing (ASTM D2434) for gradations established by the Contractor that provide the specified hydraulic conductivity. Test results are required for each proposed source and gradation. Submit test results for each source demonstrating compliance with reactivity, soundness, and abrasion requirements specified herein.

C. Samples:

1. Submit one sample per source for each gradation proposed for use on the project. Samples shall be at least one pound and shall be obtained and shipped according to ASTM D75. Submit samples at least 15 days prior to starting construction of the drainage layer and coarse aggregate encasement for leachate piping.

1.07 STORAGE AND HANDLING

A. Storage and handling of granular materials shall be according to paragraph 1004.01e of the IDOT Standard Specifications.

PART 2. PRODUCTS

2.01 MATERIALS

A. General

1. Coarse Granular materials shall be meet the Description of Gravel, as described in Section 1004.01(a)(1) of the IDOT Standard Specifications, and shall be spherical to sub-discoidal, sub-rounded to well rounded particles as defined by AGI Data Sheet, 4th Edition, Sheet 8.4 – Comparison Charts for Estimating Roundness and Sphericity.
2. Granular materials shall experience no more than 15 percent carbonate loss per ASTM D3042.
3. Granular materials shall be free of deleterious material, and shall meet the Na_2SO_4 soundness and Los Angeles Abrasion Specifications for Class B quality aggregate per paragraph 1004.01 of the IDOT Standard Specifications.
4. All material shall pass the 2 in. sieve, and no greater than 5 percent shall be retained on the No. 200 sieve.
5. Granular materials shall be innocuous to alkali-silica reactivity, and shall exhibit internal expansions of less than 0.10 percent at 16 days after casting as determined by ASTM C 1260.

B. Gypsum Management Facility Granular Materials

1. Granular Materials for Drainage Layer

Gradation for granular material for Drainage Layer shall be as required to provide a minimum hydraulic conductivity (ASTM D2434) of 1×10^{-3} cm/sec.

2. Coarse Aggregate around Ring Drain Collection Piping

Coarse Aggregate used to encase the ring drain collection piping shall be IDOT Gradation CA 7 material as outlined in Article 1004.01 of the IDOT Standard Specifications for Road and Bridge Construction.

3. Filter Sand

Filter Sand used for protective cover over the ring drain collection system shall be IDOT Gradation FA 1, Class B or better according to Article 1003 of the IDOT Standard Specifications for Road and Bridge Construction.

4. Aggregate Base Course, Type B

Aggregate Base Course, Type B used for base material for all new access roads and ***the Landfill Haul Road*** shall be IDOT Gradation CA 2, in accordance with Section 1004.04 of the IDOT Standard Specifications for Road and Bridge Construction. The requirements from Section 2.01A of this specification shall not apply.

5. Aggregate Surface Course, Type B

Aggregate Surface Course, Type B used for surface material for all new access roads and the ***Landfill Haul Road*** ~~McKinley Road relocation~~ shall be IDOT Gradation CA 6, in accordance with Section 1004.04 of the IDOT Standard Specifications for Road and Bridge Construction. The material shall originate from an IDOT approved source. The requirements from Section 2.01A of this specification shall not apply.

6. Coarse Aggregate for Leachate Collection/Leachate Detection Piping

Gradation for coarse aggregate encasement around Leachate Collection/Leachate Detection Laterals shall be as required to provide a minimum hydraulic conductivity (ASTM D2434) of 1×10^{-1} cm/sec.

B. CCB Landfill Granular Materials

1. Granular Materials for Drainage Layer and Separation Berm.

Gradation for granular material for drainage layer and separation berm shall be as required to provide a minimum hydraulic conductivity (ASTM D2434) of 1×10^{-3} cm/sec.

2. Coarse Aggregate.

Gradation for coarse aggregate shall be as required to provide a minimum hydraulic conductivity (ASTM D2434) of 1×10^{-1} cm/sec.

2.02 EQUIPMENT

Equipment for spreading and compacting granular materials shall be low ground pressure equipment to prevent damage to the underlying geosynthetic liners.

PART 3. EXECUTION

3.01 PROTECTION OF GEOSYNTHETICS

A. Protection of the geosynthetic liners is critically important. Approved geosynthetic liner shall be covered by granular material as soon as practicable. Granular material shall be placed to a minimum thickness of 1 ft before any heavy equipment or loaded trucks are allowed on the lined area.

B. No vehicular traffic shall travel directly on the geosynthetic liner other than an approved low ground pressure All Terrain Vehicle or equivalent.

C. Any damage to the geosynthetic liner system shall be repaired, as directed by the Owner's Representative, at the expense of the Contractor.

3.02 DRAINAGE LAYER (GYPSUM STACK)

A. Placement on Cell Floor

1. The granular material shall be back-dumped on the geotextile cushion fabric in a sequence of operations beginning at the perimeter of the liner on the cell floor.
2. Placement of material on the fabric shall be accomplished by spreading dumped material off of previously placed material with a bulldozer blade or endloader, in such a manner as to prevent tearing or shoving of the cloth. Dumping of material directly on the fabric will only be permitted to establish an initial working platform. No vehicles or construction

equipment shall be allowed on the fabric prior to placement of the granular blanket to a minimum thickness of 1 ft.

B. Placement on Cell Side Slopes

1. Placement of granular material on cell side slopes shall be accomplished using methods and equipment similar to that specified for placement of material on cell floor.
2. The Contractor may place earth fill material underlain with separation geotextile fabric to buttress the granular material on the slope:

   a. The Construction Quality Assurance (CQA) survey to certify thickness of drainage material shall be completed within the footprint of the gypsum stack before it is covered with separation geotextile fabric.
   b. Separation geotextile fabric shall extend beyond the toe of gypsum buttress a sufficient distance to prevent contamination of the granular drainage layer. See Sections 02373 and 02320 for construction of separation geotextile fabric.

3.03 DRAINAGE LAYER (CCB LANDFILL)

A. Placement on Cell Floor.

1. The granular material shall be back-dumped on the geotextile cushion fabric in a sequence of operations beginning at the perimeter of the liner on the cell floor.
2. Placement of material on the fabric shall be accomplished by spreading dumped material off of previously placed material with a bulldozer blade or endloader, in such a manner as to prevent tearing or shoving of the cloth. Dumping of material directly on the fabric will only be permitted to establish an initial working platform. No vehicles or construction equipment shall be allowed on the fabric prior to placement of the granular blanket to a minimum thickness of 1 ft.

B. Placement on Cell Side Slopes.

1. Placement of granular material on cell side slopes shall be accomplished using methods and equipment similar to that specified for placement of material on cell floor.
2. The Contractor may place CCB underlain with separation geotextile fabric to buttress the granular material on the slope:

   a. The Construction Quality Assurance (CQA) survey to certify thickness if drainage material shall be completed within the footprint of the CCB before CCB placement.

b. Separation geotextile fabric shall extend beyond the toe of CCB buttress a sufficient distance to prevent contamination of the granular drainage layer. See Sections 02373 and 02320 for construction of separation geotextile fabric and CCB, respectively.

C. Placement in Separation Berm.

1. Granular material for the separation berm shall be placed and spread in uniform lifts not to exceed 1 ft. The initial lift shall be placed according to paragraph A. The separation berm shall be constructed across the floor of the cell to at least the level of the top of drainage layer before any CCB is placed within the cell, and the top of berm shall be maintained at or above the level of adjacent CCB as CCB placement progresses.

3.04 COARSE AGGREGATE FOR ENCASEMENT OF RING DRAIN COLLECTION PIPING (GYPSUM MANAGEMENT FACILITY)

A. The geotextile filter fabric for encasement of leachate collection piping shall be placed on the approved cushion geotextile fabric according to Section 02373 – Geotextiles.

B. The coarse aggregate shall be placed and consolidated with a vibratory plate compactor on the encasement fabric to the width shown on the plans to the level of the bottom of the ring drain collection piping.

C. Course aggregate shall be placed and consolidated with a vibratory plate compactor along the pipe during pipe installation. The coarse aggregate shall be placed longitudinally along the pipe in lifts not to exceed 8 in. thick to a height of at least the center of the pipe. The aggregate shall be maintained at equal elevation on each side of the pipe, and the first lift of material shall be mechanically tamped to ensure that the space under the pipe is completely filled. The top of pipe shall not be covered until the CQA survey certifies leachate piping grade has been completed.

D. After the CQA survey has been completed, coarse aggregate material shall continue to be placed in lifts not to exceed 8 in. thick, as specified in the previous paragraph until the minimum cover height shown in the plans is attained.

E. The running of trucks or heavy equipment over leachate piping shall be avoided until there is at least a 12 in. cover of Filter Sand over the completed geotextile envelope.

3.05 COARSE AGGREGATE FOR ENCASEMENT OF LEACHATE COLLECTION PIPING (CCB LANDFILL)

A. Place geotextile fabric for encasement of leachate collection piping on the approved cushion geotextile fabric according to Section 02373 – Geotextiles.

B. Place and consolidate coarse aggregate with a vibratory plate compactor on the encasement fabric to the width shown on the plans to the level of the bottom of the leachate piping.

C. Place and consolidate course aggregate along the pipe during pipe installation. Place coarse aggregate longitudinally along the pipe in lifts not to exceed 8 in. thick to a height of at least the center of the pipe. Maintain the aggregate at equal elevation on each side of the pipe, and mechanically tamp the first lift of material to ensure that the space under the pipe is completely filled. Do not cover the top of pipe until the CQA survey to certify leachate piping grade has been completed.

C. After the CQA survey has been completed, continue placing coarse aggregate material in lifts not to exceed 8 in. thick, as specified in the previous paragraph until the minimum cover height shown in the plans is attained.

D. Avoid running trucks or heavy equipment over leachate piping until there is at least 12 in. cover over the completed geotextile envelope. Provide temporary ramps no steeper than 10H:1V transverse to the piping for temporary equipment crossings until the first lift of CCB is placed.

3.06 ROADWAY CONSTRUCTION

A. Prepare the roadway subgrade as shown on the plans, in accordance with Section 02200 – Earthwork.

B. Furnish Geotechnical Fabric for Ground Stabilization in accordance with Section 02373 – Geotextiles.

C. Furnish Aggregate Base Course, Type B in accordance with Article 351 of the IDOT Standard Specifications for Road and Bridge Construction.

D. Furnish Aggregate Surface Course, Type B in accordance with Article 402 of the IDOT Standard Specifications for Road and Bridge Construction.

3.07 TESTING

A. Independent gradation and permeability tests will be made by the Owner's Testing Lab during the progress of the work at frequencies as required in the project Construction Quality Assurance (CQA) Plan, included in Appendix 2.

The Contractor shall cooperate with the Testing Lab and allow such tests to be performed.

B. If tests indicate that an area of granular material or coarse aggregate does not meet the specified requirements of the project CQA Plan, then the Contractor shall remove the material and replace it with suitable material.

3.05 FINISH GRADING

The granular drainage layer shall be fine graded, but not compacted, to provide a smooth finish before a CQA survey of the completed portion of the drainage layer is requested. The CQA Officer shall direct the survey agency to determine elevations at the top of the final constructed surface of the Drainage Layer using a 100 ft. grid pattern (and the break points in slope) to verify attainment of the plan grades and elevations. To verify thickness, all horizontal survey coordinates shall be the same for the top of the cushion, and final constructed surface. Side slope thicknesses will be verified using crest (top), midpoint, and toe documentation points. In co instance shall the field determined thickness be less than 1.0 ft. The measured depths and grades shall be documented on "as built" drawings furnished to the CQA Officer by the survey agency. Ruts or erosion damage shall be repaired before placement of the separation geotextile fabric.

END OF SECTION 02315

PART 1. GENERAL

1.01 DESCRIPTION

This section pertains to furnishing and installing geotextile fabrics on prepared surfaces.

1.02 RELATED SECTIONS

The following sections contain items which are related to the work in this section:

1. 02300 - Earthwork
2. 02315 - Granular Materials
3. 02800 – HDPE Geomembrane

1.03 REFERENCES

The following references, or cited portions thereof, govern the work:

1. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007.
2. American Society for Testing and Materials (ASTM):

    a. ASTM 3776 (1996; R 2002) Standard Test Method for Mass per Unit Area (Weight) of Fabric;
    b. ASTM D 3786 (2001) Test Method for Hydraulic Bursting Strength of Textile Fabrics -- Diaphragm Bursting Strength Tester Method;
    c. ASTM D 4533 (2004) Test Method for Trapezoid Tearing Strength of Geotextiles;
    d. ASTM D 4632 (1991; R 2003) Test Method for Grab Breaking Load and Elongation of Geotextiles;
    e. ASTM D 4751 (2004) Test Method for Determining Apparent Opening Size of Geotextile;
    f. ASTM D 4833 (2000) Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products;
    g. ASTM D 4873 (2002) Guide for Identification, Storage, and Handling of Geosynthetic Rolls;
    h. ASTM D 4884 (1996; R 2003) Test Method for Strength of Sewn or Thermally Bonded Seams of Geotextiles;
    i. ASTM D5261-92(2003) Standard Test Method for Measuring Mass per Unit Area of Geotextiles

j. ASTM D6241-04 Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

1.04 MEASUREMENT AND PAYMENT

A. The Contractor shall be responsible for estimating the extent of geotextile fabric required to complete the work including fabric for laps, anchorage, repairs, and samples for Construction Quality Assurance (CQA) testing. The Contractor shall include the dollar amount associated with all geotextile construction in his Lump Sum Bid amount, except as specified in paragraph B.

B. Geotextile Fabric for Ground Stabilization, when directed by the Owner's Representative for stabilization of foundation soils, will be paid for on a time and materials basis.

C. No additional payment will be made for geotextile fabric for ground stabilization installed at the Contractor's discretion.

1.05 SUBMITTALS

A. Product Data

1. The manufacturer's list of guaranteed properties for each geotextile fabric proposed for use on the project shall be submitted.
2. The manufacturer's installation guidelines shall be submitted.

B. Samples

Samples of geotextile fabrics shall be submitted for CQA prequalification testing. Sample size and sampling frequency are specified in Appendix 2.

C. Inventory

A copy of the roll inventory that identifies, as a minimum, manufacturer or supplier, product or style number, roll number, width, and length of roll as identified on the roll label shall be submitted.

1.06 STORAGE AND HANDLING

Geotextiles shall be stored and handled according to ASTM D4873.

PART 2. PRODUCTS

2.01 MATERIALS

A. Geotextile Fabric for Liner System

Geotextile fabrics for use in the cell liner system shall consist of non-woven filaments of polypropylene, polyester, or polyethylene. Stabilizers and/or inhibitors shall be added to the base polymer if necessary to make the filaments resistant to deterioration caused by ultraviolet light and heat exposure. Reclaimed or recycled fibers or polymer shall not be added to the formulation. Non-woven fabric may be needle-punched, heat-bonded, or a combination thereof. The filaments shall be dimensionally stable (i.e., filaments shall maintain their relative position with respect to each other) and resistant to delamination. The edges of the geotextile shall be finished to prevent the outer fiber from pulling away from the geotextile. The filaments shall be free from any chemical treatment or coating that might significantly reduce porosity and permeability.

Fabric shall have the following physical properties:

Physical Properties[1]	4 oz. (Separation)	6 oz. (PWRS)	16 oz. (CA Envelope & Rub Sheet)
Mass/Unit Area (oz./yd^2) ASTM D5261	4.0	6.0	16.0
Grab Tensile Strength (lb.) ASTM D4632	115	160	380
Grab Elongation (%) ASTM D4632	50	50	50
Puncture Strength (lb.) ASTM D4833	65	85	240
Puncture (CBR) Strength (lb.) ASTM D6241	310	410	1025
Mullen Burst Strength (psi) ASTM D3786	210	280	750
Trapezoidal Tear Strength (lb.) ASTM D4533	50	60	150
Width (ft.)	15	15	15
Apparent Opening Size (AOS) Max. US Std. Sieve No. ASTM D4751	70	70	100
UV Resistance[2] (%) ASTM D4355	70	70	70
Roll Width (ft.)	15	15	15

Notes

(1) All Values listed are Minimum Average Roll Values (MARV) unless otherwise noted, calculated as the typical minus two standard deviations.

(2) UV Resistance is a minimum value and not a MARV. Evaluation to be on 2.0 inch strip tensile specimens after 500 hours exposure.

B. Geotextile Cushion

Fabric for Geotextile Cushion shall consist of non-woven filaments of polypropylene, polyester, or polyethylene. Stabilizers and/or inhibitors shall be added to the base polymer if necessary to make the filaments resistant to deterioration caused by ultraviolet light and heat exposure. Reclaimed or recycled fibers or polymer shall not be added to the formulation. Non-woven fabric may be needle-punched, heat-bonded, or a combination thereof. The filaments shall be dimensionally stable (i.e., filaments shall maintain their relative position with respect to each other) and resistant to delamination. The edges of the geotextile shall be finished to prevent the outer fiber from pulling away from the geotextile. The filaments shall be free from any chemical treatment or coating that might significantly reduce porosity and permeability.

Fabric shall have the following physical properties:

Physical Properties[1]	**10 oz. (Geotextile Cushion)**
Mass per unit area (oz/yd^2) ASTM D5261	10
Grab Tensile Strength (lb.) ASTM D4632	230
Grab Tensile Elongation (%) ASTM D4632	50
Trapezoidal Tear Strength (lb.) ASTM D4533	95
Puncture (CBR) Strength (lb.) ASTM D6241	700
Puncture (CBR) Elongation (in.) ASTM D6241	1.5
UV Resistance[2] (%) ASTM D4355	70
Apparent Opening Size (Max.) (AOS) Sieve No. - ASTM D4751	---
Roll Width (ft.)	15

Notes

(1) All Values listed are Minimum Average Roll Values (MARV) unless otherwise noted, calculated as the typical minus two standard deviations.

(2) UV Resistance is a minimum value and not a MARV. Evaluation to be on 2.0 inch strip tensile specimens after 500 hours exposure.

C. Geotechnical Fabric for Ground Stabilization

Geotechnical fabric for ground stabilization shall conform to Article 1080.02 of the IDOT Standard Specifications for Road and Bridge Construction.

D. Thread for Seams

High strength thread should be used such that seam test should conform to ASTM D4884. The thread shall meet the chemical, ultraviolet, and physical requirements of the geotextile, and the color shall be different from that of the geotextile.

E. Securing Devices

Pins, staples, and other devices that project through the geotextile fabric are not permitted for fabrics installed above the geomembrane. Sandbags, stone, or other appropriate means approved by the Owner's Representative shall be used to prevent movement of the geotextile.

2.02 EQUIPMENT

A. Equipment for spreading and compacting granular materials shall be low ground pressure equipment to prevent damage to the underlying geosynthetic liners.

PART 3. EXECUTION

3.01 SAMPLES FOR CQA TESTING

A. Geotextile fabric samples shall be obtained, identified and packaged from rolls designated by the Owner's Representative according to ASTM D4873.

B. Samples shall be 3 ft. wide by the full roll width.

3.02 BASE PREPARATION

A. Surface on which the geotextile will be placed shall be prepared to a relatively smooth surface condition, and shall be free from obstruction, debris, depressions, erosion features, or any irregularities that would prevent continuous, intimate contact of the geotextile with the entire surface. Rills, gullies, and ruts must be graded out of the surface before geotextile placement. Areas on which geotextile are to be placed shall be graded and/or dressed in accordance with Section 02200 – Earthwork and Section 02315 – Granular Materials. Prior to daily placement, the Installer shall provide the CQA Officer daily "certificates of acceptance" which document the Installer's inspection and acceptance of the underlying surface as being suitable for the geotextile installation.

B. Geotextile cushion fabric will be installed directly on the geosynthetic liner. Jointly inspect the liner with the Owner's Representative before commencing fabric installation each day. Notify the Owner's Representative promptly of any damage or defects observed in the liner as fabric installation progresses. Do not place fabric in the damaged or defective area until the liner has been repaired and

approved by the Owner's Representative. Submit a daily inspection report identifying the area of fabric placement and certifying that there were no visible defects in the area of fabric placement.

C. Do not run heavy vehicle traffic directly on the geosynthetic liner or cushion geotextile. Use vehicles and equipment as specified in paragraph 2.02 to transport and deploy fabric on the liner. Operate the equipment with care, and place protective cover over the geomembrane, if necessary, to avoid damaging the liner. Route traffic and personnel over installed cushion fabric and use the installed fabric as a working platform to the greatest extent possible.

3.03 INSTALLATION

A. General Requirements:

1. Geotextile fabric shall be unrolled and laid out following these requirements to the greatest extent practical:

   a. Orient panels with the longest dimension parallel to the slope.
   b. Minimize the number of seams in corners and odd-shaped areas.
   c. Extend panels on slopes a minimum of 5 ft onto a horizontal surface.

   Geotextile panels shall be unrolled using methods that will not damage the fabric and will protect underlying surface from damage. While unrolling, the geotextile fabric shall be visually inspected for imperfections and faulty or suspect areas marked. Ballast shall be placed on fabric to prevent wind uplift. Expansion and contraction should be allowed for by leaving slack.

   Heavy vehicle traffic shall not be run directly on geotextile fabric. Fabric in areas of heavy traffic shall be protected with protective cover over the fabric.

2. Laps

   Individual panels of geotextile fabric shall be lapped according to manufacturer's instructions and as specified herein. Provide a minimum overlap of 3 in. unless otherwise specified herein or in the plans. Shingle overlaps so that water or other material cannot run down the slope between the two layers of fabric.

3. Field Seams

Continuously sew all laps on slopes steeper than 10H:1V. This requirement does not apply to the heavy geotextile fabric for envelopment of coarse aggregate around leachate piping.

4. Defects and Repairs

Examine the installed geotextile fabric for defects, holes discontinuous seams, puckered or separated laps, etc. Repair defective laps and seams. Patch holes and defects according to manufacturer's recommendations and as directed by the Owner's Representative. Do not cover suspect or patched areas until they have been inspected and approved by the Owner's Representative.

B. Geotextile Fabric for Separation

1. Use low ground pressure equipment to avoid rutting the granular material.
2. Horizontal seams (parallel to top of slope) will be permitted on cell side slopes to facilitate staged construction of the drainage layer on the side slope.
3. Extend separation geotextile fabric into and across the bottom of the anchor trench and complete backfill of the trench according to Section 02200.

C. Geotextile Fabric for Coarse Aggregate Envelope

1. Geotextile for coarse aggregate envelope will be installed directly on the cushion fabric. Remove any foreign materials from the cushion fabric within the footprint of the coarse aggregate leachate piping encasement before installing the geotextile envelope. Place sufficient width to completely envelop the coarse aggregate and provide a longitudinal lap of at least 6 in.
2. After the coarse aggregate encasement has been completed, according to Section 02315, wrap the geotextile around the mounded aggregate, and cover the lap with at least 6 in. of material before permitting vehicle or equipment on the fabric.
3. Any ballast material other than coarse aggregate, according to Section 02315, that is placed within the envelope will require removal during coarse aggregate construction.

D. Geotechnical Fabric for Ground Stabilization

1. Install Geotechnical Fabric for Ground Stabilization in accordance with Section 210 of the IDOT Standard Specifications for Road and Bridge Construction.

2. If approved by the Owner's Representative, the Contractor may, at his own expense, install geotextile or geogrid for ground stabilization outside the limits designated by the Owner's Representative.
3. Submit as-built drawings that clearly delineate limits and type of ground stabilization.

3.04 PROTECTION

A. Protect installed fabric until it is covered by at least 1 ft. of overlying material.

B. Any damage to the geotextile during its installation or during placement of overlying materials shall be replaced by the Contractor at no cost to the Owner. Unless otherwise noted, the work shall be scheduled so that the covering of the geotextile with a layer of the specified material is accomplished within 14 calendar days after placement of the geotextile. Failure to comply shall require replacement of geotextile. The geotextile shall be protected from damage prior to and during the placement of overlying materials. Before placement of overlying materials, the Contractor shall demonstrate that the placement technique will not cause damage to the geotextile.

3.05 TESTING AND INSPECTION

A. Prequalification Testing

Geotextiles are subject to CQA testing by the Owner's Testing Consultant to verify conformance with the manufacturer's list of guaranteed properties according to the project Construction Quality Assurance Plan, included in Appendix 2. The Contractor shall provide samples as specified herein. Any fabric that does not conform to the list of guaranteed properties shall be removed from the site.

B. Installed fabric shall be inspected by the Owner's Representative. No material shall be placed on the fabric, other than ballast, until the installation has been approved by the Owner's Representative. Ballast shall not obscure seams or significant length of unseamed laps. The Owner's Representative may require removal of ballast to inspect suspect areas.

C. If the Owner's Representative suspects that completed work has been damaged by construction methods that do not conform to the specifications, he may require removal of completed work to verify the integrity of the underlying materials. The Contractor shall bear the cost of removal and subsequent repair as directed by the Owner's Representative, if the integrity of the underlying materials was damaged. If no damage was found, the Owner will pay the Contractor for the investigation work on a time and materials basis.

END OF SECTION 02373

PART 1. GENERAL

1.01 DESCRIPTION

A. This section covers furnishing and installation of a reinforced needlepunched Geosynthetic Clay Liner (GCL) at the Gypsum Management Facility and the CCB Landfill.

B. The work includes furnishing all equipment and materials, providing all labor, supervision, administration and management necessary to perform the work as specified herein and as shown on the plans.

1.02 RELATED SECTIONS

None.

1.03 REFERENCES

The following references, or cited portions thereof, govern the work

1. Geosynthetic Institute

   a. GRI-GCL3, Test Methods, Required Properties, and Testing Frequencies of Geosynthetic Clay Liners (GCLs).

2. American Society for Testing and Materials (ASTM):

   a. ASTM D 4632 (1991; R 2003), Standard Test Method for Grab Breaking Load and Elongation of Geotextiles;
   b. ASTM D 4643 (2000), Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method;
   c. ASTM D 5084 (2003), Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter;
   d. ASTM D 5261 (1992; R 2003), Test Method for Measuring Mass Per Unit Area of Geotextiles;
   e. ASTM D 5321 (2002), Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method;

f. ASTM D 5887 (2004), Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter;

g. ASTM D 5888 (1995; R 2002), Practice for Storage and Handling of Geosynthetic Clay Liners;

h. ASTM D 5889 (1997; R 2003), Practice for Quality Control of Geosynthetic Clay Liners;

i. ASTM D 5890 (2002), Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners;

j. ASTM D 5891 (2002), Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners.

1.04 SUBMITTALS

A. With the bid, the Contractor shall furnish the following information:

1. Conceptual description of the proposed plan for placement of the GCL panels over the areas of installation.
2. GCL Manufacturer's Quality Control (MQC) Plan for documenting compliance with Sections 2.01 and 2.02 of these specifications.
3. GCL manufacturer's historical data for reinforced GCL of a) 10,000-hour creep shear testing per Section 2.01 D. and b) seam flow data at 2 psi confining pressure per Section 2.01 E.
4. A copy of GCL manufacturer's International Standards Organization (ISO) Quality Certificate of Registration.
5. Statement of experience from the proposed GCL supplier.
6. Statement of experience from the proposed GCL installer.

B. At the Owner Representative's or Owner's request, the Contractor shall furnish:

1. A representative sample of the GCLs.
2. A project reference list for the GCL(s) consisting of the principal details of at least ten projects totaling at least 10 million sq. ft (100,000 sq. meters) in size.

C. Upon shipment, the Contractor shall furnish:

1. The GCL manufacturer's Quality Assurance/Quality Control (QA/QC) certifications to verify that the materials supplied for the project are in accordance with the requirements of this specification.
2. Inventory of materials received.

D. As installation proceeds, the Geosynthetics Installer's Representative shall submit certificates of subgrade acceptance, signed by the Contractor and Construction Quality Assurance (CQA) Inspector (see Sections 1.06 and 3.03) for each area that is covered by the GCL.

E. Warranty

After construction, the contractor shall submit material and installation warranty certificates.

1.05 QUALIFICATIONS

A. GCL Manufacturer must have produced at least 10 million sq. ft. (1 million sq. meters) of GCL, with at least 8 million sq. ft. (800,000 sq. meters) installed.

B. The GCL Installer must either have installed at least 1 million sq. ft. (100,000 sq. meters) of GCL, or must provide to the Engineer satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the GCL will be installed in a competent, professional manner.

1.06 CONSTRUCTION QUALITY ASSURANCE (CQA)

A. Construction Quality Assurance of the GCL installation shall be performed as outlined in the project Construction Quality Assurance Plan, included in Appendix 2 of these Specifications.

B. The GCL Installer shall provide his own CQA inspector. The Owner shall provide a third-party inspector for CQA monitoring of the GCL installation. The inspector shall be an individual or company who is independent from the manufacturer and installer and who shall be responsible for monitoring and documenting activities, related to the CQA of the GCL throughout installation.

C. Testing of the GCL as necessary to support the CQA effort shall be performed by a third party laboratory retained by the Owner and independent from the GCL manufacturer and installer.

WARRANTY

The geomembrane material shall be warranted, on a pro-rata basis against manufacturer's defects for a period of five (5) years from the date of liner installation. The installation shall be warranted against defects in workmanship for a period of (1) year from the date of liner completion.

PART 2. PRODUCTS

2.01 MATERIALS

A. The GCL shall be manufactured as a hydraulic barrier consisting of clay bonded between two layers of nonwoven geotextile by needle punching.

B. The GCL shall be manufactured to conform with the test methods, required properties, and testing frequencies of the GRI-GCL3 specification for Reinforced, Geotextile Related GCL.

C. In addition to the minimum properties given in Table 1(a) of GRI-GCL3, the GCL shall conform to the following specifications.

Test Method	Minimum Value
Bentonite Mass/Area (ASTM D 5993)	0.75 lb./ft^2
GCL Grab Tensile Strength (ASTM D 4632)	90 lb.
GCL Peel Strength (ASTM D 4632)	15 lb.

D. The reinforced GCL shall have seam test data from an independent laboratory showing that the seam flow with a grooved cut in one of the nonwoven geotextiles is less than 1×10^{-8} m^3/m^2/s at 2 psi hydraulic pressure.

E. The minimum acceptable dimensions of full-size GCL panels shall be 150 ft. (45.7 m) in length. Short rolls [(those manufactured to a length greater than 70 ft. (21 meters) but less than a full-length roll)] may be supplied at a rate no greater than three (3) per truckload or three (3) rolls every 36,000 sq. ft. (3,500 sq. meters) of GCL, whichever is less.

2.02 PRODUCT QUALITY DOCUMENTATION

The GCL manufacturer shall provide the Contractor or other designated party with manufacturing QA/QC certifications for each shipment of GCL. The certifications shall be signed by a responsible party employed by the GCL manufacturer and shall include:

A. The Manufacturer's Certification that the material was manufactured and tested in accordance with GRI-GCL3 specifications, together with a report of the test results, shall be furnished at the time of shipment.

B. The manufacturers recommended seaming method with seam test data from an independent laboratory showing that the seam flow is less than 1×10^{-8} m^3/m^2/s at 2 psi hydraulic pressure.

C. GCL lot and roll numbers supplied for the project (with corresponding shipping information).

2.03 PRODUCT LABELING

A. Prior to shipment, the GCL manufacturer shall label each roll, identifying:

1. Product identification information (Manufacturer's name and address, brand product code).

2. Lot number and roll number.
3. Roll length, width and weight.

2.04 PACKAGING

A. The GCL shall be wound around a rigid core whose diameter is sufficient to facilitate handling. The core is not necessarily intended to support the roll for lifting but should be sufficiently strong to prevent collapse during transit.

B. All rolls shall be labeled and bagged in packaging that is resistant to photodegradation by ultraviolet (UV) light.

2.05 ACCESSORY BENTONITE

A. The granular bentonite sealing clay used for overlap seaming, penetration sealing and repairs shall be made from the same natural sodium bentonite as used in the GCL and shall be as recommended by the GCL manufacturer. Seaming of GCLs shall be conducted in accordance with the manufacturer's guidelines for each particular GCL.

PART 3. EXECUTION

3.01 SHIPPING AND HANDLING

A. The rolls of GCL shall be packaged and shipped by appropriate means to prevent damage to the material and to facilitate off-loading.

B. The Installation Supervisor shall be present during delivery and unloading of the GCL. A visual inspection of each roll should be made during unloading to identify if any packaging has been damaged. Rolls with damaged packaging should be marked and set aside for further inspection. The packaging should be repaired prior to being placed in storage. The Installation Supervisor shall prepare and submit an inventory that includes lot and roll number for materials received.

C. The Installer is responsible for unloading the GCL. The Installer should contact the Manufacturer prior to shipment to ascertain the appropriateness of the proposed unloading methods and equipment.

3.02 STORAGE

A. Storage of the GCL rolls and accessory bentonite shall be the responsibility of the Installer.

B. Rolls should be stored in a manner that prevents sliding or rolling from the stacks and may be accomplished by the use of chock blocks. Rolls should be stacked at a height no higher than that at which the lifting apparatus can be safely handled (typically no higher than four).

C. All stored GCL materials and the accessory bentonite must be covered with a plastic sheet or tarpaulin until their installation.

D. The integrity and legibility of the labels shall be preserved during storage.

3.03 EARTHWORK

A. The compacted clay liner upon which the GCL is installed shall be prepared and compacted prior to installation. The surface shall be smooth, firm, and unyielding, and free of:

1. Vegetation.
2. Construction debris.
3. Sticks.
4. Sharp rocks.
5. Void spaces.
6. Ice.
7. Abrupt elevation changes.
8. Standing water.
9. Cracks larger than 0.25 in. (6 mm) in width.
10. Any other foreign matter that could contact the GCL.

B. Immediately prior to GCL deployment, the compacted clay liner shall be final-graded by the contractor to fill in all voids or cracks and then smooth-rolled to provide the best practicable surface for the GCL. At completion of this activity, no wheel ruts, footprints or other irregularities shall exist in the subgrade. Furthermore, all protrusions extending more than 0.5 in. (12 mm) from the surface shall either be removed, crushed or pushed into the surface with a smooth-drum compactor.

C. Prior to daily GCL placement, the installer shall provide to the CQA Officer daily "certificates of acceptance" which document the Installer's inspection and acceptance of the underlying surface as being suitable for GCL installation.

D. It shall be the Installer's responsibility thereafter to indicate to the Owner's Representative any change in the condition of the compacted clay liner that could cause the subgrade to be out of compliance with any of the requirements listed in this Section. The Installation Supervisor shall certify in the daily report that no GCL was placed over visibly defective low permeability soil surface.

E. At the top of sloped areas of the job site, an anchor trench for the GCL shall be excavated by the contractor in accordance with the project plans. The trench shall be excavated and approved by the CQA Inspector prior to GCL placement. No loose soil shall be allowed at the bottom of the trench and no sharp corners or protrusions shall exist anywhere within the trench.

3.04 GCL PLACEMENT

A. GCL rolls shall be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging shall be carefully removed without damaging the GCL. The orientation of the GCL (i.e., which side faces up) shall be in accordance with the Owner Representative's recommendations.

B. Equipment which could damage the GCL, shall not be allowed to travel directly on it. If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues.

C. Care must be taken to minimize the extent to which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL. A temporary geosynthetic subgrade covering commonly known as a slip sheet or rub sheet may be used to reduce friction damage during placement.

D. The GCL panels shall be placed parallel to the direction of the slope.

E. All GCL panels shall lie flat on the underlying surface, with no wrinkles or folds, especially at the exposed edges of the panels.

F. Only as much GCL shall be deployed as can be covered at the end of the working day with soil, a geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, the Installer shall remove and replace the hydrated material as directed by the Owner Representative.

3.05 ANCHORAGE

A. As directed by the project drawings and specifications, the end of the GCL roll shall be placed in an anchor trench at the top of the slope. The front edge of the trench shall be rounded so as to eliminate any sharp corners. Loose soil shall be removed from the floor of the trench. The GCL shall cover the entire trench floor, but shall not extend up the rear trench wall.

3.06 SEAMING

A. The GCL seams shall be constructed by overlapping their adjacent edges according to the manufacturer's recommendations. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris.

B. End-of-roll overlapped seams shall be constructed with a minimum overlap of 24 in. (600 mm). Seams at the ends of the panels should be constructed such that they are shingled in the direction of the grade to prevent the potential for runoff

flow to enter the overlap zone. End-of-roll overlapped seams for all reinforced GCL seams require bentonite-enhanced seams as described below.

C. Bentonite-enhanced seams shall be constructed between the overlapping adjacent panels as follows. The underlying edge of the longitudinal overlap is exposed and then a continuous bead of granular sodium bentonite is applied along a zone defined by the edge of the underlying panel and the 6-inch (150 mm) line. The granular bentonite shall be applied at a minimum application rate of one quarter pound per lineal ft. (0.4 kg/m). A similar bead of granular sodium bentonite is applied at the end-of-roll overlap.

3.07 DETAIL WORK

A. There shall be no penetrations through the GCL.

B. Cutting the GCL should be performed using a sharp utility knife. Frequent blade changes are recommended to avoid damage to the geotextile components of the GCL during the cutting process.

3.08 DAMAGE REPAIR

A. If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible, if approved by the Owner's Representative, to repair it by cutting a patch to fit over the damaged area. The patch shall be obtained from a new GCL roll and shall be cut to size such that a minimum overlap of 12 in. (300 mm) is achieved around all of the damaged area. Granular bentonite or bentonite mastic shall be applied around the damaged area prior to placement of the patch. It may be desirable to use an adhesive to affix the patch in place so that it is not displaced during cover placement. Patching shall be certified by the Installer's CQA Inspector and observed by the Owner's Representative.

PART 4. GRI-GCL3 SPECIFICATIONS

Geosynthetics Research Institute (GRI) GRI-GCL3, "Test Methods, Required Properties, and Testing Frequencies of Geosynthetic Clay Liners (GCLs).", Dated -- May 16, 2005.

END OF SECTION 02376

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Original - May 16, 2005

GRI-GCL3*

Standard Specification for

"Test Methods, Required Properties, and Testing Frequencies of Geosynthetic Clay Liners (GCLs)"

This specification was developed by the Geosynthetic Research Institute (GRI), with the cooperation of the member organizations for general use by the public. It is completely optional in this regard and can be superseded by other existing or new specifications on the subject matter in whole or in part. Neither GRI, the Geosynthetic Institute, nor any of its related institutes, warrant or indemnifies any materials produced according to this specification either at this time or in the future.

1. Scope

1.1 This specification covers the manufacturing quality control (MQC) of geosynthetic clay liners (GCLs), describing types of tests, the proper test methods, minimum and sometimes maximum values, and the minimum testing frequencies.

Note 1: Geosynthetic Clay Liners (GCLs) are also called Clay Geosynthetics Barriers (GBR-Cs).

1.2 There are two general categories of GCLs covered in this specification: reinforced and nonreinforced. Within each category there are geotextile, polymer coated geotextiles, and geomembrane/geofilm related types.

1.3 This specification is intended to aid manufacturers, suppliers, purchasers and users of GCLs in establishing an acceptable level of effort for manufacturing quality control.

*This GRI standard is developed by the Geosynthetic Research Institute through consultation and review by the member organizations. This specification will be reviewed at least every 2-years, or on an as-required basis. In this regard it is subject to change at any time. The most recent revision date is the effective version.

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1.4 This specification does not address manufacturing quality assurance (MQA), product acceptance testing, or conformance testing. These are independent activities taken by organizations other than the GCL manufacturer.

1.5 The values stated in SI (metric) units are to be regarded as the standard. The U.S. (English) units are calculated values using a "soft" conversion accuracy.

1.6 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 ASTM Standards

D 638 Test Method for Tensile Properties of Plastics
D 792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
D 882 Test Method for Tensile Properties of Thin Plastic Sheeting
D 1141 Practice for Preparation of Substitute Ocean Water
D 1505 Test Method for Density of Plastics by the Density-Gradient Method
D 4354 Practice for Sampling of Geosynthetics for Testing
D 4439 Terminology for Geosynthetics
D 4632 Test Method for Grab Breaking Load and Elongation of Geotextiles
D 4759 Practice for Determining the Specification Conformance of Geosynthetics
D 5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
D 5261 Test Method for Measuring Mass per Unit Area of Geotextiles
D 5721 Practice for Air-Oven Aging of Polyolefin Geomembranes
D 5887 Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using Flexible Wall Permeameter
D 5888 Practice for Storage and Handling of Geosynthetic Clay Liners
D 5889 Practice for Quality Control of Geosynthetic Clay Liners
D 5890 Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners
D 5891 Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners
D 5993 Test Method for Measuring the Mass Per Unit Area of Geosynthetic Clay Liners
D 5994 Test Method for Measuring the Core Thickness of Textured Geomembrane
D 6102 Guide for Installation of Geosynthetic Clay Liners
D 6141 Guide for Screening the Clay Portion of a GCL for Chemical Compatibility to Liquids

D 6243 Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method

D 6495 Guide for Acceptance Testing Requirements for Geosynthetic Clay Liners

D 6496 Test Method for Determining Average Bonding Peel Strength Between the Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners

D 6693 Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

D 6766 Test Method for Evaluation of Hydraulic Properties of Geosynthetic Clay Liners Permeated with Potentially Incompatible Liquids

D 6768 Test Method for Tensile Strength of Geosynthetic Clay Liners

2.2 GRI Standards

GM13 Test Properties, Testing Frequency and Recommended Warrant for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes

GM17 Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes

GM18 Test Properties, Testing Frequency and Recommended Warrant for Flexible Polypropylene (fPP and fPP-R) Nonreinforced and Reinforced Geomembranes (Presently suspended as of May 3, 2004)

2.3 Government Document:

U.S. Environmental Protection Agency Technical Guidance Document "Quality Control Assurance and Quality Control for Waste Containment Facilities," EPA/600/R-93/182. September 1993. 305 pgs.

3. Terminology

3.1 Definition

3.1.1 Geosynthetic Definitions:

3.1.1.1 geotextile, n a permeability geosynthetic comprised solely of textiles. (ASTM D 4439)

3.1.1.2 geomembrane, n—an essentially impermeable geosynthetic barrier composed of one or more synthetic sheets. (ASTM D 4439)

3.1.1.3 geofilm, n—a thin polymeric film which is essentially impermeable having a thickness no greater than 0.25 mm (10 mils).

3.1.1.4 geotextile-polymer, n -a geotextile which has been coated with, or impregnated by, a polymer such as polypropylene

3.1.1.5 geosynthetic clay liner, n—a manufactured hydraulic barrier consisting of clay bonded to a layer or layers of geosynthetic materials. (ASTM D 4439)

Note 1: Geotextile Related GCL is one in which two geotextiles are used respectively as cap and carrier to the bentonite. Cap and carrier designations in this standard refer to respective orientations during manufacturing. This may or may not be the as-placed orientation in the field. It can be internally reinforced by needle punching or stitching, or be nonreinforced.
Geotextile Polymer Coated GCL is one in which two geotextiles are used respectively as cap and carrier to the encased bentonite, however, one of the geotextiles has been polymer coated in a manner that the permeability and flux are decreased. Cap and carrier designations refer to the as manufactured product and not necessarily to the as-placed orientation. It can be internally reinforced by needle punching or stitching, or be nonreinforced.
Geomembrane/Geofilm Related GCL is one in which a geomembrane or geofilm is included in the cross section either above or below the cap geotextile. It can be internally reinforced needle punching or be nonreinforced. Also in the nonreinforced category is bentonite adhesively bonded to a geomembrane.

3.1.2 Material Definitions

3.1.2.1 bentonite—a distinct type of fine-grained clay soil typically containing not less than 80% montmorillionite clay, usually characterized by high swelling upon wetting.

3.1.2.2 Formulation, n - The mixture of a unique combination of ingredients identified by type, properties and quantity. For geosynthetic materials, a formulation refers to the exact percentages of resin, additives, carbon black and/or other additives. It does not necessarily refer to individual suppliers of each ingredient. The individual suppliers must meet the manufacturer's internal quality control specification.

3.1.3 Organizational Definitions:

3.1.3.1 installer, n—the party who installs, or facilitates installation of, any materials purchased from manufacturers or suppliers.

3.1.3.2 manufacturer, n—the group, corporation, partnership, or individual that manufactures a product.

3.1.3.3 purchaser, n—the person, company, or organization that purchases any materials or work to be performed.

3.1.3.4 supplier, n—the party who supplies material or services.

3.1.4 Quality Definitions:

3.1.4.1 Manufacturing Quality Control (MQC) - A planned system of inspections that is used to directly monitor and control the manufacture of a material which is factory originated. MQC is normally performed by the manufacturer of geosynthetic materials and is necessary to ensure minimum (or maximum) specified values in the manufactured product. MQC refers to measures taken by the manufacturer to determine compliance with the requirements for materials and workmanship as stated in certification documents and contract specifications. ref. EPA/600/R-93/182

3.1.4.2 Manufacturing Quality Assurance (MQA) - A planned system of activities that provides assurance that the materials were constructed as specified in the certification documents and contract specifications. MQA includes manufacturing facility inspections, verifications, audits and evaluation of the raw materials (resins and additives) and geosynthetic products to assess the quality of the manufactured materials. MQA refers to measures taken by the MQA organization to determine if the manufacturer is in compliance with the product certification and contract specifications for the project. ref. EPA/600/R-93/182

3.1.4.3 Construction Quality Control (CQC) - A planned system of inspections that are used to directly monitor and control the quality of a construction project. Construction quality control is normally performed by the geosynthetics manufacturer or installer, or for natural soil materials by the earthwork contractor, and is necessary to achieve quality in the constructed or installed system. Construction quality control (CQC) refers to measures taken by the installer or contractor to determine compliance with the requirements for materials and workmanship as stated in the plans and specifications for the project. ref. EPA/600/R-93/182

3.1.4.4 Construction Quality Assurance (CQA) - A planned system of activities that provide assurance that the facility was constructed as specified in the design. Construction quality assurance includes inspections, verification, audits, and evaluations of materials and workmanship necessary to determine and document the quality of the constructed facility. Construction quality assurance (CQA) refers to measures taken by the CQA organization to assess if the installer or contractor is in compliance with the plans and specifications for a project. ref. EPA.600/R-93/182

4. Significance and Use

4.1 GCLs must be properly manufactured in a manner consistent with a minimum level of quality control as determined by in-house testing of the final product. This specification presents the types of tests, standard methods of the testing, required (usually minimum) test values, and minimum testing frequencies which should be embodied in the manufacturer's quality control documents. The quoted tests, test methods and test values in Table 1 must appear in the MQC plan and the MQC report.

4.2 It should be clearly recognized that manufacturers may perform additional tests or at greater frequency than required in this specification, or both. In this case, the manufacturer's quality control plan will then take precedence over this specification.

4.3 It should also be recognized that purchasers and installers of GCLs may require additional tests or at a great frequency than called for in this specification, or both. The organization(s) producing such project specific specification or quality assurance plan should recognize that such requirements are beyond the current state-of-the-practice. If such a request is made by purchasers or installers, they should clearly communicate the requirements to the manufacturer or supplier during the contract decisions in order that disputes do not arise at a subsequent time.

5. Procedure

5.1 The procedures embodied in this specification are contained in the respective test methods given in Table 1.

5.1.1 The minimum recommended quality control tests for the manufacture of GCLs are given in Table 1. Specific tests are performed on the bentonite, the geosynthetic component materials, and the finished GCL. Table 1(a) is in S.I. (Metric) units and Table 1(b) is in U.S. (English) units.

Note 2: The conversion from S.I. units into U.S. units is soft.

5.1.2 The individual properties in Table 1 are minimum values; except fluid loss, moisture content, and permeability (or flux). They are maximum values. The manner of taking specimens is described in the appropriate test method. When an average value is indicated, it is listed in the table as "min. ave.", or "max. ave.".

5.2 Bentonite (as received)
Two tests are required; swell index and fluid loss. The latter is a maximum value. These tests should be performed on the bentonite prior to fabrication into a GCL.

or on bentonite taken from the manufactured product if the bentonite is modified in any way during manufacturing, e.g., if an adhesive is added.

5.3 Geotextile (as received)
Mass per unit area is required on the as-manufactured cap and carrier fabrics, with different values depending on the fabric being nonwoven or woven.

Note 3: These tests are to be performed on the geotextiles before manufacturing into the final GCL. Removal of the geotextiles from the manufactured product and subsequent testing will give erroneous values and is not an acceptable practice. The exception is polymer coated GCLs where the geotextile must be removed to determine its mass per unit area.

5.4 Geomembrane/Geofilm (as received)
The following tests are required; thickness, density, and tensile strength at break. All are minimum required values. Tensile strength at break is the lowest of machine direction and cross machine direction.

Note 4: These tests are to be performed on the geomembrane or geofilm before manufacturing into the final GCL. Removal of the geomembrane or geofilm from the manufactured product and subsequent testing will give erroneous values and is not an accepted practice.

5.5 GCL (as manufactured)
Six tests are required on the as-manufactured GCL with one having an alternative, i.e., hydraulic conductivity or flux. All are minimum values, with the exception of moisture content and hydraulic conductivity or flux.

5.6 GCL (long-term)
The purpose of these long-term or endurance tests is to provide confidence in the continuing acceptable performance of the bentonite and geosynthetic components of the installed GCL.

5.6.1 The durability of the bentonite is evaluated using a permeant consisting of 0.1 M calcium chloride solution. See ASTM D 6141 which is a guide for this particular aspect of the specification. The GCL is to be hydrated with distilled dionized water prior to conducting the tests with the calcium chloride solution. In this regard, ASTM D6766 Scenario 1 and Method C is the procedure to be used. Furthermore, this test is conducted twice at two different normal pressures, i.e., 35 and 500 kPa. The maximum allowable values are listed in Table 1.

5.6.2 The geotextiles in their as-received condition are evaluated by incubation in a forced air oven per ASTM D5721 set at 60°C for 50 days. The

minimum percent in tensile strength retained at break, as measured by ASTM D6768, is 65%. If individual yarns are used in reinforcing GCLs, they must also meet this same endurance criterion.

5.6.3 The geomembrane in its as-received condition is evaluated for durability via the appropriate GRI Specification. For high density polyethylene (HDPE), the specification is GRI GM13. For linear low density polyethylene (LLDPE), the specification is GRI GM17. For flexible polypropylene (fPP), the specification is GRI GM18.

5.6.4 The geofilm in its as-received condition is evaluated by incubation in a forced air oven per ASTM D5721 set at 60°C for 50 days. The minimum percent tensile strength retained at break for either MD or XMD, as measured by ASTM D882, is reported accordingly and must meet or exceed the specification value.

Note 5: It should be recognized that the above durability criterion for geofilms is not as stringent as the criteria for geomembranes stated in Section 5.6.3.

6. Workmanship and Appearance

6.1 Waterproof ink overlap lines should be printed on both edges of one of the surfaces (geotextile or geomembrane) of the manufactured GCL.

Note 6: The overlap lines are minimally 150 mm (6.0 in.) from the edges of the GCL. Other design-related situations may require greater overlap distances to be printed on the GCLs, e.g., when not backfilled in a timely manner.

6.2 Needle punched and stitch bonded GCLs shall be essentially free of broken needles and fragments of needles that would negatively effect the performance of the final product. There must be continuous needle detection and removal devices, e.g., metal detectors and magnets, used during manufacture of GCL products.

6.3 The manufactured GCL shall have good appearance qualities. It shall be free from such defects that would affect the specified properties and integrity of the product.

6.4 General manufacturing procedures shall be performed in accordance with the manufacturer's internal quality control guide and/or documents. ASTM D5888 and D5889 should be followed in this regard.

7. MQC Sampling

7.1 Sampling shall be in accordance with the specific test methods listed in Table 1. If no sampling protocol is stipulated in the particular test method, then test specimens shall be taken evenly spaced across the entire roll width, see ASTM D 4354.

7.2 The number of tests shall be in accordance with the appropriate test methods listed in Table 1.

7.3 The average of the test results should be calculated per the particular standard cited and compared to the minimum value listed in these tables, hence the values listed are the minimum average values and are designated as "min. ave.". When the property is a maximum value, the designation is "max. ave.".

8. MQC Retest and Rejection

8.1 If the results of any test do not conform to the requirements of this specification, retesting to determine conformance or rejection should be done in accordance with the manufacturing protocol as set forth in the manufacturer's quality manual.

9. Packaging and Marking

9.1 The GCL shall be rolled, clearly labeled, and onto a substantial core, encased in a waterproof wrapper. Packaging must be adequate for safe transportation to the point of delivery.

9.2 The label should include manufacturer, style, lot and/or roll number, weight, length and width.

10. Conformance and Certification

10.1 Conformance of the manufactured GCL to this specification, or agreed-upon variation thereof, shall be performed by the MQA organization or designated by the purchaser/owner. ASTM D 4759 can be used as a general guide, but individual test methods must be clearly stipulated and communicated to the parties involved.

10.2 Upon request of the purchaser in the contract or order, a manufacturer's certification that the material was manufactured and tested in accordance with this specification, together with a report of the test results, shall be furnished at the time of shipment.

Table 1(a) – Specification for Geosynthetic Clay Liners (GCLs)

Property	ASTM Test Method	Reinforced GCL			Non-Reinforced GCL			Testing Frequency
		GT-Related	GT Polymer Coated	GM-GF Related	GT-Related	GT Polymer Coated	GM-GF Related	
Clay (as received)								
swell index (ml/2g)	D5890	24	24	24	24	24	24	50 tonnes
fluid loss (ml)[1]	D5891	18	18	18	18	18	18	50 tonnes
Geotextiles (as received)								
cap fabric (nonwoven) - mass/unit area (g/m^2)[2]	D5261	200	200	200	70	100	n/a/70	20,000 m^2
cap fabric -(woven) - mass/unit area (g/m^2)	D5261	100	100	100	-	-	-	20,000 m^2
carrier fabric (nonwoven composite) - mass/(g/m^2)[2]	D5261	240	240	240	90	100	n/a/90	20,000 m^2
carrier fabric (woven) - mass/unit area (g/m^2)	D5261	100	100	100	-	-	-	20,000 m^2
coating - mass/unit area (g/m^2)[3]	D5261	n/a	100	n/a	n/a	100	n/a	4,000 m^2
Geomembrane/Geofilm (as received)								
thickness[5] (mm)	D5199/D5994	n/a	n/a	0.40/0.50/0.10	n/a	n/a	0.40/0.75/0.10	20,000 m^2
density (g/cc)	D1505/D792	n/a	n/a	0.92	n/a	n/a	0.92	20,000 m^2
break tensile strength, MD&XMD (kN/m)	D6693	n/a	n/a	n/a	n/a	n/a	6.0	20,000 m^2
break tensile strength, MD (kN/m)	D882	n/a	n/a	2.5	n/a	n/a	2.5	20,000 m^2
GCL (as manufactured)								
mass of GCL (g/m^2)[6]	D5993	4000	4050	4100	4000	4050	4100	4,000 m^2
mass of bentonite (g/m^2)[6]	D5993	3700	3700	3700	3700	3700	3700	4,000 m^2
moisture content[12] (%)	D5993	(4)	(4)	(4)	(4)	(4)	(4)	4,000 m^2
tensile str., MD (kN/m)	D6768	4.0	4.0	4.0	4.0	4.0	4.0	20,000 m^2
peel strength (N/m)	D6496	360	360	360	n/a	n/a	n/a	4,000 m^2
permeability[1] (m/sec), "or"	D5887	5×10^{-11}	5×10^{-12}	5×10^{-12}	5×10^{-11}	5×10^{-12}	5×10^{-12}	25,000 m^2
flux[1] ($m^3/sec\text{-}m^2$),	D5887	1×10^{-8}	1×10^{-9}	1×10^{-9}	1×10^{-8}	1×10^{-9}	1×10^{-9}	25,000 m^2
GCL permeability[1,11,7] (m/sec) (max. at 35 kPa)	D6766	1×10^{-8}	1×10^{-9}	1×10^{-9}	1×10^{-8}	1×10^{-9}	1×10^{-9}	yearly
GCL permeability[1,11,7] (m/sec) (max. at 500 kPa)	D6766 mod.	5×10^{-10}	5×10^{-11}	5×10^{-11}	5×10^{-10}	5×10^{-11}	5×10^{-11}	yearly
Component Durability								
geotextile and reinforcing yarns[8] (% strength retained)	See § 5.6.2	65	65	n/a	65	65	n/a	yearly
geomembrane	See § 5.6.3	n/a	n/a	GM Spec[9]	n/a	n/a	GM Spec[9]	yearly
geofilm/polymer treated[8] (% strength retained)	See § 5.6.4	n/a	85	80	n/a	85	80	yearly

n/a = not applicable with respect to this property

(1) These values are maximum (all others are minimum)

(2) For both cap and carrier fabrics for nonwoven reinforced GCLs, one, or the other, must contain a scrim component of mass ≥ 100 g/m^2 for dimensional stability

(3) Calculated value obtained from difference of coated fabric to as-received fabric

(4) Value is both site-specific and product-specific and is currently being evaluated

(5) First value is for smooth geomembrane; second for textured geomembrane; third for geofilm

(6) Mass of the GCL and bentonite is measured after oven drying per the stated test method

(7) Value represents GCL permeability after permeation with a 0.1 M calcium chloride solution (11.1 g $CaCl_2$ in 1-liter water)

(8) Value represents the minimum percent strength retained from the as-manufactured value after oven aging at 60°C for 50 days

(9) Durability criteria should follow the appropriate specification for the geomembrane type used, i.e., GRI GM-13 for HDPE, GRI GM-17 for LLDPE or GRI GM-18 for fPP

Table 1(b) – Specification for Geosynthetic Clay Liners (GCLs)

Property	ASTM Test Method	Reinforced GCL			Non-Reinforced GCL			Testing Frequency
		GT-Related	GT Polymer Coated	GM-GF Related	GT-Related	GT Polymer Coated	GM-GF Related	
Clay (as received)								
swell index (ml/2g)	D5890	24	24	24	24	24	24	50 tonnes
fluid loss (ml)[1]	D5891	18	18	18	18	18	18	50 tonnes
Geotextiles (as received)								
cap fabric (nonwoven) - mass/unit area (oz/yd^2)[2]	D5261	5.8	5.8	5.8	2.1	2.9	n/a/2.1	25,000 yd^2
cap fabric (woven) - mass/unit area (oz/yd^2)	D5261	3.0	3.0	3.0	-	-	-	25,000 yd^2
carrier fabric (nonwoven composite) - mass/(oz/yd^2)[2]	D5261	5.9	5.9	5.9	2.7	2.9	n/a/2.7	25,000 yd^2
carrier fabric (woven) - mass/unit area (oz/yd^2)	D5261	3.0	3.0	3.0	-	-	-	25,000 yd^2
coating - mass/unit area (oz/yd^2)[3]	D5261	n/a	2.9	n/a	n/a	2.9	n/a	5,000 yd^2
Geomembrane/Geofilm (as received)								
thickness[5] (mils)	D5199/D5994	n/a	n/a	15/20/4	n/a	n/a	15/30/4	25,000 yd^2
density (g/cc)	D1505/D792	n/a	n/a	0.92	n/a	n/a	0.92	25,000 yd^2
break tensile strength, MD&XMD (lb/in.)	D6693	n/a	n/a	n/a	n/a	n/a	34	25,000 yd^2
break tensile strength, MD & XMD (lb/in.)	D882	n/a	n/a	14	n/a	n/a	14	25,000 yd^2
GCL (as manufactured)								
mass of GCL (lb/ft^2)[6]	D5993	0.82	0.83	0.84	0.82	0.83	0.84	5,000 yd^2
mass of bentonite (lb/ft^2)[6]	D5993	0.75	0.75	0.75	0.75	0.75	0.75	5,000 yd^2
moisture content[1] (%)	D5993	(4)	(4)	(4)	(4)	(4)	(4)	5,000 yd^2
tensile str., MD (lb/in.)	D6768	23	23	23	23	23	23	25,000 yd^2
peel strength (lb/in.)	D6496	2.1	2.1	2.1	n/a	n/a	n/a	5,000 yd^2
permeability[7] (cm/sec), "or"	D5887	5×10^{-9}	5×10^{-10}	n/a	5×10^{-9}	5×10^{-10}	n/a	30,000 yd^2
flux[1] (cm^3/sec-cm^2).	D5887	1×10^{-7}	1×10^{-7}	n/a	1×10^{-6}	1×10^{-7}	n/a	30,000 yd^2
GCL permeability[1][7] (cm/sec) (max. at 5 lb/in.^{2})	D6766	1×10^{-8}	1×10^{-7}	1×10^{-7}	1×10^{-8}	1×10^{-7}	1×10^{-7}	yearly
GCL permeability[1][7] (cm/sec) (max. at 70 lb/in.^{2})	D6766 mod.	5×10^{-8}	5×10^{-8}	5×10^{-9}	5×10^{-8}	5×10^{-9}	5×10^{-9}	yearly
Component Durability								
geotextile and reinforcing yarns[8] (% strength retained)	See § 5.6.2	65	65	n/a	65	65	n/a	yearly
geomembrane	See § 5.6.3	n/a	n/a	GM Spec[9]	n/a	n/a	GM Spec[9]	yearly
geofilm/polymer treated[8] (% strength retained)	See § 5.6.4	n/a	85	80	n/a	85	80	yearly

n/a = not applicable with respect to this property

(1) These values are maximum (all others are minimum)
(2) For both cap and carrier fabrics for nonwoven reinforced GCLs: one, or the other, must contain a scrim component of mass > 2.9 oz/yd^2 for dimensional stability
(3) Calculated value obtained from difference of coated fabric to as-received fabric
(4) Value is both site-specific and product-specific and is currently being evaluated
(5) First value is for smooth geomembrane; second for textured geomembrane; third for geofilm
(6) Mass of the GCL and bentonite is measured after oven drying per the stated test method
(7) Value represents GCL permeability after permeation with a 0.1 M calcium chloride solution (11.1 g CaCl2 in 1-liter water)
(8) Value represents the minimum percent strength retained from the as-manufactured value after oven aging at 60°C for 50 days
(9) Durability criteria should follow the appropriate specification for the geomembrane used; i.e., GRI GM-13 for HDPE, GRI GM-17 for LLDPE or GRI GM-18 for fPP

PART 1. GENERAL

1.01 DESCRIPTION

This section pertains to construction of the HDPE (High Density Polyethylene) Piping for the Leachate Collection System, Process Water Recovery System, ~~***the Slurry Piping and Valves,***~~ and Recycle Pond Decant System at the Gypsum Management Facility and the Leachate Collection System for the CCB Landfill.

1.02 RELATED SECTIONS

None.

1.03 REFERENCES

The following references, or cited portions thereof, govern the work

A. American Society of Testing and Materials:

1. ASTM D 2683 (2004); Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
2. ASTM D 3261 (2003); Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
3. ASTM D 3350 (2005); Specification for Polyethylene Plastics Pipe and Fittings Materials.
4. ASTM F 412 (2001a); Terminology Relating to Plastic Piping System.
5. ASTM F 1055 (1998); Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
6. ASTM F 1056 (2004); Specification for Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings.
7. ***ASTM F714-06a Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.***
8. ***ASTM F2164-02 Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure***

1.04 SUBMITTALS

A. Qualifications

Submit qualifications of the Welding Supervisor who will be responsible for construction quality control of the pipe joining process.

B. Material Certifications

Submit manufacturer certifications that the pipe provided complies with the requirements herein.

C. Product Data

1. Submit product data and operating instructions for pipe joining equipment.
2. Submit pipe manufacturer's recommended procedures for storing, handling, and installing pipe and fittings.

1.05 QUALIFICATIONS

A. The Contractor or Subcontractor performing the work under this section shall have in his employ a Welding Supervisor who has completed a minimum of 10,000 ft of pipe joining work using the type of equipment proposed for use in this work. The Welding Supervisor shall be on site at all times during pipe line installation, and shall provide direct supervision over other employees.

1.06 WARRANTY

A. The pipe and fittings shall be warranted, on a pro-rata basis, against manufacturer's defects for a period of five (5) years from the date of pipe installation. The installation shall be warranted against defects in workmanship for a period of one (1) year from the date of completion.

PART 2. PRODUCTS

2.01 MATERIALS

A. Leachate and Process Water Collection Piping

1. Pipe material shall be High Density Polyethylene (HDPE) PE 3408, according to ASTM F412, with minimum cell classification values of 345464C, according to ASTM D3350. Iron pipe size (IPS) and standard dimension ratio (SDR) shall be as indicated in the plans.

2. Size and spacing of holes in perforated pipe shall be as indicated in the plans.

~~B. *Slurry* Sluice Piping~~

~~Pipe for HDPE Sluice Lines shall be manufactured from a PE 3408 resin. The resin material shall meet the specifications of ASTM D3350-02 with a minimum cell~~

~~classification of PE345464C. Pipe O.D. sizes 4" to 54" shall be available in steel pipe sizes (IPS). Pipe shall have a manufacturing standard of ASTM D3035 and be manufactured by an ISO 9001 certified manufacturer. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.~~

~~***Pipe shall be manufactured from a pipe resin which meets ASTM D 3350-05 with a minimum cell classification of 445474C. Pipe shall be manufactured to the dimensions of ASTM F-714. The service factor to determine the pressure rating shall be 0.63. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.***~~

C. Fittings ***(Leachate and Process Water Collection Piping)***

1. Fittings shall be made of the same material and size as the HDPE piping, and shall have a pressure rating no less than 160 psi.

2. Butt Fusion Fittings

   Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-99. Butt Fusion Fittings shall have a manufacturing standard of ASTM D3261. Molded & fabricated fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans. Fabricated fittings are to be manufactured using a Data Logger. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the quality control records.

3. Electrofusion Fittings - Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-99. Electrofusion Fittings shall have a manufacturing standard of ASTM F-1055. Fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans.

4. Flanged and Mechanical Joint Adapters - Flanged and Mechanical Joint Adapters shall be PE 3408 HDPE, Cell Classification of 345464C as determined by ASTM D-3350. Flanged and Mechanical Joint Adapters shall have a manufacturing standard of ASTM D-3261. Fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans. Flanged and Mechanical Joint Adapters are to be used for Sluice Piping only.

~~D. Valves ***and Valve Piping*** for Sluice ***Slurry*** Piping~~

~~Valves used for Sluice Piping shall be ITT Fabri-Valve XS150-ULV-Urethane~~

~~Lined Knife Gate Valves. Valve Material: Yet to Be Determined~~

~~*Valves used for the Slurry Piping System shall be Clarkson KGF Knife Gate Valve with ductile iron housing high tear strength gum rubber sleeves, C276 gate rated at 300 psig, with manual handwheel actuation.*~~

~~*Fittings and piping at valve stations shall be SILVER STREAK model fiberglass reinforced plastic (FRP) as manufactured by Fiber Glass Systems. Flanges shall have ANSI B16.5 Class 150 bolt hole patterns. Flanged connections to valves shall have ANSI B16.5 Class 300 bolt hole patterns. ASTM A307, Grade B, hex head bolts shall be supplied. Washers shall be supplied on all nuts and bolts. Gaskets shall be 1/8" thick, 60-70 durometer full-face type suitable for the service shown on the drawings and as recommended in the manufacturer's standard installation procedures. Pipe shall be installed as specified and indicated on the drawings.*~~

~~*E. Fittings for HDPE Slurry Piping*~~

1. ~~*Butt Fusion Fittings – Fittings Pipe shall be manufactured from a pipe resin which meets ASTM D 3350-05 with a minimum cell classification of 445474C. Pipe shall be manufactured to the dimensions of ASTM F-714. The service factor to determine the pressure rating shall be 0.63. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material*~~

2. ~~*Molded Butt Fusion Fittings shall have a manufacturing standard of ASTM D-3261. Molded & fabricated fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans. Fabricated fittings must have the same pressure rating as the pipe; a DR less than the pipe shall be used. Fabricated fittings are to be manufactured using a Data Logger to record temperature, fusion pressure, and a graphic representation of the fusion cycle shall be part of the Quality Control records.*~~

3. ~~*Electrofusion Fittings – Fittings shall be made from resin or pipe meeting ASTM D 3350-05 with a minimum cell classification of 445474C.; Electrofusion Fittings shall meet the manufacturing standard of ASTM F-1055. Fittings shall have the same pressure rating as the pipe or higher unless otherwise specified on the plans.*~~

4. ~~*Flanged and Mechanical Joint Adapters – Flanged and Mechanical Joint Adapters shall be made from materials containing resin that meets ASTM D 3350-05 with a minimum cell classification of 445474C.*~~

2.02 EQUIPMENT

A. Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400 degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 PSI. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself. All field welds shall be made with fusion equipment equipped with a Data Logger. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the Quality Control records.

B. Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer's specifications. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE pipe being fused. The size of the heating iron shall be ¼ inch larger than the size of the outlet branch being fused.

C. Mechanical joining will be used where the butt fusion method can not be used. Mechanical joining will be accomplished by either using a HDPE flange adapter with a Ductile Iron back-up ring or HDPE Mechanical Joint adapter with a Ductile Iron back-up ring.

D. Socket fusion, hot gas fusion, threading, solvents, and epoxies will not be used to join HDPE pipe.

PART 3. EXECUTION

3.01 MATERIAL DELIVERY, STORAGE, AND HANDLING

A. HDPE pipe and fittings shall be packaged and shipped by appropriate means to prevent damage to the material and to facilitate off-loading. The Owner will provide an on-site storage site. Storage site requirements (size and preferred location) shall be submitted with the bid documents.

B. Storage and handling shall be according to manufacturer's recommendations.

3.02 BASE PREPARATION

HDPE Piping for leachate and process water collection shall be installed on a layer of coarse aggregate placed by the Contractor in accordance with the plans. The grade of the coarse aggregate base shall be verified before installing the piping.

3.03 TRENCH INSTALLATION

Excavation, Foundation, Bedding and Haunching for the underground installation of HDPE Sluice Piping shall be in accordance with Section 20-2.20 of the "Standard Specifications for Water and Sewer Main Construction in Illinois". The trench shall be backfilled with excavated material to the top of trench surface. Excavations in areas of Structural Fill shall be backfill with and compacted to the specifications of Section 02200-Earthwork for Structural Fill. All other areas shall be backfilled to 92% of the dry density, as determined by the Standard Proctor Test ASTM D698.

3.03 INSTALLATION

All pipe and fittings shall be installed according to the manufacturer's recommendations. Removal of weld beads is not required. Contractor shall place coarse aggregate along the pipe to provide lateral stability. Welds shall not be obscured until they have been approved by the Owner's Representative, the top of pipe shall not be covered until the Construction Quality Assurance (CQA) survey has been completed to verify conformance with specified tolerances.

3.04 INSPECTIONS

A. The Owner's Representative shall shall visually inspect pipe materials to verify that each pipe material is properly stamped (by the manufacturer) for ASTM acceptance before installation. Defective or damaged materials shall be removed from the site.

B. Each weld and connection shall be visually inspected by the Owner's Representative. Defective welds shall be repaired as directed by the Owner's Representative and according to manufacturer's recommendations. Welds and connections shall not be covered until they have been approved by the Owner's Representative.

3.05 TOLERANCES

A. HDPE piping shall be located within 0.5 ft. of plan location, and elevation shall be within 0.1 ft. of plan elevation with no adverse slopes.

~~***3.06 TESTING***~~

~~***A. All Slurry Piping shall be Hydrostatic Tested in accordance with ASTM F 2164, using a Design Pressure of 270 PSIG.***~~

END OF SECTION 02936

PART 1. GENERAL

1.01 DESCRIPTION

A. This section includes installing pipe culverts and end sections for pipe culverts.

B. Storm Drainage installation shall include incidental related work such as topsoil removal, trench excavation, backfill, compaction, tie-in of existing system, etc..

1.02 RELATED SECTIONS

A. The following sections contain items which are related to the work in this section:

1. 02200 - Earthwork

1.03 REFERENCES

A. The following reference, or cited portions thereof, governs the work:

1. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007. Payment provisions shall not apply.

PART 2. PRODUCTS

2.01 PIPE CULVERTS

A. ***HDPE*** Pipe Culverts shall be installed in accordance with Article 542 of the Standard Specifications. All piping shall be Corrugated PE (Polyethylene) with a Smooth Interior, in accordance with AASHTO M 294, Type S.

2.02 METAL END SECTIONS

A. Metal End Sections shall be either aluminum or steel in accordance with Article 542.07(c) of the Standard Specifications.

2.03 REINFORCED CONCRETE CULVERT PIPE

A. Reinforced Concrete Culvert Pipe shall be furnished in accordance with Article 1042.06(a) of the Standard Specifications.

2.03 PRECAST REINFORCED CONCRETE FLARED END SECTIONS

A. Precast Reinforced Concrete Flared End Sections shall be furnished in accordance with Article 1042.07(a) of the Standard Specifications.

PART 3. EXECUTION

3.01 STORM DRAINAGE PIPING INSTALLATION

A. Construct pipe culverts in accordance with the Article 542 of the Standard Specifications. Bedding and Haunching shall be IDOT CA-6 Gradation. Trench excavations are to be backfilled with on-site clayey materials instead of sand. Compact backfill to 95 percent of the maximum dry density as determined by the Standard Proctor test – ASTM D-698.

3.02 ~~METAL~~ END SECTION INSTALLATION

A. End Treatments shall be installed according to Article 542.07 of the Standard Specifications.

END OF SECTION 02700

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PART 1. GENERAL

1.01 DESCRIPTION

A. This section includes manufacturing, furnishing, and installing High Density Polyethylene (HDPE) Geomembranes for the Gypsum Management Facility and the CCB Landfill.

B. The work includes furnishing all equipment and materials and providing all labor, supervision, administration and management necessary to perform the work as shown on the plans.

1.02 RELATED SECTIONS

A. The following sections contain items which are related to the work in this section:

1. 02373 – Geotextiles
2. 02376 – Geosynthetic Clay Liner

1.03 REFERENCES

A. The following references, or cited portions thereof, govern the work:

1. American Society for Testing and Materials (ASTM):

   a. D 638, Standard Test Method for Tensile Properties of Plastics.
   b. D 751, Standard Test Methods for Coated Fabrics.
   c. D 792, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
   d. D 1004, Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
   e. D 1204, Standard Test Method for Linear Dimensional Changes of Non Rigid Thermoplastic Sheeting or Film at Elevated Temperature.
   f. D 1238, Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
   g. D 1505, Standard Test Method for Density of Plastics by Density-Gradient Technique.
   h. D 1603, Standard Test Method for Carbon Black in Olefin Plastics.
   i. D 3895, Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis.

j. D 4218, Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.

k. D 4437, Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes.

l. D 4833, Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.

m. D 5199, Standard Test Method for Measuring Nominal Thickness of Smooth Geomembranes.

n. D 5397, Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefins using Notched Constant Tensile Load Test.

o. D 5596, Standard Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds.

p. D 5641, Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.

q. D 5721, Practice for Air-Oven Aging of Polyolefin Geomembranes.

r. D 5820, Test Method for Air Testing.

s. D 5885, Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry.

t. D 5994, Standard Test Method for Measuring Nominal Thickness of Textured Geomembranes

u. D 6365, Standard Practice for the Nondestructive Testing of Geomembrane Seams using The Spark Test

2. Geosynthetic Research Institute (GRI):

a. GRI GM 6, Pressurized Air Channel Test for Dual Seamed Geomembranes

b. GRI GM 9, Cold Weather Seaming of Geomembranes

c. GRI GM 10, Specification for Stress Crack Resistance of HDPE Geomembrane Sheet

d. GRI GM 13, Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes

e. GRI GM 14, Test Frequencies for Destructive SeamTesting

1.04 SUBMITTALS

A. Submit the following to the Engineer or Owner, for review and approval, within a reasonable time so as to expedite shipment or installation of the Geomembrane:

1. Documentation of manufacturer's qualifications as specified in subsection 1.05A of this Section.

2. Manufacturer's Quality Control program manual or descriptive documentation.

3. A material properties sheet, including at a minimum all properties specified in GRI GM 13, including test methods used.

4. Sample of the material.

5. Documentation of Installer's qualifications, as specified below and in subsection 1.05B of this Section.
   a. Submit a list of at least ten completed facilities. For each name and type of facility; its location; the date of installation; phone number of contact at the facility; type and thickness of geomembrane and; surface area of the installed geomembrane.
   b. Submit resumes or qualifications of the Installation Supervisor, Master Seamer and Technicians to be assigned to this project.
   c. Quality Control Program.

6. Example Material Warranty and Liner Installation Warranty complying with subsections 1.07 and 1.08 of this Section.

7. Resin Supplier's name, resin production plant identification, resin brand name and number, production date of the resin, resin Manufacturer's quality control certificates, and certification that the properties of the resin meet the requirements of these specifications.

B. Shop Drawings

1. Submit copies of shop drawings for engineer's approval within a reasonable time so as not to delay the start of geomembrane installation. Shop drawings shall show the proposed panel layout identifying seams and details. Seams should generally follow direction of the slope. Butt seams or roll-end seams should not occur on a slope unless approved by the Owner's Representative. Butt seams on a slope, if allowed, should be staggered.

2. Placement of geomembrane will not be allowed to proceed until Owner's Representative has received and approved the shop drawings.

C. Additional Submittals (In-Progress and at Completion)

1. Manufacturer's warranty (refer to subsection 1.08).
2. Geomembrane installation warranty (refer to subsection 1.09).
3. Daily written acceptance of subgrade surface (refer to subsection 3.01.C).
4. Low-temperature seaming procedures if applicable (refer to subsection 3.03.A)
5. Prequalification test seam samples (refer to subsection 3.05.A.6).
6. Field seam non-destructive test results (refer to subsection 3.05.B.1).
7. Field seam destructive test results (refer to subsection 3.05.C.6).
8. Daily field installation reports (refer to subsection 3.05.G).

9. Installation record drawing, as discussed in subsection 3.05.G).

1.05 QUALITY CONTOL

A. Manufacturer's Qualifications:

The manufacturer of geomembrane of the type specified or similar product shall have at least five years experience in the manufacture of such geomembrane. In addition, the geomembrane manufacturer shall have manufactured at least 10,000,000 sq. ft. of the specified type of geomembrane or similar product during the last five years.

B. Installer's Qualifications:

1 The Geomembrane Installer shall be the Manufacturer, approved Manufacturer's Installer or a contractor approved by the Owner's Representative to install the geomembrane.

2 The Geomembrane Installer shall have at least three years experience in the installation of the specified geomembrane or similar. The Geomembrane Installer shall have installed at least 10 projects involving a total of 5,000,000 sq. ft. of the specified type of geomembrane or similar during the last three years.

3 Installation shall be performed under the direction of a field Installation Supervisor who shall be responsible throughout the geomembrane installation, for geomembrane panel layout, seaming, patching, testing, repairs, and all other activities of the Geomembrane Installer. The Field Installation Supervisor shall have installed or supervised the installation and seaming of a minimum of 10 projects involving a total of 5,000,000 sq. ft. of geomembrane of the type specified or similar product.

4 Seaming shall be performed under the direction of a Master Seamer (who may also be the Field Installation Supervisor or Crew Foreman) who has seamed a minimum of 3,000,000 sq. ft. of geomembrane of the type specified or similar product, using the same type of seaming apparatus to be used in the current project. The Field Installation Supervisor and/or Master Seamer shall be present whenever seaming, patching, other welding operations, and testing is performed.

5 All seaming, patching, other welding operations, and testing shall be performed by qualified technicians employed by the Geomembrane Installer.

1.06 DELIVERY, STORAGE AND HANDLING

A. Each roll of geomembrane delivered to the site shall be labeled by the manufacturer. The label shall be firmly affixed and shall clearly state the manufacturer's name, product identification, material thickness, roll number, roll dimensions and roll weight.

B. Geomembrane shall be protected from mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions.

C. Rolls shall be stored away from high traffic areas. Continuously and uniformly support rolls on a smooth, level prepared surface.

D. Rolls shall not be stacked more than three high.

1.07 PROJECT CONDITIONS

Geomembrane shall not be installed in the presence of standing water, while precipitation is occurring, during excessive winds, or when material temperatures are outside the limits specified in Section 3.03.

1.08 MATERIAL WARRANTY

As required by specification, or as required in GRI GM 13 (attachment A)

1.09 GEOMEMBRANE INSTALLATION WARRANTY

The Geomembrane Installer shall guarantee the geomembrane installation against defects in the installation and workmanship for 1 year commencing with the date of final acceptance.

1.10 GEOMEMBRANE PRE-CONSTRUCTION MEETING

A. Geomembrane Pre-Construction Meeting shall be held at the site prior to installation of the geomembrane. At a minimum, the meeting shall be attended by the Geomembrane Installer, Owner, Owner's representative (Engineer and/or CQA Firm), and the General Contractor.

B. Topics for this meeting shall include:

1. Responsibilities of each party.
2. Lines of authority and communication. Resolution of any project document ambiguity.
3. Methods for documenting, reporting and distributing documents and reports.
4. Procedures for packaging and storing archive samples.
5. Review of time schedule for all installation and testing.
6. Review of panel layout and numbering systems for panels and seams including details for marking on geomembrane.
7. Procedures and responsibilities for preparation and submission of as-built panel and seam drawings.
8. Temperature and weather limitations. Installation procedures for adverse weather conditions. Defining acceptable subgrade, geomembrane, or ambient moisture and temperature conditions for working during liner installation.
9. Subgrade conditions, dewatering responsibilities and subgrade maintenance plan.
10. Deployment techniques including allowable subgrade for the geomembrane.
11. Plan for controlling expansion/contraction and wrinkling of the

geomembrane.

12. Covering of the geomembrane and cover soil placement.
13. Measurement and payment schedules.
14. Health and safety.

C. The meeting shall be documented by the Owner's Representative and minutes shall be transmitted to all parties.

PART 2. PRODUCTS

2.01 SOURCE QUALITY CONTROL

Manufacturing Quality Control

A. The test methods and frequencies used by the manufacturer for quality control/quality assurance of the above geomembrane prior to delivery, shall be in accordance with GRI GM13, or modified as required for project specific conditions.

B. The manufacturer's geomembrane quality control certifications, including results of quality control testing of the products, as specified in subsection 2.01.C of this Section, must be supplied to the Owner's Representative. The certification shall be signed by a responsible party employed by the manufacturer, such as the QA/QC Manager, Production Manager, or Technical Services Manager. Certifications shall include lot and roll numbers and corresponding shipping information.

C. The Manufacturer will provide Certification that the geomembrane and welding rod supplied for the project have the same base resin and material properties.

2.02 GEOMEMBRANE

A. The geomembrane shall consist of new, first quality products designed and manufactured specifically for the purpose of this work which shall have been satisfactorily demonstrated by prior testing to be suitable and durable for such purposes. The geomembrane rolls shall be seamless, high density polyethylene (HDPE- Density >0.94g/cm) containing no plasticizers, fillers or extenders and shall be free of holes, blisters or contaminants, and leak free verified by 100% in line spark or equivalent testing. The geomembrane shall be supplied as a continuous sheet with no factory seams in rolls. Smooth Geomembrane shall meet the property requirements shown in Table 1(a) of the GRI GM13 Specifications included at the end of this Section. Textured Geomembrane shall meet the property requirements shown in Table 2(a) of the GRI GM13 Specifications included at the end of this Section.

B. Material shall be reviewed for conformance to the project specifications by the Owner's Representative.

PART 3. EXECUTION

3.01 SUBGRADE PREPARATION

A. Geomembrane installed over geosynthetic clay liner (GCL) (Gypsum Stack and CCB Landfill).

The area of GCL to be covered with geomembrane shall be jointly inspected by the Geosynthetics Installer's CQA Representative daily with the Owner's Representative before commencing geomembrane installation for the day, and the condition of the GCL shall be continuously observed as geomembrane installation progresses. Rocks, stones, sticks, sharp objects and debris of any kind shall be removed from the surface of the GCL. The Owner's Representative shall be notified of any discontinuities, premature hydration, or otherwise defective GCL. Geomembrane shall not be placed over suspect areas until they have been repaired to the satisfaction of the Owner's Representative. The Geosynthetics Installer's CQA Representative shall submit a certificate of acceptance to the Owner's Representative daily, stating that the GCL surface was acceptable at the time of geomembrane installation.

B. Geomembrane installed over cushion dirt.(Gypsum Stack only) ***or Earth Fill Material (Recycle Pond only)***

The area of cushion dirt to be covered with geomembrane shall be prepared in accordance with the Section 02200 – Earthwork. The surface shall be smooth and free of ruts and holes, rocks, stones, sticks, sharp objects and debris of any kind.

C. The Geomembrane installer shall provide daily, a certificate of acceptance for the surface to be covered by the geomembrane in that day's operations. The surface shall be maintained in a manner, during geomembrane installation, to ensure subgrade suitability.

D. All subgrade damaged by construction equipment and deemed unsuitable by the Owner's Representative for geomembrane deployment shall be repaired prior to placement of the geomembrane. All repairs shall be reviewed by the Owner's Representative and approved by the Geomembrane Installer. This damage, repair, and the responsibilities of the contractor and Geomembrane Installer shall be defined in the preconstruction meeting.

3.02 GEOMEMBRANE PLACEMENT

A. No geomembrane shall be deployed until the applicable certifications and quality control certificates listed in subsection 1.04 of this Section are submitted to and approved by the Owner's Representative. Should geomembrane material be deployed prior to approval by the Owner's Representative it will be at the sole risk of the Geomembrane Installer and/or Contractor. If the material does not meet project specifications it shall be removed from the work area at no cost to the

owner.

B. The geomembrane shall be installed to the limits shown on the project drawings and essentially as shown on approved panel layout drawings.

C. No geomembrane material shall be unrolled and deployed if the material temperatures are lower than 0 degrees C (32 degrees F). Temperature limitations should be defined in the preconstruction meeting. Typically, only the quantity of geomembrane that will be anchored and seamed together in one day should be deployed.

D. No vehicular traffic shall travel on the geomembrane other than an approved low ground pressure All Terrain Vehicle or equivalent.

E. Sand bags or equivalent ballast shall be used as necessary to temporarily hold the geomembrane material in position under the foreseeable and reasonably - expected wind conditions. Sand bag material shall be sufficiently close- knit to prevent soil fines from working through the bags and discharging on the geomembrane.

F. Geomembrane placement shall not be done if moisture prevents proper subgrade preparation, panel placement, or panel seaming. Moisture limitations will be defined in the preconstruction meeting.

G. Damaged panels or portions of the damaged panels which have been rejected shall be marked and their removal from the work area recorded.

H. The geomembrane shall not be allowed to "bridge over" voids or low areas in the subgrade. In these areas, the subgrade shall be prepared to allow the geomembrane to rest in intimate contact with the subgrade.

I. Wrinkles caused by panel placement or thermal expansion should be minimized in accordance with section 1.10 B11.

J. Considerations on Site Geometry: In general, seams shall be oriented parallel to the line of the maximum slope. In corners and odd shaped geometric locations, the total length of field seams shall be minimized. Seams shall not be located at low points in the subgrade.

K. Overlapping: The panels shall be overlapped prior to seaming to whatever extent is necessary to effect a good weld and allow for proper testing. In no case shall this overlap be less than 75mm (3 in.).

3.03 SEAMING PROCEDURES

A. No geomembrane material shall be seamed when liner temperatures are less than 0 degrees C (32 degrees F).

B. No geomembrane material shall be seamed when the sheet temperature is above 75 degrees C (170 degrees F) as measured by an infrared thermometer or surface thermocouple.

C. Seaming shall primarily be performed using automatic fusion welding equipment and techniques. Extrusion welding shall be used where fusion welding is not possible such as at pipe penetrations, patches, repairs and short (less than a roll width) runs of seams.

D. Fishmouths or excessive wrinkles at the seam overlaps, shall be minimized and when necessary cut along the ridge of the wrinkles back into the panel so as to

effect a flat overlap. The cut shall be terminated with a keyhole cut (nominal 10 mm (1/2 in) diameter hole) so as to minimize crack/tear propagation. The overlay shall subsequently be seamed. The key hole cut shall be patched with an oval or round patch of the same base geomembrane material extending a minimum of 150 mm (6 in.) beyond the cut in all directions.

3.04 PIPE AND STRUCTURE PENETRATION SEALING SYSTEM

A. Provide penetration sealing system as shown in the Project Drawings.

B. Penetrations shall be constructed from the base geomembrane material, flat stock, prefabricated boots and accessories as shown on the Project Drawings. The pre-fabricated or field fabricated assembly shall be field welded to the geomembrane as shown on the Project Drawings so as to prevent leakage. This assembly shall be tested as outlined in section 3.05.B. Alternatively, where field non destructive testing can not be performed, attachments will be field spark tested by standard holiday leak detectors in accordance with ASTM 6365. Spark testing should be done in areas where both air pressure testing and vacuum testing are not possible.

1. Equipment for Spark testing shall be comprised of but not limited to: A hand held holiday spark tester and conductive wand that generates a high voltage.
2. The testing activities shall be performed by the Geomembrane Installer by placing an electrically conductive tape or wire beneath the seam prior to welding. A trial seam containing a non welded segment shall be subject to a calibration test to ensure that such a defect (non welded segment) will be identified under the planned machine settings and procedures. Upon completion of the weld, enable the spark tester and hold approximately 25mm (1 in) above the weld moving slowly over the entire length of the weld in accordance with ASTM 6365. If there is no spark the weld is considered to be leak free.
3. A spark indicates a hole in the seam. The faulty area shall be located, repaired and retested by the Geomembrane Installer.
4. Care should be taken if flammable gases are present in the area to be tested.

3.05 FIELD QUALITY CONTROL

The Owner's Representative shall be notified prior to all pre qualification and production welding and testing, or as agreed upon in the pre construction meeting.

A. Prequalification Test Seams

1. Test seams shall be prepared and tested by the Geomembrane Installer to verify that seaming parameters (speed, temperature and pressure of welding equipment) are adequate.
2. Test seams shall be made by each welding technician and tested in accordance with ASTM D 4437 at the beginning of each seaming period. Test seaming shall be performed under the same conditions and with the same equipment and operator combination as production seaming. The

test seam shall be approximately 3.3 meters (10 feet) long for fusion welding and 1 meter (3 feet) long for extrusion welding with the seam centered lengthwise. At a minimum, tests seams should be made by each technician 1 time every 4–6 hours; additional tests may be required with changes in environmental conditions.

3. Two 25 mm (1 in) wide specimens shall be die-cut by the Geomembrane Installer from each end of the test seam. These specimens shall be tested by the Geomembrane Installer using a field tensiometer testing both tracks for peel strength and also for shear strength. Each specimen shall fail in the parent material and not in the weld, "Film Tear Bond"(F.T.D. failure). Seam separation equal to or greater than 10% of the track width shall be considered a failing test.
4. The minimum acceptable seam strength values to be obtained for all specimens tested are listed in Subsection 3.05.C.4 of this Section. All four specimens shall pass for the test seam to be a passing seam.
5. If a test seam fails, an additional test seam shall be immediately conducted. If the additional test seam fails, the seaming apparatus shall be rejected and not used for production seaming until the deficiencies are corrected and a successful test seam can be produced.
6. A sample from each test seam shall be labeled. The label shall indicate the date, geomembrane temperature, number of the seaming unit, technician performing the test seam and pass or fail description. The sample shall then be given to the Owner's Representative for archiving.

B. Field Seam Non-destructive Testing

1. All field seams shall be non-destructively tested by the Geomembrane Installer over the full seam length before the seams are covered. Each seam shall be numbered or otherwise designated. The location, date, test unit, name of tester and outcome of all non-destructive testing shall be recorded and submitted to the Owner's Representative.
2. Testing should be done as the seaming work progresses, not at the completion of all field seaming. All defects found during testing shall be numbered and marked immediately after detection. All defects found should be repaired, retested and remarked to indicate acceptable completion of the repair.
3. Non-destructive testing shall be performed using vacuum box, air pressure or spark testing equipment.
4. Non-destructive tests shall be performed by experienced technicians familiar with the specified test methods. The Geomembrane Installer shall demonstrate to the Owner's Representative all test methods to verify the test procedures are valid.
5. Extrusion seams shall be vacuum box tested by the Geomembrane Installer in accordance with ASTM D 4437 and ASTM D 5641 with the following equipment and procedures:
   a. Equipment for testing extrusion seams shall be comprised of but not limited to: a vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft rubber gasket

attached to the base, port hole or valve assembly and a vacuum gauge; a vacuum pump assembly equipped with a pressure controller and pipe connections; a rubber pressure/vacuum hose with fittings and connections; a plastic bucket; wide paint brush or mop; and a soapy solution.

b. The vacuum pump shall be charged and the tank pressure adjusted to approximately 35 kPa (5 psig).

c. The Geomembrane Installer shall create a leak tight seal between the gasket and geomembrane interface by wetting a strip of geomembrane approximately 0.3m (12 in) by 1.2m (48 in) (length and width of box) with a soapy solution, placing the box over the wetted area, and then compressing the box against the geomembrane. The Geomembrane Installer shall then close the bleed valve, open the vacuum valve, maintain initial pressure of approximately 35 kPa (5 psig) for approximately 5 seconds. The geomembrane should be continuously examined through the viewing window for the presence of soap bubbles, indicating a leak. If no bubbles appear after 5 seconds, the area shall be considered leak free. The box shall be depressurized and moved over the next adjoining area with an appropriate overlap and the process repeated.

d. All areas where soap bubbles appear shall be marked, repaired and then retested.

e. At locations where seams cannot be non destructively tested, such as pipe penetrations, alternate nondestructive spark testing (as outlined in section 3.04.B) or equivalent should be substituted.

f. All seams that are vacuum tested shall be marked with the date tested, the name of the technician performing the test and the results of the test.

6. Double Fusion seams with an enclosed channel shall be air pressure tested by the Geomembrane Installer in accordance with ASTM D 5820 and ASTM D 4437 and the following equipment and procedures:

a. Equipment for testing double fusion seams shall be comprised of but not limited to: an air pump equipped with a pressure gauge capable of generating and sustaining a pressure of 210 kPa (30 psig), mounted on a cushion to protect the geomembrane; and a manometer equipped with a sharp hollow needle or other approved pressure feed device.

b. The Testing activities shall be performed by the Geomembrane Installer. Both ends of the seam to be tested shall be sealed and a needle or other approved pressure feed device inserted into the tunnel created by the double wedge fusion weld. The air pump shall be adjusted to a pressure of 210 kPa (30 psig), and the valve closed,. Allow 2 minutes for the injected air to come to equilibrium in the channel, and sustain pressure for 5 minutes. If pressure loss does not exceed 28 kPa (4 psig) after this five minute period the seam shall be considered leak tight. Release pressure from the opposite end verifying pressure drop on needle to ensure testing of

the entire seam. The needle or other approved pressure feed device shall be removed and the feed hole sealed.

c. If loss of pressure exceeds 28 kPa (4 psig) during the testing period or pressure does not stabilize, the faulty area shall be located, repaired and retested by the Geomembrane Installer.

d. Results of the pressure testing shall be recorded on the liner at the seam tested and on a pressure testing record.

C. Destructive Field Seam Testing

1. One destructive test sample per 150 linear m (500 linear ft) seam length or another predetermined length in accordance with GRI GM 14 shall be taken by the Geomembrane Installer from a location specified by the Owner's Representative. The Geomembrane Installer shall not be informed in advance of the sample location. In order to obtain test results prior to completion of geomembrane installation, samples shall be cut by the Geomembrane Installer as directed by the Owner's Representative as seaming progresses.

2. All field samples shall be marked with their sample number and seam number. The sample number, date, time, location, and seam number shall be recorded. The Geomembrane Installer shall repair all holes in the geomembrane resulting from obtaining the seam samples. All patches shall be vacuum box tested or spark tested. If a patch cannot be permanently installed over the test location the same day of sample collection, a temporary patch shall be tack welded or hot air welded over the opening until a permanent patch can be affixed.

3. The destructive sample size shall be 300 mm (12 in) wide by 1 m (36 in) long with the seam centered lengthwise. The sample shall be cut into three equal sections and distributed as follows: one section given to the Owner's Representative as an archive sample; one section given to the Owner's Representative for laboratory testing as specified in paragraph 5 below; and one section retained by the Geomembrane Installer for field testing as specified in paragraph 4 below.

4. For field testing, the Geomembrane Installer shall cut 10 identical 25 mm (1 in) wide replicate specimens from his sample. The Geomembrane Installer shall test five specimens for seam shear strength and five for peel strength. Peel tests will be performed on both inside and outside weld tracks. To be acceptable, 4 of 5 test specimens must pass the stated criteria in section 2.02 with less than 10% separation. If 4 of 5 specimens pass, the sample qualifies for testing by the testing laboratory if required.

5. If independent seam testing is required by the specifications it shall be conducted in accordance with ASTM 5820 or ASTM D4437 or GRI GM 6.

6. Reports of the results of examinations and testing shall be prepared and submitted to the Owner's Representative.

7. For field seams, if a laboratory test fails, that shall be considered as an indicator of the possible inadequacy of the entire seamed length corresponding to the test sample. Additional destructive test portions shall

then be taken by the Geomembrane Installer at locations indicated by the Engineer, typically 3 m (10 ft) on either side of the failed sample and laboratory seam tests shall be performed. Passing tests shall be an indicator of adequate seams. Failing tests shall be an indicator of non-adequate seams and all seams represented by the destructive test location shall be repaired with a cap-strip extrusion welded to all sides of the capped area. All cap-strip seams shall be non-destructively vacuum box tested until adequacy of the seams is achieved. Cap strip seams exceeding 50 M in length (150 FT) shall be destructively tested.

D. Identification of Defects

1. Panels and seams shall be inspected by the Installer and Owner's Representative during and after panel deployment to identify all defects, including holes, blisters, undispersed raw materials and signs of contamination by foreign matter.

E. Evaluation of Defects: Each suspect location on the liner (both in geomembrane seam and non-seam areas) shall be non-destructively tested using one of the methods described in Section 3.05.B. Each location which fails non-destructive testing shall be marked, numbered, measured and posted on the daily "installation" drawings and subsequently repaired.

1. If a destructive sample fails the field or laboratory test, the Geomembrane Installer shall repair the seam between the two nearest passed locations on both sides of the failed destructive sample location.
2. Defective seams, tears or holes shall be repaired by reseaming or applying a extrusion welded cap strip.
3. Reseaming may consist of either:
   a. Removing the defective weld area and rewelding the parent material using the original welding equipment; or
   b. Reseaming by extrusion welding along the overlap at the outside seam edge left by the fusion welding process.
4. Blisters, larger holes, and contamination by foreign matter shall be repaired by patches and/or extrusion weld beads as required. Each patch shall extend a minimum of 150 mm (6 in) beyond all edges of the defects.
5. All repairs shall be measured, located and recorded.

F. Verification of Repairs on Seams: Each repair shall be non-destructively tested using either vacuum box or spark testing methods. Tests which pass the non-destructive test shall be taken as an indication of a successful repair. Failed tests shall be reseamed and retested until a passing test results. The number, date, location, technician and test outcome of each patch shall be recorded.

G. Daily Field Installation Reports: At the beginning of each day's work, the Installer shall provide the Engineer with daily reports for all work accomplished on the previous work day. Reports shall include the following:

1. Total amount and location of geomembrane placed;

2. Total length and location of seams completed, name of technicians doing seaming and welding unit numbers;
3. Drawings of the previous day's installed geomembrane showing panel numbers, seam numbers and locations of non-destructive and destructive testing;
4. Results of pre-qualification test seams;
5. Results of non-destructive testing; and
6. Results of vacuum testing of repairs.

H. Destructive test results shall be reported prior to covering of liner or within 48 hours.

3.06 LINER ACCEPTANCE

A. Geomembrane liner will be accepted by the Owner's Representative when:

1. The entire installation is finished or an agreed upon subsection of the installation is finished;
2. All Installer's QC documentation is completed and submitted to the owner
3. Verification of the adequacy of all field seams and repairs and associated geomembrane testing is complete.

3.07 ANCHOR TRENCH

A. Construct as specified on the project drawings.

3.08 DISPOSAL OF SCRAP MATERIALS

A. On completion of installation, the Geomembrane Installer shall dispose of all trash and scrap material in a location designated by the Owner's Representative, remove equipment used in connection with the work herein, and shall leave the premises in a neat acceptable manner. Scrap sections larger than 5 feet on each edge shall be segregated from smaller scraps and retained by the Owner. No scrap material shall be allowed to remain on the geomembrane surface.

PART 4. GRI GM13 SPECIFICATIONS

Geosynthetics Research Institute (GRI) Test Method GM13 – "Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes", Revision 8, Dated July 10, 2006.

ATTACHMENT A:

Minimum Average Weld Properties for Smooth and Textured HDPE Geomembranes (English units)								
Property	**Test Method**	**30 mil**	**40 mil**	**50 mil**	**60 mil**	**80 mil**	**100 mil**	**120 mil**
Peel strength (fusion & extrusion) lb/in.	ASTM 4437	39	52	65	78	104	130	156
Shear strength (fusion & extrusion) lb/in.	ASTM 4437	60	80	100	120	160	200	239

END OF SECTION 02800

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GRI Test Method GM13*

Standard Specification for

"Test Methods, Test Properties and Testing Frequency for
High Density Polyethylene (HDPE) Smooth and Textured Geomembranes"

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1. Scope

1.1 This specification covers high density polyethylene (HDPE) geomembranes with a formulated sheet density of 0.940 g/ml, or higher, in the thickness range of 0.75 mm (30 mils) to 3.0 mm (120 mils). Both smooth and textured geomembrane surfaces are included.

1.2 This specification sets forth a set of minimum, physical, mechanical and chemical properties that must be met, or exceeded by the geomembrane being manufactured. In a few cases a range is specified.

1.3 In the context of quality systems and management, this specification represents manufacturing quality control (MQC).

Note 1: Manufacturing quality control represents those actions taken by a manufacturer to ensure that the product represents the stated objective and properties set forth in this specification.

1.4 This standard specification is intended to ensure good quality and performance of HDPE geomembranes in general applications, but is possibly not adequate for the complete specification in a specific situation. Additional tests, or more restrictive

*This GRI standard is developed by the Geosynthetic Research Institute through consultation and review by the member organizations. This specification will be reviewed at least every 2-years, or on an as-required basis. In this regard it is subject to change at any time. The most recent revision date is the effective version.

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values for test indicated, may be necessary under conditions of a particular application.

Note 2: For information on installation techniques, users of this standard are referred to the geosynthetics literature, which is abundant on the subject.

2. Referenced Documents

2.1 ASTM Standards

D 792 Specific Gravity (Relative Density) and Density of Plastics by Displacement
D 1004 Test Method for Initial Tear Resistance of Plastics Film and Sheeting
D 1238 Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
D 1505 Test Method for Density of Plastics by the Density-Gradient Technique
D 1603 Test Method for Carbon Black in Olefin Plastics
D 3895 Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis
D 4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
D 4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
D 5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
D 5397 Procedure to Perform a Single Point Notched Constant Tensile Load – (SP-NCTL) Test: Appendix
D 5596 Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
D 5721 Practice for Air-Oven Aging of Polyolefin Geomembranes
D 5885 Test method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry
D 5994 Test Method for Measuring the Core Thickness of Textured Geomembranes
D 6693 Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

2.2 GRI Standards

GM10 Specification for the Stress Crack Resistance of Geomembrane Sheet
GM 11 Accelerated Weathering of Geomembranes using a Fluorescent UVA-Condensation Exposure Device
GM 12 Measurement of the Asperity Height of Textured Geomembranes Using a Depth Gage

2.3 U. S. Environmental Protection Agency Technical Guidance Document "Quality Control Assurance and Quality Control for Waste Containment Facilities." EPA/600/R-93/182. September 1993, 305 pgs.

3. Definitions

Manufacturing Quality Control (MQC) - A planned system of inspections that is used to directly monitor and control the manufacture of a material which is factory originated. MQC is normally performed by the manufacturer of geosynthetic materials and is necessary to ensure minimum (or maximum) specified values in the manufactured product. MQC refers to measures taken by the manufacturer to determine compliance with the requirements for materials and workmanship as stated in certification documents and contract specifications.
ref. EPA/600/R-93/182

Manufacturing Quality Assurance (MQA) - A planned system of activities that provides assurance that the materials were constructed as specified in the certification documents and contract specifications. MQA includes manufacturing facility inspections, verifications, audits and evaluation of the raw materials (resins and additives) and geosynthetic products to assess the quality of the manufactured materials. MQA refers to measures taken by the MQA organization to determine if the manufacturer is in compliance with the product certification and contract specifications for the project.
ref. EPA/600/R-93/182

Formulation, n - The mixture of a unique combination of ingredients identified by type, properties and quantity. For HDPE polyethylene geomembranes, a formulation is defined as the exact percentages and types of resin(s), additives and carbon black.

4. Material Classification and Formulation

4.1 This specification covers high density polyethylene geomembranes with a formulated sheet density of 0.940 g/ml, or higher. Density can be measured by ASTM D1505 or ASTM D792. If the latter, Method B is recommended.

4.2 The polyethylene resin from which the geomembrane is made will generally be in the density range of 0.932 g/ml or higher, and have a melt index value per ASTM D1238 of less than 1.0 g/10 min.

4.3 The resin shall be virgin material with no more than 10% rework. If rework is used, it must be a similar HDPE as the parent material.

4.4 No post consumer resin (PCR) of any type shall be added to the formulation.

5. Physical, Mechanical and Chemical Property Requirements

5.1 The geomembrane shall conform to the test property requirements prescribed in Tables 1 and 2. Table 1 is for smooth HDPE geomembranes and Table 2 is for single and double sided textured HDPE geomembranes. Each of the tables are given in English and SI (metric) units. The conversion from English to SI (metric) is soft.

Note 3: The tensile strength properties in this specification were originally based on ASTM D 638 which uses a laboratory testing temperature of 23°C ± 2°C. Since ASTM Committee D35 on Geosynthetics adopted ASTM D 6693 (in place of D 638), this GRI Specification followed accordingly. The difference is that D 6693 uses a testing temperature of 21°C ± 2°C. The numeric values of strength and elongation were not changed in this specification. If a dispute arises in this regard, the original temperature of 23°C ± 2°C should be utilized for testing purposes.

Note 4: There are several tests often included in other HDPE specifications which are omitted from this standard because they are outdated, irrelevant or generate information that is not necessary to evaluate on a routine MQC basis. The following tests have been purposely omitted:

- Volatile Loss
- Dimensional Stability
- Coeff. of Linear Expansion
- Resistance to Soil Burial
- Low Temperature Impact
- ESCR Test (D 1693)
- Wide Width Tensile
- Water Vapor Transmission
- Water Absorption
- Ozone Resistance
- Modulus of Elasticity
- Hydrostatic Resistance
- Tensile Impact
- Field Seam Strength
- Multi-Axial Burst
- Various Toxicity Tests

Note 5: There are several tests which are included in this standard (that are not customarily required in other HDPE specifications) because they are relevant and important in the context of current manufacturing processes. The following tests have been purposely added:

- Oxidative Induction Time
- Oven Aging
- Ultraviolet Resistance
- Asperity Height of Textured Sheet (see Note 6)

Note 6: The minimum average value of asperity height does not represent an expected value of interface shear strength. Shear strength

associated with geomembranes is both site-specific and product-specific and should be determined by direct shear testing using ASTM D5321/ASTM D6243 as prescribed. This testing should be included in the particular site's CQA conformance testing protocol for the geosynthetic materials involved, or formally waived by the Design Engineer, with concurrence from the Owner prior to the deployment of the geosynthetic materials.

Note 7: There are other tests in this standard, focused on a particular property, which are updated to current standards. The following are in this category:

- Thickness of Textured Sheet
- Puncture Resistance
- Stress Crack Resistance
- Carbon Black Dispersion (In the viewing and subsequent quantitative interpretation of ASTM D 5596 only near spherical agglomerates shall be included in the assessment).

Note 8: There are several GRI tests currently included in this standard. Since these topics are not covered in ASTM standards, this is necessary. They are the following:

- UV Fluorescent Light Exposure
- Asperity Height Measurement

5.2 The values listed in the tables of this specification are to be interpreted according to the designated test method. In this respect they are neither minimum average roll values (MARV) nor maximum average roll values (MaxARV).

5.3 The properties of the HDPE geomembrane shall be tested at the minimum frequencies shown in Tables 1 and 2. If the specific manufacturer's quality control guide is more stringent and is certified accordingly, it must be followed in like manner.

Note 9: This specification is focused on manufacturing quality control (MQC). Conformance testing and manufacturing quality assurance (MQA) testing are at the discretion of the purchaser and/or quality assurance engineer, respectively.

6. Workmanship and Appearance

6.1 Smooth geomembrane shall have good appearance qualities. It shall be free from such defects that would affect the specified properties of the geomembrane.

6.2 Textured geomembrane shall generally have uniform texturing appearance. It shall be free from agglomerated texturing material and such defects that would affect the specified properties of the geomembrane.

6.3 General manufacturing procedures shall be performed in accordance with the manufacturer's internal quality control guide and/or documents.

7. MQC Sampling

7.1 Sampling shall be in accordance with the specific test methods listed in Tables 1 and 2. If no sampling protocol is stipulated in the particular test method, then test specimens shall be taken evenly spaced across the entire roll width.

7.2 The number of tests shall be in accordance with the appropriate test methods listed in Tables 1 and 2.

7.3 The average of the test results should be calculated per the particular standard cited and compared to the minimum value listed in these tables, hence the values listed are the minimum average values and are designated as "min. ave."

8. MQC Retest and Rejection

8.1 If the results of any test do not conform to the requirements of this specification, retesting to determine conformance or rejection should be done in accordance with the manufacturing protocol as set forth in the manufacturer's quality manual.

9. Packaging and Marketing

9.1 The geomembrane shall be rolled onto a substantial core or core segments and held firm by dedicated straps/slings, or other suitable means. The rolls must be adequate for safe transportation to the point of delivery, unless otherwise specified in the contract or order.

10. Certification

10.1 Upon request of the purchaser in the contract or order, a manufacturer's certification that the material was manufactured and tested in accordance with this specification, together with a report of the test results, shall be furnished at the time of shipment.

ENGLISH UNITS

Table 1(a) – High Density Polyethylene (HDPE) Geomembrane -Smooth

Properties	Test Method	Test Value							Testing Frequency (minimum)
		30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
Thickness (min. ave.)	D5199	nom.	Nom.	Nom.	Nom.	Nom.	Nom.	Nom.	Per roll
• lowest individual of 10 values		-10%	-10%	-10%	-10%	-10%	-10%	-10%	
Density mg/l (min.)	D 1505/D 792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	200,000 lb
Tensile Properties *(1)* (min. ave.)	D 6693 Type IV								20,000 lb
• yield strength		63 lb/in.	84 lb/in.	105 lb/in.	126 lb/in.	168 lb/in.	210 lb/in.	252 lb/in.	
• break strength		114 lb/in.	152 lb/in.	190 lb/in.	228 lb/in.	304 lb/in.	380 lb/in	456 lb/in.	
• yield elongation		12%	12%	12%	12%	12%	12%	12%	
• break elongation		700%	700%	700%	700%	700%	700%	700%	
Tear Resistance (min. ave.)	D 1004	21 lb	28 lb	35 lb	42 lb	56 lb	70 lb	84 lb	45,000 lb
Puncture Resistance (min. ave.)	D 4833	54 lb	72 lb	90 lb	108 lb	144 lb	180 lb	216 lb	45,000 lb
Stress Crack Resistance *(2)*	D5397 (App.)	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	per GRI-GM10
Carbon Black Content (range)	D 1603 *(3)*	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	20,000 lb
Carbon Black Dispersion	D 5596	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	45,000 lb
Oxidative Induction Time (OIT) (min. ave.) *(5)*									200,000 lb
(a) Standard OIT	D 3895	100 min.	100 min.	100 min.	100 min.	100 min.	100 min.	100 min.	
— or —									
(b) High Pressure OIT	D 5885	400 min.	400 min.	400 min.	400 min.	400 min.	400 min.	400 min.	
Oven Aging at 85°C *(5), (6)*	D 5721								
(a) Standard OIT (min. ave.) - % retained after 90 days	D 3895	55%	55%	55%	55%	55%	55%	55%	per each formulation
or									
(b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5885	80%	80%	80%	80%	80%	80%	80%	
UV Resistance *(7)*	GM 11								
(a) Standard OIT (min. ave.)	D 3895	N.R. *(8)*	N.R. *(8)*	N.R. *(8)*	N.R. *(8)*	N.R. *(8)*	N.R. *(8)*	N.R. *(8)*	per each formulation
— or —									
(b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(9)*	D 5885	50%	50%	50%	50%	50%	50%	50%	

(1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
Yield elongation is calculated using a gage length of 1.3 inches
Break elongation is calculated using a gage length of 2.0 in.

(2) The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.

(3) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.

(4) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
9 in Categories 1 or 2 and 1 in Category 3

(5) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(6) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(7) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.

(8) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(9) UV resistance is based on percent retained value regardless of the original HP-OIT value.

SI (METRIC) UNITS

Table 1(b) – High Density Polyethylene (HPDE) Geomembrane - Smooth

Properties	Test Method	Test Value							Testing Frequency (minimum)
		0.75 mm	1.00 mm	1.25 mm	1.50 mm	2.00 mm	2.50 mm	3.00 mm	
Thickness - mils (min. ave.) • lowest individual of 10 values	D5199	nom. (mil) -10%	nom. (mil) -10%	nom. (mil) -10%	nom. (mil) -10%	nom. (mil) -10%	nom. (mil) -10%	nom. (mil) -10%	per roll
Density (min.)	D 1505/D 792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	90,000 kg
Tensile Properties *(1)* (min. ave.) • yield strength • break strength • yield elongation • break elongation	D 6693 Type IV	11 kN/m 20kN/m 12% 700%	15 kN/m 27 kN/m 12% 700%	18 kN/m 33 kN/m 12% 700%	22 kN/m 40 kN/m 12% 700%	29 kN/m 53 kN/m 12% 700%	37 kN/m 67 kN/m 12% 700%	44 kN/m 80 kN/m 12% 700%	9,000 kg
Tear Resistance (min. ave.)	D 1004	93 N	125 N	156 N	187 N	249 N	311 N	374 N	20,000 kg
Puncture Resistance (min. ave.)	D 4833	240 N	320 N	400 N	480 N	640 N	800 N	960 N	20,000 kg
Stress Crack Resistance *(2)*	D 5397 (App.)	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	per GRI GM-10
Carbon Black Content - %	D 1603 *(3)*	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	9,000 kg
Carbon Black Dispersion	D 5596	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	note *(4)*	20,000 kg
Oxidative Induction Time (OIT) (min. ave.) *(5)* (a) Standard OIT — or — (b) High Pressure OIT	D 3895 D 5885	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	90,000 kg
Oven Aging at 85°C *(5), (6)* (a) Standard OIT (min. ave.) - % retained after 90 days — or — (b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5721 D 3895 D 5885	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	per each formulation
UV Resistance *(7)* (a) Standard OIT (min. ave.) — or — (b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(9)*	D 3895 D 5885	N. R. *(8)* 50%	N.R. *(8)* 50%	N.R. *(8)* 50%	N.R. *(8)* 50%	N.R. *(8)* 50%	N.R. *(8)* 50%	N.R. *(8)* 50%	per each formulation

(1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction
Yield elongation is calculated using a gage length of 33 mm
Break elongation is calculated using a gage length of 50 mm

(2) The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.

(3) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.

(4) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
9 in Categories 1 or 2 and 1 in Category 3

(5) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(6) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(7) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.

(8) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(9) UV resistance is based on percent retained value regardless of the original HP-OIT value.

Table 2(a) – High Density Polyethylene (HDPE) Geomembrane - Textured

Properties	Test Method	Test Value							Testing Frequency (minimum)
		30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
Thickness mils (min. ave.)	D 5994	nom. (-5%)	nom. (-5%)	nom. (-5%)	nom. (-5%)	nom. (-5%)	nom. (-5%)	nom. (-5%)	per roll
• lowest individual for 8 out of 10 values		-10%	-10%	-10%	-10%	-10%	-10%	-10%	
• lowest individual for any of the 10 values		-15%	-15%	-15%	-15%	-15%	-15%	-15%	
Asperity Height mils (min. ave.) *(1)*	GM 12	10 mil	10 mil	10 mil	10 mil	10 mil	10 mil	10 mil	every 2nd roll *(2)*
Density (min. ave.)	D 1505/D 792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	200,000 lb
Tensile Properties (min. ave.) *(3)*	D 6693 Type IV								20,000 lb
• yield strength		63 lb/in	84 lb/in	105 lb/in	126 lb/in	168 lb/in	210 lb/in	252 lb/in	
• break strength		45 lb/in	60 lb/in	75 lb/in	90 lb/in	120 lb/in	150 lb/in	180 lb/in	
• yield elongation		12%	12%	12%	12%	12%	12%	12%	
• break elongation		100%	100%	100%	100%	100%	100%	100%	
Tear Resistance (min. ave.)	D 1004	21 lb	28 lb	35 lb	42 lb	56 lb	70 lb	84 lb	45,000 lb
Puncture Resistance (min. ave.)	D 4833	45 lb	60 lb	75 lb	90 lb	120 lb	150 lb	180 lb	45,000 lb
Stress Crack Resistance *(4)*	D 5397 (App.)	300 hr	300 hr	300 hr	300 hr	300 hr	300 hr	300 hr	per GRI GM10
Carbon Black Content (range)	D 1603 *(5)*	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	20,000 lb
Carbon Black Dispersion	D 5596	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	45,000 lb
Oxidative Induction Time (OIT) (min. ave.) *(7)*									200,000 lb
(a) Standard OIT	D 3895	100 min.	100 min.	100 min.	100 min.	100 min.	100 min.	100 min.	
or									
(b) High Pressure OIT	D 5885	400 min.	400 min.	400 min.	400 min.	400 min.	400 min.	400 min.	
Oven Aging at 85°C *(7)* *(8)*	D 5721								
(a) Standard OIT (min. ave.) - % retained after 90 days	D 3895	55%	55%	55%	55%	55%	55%	55%	per each formulation
- - or —									
(b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5885	80%	80%	80%	80%	80%	80%	80%	
UV Resistance *(9)*	GM11								
(a) Standard OIT (min. ave.)	D 3895	N.R. *(10)*	N.R. *(10)*	N.R. *(10)*	N.R. *(10)*	N.R. *(10)*	N.R. *(10)*	N.R. *(10)*	per each formulation
— or —									
(b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(11)*	D 5885	50%	50%	50%	50%	50%	50%	50%	

(1) Of 10 readings, 8 out of 10 must be ≥ 7 mils, and lowest individual reading must be ≥ 5 mils, also see Note 6

(2) Alternate the measurement side for double sided textured sheet

(3) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction
Yield elongation is calculated using a gage length of 1.3 inches
Break elongation is calculated using a gage length of 2.0 inches

(4) P-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials.
The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.

(5) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.

(6) Carbon black dispersion (only near spherical agglomerates) for 10 different views
9 in Categories 1 or 2 and 1 in Category 3

(7) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(8) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(9) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.

(10) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(11) UV resistance is based on percent retained value regardless of the original HP-OIT value.

Table 2(b) – High Density Polyethylene (HDPE) Geomembrane - Textured

Properties	Test Method	Test Value							Testing Frequency (minimum)
		0.75 mm	1.00 mm	1.25 mm	1.50 mm	2.00 mm	2.50 mm	3.00 mm	
Thickness mils (min. ave.) • lowest individual for 8 out of 10 values • lowest individual for any of the 10 values	D 5994	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	per roll
Asperity Height mils (min. ave.) *(1)*	GM 12	0.25 mm	0.25 mm	0.25 mm	0.25 mm	0.25 mm	0.25 mm	0.25 mm	every 2nd roll *(2)*
Density (min. ave.)	D 1505/D 792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	90,000 kg
Tensile Properties (min. ave.) *(3)* • yield strength • break strength • yield elongation • break elongation	D 6693 Type IV	11 kN/m 8 kN/m 12% 100%	15 kN/m 10 kN/m 12% 100%	18 kN/m 13 kN/m 12% 100%	22 kN/m 16 kN/m 12% 100%	29 kN/m 21 kN/m 12% 100%	37 kN/m 26 kN/m 12% 100%	44 kN/m 32 kN/m 12% 100%	9,000 kg
Tear Resistance (min. ave.)	D 1004	93 N	125 N	156 N	187 N	249 N	311 N	374 N	20,000 kg
Puncture Resistance (min. ave.)	D 4833	200N	267 N	333 N	400 N	534 N	667 N	800 N	20,000 kg
Stress Crack Resistance *(4)*	D 5397 (App.)	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	per GRI GM13
Carbon Black Content (range)	D 1603 *(5)*	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	9,000 kg
Carbon Black Dispersion	D 5596	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	20,000 kg
Oxidative Induction Time (OIT) (min. ave.) *(7)* (a) Standard OIT — or — (b) High Pressure OIT	D 3895 D 5885	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	90,000 kg
Oven Aging at 85°C *(7), (8)* (a) Standard OIT (min. ave.) - % retained after 90 days or — (b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5721 D 3895 D 5885	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	per each formulation
UV Resistance *(9)* (a) Standard OIT (min. ave.) — or — (b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(11)*	GM11 D 3895 D 5885	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	per each formulation

(1) Of 10 readings, 8 out of 10 must be ≥ 0.18 mm, and lowest individual reading must be ≥ 0.13 mm, also see Note 6.

(2) Alternate the measurement side for double sided textured sheet

(3) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
Yield elongation is calculated using a gage length of 33 mm
Break elongation is calculated using a gage length of 50 mm

(4) The SP-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials.
The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.

(5) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.

(6) Carbon black dispersion (only near spherical agglomerates) for 10 different views
9 in Categories 1 or 2 and 1 in Category 3

(7) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

(8) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

(9) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.

(10) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

(11) UV resistance is based on percent retained value regardless of the original HP-OIT value.

Adoption and Revision Schedule

for

HDPE Specification per GRI-GM13

"Test Methods, Test Properties, Testing Frequency for
High Density Polyethylene (HDPE) Smooth and Textured Geomembranes"

Adopted:	June 17, 1997
Revision 1:	November 20, 1998; changed CB dispersion from allowing 2 views to be in Category 3 to requiring all 10 views to be in Category 1 or 2. Also reduced UV percent retained from 60% to 50%.
Revision 2:	April 29, 1999: added to Note 5 after the listing of Carbon Black Dispersion the following: "(In the viewing and subsequent quantitative interpretation of ASTM D5596 only near spherical agglomerates shall be included in the assessment)" and to Note (4) in the property tables.
Revision 3:	June 28, 2000: added a new Section 5.2 that the numeric table values are neither MARV or MaxARV. They are to be interpreted per the the designated test method.
Revision 4:	December 13, 2000: added one Category 3 is allowed for carbon black dispersion. Also, unified terminology to "strength" and "elongation".
Revision 5:	May 15, 2003: Increased minimum acceptable stress crack resistance time from 200 hrs to 300 hrs.
Revision 6:	June 23, 2003: Adopted ASTM D 6693, in place of ASTM D 638, for tensile strength testing. Also, added Note 2.
Revision 7:	February 20, 2006: Added Note 6 on Asperity Height clarification with respect to shear strength.
Revision 8:	Removed recommended warranty from specification.

PART 1. GENERAL

1.01 DESCRIPTION

This section pertains to seeding and placing mulch or erosion control blanket over seeded areas.

1.02 RELATED SECTIONS

A. Specified elsewhere:

1. 02200 - Earthwork

1.03 REFERENCES

The following reference or cited portions thereof, current at date of bidding documents unless otherwise specified, governs the work.

A. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, adopted January 1, 2007.

1.04 SPECIFICATIONS

A. Work shall conform to the applicable requirements of Sections 250 and 251 of Standard Specifications for Road and Bridge Construction and to the requirements hereinafter specified.

B. Exceptions: All references in the IDOT specifications to methods of measurement and payment shall not apply.

1.05 WARRANTY

A. Warranty for one (1) year plus one growing season from date of substantial completion shall be provided.

PART 2. PRODUCTS

2.01 MATERIALS

A. Seed: Seed shall conform to Article 1081.04 of the IDOT Standard Specifications where IDOT seed mixtures are specified. In areas where Ameren Energy

Generating hay seeding mix is specified, it shall be composed as follows:

Seed Type	Pounds/Acre
Vernal Alfalfa	12
Wrangler Alfalfa	8
Medium Red Clover	6
Timothy	4

B. Mulch Material and Erosion Control Blanket: Mulch material shall conform to Article 1081.06 and the excelsior blanket/knitted straw mat shall conform to Article 1081.10 of the IDOT Standard Specifications.

C. Fertilizer and agricultural ground limestone will not be permitted.

PART 3. EXECUTION

3.01 CONSTRUCTION

A. Seed bed preparation and seeding methods shall conform to Section 250 of the IDOT Specifications. Seeding of areas disturbed by construction activities after September 30, 2008 may be deferred until Spring 2009 at no additional cost to the Owner.

B. Seed shall be applied to the perimeter berm ditch, to disturbed portions of the perimeter berm, and to all disturbed earth surfaces outside of the existing perimeter berm. IDOT seeding mixture 7 shall be used on stockpiles. IDOT seeding mixture 1A shall be used on the gypsum stack perimeter earthen berm, the recycle pond dam embankment and on slopes that are 4H:1V or steeper. The Ameren hay seed mix shall be used on slopes flatter than 4H:1V.

C. Application rates for IDOT seed mixtures shall be as specified in Section 250 of the IDOT Specifications. The application rate for the Ameren Energy Resources Generating's seed mix shall be as specified in the Ameren Energy Resources Generating's hay seeding mix.

D. Seeded areas shall be mulched in accordance with Article 251.03. The Contractor may use either Method 2 or Method 3.

3.02 MAINTENANCE OF COMPLETED WORK

A. All areas seeded by the Contractor shall be maintained by the Contractor during the period between completion of such work and final completion and acceptance of the Contractor's work by the Owner. This maintenance shall be such that the completed work, at time of acceptance, complies in all respects with the requirements herein

specified.

B. The areas seeded will be required to germinate. If the seed does not germinate, the Contractor will be required to regrade and reseed at no additional cost to the Owner.

END OF SECTION 02936

PART 1. GENERAL

1.01 WORK INCLUDES

A. The complete installation of the formwork for cast-in-place concrete, with shoring, bracing and anchorage, openings for other work, form accessories, form stripping.

1.02 RELATED SECTIONS

A. Section 03200 - Concrete Reinforcement.

B. Section 03300 - Cast-In-Place Concrete.

C. Section 03400 – Concrete Embedment Liner.

1.03 REFERENCES

A. ACI 347 - Recommended Practice For Concrete Formwork.

B. ACI 301 - Specifications For Structural Concrete For Buildings.

1.04 DESIGN REQUIREMENTS

A. Design, engineer and construct formwork, shoring and bracing to conform to design and code requirements; resultant concrete to conform to required shape, line and dimension.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 347 and 301.

1.06 REGULATORY REQUIREMENTS

A. Conform to applicable code for design, fabrication, erection and removal of formwork.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.08 COORDINATION

A. Coordinate this Section with other Sections of work which require attachment of components of formwork.

B. If formwork is placed which results in insufficient concrete cover over reinforcement. request instructions from Owner's Representative before proceeding.

PART 2. PRODUCTS

2.01 WOOD FORM MATERIALS

A. Softwood Plywood: 3/4 in. PS 1-83 "B-B" (concrete form) plywood, Class I, exterior grade or better, mill-oiled and edge sealed with each piece bearing legible inspection trademark.

B. Architectural Plywood: 3/4 in. PS 1-83 "B-B" plyform. Class I, with High Density smooth overlay, 1 surface, edge sealed with each piece bearing legible inspection trademark.

2.02 MANUFACTURERS - PREFABRICATED FORMS

A. Weyerhauser Concrete Form.

B. Georgia Pacific, G-P Exterior Soft Wood Plywood Product.

C. Plywood and Door Corporation's Finn-Form.

2.03 PREFABRICATED FORMS

A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

2.04 FORMWORK ACCESSORIES

A. Form Ties: Snap-off type, galvanized metal, adjustable length, 1 in. back break dimension, free of defects that could leave holes larger than 1 in. in concrete surface; Dayton-Sure Grip snap-in-form ties, as manufactured by Dayton Superior

Corp., Symons Ties as manufactured by Symons Corporation, Snap-Tys as manufactured by Richmond Corporation. Ties shall be removed after forms are removed, and holes filled with mortar that matches the adjacent surfaces.

B. Form Release Agent: Colorless mineral oil which will not stain concrete, or absorb moisture; by Magic Kote manufactured by Symons Manufacturing Co., Form Coat manufactured by Concrete Services Co., Formcel manufactured by Lambert Corp.

C. Corners: Chamfered, wood strip type; 3/4 x 3/4 in. size on all exterior corners, 3 x 3 in. size where shown on the drawings; maximum possible lengths.

D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

E. Concrete Embedment Liner, where required, shall be installed in accordance with Section 03400 – Concrete Embedment Liner.

PART 3. EXECUTION

3.01 EXAMINATION

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.02 EARTH FORMS

A. Earth forms are not permitted, except for footings.

3.03 ERECTION - FORMWORK

A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301. Metal forms shall be installed in strict accordance with manufacturer's directions and specifications.

B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

D. Align joints and make watertight. Keep form joints to a minimum.

E. Obtain approval before framing openings in structural members which are not indicated on drawings.

3.04 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are affected by agent.

3.05 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in or passing through concrete work.

B. Locate and set in place items which will be cast directly into concrete.

C. Coordinate work of other Sections in forming and placing openings, slots, reglets, recesses, chases, sleeves, bolts, anchors, and other inserts.

D. Install accessories in accordance with manufacturer's instructions, straight, level, and plumb. Ensure items are not disturbed during concrete placement.

E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.06 FORM CLEANING

A. Clean and remove foreign matter within forms as erection proceeds.

B. Clean formed cavities of debris prior to placing concrete.

C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts or water to clean out forms. Use compressed air or other means to remove foreign matter.

3.07 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 301.

3.08 FIELD QUALITY CONTROL

A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

B. Do not reuse wood formwork more than three times for concrete surfaces to be exposed to view. Do no patch formwork.

3.09 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finished concrete surfaces scheduled for exposure to view.

C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

END OF SECTION 03100

PART 1. GENERAL

1.01 WORK INCLUDES

A. The complete installation of the reinforcing steel bars and accessories for cast-in-place concrete.

1.02 RELATED SECTIONS

A. Section 03100 - Concrete Formwork.

B. Section 03300 - Cast-in-Place Concrete.

1.03 REFERENCES

A. ACI 301 - Structural Concrete for Buildings.

B. ACI 318 - Building Code Requirements For Reinforced Concrete.

C. ACI SP-66 - American Concrete Institute - Detailing Manual.

D. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

E. CRSI - Concrete Reinforcing Steel Institute Manual of Practice.

1.04 SUBMITTALS

A. Submit under provisions of Section 01010.

B. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel, and bending and cutting schedules. Contract drawings shall not be reproduced as the basis for shop drawings.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with CRSI Manual of Standard Practice.

B. Submit certified copies of mill test report of reinforcement materials analysis.

1.06 COORDINATION

A. Coordinate with placement of formwork, formed openings and other work.

PART 2. PRODUCTS

2.01 REINFORCEMENT

A. Reinforcing Steel: ASTM A615, 60 ksi yield grade; deformed billet steel bars.

2.02 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage, annealed steel wire, epoxy coated when used with epoxy-coated reinforcement.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions.

C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic coated steel type; size and shape as required.

2.03 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI Manual of Standard Practice and ACI SP-66.

B. Splice reinforcement on at locations indicated on drawings. Indicate location of splices on shop drawings.

PART 3. EXECUTION

3.01 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position. Clean reinforcement of foreign particles or coatings.

B. Accommodate placement of formed openings.

C. Conform to ACI 318 code for concrete cover over reinforcement.

3.02 FIELD QUALITY CONTROL

A. Contractor shall notify the Owner's Representative at least 24 hrs. in advance of concrete placement. Placement of reinforcing shall occur in such sequence that the Owner's Representative has sufficient time to inspect the correctness of the reinforcing within the placement area. The Owner's Representative retains the right to require necessary revisions be made before concrete is placed.

END OF SECTION 03200

PART 1. GENERAL

1.01 WORK INCLUDES

A. The complete installation of cast-in-place concrete structures, including joint sealants.

1.02 RELATED SECTIONS

A. Section 03100 - Concrete Formwork: Formwork and accessories.

B Section 03200 - Concrete Reinforcement.

C. Section 03400 – Concrete Embedment Liner

1.03 REFERENCES

A. ACI 301 – Structural Concrete for Buildings.

B. ACI 302 - Guide for Concrete Floor and Slab Construction.

C. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

D. ACI 305R - Hot Weather Concreting.

E. ACI 306R - Cold Weather Concreting.

F. ACI 308 - Standard Practice for Curing Concrete.

G. ACI 318 - Building Code Requirements for Reinforced Concrete.

H. ASTM C31 - Concrete Test Specimens.

I. ASTM C33 - Concrete Aggregates.

J. ASTM C94 - Ready-Mixed Concrete.

K. ASTM C150 - Portland Cement.

L. ASTM C260 - Air Entraining Admixtures for Concrete.

M. ASTM C494 - Chemical Admixtures for Concrete.

1.04 SUBMITTALS

A. Product Data: Provide data on joint devices, attachment accessories, admixtures.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Acquire cement and aggregate from same source for all work.

C. Conform to ACI 305R when concreting during hot weather.

D. Conform to ACI 306R when concreting during cold weather.

1.06 COORDINATION

A. Coordinate this Section with other Sections which require embedment of components in cast-in-place concrete.

1.07 PRODUCT DATA

A. Submit proposed mix design to Owner's Representative for review prior to commencement of work. Identify source and provide material certificates for cement, fine and coarse aggregates. Provide recent laboratory gradation for fine and coarse aggregates and mix design information in accordance with ACI 301.

B. Submit Construction joint plan.

PART 2. PRODUCTS

2.01 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I - Normal Portland Type, Gray Color.

B. Fine and Coarse Aggregates: ASTM C33.

C. Water: Potable.

2.02 ADMIXTURES

A. Air Entrainment: ASTM C260.

B. Chemical: ASTM C494. Maximum 0.05% Chloride Ion Contents.

C. The use of calcium chloride in any concrete is not permitted.

2.03 ACCESSORIES

A. Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

B. Curing Compound: Dress and Seal No. 18 by L&M Construction Chemicals, MB-429 by Master Builders, or Sikagard Cure/Hard by the Sika Corporation.

C. Epoxy Grouted Adhesive Anchors: Hilti, Red Head, Simpson, or Rawl.

2.04 CONCRETE MIX

A. Mix concrete in accordance with ACI 304. Deliver concrete in accordance with ASTM C94.

B. Select proportions for normal weight concrete in accordance with ACI 301.

C. Provide normal weight concrete of the following characteristics:

1. Compressive strength at 28 days: 4,000 psi.

2. Slump: 4 in. - A tolerance of up to 1 in. above the maximum shall be allowed for one batch in any five consecutive batches tested.

3. Water/cement ratios: 0.4 (max).

D. Use accelerating admixtures in cold weather only when approved by Owner's Representative. Use of admixtures will not relax cold weather placement requirements.

E. Use set-retarding admixtures during hot weather only when approved by Owner's Representative.

F. Water-reducing admixtures may be used in all concrete except footings and in strict compliance with the manufacturer's directions.

G. Add air-entraining agent to concrete mix for air content of 6% (± 1%).

PART 3. EXECUTION

3.01 EXAMINATION

A. Verify requirements for concrete cover over reinforcement.

B. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

3.02 PLACING CONCRETE

A. Place concrete in accordance with ACI 301.

B. Notify Owner's Representative minimum of 24 hours prior to commencement of operations.

C. Ensure reinforcement, inserts, and embedded parts are not disturbed during concrete placement.

D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

E. Place concrete continuously between predetermined expansion, control, and construction joints.

F. When air temperature is between 80°F and 90°F, reduce the mixing and delivery time specified in ASTM C94 from 1-1/2 hours to 75 minutes. When the air temperature is above 90°F, reduce the mixing and delivery time to 60 minutes.

G. Cold weather concreting. Comply with ACI 306 except as follows:

1. In freezing weather, provide suitable means for maintaining concrete temperature at a minimum of 70°F for three days, or 50°F for five days after placing.

2. Cooling of concrete to outside temperature: Not faster than 1° per hour for first day and 2° per hour thereafter until outside temperature is reached.

3. Maximum temperature of concrete produced with heated aggregated, heated water, or both, at any time during its production or transportation: 90°F.

4. Do not mix chemicals or other foreign materials in concrete to prevent freezing or to accelerate hardening of concrete, unless approved in writing by Owner's Representative.

H. Hot weather concreting. Comply with ACI 305R.

1. ACI recommendations shall be observed when any combination of high air

temperature, low relative humidity and wind velocity tend to impair the quality of fresh or hardened concrete.

2. Retarding and water reducing admixtures shall be approved in writing for each concrete mix design prior to placement.

3.03 CONCRETE FINISHING

A. Provide exterior concrete formed surfaces to be left exposed with smooth rubbed finish in accord with ACI 301. All other formed surfaces shall have fins, projections and offsets removed.

B. Provide Class A tolerances to exterior concrete slabs according to ACI 301.

1. Broom finish all exterior slabs. Broom out all tool marks.

C. Pitch slabs to drain.

3.04 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for a period necessary for hydration of cement and hardening of concrete in accordance with ACI 308.

C. Cure and protect finished concrete slabs in accordance with ACI 308.

3.05 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed in accordance with ACI 301 and under provisions of Section 01010, paragraph 8.0.

B. Testing firm will take cylinders, perform slump and air entrainment tests in accordance with ACI 301.

C. Provide free access to Work and cooperate with appointed firm.

D. Submit proposed concrete mix design to Owner's Representative firm for review 14 days prior to commencement of Work.

E. Testing frequency shall be as specified in Section 01010, paragraph 8, except that one additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.

3.06 PATCHING

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Repair or replacement of defective concrete will be determined by Owner's Representative and performed by the Contractor at no additional cost to the project.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Owner's Representative for each individual area.

END OF SECTION 03300

PART 1. GENERAL

1.01 WORK INCLUDES

A. Specifications and guidelines for manufacturing and installing high-density polyethylene embedment liners.

1.02 RELATED SECTIONS

A. Section 03100 - Concrete Formwork.

B. Section 03300 - Cast-in-Place Concrete.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. D 1505 Test Method for Density of Plastics by the Density-Gradient Technique
2. D 1603 Test Method for Carbon Black in Olefin Plastics
3. D 5199 Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
4. D 5596 Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
5. D 6693 Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
6. D 1204 Standard Test Method for Linear Dimensional Changes of Nongrid Thermoplastic Sheeting or Film at Elevated Temperature
7. D 696 Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C With a Vitreous Silica Dilatometer
8. D 746 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
9. D 570 Standard Test Method for Water Absorption of Plastics
10. E 96 Standard Test Method for Water Vapor Transmission of Material

1.04 SUBMITTALS

A. All work for and in connection with the installation of the lining, field seaming and welding joints shall be completed in strict conformity with all applicable instructions and recommendations of the liner manufacturer.

B. Included with the shipment of liner, submit certified test reports that the liner and material are manufactured in accordance with standards specified herein.

1.05 QUALIFICATIONS

A. The HDPE liner specified in this section shall be furnished by a manufacturer who is fully experienced, reputable and qualified in the manufacturing of the materials. The manufacturer must at least 10 years of manufacturing experience.

B. Locking devices must be extruded to the sheet as a one step process.

C. Liner shall be GSE StudLiner as manufactured by GSE Lining Technology, Inc.

D. Liner shall be 8 feet in width.

E. Liner shall demonstrate a minimum pull-out strength of 14,000 psf.

1.06 COORDINATION

A. Coordinate with placement of formwork, formed openings and other work.

PART 2. PRODUCTS

2.01 ROLL DIMENSIONS

A. Embedment sheets shall be produced in rolls that are 8.0 ft (2.4 m) in width and a thickness range of 80 mils (2.0 mm) to 200 mils (5.0 mm) in thickness. Roll lengths vary according to thickness.

B. Locking studs of the same material as that of the liner shall be integrally extruded with the sheet. Stud spacing shall be on approximate 1.25 in (30 mm) centers, such that there are approximately 110 studs per square foot (1200 per square meter).

2.02 MATERIAL PROPERTIES

A. The material used in the embedment liner and in all welding strips shall be made from 97-98% virgin high density polyethylene and 1.5-3% carbon black or pigmentation for the purpose of an otherwise specified color.

B. Plasticizer shall not be added to the resin formulation.

C. Embedment sheet and welding strips shall be free of holes, pinholes, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.

D. The HDPE cap strips shall be made from HDPE, have good impact resistance and have an elongation sufficient to bridge up to 1/4 inch settling cracks.

E. Cap strips shall be approximately 4 inches wide or greater and shall be equivalent to that of the liner.

F. Material shall maintain a repairable state through it's lifecycle by methods approved and recommended by the manufacturer.

G. Embedment sheets shall have the following physical properties when tested in accordance with Table 1.

H. Raw resin shall have the following properties when tested in accordance with Table 2.

Table 1: Material Properties

Property	Test Method	Nominal Value				Testing Frequency
Thickness, mm (mil)	ASTM D 5199	2.00 (80)	3.00 (120)	4.00 (160)	5.00 (200)	1/every 5th roll
Density, g/cm³	ASTM D 1505	0.94	0.94	0.94	0.94	1/100,000 ft²
Tensile Properties Strength@Yield, lb/in² (MPa) Elongation @ Break, %	ASTM D 6693 Type IV, Dumbell G.L. = 2.0in.	2,200 (14.5) 500	2,200 (14.5) 500	2,200 (14.5) 500	2,200 (14.5) 500	1/100,000 ft²
Stud Pull-Out Strength[1], lb/ft² (kN/m²)		>14,000 (669.89)	>14,000 (669.89)	>14,000 (669.89)	>14,000 (669.89)	1/ product
Carbon Black Content/ Pigment Content, % Black Liner Gray Liner	ASTM D 1603, mod. ASTM D 5630, mod.	2-3 1.5 – 2.5	2-3 1.5 – 2.5	2-3 1.5 – 2.5	2-3 1.5 – 2.5	1/100,000 ft²
Carbon Black Dispersion[2]	ASTM D 5596	Note 2	Note 2	Note 2	Note 2	1/100,000 ft²
Notched Constant Tensile Load, hours	ASTM D 5397	400	400	400	400	1/ formulation
Coefficient of Linear Thermal Expansion, per °C	ASTM D 696	1.20E-04	1.20E-04	1.20E-04	1.20E-04	1/ product
Low Temperature Brittleness, °C	ASTM D 746	-77	-77	-77	-77	1/ product
Dimensional Stability, % (each direction)	ASTM D 1204	± 1.0	± 1.0	± 1.0	± 1.0	1/ product
Water Absorption, %	ASTM D 570	0.1	0.1	0.1	0.1	1/ product
Water Vapor Transmission, (g/m²/day)	ASTM E 96	<0.01	<0.01	<0.01	<0.01	1/ product

[1]Note: Concrete must have a compressive strength of at least 5,000 lb/in² (34,500 kPa).

[2]Note: Dispersion only applies to near spherical agglomerates. 8 of 10 views shall be Category 1 or 2. No more than 1 view for category 3.

Table 2: Raw Material Properties

Property	Test Method	Value	Testing Frequency
Density, g/cm3	ASTM D 1505	0.932	1/ resin lot
Melt Flow, g/10 min	ASTM D 1238 (190/2.16)	≤ 1.0	1/ resin lot
OIT, minutes	ASTM D 3895 (1atm/200°C)	100	1/ formulation

2.03 MATERIAL SUPPLY

A. Embedment sheets shall be supplied in roll form, sheets, pre-fabricated tubes or panels.

B. Cap strips shall be supplied in 4 inch widths or greater.

PART 3. EXECUTION

3.01 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position. Clean reinforcement of foreign particles or coatings.

B. Accommodate placement of formed openings.

C. Conform to ACI 318 code for concrete cover over reinforcement.

3.02 FIELD QUALITY CONTROL

A. Contractor shall notify the Owner's Representative at least 24 hrs. in advance of concrete placement. Placement of the Concrete Embedment Liner shall occur in such sequence that the Owner's Representative has sufficient time to inspect the correctness of the placement within the concrete formwork area. The Owner's Representative retains the right to require necessary revisions be made before concrete is placed.

END OF SECTION 03200

APPENDIX 2

CONSTRUCTION QUALITY ASSURANCE PLAN

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APPENDICES

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1.0 INTRODUCTION

This Plan describes the Construction Quality Assurance (CQA) program for the proposed Gypsum Management and CCB Landfill Facilites at the Ameren Duck Creek Power Plant in Fulton County, Illinois. The plan has been developed in accordance with the requirements of 35 IAC Part 811, Subpart E entitled *Construction Quality Assurance* Programs.

The Plan requires a scheduled program of CQA monitoring, inspection, sampling and testing to verify compliance with project plans and specifications. The Plan also addresses the testing requirements for test soil liners that will be constructed to verify materials and construction methods for the full-scale liners. The goal of this program is to achieve a reasonable degree of certainty that the construction of the facilites meets the specified designs.

Appendix A lists the testing methods, acceptance requirements and testing frequencies that shall guide the implementation of this plan. Also listed is the party responsible for conducting the testing for each of the constucted components of the landfill. The plan requires oversight by the CQA Officer for all testing carried out by the geosynthetic installers.

The CQA Plan also requires preparation by the CQA Officer of a final report at the end of construction that provides all inspection and testing documentation and certifies that the facilites have been constructed in accordance with the engineering design.

This Plan is intended to supplement, the project plans and specifications. Where a conflict exists, the approved CQA Plan will govern.

2.0 RESPONSIBILITY AND AUTHORITY OF PROJECT PERSONNEL

The project participants involved in the construction and quality assurance oversight of the construction are shown in Figure 2.1 *Project Organization Chart*. The Owner is the Ameren Energy Resources Generating Company (AERG or Ameren) who will retain a General Contractor to construct the facilities and a CQA Officer to provide the quality assurance oversight services. The following list the responsibilities and authority of each of the participants shown in Figure 2.1.

2.1 Owner

Ameren Energy Resources Generating Company (Ameren) is responsible for obtaining all necessary permits for construction and operation of the facilities. Ameren retains under contract all parties for the construction including the General Contractor, the Design Engineer (Hanson Professional Services Inc.), the CQA Officer, and the CQA testing and monitoring firms.

The Ameren Construction Manager will be in charge of coordinating overall construction activities and will act as Ameren's primary interface with the General Contractor. The Construction Manager coordinates all matters involving contract issues with the Ameren Project Manager including approving field changes to the project plans and specifications.

2.2 Design Engineer

The Design Engineer (Hanson Professional Services Inc.) is responsible for development of plans and specifications that fulfill the needs of the Owner and meet the requirements of the regulatory agencies. The Design Engineer is also responsible for responding to Contractor requests for information (RFIs) during the construction process as may be required to clarify the plans and specifications or to address identified conflicts in the documents. The Design Engineer is further responsible for developing any modifications to the plans and specifications as may be required to address changed field conditions, field cost savings, design improvements or other necessary or desired modifications as approved by the Owner.

2.3 CQA Personnel

2.3.1 Key Personnel (Owner's Representative)

Ameren will retain a CQA Officer for the project who will report directly to Ameren's Construction Manager (see Figure 2.1 *Organization Chart*). The CQA Officer shall be a professional engineer registered in the State of Illinois, who is a person other than the operator or an employee of the operator, and who will supervise and be responsible for all inspection, testing, and other activities required to be implemented as part of the CQA program. The CQA Officer will also be responsible for, and will provide direct supervision to, the testing and monitoring firms shown in Figure 2.1 who will perform the monitoring, testing, sampling, and inspections required by the CQA program as described more specifically in Section 6.0. The CQA Officer will be present at the outset of major undertakings and at critical times during the construction. The time that the CQA Officer must be at the project site will be dependent upon the type of construction being conducted. The CQA Officer will exercise his/her own professional judgment to be present at the project site as required to assume full responsibility for the inspection and testing performed by those persons under his/her direct supervision. The CQA Officer shall have sufficient on-site full-time staff to adequately carry out the quality assurance activities specified herein.

If the CQA Officer is unable to be present to perform duties as outlined, then the CQA Officer will provide, in writing, reasons for his/her absence including designation of the person who will exercise professional judgment in carrying out the duties of a CQA Officer as the designated CQA Officer-in-absentia. A signed statement shall be provided and recorded that the CQA Officer assumes full responsibility for all inspections performed and reports prepared by the designated CQA Officer-in-absentia during any absence of the CQA Officer.

It is required that the CQA Officer (or his designated representative), with on-site support personnel as required, provide oversight of the monitoring, inspection, testing and/or sampling of the following construction activities for the facilities:

- Test Liner,
- Excavation, grading, and preparation of the subgrade and foundation,
- Placement of the compacted soil liner,
- Placement of geosynthetic components,

- Installation of the leachate drainage and collection systems.
- Construction of surface water ditches, channels, berms, and drainage structures, and
- Placement of concrete structures.

The CQA Officer (or his designated representative) must certify that the sampling, inspection and test results for the major elements of the construction are in compliance with established design requirements before subsequent sequential items of the construction can be initiated. The major elements of Work requiring compliance certification include:

- Subgrade prior to placement of soil test liner (CCB landfill facility only),
- Soil test liner prior to placement of the low permeability soil liner,
- Subgrade prior to placement of the low permeability soil liner (CCB landfill facility only),
- Low permeability soil liner prior to placement of the geosynthetic clay liner (GCL),
- GLC liner prior to placement of the geomembrane,
- Geomembrane prior to placement of the geotextile cushion,
- Geotextile cushion prior to placement of the drainage layer,
- Piping installation prior to completed placement of the drainage layer,
- Drainage layer prior to placement of geotextile fabric,
- Cushion Dirt prior to placement of the geomembrane (gypsum facility only), and
- Geosynthetic installations in anchor trenches prior to backfilling.

Certification will require a through review of all inspection, sampling and testing completed for the work item to ensure that all design requirements have been met, a visual inspection of the work item, and the completion and signing of form CQAP 2.1 *CQA Certification* by the CQA Officer. The Contractor or Installer for the immediately following item of work shall not be allowed to initiate work until completion of the signed form by the CQA Officer.

The completed and signed forms CQAP-2.1 shall be filed as a project records in accordance with the provisions of Section 11.0

2.3.2 Document Controller

The staff of the CQA Officer shall include a Document Controller who will be responsible for: (1) control of the CQA Plan to ensure that only current documents are being employed by the CQA staff and (2) filing of all CQA records related to the monitoring, sampling, inspecting and testing specified in the CQA Plan.

Requirements for control of the CQA Plan and for filing of project records are presented in Section 11.0.

2.4 Testing and Monitoring Firms

The testing and monitoring firms, under the direction of the CQA Officer (see Figure 2.1), shall be responsible for conducting the quality assuranace sampling, inspection and testing required by Section 6.0 of the CQA Plan <u>except that</u> only monitoring and limited (independent) sampling and testing shall be required for the geosynthetics (i.e., geomembranes, geothensytic clay liners and

geotextiles). The suppliers and installers shall be responsible for all the sampling and testing required by Section 6.0 for the geosynthetics (see Section 2.6).

2.4.1 *Soil/Concrete Testing (Lab and Field)*

One or more soil/concrete testing firms that has been qualified by the Illinois Department of Transporation (IDOT) will be retained to perform the field and laboratory sampling and testing required by the CQA Plan. Materials sampled and tested will include fine-grained soils, coarse grained soils, aggregates, rip rap and concrete.

Each firm shall be required to provide "certificates of calibration" (or other proof of calibration) to the CQA Officer for each of the measuring and/or test equipment used in the laboratory or field; except that such certificates are not required for commercial grade equipment such as rulers, tape measures or other devices that provide adequate accuracy for their intended purpose.

All field and laboratory forms proposed for collection of data shall be subject to review by Ameren prior to use. Forms deemed to be incomplete or otherwise shall be modified to meet the intent of the CQA Plan.

2.4.2 *Surveyor*

One or more surveyors will be retained to verify attainment of specified elevations, slopes and grades within the tolerances required by the CQA Plan. The firm(s) selected shall have the capacity to complete all work by or under the supervision of an Illinois Professional Land Surveyor.

Each surveyor will be required to provide "certificates of calibration" (or other proof of calibration) to the CQA Officer for each surveying device used; except that such certificates are not required for commercial grade equipment such as rulers, tape measures or other devices that provide adequate accuracy for their intended purpose.

All field forms proposed for collection of data shall be subject to review by Ameren prior to use. Forms deemed to be incomplete or otherwise unacceptable shall be modified to meet the intent of the CQA Plan.

2.4.3 *Geosynthetics Monitor and Geosynthetics Testing Laboratory*

A geosynthetics monitoring firm will be retained to conduct oversight of the quality assurance inspections, testing and sampling carried out in the field by the suppliers and installers for the geosynthetics (see Section 2.5) to ensure that the requirements of the CQA Plan are met including directing additional inspection, sampling and testing as may be deemed necessary by the monitoring firm. The monitoring firm will also collect its own representative samples of the geosynthetics for independent testing by a geosynthetics testing laboratory. The monitoring firm shall have previous experience in installation oversight of at least 10,000,000 sq. ft. of similar geosynthetic materials.

The laboratory will be independent of both the manufacturer and the installer of the geosynthetics and will be required to have its own QA plan for the project work. The QA Plan shall be subject to review by Ameren prior to start of services.

All field and laboratory forms proposed for collection of data shall be subject to review by Ameren prior to use. Forms deemed to be incomplete or otherwise unacceptable shall be modified to meet the intent of the CQA Plan.

2.5 Contractors, Suppliers and Installers

The contractor, subcontractors, suppliers and installers are responsible for completing their portions of the work within specified schedules and in accordance with the requirements of the plans and specifications. They additionally shall accommodate the monitoring, sampling, inspections and testing that are the responsibility of the CQA Officer under the QCA Plan.

The geosynthetic Suppliers and Installers shall provide the quality assurance inspection, sampling and testing as required by Section 6.0 of the CQA Plan. Additionally, the geosynthetic suppliers shall be required to submit "certificates of acceptance" for certain items of work that precede their construction activities. The "certificates" are more specifically discussed in Section 4.0.

3.0 PROJECT MEETINGS

Periodic meetings will be held during the life of the project to enhance coordination among the various parties involved. Meetings will include preconstruction meetings, routine progress meetings and, as needed, problem or work deficiency meetings.

3.1 Preconstruction Meetings

Preconstruction meetings shall be held at the site for the major earthwork. items and geosynthetic installations. At a minimum. the Ameren Construction Manager, the CQA Officer, representatives of the testing firms, and the earthwork contractor or geosynthetic installer should attend. In addition to the topics for discussion as listed in the project specifications. the following CQA items will be covered:

- Discuss the established protocol for inspections, tests and sampling including use of form CQAP 8.1 *Daily Inspection Report* (see Section 8.0).
- Discuss items of work requiring CQA Officer certification or Installer acceptance before subsequent work items can be initiated (see Section 4.0), and
- Discuss the established protocol for handling construction deficiencies, corrective measures, and retesting (see Section 7.0).

The meeting shall be conducted by the Ameren Construction Manager or CQA Officer and will be documented by CQA personnel with distribution to all attendees. Meeting minutes will be filed as project records in accordance with Section 11.0.

3.2 Progress Meetings

At the discretion of the Ameren Construction Manager or the CQA Officer, brief progress meetings will be scheduled to discuss on-going and up-coming construction activities. The meeting will be attended by the Ameren Construction manager, the CQA Officer, and the appropriate site foreman (i.e. when earthwork is being performed, the earthwork foreman will be present; when geosynthetics are being installed, the installer foreman will be present, etc.). In addition to the CQA Officer topics of discussion regarding progress, the following CQA items should be reviewed:

- Discuss the established protocol for inspections, tests and sampling including use of form CQAP 8.1 *Daily Inspection Report* (see Section 8.0),
- Discuss items of work requiring CQA Officer certification or Installer acceptance before new work items can be initiated (see Section 4.0), and
- Discuss the established protocol for handling construction deficiencies, corrective measures, and retesting (see Section 7.0).

These meetings will be documented by the CQA Officer with distribution to all attendees including the Ameren Project Manager. Meeting minutes will be filed as project records in accordance with Section 11.0.

3.3 Problem or Work Deficiency Meetings

Special meetings will be approved by the CQA Officer when a problem or work deficiency is present (or is likely to occur) that is (or could be) of a serious nature. At a minimum, the meeting should be attended by theAmeren Construction Manager, earthwork or installer foremen as appropriate, and the CQA Officer. The Ameren Project Manager should attend those meetings that include discussions of severe and/or recurring problems or deficiencies. The purpose of these meetings is to define and resolve the problem or work deficiency in the following manner:

- Define the problem or deficiency and its probable causes,
- Discuss alternative actions to address the problem or deficiency ,
- Implement the selected action to resolve the problem or deficiency, and
- Verify that the implemented action has been effective.

The meeting will be documented by the CQA Officer with distribution to all attendees including the Ameren Project Manager. Meeting minutes will be filed as project records in accordance with Section 11.0.

4.0 IN-PROGRESS ACCEPTANCE OF WORK

4.1 Introduction

It is very important during placement of the geosynthetics not to entrap fugitive clay, stones, sand, etc. that could damage the geosynthetic, cause clogging of drains or filters, or hamper seaming of the geosynthetic. The geosynthetic installers shall accept responsibility for inspecting

the substrate (on a daily basis) to ensure such entrapments are not present within the substrate area to be covered each day. When found acceptable, the installer shall complete and sign form CQAP-4.1 *Installer Certificate of Acceptance* that documents (on a daily basis) acceptance of the substrate for geosynthetic placement. The Installer shall provide the original signed document to the CQA Officer for his signature of receipt.

Completed and signed forms CQAP-4.1 shall be filed as project records in accordance with the provisions of Section 11.0.

4.2 Elements of Work Requiring Prior Acceptance

The following table cites the elements of work that shall require daily "certificates of acceptance" for the substrate including the installer responsible for providing the certification. Any other areas of geosynthetic installation not included in the table shall still be subject to the requirements of this section.

Table 4.1 Installer Certifications for Acceptance of Work

Substrate to Be Accepted by Installer	Installer
1. Surface of Low Permeability Soil Liner	Geosynthetic Clay Liner (GLC) Installer
2. Surface of Geosynthethic Clay Liner (GCL)	Geomembrane Installer
3. Surface of Geomembrane	Geotextile Cushion Installer
4. Surface of Drainage Layer	Geotextile Filter Installer
5. Surface of Cushion Dirt	Geomembrane Installer

5.0 TEST SOIL LINER

5.1 Introduction

A compacted low permeability soil test liner shall be constructed within the footprint of the proposed soil liner prior to any work being initiated on the full scale construction. The purpose of the test liner is to verify that the materials and methods of construction proposed for the full scale liner will provide the quality of construction required by the CQA Plan. Additional soil test liners shall be constructed for each time the material properties from a new borrow source are found to be significantly different or there is a significant change in the methods of construction and/or equipment.

The test liner will be constructed on a competent foundation from the same prequalified soil material sources, to the same design specifications, and with similar equipment and procedures as are proposed by the contractor for the full scale liner. The foundation (subgrade) for the soil test liner shall be subject to the requirements of Section 6.2.1 and sampling/testing for material prequalification and placement shall be that provided in Section 6.2.2 except that:

1. The survey grid for foundation grade verification and for liner thickness verification shall be as established by the CQA Officer.

2. The frequencies for placement testing shall be as established by the CQA Officer.

3. The testing for hydraulic conductivity shall be as provided in Section 5.2.

5.2 Sampling and Testing Program

The soil test liner shall be sampled and tested under the direction of the CQA officer as described below for each of the physical properties listed.

1. At least five (5) two-stage field tests (ASTM designation D 6391-06) shall be used on the test liner to determine the hydraulic conductivity. Both the vertical hydraulic conductivity (k1) and the horizontal hydraulic conductivity (k2) shall be calculated.

2. Undisturbed samples (Shelby tubes) will be tested in the laboratory for vertical hydraulic conductivity to determine if there is a statistical correlation to the field testing results. At least two (2) samples should be tested.

3. The determination of other engineering parameters including, but not limited to, particle size analysis, liquid limits, plastic limits, water contents, and unconfined compressive strengths that are needed to evaluate the full scale liner shall be as directed by the CQA Officer.

5.3 Requirements for CQA Certification of Test Soil Liner for Landfill Construction

1. At least four of the five field hydraulic conductivity tests shall result in a measured vertical hydraulic conductivity of 5.0×10^{-7} cm/sec or less. No test shall have a hydraulic conductivity greater than 1.0×10^{-6} cm/sec.

2. The laboratory hydraulic conductivity tests shall indicate a measured vertical hydraulic conductivity of 1.0×10^{-6} or less.

5.4 Requirements for CQA Certification of Test Soil Liner for Gypsum Stack

1. At least four of the five field hydraulic conductivity tests shall result in a measured vertical hydraulic conductivity of 5.0×10^{-5} cm/sec or less. No test shall have a hydraulic conductivity greater than 1.0×10^{-4} cm/sec.

3. The laboratory hydraulic conductivity tests shall indicate a measured vertical hydraulic conductivity of 1.0×10^{-4} or less.

5.5 Report of Results and Certification

The CQA Officer shall prepare reports describing the test programs carried out and the results obtained. The reports shall be filed as project records in accordance with Section 11.0.

The CQA Officer shall review the sampling and test results for the test soil liners and, if found in agreement with requirements, provide certification for the work using form CQAP 2.1.

6.0 SAMPLING AND TESTING REQUIREMENTS

6.1 Introduction

Prequalification and placement sampling/testing requirements for the various materials and construction activities are as summarized in Table A.1. Frequencies for material placement testing listed in Table A.1 are based on the volume of material used in construction and are to be considered minimums. The CQA Officer shall select the specific locations for testing on a random basis exercising professional judgment to ensure that testing and sampling fairly represent the construction.
The testing firms under the direction of the CQA Officer shall be responsible for the sampling and testing listed in Table A.1 for: (1) the Soils Prequalification and Placement Testing, (2) the Drainage Media Prequalification and Placement Testing, and (3) the Other Material Placement Testing. The geosynthetic installers shall be responsible for the sampling and testing listed in Table A.1 for the Geosynthetics Prequalification and Placement Testing with daily overview (and some independent laboratory testing) by the geosynthetic firms and the CQA Officer.

The results of the sampling and testing shall be documented on a daily basis by each agency or installer providing the quality assurance activities and the originals of the sampling and testing results provided to the CQA Officer. The CQA officer shall complete form CQAP 8.1 *Daily Inspection Report* (see Section 8.0) for each of the testing firms or installer proving results and attach the results to the form. The completed form CQAP 8.1 and attached results shall be incorporated into the *Daily Summary Report* (see Section 8.0).

6.2 Soils

6.2.1 Foundation (Subgrade) – Low Permeability Soil Liner

6.2.1a. Foundation Grade Verification

Following excavation for the low permeability soil liner, the CQA Officer shall direct the surveyor to verify that actual depths and grades of the foundation (subgrade) are in accordance with the plans and specifications. Elevations shall be surveyed on a 100 ft grid pattern for the bottom of the cell. The points surveyed for side slopes will be at the top, midpoint, and toe. In addition, all breaks in grade will be surveyed. Foundation excavation grading shall meet a control tolerance requirement of 0 ft to -0.4 ft. The measured depths and grades shall be documented on "as built" drawings furnished to the CQA Officer by the surveyor.

The CQA Officer shall review the survey data for conformance to requirements and, if found in agreement with requirements, provide certification for the work using form CQAP 2.1.

6.2.1b. Foundation Fill

Foundation (subgrade) materials not meeting the requirements of the plans and specifications are required to be excavated and replaced with suitable foundation fill to develop a stable foundation for the landfill. The CQA Officer shall make a foundation inspection with the soil testing firm and direct any sampling and testing necessary to identify areas requiring removal and replacement. The CQA Officer shall inform the earthwork contractor of unsuitable areas requiring removal and replacement.

Foundation fill used by the contractor for replacement shall be sampled and tested by the soil testing firm to check compliance with the prequalification and placement requirements listed in Table A-1. The CQA Officer shall direct the surveying firm to determine the locations and extent of all removal and replacement activity and to document all such information on "as built" drawings to be furnished to the CQA Officer.

The CQA Officer shall review the sampling and test results for the foundation fill and, if found in agreement with the prequalification and placement requirements, provide certification for the work using form CQAP 2.1. The certification for foundation fill may be provided on the same form providing the certification for foundation grade.

6.2.2 Low Permeability Soil Liner

6.2.2a. Prequalification Testing

Table 1.1 requires that prequalification testing for each soil type being used for liner construction at the landfill include the development of an "acceptable zone" of moisture-density for the compacted soil that will result in a liner with a minimum hydraulic conductivity of 1.0×10^{-6} cm/sec. The resulting "acceptable zone" then serves as the major control for material placement during construction.

The CQA officer shall direct the soil testing agency to determine the "acceptable zone" for each soil type to be used for landfill liner construction and provide the results in a written report to be available for comparisons with the material placement testing results. The determination of the "acceptable zone" shall be in accordance with Appendix B or other published methodology used in the profession. The report will be filed as a project record in accordance with Section 11.0.

There is no prequalification testing required for the soil materials to be used for the gypsum stack liner construction except that the materials selected shall have sufficient fines to achieve the in-place hydraulic conductivity specified in Section 5.4.

6.2.2b. Material Thickness Testing

The CQA Officer shall direct the survey agency to determine elevations at the foundation of the soil liner and at the final constructed surface using a 100 ft grid pattern (and the break points in slope) to verify attainment of the plan grades and elevations. To verify liner thickness, all horizontal survey coordinates shall be the same for the foundation and final constructed surface. Side slope thicknesses will be verified using crest (top), midpoint, and toe documentation points.

The measured depths and grades shall be documented on "as built" drawings furnished to the CQA Officer by the surveyor agency.

6.2.2c. Moisture/Density Testing

Moisture/density testing of the compacted soil liner shall be conducted by the soil testing agency under the requirements and at the frequencies specified in TableA.1. During construction of the soil liner the CQA Officer shall confirm the following:

- Use of the same construction equipment as used in the test soil liner.
- Use of same procedures, such as number of passes and speed,
- Uniformity of coverage by compaction equipment,
- Consistent achievement of density, water content and permeability of each successive lift.
- Use of methods to bond successive lifts together,
- Achievement of liner strengths on sidewalls,
- Contemporaneous placement of protective covering to prevent drying and desiccation, where necessary,
- Prevention of placement of frozen material or the placement of material on frozen ground,
- Prevention of damage to completed liner sections, and
- That construction proceeds only during favorable climatic conditions.

6.2.2d. Hydraulic Conductivity Testing

Samples of the in-place liner shall be obtained and tested for hydraulic conductivity under the requirements and at the minimum frequency as specified in Table A.1. Multiple samples may be collected at a given test location for the purpose of retesting in the event of unacceptable hydraulic conductivity results from the initial sample.

Boreholes, excavations or other disturbances to the soil liner resulting from the obtainment of samples shall be backfilled as directed by the CQA Officer.

6.2.2e. Certification of Work

The CQA Officer shall review the sampling and test results for the low permeability soil liner and, if found in agreement with the prequalification and placement requirements, provide certification for the work using form CQAP 2.1.

6.2.3 Berms

6.2.3a. Landfill Containment Berms

The CQA Officer shall direct verification of excavated foundation (subgrade) depths and grades as specified in Section 6.2.1a except that the foundation grid shall be as directed by the CQA Officer. Foundation fills shall be as specified in Section 6.2.1b.

Prequalification testing for material sources shall meet the requirements in Table A.1.

The CQA Officer shall direct the soil agency to conduct the following inspection activities during berm construction:

- Observation of fill material characteristics.
- Observation of loose lift thickness.
- Observation of clod size reduction and material homogenization, and
- Placement testing as specified in Table A.1.

Documentation of construction on "as-built" plans shall be as specified in Section 6.5.2.

The CQA Officer shall review the sampling and test results for the landfill containment berms and, if found in agreement with the prequalification and placement requirements, provide certification for the work using form CQAP 2.1.

6.2.3b Temporary Cell Separation Berms

The CQA Officer shall direct verification of excavated foundation (subgrade) depths and grades as specified in Section 6.2.1a except that the foundation grid shall be as directed by the CQA Officer. Foundation fills shall be as specified in Section 6.2.1b.

Prequalification testing for material sources shall meet the requirements in Table A.1.

The CQA Officer shall direct the soil agency to conduct the following inspection activities during berm construction:

- Observation of fill material characteristics,
- Observation of loose lift thickness.
- Observation of clod size reduction and material homogenization,
- Placement testing as specified in Table A.1, and
- Measurements of berm slopes.

6.3 Geosynthetics

6.3.1 Geosynthetic Clay Liner (GCL)

6.3.1a. Prequalification Testing

The geosynthetic clay liner (GCL) installer shall provide to the CQA Officer the test results from a qualified laboratory for the type and frequency of prequalification testing listed in Table A.1. The submittal shall include certification from the laboratory that the test results verify the manufacturer's guaranteed properties.

The CQA Officer shall direct the geosynthetics QA monitor firm to select a representative number of additional samples of the GCL for submittal to the monitor's geosynthetic laboratory for independent verification of the manufacturer's guaranteed properties.

The results of laboratory testing shall meet the GCL manufacturer's specifications as shown in the following table.

GCL Laboratory Testing Methods/Minimum Values Required	
Test Method	**Minimum Value**
Bentonite Mass/Area (ASTM D5993)	0.75 lb./ft^2
GCL Grab Tensile Strength (ASTM D4632)	90 lb.
GCL Peel Strength (ASTM D4632)	15 lb.

The installer shall direct the test laboratory to submit the results of all laboratory test results and certification to the Document Controller for filing as project records in accordance with Section 11.0.

6.3.1b. Installer Certification of Placement Surface

Prior to daily clay liner placement, the installer shall provide to the CQA Officer daily "certificates of acceptance" (form CQAP-4.1) which document the installer's inspection and acceptance of the underlying surface as being suitable for the GCL installation (see Section 4.0).

All daily "certificates of acceptance" (form CQAP-4.1) shall be filed as project records in accordance with Section 11.0.

6.3.1c Deployment

The CQA Officer shall direct the geosynthetic QA monitor firm to oversee activities of the installer during placement and field testing of the GCL.

Incoming rolls of GCL shall be inventoried and inspected by the installer. Manufacturer's certifications will be inspected for conformance with the requirements of this plan. Holes or other visible defects shall be recorded in the CQA Officer's daily report and clearly marked on the GCL roll for identification of necessary repairs or rejection of the roll.

GCL shall be placed such that all seams run parallel to the slope. GCL should be dry when installed. Wet or hydrated GCL shall not be used. GCL panels shall be laid with a minimum 6 in. overlap on longitudinal seams and a minimum 12 in. overlap on panel end seams. Seam overlaps shall be placed such that the direction of flow is from the top panel to the underlying panel to form a shingle effect. Direct contact with GCL shall be minimized.

6.3.1d. Seaming

The GCL shall be sealed in accordance with the recommendations of the GCL manufacturer. Dry bentonite having the same chemical and material properties as the GCL shall be evenly dispersed from the panel edge to the lap line continuously along the seam or overlap areas. All dirt, gravel, or other debris shall be removed from the seam or overlap areas.

Prior to covering the GCL, the installer shall verify all exposed seams or overlaps and examine the GCL for any defects. At the judgment of the installer, a panel or section that becomes seriously damaged or hydrated shall be replaced. All repairs shall be made by placement of a

patch of the same material over the damaged area at least 1 ft beyond the repair area. The GCL will be immediately covered and protected from precipitation by the overlaying geomembrane.

6.3.1e. Shear Strength Conformance Testing

Shear strength conformance tests shall be performed on the GCL to verify the interface shear strengths of the GCL with the appropriate material (HDPE geomembrane or compacted clay). The results of the shear strength conformance tests will be used to confirm that the actual interface shear strengths are equal to or greater than the interface shear strengths used in the stability analyses. Shear strength conformance tests on subsequent phases and/or cell development need not be performed if the same manufacturer and materials are used in the construction of the subsequent phase and/or cell. Conformance testing shall be in accordance with ASTM D 5321 or other suitable method.

6.3.2 Geomembrane

6.3.2a. Prequalification Testing

The geomembrane installer shall provide to the CQA Officer the test results from a qualified laboratory for the type and frequency of prequalification testing listed in Table A.1. The submittal shall include certification from the laboratory that the test results verify the manufacturer's guaranteed properties.

The CQA Officer shall direct the geosynthetics QA monitor firm to select a representative number of additional samples of the geomembrane for submittal to the monitor's geosynthetic laboratory for independent verification of the manufacturer's guaranteed properties.

The installer shall direct the test laboratory to submit the results of all laboratory results and certification to the Document Controller for filing as project records in accordance with Section 11.0.

6.3.2b. Installer Certification of Placement Surface

Prior to daily geomembrane placement, the installer shall provide to the CQA Officer daily "certificates of acceptance" (form CQAP-4.1) which document the installer's inspection and acceptance of the underlying surface as being suitable for the geomembrane installation (see Section 4.0).

All daily "certificates of acceptance" (form CQAP-4.1) shall be filed as project records in accordance with Section 11.0.

6.3.2c. Placement Testing for Seam Overlap

The contractor and installer shall arrange geomembrane sections such that the use of field seams is minimized and that horizontal seams are not used on side slopes. Seam overlaps shall be field measured by the installer to verify the requirement in Table A.1 is met for all seams within the geomembrane footprint. The CQA Officer shall direct the geosynthetics QA monitor firm to

make independent measurements of a representative number of seam overlaps for additional verification of the requirement in Table A.1.

At completion of geomembrane placement, the installer shall provide the CQA Officer with "as-built" drawings of the geomembrane installation showing all seam locations and seam measurement locations.

6.3.2d. Placement Non-Destructive Testing

The installer shall conduct non-destructive testing of seams at the frequency specified in Table A.1. All seams shall be nondestructively tested over their full-length using a vacuum test unit, air pressure test or other method approved by the CQA Officer. Continuity testing will be completed as the seaming progresses.

The CQA Officer shall direct the geosynthetics QA monitor firm to monitor all non-destructive testing carried out by the installer.

The installer shall submit all non-destructive field testing results to the CQA Officer for filing as project records in accordance with Section 11.0.

Vacuum testing and air pressure testing procedures shall be as given in the following sections.

Vacuum Testing (Extruded Welds)

The following procedures are applicable to those processes which produce an extruded weld.

Equipment

The following equipment shall be used when conducting vacuum tests:

- A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, a port hole or valve assembly, and a vacuum gauge,
- A steel vacuum tank and pump assembly equipped with a pressure controller and pipe connections,
- A rubber pressure/vacuum hose with fittings and connections,
- A bucket, and
- A soapy solution.

Procedures

The following procedures will be followed:

1. Energize the vacuum pump and reduce the tank pressure to approximately minus 5 psi (10 in. of Hg) gauge.
2. Wet a strip of geomembrane approximately 12 in. wide by 48 in. long (an area larger than the coverage size of the vacuum box) with the soapy solution.
3. Place the box over the wetted area.
4. Close the bleed valve and open the vacuum valve.
5. Verify that a leak tight seal is created.

6. For a period of not less than 10 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.
7. If no bubble appears after 10 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area, repeat the process.
8. All areas where soap bubbles appear will be marked and repaired and then retested until passing test results are obtained.

Air Pressure Testing (For Double Fusion Seam Only)

The following procedures are applicable to those processes which produce a double seam with an enclosed space.

Equipment

The equipment will be comprised of the following:

- An air pump (manual or motor driven) equipped with pressure gauge capable of generating and sustaining a pressure between 25 psi to 30 psi and mounted on a cushion to protect the geomembrane,
- A rubber hose with fittings and connections, and
- A sharp hollow needle, or other approved pressure feed device.

Procedures

The following procedures will be observed:

1. Both ends of the seam to be tested will be sealed.
2. A needle or other approved pressure feed device will be inserted into the tunnel created by the fusion weld.
3. A protective cushion will be inserted between the air pump and the geomembrane.
4. The air pump will be energized to a pressure between 25 psi and 30 psi. The valve will be closed, and the pressure will be sustained for approximately 5 minutes.
5. If loss of pressure exceeds 3 psi or does not stabilize, the faulty area will be located, then repaired and retested until passing test results are obtained.
6. At the conclusion of a passing air pressure test, the opposite end of the seam will be slit and subsequent drop in pressure will be monitored. This will ensure that the entire seam was completely tested.
7. Remove needle or other approved pressure feed device and seal.

6.3.2e. Placement Destructive Testing

General

Destructive seam tests shall be performed at randomly selected geomembrane locations. The purpose of these tests is to evaluate seam strength. Seam strength testing shall be done as the seaming work progresses, not at the completion of all field seaming.

The CQA Officer shall direct the geosynthetics QA monitor firm to monitor all destructive testing carried out by the installer.

The installer shall submit the results of all destructive testing to the CQA Officer for filing as project records in accordance with Section 11.0.

Location and Frequency

The installer shall select locations where seam samples will be cut out for testing. Those locations shall be established as follows:

1. Selection will be at a minimum frequency of one test location per 500 ft of seam length. This minimum frequency is to be determined as an average taken throughout the entire area of placement.

2. Test locations will be determined during seaming at the installer's discretion. Selection of such locations may be prompted by suspicion of excess crystallinity, contamination, offset welds, or any other potential cause of imperfect welding.

The CQA Officer shall direct the geosynthetics QA monitor firm to select and cut out a representative number of additional samples for independent laboratory testing.

Sampling Procedure

Samples will be cut as the seaming progresses in order to have laboratory test results before the geomembrane is covered by another material. The installer shall:

- Assign a number to each sample, and mark it accordingly,
- Record sample location on layout ("as-built") drawing, and
- Record reason for taking the sample at this location (e.g., statistical routine, suspicious feature of the geomembrane).

All holes in the geomembrane resulting from destructive seam sampling shall be immediately repaired. The continuity of the new seams in the repaired area shall be vacuum tested.

Field Testing

The installer shall test in the field, by tensiometer, two 1 in. wide sample strips from the samples identified for destructive testing; one for peel and one for shear. This testing shall include the independent samples obtained by the geosynthetics QA monitor firm. Field testing will prequalify samples for laboratory testing. The requirements and frequency for field testing shall be as provided in the table at the end of this section.

The installer shall conduct all field tests and mark all samples and portions with their number. The installer shall also log the date, time, ambient temperature, number of seaming unit, name of seamer, welding apparatus temperatures and pressures, and pass or fail description, and attach a copy to each sample portion.

Geosynthetic Quality Assurance Laboratory Testing

Prequalifying field tests shall identify samples for laboratory testing. The installer's quality assurance laboratory shall be as selected by the installer with concurrence of the CQA Officer.

Testing shall include shear strength and peel adhesion. At least five specimens shall be tested by the installer's laboratory for each method. Specimens shall be selected alternately by test from the samples (i.e., peel, shear). All laboratory testing shall be accordance with ASTM D 4437.

The CQA Officer shall direct the geosynthetic QA monitor firm to have additional samples tested for peel and strength by the monitor's independent geosynthetics laboratory as deemed necessary.

Procedures for Destructive Test Failure

The following procedures will apply whenever a sample fails a destructive test, whether the test was conducted in the laboratory or by field tensiometer. The installer has two options:

1. The installer may reconstruct the seam between any two passed test locations.

2. The installer may trace the welding path to an intermediate location at least 10 ft from the point of the failed test in each direction, and take a small sample for an additional field test at each location. If these additional samples pass the tests, then full laboratory samples are taken. If these laboratory samples pass the tests, then the seam is reconstructed between these locations. If either sample fails, then the process is repeated to establish the zone in which the seam should be reconstructed.

All acceptable seams must be bounded by two locations from which samples passing laboratory destructive tests have been taken. In cases exceeding 150 ft of reconstructed seam, a sample taken from the zone in which the seam has been reconstructed must pass destructive testing.

The installer will document all actions taken in conjunction with destructive test failures.

Geomembrane Destructive Seam Tests and Frequency

Property	Test Method	60-mil HDPE	40-mil HDPE	40-mil LLDPE	Frequency
Seam Shear Strength	ASTM D 4437	120 ppi	80 ppi	44 ppi	See Note 1
Seam Peel Strength (hot wedge fusion)	ASTM D 4437	78 ppi	52 ppi	40 ppi	See Note 1
Seam Peel Strength (fillet extrusion)	ASTM D 4437	72 ppi	45 ppi	40 ppi	See Note 1

Notes:

1. Destructive testing of seams shall occur at a minimum frequency of once per 500 ft of seam length.
2. Values apply for both smooth and textured geomembranes.

6.3.3 Geotextile

6.3.3a. Prequalification Testing

The geotextile installer shall provide to the CQA Officer the test results from a qualified laboratory for the type and frequency of prequalification testing listed in Table A.1. The submittal

shall include certification from the laboratory that the test results verify the manufacturer's guaranteed properties.

The CQA Officer shall direct the geosynthetics QA monitor firm to select a representative number of additional samples of the geomembrane for submittal to the monitor's geosynthetic laboratory for independent verification of the manufacturer's guaranteed properties.

The installer shall submit the results of all laboratory results and certification to the CQA Officer for filing as project records in accordance with Section 11.0.

6.3.3b. Installer Certification of Placement Surface

Prior to daily geotextile placement, the installer shall provide to the CQA Officer daily "certificates of acceptance" (form CQAP-4.1) which document the installer's inspection and acceptance of the underlying surface as being suitable for the geotextile installation (see Section 4.0).

All daily "certificates of acceptance" (form CQAP-4.1) shall be filed as project records in accordance with Section 11.0.

6.3.3c. Deployment

Incoming rolls of geotextile shall be inventoried and inspected by the installer. Manufacturer's certifications will be inspected for conformance with the requirements of this plan. Holes, tears, or other visible defects will be recorded in the CQA Officer's daily report and clearly marked on the synthetic for identification of necessary repairs.

The installer shall check that the geosynthetic installation conforms to the construction requirements and manufacturer's recommendations. The CQA Officer shall direct the geosynthetics QA monitor firm to oversee the inspections by the installer.

On slopes steeper than 10H:1V, all geotextiles shall be continuously sewn. Geotextiles shall be overlapped a minimum of 3 in. prior to seaming. This requirement does not apply to the leachate system filter fabric. All sewing shall be done using thread with physical, chemical, and ultraviolet high resistance properties equal to or exceeding those of the geotextile. The CQA Officer shall direct the geosynthetics QA monitor firm to make independent measurements of a representative number of seam overlaps for additional verification of the requirement in Table A.1.

The 10-oz. cushion geotextile (immediately above the geomembrane liner and beneath the drainage layer) shall be placed with vertical seams running up the slopes and into the anchor trench. Horizontal seams (perpendicular to the slope) shall be allowed on side slopes for the 4-oz. filter geotextile overlaying the drainage layer to facilitate staged construction of the drainage layer going up the slope. All overlaps shall be "shingled" so that water or other material can not run down the slope between the geotextile seams.

6.4 Drainage Media

6.4.1 Granular Drainage Layer

6.4.1a. Prequalification Testing

Each source of material for the drainage layer shall be tested for hydraulic conductivity and grain size analyses in accordance with Table A.1 to determine suitability of the source.

6.4.1b. Material Thickness Testing During Placement

The CQA Officer shall direct the survey firm to determine elevations at the top of the geotextile cushion and at the final constructed surface of the granular drainage layer using a 100 ft grid pattern (and the break points in slope) to verify attainment of the plan grades and elevations. To verify liner thickness, all horizontal survey coordinates shall be the same for the top of the cushion and final constructed surface. Side slope thicknesses will be verified using crest (top), midpoint, and toe documentation points.

The CQA officer may approve the use of thickness plates as an alternative method to surveying.

In no instance shall the field determined thickness be less than 1.0 ft. The measured depths and grades shall be documented on "as built" drawings furnished to the CQA Officer by the surveyor.

6.4.1c. Gradation and Hydraulic Conductivity Testing During Placement

The CQA officer shall direct the soil test firm to take an initial sample of the granular drainage layer within the first 100 cu. yds. of material placement and test for hydraulic conductivity and grain size to confirm suitability of the source. Continuing sampling and testing shall be completed at the frequencies specified in Table A.1.

Compaction of the drainage layer shall not be allowed during placement to avoid breakdown of materials

Gradation tests may be considered passing provided the hydraulic conductivity requirements are met and the specified percentage of fines is not exceeded.

6.4.d. Certification of Work

The CQA Officer shall review the sampling and test results for the granular drainage layer and, if found in agreement with the prequalification and placement requirements, provide certification for the work using form CQAP 2.1.

6.4.2 Coarse Aggregate

6.4.2a. Prequalification Testing

Each source of material for the coarse aggregate shall be tested for hydraulic conductivity and grain size analyses in accordance with Table A.1 to determine suitability of the source.

6.4.2b. Material Placement

The CQA Officer shall direct that inspection of piping as provided in Section 6.5.1 be completed prior to placement of coarse aggregate around the piping. Compaction of the coarse aggregate shall not be allowed during placement to avoid breakdown of materials.

The CQA officer shall direct the soil test firm to take an initial sample of the coarse aggregate within the first 100 cu. yds. of material placement and test for hydraulic conductivity and grain size to confirm suitability of the source. Continuing sampling and testing shall be completed at the frequencies specified in Table A.1.

Gradation tests may be considered passing provided the hydraulic conductivity requirements are met and the specified percentage of fines is not exceeded.

6.4.2c. Certification of Work

The CQA Officer shall review the sampling and test results for the coarse aggregate and, if found in agreement with the prequalification and placement requirements, provide certification for the work using form CQAP 2.1.

6.5 Other Material Placement Testing

6.5.1 Placement testing of Leachate Piping System

The CQA Officer shall direct the surveyor to check the invert elevations and plan coordinates for the constructed piping system at the locations and frequencies specified in Table A.1.

The CQA Officer or other CQA staff shall inspect pile size, materials and connections including all components of the leachate collection and management systems to verify compliance with plan and specification requirements.

The measured grades and coordinates shall be documented on "as built" drawings furnished to the CQA Officer by the surveyor.

The CQA Officer shall review the survey results for the leachate piping system and management systems and, if found in agreement with the placement requirements, provide certification for the work using form CQAP 2.1.

6.5.2 Placement Testing of Surface Water Management System

The CQA Officer shall direct the survey agency to determine the elevations and grades of the constructed berms and channels in accordance with the requirements and frequency specified in Table A.1.

The measured elevations and grades shall be documented on "as built" drawings furnished to the CQA Officer by the surveyor.

6.5.3 Placement Testing of Concrete

The CQA Officer shall direct the soil test firm to carry out placement testing for concrete in accordance with the requirements and frequency specified in Table A.1.

The contractor shall submit proposed concrete mix designs to the CQA Officer for review prior to ordering of concrete.

The CQA Officer shall review the concrete testing results and, if found in agreement with the placement requirements, provide certification for the work using form CQAP 2.1.

7.0 CORRECTIVE MEASURES

The CQA Officer shall reject and require replacement of all materials for which sampling, testing or inspection results show that prequalification requirements are not met. The CQA Officer shall also reject workmanship (and require corrective rework) for which sampling, testing or inspection results show that material placement requirements are not met. The lateral and/or vertical extent of corrective measures for rework shall be based on the frequency of testing and judgment of the CQA Officer.

The CQA Officer may neglect the occasional occurrence of failed moisture/density tests or laboratory hydraulic conductivity tests carried out for the low permeability soil liner provided the failed tests can be shown to be outliers and are not concentrated in one area or lift. The CQA officer shall provide written justification in the Daily Summary Report for assignment of failed tests as outliers.

8.0 DOCUMENTATION OF SAMPLING AND TESTING

8.1 Daily Summary Reports

A daily summary report shall be prepared by the CQA Officer, or under the direct supervision of the CQA Officer, during each day of activity. Form CQAP 8.1 *Daily Summary Report* shall serve as the base document to which the daily inspection reports (see Section 8.2) are to be attached.

Each report shall be signed and dated by the CQA Officer and CQA Officer-in-absentia. The original report (and attachments) shall be submitted to the Document Controller and filed as a project record in accordance with Section 11.0.

8.2 Daily Inspection Reports

A daily inspection report shall be prepared by the CQA Officer, or under the direct supervision of the CQA Officer. for each day that materials, or placement of materials, are being inspected, sampled or tested. Form CQAP 8.2 *Daily Inspection Report* shall serve as the base document to which the test data, photographic records, test results, etc. are to be attached.

Each report shall be signed and dated by the CQA Officer or CQA Officer-in-absentia. The original report (and attachments) shall be submitted to the CQA Officer who shall incorporate the report into the daily summary report.

8.3 Photographs

Photographs may be incorporated into the daily inspection report or daily summary report to provide a visual record of work progress, inspection/testing activity, construction work, or other items considered important to the report. The photographs, at a minimum, shall be furnished with the following information:

- The location, date and time of the photograph,
- A description of the item photographed including direction of view (N,S,E or W),
- Personnel, testing agencies, installers or contractors present, and
- Name of photographer.

9.0 FINAL CERTIFICATION REPORT

Upon completion of the construction contract (but before the landfill or gypsum stack is placed into service), the CQA Officer shall submit an acceptance report to the Illinois Environmental Protection Agency. The acceptance report shall contain the following:

- A certification by the CQA officer that the construction has been prepared and constructed in accordance with the engineering design.
- As-built drawings as specified herein, and
- All daily summary reports.

10.0 CONSTRUCTION MANAGEMENT ACTIVITIES

10.1 Requests for Information (RFIs)

The general contractor or installer may, after exercising due diligence to locate required information, request from the CQA Officer clarification or interpretation of the contract documents. The general contractor or installer shall make specific reference to the contract drawing(s) or specification(s) in question and include estimates of any cost or schedule impacts that could possibly be associated with the requested clarification or interpretation.

The general contractor or installer shall initiate the RFI in a timely manner using form CQAP-10.1 *Request for Information*. The CQA Officer shall, with reasonable promptness, respond to the RFI on the same form CQAP-10.1 and return a copy of the completed form to the party making the request as final disposition of the matter.

Additional copies of the completed form shall be distributed as directed by the CQA Officer. All RFI's shall be filed as project records in accordance with Section 11.0.

10.2 Review of Contractor Submittals

The Contractor shall submit shop drawings, product data and samples to the CQA Officer in accordance with the requirements of the project specifications and with such promptness as to cause no delay of the work. The Contractor shall not authorize purchase, fabrication, erection, processing or shipping of any items associated with the submittal until review of the shop drawings, product data or samples has been completed by the CQA Officer and no resubmittals are required by the CQA Officer.

All submittals from subcontractors shall be reviewed first by the Contractor to satisfy the contractor's responsibilities for lengths, dimensions, quantities, means and methods, and other such items.

The CQA Officer and/or Design Engineer shall review the submittals for conformance with design concepts and conformance with the information shown in the contract documents. Upon completion of review, the CQA Officer shall return the submittal to the Contractor with one of the following notations for each item in the submittal:

- No exceptions taken.
- Furnish as corrected,
- Revise and resubmit,
- Submit specified item, or
- Rejected.

The Contractor shall resubmit corrected shop drawings, product data or samples for those items noted as requiring revision or submission or noted as rejected.

The CQA Officer shall maintain copies of all submittals and a log documenting submittal descriptions, dates of receipt, dates of return, review personnel, and actions taken on the submittals. Copies of submittals and the log shall be filed as project records in accordance with Section 11.0.

10.3 Field Change Order Process

The Contractor shall be responsible for preparing requests for field change order (FCO) in accordance with AREG procedures and submitting the FCO requests on the appropriate AREG FCO form to the CQA Officer.

The CQA Officer shall be responsible for reviewing the FCO with the Design Engineer, determining agreement or non-agreement with the requested change, and submitting the documented decision to the Contractor on the appropriate AREG CFO form with copies to the Ameren Project Manager. Agreement to the FCO shall require signature approval of the Ameren Project Manager.

The CQA Officer shall maintain an on-going log of authorized FCOs and running balance of project costs. Copies of the FCOs and log of authorized FCOs shall be retained as project records in accordance with Section 11.0.

11.0 DOCUMENT CONTROL AND PROJECT RECORDS

11.1 CQA Plan

The CQA officer shall control the preparation, issue and revisions of the CQA Plan so that correct documents are being employed by the project participants. The CQA Plan, including all changes thereto, shall be reviewed for adequacy and approved for release by the CQA Officer and Ameren Project Manager.

The Document Controller shall issue controlled copies of the CQA Plan and maintain all records associated with its preparation, issue and revisions.

11.2 Project Records

The maintenance of project records during construction of the landfill shall be the responsibility of the Document Controller and shall be protected against damage, deterioration, and loss. Records shall be maintained in a manner as to be readily identifiable and retrievable.

Control of CQA documents and samples during the construction process shall be as shown in Figure 11.1. All original CQA documents from both the field and laboratories shall be ultimately furnished to the Document Controller for filing and maintenance. Samples may be discarded after testing and documentation of results is complete.

Project records shall be made available to the Ameren Project Manager as requested during construction and, when requested, shall be turned over to AERG at completion of the construction contract.

Records shall include, but not be limited to, the following:

- CQA Plan (all revision levels),
- CQA Plan documentation (reviews, issuance and revisions),
- Meeting minutes,
- Daily inspection reports (form CQAP 8.1),
- Daily summary reports (form CQAP 8.2),
- Certificates of acceptance by geosynthetic installers,
- CQA certifications (form CQAP 2.1),
- Certificates of calibration for inspection, measuring and test equipment,
- Report for test soil liner,
- Report for compacted soil liner "acceptable zone",
- "As-built" drawings,
- Laboratory test results for soils, drainage media, and concrete,
- Laboratory test results for geosynthetics,
- Laboratory certifications of manufacturer's guaranteed properties for geosynthetics,
- Contractor Requests for Field Change Order (AERG FCO form),

- Log of Authorized Field Change Orders,
- Shop drawing submittals,
- Log of shop drawing submittals,
- Requests for information from contractor/installers,
- Responses to requests for information, and
- Final certification report.

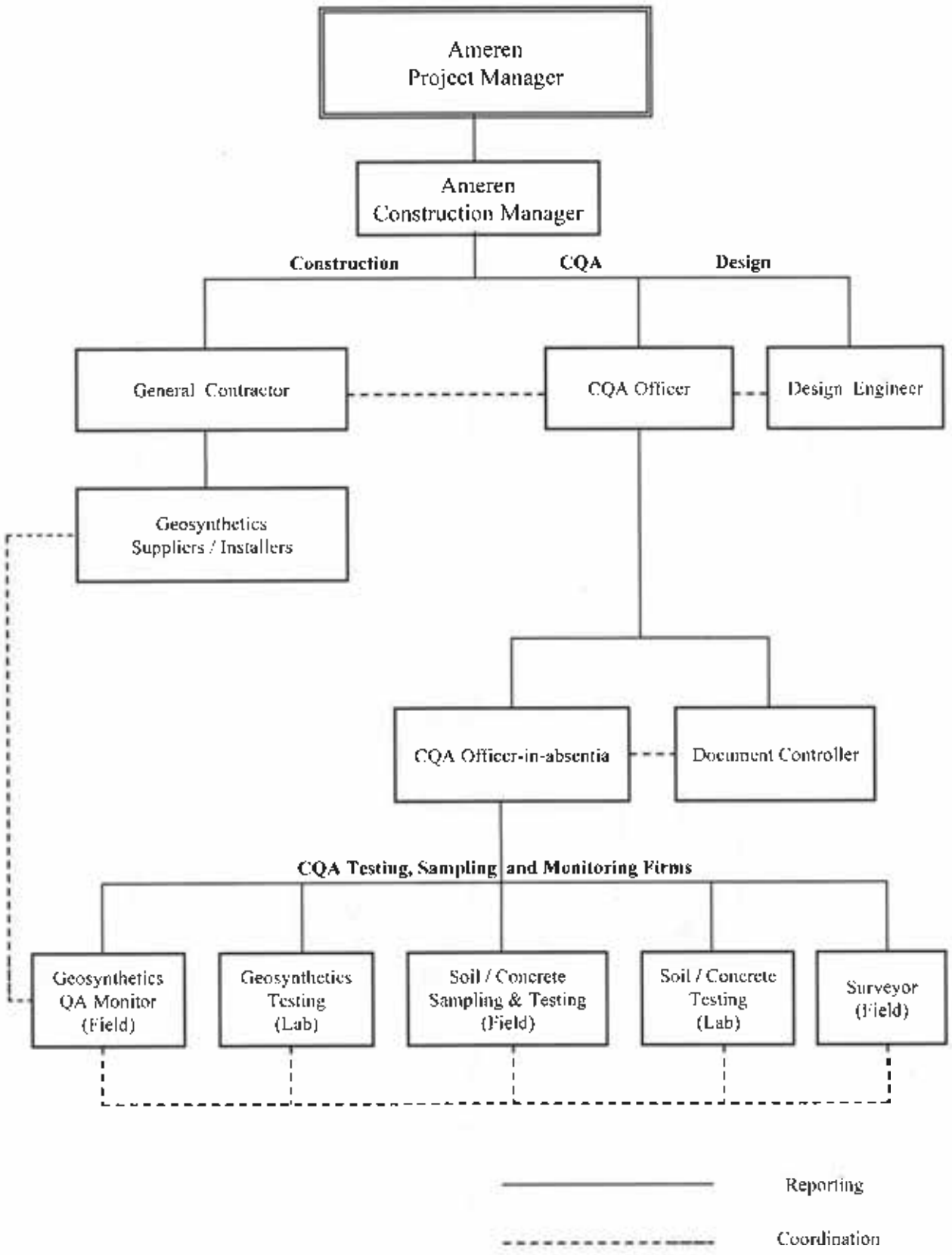

Figure 2.1 Project Organization Chart

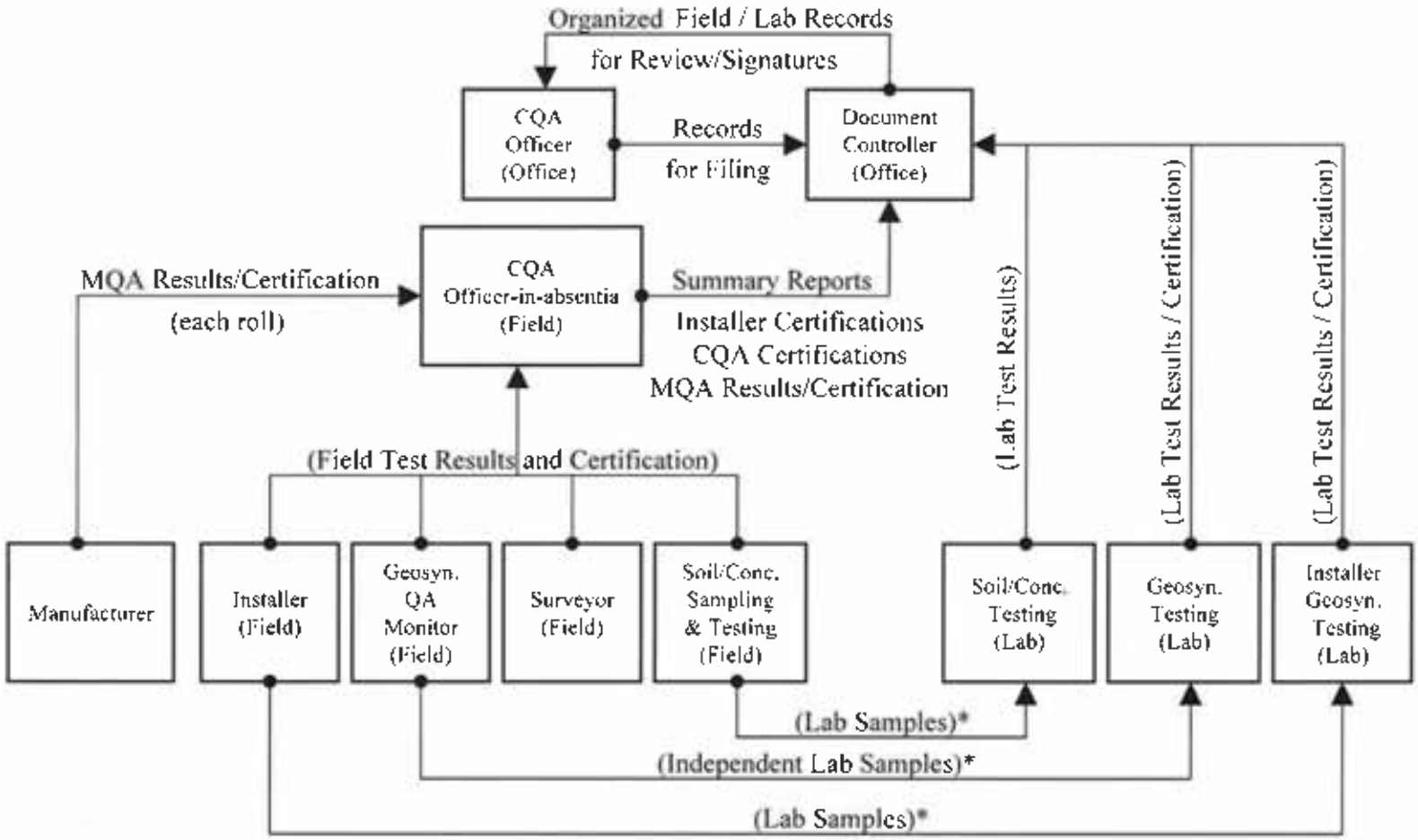

Figure 11.1 Control of CQA Documents and Samples

* Transmittal letters shall direct the original lab test results/certifications to be sent to Document Controller with copies to submitting installer or testing/monitoring agency.

Appendix A

Material Testing and Frequency

TABLE A.1: MATERIAL TESTING & FREQUENCY

Property/Test Method	Requirement/Specification	Frequency	Responsibility
SOILS - PREQUALIFICATION TESTING			
FOUNDATION FILL & BERMS			CQA Officer
Standard Proctor Curve - ASTM D698		Per soil type (See Note 2)	
Atterberg Limits - ASTM D4318	PI > 5, LL > 20%	Per soil type	
Grain Size Analysis - ASTM D422	200 Sieve > 50%	Per soil type	
Hydraulic Conductivity - ASTM D5084	See Note 1	Per soil type	
		Per soil type	
SOIL LINER			CQA Officer
Standard Proctor Curve - ASTM D698	"Acceptable Zone" see Appendix B	Per soil type	
Atterberg Limits - ASTM D4318	USCS Classification	Per soil type	
Grain Size Analysis - ASTM D422	USCS Classification	Per soil type	
Hydraulic Conductivity - ASTM D5084	1.0×10^{-7} cm/sec	Per soil type	
Develop "Acceptable Zone"	"Acceptable Zone" see Appendix B	Per soil type	
3' PROTECTIVE FINAL SOIL COVER			Not Applicable to this Contract
Standard Proctor Curve - ASTM D698*	"Acceptable Zone" see Appendix B	Per soil type*	
Atterberg Limits - ASTM D4318*	USCS Classification	Per soil type*	
Grain Size Analysis - ASTM D422*	USCS Classification	Per soil type*	
Hydraulic Conductivity - ASTM D5084	See Note 1	Per soil type*	
Develop "Acceptable Zone"*	"Acceptable Zone" see Appendix B	Per soil type*	
Suitable for Vegetation	Visual Acceptance	Per soil type	

* On the first two feet of the protective layer only. (The third foot is topsoil.)

Note 1: There is no specific requirement for hydraulic conductivity for the foundation, berms and final cover soils as they are not part of the liner system. However, insitu materials on the site generally exhibit hydraulic conductivities in the range of 1×10^{-4} cm/sec to 1×10^{-5} cm/sec. The construction contractor will attempt to utilize the most impermeable materials available (as identified visually) when constructing foundation fill and berms. For purposes of a complete construction record, hydraulic conductivity of placed foundation fill and side berms will be field tested at a rate of 1 test per each 10,000 cubic yards of material placed, although no specific threshold values are required.

Note 2: "Soil Type" refers to differences in soil color and/or textural consistency that would be indicative of differences in soil characteristics.

Note for Geosynthetics: See Section 6.0 of the CQA Plan for additional GCL and geomembrane testing requirements.

TABLE A.1: MATERIAL TESTING & FREQUENCY

Property/Test Method	Requirement/Specification	Frequency	Responsibility
SOILS - MATERIAL PLACEMENT TESTING			
FOUNDATION			CQA Officer
Survey	0 to -0.5 feet Design Grade	100-foot grid	
FOUNDATION FILL & BERMS			CQA Officer
Density/Moisture - ASTM D2922 & D3017	90% Standard Proctor Density and -1% to Optimum Moisture Content	1 per 10,000 cubic yards (minimum 1 per compacted lift)	
Strength	0.5 tsf (hand-held penetrometer)	1 per 10,000 cubic yards (minimum 1 per compacted lift)	
Hydraulic Conductivity - ASTM D5084	See Note 1	1 per 10,000 cubic yards	
Sieve and Hydrometer Analysis of Soils - ASTM D422	200 Sieve > 50%	Per Soil Type	
Liquid Limit, Plastic Limit and Plasticity Index (Atterberg Limits) - ASTM D4318	PI > 5, LL > 20	Per Soil Type	
SOIL LINER			CQA Officer
Thickness	5 feet minimum thickness (base), 1 foot minimum thickness (cover), and maintain design grade	100-foot grid	
Density/Moisture - ASTM D2922 & D3017	95% Standard Proctor Density and Optimum to +5% Moisture Content in accordance with "Acceptable Zone" (see Note 3)	1 per acre per lift or 1 per 1,000 cubic yards	
Strength	0.5 tsf (hand-held penetrometer)	1 per acre per lift or 1 per 1,000 cubic yards	
Hydraulic Conductivity - ASTM D5084	See Note 4	1 per 10,000 cubic yards	
PROTECTIVE FINAL SOIL COVER			Not Applicable to this Contract
Thickness	3 feet minimum total thickness including 1 foot of topsoil - maintain design grade	100-foot grid	
Density/Moisture* - ASTM D2922 & D3017	90% Standard Proctor Density and -3% to Optimum Moisture Content	1 per 10,000 cubic yards (minimum 1 per compacted lift)	
Strength*	0.5 tsf (hand-held penetrometer)	1 per 10,000 cubic yards (minimum 1 per compacted lift)	

* On the first two feet of the protective layer only. (The third foot is topsoil.)

Note 1: There is no specific requirement for hydraulic conductivity for the foundation, berms and final cover soils as they are not part of the liner system. However, insitu materials on the site generally exhibit hydraulic conductivities in the range of 1×10^{-4} cm/sec to 1×10^{-5} cm/sec. The construction contractor will attempt to utilize the most impermeable materials available (as identified visually) when constructing foundation fill and berms. For purposes of a complete construction record, hydraulic conductivity of placed foundation fill and side berms will be field tested at a rate of 1 test per each 10,000 cubic yards of material placed, although no specific threshhold values are required.

Note 3: Acceptable Zone" restriction applies only to the soil liner for the landfill. The gypsum stack soil liner shall only be required to meet the compaction and moisture content specification.

Note 4: The hydraulic conductivity for the landfill soil liner is 1.0×10^{-6} cm/sec(maximum) and for the gypsum stack soil liner is 1.0×10^{-5} cm/sec (maximum).

TABLE A.1: MATERIAL TESTING & FREQUENCY

Property/Test Method	Requirement/Specification	Frequency	Responsibility
GEOSYNTHETICS - PREQUALIFICATION TESTING			
GEOMEMBRANES (60 mil smooth, 60 mil textured, 40 mil textured)			Installer
Raw Material	Manufacturer's List of Guaranteed Properties	All rolls	
Geomembrane Properties	Manufacturer's List of Guaranteed Properties	All rolls	
Puncture Resistance - ASTM D4833	Manufacturer's List of Guaranteed Properties	1 per 100,000 square feet or per raw material batch, whichever is greater. Sample 3 feet wide by the full roll width	
Tear Resistance - ASTM D1004	Manufacturer's List of Guaranteed Properties	1 per 100,000 square feet or per raw material batch, whichever is greater. Sample 3 feet wide by the full roll width	
Thickness - ASTM D5199/D5994	Manufacturer's List of Guaranteed Properties	1 per 100,000 square feet or per raw material batch, whichever is greater. Sample 3 feet wide by the full roll width	
Tensile Strength and Elongation - ASTM D638 (Modified) or D6693	Manufacturer's List of Guaranteed Properties	1 per 100,000 square feet or per raw material batch, whichever is greater. Sample 3 feet wide by the full roll width	
GEOTEXTILES (Non-Woven, 4 ounce, 10 ounce, 16 ounce)			Installer
Geotextile Properties	Manufacturer's List of Guaranteed Properties	All rolls	
Mass per Unit Area - ASTM D5261	Manufacturer's List of Guaranteed Properties	1 per lot or one per 100,000 square feet, whichever is greater. Sample 3 feet wide by the full roll width	
Grab Tensile Strength - ASTM D4632	Manufacturer's List of Guaranteed Properties	1 per lot or one per 100,000 square feet, whichever is greater. Sample 3 feet wide by the full roll width	
Trapezoidal Tear Strength - ASTM D4533	Manufacturer's List of Guaranteed Properties	1 per lot or one per 100,000 square feet, whichever is greater. Sample 3 feet wide by the full roll width	
Apparent Opening Size - ASTM D4751	Manufacturer's List of Guaranteed Properties	1 per lot or one per 100,000 square feet, whichever is greater. Sample 3 feet wide by the full roll width	
Puncture Resistance - ASTM D4833	Manufacturer's List of Guaranteed Properties	1 per lot or one per 100,000 square feet, whichever is greater. Sample 3 feet wide by the full roll width	
Permittivity - ASTM D4491	Manufacturer's List of Guaranteed Properties	1 per lot or one per 100,000 square feet, whichever is greater. Sample 3 feet wide by the full roll width	

TABLE A.1: MATERIAL TESTING & FREQUENCY

Property/Test Method	Requirement/Specification	Frequency	Responsibility
GEOSYNTHETICS - PREQUALIFICATION TESTING			
GEOSYNTHETIC CLAY LINER (GCL)			Installer
GCL Properties	Manufacturer's List of Guaranteed Properties	All rolls	
Bentonite Mass/Area - ASTM D5993	Manufacturer's List of Guaranteed Properties	1 per 100,000 square feet or per raw material batch, whichever is greater. Sample 3 feet wide by the full roll width	
Grab Tensile Strength - ASTM D4632	Manufacturer's List of Guaranteed Properties	1 per 100,000 square feet or per raw material batch, whichever is greater. Sample 3 feet wide by the full roll width	
Peel Strength - ASTM D4632	Manufacturer's List of Guaranteed Properties	1 per 100,000 square feet or per raw material batch, whichever is greater. Sample 3 feet wide by the full roll width	
GEOSYNTHETICS - MATERIAL PLACEMENT TESTING			
GEOMEMBRANES (60 mil smooth, 60 mil textured, 40 mil textured)			Installer
Seam Overlap	3" to 4"	All Seams	
Non-Destructive Testing	As per Section 6.3d of CQA Plan	All Seams	
Destructive Testing	As per Section 6.3e of CQA Plan	Minimum One Every 500 Feet	
GEOTEXTILES (Non-Woven, 4 ounce, 10 ounce, 26 ounce)			Installer
Seam Overlap	3" to 4"	All Seams	
Installation	Physical Installation per Section 6.3c of CQA Plan	None	
GEOSYNTHETIC CLAY LINER (GCL)			Installer
Seam Overlap	As per Section 6.3d of CQA Plan	All Seams	
Installation	Physical Installation per Section 6.3c of CQA Plan	None	

TABLE A.1: MATERIAL TESTING & FREQUENCY

Property/Test Method	Requirement/Specification	Frequency	Responsibility
DRAINAGE MEDIA - PREQUALIFICATION TESTING			
GRANULAR DRAINAGE LAYER			
Hydraulic Conductivity - ASTM D2434	1.0×10^{-3} cm/sec (Minimum)	One Test per Source	CQA Officer
Grain Size Analysis - ASTM D422	Field Established Based on Hydraulic Conductivity (Fines Passing #200<5%)	One Test per Source	
COARSE AGGREGATE			
Hydraulic Conductivity - ASTM D2434	1.0×10^{-1} cm/sec (Minimum)	One Test per Source	CQA Officer
Grain Size Analysis - ASTM D422	Field Established Based on Hydraulic Conductivity (Fines Passing #200<5%)	One Test per Source	
DRAINAGE MEDIA - MATERIAL PLACEMENT TESTING			
GRANULAR DRAINAGE LAYER			
Thickness	One Foot Minimum Thickness	100 Foot Grid	CQA Officer
Gradation - ASTM D422	Field Established Based on Hydraulic Conductivity (Fines Passing #200 < 5%)	1 per 3,000 cubic yards	
Hydraulic Conductivity - ASTM D2434	1.0×10^{-3} cm/sec (Minimum)	1 per 10,000 cubic yards	
COARSE AGGREGATE			
Gradation - ASTM D422	Field Established Based on Hydraulic Conductivity (Fines Passing #200 < 5%)	1 per 3,000 cubic yards	CQA Officer
Hydraulic Conductivity - ASTM D2434	1.0×10^{-1} cm/sec (Minimum)	1 per 10,000 cubic yards	

TABLE A.1: MATERIAL TESTING & FREQUENCY

Property/Test Method	Requirement/Specification	Frequency	Responsibility
OTHER MATERIAL PLACEMENT TESTING REQUIREMENTS			
LEACHATE PIPING SYSTEM ELEVATIONS & LOCATIONS			CQA Officer
Survey	Elevation +/- 0.1 feet with no adverse slopes. Plan location +/- 0.5 feet.	Every 100 feet and connections	
Welds and Connections	Visual Inspection	Each connection	
SURFACE WATER MANAGEMENT SYSTEM			CQA Officer
Survey	Field established for positive drainage (+/- 0.4 feet)	Inlet and Outlet and every 100 lineal feet along ditch channel	
CONCRETE			CQA Officer
Slump - ASTM C143	2" to 4" at time of placement	1 per 25 cubic yards or minimum 1 per day	
Air Entrainment - ASTM C231	5% to 7% at time of placement	1 per 100 cubic yards or minimum 1 per day	
Compressive Strength - ASTM C31 and C39	3,500 psi at 28 days	2 cylinders per 50 cubic yards or minimum 2 cylinders per day	
Delivery Time - ASTM C94	Total Mixing and Delivery Time Less than 1.5 Hours	Each Delivery	

Appendix B

Acceptable Zone Procedure

PROCEDURE FOR DETERMINATION OF SOIL LINER ACCEPTABLE ZONE OF COMPACTION AND MOISTURE CONTENT

INTRODUCTION

One of the most significant factors affecting the performance of compacted soil liners is the adequate control of water content and dry unit weight during construction. A carefully written compaction specification will result in a compacted soil liner achieving the required hydraulic conductivity while also satisfying other factors affecting performance such as strength, compressibility, and resistance to desiccation. Because a soil liner is meant to be a hydraulic barrier, hydraulic conductivity requirements are the primary factor affecting the criteria of a compaction specification. The specification should be then tightened as necessary to meet other performance standards.

For this project, the specification will require that the soil be compacted to at least 95 percent maximum dry density as obtained from the Standard Proctor test per ASTM D 698, with a moisture range of optimum to 5 percentage points wet of optimum. Testing of the proposed liner soils will be performed to determine its acceptable density and moisture content zone for a maximum hydraulic conductivity of 1.0×10^{-6} cm/sec for the final cover and base liner. Research work performed by Benson and Daniel (1990) shows that the acceptable zone can be expected to parallel a "line of optimums." This procedure should be run when a new source of soil is selected for liner construction or when the Proctor density changes by 10 pcf or more.

PROCEDURE

The following steps will be performed during prequalification of a soil source for liner construction. The source investigation will identify consistency of the soil and have completed soil index tests including grain size distribution and Atterberg Limit determinations. Once the initial index testing is complete, a proper value for Proctor density can be selected, and then the following steps can be followed.

- Compact three samples at a controlled moisture of ±1 percent of optimum moisture at approximately 97 percent to 93 percent of standard Proctor maximum dry density. These samples should be tested for hydraulic conductivity using ASTM D 5084. If all samples pass, it can be assumed as confirmation that the specified 95 percent of maximum dry density is an appropriate lower density range.

- If all three initial hydraulic conductivity test results are $\leq 1.0 \times 10^{-6}$ cm/sec for the base liner and the final cover, then three more samples shall be prepared to confirm the moisture content range. Using approximately 93 percent to 95 percent dry density, prepare one sample at -1 points (dry of optimum), one at +3 points and one at +8 points of optimum moisture content. Test these new samples for hydraulic conductivity using ASTM D 5084. If all samples pass, it can be assumed as confirmation that the optimum to +5 percentage points is an appropriate moisture content range.

- If the first two steps do not confirm the permeability window, the CQA Officer will determine if the soil will be used for construction. If it will be used, then further testing can be performed to define a smaller acceptable zone.

- In some cases, the borrow sources may be so variable that composting of the soil will be required for testing. In these cases, three or four Proctor tests should be performed to determine the range of maximum dry density. If the range of maximum dry densities is less than 10 pcf, a composite can be tested as outlined above. If the range of maximum dry densities is greater, the highest and lowest soil values should be tested to determine an acceptable range.

Selection of density value shall be based on inspector's identification of soil percentages. Prequalification testing will assure the conformance of permeability.

USE OF THE ACCEPTABLE RANGE

During construction, the acceptable window will be verified by the specified interval of construction sample testing. Each sample will be tested for density, moisture, grain size, and Atterberg Limits when submitted for hydraulic conductivity testing. The results can then be compared to prequalification testing to verify soil consistency and passing hydraulic conductivity. These tests can also be plotted on the Proctor curve as documentation of acceptable zone or as a demonstration that the zone can be enlarged.

Appendix E: Operation and Maintenance Manual, Duck Creek Energy Center, Gypsum Management Facility

Operation and Maintenance Manual
Illinois Power Resources Generating, LLC
Duck Creek Energy Center
Gypsum Management Facility
Fulton County, Illinois

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Revised August 2014

OPERATION AND MAINTENANCE MANUAL
DUCK CREEK ENERGY CENTER
GYPSUM MANAGEMENT FACILITY
FULTON COUNTY, ILLINOIS

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SECTION 1.0
GENERAL

This operation and maintenance (O&M) manual outlines objectives, proposed policies, responsibilities, and procedures for Illinois Power Resources Generating, LLC (IPRG) and Contractor personnel who are responsible for the management of the Duck Creek Energy Center Gypsum Management Facility (GMF). The GMF incorporates two reservoirs, the Gypsum Stack and the Recycle Pond, for processing and storing gypsum.

1.1 REASONS FOR DEVELOPMENT OF THE O&M MANUAL

In addition to providing guidance to the IPRG and Contractor personnel who are responsible for the operations and maintenance of Duck Creek GMF, this manual has been prepared in accordance with state regulations. The State of Illinois Rivers, Lakes and Streams Act, (615 ILCS 5) Paragraph 23a includes the statement "The Department is authorized to carry out inspections of any dam within the State, and to establish standards and issue permits for the safe construction of new dams and the reconstruction, repair, operation and maintenance of all existing dams." (emphasis added).

Part 3702 of the 17 Illinois Administrative Code, Chapter I entitled the "Construction and Maintenance of Dams" details the requirements to obtain a permit for the construction, operation, and maintenance of a dam. Section 3702.40 b) includes the following statement:

> "5) As a condition of each permit, the dam owner shall submit a maintenance plan detailing the procedures and schedules to be followed to maintain the dam and its appurtenances in a reasonable state of repair."

Thus it is a requirement of all dam owners who have dams which fall under the jurisdiction of the Illinois Department of Natural Resources to operate and maintain them safely.

As a dam owner, IPRG is responsible for the safety of the public and for maintaining the structures at the facility for both safety and economy. The overall public interest is served by providing a document to serve as a basis for the safe and economical operation and maintenance of the dam during both emergency and day-to-day conditions.

1.2 GENERAL RESPONSIBILITIES CONCERNING DAMS

IPRG is responsible for the operation and maintenance of the Gypsum Stack Dam and the Recycle Pond Dam. These responsibilities include general maintenance (mowing, removing debris from decants, placing riprap where needed, etc.), operation, inspection and emergency action decisions. IPRG plans to enter into an agreement with an independent contractor to perform certain aspects of the operation and maintenance of the GMF.

SECTION 2.0
DEFINITIONS

Abutment - That part of the valley side or concrete walls against which the dam is constructed. Right and left abutments are those on respective sides of an observer when viewed looking downstream.

Appurtenant Works - The structures or machinery auxiliary to dams which are built to operate and maintain dams; such as outlet works, spillways, gates, valves, channels, etc.

Boil - A stream of water discharging from the ground surface downstream of the dam carrying with it a volume of soil which is distributed around the hole formed by the discharging water.

Berm - A horizontal step or bench in the sloping profile of an embankment dam.

Breach - A break, gap, or opening (failure) in a dam which releases impoundment water.

Dam - A barrier built for impounding or diverting the flow of water.

Dike (Levee) - An embankment, usually applied to embankments or structures built to protect land from flooding.

Drain, Layer or Blanket - A layer of pervious material in a dam to facilitate the drainage of the embankment including such items as a toe drain, a weephole, and a chimney drain.

Drawdown - The resultant lowering of the water surface level due to the release of water from the impoundment.

Duck Creek Plant Datum - the Duck Creek Station horizontal and vertical coordinate system ("Plant System") on which the design and construction survey information, and elevations used in this document is based. Reference the control points shown on the construction drawings (Drawing C180-C102-04, Rev 3, or later) for horizontal and vertical control information.

Embankment - Fill material, usually rock or earth, placed with sloping sides.

Earthen Dam - Any dam constructed of excavated natural materials.

Failure - An incident resulting in the uncontrolled release of water from the dam.

Freeboard - The vertical distance between a stated water level and the top of the dam.

Gate or Valve - In general, a device in which a leaf or member is moved across the waterway to control or stop the flow.

Groin - The junction of the upstream or downstream face of the dam with the valley wall.

Maintenance - The upkeep, involving labor and materials, necessary for efficient operation of dams and their appurtenant works.

Operation - The administration, management, and performance needed to operate the dam and appurtenant works.

Operation and Maintenance Inspection - Inspections conducted by the dam Operator. These inspections are frequent visual "Walk-around" inspections of the dam surface and appurtenant works.

Outlet - An opening through which water can freely discharge for a particular purpose from an impoundment.

Phreatic Surface - The upper surface of saturation in an embankment.

Piping - The progressive development of internal erosion by seepage, appearing downstream as a hole or seam, discharging water that contains soil particles.

Riprap - A layer of large stones, broken rock or precast blocks placed in a random fashion usually on the upstream slope of an embankment dam, on a reservoir shore, or on the sides of a channel as a protection against wave and ice action.

Silt/Sediment - Soil particles and debris in an impoundment.

Slump/Slide Area - A portion of earth embankment which moves downslope, sometimes suddenly, often with cracks developing.

Spillway System - A structure or structures over or through which flows are discharged. If the flow is controlled by gates, it is considered a controlled spillway. If the elevation of the spillway crest is the only control of the flows, it is considered an uncontrolled spillway.

Emergency Spillway - A spillway designed to operate very infrequently, only during exceptionally large floods, usually constructed of materials expected to erode slowly.

Principal Spillway - The main spillway which controls both normal and flood flows and is usually constructed of non-erodable materials.

Auxiliary Spillway - A spillway which works in conjunction with the principal spillway to control flood flows and is usually constructed of non-erodable materials.

Stilling Basin - A basin constructed to dissipate the energy of fast flowing water, such as from a spillway, and to protect the streambed from erosion.

Toe of Embankment - The junction of the face of the dam with the ground surface in the floodplain upstream or downstream of the dam.

SECTION 3.0
INFORMATION ABOUT THE DAMS

3.1 LOCATION

The Gypsum Stack and Recycle Pond Dams are located in the NW 1/4 of Section 18, Township 6 North, Range 5 East of the Forth Principal Meridian in Fulton County, Illinois. More specifically, the dams are located east of Bethel Cemetery Road approximately 2 miles southeast of Canton, Illinois. A map showing the location of the dams is included in Appendix A.

3.2 DESCRIPTION OF DAM AND APPURTENANCES

The gypsum stack dam has a maximum earthen embankment height of 32 ft and a maximum impounding capacity of 773 acre-ft, measured at the top of the earthen dam elevation of 620 ft per Duck Creek Plant Datum (EL 620). However, due to the "stacking" of gypsum above the top of the earthen dam, the total volume within the completed gypsum stack will be approximately 2256 acre-ft. The recycle pond dam has a maximum embankment height of 41 ft and a maximum impounding capacity of 150 acre-ft (measured at the top of dam elevation of 615 ft).

The gypsum stack dam has a single high density polyethylene (HDPE) lined spillway (transfer channel) which discharges to the recycle pond. The transfer channel is a trapezoidal channel with 3H:1V side slopes. The transfer channel transitions from a 16-ft bottom width at an invert elevation of 614.0 ft at the upstream end, to a 35-ft bottom width at an invert elevation of 609.0 ft at the downstream end. A 2-ft tall HDPE covered concrete weir, located near the upstream end of the transfer channel, is fitted with stop logs capable of raising the discharge control elevation to 616.0 ft. To protect the HDPE liner from abrasion during flows, the transfer channel and a portion of the recycle pond dam incorporate an additional sacrificial layer of HDPE at the location where the transfer channel discharges to the recycle pond.

The emergency spillway for the recycle pond consists of four 42-inch diameter HDPE pipes which discharge into a riprap lined plunge pool. The upstream inverts of the pipes are at EL 610.0 and the downstream inverts are at EL 607.0. The emergency spillway has been provided in the event of an accidental overfilling of the recycle pond or catastrophic rainfall only. It is not expected to be activated during the life of the facility.

Pertinent data about the dams, appurtenant works, and reservoirs are presented in Appendix B.

3.3 SIZE CLASSIFICATION

The gypsum stack earthen dam has a maximum embankment height of 32 ft and a maximum impounding capacity of 773 acre-ft (measured at the top of dam elevation of 620 ft). Based on IDNR criteria, the gypsum stack earthen dam is classified as a small-size dam. However, since the gypsum stack is planned to ultimately meet or exceed 100 ft in height, the gypsum stack will eventually be classified as a large-size dam.

The recycle pond dam has a maximum embankment height of 41 ft and a maximum impounding capacity of 150 acre-ft (measured at the top of dam elevation 615 ft). Since the recycle pond dam embankment exceeds 40 ft in height, it is classified as an intermediate-size dam.

3.4 HAZARD CLASSIFICATION

The breach wave resulting from a failure of either dam is expected to be contained within the Duck Creek Reservoir located immediately downstream. Considering the low probability for causing loss of life or economic loss to adjacent landowners, both dams are classified as CLASS III, LOW HAZARD POTENTIAL dams.

SECTION 4.0
OPERATIONS ACTIVITIES

The operations plan describes the proposed operation of the Duck Creek Gypsum Management Facility (GMF) which includes the gypsum stack and the recycle pond.

4.1 SITE OPERATIONS

The GMF will receive flue gas desulfurization sludge (gypsum) from the Duck Creek Energy Center (the Plant). Gypsum will be transported to the GMF in slurry form (approximately 20 percent solids) and allowed to settle. Clarified process water will then be siphoned or decanted to the recycle pond and returned to the Plant for reuse via pipeline.

The GMF will potentially receive gypsum slurry 24 hours per day, seven days per week. Routine operation and maintenance activities are expected to be conducted during day shift hours. The filling times and staging chronology included in this document are calculated from gypsum production rates estimated at 23,500 tons per month, which is based on the plant burning high sulfur coal (6.8 lbs of SO_2 per million BTU) at a 90% capacity factor. The sluice and process water return rates referenced in this document are per the Hitachi Power Systems America, Ltd. MATERIAL BALANCE Case Study: 4,131 mmBtu/hr Drawing No. 0013-361-110-0381 Rev. B dated 3-19-07. Variations in these parameters would result in variations in the estimated chronology and flow rates.

The Plant is a restricted access location. A series of fences and gates exist to prevent unauthorized access to the property. The proposed GMF is located within the restricted plant confines, and is, therefore, not accessible to the general public.

4.2 PERSONNEL

The proposed GMF will be owned and operated by IPRG. Corporate offices are located in Houston, Texas. IPRG plans to enter into an agreement with an independent Contractor to perform certain aspects of the operation and maintenance of the GMF. The contractual operator (Operator) of the gypsum stack will be responsible for daily operation and maintenance of the gypsum stack, recycle pond and peripheral areas.

4.3 OPERATION OF VAULTS AND VALVES

IPRG personnel will be responsible for the operation of the valves which control the flow of slurry and water between the Plant, recycle pond and gypsum stack to the first valve vault located at the recycle pond entrance road. Beyond that point, the Operator will be responsible for distribution of gypsum slurry to various areas of the gypsum stack (this includes the valve vaults on the mid-western side of the gypsum stack and the north side of the gypsum stack). Two redundant pipes will carry the gypsum slurry from the plant. Although only one pipe will be in use at any time, conditions at the plant may result in a discharge pipe switch at any time. BOTH PIPES MUST BE AVAILABLE TO DISCHARGE GYPSUM AT ALL TIMES WHEN

THE PLANT IS OPERATING. Valves to both pipes must be open, and the ends of both pipes must be positioned so that there would be no restrictions to gypsum discharge at any time.

4.4 GYPSUM MANAGEMENT FACILITY STARTUP

The major components of the GMF consist of:

- The gypsum stack;
- The recycle pond;
- The HDPE-lined earthen transfer channel that connects the two structures, and through which clarified process water will be decanted from the gypsum stack into the recycle pond; and
- The recycle pond decant system and pump-house, through which process water will be returned to the Plant for reuse.

Upon completion of the recycle pond construction, the recycle pond will be partially filled with water pumped from the Plant or from Duck Creek Reservoir. The recycle pond pumps will be commissioned and then shut off pending the introduction of slurry into the gypsum stack. Procedures for these operations are discussed in the following sections.

4.4.1 Siphon Installation and Operation

The bottom of the gypsum stack is approximately 29 ft below the transfer channel invert elevation of 614 ft. During the period when the gypsum sluicing and stacking operations are conducted below the transfer channel elevation, clarified water must be siphoned from the gypsum stack to the recycle pond. Based on a slurry discharge rate of 653 gal/minute (gpm), and an average reclaim water return rate of 626 gpm, a minimum of two redundant (2) 10-inch diameter HDPE siphons should be primed and operable at all times. Installation of the siphon pipes and valves is included in the original GMF construction.

Each of the siphon pipes will pass through the transfer channel and the outlet end of the siphon pipes shall be laid on the bottom of the recycle pond at elevation 590 ft. Ballast will be required at the outlet of the pipe to prevent the pipes from potentially floating to the surface and breaking the siphon. Ballast or other means of restraint may also be required in the transfer channel to hold the pipes in place. For a 300 ft long, 10-inch diameter HDPE siphon, the water level in the gypsum stack will need to be approximately 4.5 ft higher than the water level in the recycle pond in order to pass the equilibrium process water return rates discussed above.

4.4.2 Initial Filling of Recycle Pond With Water

The recycle pond will initially be partially filled with water pumped from Duck Creek Reservoir or the plant. The recycle pond will be filled to a water surface elevation of 598 ft in order to accommodate proper pump functioning during commissioning and startup of the slurry discharge to the gypsum stack. Duck Creek plant personnel will monitor and regulate the water level in the recycle pond.

4.4.3 Commissioning the Pumps and Siphons

Once the recycle pond and gypsum stack have operational levels of water, the siphons, the recirculation pump system (recycle pond to gypsum stack), and the recycle pump system (recycle pond to plant) will be primed and tested. IPRG will be responsible for operation and maintenance of the recycle / recirculation pumps.

4.5 GYPSUM MANAGEMENT FACILITY OPERATION

The gypsum slurry (approximately 20 percent solids) will be pumped from the Plant to the gypsum stack via piping. Piping will be HDPE with a pressure rating for the design hydraulic and static head. The HDPE pipe will discharge the slurry into the gypsum stack, and the gypsum will settle by gravity.

The water level in the recycle pond should be maintained at a minimum elevation of 598 ft in order to insure uninterrupted pumping of water back to the plant. However, at times, there will be intermittent outages at the plant. During an outage, bottom drains in the gypsum stack will continue to discharge water to the recycle pond and the recycle pumps will continue to recirculate water from the recycle pond to the gypsum stack. The recirculation of water is required during outages in order to utilize the water storage capacity of the gypsum to help maintain sufficient storage capacity in the recycle pond to accommodate all precipitation runoff from the entire gypsum stack/recycle pond area during an expected maximum 12-week maintenance outage at the Plant.

At a placement rate of 23,500 tons per month, it will take approximately 3 years to fill the gypsum stack with gypsum to the invert of the HDPE-lined transfer channel at EL 614. Until that time, clarified return water will be siphoned into the recycle pond using one of two redundant 10-inch diameter siphon pipelines. Water that flows from the gypsum stack to the recycle pond will be pumped back to the Plant for reuse, or recirculated to the top of the gypsum stack during periods when the plant is shutdown.

In order to stack the gypsum material with the required factors of safety for slope stability, a system of strategically placed perimeter ditches and dikes must be constructed. Interior dikes will also need to be constructed to accommodate the installation of ring drains and the development of cells located within the gypsum stack. Key components of the gypsum stacking process are described in the following sections to highlight the effort required to successfully stack gypsum with the required factors of safety against slope failure.

4.5.1 Initial Filling With Gypsum Slurry

There are two redundant gypsum slurry pipelines which will be capable of discharging midway along the north side or west side of the of the gypsum stack at a maximum rate of 1.5 cfs (675 gal/min). The initial construction of the GMF includes a ring drain system on the HDPE liner on the bottom of the gypsum stack. When gypsum slurry is initially discharged into the gypsum stack, **extreme care must be taken to prevent any erosion of the sand layer over the ring drain**. **Any displacement of sand may impair the function of the ring drain.** If necessary, the sand layer may be protected with a layer of larger aggregate or temporarily

covered with an approved geotextile wherever necessary to prevent erosion of the sand layer. It may be preferable to use a flange-connected pipe extension to extend the slurry discharge line to the interior side of the ring drain so that the bottom troughs will collect the water and prevent erosion of the sand layer. The pipe extension can be removed when the ring drains are covered and protected by settled gypsum. If any ring drain sand is displaced, the Operator shall immediately notify Ameren so that an appropriate response and repair method can be determined. Please see Figure A for details and a general depiction of the ring drain assembly.

Settled gypsum will gradually create a plane of material (gypsum beach) sloping gently towards the south end of the gypsum stack. Please see Figure B for a depiction of the gypsum beach. Clarified water will collect in the south end of the gypsum stack and will be siphoned into the recycle pond when it reaches EL 602.5, the level necessary to provide the head to siphon the process water at the system equilibrium rates. The GMF Operator will be responsible for operation and maintenance of the siphons. At the design flow rates, it will take approximately 95 days of operation in order for the water in the gypsum stack to reach this level.

4.5.2 Gypsum Dike and Cell Construction

The bottom slope of the gypsum stack liner, and the siphoning of water from the gypsum stack to the recycle pond, will partially drain the gypsum to allow for "early stacking" of material below the crest of the earthen dam. This is advantageous for several reasons. One reason is that the construction of compacted dikes at a lower elevation may improve foundation conditions for the remainder of the stack. Employing stacking procedures at a lower elevation also affords the opportunity for the Operator to become familiar with the material and develop confidence in a construction routine which will maximize stability when stacking the material above the top of the earthen embankment. Early stacking also allows Ameren the opportunity to complete preliminary testing on proposed piezometer locations for development of a piezometer installation and monitoring plan, as discussed in Section 4.5.8, which will be refined prior to stacking above the top of the earthen embankment.

The procedures for controlling the deposition of gypsum will begin once the gypsum beach at the north end of the gypsum stack reaches an elevation of approximately 605 ft, NGVD, which is 10 ft above the HDPE liner (7.5 ft above the top of the ring drain assemblies). Based on an assumed deposited gypsum slope of 0.3%, and a water level of 602.5 ft, the gypsum beach which will be visible above water is predicted to span half the length of the gypsum stack (reference Figure B). At full production (16.7 acre-ft deposited per month), the time required for the gypsum beach to reach this configuration is estimated at five to six months. .

The first procedural steps in controlling the deposition of (stacking) gypsum are the construction of a perimeter ditch, a perimeter dike, a rim ditch, and a rim dike. The perimeter ditch is the ditch which will be formed between the earthen embankment and the gypsum. The perimeter dike is the gypsum dike on the interior side of the perimeter ditch. The rim ditch is a ditch which will be formed on the interior side of the perimeter dike. The rim dike is a gypsum dike which will be formed on the interior side of the rim ditch. These basic components of the gypsum stack are illustrated in Figure C. Specific details pertaining to the ditches are provided in Sections 4.5.3 and 4.5.4.

During the initial stages of stacking, the perimeter ditch, perimeter dike, rim ditch and rim dike will be constructed simultaneously. They will be constructed by building two elevated dikes on the gypsum beach beginning at the middle of the north side and proceeding both clockwise and counterclockwise around the perimeter of the gypsum beach (see Figure D). Access to the beach will be provided by carefully pushing an approved fill material onto the beach from the crest of the earthen embankment to create an access pad. The thickness of the fill layer will need to be at least 24-inches over the geomembrane liner to avoid damage to the liner, and will need to be at least 36-inches over the gypsum beach. Once the fill material has been placed far enough out onto the beach to allow excavation of the gypsum without damaging the liner, the access pad can be completed using gypsum excavated from the beach (see Figure E).

Gypsum excavated from the beach is expected to be soft and saturated and must be windrowed and allowed to dewater before it can be spread and compacted to form the roadway. The gypsum is expected to dewater sufficiently in 24 hours to allow spreading and compacting. Adequate compaction is expected to be achieved by tracking with a D-6 dozer or similar equipment.

After construction of the dikes and ditches has begun, the slurry discharge lines should be relocated to discharge to the rim ditch. This will allow the rim ditch to be refilled each day to provide gypsum for raising the roadway as the excavator retreats from the most recently placed windrow. The rim ditch will also serve as the primary means of diverting slurry around the stack to the location where deposition is desired.

When the initial perimeter dike is completed, the top of the perimeter dike should be at least 30 ft wide, at least 10 ft above the beach and the side slopes graded to be 3.0H:1.0V (see Detail A on Figure B). The top of the initial rim dike should be at least 3.5 ft above the beach. Additional interior dikes may also be constructed as needed to create cells which facilitate the settling process. The exterior side slope of the rim dike shall be 3.0H:1.0V. The interior side slope of the rim dike and the side slopes on any interior dikes may be allowed to form at the angle of repose for the gypsum material. **A minimum freeboard of 3.5 ft must be maintained between the slurry level in the rim ditch and the crest of the perimeter dike. Subsequently, the perimeter dike must always be maintained at an elevation at least 3.5 ft higher than the rim dike or any other interior dike.**

The rim and perimeter dikes should be raised in lift increments of approximately 1 foot and may be moved laterally each lift as needed to maintain the required design slopes of 3.0H:1.0V on the perimeter dike. The slopes can be graded with a smooth-edged excavator bucket, e.g., a finish or cleanup bucket. **Under no circumstances should the slopes of the gypsum stack be graded using a toothed excavator bucket**.

Clarified water will be transferred from the rim ditch to the perimeter ditch where it will be carried to the transfer channel for discharge to the recycle pond. The GMF construction included installation of a stop log system for the transfer channel. The stop logs may be used for **temporary** reductions in flow to the Recycle Pond and increases in water levels in the gypsum stack for water balance purposes during operation. During the initial stacking process, when a siphon must be used to transfer water to the recycle pond, the transfer of water from the rim ditch

to the perimeter ditch may be achieved with an open cut through the perimeter dike. However, once the perimeter dike rises above elevation 614 ft (the invert of the transfer channel), decants, stilling wells and splash pads (see Sections 4.5.5 and 4.5.7) are required for the purpose of transferring clarified water from the rim ditch to the perimeter ditch.

4.5.3 Perimeter Ditch

Throughout the stacking operations, a perimeter ditch must be constructed and maintained around the toe of the gypsum stack. The perimeter ditch will be located between the perimeter dike (outer gypsum slope) and the HDPE lined earthen embankment. This ditch will collect water from the ring drains, decants and rainfall runoff, and convey it to the transfer channel where it will be discharged to the recycle pond. The perimeter ditch shall be constructed by covering the HDPE liner with a 2 ft thick protective layer of gypsum and shaping the channel to the required dimensions. The perimeter ditch is required to have a maximum invert elevation of 614 ft (6 ft below the top of the earthen perimeter dam) and a bottom width of at least 5 ft. A larger ditch bottom width may be utilized to reduce the frequency of any dredging necessary to maintain the minimum required dimensions.

4.5.4 Rim Ditch

The rim ditch will be the primary means of diverting slurry from the slurry discharge pipes to the desired deposition area. The rim ditch will also transport clarified water to the decant structures so the water can be discharged to the perimeter ditch. Consequently, the width of the rim ditch will vary according to the needs at any particular location on the gypsum stack. There may also be cases were blocking the rim ditch is desirable to divert water into a particular cell. There are only two primary constraints on the construction of the rim ditch: (1) the outer slope shall not be steeper than 3.0H:1.0V (this is the inner slope of the perimeter dike); and (2) the normal operating water level shall be at least 3.5 ft below the top of the perimeter dike.

4.5.5 Installation and Operation of Decants and Stilling Wells

The progressive stacking of gypsum will require the installation of at least four (4) decant structures (2 redundant sets of 2) in the rim ditch to convey water to the lower perimeter ditch without eroding the gypsum stack slopes. A minimum of two (2) decant structures are required in order to maintain the water level in the rim ditch and provide adequate discharge capacity for design precipitation events. An additional redundant set of two (2) decant structures will also be required to be installed. The decant structures will consist of 16-inch diameter solid wall HDPE IPS DR 11 pipe sections with 12-inch diameter screw-capped tees installed at 6 ft intervals along the length of the pipe. (When installed on a 3H:1V slope, the tees at 6 ft intervals will translate to 2 ft elevation intervals.) The decant structures will each discharge to a stilling well located in the perimeter ditch at the toe of the outer gypsum stack slope.

During construction of the first gypsum dike above elevation 614 ft (the invert elevation of the perimeter ditch and transfer channel), a 16-inch diameter solid wall HDPE IPS DR11 pipe will be installed as shown in Figure F**Error! Reference source not found.**. The horizontal portion of the pipe will be approximately 80 ft long with an invert at EL 614. The inlet end of the horizontal pipe will be attached to the first decant pipe section with an 18.4 degree angle

fitting. Prior to backfilling over the horizontal portion of the pipe, a 20 ft wide geogrid must be installed over the entire horizontal portion of the pipe, to prevent the pipe from potentially floating out of the saturated gypsum layer during the initial stages of the stacking operation.

The outlet end of the decant pipe will be welded to, and discharge into, a 48-inch diameter HDPE stand pipe with a 1-inch thick HDPE plate welded to the bottom. The stand pipe will have a top elevation of 618 ft and a bottom elevation of 611 ft. The stand pipe will be filled with concrete ballast to EL 614 (see Detail A on Figure F). Additionally, a 4-inch diameter low flow drain will be installed in the stand pipe at elevation 614 ft in order to allow for the cleanout of any gypsum which might accumulate in the stand pipe. In order to allow for proper function of the stilling well, the low flow drain pipe should not be installed in line with the 16-inch decant pipe, but rather offset to one side.

Each time the perimeter gypsum dike is raised, a new decant pipe section will be butt welded to the decant structure. The decant pipe section will be supported by the interior 3H:1V slope of the rim ditch. The water level in the rim ditch will be progressively raised through the stacking operation by capping the appropriate tees in the decant pipe sections. As previously stated, the normal water level shall be at least 3.5 ft below the crest of the perimeter gypsum dike.

4.5.6 Installation of Upper Ring Drains

Upon completion of the first gypsum dike above elevation 614 ft, and prior to construction of the next progressively stacked dike, two interior ring drains must be installed concurrent with development and operation of the interior gypsum cells. Additional ring drains will be required as the height of the gypsum stack increases. Final details and specifications for the upper ring drains will be provided by the design engineer at the time of installation. The upper ring drains are required to control the phreatic surface which will develop within the stack. A preliminary design for the upper ring drains is as follows, as shown on Figure C: A 3 ft tall gypsum dike will be constructed along the centerline of the proposed ring drain using the same techniques as for gypsum dike construction. After construction of the dike, a 4 ft deep channel with a 4 ft bottom width will be excavated along the center of the dike. Side slopes on the cut should be no steeper than 1:1. The bottom and sides of the cut should be filled with IDOT FA1 gradation sand to form a layer which is 1 ft thick. After the sand is placed, the channel will then be lined with non-woven geotextile to be specified by the design engineer. The geotextile will be covered with coarse granular material (to be specified) 2 ft wide by 2 ft deep, with a perforated HDPE pipe imbedded in the center. The fabric will then be wrapped over the top of the coarse granular material and covered with an additional 1 ft thick layer of FA1 gradation sand. The gypsum must not be in direct contact with the non-woven geotextile. The upper ring drains will discharge to the perimeter ditch via solid-wall HDPE pipe.

4.5.7 Splash Pads at Ring Drain & Decant Discharge Locations

At each location where a ring drain and/or a decant structure discharges to the perimeter ditch, the ditch shall be lined with a material capable of resisting the erosive velocities. Materials such as concrete, cable stayed concrete blocks or a geogrid backfilled with washed

aggregate may be acceptable. Operator-proposed methods shall be submitted to Ameren for approval prior to placement. The splash pads shall be installed concurrently with or immediately after construction of the perimeter ditch, ring drain outlets and decant stilling wells.

4.5.8 Piezometer Installation and Monitoring

The side slopes of the gypsum stack will be constructed with 3.0H:1.0V side slopes. (After consolidation of the settled gypsum over time, the final slopes are expected to approach 3.75H:1.0V.) The stability of the gypsum stack slopes is critically dependent on the location of the phreatic surface which will develop within the gypsum stack. Proper installation and functioning of the ring drains will ensure that the phreatic surface is located an adequate distance from the surface of the slope as necessary to maintain a stable slope. In order to monitor the phreatic surface within the gypsum stack, piezometers will be installed on each side of the gypsum stack. A preliminary piezometer detail is included on Figure C. The location and depth of each piezometer will be determined by the design engineer prior to installation, and an installation and monitoring plan will be developed based on information obtained during the initial gypsum stacking operations below the level of the earthen berm. "Critical elevations" corresponding to the anticipated readings at various stages during the progressive raising of the gypsum stack will be established for each piezometer. The water level in each piezometer will be read and recorded in accordance with a specified schedule. If at any time a reading is recorded higher than the "critical elevation" for that stage of operation, Ameren and the design engineer must be contacted immediately for evaluation of the reading. It is imperative that the piezometers are installed and monitored in accordance with the plan and the design engineer's specifications. Depending on the piezometer readings, it may also be necessary to install additional seepage collection drains to maintain the phreatic surface at or below the critical level within the gypsum stack.

Figure A – Bottom Ring Drain Assembly

Figure B - Initial Gypsum Dike Construction

Figure C - Components of Gypsum Stack

Figure D - Progression of Ditch and Dike Construction

Figure E - Access Pad Extension onto Gypsum Beach

Figure F - Decant Pipe and Stilling Well Details

SECTION 5.0 DAM INSPECTIONS

The inspection program includes two types of dam inspections which are required to be performed in accordance with IDNR/OWR's Rules for Construction and Maintenance of Dams. The first type of inspection is regularly conducted by the dam Operator and is referred to as an Operation and Maintenance Inspection. The second type of inspection, referred to as the Engineering Inspection, is conducted by a qualified engineer approved by Ameren.

Inspections shall be conducted throughout the operating life of the structures. The "operating life of the structure" will be considered to cease upon receipt of written affirmation from IDNR/OWR indicating that the structure is no longer considered a dam. Copies of all inspection reports shall be maintained at the Plant for the operating life of the structures.

5.1 OPERATION AND MAINTENANCE INSPECTION

"Walk-around" inspections of the dams and appurtenant works are to be made by the dam Operator. During these inspections, a checklist of items to be maintained and items to be observed should be recorded. The checklist provided in Appendix B shall be utilized for these inspections. **If any of the following items are found to be unusual or are cause for concern, the Ameren Shift Supervisor should be immediately notified.**

Frequency: Weekly. Also, during and after unusual events such as heavy rainfall or after an earthquake.

Inspection Items: During each inspection the following items should be noted in particular.

1. Water Level - Maximum levels as a result of heavy rainfall should be recorded.

2. Earth Embankment - Walk the crest, side slopes and downstream toe of the dam concentrating on surface erosion, seepage, cracks, settlement, slumps, slides, and animal burrows. These are described as follows:

   - Surface Erosion - Removal of vegetative cover by water action or pedestrian or vehicle usage forming deep ruts or gullies.

   - Seepage - The passage of water through and/or underneath the earth embankment abutment and natural groundline or at the contact between the embankment and outlet works. It can be indicated by cattails or other wet environmental vegetation, erosion, channelization, or slumping on the embankment face.

   - Cracks - Deep cracks usually indicate the movement of the dam and/or the foundation and can be in either the longitudinal (along the length of the dam) or transverse (across the dam) directions. Cracking can be an indicator of the

beginning of slumps. Shallow cracks may develop during the summer when the surface soils of the embankment become severely dried and are usually of no concern in regard to the safety of the dam.

- Settlement - Settlement is indicated by depressions or low spots and can be signs of consolidation of the dam or foundation or the loss of material beneath the settlement area.

- Slumps/Slides - A slow or sudden movement of the earth embankment slope on either face toward the toe of the dam.

- If seepage indicates the presence of soil particles, or if deep cracks, settlement, slumps, or slides are noticed, a qualified engineer should be contacted immediately for consultation.

- Animal Burrows - Animal burrows result in a loss of earth embankment material and can provide seepage paths for water through the embankment.

3. Gypsum Embankment - Walk the crest, side slopes and downstream toe of the dam concentrating on surface erosion, seepage, cracks, settlement, slumps, slides and animal burrows. The descriptions for these are the same as for earth embankment.

4. Vegetation - Grass should be a thick vigorous growth to stabilize the earth embankment soils and prevent erosion from occurring. Note the height of the grass; if greater than 1 foot a mowing of the area should be scheduled before the next inspection. There should be NO trees on the earth embankment and NONE within a minimum of 20 ft of the embankment toes or other structures. The gypsum embankment will not be seeded and is not expected to have any vegetation.

5. Gypsum Stack piezometers should be inspected for any damage or loss of function. Damaged piezometers must be promptly repaired or replaced since their function is critical to ensuring stability of the gypsum stack.

6. The water level in each Gypsum Stack piezometer must be measured and recorded. If the water level in any piezometer is above the "critical elevation" as discussed in Section 4.5.8, Ameren should be notified and the **design engineer should be immediately consulted for guidance on an appropriate course of action**.

7. Gypsum Stack LD/LCRS Drains - The change in location or amount of flows discharging from the Leak Detection/Leachate Collection Recovery System (LD/LCRS) should be recorded. If a significant change has occurred, a qualified engineer should be contacted for consultation.

8. Gypsum Stack Ring Drains - The change in location or amount of flows discharging from the Ring Drains should be recorded. If a significant change has occurred, a qualified engineer should be contacted for consultation.

9. Gypsum Stack Fixed Decant – Check the alignment and supports for the pipe. Record the amount of flows discharging from the pipe and any erosion or scour around the discharge point.

10. Gypsum Stack Perimeter Ditch – The perimeter ditch should have a consistent prismatic shape for the entire length. Inspect the perimeter ditch for evidence of erosion, sediment deposition and irregularity in channel geometry, especially in the vicinity of siphon, decant or ring drain outfall structures. If irregularities are noted, repairs should be scheduled and completed.

11. Stop Logs - Check to make sure that the stop logs in the transfer ditch are undamaged, and, if installed, are operating well and allowing for the free flow of water over them.

12. Transfer Channel - Check for any debris or other obstructions which may block or restrict the free flow of water. Check for any pools or undulation of the floor of the channel.

13. Recycle Pond Decant - Check for any debris or other obstructions around the Recycle Pond decant which may block or restrict the free flow of water. The emergency dewatering valve should be lubricated. If there is no return water in the pipe, the emergency dewatering valve should be exercised. Record the physical and operating conditions of the system.

14. Recycle Pond Drop Inlet Spillways - Check for any debris or other obstructions around the inlet crest and at the bottom of the drop inlet which may block or restrict the free flow of water. Check for the development of any rusty areas on the concrete, and seepage, cracking, breaking, or spalling of the concrete. Check for settlement or cracking of the crest. Check for any debris in the pipes which may restrict the flow of water. Check for any tears or leaks in the HDPE liner covering the concrete.

15. Recycle Pond Rip Rap Basin - Check for any debris or other obstructions in the riprap basin which may block or restrict the free flow of water. Check to make sure that the rip rap is remaining in a uniform position. Freeze/thaw action or flow over the rip rap may tend to lift or fracture, thus requiring replacement or leveling to maintain the necessary level of protection. NO trees or woody vegetation should be growing through the rip rap.

16. Fences - Check for damage, accumulated debris, operation of gates and locks, and adequacy of locations (this may change with time as people access the area or development occurs in the area).

17. Perimeter - Check the perimeter of the dams for a distance of at least 100 ft beyond the toe for signs of seepage or boils.

18. HDPE Liner – Wherever exposed, the HDPE Liner should be inspected for tears, gouges, protrusions under the liner and abrasion.

Records: Log books of activities occurring at the dam is to be kept current by the dam Operator. The log books shall be made available for review by the inspecting engineer during the Engineering Inspection. The log books should contain at the least the following documentation:

1. Completed operation and maintenance inspection checklists
2. Readings from all piezometers on the Gypsum Stack
3. Additional visual observations
4. A list of maintenance performed
5. A list of any unusual occurrences at the dam
6. A copy of the engineering inspection reports

5.2 ENGINEERING INSPECTION

The engineering inspection is to be conducted by a qualified engineer approved by IPRG. The inspection will provide a thorough evaluation of the dam and appurtenant structures. The forms provided in Appendix C shall be utilized for these inspections.

Frequency: The Gypsum Stack Dam and Recycle Pond Dam are classified as CLASS III, LOW HAZARD POTENTIAL dams. Class III dams are to be inspected at least once every five years.

Inspection Items: The engineer will thoroughly inspect all of the items noted under Operation and Maintenance Inspection.

Records: The Dam Inspection Report form, Appendix C, will be completed by the inspecting engineer and will be signed and sealed by an Illinois Registered Professional Engineer. This report will document any deficiencies; recommend remedial actions; and establish time requirements for addressing the deficiencies. The original report will be retained in Ameren's file and a copy of the report will be submitted to the Illinois Department of Natural Resources, Office of Water Resources.

SECTION 6.0
MAINTENANCE ACTIVITIES

Timely repairs are a must after problem areas have been identified. The dam Operator is to perform the work required to correct items noted in the operation and maintenance and engineering inspections. Such items include mowing, seeding, tree and brush removal, replacing rip rap, repairing fences and locks, clearing debris, etc. The maintenance activities specified in the following sections are minimum requirements. NOTE: NO alterations or repairs to structural elements should be made without the assistance of a qualified engineer and the concurrence of the Illinois Department of Natural Resources, Office of Water Resources.

6.1 ROUTINE MAINTENANCE

Debris: Remove all trash, logs and other debris which may obstruct flow into the principal spillway pipes and drop inlets, or block passage from their discharge channels.

Rip Rap: Replace rip rap as needed to provide adequate protection against erosion.

Vegetation Control:

1. Maintain a good grass cover on the embankment by seeding, fertilizing and mulching areas which are refilled, barren, or thinly vegetated. Seeding mixtures used for maintenance reseeding shall result in a cover compatible with adjacent cover. The seeding mixture specified at the time of the dam's construction was IDOT Standard Specifications Class 1A (Salt Tolerant Lawn Mixture) as follows:

   IDOT Class 1A Salt Tolerant Lawn Mixture
   Bluegrass .....60 lb/acre
   Perennial Ryegrass.....20 lb/acre
   Dawsons Red Fescue.....20 lb/acre
   Scaldis Hard Fescue .....20 lb/acre
   Fults Salt Grass .....60 lb/acre

2. Grassed areas such as the embankment and the areas beyond the embankment toes for a distance of at least 20 ft should be mowed at least twice annually or at any time the height of the grass exceeds 1 foot.

3. All erosion areas will be filled and compacted, reseeded, fertilized and mulched to establish a thick erosion resistant cover.

4. Remove all trees and brush growing on the dam embankment to prevent development of a root system which could provide seepage paths. Herbicides utilized for tree and brush control are discussed in Appendix D.

5. Keep the riprap basin clear of weeds, brush, and trees.

6. Remove all trees and brush growing on the dam embankment to prevent development of a root system which could provide seepage paths. Herbicides utilized for tree and brush control are discussed in Appendix D.

7. Clear all brush and trees to a distance of approximately 20 ft beyond both toes of the dam.

Animal Damage: Fill rodent holes and other animal burrows with compacted clayey dirt and reseed. If rodents become a nuisance, an effective rodent control program as approved by the Illinois Department of Natural Resources District Wildlife Biologist should be implemented.

Signs: All warning sings shall be maintained (repaired, painted, or replaced) as needed.

6.2 EROSION AND DUST CONTROL

As stacking operations commence, the dewatered gypsum is expected to form a thin layer of "crust" which will resist erosion and prevent the migration of fugitive dust from the gypsum stack. (This expectation is based on a case study of flue-gas desulfurization by-product (gypsum) stacking by the Electric Power Research Institute entitled Evaluation of Chiyoda Thoroughbred 121 FGD Process and Gypsum Stacking, Volume 3 Addendum, dated March 1981.) Should a protective layer of crust fail to form or fail to provide adequate erosion and dust control, appropriate measures for addressing these concerns will be implemented.

APPENDIX A
LOCATION MAP

APPENDIX B
PERTINENT DATA ABOUT THE DAMS

Gypsum Stack Dam

DAM		
Top of Dam Elevation	620	ft
Invert of Reservoir Elevation	585	ft
Reservoir Area at Invert	0.7	acres
Reservoir Area at Top of Dam	31.6	acres
Total Reservoir Volume	773.2	acre-ft
Total Watershed Area	31.6	acres

TRANSFER CHANNEL		
Bottom Width	16.00	ft
Top Width	16.00	ft
Depth	6.00	ft
Upstream Invert	614.00	ft
Downstream Invert	609.00	ft
Weir Elevation	616.00	ft
Weir Length	16.00	ft

PERIMETER DITCH		
Bottom Width	5.00	ft
Top Width	44.00	ft
Depth	6.00	ft
Outer Side Slope	3.5:1	H:V
Inner Side Slope	3:1	H:V
Upstream Invert	615.16	ft
Downstream Invert	614.00	ft
Ditch slope	0.00050	ft/ft
Bank Full Cross-sectional Area	147.00	sf
Length of Each Ditch (Centerline)	2322.00	ft
Bank Full Volume of Each Ditch	7.84	acre-ft
Total Ditch length (Centerline)	4644.00	ft
Total Ditch Bank Full Volume	15.67	acre-ft

0.5 PMF STORM EVENT		
Critical Storm Duration	24	hours
Peak Inflow	374.7	cfs
Peak Outflow	190	cfs
Total Inflow	54.88	acre-ft
Total Outflow	54.91	acre-ft
Peak Storage	9.46	acre-ft
Peak WSEL (HEC-HMS)	618.5	ft
Peak WSEL (HEC-RAS)	618.31	ft
Freeboard over Max WSEL	1.5	ft
Wave Runup/Wind Setup	1.48	ft

100-YR STORM EVENT		
Critical Storm Duration	0.5	hours
Peak Inflow	274.7	cfs
Peak Outflow	91.4	cfs
Total Inflow	21.08	acre-ft
Total Outflow	21.12	acre-ft
Peak Storage	6.31	acre-ft
Computed WSEL (HEC-HMS)	617.54	ft
Computed WSEL (HEC-RAS)	617.66	ft
Freeboard over Max WSEL	2.34	ft
Wave Runup/Wind Setup	1.48	ft

Recycle Pond Dam

DAM		
Top of Dam Elevation	615	ft
Invert of Reservoir Elevation	592	ft
Reservoir Area at Invert	4.87	acres
Reservoir Area at Top of Dam	8.21	acres
Total Reservoir Volume	150.4	acre-ft
Total Watershed Area	39.81	acres

SPILLWAY		
Pipe Length	60	ft
Pipe Diameter (Inside)	42	inch
Number of Pipes	4	
Pipe Slope	0.03333	Ft/ft
Upstream Invert	610	ft
Downstream Invert	607	ft
Entrance Loss Coefficient	0.9	

0.5 PMF Storm Event - Starting WSEL @ 610		
Critical Storm Duration	24	hours
Peak Inflow	252.4	cfs
Peak Outflow	123.6	cfs
Total Inflow	65.96	acre-ft
Total Outflow	62.88	acre-ft
Peak Storage	135.79	acre-ft
Peak WSEL (HEC-HMS)	612.99	ft
Peak WSEL (HEC-RAS)	613.00	ft
Freeboard over Peak WSEL	2.01	ft
Wave Runup/Wind Setup	1.77	ft
Peak Spillway Outlet Velocity	12.73	fps

100-yr Storm Event - Starting WSEL @ 610		
Critical Storm Duration	2	hours
Peak Inflow	107.1	cfs
Peak Outflow	29.5	cfs
Total Inflow	27.22	acre-ft
Total Outflow	24.15	acre-ft
Peak Storage	125.25	acre-ft
Peak WSEL (HEC-HMS)	611.37	ft
Computed WSEL (HEC-RAS)	611.37	ft
Freeboard over Peak WSEL	3.63	ft
Wave Runup/Wind Setup	1.77	ft
Peak Spillway Outlet Velocity	9.92	fps

0.5 PMF Storm Event - Starting WSEL @ 599.5		
Critical Storm Duration	24	hours
Peak Inflow	252.1	cfs
Peak Outflow	0	cfs
Total Inflow	65.96	acre-ft
Total Outflow	0	acre-ft
Peak Storage	114.47	acre-ft
Peak WSEL (HEC-HMS)	609.70	ft
Freeboard over Peak WSEL	5.3	ft
Wave Runup/Wind Setup	1.77	ft

100-yr Storm Event - Starting WSEL @ 604		
Critical Storm Duration	24	hours
Peak Inflow	32.3	cfs
Peak Outflow	0	cfs
Total Inflow	36.46	acre-ft
Total Outflow	0	acre-ft
Peak Storage	114.07	acre-ft
Peak WSEL (HEC-HMS)	609.64	ft
Freeboard over Peak WSEL	5.36	ft
Wave Runup/Wind Setup	1.77	ft

APPENDIX C
OPERATION AND MAINTENANCE INSPECTION CHECKLIST

OPERATION AND MAINTENANCE INSPECTION CHECKLIST

Dam Name (circle one): Gypsum Stack Dam Recycle Pond Dam

Date: _____ Time: _____

Name of Inspector: _____

Reservoir Elevation: _____ ft

ITEM	NO	YES	IF YES
Record Piezometer Readings for Gypsum Stack. Are any readings above the critical level? (see section 4.8.2 of O&M)			Contact Engineering Manager and notify Hanson Professional Services
Note the condition of the Piezometers on the Gypsum Stack. Any damage?			Contact Engineering Manager
Deep Surface Cracks			Contact Engineering Manager
Slump or Slide on the upstream or downstream face			Contact Engineering Manager
Erosion from runoff, wave action or traffic			Repair and stabilize
Wet areas on the gypsum or earthen embankment indicating seepage			Contact Engineering Manager
Flows of cloudy water from seepage areas on the gypsum or earthen embankment			Contact Engineering Manager
Uneven settlement			Contact Engineering Manager
Trees, brush or burrow holes on the embankment or in the riprap basin			Remove trees and brush, fill holes
Transfer channel or Spillway pipes blocked			Clear immediately
Damage to stop logs			Repair or replace
Tear in Liner			Repair and schedule engineer inspection
Settlement or displacement of Gypsum Stack siphon decant pipes or outlets			Schedule engineer inspection
Settlement or displacement of Gypsum Stack fixed decant pipes or outlets			Schedule engineer inspection
Discharge from Gypsum Stack LD/LCRS Drains?			Record discharge rate for each outlet (time to fill bucket)
Discharge from Gypsum Stack Ring Drains?			Record discharge rate for each outlet (time to fill bucket)
Gypsum Stack Perimeter Ditch erosion			Schedule repair
Problems with Recycle Pond decant			Contact Engineering Manager
Height of grass (inches		inches	If more than 1 foot, schedule mowing

APPENDIX D
ENGINEERING INSPECTION FORM

Dam Inspection Report

Name of Dam IPRG Duck Creek Gypsum Stack & Recycle Pond Dams Dam ID No. IL50573 & IL50574

Permit Number DS2007125 Class of Dam III

Location NW 1/4 Section 18 Township 6N Range 5E 4th P.M.

Owner _____ _____
Name Telephone Number (Day)

_____ _____
Street Telephone Number (Night)

_____ County Fulton
City Zip Code

Type of Dam Homogeneous earthen embankment (gypsum stack is homogeneous gypsum embankment)

Type of Spillway _____

Date(s) Inspected _____

Weather When Inspected _____

Temperature When Inspected _____

Pool Elevation When Inspected _____

Tailwater Elevation When Inspected _____

Inspection Personnel:

_____
Name Title

_____
Name Title

_____
Name Title

_____
Name Title

Professional Engineer's Seal

The Department of Natural Resources is requesting information that is necessary to accomplish the statutory purpose as outlined under the River, Lakes and Streams Act, 615 ILCS 5 (1994 State Bar Edition). Submittal of this information is REQUIRED. Failure to provide the required information could result in the initiation of non-compliance procedures as outlined in Section 702.160 of the "Rules for Construction and Maintenance of Dams". This form has been approved by the State Forms Management Center.

CONDITION CODES

EC	**-**	**Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; such as, pool draw down, work stoppage, plant stoppage.**
NE	**-**	**No evidence of a problem**
GC	**-**	**Good condition**
MM	**-**	**Item needing minor maintenance and/or repairs within the year, the safety or integrity of the item is not yet imperiled**
IM	**-**	**Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.**
EC	**-**	**Emergency condition which if not immediately repaired or other appropriate measures taken could lead to failure of the dam**
OB	**-**	**Condition requires regular observation to ensure that the condition does not become worse**
NA	**-**	**Not applicable to this dam**
NI	**-**	**Not inspected - list the reason for non-inspection under deficiencies**
EC	**-**	**Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; such as, pool draw down, work stoppage, plant stoppage.**

GYPSUM STACK - EARTH EMBANKMENT

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Surface Cracks			
Vertical and Horizontal Alignment of Crest			
Unusual movement or Cracking at or Beyond Toe			
Sloughing or Erosion of Outer Embankment Slopes			
Upstream Face Slope Protection (HDPE Liner)			
Seepage			
Animal Damage			

GYPSUM STACK - EARTH EMBANKMENT

(Continued)

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Vegetative Cover			

GYPSUM STACK - GYPSUM EMBANKMENT

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Surface Cracks			
Vertical and Horizontal Alignment of Crest			
Unusual movement or Cracking at or Beyond Toe			
Sloughing or Erosion of **Outside** Embankment Slopes			
Sloughing or Erosion of **Inside** Embankment Slopes			
Seepage			
Animal Damage			

GYPSUM STACK - GYPSUM EMBANKMENT

(Continued)

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Condition of Piezometers on Gypsum Stack			
Piezometer Readings on Gypsum Stack Above Critical Level?			

GYPSUM STACK – PERIMETER DITCH

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Ditch Geometry (15 ft bottom width, 3:1 slopes, 8-9 ft depth)			
Concrete Apron at ring drain outlets			
Ring Drain Discharge Pipes			
Stilling Wells for Fixed Decants			

TRANSFER CHANNEL - (between gypsum stack and recycle pond)

[ ] Drop Inlet Structure [X] Overflow Spillway Structure [ ] Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Debris			
Side Slope Stability			
HPDE Liner			
HDPE Liner Welds			
Stop Logs			
Differential Settlement			

RECYCLE POND - EMBANKMENT

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Surface Cracks			
Vertical and Horizontal Alignment of Crest			
Unusual movement or Cracking at or Beyond Toe			
Sloughing or Erosion of Outer Embankment Slopes			
Upstream Face Slope Protection (HDPE Liner)			
Seepage			
Animal Damage			

RECYCLE POND - EMBANKMENT

(Continued)

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Vegetative Cover			

RECYCLE POND - PRINCIPAL SPILLWAY (Left, Looking Downstream)

[X] Drop Inlet Structure [ ] Overflow Spillway Structure [ ] Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Alignment of Structure Walls			
Construction Joints			
Differential Settlement			
Erosion, Spalling, Cavitation			
Joint Separation			
Seepage Around or into Conduit			
Surface Cracks			

RECYCLE POND - PRINCIPAL SPILLWAY (Left, Looking Downstream)

(Continued)

[X] Drop Inlet Structure [ ] Overflow Spillway Structure [ ] Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Structural Cracks			

RECYCLE POND - PRINCIPAL SPILLWAY (Center)

[X] Drop Inlet Structure [ ] Overflow Spillway Structure [ ] Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Alignment of Structure Walls			
Construction Joints			
Differential Settlement			
Erosion, Spalling, Cavitation			
Joint Separation			
Seepage Around or into Conduit			
Surface Cracks			

RECYCLE POND - PRINCIPAL SPILLWAY (Center)

(Continued)

[X] Drop Inlet Structure [ ] Overflow Spillway Structure [ ] Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Structural Cracks			

RECYCLE POND - PRINCIPAL SPILLWAY (Right, Looking Downstream)

[X] Drop Inlet Structure [ ] Overflow Spillway Structure [ ] Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Alignment of Structure Walls			
Construction Joints			
Differential Settlement			
Erosion, Spalling, Cavitation			
Joint Separation			
Seepage Around or into Conduit			
Surface Cracks			

RECYCLE POND - PRINCIPAL SPILLWAY (Right, Looking Downstream)

(Continued)

[X] Drop Inlet Structure [ ] Overflow Spillway Structure [ ] Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Structural Cracks			

RECYCLE POND - ENERGY DISSIPATOR

[X] Principal Spillway [ ] Outlet Works Type: Riprap Basin

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Riprap			
Outlet Channel			
Debris			

RECYCLE POND - DECANT STRUCTURE

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Alignment			
Connection to Bollard			
Debris in Inlets			
Condition of Pipe			
Condition of Liner Beneath Pipe			
Connection to Ballast			
Connection of Pipe Boot to Liner			

RECYCLE POND - DECANT STRUCTURE

(continued)

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE
Seepage Around or into Conduit			

RECYCLE POND – WATER LEVEL GAGE STRUCTURE

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES & SCHEDULE

APPENDIX E
HERBICIDES

HERBICIDES

Site personnel should check with the Illinois Department of Natural Resources, Regional Fisheries Biologist and the Regional Wildlife Biologist before using any herbicide. Read the product label prior to use and follow the use directions and precautions accordingly.

On March 1, 1979 the U.S. Environmental Protection Agency (U.S.E.P.A.) halted the use of the herbicide 2, 4, 5-T in parks and recreation areas. The use of silvex (2, 4, 5-TP) around water has also been banned.

The Agronomy Department at the University of Illinois and the Aquatic Biology Section of the Department of Natural Resources, Office of Scientific Research and Analysis indicate that the herbicides containing the 2, 4-D or 2, 4-DP are legal for use in parks and recreation areas and effective for controlling brush and woody growth. Some examples of approved herbicides are:

1. Tordon RTU by DOW Chemical. (Can be obtained with blue dye.)
2. WEEDONE 170 by Union Carbide
3. WEEDONE, 2, 4-DP by Union Carbide
4. A 1% to 2% solution of ROUNDUP
5. Garlon by DOW Chemical
6. Banvel by Sandoz

Your distributor may carry brand name herbicides other than those listed above. Be certain that the product does not contain the ingredients 2, 4, 5-T or 2, 4, 5-TP. An example of an unacceptable product is ESTERON 2, 4, 5 by DOW Chemical.

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October 11, 2021

Illinois Power Resources Generating, LLC
17751 North Cilco Road
Canton, Illinois 61520

Subject: USEPA CCR Rule and IEPA Part 845 Rule Applicability Cross-Reference
2021 USEPA CCR Rule Periodic Certification Report
GMF Pond, Duck Creek Power Plant, Canton, Illinois

At the request of Illinois Power Resources Generating, LLC (IPRG), Geosyntec Consultants (Geosyntec) has prepared this letter to document how the attached 2021 United States Environmental Protection Agency (USEPA) CCR Rule Periodic Certification Report (Report) was prepared in accordance with both the Federal USEPA CCR Rule[1] and the state-specific Illinois Environmental Protection Agency (IEPA) Part 845 Rule[2]. Specific sections of the report and the applicable sections of the USEPA CCR Rule and Illinois Part 845 Rule are cross-referenced in **Table 1**. A certification from a Qualified Professional Engineer for each of the CCR Rule sections listed in **Table 1** is provided in Section 9 of the attached Report. This certification statement is also applicable to each section of the Part 845 Rule listed in **Table 1.**

Table 1 – USEPA CCR Rule and Illinois Part 845 Rule Cross-Reference

Report Section	USEPA CCR Rule		Illinois Part 845 Rule	
3	§257.73 (a)(2)	Hazard Potential Classification	845.440	Hazard Potential Classification Assessment[3]
4	§257.73 (c)(1)	History of Construction	845.220(a)	Design and Construction Plans (Construction History)
5	§257.73 (d)(1)	Structural Stability Assessment	845.450 (a) and (c)	Structural Stability Assessment
6	§257.73 (e)(1)	Safety Factor Assessment	845.460 (a-b)	Safety Factor Assessment
7	§257.82 (a)(1-3)	Adequacy of Inflow Design Control System Plan	845.510(a), (c)(1), (c)(3)	Hydrologic and Hydraulic Capacity Requirements / Inflow Design Flood Control System Plan
	§257.82 (b)	Discharge from CCR Unit	845.510(b)	Discharge from CCR Surface Impoundment

[1] United Stated Environmental Protection Agency, 2015. *40 CFR Parts 257 and 261, Hazardous and Solid Waste Management System, Disposal of Coal Combustion Residuals from Electric Utilities, Final Rule.*
[2] State of Illinois, Joint Committee on Administrative Rule, Administrative Code (2021). *Title 35: Environmental Protection, Subtitle G: Waste Disposal, Chapter I: Pollution Control Board, Subchapter j: Coal Combustion Waste Surface Impoundment, Part 845 Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments.*
[3] "Significant" and "High" hazard, per the CCR Rule[1], are equivalent to Class II and Class I hazard potential, respectively, per Part 845[2].

CLOSING

This letter has been prepared to demonstrate that the content and Qualified Professional Engineer Certification of the 2021 Periodic USEPA CCR Rule Certification Report fulfills the corresponding requirements of Part 845 of Illinois Administrative Code listed in **Table 1**.

Sincerely,

Lucas P. Carr, P.E.
Senior Engineer

John Seymour, P.E.
Senior Principal

2021 USEPA CCR RULE PERIODIC CERTIFICATION REPORT §257.73(a)(2), (c), (d), (e) and §257.82 GMF POND Duck Creek Power Plant Fulton County, Illinois

Submitted to

Illinois Power Resources Generating, LLC

17751 North Cilco Road
Canton, Illinois 61520

Submitted by

Geosyntec consultants

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1 McBride and Son Center Drive, Suite 202
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October 11, 2021

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EXECUTIVE SUMMARY

This Periodic United States Environmental Protection Agency (USEPA) Coal Combustion Residuals (CCR) Rule [1] certification report (Periodic Certification Report) for the GMF Pond[1] at the Duck Creek Power Plant (DCPP) has been prepared in accordance with Rule 40, Code of Federal Regulations (CFR) §257. herein referred to as the "CCR Rule" [1]. The CCR Rule requires that initial certifications for existing CCR surface impoundment, completed in 2016 and subsequently posted on the Illinois Power Resources Generating, LLC (IPRG) CCR Website ([2], [3], [4], [5], [6]) be updated on a five-year basis.

The initial certification reports developed in 2016 and 2017 ([2], [7], [3], [4], [5], [6], [8]) were independently reviewed by Geosyntec. Additionally, field observations, interviews with plant staff, and evaluations were performed to compare conditions in 2021 at the GMF Pond relative to the 2016 initial certifications. These tasks determined that updates are not required for the Initial Hazard Potential Classification or Inflow Design Flood Control Plan. However, due to changes at the site and technical review comments, updates were required and were performed for the:

- History of Construction Report,
- Initial Structural Stability Assessment, and
- Initial Safety Factor Assessment.

Geosyntec's evaluations of the initial certification reports and updated engineering evaluations determined that the GMF Pond meets all requirements for hazard potential classification, history of construction reporting, structural stability assessment, safety factor assessment, and hydrologic and hydraulic control. **Table 1** provides a summary of the initial 2016 certifications and the updated 2021 periodic certifications.

[1] The GMF Pond is also referred to as ID Number W05780100001-04, GMF Pond by the Illinois Environmental Protection Agency (IEPA); CCR unit ID 203 by IPRG, and IL50573 within the National Inventory of Dams (NID) maintained by the Illinois Department of Natural Resources (IDNR). Within this document it is referred to as the GMF Pond or the GMFP.

Table 1 – Periodic Certification Summary

	CCR Rule Reference	Requirement Summary	2016 Initial Certification		2021 Periodic Certification	
			Requirement Met?	Comments	Requirement Met?	Comments
Hazard Potential Classification						
3	§257.73(a)(2)	Document hazard potential classification	Yes	Impoundment was determined to have Significant hazard potential classification [2].	Yes	Updates were not determined to be necessary. Geosyntec recommends retaining the Significant hazard potential classification.
History of Construction						
4	§257.73(c)(1)	Compile a history of construction	Yes	A history of Construction report was prepared for the GMF Pond [3].	Yes	The Duck Creek Power Plant closed and CCR materials are no longer being placed in the GMF Pond. A letter listing updates to the History of Construction report is provided in **Attachment C.**
Structural Stability Assessment						
5	§257.73(d)(1)(i)	Stable foundations and abutments	Yes	Foundations and abutments were found to be stable [8].	Yes	Foundations and abutments were found to be stable after performing updated slope stability analyses.
	§257.73(d)(1)(ii)	Adequate slope protection	Yes	Slope protection was adequate [8].	Yes	No changes were identified that may affect this requirement.
	§257.73(d)(1)(iii)	Sufficiency of dike compaction	Yes	Dike compaction was sufficient for expected ranges in loading conditions [8].	Yes	Dike compaction found to be sufficient after performing updated slope stability analyses.
	§257.73(d)(1)(iv)	Presence and condition of slope vegetation	Yes	Vegetation was present on exterior slopes and is maintained. Interior slopes had alternate protection (geomembrane liner) [8].	Yes	No changes were identified that may affect this requirement.
	§257.73(d)(1)(v)(A) and (B)	Adequacy of spillway design and management	Yes	Spillways were adequately designed and constructed and were expected to adequately manage flow during 1,000-year flood [8].	Yes	No changes were identified that may affect this requirement.
	§257.73(d)(1)(vi)	Structural integrity of hydraulic structures	Not Applicable	Hydraulic structures penetrating the dikes or underlying the base of the GMF Pond were not present [8].	Not Applicable	No changes were identified that may affect this requirement.
	§257.73(d)(1)(vii)	Stability of downstream slopes inundated by water body.	Not Applicable	Inundation of exterior slopes was not expected; this requirement was not applicable [8].	Not Applicable	No changes were identified that may affect this requirement.
Safety Factor Assessment						
6	§257.73(e)(1)(i)	Maximum storage pool safety factor must be at least 1.50	Yes	Safety factors were calculated to be 4.27 and higher [8].	Yes	Safety factors from an updated slope stability analyses were calculated to be 3.47 and higher.
	§257.73(e)(1)(ii)	Maximum surcharge pool safety factor must be at least 1.40	Yes	Safety factors were calculated to be 4.26 and higher [8].	Yes	Safety factors from an updated slope stability analyses were calculated to be 3.47 and higher.
	§257.73(e)(1)(iii)	Seismic safety factor must be at least 1.00	Yes	Safety factors were calculated to be 2.37 and higher [8].	Yes	Safety factors from an updated slope stability analyses were calculated to be 1.88 and higher.
	§257.73(e)(1)(iv)	For dike construction of soils that have susceptible to liquefaction, safety factor must be at least 1.20	Not Applicable	Dike soils were not susceptible to liquefaction [8].	Not Applicable	No changes were identified that may affect this requirement.
Inflow Design Flood Control System Plan						
7	§257.82(a)(1), (2), (3)	Adequacy of inflow design control system plan.	Yes	Flood control system adequately managed inflow and peak discharge during the 1,000-year, 24-hour, Inflow Design Flood [8].	Yes	No changes were identified that may affect this requirement.
	§257.82(b)	Discharge from CCR Unit	Yes	Discharge into Waters of the United States is not expected during 1,000-year, 24-hour Inflow Design Flood conditions [8].	Yes	No changes were identified that may affect this requirement.

SECTION 1

INTRODUCTION AND BACKGROUND

This Periodic United States Environmental Protection Agency (USPA) Coal Combustion Residual (CCR) Rule [1] Certification Report was prepared by Geosyntec Consultants (Geosyntec) for Illinois Power Resources Generations, LLC (IPRG) to document the periodic certification of the GMF Pond at the Duck Creek Power Plant (DCPP) located at 17751 North Cilco Road in Canton, Illinois, 61520. The location of Duck Creek is provided in **Figure 1**, and a site plan showing the location of the GMF Pond, among other closed and open CCR units and non-CCR surface impoundments, is provided in **Figure 2**.

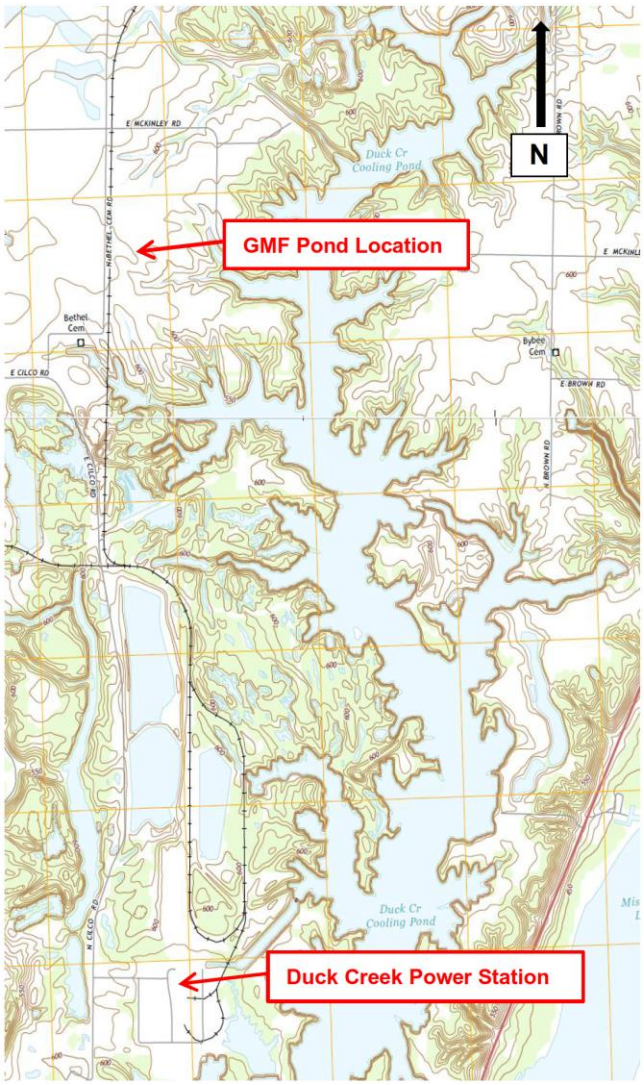


Figure 1 – Site Location Map (from AECOM, 2016)

Figure 2 – Site Plan

1.1 GMF Pond Description

DCPP was retired in 2019. Prior to retirement, two active CCR surface impoundments – the GMF Pond and the Bottom Ash Basin, and one CCR landfill, were used for managing CCRs generated at DCPP [8]. This certification report only pertains to the GMF Pond. The GMF Pond has a "Significant" hazard potential, based on the initial hazard potential classification assessment performed by Stantec in 2016 in accordance with §257.73(a)(2) ([2], [7]).

The GMF Pond served as the wet impoundment basin for gypsum proceeded by the emissions scrubbers at DCPP. The GMF Pond was constructed between 2008 and 2009 and received inflow from three pairs of 10-in diameter high-density polyethylene (HDPE) gypsum slurry pipes. Clear water discharge from the GMF Pond flows downstream into the approximately 8.5-acre GMF Recycle Pond, which is a non-CCR unit, via a lined channel (transfer channel). The transfer channel is approximately 150-ft long, trapezoidal in shape, lined with 60-mil HDPE, has 3H:1V (horizontal to vertical) side slopes, and a depth of 6 ft. Stoplogs are present within the transfer channel that would allow the pool level to be maintained as high as El. 616.0 ft[2]. The channel transitions from a 16-ft bottom width at an invert elevation of 614.0 ft at the upstream end to a 35-ft bottom width at an invert elevation of 609.0 ft at the downstream end. Outflow from the GMF Recycle Pond was formerly pumped back to DCPP to be recycled for use in the wet scrubber system [8]. Currently, the GMF Pond and GMF Recycle Pond are maintained in a zero-discharge configuration, where the only inflows are precipitation flowing directly into the impoundments and the only outflows are evaporation.

The GMF Pond has a composite liner system that is present underneath the entire footprint of the pond and extends up the interior slopes. The liner system includes, from bottom to top, a 3-ft thick layer of compacted clay that is overlain by a geosynthetic clay liner (GCL) and a 60-mil textured HDPE geomembrane, all of which serve as the lower liner. Above the lower liner, a 10-oz

[2] All elevations are in the North American Vertical Datum of 1988 (NAVD88), unless otherwise noted.

geotextile is overlain by a 1-ft thick granular drainage layer and a 4-oz geotextile filter. The upper liner is comprised from bottom to top of a 1-ft thick soil cushion layer and a 60-mil textured HDPE geomembrane. The upper geomembrane liner is exposed at the pond bottom and side slopes [8].

As formerly operated, the normal pool of the GMF Pond was El. 615.0 ft, as controlled by the stoplog structure at the top of the transfer channel. The GMF Pond is approximately 31.6 acres in size and has a total perimeter embankment length of approximately 4,560 ft. The perimeter dike was constructed to include a crest width of approximately 30 ft and crest height ranging from approximately 5 to 10 ft along the eastern side of the pond. The interior of the ponds extends deeper than the exterior slopes; the maximum interior slope height is approximately 45 ft in the southwest corner of the pond. The design elevation of the embankment crest is 620 ft. Both interior and exterior slopes have an orientation of 3.5H:1V (horizontal to vertical).

Initial certifications for the GMF Pond for Hazard Potential Classification (§257.73(a)(2)), History of Construction (§257.73(c)), Structural Stability Assessment (§257.73(d)), Safety Factor Assessment (§257.73(e)(1)), and Inflow Design Flood Control System Plan (§257.82) were completed by Stantec and AECOM in 2016 and 2017 and subsequently posted to IPRG's CCR Website ([2], [3], [4], [5], [6]). Additional documentation for the initial certifications included a detailed operating record reports containing calculations and other information prepared for the hazard potential classification by Stantec [7] and for the structural stability assessment, safety factor assessment, and inflow design flood control system plan by AECOM [8]. These operating record reports were not posted to IPRG's CCR Website.

1.2 Report Objectives

The following objectives are associated with this report:

- Compare site conditions from 2015/2016, when the initial certifications were developed, to site conditions in 2020/2021, when data for the periodic certification was obtained, and evaluate if updates are required to the:
    - §257.73(a)(2) Hazard Potential Classification [2].
    - §257.73(c) History of Construction [3].
    - §257.73(d) Structural Stability Assessment [4].
    - §257.73(e) Safety Factor Assessment [5], and/or
    - §257.82 Inflow Design Flood Control System Plan [6].
- Independently review the Hazard Potential Classification ([2], [7]), Structural Stability Assessment ([4], [8]), Safety Factor Assessment ([5], [8]), and Inflow Design Flood

Control System Plan ([6], [8]) reports to determine if updates may be required based on technical considerations.

- The History of Construction report [3] was not independently reviewed for technical considerations, as this report contained historical information primarily developed prior to promulgation of the CCR Rule [1] for the CCR units at DCPP, and did not include calculations or other information used to certify performance and/or integrity of the impoundments under §257.73(a)(2), §257.73(c)-(e), or §257.82.

- Confirm that the GMF Pond meets all of the requirements associated with §257.73(a)(2), (c), (d), (e), and §257.82, or, if the GMF Pond does not meet any of these requirements, provide recommendations for compliance with those sections of the CCR Rule [1].

SECTION 2

COMPARISION OF INITIAL AND PERIODIC SITE CONDITIONS

2.1 Overview

This section describes the comparison of conditions at the GMF Pond between the start of the initial CCR certification program in 2015 and 2016 (initial conditions) and subsequent collection of periodic certification site data in 2020 and 2021 (periodic conditions).

2.2 Review of Annual Inspection Reports

Annual onsite inspections for the GMF Pond were performed between 2016 and 2020 ([9], [10], [11], [12], [13]) were certified by a licensed professional engineer in accordance with §257.83(b). Each inspection report stated the following information, relative to the previous inspection:

- A statement that no changes in geometry of the impounding structure were observed since the previous inspection;
- A statement that no instrumentation was present;
- Approximate volumes of impounded water and CCR at the time of inspection;
- A statement that no appearances of actual or potential structural weakness or other disruptive conditions were observed; and
- A statement that no other changes which may have affected the stability or operation of the impounding structure were observed.

In summary, the reports did not indicate any significant changes to the GMF Pond between 2015 and 2020. No signs of instability, structural weakness, or changes which may have affected the operation or stability of the GMF Pond were noted in the inspection reports.

2.3 Review of Instrumentation Data

Multiple groundwater monitoring wells are present around the GMF Pond. Eight of the groundwater monitoring wells, G50S, G51S, G54C, G57C, G57S, G60S, G64S, and X301 have been monitored periodically since by IPRG. Water level readings were provided from December 2, 2015 through June 21, 2021 for most of the wells, with the exception of X301, for which water level readings were provided starting on March 2, 2015, and G54C, for which readings were provided starting on April 14, 2021. Geosyntec reviewed the water levels to evaluate if significant fluctuations, partially increases in phreatic levels, may have occurred between development of the

initial structural stability and factor of safety certifications ([4], [5], [8]) and June 21, 2021. Available monitoring well water levels are plotted in **Attachment A**.

In summary, only minor changes in phreatic conditions were observed in the available monitoring well level data. Phreatic levels typically exhibited consistent seasonal variations of 5 to 10 ft, with the exception of X301 and G54C, which varied by approximately 2 ft. These levels do not significantly differ from those utilized for the initial structural stability and factor of safety certifications ([4], [5], [8]).

2.4 Comparison of Initial to Periodic Surveys

The initial survey of the GMF Pond, conducted by Weaver Consultants (Weaver) in 2015 [14], was compared to the periodic survey of the GMF Pond, conducted by IngenAE, LLC (IngenAE) in 2020 [15], using AutoCAD Civil3D 2021 software. This comparison quantified changes in the volume of CCR placed within the GMF Pond and considered volumetric changes above and below the starting water surface elevation (SWSE) used for the 2016 §257.82 inflow design flood control plan hydraulic analysis [6]. Potential changes to embankment geometry were also evaluated. This comparison is presented in side-by-side comparison of the two surveys in **Drawing 1,** and a plan view isopach map denoting changes in ground surface elevation in **Drawing 2**. A summary of the water elevations and changes in CCR volumes is provided in **Table 2**.

Table 2 – Initial to Periodic Survey Comparison

Initial Surveyed Pool Elevation (ft)	614.2
Periodic Surveyed Pool Elevation (ft)	613.9
Initial §257.82 Starting Water Surface Elevation (SWSE) (ft)	616.0
Total Change in CCR Volume* (CY)	+ 8,000 (Fill)
Change in CCR Volume Above SWSE* (CY)	- 9,000 (Cut)
Change in CCR Volume Below SWSE* (CY)	+ 17,000 (Fill)

*All volumes rounded to the nearest 1,000 CY

The comparison indicated that approximately 8,000 CY of CCR was placed in the GMF Pond between the initial and periodic surveys. The CCR was placed entirely below the SWSE and a net cut occurred above the SWSE. CCR grades above the SWSE were generally similar to the initial survey (e.g., within +/- 2 ft). These changes are considered unlikely to result in increase in the peak water surface elevation (PWSE) during a flood event, as additional flood storage is present relative to conditions observed in 2015. No significant changes to embankment geometry appeared to have occurred between the initial and periodic surveys.

2.5 Comparison of Initial to Periodic Aerial Photography

Initial aerial photographs of the GMF Pond collected by Weaver in 2015 [14] were compared to periodic aerial photographs collected by IngenAE in 2020 [15] to visually evaluate if potential site changes (i.e., changes to the embankment, outlet structures, limits of CCR, other appurtenances)

may have occurred. A comparison of these aerial photographs is provided in **Drawing 3**. No significant changes were noted during this comparison.

2.6 Comparison of Initial to Periodic Site Visits

An initial site visit to the GMF Pond was conducted by AECOM in 2015 and documented with a Site Visit Summary and corresponding photographs [16]. A periodic site visit was conducted by Geosyntec on May 27, 2021, with Mr. Lucas P. Carr, P.E. conducting the site visit. The site visit was intended to evaluate potential changes at the site since the initial certifications were prepared (i.e., modification to the embankment, outlet structures or other appurtenances, limits of CCR, maintenance programs, repairs), in addition to performing visual observations of the GMF Pond to evaluate if the structural stability requirements (§257.73(d)) were still met. The stie visit included walking the perimeter of the GMF Pond, visually observing conditions, recording field notes, and collecting photographs. The site visit is documented in a photographic log provided in **Appendix A**. A summary of significant findings from the periodic site visit is provided below:

- Overall site maintenance appears to be similar to conditions observed in 2015.
- No signs or structural stability, erosion, or required maintenance items were observed during the stie visit.

2.7 Interview with Power Plant Staff

An interview with Mr. Daryl Johnson and Mr. Brandon Potter of the DCPP was conducted by Lucas P. Carr, P.E. of Geosyntec on May 27, 2021. Mr. Johnson, at the time of the interview, had been employed at the DCPP for 8 years and was responsible for environmental compliance and completed weekly CCR inspections on some years, including for the GMF Pond, in addition to managing vegetation maintenance. Mr. Potter, at the time of the interview, had been employed at DCPP for 10 years and assisted in the inspection and operation of the GMF Pond. The interview included a discussion of included a discussion of potential changes that that may have occurred at the GMF Pond since development of the initial certifications ([2], [7], [3], [4], [5], [6], [8]).

- Were any construction projects completed for the GMF Pond since 2015, and, if so, are design drawings and/or details available?
    - No.
- Were there any changes to the purpose of the GMF Pond since 2015?
    - The DCPP was closed in December of 2019. Sluicing into the GMF Pond and pumping of water from the GMF Recycle Pond was stopped at this time.
- Were there any changes to the to the instrumentation program and/or physical instruments for the GMF Pond since 2015?

  - The GMF Pond does not have instrumentation, so no changes occurred.

- Have area-capacity curves for the GMF Pond been prepared since 2015?
  - No known area-capacity curves have been developed.
- Were there any changes to spillways and/or diversion features for the GMF Pond completed since 2015?
  - No.
- Were there any changes to construction specifications, surveillance, maintenance, and repair procedures for the GMF Pond since 2015?
  - No.
- Were there any instances of dike and/or structural instability for the GMF Pond since 2015?
  - No known instances occurred.

SECTION 3

HAZARD POTENTIAL CLASSIFICATION - §257.73(a)(2)

3.1 Overview of Initial HPC

The Initial Hazard Potential Classification (Initial HPC) was prepared by Stantec Consulting Services, Inc. (Stantec) in 2016 ([2], [7]), following the requirements of §257.73(a)(2). The Initial HPC included the following information:

- Visual analysis to evaluate potential hazards associated with a failure of the GMF Pond perimeter dike, along the north, south, east, and west embankments of the GMF Pond.
- Evaluation of potential breach flow paths using elevation data and aerial imagery to assess potential impacts to downstream structures, infrastructure, and waterways.
- While a breach map is not included within the Initial HPC, it included within the §257.73(a)(3) Initial Emergency Action Plan (Initial EmAP) [17].

The visual analysis indicated that only structures owned by DCPP were within the potential breach path, and that public impacts were limited to portions of North Bethel Cemetery Road and the railroad leading to the Power Plant. The reported noted that North Bethel Cemetery Road is intermittently used, and the at-risk population was considered transient. The Initial HPC concluded that breach of the GMF pond would be unlikely to result in a probable loss of human life, although the breach could cause CCR to be released into downstream waterways, thereby causing environmental damage. The Initial HPC therefore recommended a “Significant” hazard potential classification for the GMF Pond [2].

3.2 Review of Initial HPC

Geosyntec performed a review of the Initial HPC ([2], [7]), in terms of technical approach, assessment of the results, and applicable requirements of the CCR Rule [1]. No significant technical issues were noted within the technical review, although a detailed review (e.g., check) of the calculations was not performed as the initial HPC utilized a visual assessment.

3.3 Summary of Site Changes Affecting the Initial HPC

Geosyntec did not identify any changes at the site that may affect the HPC. No new structures, infrastructure, frequently occupied facilities/areas, or waterways were observed to be present in the probable breach area indicated in the Initial EmAP [17]. Additionally, no significant changes to the topography in the probable breach were identified.

3.4 Periodic HPC

Geosyntec recommends retaining the "Significant" hazard potential classification for the GMF Pond, per §257.73(A)(2), based on the lack of site changes potentially affecting the Initial HPC occurring since the initial HPC was developed, as described in **Section 3.3**, and the lack of significant review comments, as described in **Section 3.2**. Updates to the Initial HPC reports ([2], [7]) are not recommended at this time.

SECTION 4

HISTORY OF CONSTRUCTION REPORT - §257.73(c)

4.1 Overview of Initial HoC

The Initial History of Construction report (Initial HoC) was prepared by AECOM in 2016 [3] following the requirements of §257.73(c) and included information on all non-incised CCR surface impoundments at DCPP, including the GMF Pond, Ash Pond No. 1, and Ash Pond No. 2. This report only discusses the HoC as it pertains to the GMF Pond. The Initial HoC included the following information for the GMF Pond:

- The name and address of the owner/operator,
- Location maps,
- Statements of purpose,
- The names and size of the surrounding watershed,
- A description of the foundation and abutment materials,
- A description of the dike materials,
- Approximate dates and stages of construction,
- Available design and engineering drawings,
- A summary of instrumentation,
- Area-capacity curves for the GMF Pond,
- Information on spillway structures,
- Construction specifications,
- Inspection and surveillance plans,
- A statement that operations and maintenance plans are being generated or revised, and that the report will be updated when the new plans are available,
- A statement that no known historical structural instability has occurred at the CCR surface impoundments.

4.2 Summary of Site Affecting the Initial HoC

One significant change at the site that occurred after development of the initial HoC report [3] was identified and is described below:

- Electricity generation at the DCPP ceased in December of 2019 and the pumping of inflow and outflow into and from the GMF Recycle Pond ceased at this time.
    - An update to the HoC report was performed to state that the DCPP is no longer active and the GMF Pond is no lower receiving inflows and outflow is no longer pumped back to the DCPP. A letter documenting changes to the HoC report is provided in **Attachment C**.

SECTION 5

STRUCTURAL STABILITY ASSESSMENT - §257.73(d)

5.1 Overview of Initial SSA

The Initial Structural Stability Assessment (Initial SSA) was prepared by AECOM in 2016 ([4], [8]), following the requirements of §257.73(d)(1), and included the following evaluations:

- Stability of dike foundations, dike abutments, slope protection, dike compaction, and slope vegetation,
- Spillway stability including capacity, structural stability and integrity; and
- Downstream slope stability under sudden drawdown conditions for a downstream water body.

The Initial SSA ([4], [8]) concluded that the GMF Pond met all structural stability requirements for §257.73(d)(1)(i)-(vii). This included noting that the structural integrity of hydraulic structures (§257.73(d)(1)(vi)) was not applicable, due to no hydraulic structures penetrating or underlying the base of the GMF Pond. Additionally, it was noted that the stability of downstream slopes inundated by water bodies (§257.73(d)(1)(vii) was also not applicable, due to inundation of the downstream slopes not being expected.

5.2 Review of Initial SSA and Updated Periodic SSA

Geosyntec performed a review of the Initial SSA ([4], [8]) in terms of technical approach, calculation input parameters and methodology, recommendations, and completeness. The review included the following tasks:

- Reviewing photographs collected in 2015 and used to demonstrate compliance with §257.73(d)(1)(i)-(vii).
- Reviewing geotechnical calculations used to demonstrate the stability of foundations, per §257.73(d)(1)(i) and sufficiency of dike compaction, per §257.73(d)(1)(iii), in terms of supporting geotechnical investigation and testing data, input parameters, analysis methodology, selection of critical cross-sections, and loading conditions.
- Review of the methodology used to demonstrate that a downstream water body that could induce a sudden drawdown condition, per §257.73(d)(1)(vii), is not present.

One review comment and corresponding recommended technical update was identified during review of the geotechnical analyses supporting the sufficiency of dike compaction

(§257.73(d)(1)(i)) and foundation and abutment stability (§257.73(d)(1)(iii) portions of the Initial SSA. These analyses were performed for the Initial Safety Factor Assessment (SFA) but also utilized to support the initial SSA. The review comment and subsequent updates the Initial SFA, are discussed in **Section 6.**

5.3 Summary of Site Changes Affecting the Initial SSA

No changes since development of the Initial SSA were identified that would require updates to the Initial SSA ([4], [8]).

5.4 Periodic SSA

The updated Periodic SFA (**Section 7**) indicates that foundations and abutments are stable and dike compaction is sufficient for expected ranges in loading conditions, as slope stability factors of safety for slip surfaces passing through the dike and foundation were found to meet or exceed the requirements of §257.73(e)(1), including for static maximum storage pool conditions and post-earthquake (i.e., liquefaction) loading conditions considering seismically-induced strength loss in the foundation soils. Therefore, the requirements of §257.73(d)(1)(i) and §257.73(d)(1)(iii) are met for the Periodic SSA.

SECTION 6

SAFETY FACTOR ASSESSMENT - §257.73(e)(1)

6.1 Overview of Initial SFA

The Initial Safety Factor Assessment (Initial SFA) was prepared by AECOM in 2016 ([5], [8]) following the requirements of §257.73(e)(1). The Initial SFA included the following information:

- A geotechnical investigation program with in-situ and laboratory testing;
- An assessment of the potential for liquefaction in the dike and foundation soils;
- The development of a single slope stability cross-sections for limit equilibrium stability analysis utilizing GeoStudio SLOPE/W software; and
- The analysis of the cross-section for maximum storage pool, maximum surcharge pool, and seismic loading conditions.
    - Liquefaction loading conditions were not evaluated as liquefaction-susceptible soil layers were not identified in either the embankments or foundation soils.

The Initial SFA concluded that the GMF Pond met all safety factor requirements, per §257.73(e), as all calculated safety factors were equal to or higher than the minimum required values.

6.2 Review of Initial SFA

Geosyntec performed a review of the Initial SFA ([5], [8]) in terms of technical approach, calculation input parameters and methodology, recommendations, and completeness. The review included the following tasks:

- Reviewing geotechnical calculations used to demonstrate the acceptable safety factors, per §257.73(e)(1), in terms of:
    - Completeness and adequacy of supporting geotechnical investigation and testing data;
    - Completeness and approach of liquefaction triggering assessments; and
    - Input parameters, analysis methodology, selection of critical cross-sections, and loading conditions utilized for slope stability analyses.
    - Phreatic conditions based on piezometric data collected between March 2, 2015 June 21, 2021, as discussed in **Section 2.3**.

One review comment was identified during review of the Initial SFA. The comment and the is described below:

- The Initial SFA utilized a single cross-section (A-A') along the eastern embankment where the exterior slope is approximately 8 ft tall. However, the maximum height of the exterior slope is approximately 11 ft at the southwest corner of the embankment.

6.3 Summary of Site Changes Affecting the Initial SFA

No changes since development of the Initial SFA were identified that would require updates to the Initial SFA ([5], [8]).

6.4 Periodic SFA

Following review of the Initial SFA ([5], [8]), Geosyntec developed a new slope stability analysis cross-section (B-B') at the southwest corner of the GMF Pond embankment to account for the maximum embankment height of 11 ft. The model was developed utilizing the following approach and input data:

- Ground surface geometry was obtained from the 2020 survey of the GMF Pond [15].

- Subsurface stratigraphy was obtained from 2007 borings B-53 and B-67, as provided in the Initial SFA report [8]. Geosyntec reviewed the boring data and determined that subsurface conditions were similar to conditions at cross-section A-A'. Therefore, the soil properties (i.e., strength, unit weight) from the Initial SFA ([5], [8]) were utilized for cross-section B-B',

- Piezometric levels in the foundation soils were assumed to follow the ground surface past the embankment toe, per providing readings from monitoring wells G51S and G54C; and,

- All other analysis settings and input data from the Initial SFA ([5], [8]) was utilized, including, but not limited to, software package and version, slip surface search routines and methods, and pseudostatic seismic coefficients.

Factors of safety form the Periodic SFA (cross-section B-B') and Initial SFA (cross-section A-A') are summarized in **Table 3** and confirm that the GMF Pond meets the requirements of §257.73(e)(1). A location of the cross-section B-B' in plan and analysis output data for cross-section B-B' is provided in **Attachment D**.

Table 3 – Factors of Safety from Periodic SFA

	Structural Stability Assessment (§257.73(d)) and Safety Factor Assessment (§257.73(e))				Structural Stability Assessment (§257.73(d))
Cross-Section	**Maximum Storage Pool §257.73(e)(1)(i) Minimum Required = 1.50**	**Maximum Surcharge Pool §257.73(e)(1)(ii) Minimum Required = 1.40**	**Seismic §257.73(e)(1)(iii) Minimum Required = 1.00**	**Dike Liquefaction §257.73(e)(1)(iv) Minimum Required = 1.20**	**Foundation Liquefaction §257.73(d)(1)(i) Minimum Required = 1.20**
A-A'	4.27	4.26	2.37	N/A	N/A
B-B'	3.47*	3.47*	1.88*	N/A	N/A

Notes:
[1]Denotes cross-section where results from the Initial SFA are presented due to no observed changes relative to the Initial IDF.
[2]Denotes cross-section where changes are occurred, and results are presented from the updated Periodic SFA.
*Indicates critical cross-section (i.e., lowest calculated factor of safety out of the two cross-sections analyzed)
N/A – Loading condition is not applicable.

SECTION 7

INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN - §257.82

7.1 Overview of Initial IDF

The Initial Inflow Design Flood Control System Plan (Initial IDF) was prepared by AECOM in 2016 ([6], [8]) following the requirements of §257.82. The Initial IDF included the following information:

- A hydraulic and hydrologic analysis, performed for the 1,000-year design flood event because of the hazard potential classification of "significant", which corresponded to 9.37 inches of rainfall over a 24-hour period.
- The Initial IDF utilized a HydroCAD Version 8.5 model to evaluate spillway flows and pool level increases during the design flood, with a SWSE of 616.0 ft.

The Initial IDF ([6], [8]) concluded that the GMF Pond met the requirements of §257.82, as the peak water surface estimated by the HydroCAD model was El. 618.3 ft, relative to a minimum GMF Pond dike crest elevation of 620.0 ft. Therefore, overtopping was not expected. The Initial IDF also evaluated the potential for discharge from the CCR unit and determined that discharge into Waters of the United States and no overtopping was expected during the 1,000-year design flood.

7.2 Review of Initial IDF

Geosyntec performed a review of the Initial IDF ([6], [8]) in terms of technical approach, calculation input parameters and methodology, recommendations, and completeness. The review included the following tasks:

- Reviewing the return interval used vs. the hazard potential classification.
- Reviewing the rainfall depth and distribution for appropriateness.
- Performing a high-level review of the inputs to the hydrological modeling.
- Reviewing the hydrologic model parameters for spillway parameters, starting pool elevation, and storage vs. the reference data.
- Reviewing the overall Initial IDF vs. the applicable requirements of the CCR Rule [1].

No significant technical issues were noted within the technical review, although a detailed review (e.g., check) of the calculations was not performed.

7.3 Summary of Site Changes Affecting the Initial IDF

No changes since development of the Initial IDF were identified that would require updates to the Initial IDF ([6], [8]).

SECTION 8

CONCLUSIONS

The GMF Pond at DCPP was evaluated relative to the USEPA CCR Rule periodic assessment requirements for:

- Hazard potential classification (§257.73(a)(2)),
- History of Construction reporting (§257.73(d)),
- Structural stability assessment (§257.73(d)),
- Safety factor assessment (§257.73(e)), and
- Inflow design flood control system planning (§257.82).

Based on the evaluations presented herein, the referenced requirements are satisfied.

SECTION 9

CERTIFICATION STATEMENT

CCR Unit: Illinois Power Resources Generation, LLC; Duck Creek Power Plant, GMF Pond

I, Lucas P. Carr, being a Registered Professional Engineer in good standing in the State of Illinois, do hereby certify, to the best of my knowledge, information, and belief that the information contained in this 2021 USEPA CCR Rule Periodic Certification Report, has been prepared in accordance with the accepted practice of engineering. I certify, for the above-referenced CCR Unit, that the periodic assessment of the hazard potential classification, history of construction report, structural stability, emergency action plan, safety factors, and inflow design flood control system planning, dated October 2021, were conducted in accordance with the requirements of 40 CFR §257.73(a)(2), (c), (d), (e), and §257.82.

Lucas P. Carr

10/11/2021

Date

Exp. 11/30/2021

SECTION 10

REFERENCES

[1] United States Environmental Protection Agency, 40 CFR Parts 257 and 261; Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule, 2015.

[2] Stantec Consulting Services Inc., "Initial Hazard Potential Classification Assessment, EPA Final CCR Rule, GMF Pond, Duck Creek Power Station, Fulton County, Illinois," Fenton, MO, October 12, 2016.

[3] AECOM, "History of Construction, USEPA Final CFR Rule, 40 CFR §257.73(c), Duck Creek Power Station, Canton, Illinois," October 2016.

[4] AECOM, "CCR Rule Report: Initial Structural Stability Assessment for GMF Pond at Duck Creek Power Station," October 2016.

[5] AECOM, "CCR Rule Report: Initial Safety Factor Assessment for GMF Pond at Duck Creek Power Station," St. Louis, MO, October 2016.

[6] AECOM, "CCR Rule Report: Initial Inflow Design Flood Control System Plan for GMF Pond at Duck Creek Power Station," October 2016.

[7] Stantec Consulting Services Inc., "Documentation of Initial Hazard Potential Classification Assessment, GMF Pond, Duck Creek Power Station, Fulton County, Illinois," October 12, 2016.

[8] AECOM, "CCR Certification Report: Initial Structural Stability Assessment, Initial Safety Factor Assessment, and Initial Inflow Design Flood Control System Plan for GMF Pond at Duck Creek Power Station," October 2016.

[9] J. Knutelski and J. Campbell, "Annual CCR Surface Impoundment Inspection Report (per 40 CFR 257.83(b)(2)), Duck Creek Power Station, GMF Pond," January 18, 2017.

[10] J. Knutelski and J. Campbell, "Annual CCR Surface Impoundment Inspection Report (per 40 CFR 257.83(b)(2)), Duck Creek Power Station, GMF Pond," February 7, 2018.

[11] J. Knutelski, "Annual Inspection by a Qualified Professional Engineer, 40 CFR §2357.83(b), Duck Creek Power Station, GMF Pond," January 10, 2019.

[12] J. Knutelski, "Annual Inspection by a Qualified Professional Engineer, 40 CFR §257.83(b), Duck Creek Power Station, GMF Pond," January 8, 2020.

[13] J. Knutelski, "Annual Inspection by a Qualified Professional Engineer, 40 CFR §257.83(b), Duck Creek Power Station, GMF Pond," January 6, 2021.

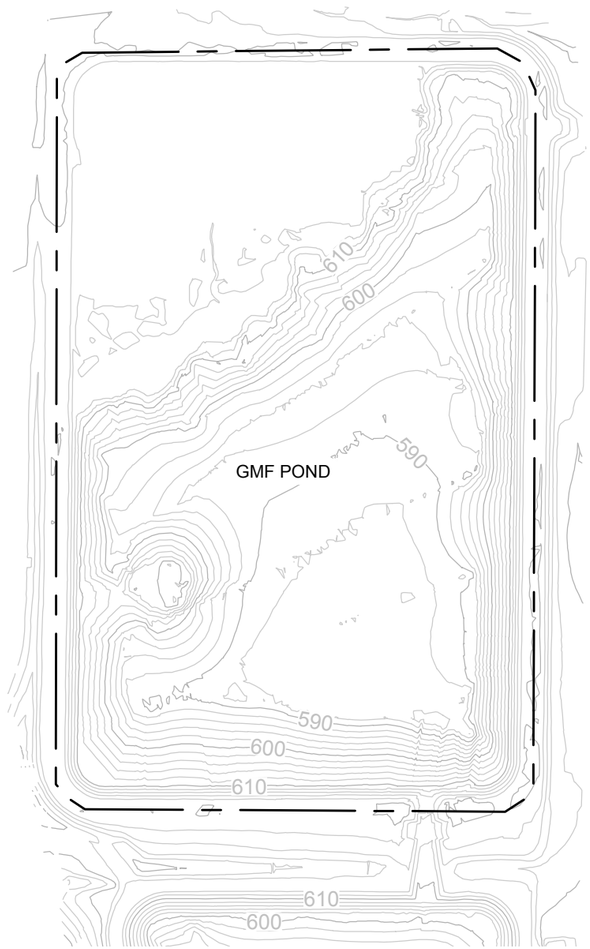
[14] Weaver Consultants Group, "Dynegy, Collinsville, Illinois, 2015 - Duck Creek Existing Topography," December 1, 2015.

[15] IngenAE, "Luminant, Illinois Power Resrouces Generating, LLC, Duck Creek Power Station, December 2020 Topography," February 9, 2021.

[16] AECOM, "Initial Site Visit CCR Unit Summary, Dynegy CCR Compliance Program - Duck Creek, Duck Creek GMF Primary Pond," June 23, 2015.

[17] Stantec Consulting Services Inc., "Duck Creek Power Station, Emergency Action Plan (EAP)," April 13, 2017.

DRAWINGS



INITIAL SURVEY
12-01-2015 TOPOGRAPHY

PERIODIC SURVEY
02-09-2021 TOPOGRAPHY

0 300
SCALE IN FEET

NOTES:

1. THE INITIAL SURVEY WAS TAKEN FROM THE DRAWING PACKAGE TITLED “DYNEGY, COLLINSVILLE, ILLINOIS, 2015 - DUCK CREEK EXISTING TOPOGRAPHY”, PREPARED BY WEAVER CONSULTANTS GROUP, DATED DECEMBER 1, 2015.
2. THE PERIODIC SURVEY WAS TAKEN FROM THE DRAWING PACKAGE TITLED “LUMINANT, ILLINOIS POWER RESOURCES GENERATING, LLC, DUCK CREEK POWER STATION, DECEMBER 2020 TOPOGRAPHY”, PREPARED BY INGENAE, DATED FEBRUARY 9, 2021.
3. ALL SURVEY DATA WAS COLLECTED IN THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88) AND NORTH AMERICAN DATUM OF 1983 (NAD83) FOR VERTICAL AND HORIZONTAL COORDINATES, RESPECTIVELY.

INITIAL TO PERIODIC SURVEY COMPARISON
GMF POND
DUCK CREEK POWER STATION
CANTON, ILLINOIS

Geosyntec consultants

DRAWING 1

GLP8027.03 | MAY 2021

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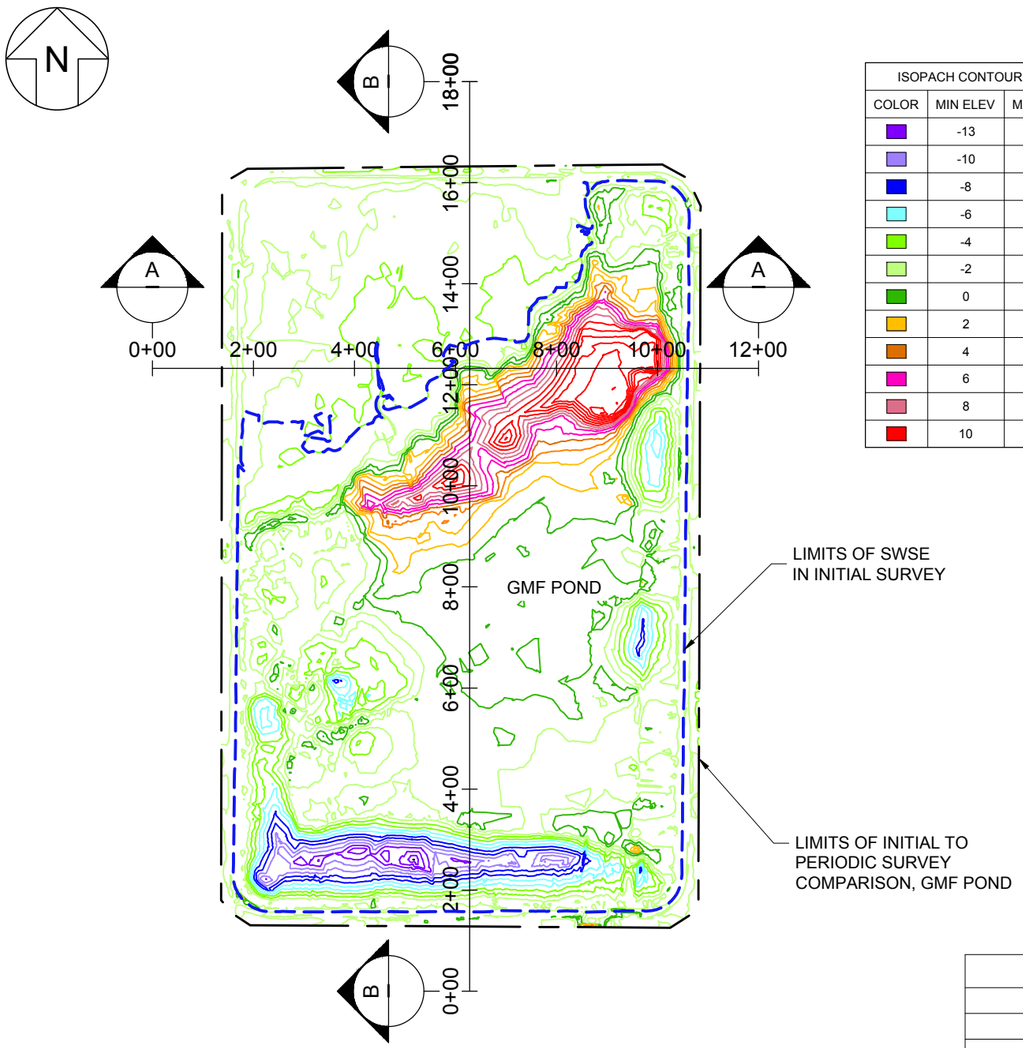

ISOPACH CONTOUR KEY		
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	-8	-6
	-6	-4
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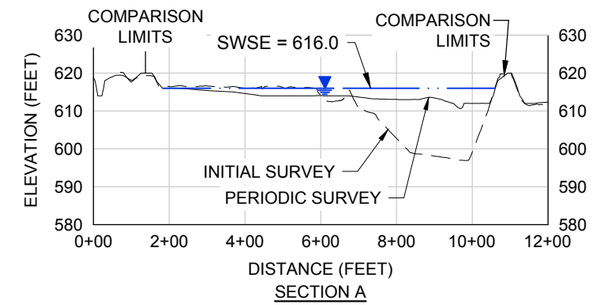
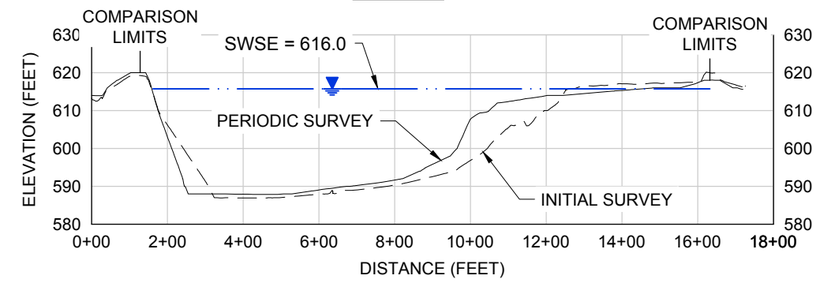
	8	10
	10	17



SECTION A



SECTION B

0 40
VERT: SCALE IN FEET

0 400
HORZ: SCALE IN FEET

INITIAL TO PERIODIC SURVEY COMPARISON SUMMARY			
SURFACE IMPOUNDMENT	CUT*	FILL*	NET (CU. YD.)*
GMF POND	54,000	62,000	8,000 (FILL)
ABOVE SWSE	10,000	1,000	9,000 (CUT)
BELOW SWSE	44,000	61,000	17,000 (FILL)

* ALL VOLUMES ROUNDED TO THE NEAREST 1,000 CY

NOTES:

1. THE INITIAL SURVEY WAS TAKEN FROM THE DRAWING PACKAGE TITLED “DYNEGY, COLLINSVILLE, ILLINOIS, 2015 - DUCK CREEK EXISTING TOPOGRAPHY”, PREPARED BY WEAVER CONSULTANTS GROUP, DATED DECEMBER 1, 2015.
2. THE PERIODIC SURVEY WAS TAKEN FROM THE DRAWING PACKAGE TITLED “LUMINANT, ILLINOIS POWER RESOURCES GENERATING, LLC, DUCK CREEK POWER STATION, DECEMBER 2020 TOPOGRAPHY”, PREPARED BY INGENAE, DATED FEBRUARY 9, 2021.
3. ALL SURVEY DATA WAS COLLECTED IN THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88) AND NORTH AMERICAN DATUM OF 1983 (NAD83) FOR VERTICAL AND HORIZONTAL COORDINATES, RESPECTIVELY.
4. THE STARTING WATER SURFACE ELEVATION (SWSE) OF THE GMF POND IS EL. 616.0 FT, AS NOTED IN THE REPORT TITLED “CCR CERTIFICATION REPORT: INITIAL STRUCTURAL STABILITY ASSESSMENT, INITIAL SAFETY FACTOR ASSESSMENT, AND INITIAL INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN FOR GMF POND AT DUCK CREEK POWER STATION”, PREPARED BY AECOM, DATED OCTOBER, 2016.

0 300
SCALE IN FEET

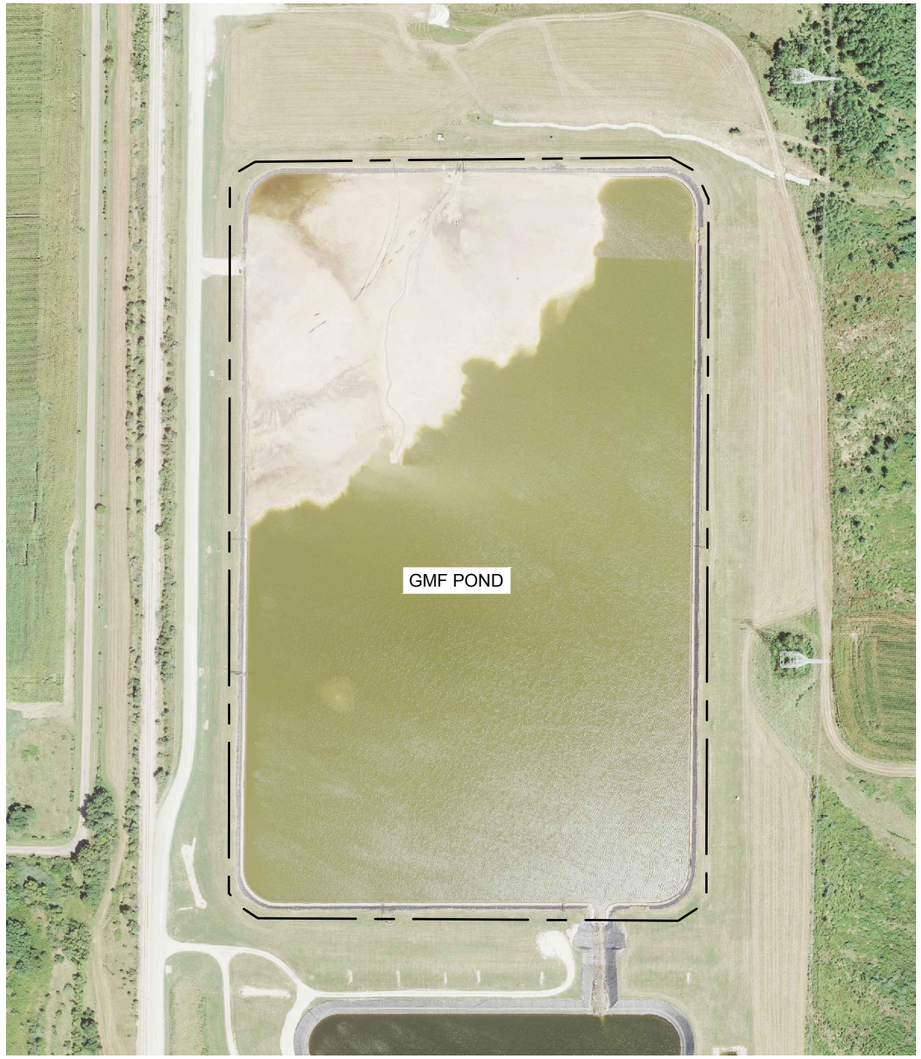
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

Geosyntec consultants

DRAWING 2

GLP8027.03 | AUGUST 2021

P:\CADD\PROJECTS\VVISTRA PONDS\DUCK CREEK\FIGURES\ISOPACH-1 - Last Saved by: KHanavec on 8/3/21



INITIAL AERIAL
12-01-2015 IMAGERY

PERIODIC AERIAL
02-09-2021 IMAGERY

0 300
SCALE IN FEET

NOTES:

1. THE INITIAL IMAGERY WAS TAKEN FROM THE DRAWING PACKAGE TITLED “DYNEGY, COLLINSVILLE, ILLINOIS, 2015 - DUCK CREEK EXISTING TOPOGRAPHY”, PREPARED BY WEAVER CONSULTANTS GROUP, DATED DECEMBER 1, 2015.
2. THE PERIODIC IMAGERY WAS TAKEN FROM THE DRAWING PACKAGE TITLED “LUMINANT, ILLINOIS POWER RESOURCES GENERATING, LLC, DUCK CREEK POWER STATION, DECEMBER 2020 TOPOGRAPHY”, PREPARED BY INGENAE, DATED FEBRUARY 9, 2021.

INITIAL TO PERIODIC AERIAL IMAGERY
COMPARISON
GMF POND
DUCK CREEK POWER STATION
CANTON, ILLINOIS

Geosyntec consultants

GLP8027.03 | MAY 2021

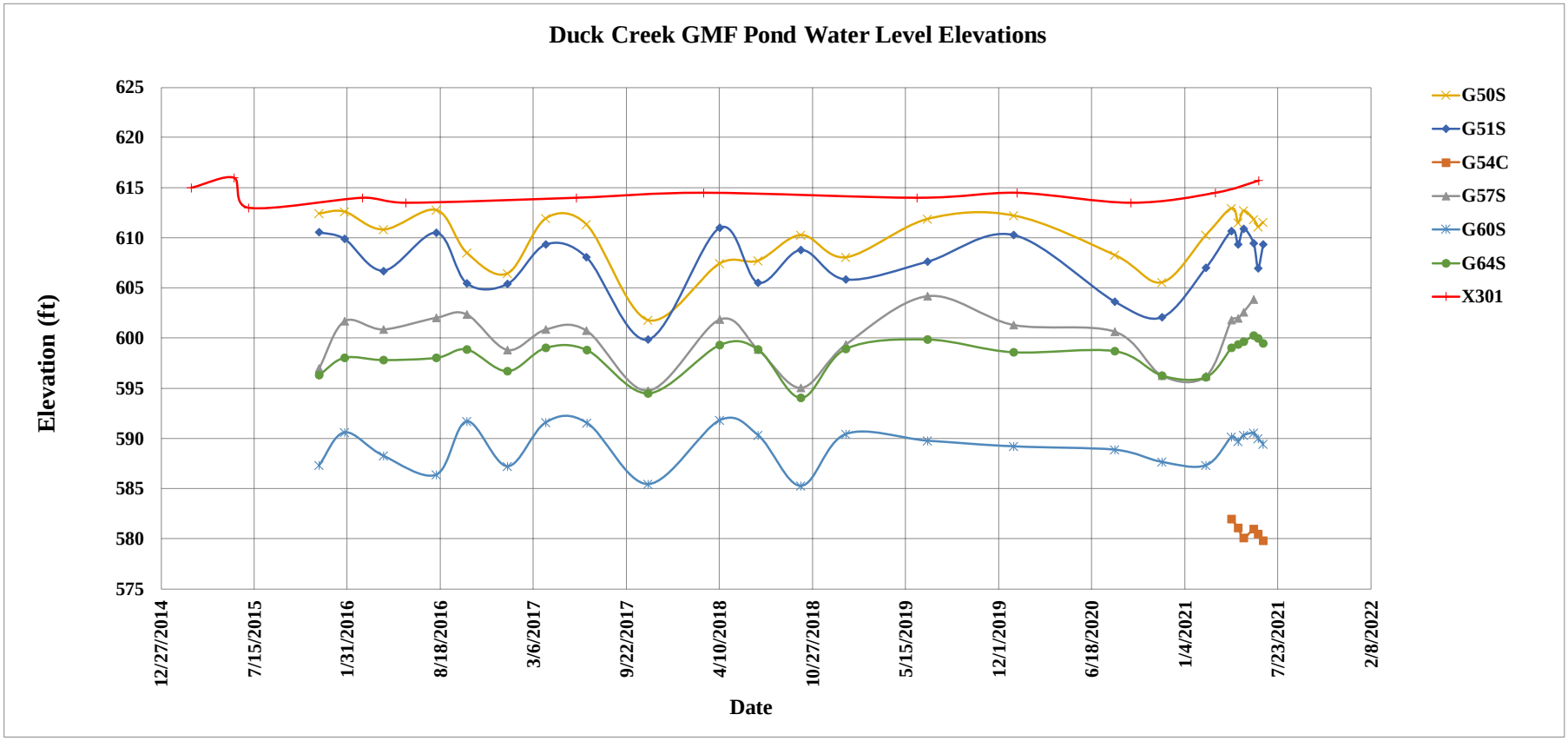
DRAWING
3

P:\CADD\PROJECTS\VISTRA PONDS\DUCK CREEK\FIGURES\GLP802703F02 - Last Saved by: KHanavec on 5/24/21

ATTACHMENTS

Attachment A

GMF Pond Piezometer Data Plots



NOTES:
1. Piezometeric data was taken from the spreadsheet titled "DC_GW_Elev_Export_Vistra_20210722", provided by the Duck Creek Power Plant.

PIEZOMETER DATA PERIODIC CERTIFICATION DUCK CREEK POWER PLANT- GMF POND FULTON, ILLINOIS		
Geosyntec consultants		Figure 1
GLP8027	7/23/2021	

Attachment B

GMF Pond Site Visit Photolog

GEOSYNTEC CONSULTANTS
Photographic Record

Geosyntec consultants

Site Owner: Illinois Power Resources Generating **Project Number:** GLP8027

CCR Unit: GMF Pond (GMFP) **Site:** Duck Creek Power Plant

Photo: 01

Date: 05/27/2021

Direction Facing: SE

Comments: GMFP north overview

Photo: 02

Date: 05/27/2021

Direction Facing: S

Comments: GMFP north overview

GEOSYNTEC CONSULTANTS
Photographic Record

Geosyntec consultants

Site Owner: Illinois Power Resources Generating **Project Number:** GLP8027

CCR Unit: GMF Pond (GMFP) **Site:** Duck Creek Power Plant

Photo: 03

Date: 05/27/2021

Direction Facing: E

Comments: GMFP north interior slope and crest.

Photo: 04

Date: 05/27/2021

Direction Facing: E

Comments: GMFP north exterior slope and crest.

GEOSYNTEC CONSULTANTS
Photographic Record

Geosyntec consultants

Site Owner: Illinois Power Resources Generating **Project Number:** GLP8027

CCR Unit: GMF Pond (GMFP) **Site:** Duck Creek Power Plant

Photo: 05

Date: 05/27/2021

Direction Facing: S

Comments: GMFP east exterior slope and crest.

Photo: 06

Date: 05/27/2021

Direction Facing: N

Comments: GMFP east exterior slope and crest.

GEOSYNTEC CONSULTANTS
Photographic Record

Geosyntec consultants

Site Owner: Illinois Power Resources Generating **Project Number:** GLP8027

CCR Unit: GMF Pond (GMFP) **Site:** Duck Creek Power Plant

Photo: 07

Date: 05/27/2021

Direction Facing: S

Comments: GMFP east interior slope and crest.

Photo: 08

Date: 05/27/2021

Direction Facing: S

Comments: GMFP east slope crest.

GEOSYNTEC CONSULTANTS
Photographic Record

Geosyntec consultants

Site Owner: Illinois Power Resources Generating **Project Number:** GLP8027

CCR Unit: GMF Pond (GMFP) **Site:** Duck Creek Power Plant

Photo: 09

Date: 05/27/2021

Direction Facing: W

Comments: GMFP south crest and transfer channel.

Photo: 10

Date: 05/27/2021

Direction Facing: W

Comments: GMFP transfer channel and weir. All stoplogs were installed.

GEOSYNTEC CONSULTANTS
Photographic Record

Geosyntec consultants

Site Owner: Illinois Power Resources Generating **Project Number:** GLP8027

CCR Unit: GMF Pond (GMFP) **Site:** Duck Creek Power Plant

Photo: 11

Date: 05/27/2021

Direction Facing: W

Comments: GMFP south dike interior slope.

Photo: 12

Date: 05/27/2021

Direction Facing: NW

Comments: GMFP southwest corner overview.

GEOSYNTEC CONSULTANTS
Photographic Record

Geosyntec consultants

Site Owner: Illinois Power Resources Generating **Project Number:** GLP8027

CCR Unit: GMF Pond (GMFP) **Site:** Duck Creek Power Plant

Photo: 13

Date: 05/27/2021

Direction Facing: W

Comments: GMFP southwest corner exterior dike overview.

Photo: 14

Date: 05/27/2021

Direction Facing: N

Comments: GMFP west dike overview.

GEOSYNTEC CONSULTANTS
Photographic Record

Geosyntec consultants

Site Owner: Illinois Power Resources Generating **Project Number:** GLP8027

CCR Unit: GMF Pond (GMFP) **Site:** Duck Creek Power Plant

Photo: 15

Date: 05/27/2021

Direction Facing: N

Comments: GMFP west interior dike overview.

Photo: 16

Date: 05/27/2021

Direction Facing: N

Comments: GMFP west exterior dike overview.

GEOSYNTEC CONSULTANTS
Photographic Record

Geosyntec consultants

Site Owner: Illinois Power Resources Generating **Project Number:** GLP8027

CCR Unit: GMF Pond (GMFP) **Site:** Duck Creek Power Plant

Photo: 17

Date: 05/27/2021

Direction Facing: N

Comments: GFMP west interior dike overview.

Photo: 18

Date: 05/27/2021

Direction Facing: N

Comments: GMFP west exterior dike overview.

GEOSYNTEC CONSULTANTS
Photographic Record

Geosyntec consultants

Site Owner: Illinois Power Resources Generating **Project Number:** GLP8027

CCR Unit: GMF Pond (GMFP) **Site:** Duck Creek Power Plant

Photo: 19

Date: 05/27/2021

Direction Facing: E

Comments: GMFP northwest corner overview.

Photo: 20

Date: 05/27/2021

Direction Facing: S

Comments: GMFP west dike overview.

Attachment C

Periodic History of Construction Report Update Letter

Geosyntec consultants

1 McBride and Son Center Drive, Suite 202
Chesterfield, MO 63005
PH 636-812-0800
www.geosyntec.com

October 11, 2021

Illinois Power Resources Generating, LLC
17751 North Cilco Road
Canton, Illinois 61520

Subject: Periodic History of Construction Report Update Letter
USEPA Final CCR Rule, 40 CFR §257.73(c)
Duck Creek Power Plant
Canton, Illinois

At the request of Illinois Power Resources Generating, LLC (IPRG), Geosyntec Consultants (Geosyntec) has prepared this Letter to documents updates to the Initial History of Construction (HoC) report for the Duck Creek Power Plant (DCPP), also known as the Duck Creek Power Station (DUC). The Initial HoC report was prepared by AECOM in October of 2016 [1] in accordance with 40 Code of Federal Regulations (CFR) §257.73(c) of the United States Environmental Protection Agency (USEPA) Coal Combustion Residuals Rule, known as the CCR Rule [2]. This letter also includes information required by Section 845.220(a)(1)(B) (Design and Construction Plans) of the state-specific Illinois Environmental Protection Agency (IEPA) Part 845 CCR Rule [3] that is not expressly required by §257.73(c).

BACKGROUND

The CCR Rule required that, by October 17, 2016, Initial HoC reports to be compiled for existing CCR surface impoundments with: (1) a height of five feet or more and a storage volume of 20 acre-feet or more, or (2) a height of 20 feet or more. The Initial HoC report was required to contain, to the extent feasible, the information specified in 40 CFR §257.73(c)(1)(i)-(xii). The Initial HoC report for DCPP, which included three existing CCR surface impoundments, the GMF Pond (GMFP), Ash Pond No. 1 (AP1), and Ash Pond No. 2 (AP2), was prepared and subsequently posted to IPRG's CCR Website prior to October 17, 2016.

The CCR Rule requires that Initial HoC to be updated if there is a significant change to any information complied in the Initial HoC report, as listed below:

§ 257.73(c)(2): If there is a significant change to any information complied under paragraph (c)(1) of this section, the owner or operator of the CCR unit must update the relevant information and place it in the facility's operating record as required by § 257.105(f)(9).

IPRG retained Geosyntec to review the Initial HoC report, review reasonably and readily available information for the GMFP, AP1, and AP2 generated since the Initial HoC report was prepared, and perform a site visit to DCPP to evaluate if significant changes may have occurred since the Initial HoC report was prepared.

This Letter contains the results of Geosyntec's evaluation and documents significant changes that have occurred at the GMFP, AP1, and AP2 at DCPP, as they pertain the requirements of §257.73(c)(1)(i)-(xii)

UPDATES TO HISTORY OF CONSTRUCTION REPORT

Geosyntec's evaluation for the DCPP GMFP, AP1, and AP2 determined that no known significant changes requiring updates to the information in the Initial HoC report pertaining to §257.73(c)(1)(i)-(ii), §257.73(c)(1)(iv)-(vii), §257.73(c)(1)(ix), and §257.73(c)(1)(xi)-(xii) of the CCR Rule had occurred since the Initial HoC report was developed.

However, Geosyntec's evaluation determined that significant changes at the DCPP GMFP, AP1, and AP2 pertaining to §257.73(c)(1)(iii), §257.73(c)(1)(viii), §257.73(c)(1)(x) of the CCR Rule had occurred since the Initial HoC report had been developed. Additionally, information how long the CCR surface impoundments have been operating and the types of CCR in the surface impoundments, as required by Section 845.220(a)(1)(B) of the Part 845 Rule were not included in the Initial HoC report, as this information is not required by the CCR Rule. Each change and the subsequent updates to the Initial HoC report is described within this section.

Section 845.220(a)(1)(B): A statement of … how long the CCR surface impoundment has been in operation, and the types of CCR that have been placed in the surface impoundment.

GMF Pond

GMFP is in operation since 2009. As of the date of this report, the GMFP has been present for approximately 12 years.

CCR placed in the GMFP is being used to store and dispose of gypsum and to clarify recycled process water for plant operations [4].

Ash Pond No. 1

AP1 was in operation from 1976 until November 2015, for a total of approximately 39 years.

CCR placed in AP1 was used to store and dispose of fly ash and bottom ash [4].

Ash Pond No. 2

AP2 was in operation from 1986 until November 2015, for a total of approximately 35 years.

CCR placed in AP2 was used to store and dispose of fly ash and bottom ash and to clarify CCR contact stormwater prior to discharge.

§257.73(c)(1)(i): The name and address of the person(s) owning or operating the CCR unit; the name associated with the CCR unit; and the identification number of the CCR unit if one has been assigned by the state.

The state identification numbers (ID) for the GMFP, AP1 and AP2 have been assigned by the Illinois Environmental Protection Agency (IEPA). The IDs are listed in **Table 1**.

Table 1 – IEPA ID Numbers

CCR Surface Impoundment		State ID
Ash Pond No. 1		W0578010001-01
Ash Pond No. 2		W0578010001-02
GMF Pond		W0578010001-04

§ 257.73(c)(1)(iii): A statement of the purpose for which the CCR unit is being used.

AP1 and AP2 were closed in 2021, in substantial compliance with the written closure plans posted to IPRG's CCR Website ([5], [6]), and as documented by a certified Notification of Completion of Closure posted to IPRG's CCR Website [7]. Therefore, AP1 and AP2 are no longer capable of storing CCR or free liquids.

The DCPP was retired in December of 2019, with the generation of electricity ceased at that time. Therefore, the GMFP is no longer being used to storge and disposed of gypsum or to clarify recycled process water for use in plant operations, as gypsum is no longer being generated and process water is no longer required by the DCPP.

§ 257.73(c)(1)(viii): A description of the type, purpose, and location of existing instrumentation.

Instrumentation monitoring at AP1 and AP2 is no longer required as both CCR surface impoundments were closed in accordance with §257.102 [7], and the instrumentation

network was modified at that time. Therefore, the instrumentation locations shown in Appendix C of the Initial HoC report are no longer applicable to AP1 and AP2.

§ 257.73(c)(1)(x): A description of each spillway and diversion design features and capacities and calculations used in their determination.

AP1 and AP2 no longer retain free water as both CCR surface impoundments were closed in 2021 [7]. Therefore, spillways are no longer present the information regarding the spillways of these structures, as presented in the Initial HoC report, is no longer applicable to AP1 and AP2.

CLOSING

This letter has been prepared to document Geosyntec's evaluation of changes that have occurred at the GMFP, AP1, and AP2 at the DCPP since the Initial HoC was developed, based on reasonably and readily available information provided by IPRG, observed by Geosyntec during the site visit, or generated by Geosyntec as part of subsequent calculations.

Sincerely,

Lucas P. Carr, P.E.
Senior Engineer

John Seymour, P.E.
Senior Principal

REFERENCES

[1] AECOM, "History of Construction, USEPA Final CCR Rule, 40 CFR § 257.73(c), Duck Creek Power Station, Canton, Illinois," October 2016.

[2] United Stated Environmental Protection Agency, "40 CFR Parts 257 and 261, Hazardous and Solid Waste Management System, Disposal of Coal Combustion Residuals from Electric Utilities, Final Rule, 2015," 2015.

[3] Illinois Environmental Protection Agency, "35 Ill. Adm. Code Part 845, Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments," Springfield, IL, 2021.

[4] AECOM, "History of Construction, USEPA Final CCR Rule, 40 CFR § 257.73(c), Hennepin Power Station, Hennepin, Illinois," October 2016.

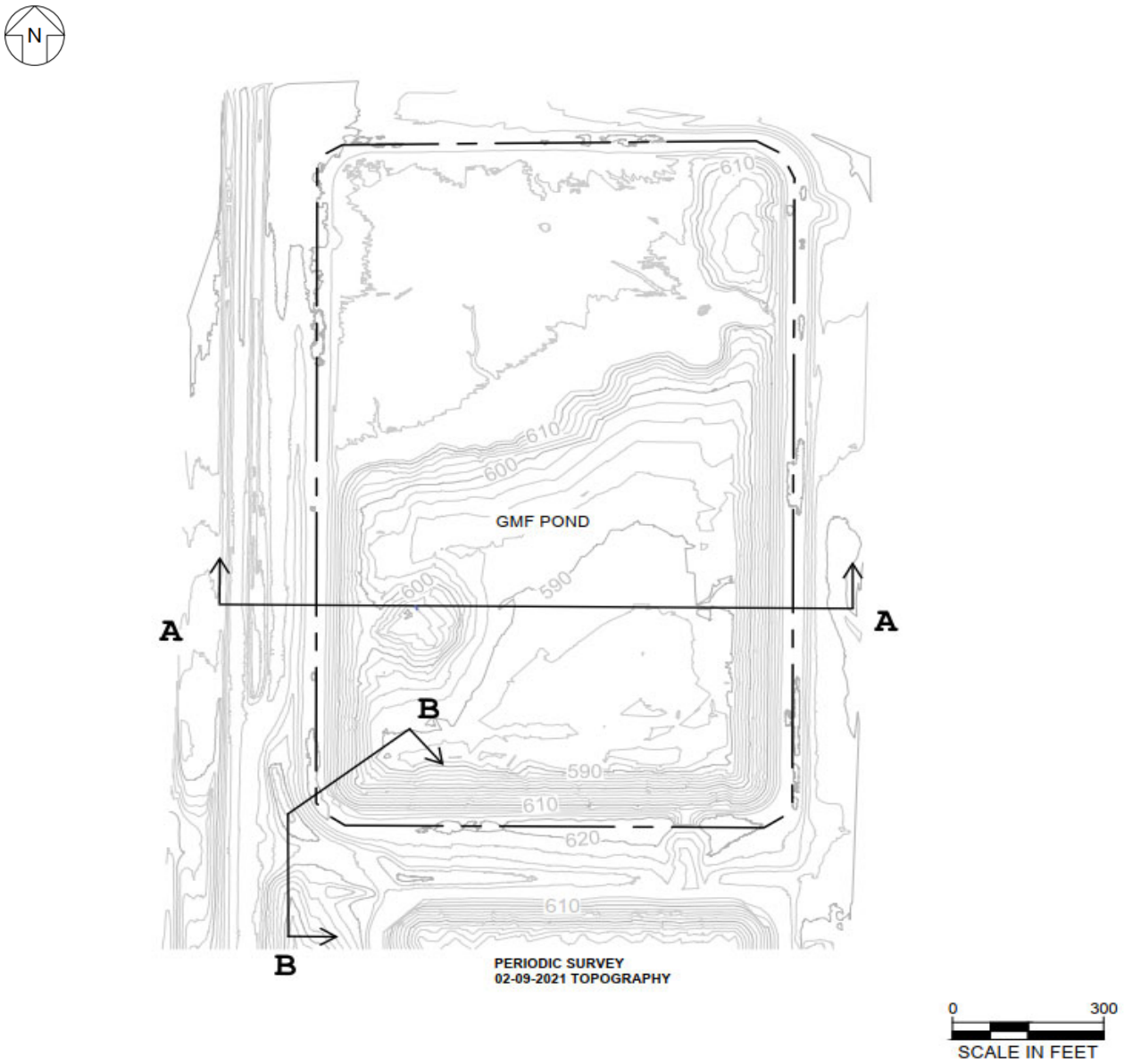
[5] V. Modeer, "Closure Plan for Existing CCR Sruface Impoundment, 40 CFR 257.102(b), Duck Creek Power Station, Illinois Power Resoruces Generation, LLC, Ash Pond No. 1," December 17, 2020.

[6] V. Modeer, "Closure Plan for Existing CCR Surface Impoundment, 40 CFR 257.102(b), Duck Creek Power Station, Illinois Power Resoruces Generating, LLC, Ash Pond No. 2," December 17, 2020.

[7] D. Tickner, "Duck Creek Power Station; Ash Pond No.1 and No. 2, Notificaiton of Completion of Closure," Luminant, Collinsville, Illinois, January 22, 2021.

Attachment D

Periodic Structural Stability and Safety Factor Assessment Analyses



NOTES:

1. The cross-sections are shown on the periodic topography of GMF Pond, prepared by IngenAE, dated February 9, 2021.
2. A-A is the cross-section used in the 2016 AECOM initial SFA & SSA and cross-section B-B is the 2021 Geosyntec updated periodic SFA.

CROSS-SECTION LOCATIONS
PERIODIC CERTIFICATION
DUCK CREEK POWER PLANT- GMF POND
FULTON, ILLINOIS

Geosyntec consultants

Figure D-1

GLP8027 | 8/25/2021

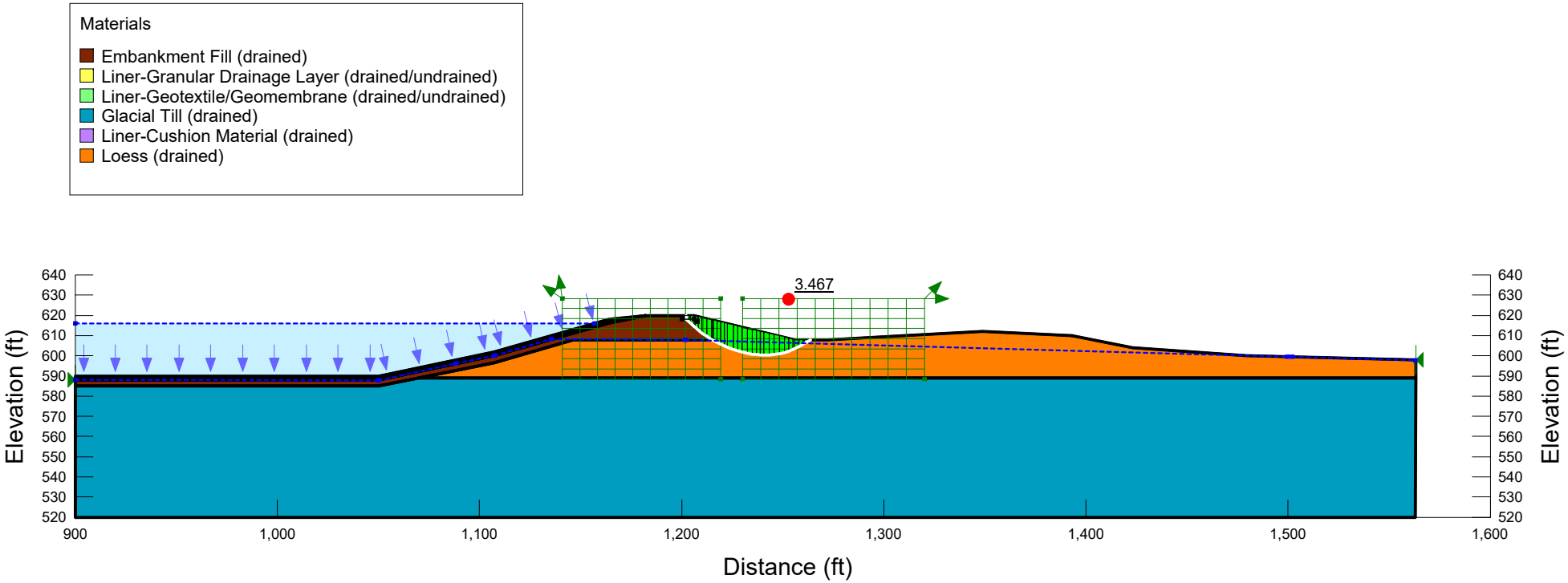
\\STLOUISMO-01\Data\Company\Projects_post_2014\GLP8027_CCR_ReCert\500_Technical\503_DUC\503d_Periodic_Report\GMF\Revised SFA\New Section_2021\[DUC_GMF_New Section_20210824.xlsx]Plot1[2]

Dynegy CCR Program - Duck Creek Power Plant
GMF Pond Section B-B
Canton, Illinois

Drawn by: PK Date: 8/25/2021
Checked by: LPC Date: 8/25/2021

Name: Static, Long-Term, Block Failure Surface

Name: Embankment Fill (drained) Unit Weight: 116 pcf Cohesion': 150 psf Phi': 32 °
Name: Liner-Granular Drainage Layer (drained/undrained) Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 °
Name: Liner-Geotextile/Geomembrane (drained/undrained) Unit Weight: 75 pcf Cohesion': 100 psf Phi': 25 °
Name: Glacial Till (drained) Unit Weight: 125 pcf Cohesion': 200 psf Phi': 30 °
Name: Liner-Cushion Material (drained) Unit Weight: 116 pcf Cohesion': 0 psf Phi': 38 °
Name: Loess (drained) Unit Weight: 116 pcf Cohesion': 100 psf Phi': 32 °



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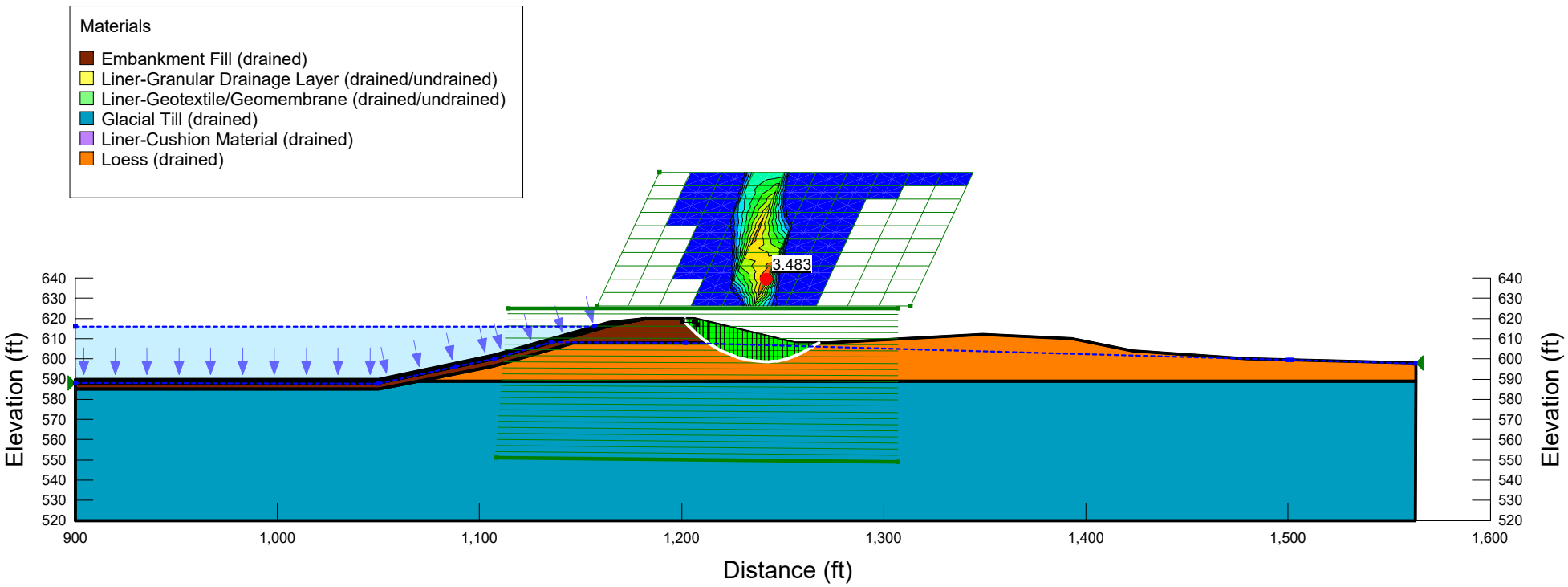
Dynegy CCR Program - Duck Creek Power Plant
GMF Pond Section B-B
Canton, Illinois

Drawn by: PK Date: 8/25/2021
Checked by: LPC Date: 8/25/2021

Name: Static, Long-Term, Circular Failure Surface

Name: Embankment Fill (drained) Unit Weight: 116 pcf Cohesion': 150 psf Phi': 32 °
Name: Liner-Granular Drainage Layer (drained/undrained) Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 °
Name: Liner-Geotextile/Geomembrane (drained/undrained) Unit Weight: 75 pcf Cohesion': 100 psf Phi': 25 °
Name: Glacial Till (drained) Unit Weight: 125 pcf Cohesion': 200 psf Phi': 30 °
Name: Liner-Cushion Material (drained) Unit Weight: 116 pcf Cohesion': 0 psf Phi': 38 °
Name: Loess (drained) Unit Weight: 116 pcf Cohesion': 100 psf Phi': 32 °



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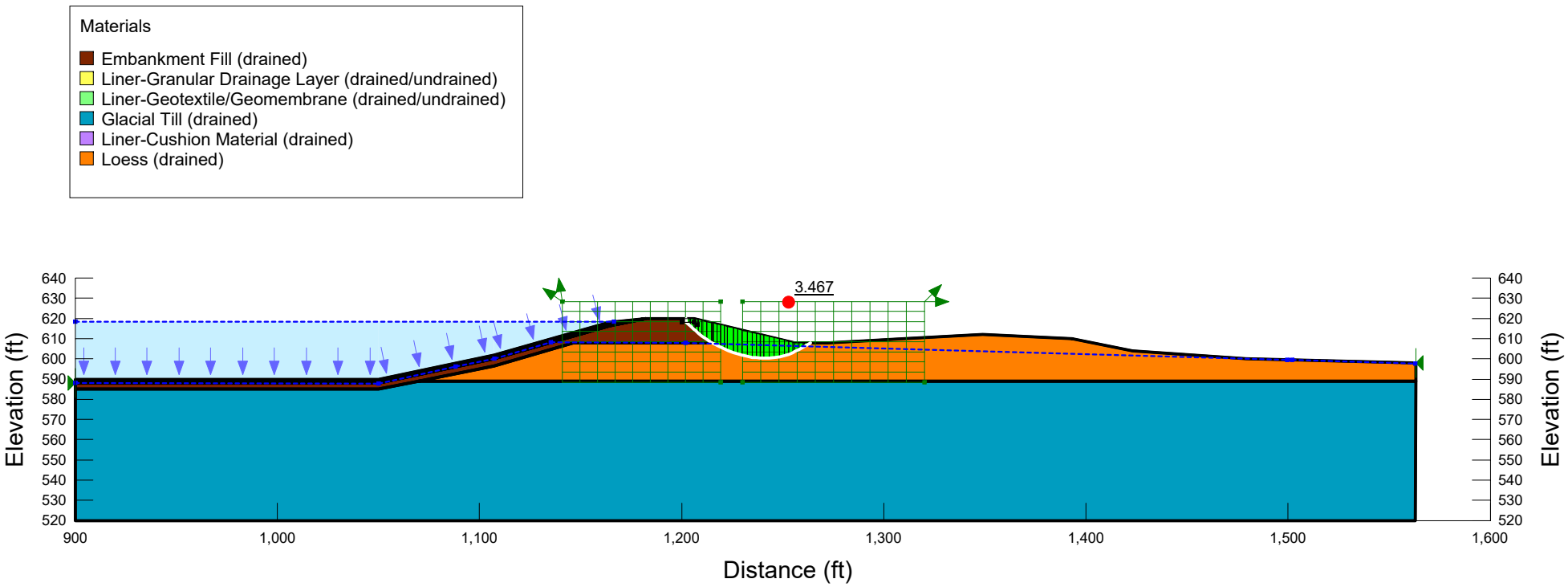
Dynegy CCR Program - Duck Creek Power Plant
GMF Pond Section B-B
Canton, Illinois

Drawn by: PK Date: 8/25/2021
Checked by: LPC Date: 8/25/2021

Name: Static, Surchage Pool, Block Failure Surface

Name: Embankment Fill (drained) Unit Weight: 116 pcf Cohesion': 150 psf Phi': 32 °
Name: Liner-Granular Drainage Layer (drained/undrained) Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 °
Name: Liner-Geotextile/Geomembrane (drained/undrained) Unit Weight: 75 pcf Cohesion': 100 psf Phi': 25 °
Name: Glacial Till (drained) Unit Weight: 125 pcf Cohesion': 200 psf Phi': 30 °
Name: Liner-Cushion Material (drained) Unit Weight: 116 pcf Cohesion': 0 psf Phi': 38 °
Name: Loess (drained) Unit Weight: 116 pcf Cohesion': 100 psf Phi': 32 °



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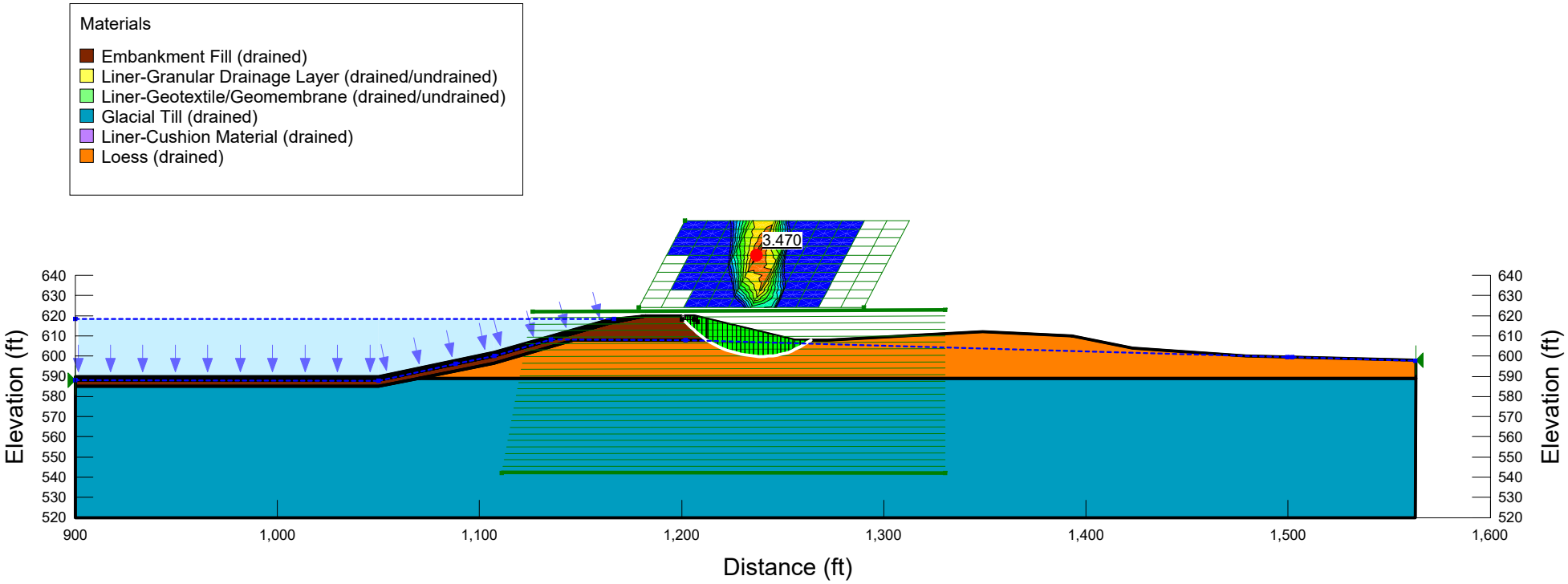
Dynegy CCR Program - Duck Creek Power Plant
GMF Pond Section B-B
Canton, Illinois

Drawn by: PK Date: 8/25/2021
Checked by: LPC Date: 8/25/2021

Name: Static, Surcharge Pool, Circular Failure Surface

Name: Embankment Fill (drained) Unit Weight: 116 pcf Cohesion': 150 psf Phi': 32 °
Name: Liner-Granular Drainage Layer (drained/undrained) Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 °
Name: Liner-Geotextile/Geomembrane (drained/undrained) Unit Weight: 75 pcf Cohesion': 100 psf Phi': 25 °
Name: Glacial Till (drained) Unit Weight: 125 pcf Cohesion': 200 psf Phi': 30 °
Name: Liner-Cushion Material (drained) Unit Weight: 116 pcf Cohesion': 0 psf Phi': 38 °
Name: Loess (drained) Unit Weight: 116 pcf Cohesion': 100 psf Phi': 32 °



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Dynegy CCR Program - Duck Creek Power Plant
GMF Pond Section B-B
Canton, Illinois

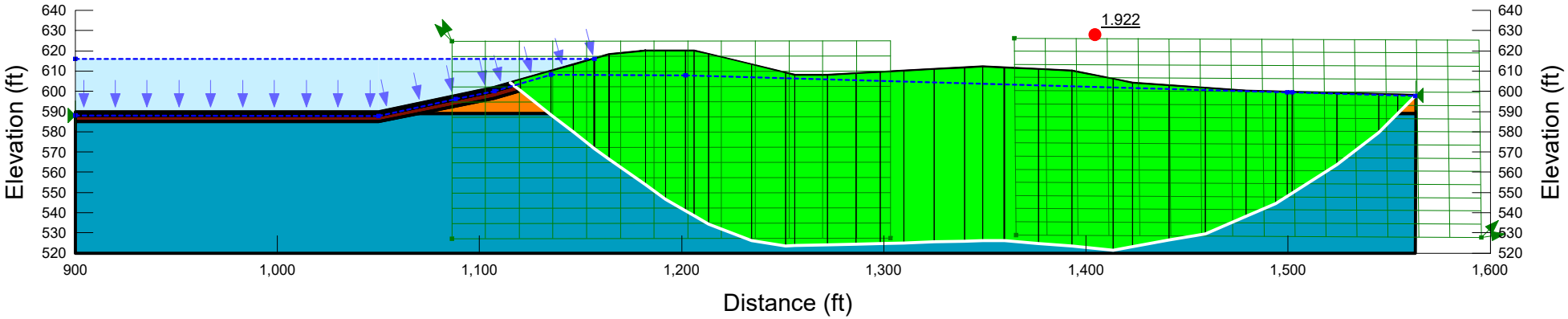
Drawn by: PK Date: 8/25/2021
Checked by: LPC Date: 8/25/2021

Name: Seismic, Block Failure Surface

Name: Liner-Granular Drainage Layer (drained/undrained) Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 °
Name: Liner-Geotextile/Geomembrane (drained/undrained) Unit Weight: 75 pcf Cohesion': 100 psf Phi': 25 °
Name: Liner-Cushion Material (undrained) Unit Weight: 116 pcf Cohesion': 660 psf Phi': 0 °
Name: Embankment Fill (undrained) Unit Weight: 116 pcf Cohesion': 2,150 psf Phi': 0 °
Name: Glacial Till (undrained) Unit Weight: 125 pcf Cohesion': 1,900 psf Phi': 0 °
Name: Loess (undrained) Unit Weight: 116 pcf Cohesion': 1,250 psf Phi': 0 °

Horz Seismic Coef.: 0.116 g

Materials
- Liner-Granular Drainage Layer (drained/undrained)
- Liner-Geotextile/Geomembrane (drained/undrained)
- Liner-Cushion Material (undrained)
- Embankment Fill (undrained)
- Glacial Till (undrained)
- Loess (undrained)



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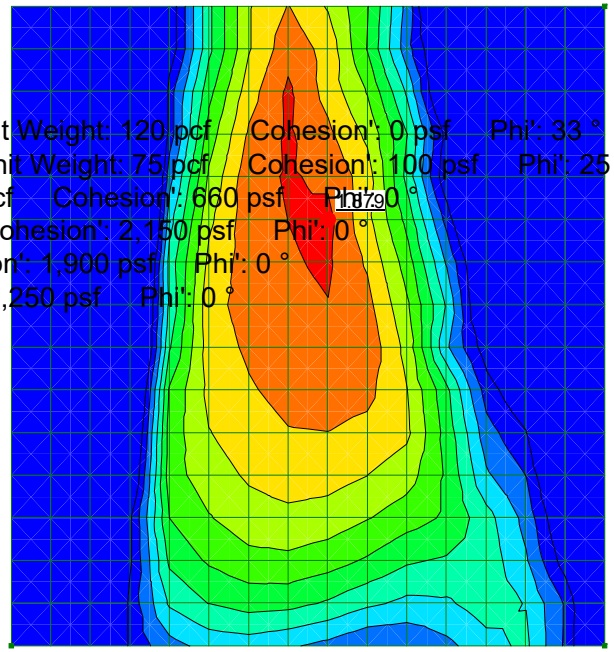
Dynegy CCR Program - Duck Creek Power Plant
GMF Pond Section B-B
Canton, Illinois

Drawn by: PK Date: 8/25/2021
Checked by: LPC Date: 8/25/2021

Name: Seismic, Circular Failure Surface

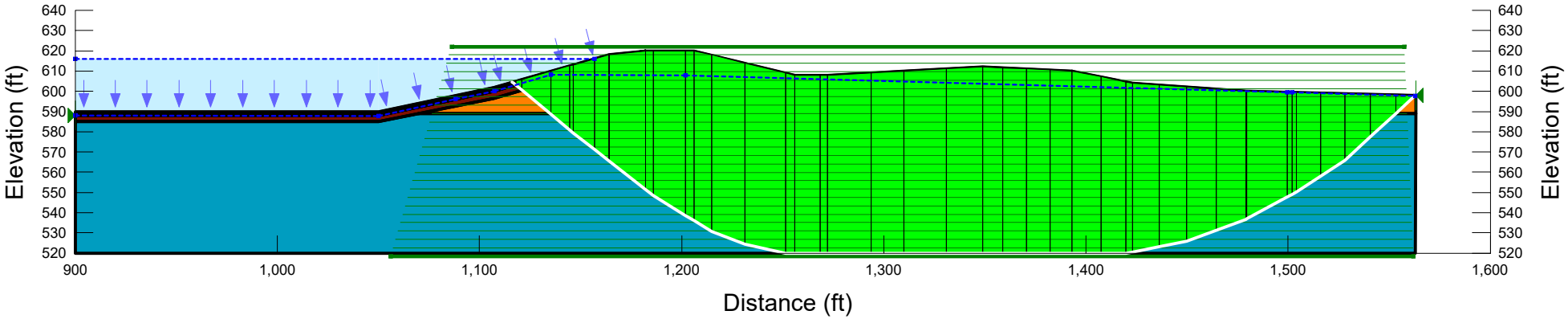
Name: Liner-Granular Drainage Layer (drained/undrained) Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 °
Name: Liner-Geotextile/Geomembrane (drained/undrained) Unit Weight: 75 pcf Cohesion': 100 psf Phi': 25 °
Name: Liner-Cushion Material (undrained) Unit Weight: 116 pcf Cohesion': 660 psf Phi': 0 °
Name: Embankment Fill (undrained) Unit Weight: 116 pcf Cohesion': 2,150 psf Phi': 0 °
Name: Glacial Till (undrained) Unit Weight: 125 pcf Cohesion': 1,900 psf Phi': 0 °
Name: Loess (undrained) Unit Weight: 116 pcf Cohesion': 1,250 psf Phi': 0 °

Horz Seismic Coef.: 0.116 g



Materials

- Liner-Granular Drainage Layer (drained/undrained)
- Liner-Geotextile/Geomembrane (drained/undrained)
- Liner-Cushion Material (undrained)
- Embankment Fill (undrained)
- Glacial Till (undrained)
- Loess (undrained)



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Dynegy CCR Program - Duck Creek Power Plant
GMF Pond Section B-B
Canton, Illinois

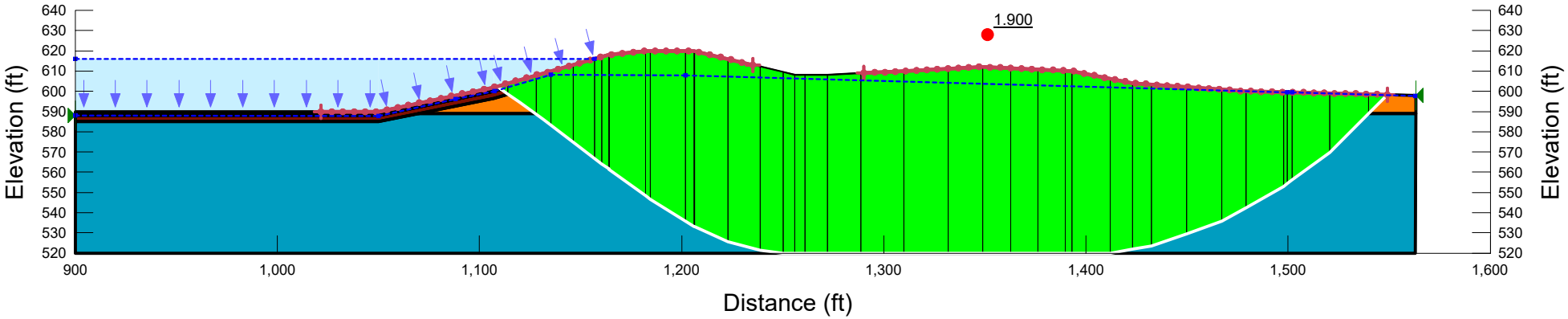
Drawn by: PK Date: 8/25/2021
Checked by: LPC Date: 8/25/2021

Name: Seismic, Entry-Exit Failure Surface

Name: Liner-Granular Drainage Layer (drained/undrained) Unit Weight: 120 pcf Cohesion': 0 psf Phi': 33 °
Name: Liner-Geotextile/Geomembrane (drained/undrained) Unit Weight: 75 pcf Cohesion': 100 psf Phi': 25 °
Name: Liner-Cushion Material (undrained) Unit Weight: 116 pcf Cohesion': 660 psf Phi': 0 °
Name: Embankment Fill (undrained) Unit Weight: 116 pcf Cohesion': 2,150 psf Phi': 0 °
Name: Glacial Till (undrained) Unit Weight: 125 pcf Cohesion': 1,900 psf Phi': 0 °
Name: Loess (undrained) Unit Weight: 116 pcf Cohesion': 1,250 psf Phi': 0 °

Horz Seismic Coef.: 0.116 g

Materials
- Liner-Granular Drainage Layer (drained/undrained)
- Liner-Geotextile/Geomembrane (drained/undrained)
- Liner-Cushion Material (undrained)
- Embankment Fill (undrained)
- Glacial Till (undrained)
- Loess (undrained)



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APPENDIX B

Narrative Description

GOLDER
MEMBER OF WSP

APPENDIX B

Narrative Description of the Gypsum Management Facility Pond

Duck Creek Power Plant

Submitted to:

Illinois Environmental Protection Agency

1021 North Grand Avenue East
P. O. Box 19276
Springfield, Illinois 62794-9276

Submitted by:

Illinois Power Resources Generating, LLC

1500 Eastport Plaza Drive
Collinsville, Illinois 62234

Prepared by:

Golder Associates USA Inc.
701 Emerson Road, Suite 250
Creve Coeur, Missouri 63141

21454861-7-R-0

January 25, 2022

Table of Contents

1.0 FACILITY INFORMATION 1

1.1 Coal Combustion Residuals Material Received 1

1.1.1 Chemical Analysis 1

1.2 Facility Capacity 1

1.3 Facility Operation 1

1.4 Transportation Plan 1

ATTACHMENTS

Figure 1
Transportation Plan

ATTACHMENT 1
Chemical Analysis

1.0 FACILITY INFORMATION

1.1 Coal Combustion Residuals Material Received

The Gypsum Management Facility (GMF) Pond is used to store gypsum (calcium sulfate), a byproduct of the wet scrubber system that was used for flue gas desulfurization at the Duck Creek Power Plant. The synthetic gypsum is generally of the same chemical makeup as natural gypsum.

1.1.1 Chemical Analysis

Available information regarding chemical analysis of the gypsum that is stored in the GMF Pond is provided in Attachment 1.

1.2 Facility Capacity

The GMF Pond capacity was estimated as 2,200,000 cubic yards in the closure plan prepared in 2016 for compliance with 40 CFR 257.102. However, the Duck Creek Power Plant was retired in December 2019, before the GMF Pond could be filled to its capacity. The amount of coal combustion residuals (CCR) currently contained in the GMF Pond was estimated by a volumetric analysis using Autodesk Civil 3D as approximately 400,000 cubic yards. No additional CCR will be placed in the GMF Pond.

1.3 Facility Operation

The GMF Pond is no longer receiving CCR or other waste streams. The GMF Pond received CCR from early 2009 until the Duck Creek Power Plant was retired in December 2019.

1.4 Transportation Plan

During operation, transport of CCR to the GMF Pond was by pipeline. Figure 1 shows the main route that is used for vehicle travel between the Duck Creek Power Plant and the GMF Pond. Figure 1 also shows the route that will be used to transport borrow materials from a soil stockpile to the GMF Pond for closure and to transport soils excavated during closure to the soil stockpile. These routes are all on site.

Signature Page

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https://golderassociates.sharepoint.com/sites/141778/project files/5 technical work/duck creek/gypsum and gypsum recycle ponds/permit application/final/app b narr descr/appb-gmf_narrative_description.docx

FIGURE 1

Transportation Plan

LEGEND

- ROUTE BETWEEN GYPSUM MANAGEMENT FACILITY POND AND ON-SITE LANDFILL OR BORROW AREA
- ROUTE BETWEEN DUCK CREEK POWER PLANT AND GYPSUM MANAGEMENT FACILITY POND

REFERENCE(S)

AERIAL IMAGERY OBTAINED FROM ESRI-PROVIDED BASEMAP SURVEY. IMAGERY COLLECTED 5/14/2017, 10/21/2017, AND 4/1/2019.

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC
DUCK CREEK POWER PLANT

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-24
DESIGNED	DVS
PREPARED	DVS
REVIEWED	JJS
APPROVED	JEO

PROJECT
GYPSUM MANAGEMENT FACILITY POND
PART 845 CONSTRUCTION PERMIT APPLICATION

TITLE
TRANSPORTATION PLAN

PROJECT NO.	REV.	FIGURE
21454861	A	1

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ATTACHMENT 1

Chemical Analysis

DYNEGY

Safety Data Sheet

Section 1
Identification of the Substance and of the Supplier

1.1 Product Identifier

Product Name/Identification:	FGD Gypsum
Synonyms:	Gypsum, calcium sulfate dihydrate, calcium sulphate dihydrate, gesso, alabaster, plaster of Paris.
Formula:	UVCB Substance

1.2 Relevant Identified Uses of the Substance or Mixture and Uses Advices Against

Relevant Identified Uses:	Component of wallboard, concrete, roofing material, bricks, cement kiln feed, agricultural amendment.
Uses Advised Against:	None known.

1.3 Details of the Supplier of the SDS

Manufacturer/Supplier:	Dynegy, Inc.
Street Address:	601 Travis Street, Suite 1400
City, State and Zip Code:	Houston, TX 77002
Customer Service Telephone:	800-633-4704

Section 2
Hazards Identification

2.1 Classification of the Substance

GHS Classification(s) according to OSHA Hazard Communication Standard (29 CFR 1910.1200):

- STOT-SE Category 3 (Respiratory Irritation)
- STOT-RE Category 1 (Lungs)
- Carcinogen Category 1A

2.2 Label Elements

Labelling according to 29 CFR 1910.1200 Appendices A, B and C*	
Hazard Pictogram(s):	
Signal word:	**DANGER**
Hazard Statement(s):	*May cause respiratory irritation.* *Causes damage to lungs after repeated/prolonged exposure via inhalation.* *May cause cancer of the lungs.*
Precautionary Statement(s):	*Obtain special instructions before use.* *Do not handle until all safety precautions have been read and understood.* *Do not breathe dust.* *Wash hands thoroughly after handling.* *Do not eat, drink or smoke when using this product.* *Wear protective gloves/protective clothing/eye protection/face protection.* *Do not eat drink or smoke when using this product.* *Use outdoors or in a well-ventilated area.* *If inhaled: Remove to fresh air and keep comfortable for breathing.* *Get medical advice/attention if you feel unwell.* *Store in a secure area.* *Dispose of product in accordance with local/national regulations.*

The following elements may be present in trace amounts as oxides: aluminum, calcium, iron, magnesium, nickel, phosphorus, potassium, silicon, sulfur, titanium, and vanadium. The exact composition of the gypsum will be dependent on the fuel source and flue additives composed of many constituents.

2.3 Other Hazards

Listed Carcinogens:

-Respirable Crystalline Silica

IARC: [Yes] **NTP:** [Yes] **OSHA:** [Yes] **Other:** **(ACGIH)** [Yes]

Section 3
Composition/Information on Ingredients

Substance	*CAS No.*	*Percentage (%)*	*GHS Classification*
Calcium sulfate, dihydrate	*10104-14-1*	*90 - 99%*	*STOT – Single Exposure Category 3 (Respiratory Irritation)*
Crystalline Silica	*14808-60-7*	*≥0.1 - 3%*	*STOT – Repeated Exposure Category 1 (Lung)* *Carcinogen, Category 1A*
Silica, crystalline respirable (RCS)	*14808-60-7*	*See Footnote 1*	*STOT – Repeated Exposure Category 1 (Lungs)* *Carcinogen Category 1A*
Fly Ash	*68131-74-8*	*<2%*	*STOT – Single Exposure Category 3 (Respiratory Irritation)*

Footnote 1: *The percentage of respirable crystalline silica has not been determined. Therefore, a GHS classification of Carcinogen, Category 1A has been assigned.*

Section 4
First Aid Measures

4.1 Description of First Aid Measures

Inhalation:	If product is inhaled and irritation of the nose or coughing occurs, remove person to fresh air. Get medical advice/attention if respiratory symptoms persist.
Skin Contact:	If skin exposure occurs, wash with soap and water.
Eye Contact:	If product gets into the eye, rinse copiously with water for several minutes. Remove contact lenses, if present and easy to do. Seek medical attention/advice if irritation occurs or persists.
Ingestion:	No specific first aid measures are required.

4.2 Most Important Health Effects, Both Acute and Delayed

Acute Effects: Short-term airborne exposure to FGD gypsum dust may cause respiratory irritation. Direct exposure can dry and irritate the skin and cause dermatitis or eye irritation through mechanical abrasion.

Chronic Effects: Chronic (long-term) exposure to FGD gypsum may cause lung damage from repeated exposure. Prolonged inhalation of dusts containing respirable crystalline silica above certain concentrations may cause lung disease (silicosis) and lung cancer.

4.3 Indication of Any Immediate Medical Attention and Special Treatment Needed

Seek first aid or call a doctor or Poison Control Center if contact with eyes occurs and irritation remains after rinsing. Get medical advice if inhalation occurs and respiratory symptoms persist.

Section 5
Firefighting Measures

5.1 Extinguishing Media

Suitable Extinguishing Media:	Product is not flammable. Use extinguishing media appropriate for surrounding fire.
Unsuitable Extinguishing Media:	Not applicable, the product is not flammable.

5.2 Special Hazards Arising from the Substance or Mixture

Hazardous Combustion Products:	Above 1450°C (~2600°F), gypsum decomposes to calcium oxide and sulfur dioxide.

5.3 Advice for Firefighters

Special Protective Equipment and Precautions for Firefighters:	As with any fire, wear self-contained breathing apparatus (NIOSH approved or equivalent) and full protective gear.

Section 6
Accidental Release Measures

6.1 Personal Precautions, Protective Equipment and Emergency Procedures

Personal precautions/Protective Equipment:	See Section 8.2.2 Individual Protective Measures. For concentrations exceeding Occupational Exposure Levels (OELs), use a self-contained breathing apparatus (SCBA).
Emergency procedures:	Use scooping, water spraying/flushing/misting or ventilated vacuum cleaning systems to clean up spills. Do not use pressurized air.

6.2 Environmental Precautions

Environmental precautions:	Prevent contamination of drains or waterways and dispose according to local and national regulations.

6.3 Methods and Material for Containment and Cleaning Up

Methods and materials for containment and cleaning up:	Do not use brooms or compressed air to clean surfaces. Use dust collection vacuum and extraction systems. Large spills of dry product should be removed by a vacuum system. Dampened material should be removed by mechanical means and recycled or disposed of according to local and national regulations.

See Sections 8 and 13 for additional information on exposure controls and disposal.

Section 7
Handling and Storage

7.1 Precautions for Safe Handling

Practice good housekeeping. Use adequate exhaust ventilation, dust collection and/or water mist to maintain airborne dust concentrations below permissible exposure limits (note: respirable crystalline silica dust may be in the air without a visible dust cloud).

Do not permit dust to collect on walls, floors, sills, ledges, machinery, or equipment. Maintain and test ventilation and dust collection equipment. In cases of insufficient ventilation, wear a NIOSH approved respirator for silica dust when handling or disposing dust from this product. Avoid contact with skin and eyes. Wash or vacuum clothing that has become dusty. Avoid eating, smoking, or drinking while handling the material.

7.2 Conditions for Safe Storage, Including any Incompatibilities

Minimize dust produced during loading and unloading.

Section 8
Exposure Controls/Personal Protection

8.1 Control Parameters

OCCUPATIONAL EXPOSURE LIMITS					
SUBSTANCE		**OSHA PEL TWA (mg/m^3)**	**NIOSH REL TWA (mg/m^3)**	**ACGIH TLV TWA (mg/m^3)**	**CA - OSHA PEL (mg/m^3)**
Particulates Not Otherwise Regulated	Total	15	15	10	10
	Respirable	5	5	3	5
Respirable Crystalline Silica	Total Respirable	0.05-	0.05	0.025	0.05
Calcium Sulfate, anhydrous (CAS# 7778-18-9)	Total Dust	*	10	10	*
	Respirable	*	5	-	*
Note: In the absence of a CA-PEL, the value for Particulates Not Otherwise Regulated (PNOR) is applied.					

8.2 Exposure Controls

8.2.1 Engineering Controls

Provide ventilation to maintain the ambient workplace atmosphere below the occupational exposure limit(s). Use general and local exhaust ventilation and dust collection systems as necessary to minimize exposure.

8.2.2 Personal Protective Equipment (PPE)

Respiratory protection:	Wear a NIOSH approved particulate respirator if exposure to airborne particulates is unavoidable and where occupational exposure limits may be exceeded. If airborne exposures are anticipated to exceed applicable PELs or TLVs, a self-contained breathing apparatus or airline respirator is recommended.
Eye and face protection:	If eye contact is possible, wear protective glasses with side shields. Avoid contact lenses.
Hand and skin protection:	Wear gloves and protective clothing. Wash hands with soap and water after contact with material.

Section 9
Physical and Chemical Properties

9.1 Information on Basic Physical and Chemical Properties

Property: Value	Property: Value
Appearance (physical state, color, etc.): White or gray cake-like material	**Upper/lower flammability or explosive limits:** Not applicable
Odor: Odorless	**Vapor Pressure (Pa):** Not applicable
Odor threshold: Not applicable	**Vapor Density:** Not applicable
pH (25 °C) (in water): 6 - 8	**Specific gravity or relative density:** 2.0 – 2.9
Melting point/freezing point (°C): 128	**Water Solubility:** 0.1 – 0.3%
Initial boiling point and boiling range (°C): >163	**Partition coefficient: n-octane/water:** Not determined
Flash point (°C): Not determined	**Auto ignition temperature (°C):** Not applicable
Evaporation rate: Not applicable	**Decomposition temperature (°C):** 1450
Flammability (solid, gas): Nonflammable/non-combustible	**Viscosity:** Not applicable

Section 10
Stability and Reactivity

10.1 Reactivity:	Avoid contact with strong acids or oxidizers and diazomethane.
10.2 Chemical stability:	The material is stable under normal use conditions.
10.3 Possibility of hazardous reactions:	The material is a relatively stable, inert material; polymerization will not occur.
10.4 Conditions to avoid:	Product can become airborne in moderate winds. Dry material should be stored in silos. Materials stored out of doors should be covered or maintained in a damp condition.
10.5 Incompatible materials:	Acids, ammonium salts, diazomethane, phosphorus and aluminum metal.
10. 6 Hazardous decomposition products:	None known.

Section 11
Toxicological Information

11.1 Information on Toxicological Effects

Endpoint	Data
Acute oral toxicity	Oral LD50 > 2000 mg/kg
Acute dermal toxicity	No data.
Acute inhalation toxicity	Inhalation LC50: > 3.26 mg/L
Skin corrosion/irritation	Not irritating or corrosive to skin based on 4-hour, semi-occlusive exposure to rabbits.
Eye damage/irritation	No positive responses in rabbits based upon 24-, 48-, and 72-hour mean scores for corneal opacity, iritis, conjunctival redness/edema.
Respiratory/skin sensitization	Not a respiratory or dermal sensitizer.
Germ cell mutagenicity	Several in vitro and in vivo mutagenicity assays determined that calcium sulfate, dihydrate was non-mutagenic, with and without metabolic activation.
Carcinogenicity	No data on calcium sulfate, dihydrate. Carcinogenic studies were not conducted based on the non-neoplastic effects noted in the oral and inhalation repeated dose studies as well as the negative mutagenicity assays. Respirable crystalline silica has been identified as a carcinogen by NTP, IARC, ACGIH and OSHA.
Reproductive toxicity	No significant developmental or reproductive toxicity were identified in rabbits after exposure to either calcium sulfate, dehydrate or calcium sulfate, dihydrate.
STOT-SE	Acute toxicity testing did not result in direct organ toxicity after a single exposure to calcium sulfate, dihydrate. However, as the form tested was not indicated, FGD gypsum dust may result in mechanical respiratory irritation.
STOT-RE	A repeat dose oral toxicity study (35-45 days) with calcium sulfate, dihydrate conducted using rats reported a NOAEL for males of 100 mg/kg/day on the basis of decreased total protein, albumin, blood urea nitrogen, and creatinine levels observed at the 300 and 1,000 mg/kg/day dose groups. No effects were observed in females. Repeated inhalation exposures to high levels of respirable crystalline silica may result in lung damage (silicosis) and lung cancer.
Aspiration Hazard	Not applicable based on product form.

Section 12
Ecological Information

12.1 Toxicity

Calcium sulfate (CAS# 7778-18-9) [1]	
Toxicity to Fish	Fathead Minnow (*Pimephales promelas*): Acute, 7-day LC50 > 1,970 mg/L Acute, 96-hour NOEC = 1,470 mg/L
	Rainbow trout (*Oncorhynchus mykiss*): Chronic, 30-day NOEC (survival, growth, reproduction) = 732 mg/L
	Bluegill (*Lepomis macrochirus*): Acute, 96-hour LC50 = 2,890 mg/L
Toxicity to Aquatic Invertebrates	Water Flea (*Ceriodaphnia dubia*): Acute, 96-hour NOEC = 1447.4 mg/L
	Water Flea (*Daphnia magna*): Acute, 48-hour LC50 = 1,970 mg/L Chronic, 21-day NOEC (and 42-day post-hatch): 1,600 mg/L
Toxicity to Aquatic Algae and Plants	Algae (*Navicula seminulum; Nitzschia linearis*): Chronic, 96-hour LC50 and EC50 (growth) = 3,200 mg/L

[1]The aquatic toxicity of sulfate has been shown to be dependent on water hardness, generally decreasing as hardness increases.

12.2 Persistence and Degradability

Not relevant for inorganic materials.

12.3 Bioaccumulative Potential

This material does not contain any compounds that that would bioaccumulate up the food chain.

12.4 Mobility in Soil

No data available.

12.5 Results of PBT and vPvB Assessment

This material does not contain any compounds classified as “persistent, bioaccumulative or toxic” nor as “very persistent/very bioaccumulative”.

12.6 Other Adverse Effects

None known.

Section 13
Disposal Considerations

See Sections 7 and 8 above for safe handling and use, including appropriate industrial hygiene practices.

Dispose of all waste product and containers in accordance with federal, state and local regulations.

Section 14
Transport Information

Regulatory entity: U.S. DOT	Shipping Name:	Not Regulated
	Hazard Class:	Not Regulated
	ID Number:	Not Regulated
	Packing Group:	Not Regulated

Section 15
Regulatory Information

15.1 Safety, Health and Environmental Regulations/Legislation Specific for the Mixture

- TSCA Inventory Status
  - FGD gypsum as well as listed impurities are on the TSCA Inventory.
- California Proposition 65

  The following substances are known to the State of California to be carcinogens and/or reproductive toxicants:
  - Respirable crystalline silica
- State Right-to-Know (RTK)

Component	CAS	MA[1,2]	NJ[3,4]	PA[5]	RI[6]
Gypsum; calcium sulfate; calcium sulfate dihydrate	7778-18-9 or 10101-41-4	Yes	Yes	Yes	No
Calcium carbonate	1317-65-3	Yes	Yes	Yes	No
Silica-crystalline (SiO2), quartz	14808-60-7	Yes	Yes	Yes	No

[1] Massachusetts Department of Public Health, no date
[2] 189th General Court of The Commonwealth of Massachusetts, no date
[3] New Jersey Department of Health and Senior Services, 2010a
[4] New Jersey Department of Health, 2010b
[5] Pennsylvania Code, 1986
[6] Rhode Island Department of Labor and Training, no date

Section 16
Other Information, Including Date of Preparation or Last Revision

16.1 Indication of Changes

Date of preparation or last revision: February 27, 2018

16.2 Abbreviations and Acronyms

- ACGIH: American Conference of Industrial Hygienists
- CA: California
- CAS: Chemical Abstract Services
- CCP: Coal Combustion Product
- CFR: Code of Federal Regulations
- EPA: Environmental Protection Agency
- FGD: Flue Gas Desulfurization
- GHS: Globally Harmonized System of Classification and Labelling
- IARC: International Agency for Research on Cancer
- LC50: Concentration estimated to result in the mortality of 50% of an animal population
- LD50: Dose estimated to result in the mortality of 50% of an animal population
- MA: Massachusetts
- NA: Not Applicable
- NJ: New Jersey

- NOEC: No observed effect concentration
- NIOSH: National Institute of Occupational Safety and Health
- NOx: Nitrogen oxides
- NTP: US National Toxicology Program
- OEL: Occupational Exposure Limit
- OSHA: Occupational Safety and Health Administration
- PA: Pennsylvania
- PBT: Persistent, Toxic and Bioaccumulative
- PEL: Permissible exposure limit
- PPE: Personal Protective Equipment
- REL: Recommended exposure limit
- RI: Rhode Island
- RCS: Respirable Crystalline Silica
- RTK: Right-to-Know
- SCBA: Self-contained breathing apparatus
- SDS: Safety Data Sheet
- STEL: Short-term exposure limit
- STOT-RE: Specific target organ toxicity-repeated exposure
- STOT-SE: Specific target organ toxicity-single exposure
- TLV: Threshold limit value
- TSCA: Toxic Substances Control Act
- TWA: Time-weighted average
- UEL: Upper explosive limit
- UVCB: Unknown or Variable Composition/Biological
- U.S.: United States
- U.S. DOT: United States of Department of Transportation

16.3 Other Hazards

Hazardous Materials Identification System (HMIS) Degree of hazard (0= low, 4 = extreme)							
Health:	1*	**Flammability:**	0	**Physical Hazards:**	0	**Personal protection:****	

** Chronic Health Effects*
******* Appropriate personal protection is defined by the activity to be performed.*
See Section 8 for additional information.

DISCLAIMER:

This SDS has been prepared in accordance with the Hazard Communication Rule 29 CFR 1910.1200. Information herein is based on data considered to be accurate as of date prepared. No warranty or representation, express or implied, is made as to the accuracy or completeness of this data and safety information. No responsibility can be assumed for any damage or injury resulting from abnormal use, failure to adhere to recommended practices, or from any hazards inherent in the nature of the product.

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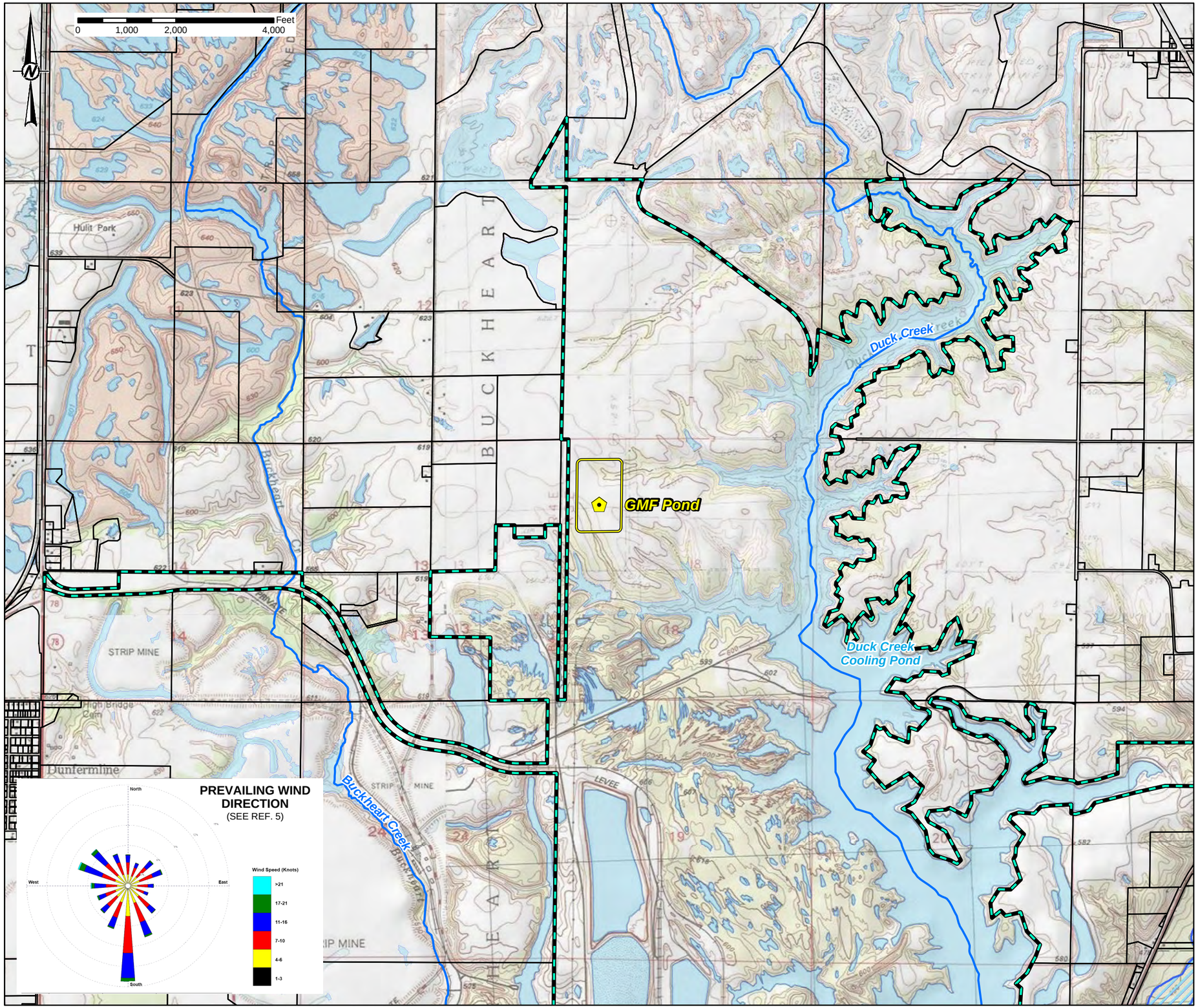
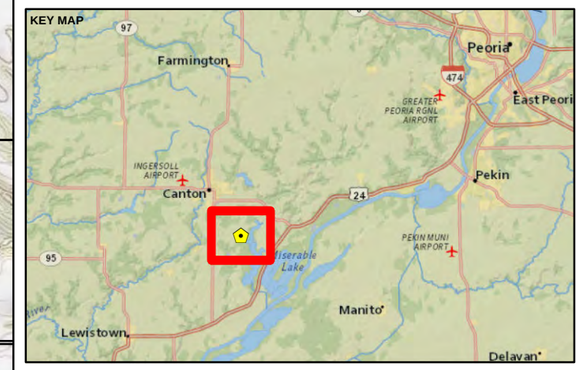
APPENDIX C

Map Package



LEGEND

- SITE LOCATION
- SURFACE WATER - LINEAR FEATURE
- SURFACE WATER BODY
- FEMA 100-YEAR FLOODPLAIN
- IPRG BOUNDARY
- NEIGHBORING PROPERTY BOUNDARIES
- GMF BOUNDARY



NOTES

1. A SEARCH OF THE ILLINOIS DEPARTMENT OF NATURAL RESOURCES (IDNR) NATURAL HERITAGE DATABASE FOR NATURAL AREAS AND PROTECTED AREAS WITHIN 1,000 METERS OF THE GMF POND WAS PERFORMED. ACCORDING TO THE IDNR NATURAL HERITAGE DATABASE, THERE ARE 15 NATURAL AREAS IN FULTON COUNTY, INCLUDING TWO CATEGORY III - NATURE PRESERVES (HARPER-RECTOR WOODS NATURE PRESERVE [34.67 ACRES] AND KEDZIOR WOODLANDS LAND AND WATER RESERVE [163.64 ACRES]). NO NATURAL AREAS WERE IDENTIFIED WITHIN 1,000 METERS OF THE GMF POND.
2. THE IDNR NATURAL HERITAGE DATABASE THREATENED AND ENDANGERED SPECIES BY COUNTY LISTS 11 STATE THREATENED AND 12 STATE ENDANGERED SPECIES IN FULTON COUNTY. THE USFWS ENVIRONMENTAL CONSERVATION ONLINE SYSTEM LISTS THREE FEDERALLY THREATENED AND ONE FEDERALLY ENDANGERED SPECIES IN FULTON COUNTY.

REFERENCES

1. TOPOGRAPHIC BASEMAP: UNITED STATES GEOLOGICAL SURVEY 7.5-MINUTE TOPOGRAPHIC QUADRANGLES SHOWN: CANTON, BANNER, SAINT DAVID, AND DUCK ISLAND.
2. PROPERTY BOUNDARIES: FULTON COUNTY ASSESSOR'S OFFICE, APRIL 2021.
3. FLOODPLAIN DATA: FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA). PANEL 17057C0250E, EFFECTIVE ON FEBRUARY 4, 2011.
4. SURFACE WATER FEATURES: NATIONAL HYDROGRAPHY DATASET (NHD), USGS.
5. PREVAILING WIND DIRECTION GRAPHIC: ILLINOIS STATE CLIMATOLOGIST OFFICE. 1961-1990 ANNUAL AVERAGE WIND SPEEDS AND DIRECTIONS, AS MEASURED AT STATION #14842 -PEORIA/GREATER PEORIA ARPT, IL.

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC

PROJECT
DUCK CREEK POWER PLANT
GMF POND

TITLE
SITE LOCATION MAP

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-10-19
DESIGNED	JS
PREPARED	KJC/RHG
REVIEWED	-
APPROVED	-

PROJECT NO.
21454861

FIGURE
1

PATH: M:\Vista\Luminant\845\Duck Creek\11x17_21454861_SiteLocationMaps_DDP.mxd PRINTED ON: 2021-10-19 AT 9:41:09 AM

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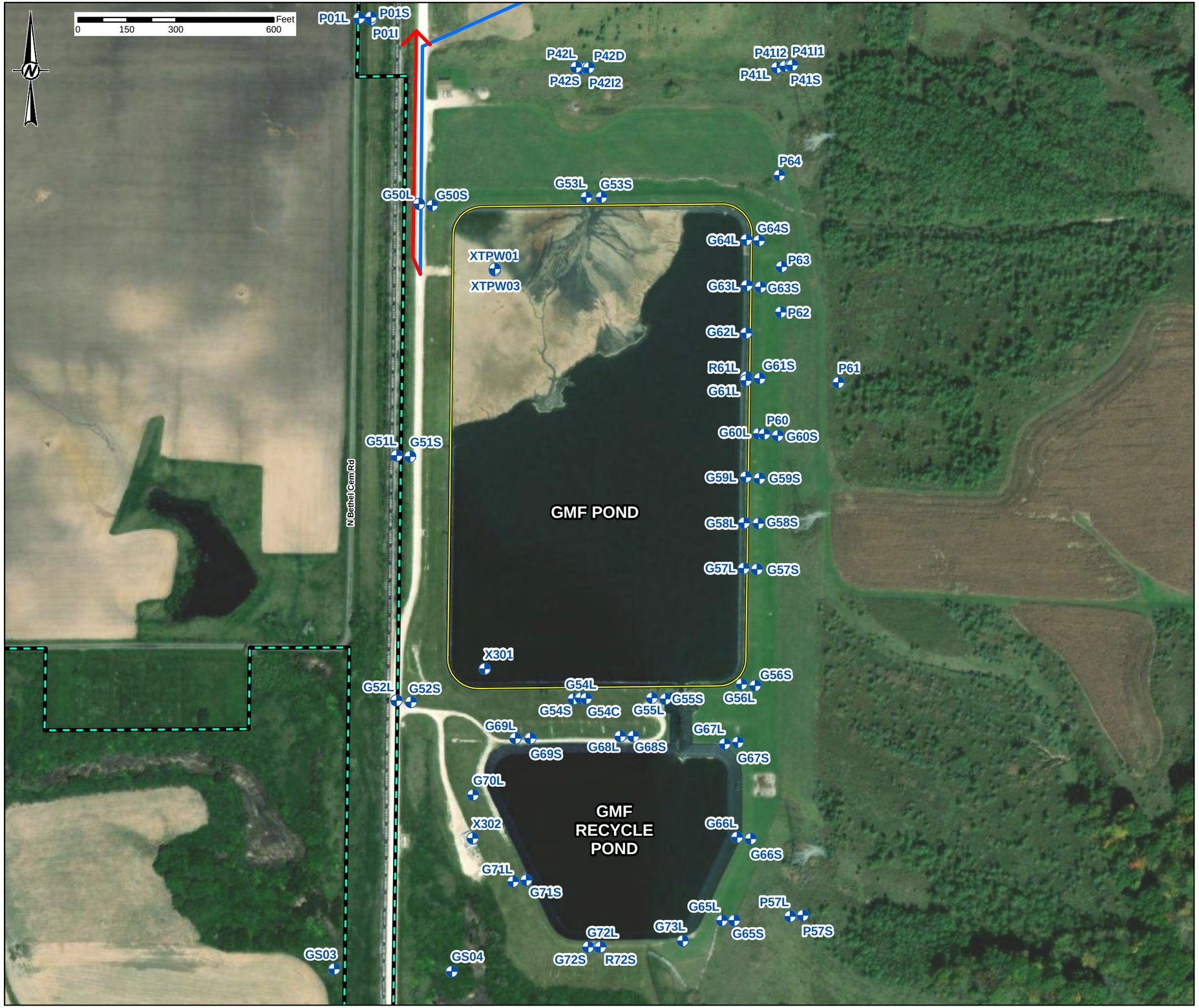
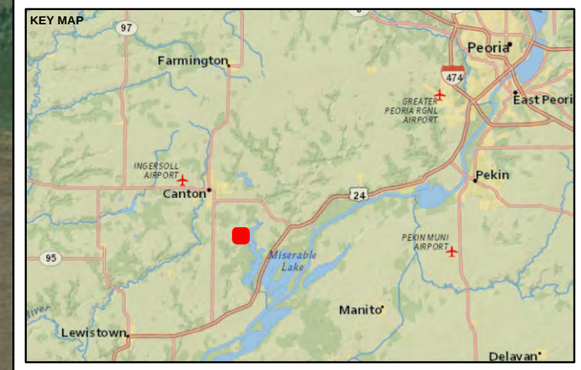


LEGEND

- IPRG BOUNDARY
- GMF BOUNDARY
- ROUTE BETWEEN GMF AND ON-SITE BORROW AREA
- ROUTE BETWEEN GMF AND ON-SITE LANDFILL
- WELL LOCATION



REFERENCES

1. AERIAL BASEMAP: ESRI PROVIDED BASEMAP SERVICE. VIVID. MAXAR. IMAGERY COLLECTED 10/21/2017.
2. PROPERTY BOUNDARIES: FULTON COUNTY ASSESSOR'S OFFICE, APRIL 2021.

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC

PROJECT
DUCK CREEK POWER PLANT
GMF POND

TITLE
SITE PLAN MAP

CONSULTANT
GOLDER MEMBER OF WSP

YYYY-MM-DD	2021-10-19
DESIGNED	JS
PREPARED	KJC/RHG
REVIEWED	-
APPROVED	-

PROJECT NO.
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APPENDIX D

Hydrogeologic Site Characterization

Intended for
Illinois Power Resources Generating, LLC

Date
October 25, 2021

Project No.
1940100806-003

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT

GYPSUM MANAGEMENT FACILITY POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL Bright ideas. Sustainable change.

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT DUCK CREEK POWER PLANT GYPSUM MANAGEMENT FACILITY POND

Project Name	**Duck Creek Power Plant Gypsum Management Facility Pond**
Project No.	**1940100806-003**
Recipient	**Illinois Power Resources Generating, LLC**
Document Type	**Hydrogeologic Site Characterization Report**
Revision	**FINAL**
Date	**October 25, 2021**

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ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
§	Section
35 I.A.C.	Title 35 of the Illinois Administrative Code
40 C.F.R.	Title 40 of the Code of Federal Regulations
bgs	below ground surface
CCR	coal combustion residuals
cm/s	centimeters per second
CSM	conceptual site model
CQA	Construction Quality Assurance
DCPP	Duck Creek Power Plant
DWW	Illinois Drinking Water Watch
ESRI	Environmental Systems Research Institute
FEMA	Federal Emergency Management Agency
ft/day	feet per day
ft/ft	feet per feet
GMF	Gypsum Management Facility
GMP	Groundwater Monitoring Plan
GWPS	Groundwater Protection Standard
Hanson	Hanson Professional Services, Inc.
HCR	Hydrogeologic Site Characterization Report
HDPE	high density polyethylene
HMP	Hydrogeologic Monitoring Plan
HUC	Hydrologic Unit Code
ID	identification
IDNR	Illinois Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
ILWATER	Illinois Water and Related Wells
IPRG	Illinois Power Resources Generating, LLC
ISAS	Illinois State Archaeological Survey
ISGS	Illinois State Geological Survey
ISWS	Illinois State Water Survey
mg/L	milligrams per liter
mil	millimeter
msl	above mean sea level
NAVD88	North American Vertical Datum of 1988
NGWMN	National Groundwater Monitoring Network
NID	National Inventory of Dams
No.	Number
NRCS	Natural Resources Conservation Service
NRT	Natural Resource Technology, Inc.
NRT/OBG	Natural Resource Technology, Inc., an OBG Company
oz/yd^2	ounce per square yard

Part 845	Residuals in Surface Impoundments: Title 35 of the Illinois Administrative Code § 845
pCi/L	picocuries per liter
pcf	Pound per cubic foot
PMP	potential migration pathway
Ramboll	Ramboll Americas Engineering Solutions, Inc.
RCRA	Resource Conservation and Recovery Act
RQD	rock quality designation
SDWIS	Safe Drinking Water Information System
SI	Surface Impoundment
SSURGO	Soil Survey Geographic
SU	standard unit
TDS	total dissolved solids
USCS	Unified Soil Classification System
USFWS	United States Fish and Wildfire Service
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

EXECUTIVE SUMMARY

This Hydrogeologic Site Characterization Report (HCR) for the Gypsum Management Facility (GMF) Pond at Duck Creek Power Plant (DCPP) expands upon the hydrogeology, groundwater quality data, and conceptual site model (CSM) presented in previous hydrogeologic investigation reports prepared for the GMF Pond. This report has been assembled to satisfy the information and analysis requirements of Title 35 of the Illinois Administrative Code (35 I.A.C.) Section (§) 845.620 as summarized in **Table ES-1**. The CSM includes hydrogeologic and groundwater quality data specific to the GMF Pond, which has been collected from 2015 to 2021. The GMF Pond (Vistra identification [ID] number [No.] 203, Illinois Environmental Protection Agency [IEPA] ID No. W0578010001-04, and National Inventory of Dams [NID] No. IL50573) is located at the DCPP southwest of Canton, Illinois (**Figure 1-1**).

The DCPP is located near the Duck Creek Cooling Pond, which was used as a source of cooling water for the power plant when it was active, and several small ponds which are remnants of the area's surface mining history. Prior to construction of the power plant and associated facilities, strip mining of coal took place within the property boundary of the DCPP. Currently, land use adjacent to the DCPP is agriculture, pasture, and forest with minimal development.

The GMF Pond is a 1500-foot by 900-foot earthen berm double-lined coal combustion residuals (CCR) Surface Impoundment (SI) located north of the former power plant. The GMF Pond decant water discharges to the lined GMF Recycle Pond. Several other CCR units are located on the DCPP property, including the Landfill located due north of the GMF Pond; the closed units, Ash Pond No. 1 and Ash Pond No. 2, located south of the GMF Pond; and the Bottom Ash Basin located between the former power plant and the closed Ash Pond Nos. 1 and 2.

Strip mining has occurred in this area since the 1930s. Strip mining in the site vicinity extracted coal from the Springfield (No. 5) Coal seam. Mining operations in the area have ceased. Strip mining has completely disrupted the natural stratigraphy down to the Springfield (No. 5) coal unit at some portions of the DCPP property. Previous investigations completed outside of the GMF Pond indicated that bedrock in the area is overlain by mine spoil ranging in thickness from approximately 10 to 75 feet. The mine spoil consists of excavated bedrock (weathered shale, shale fragments, and some coal fines) mixed with the sand, silts and silty clays of the unconsolidated glacial and aeolian deposits. The GMF Pond is located immediately adjacent to and downgradient of several former large surface mining areas.

In addition to the CCR within the lined GMF Pond, there are five layers of unlithified material present above the Pennsylvanian-age shaley siltstone and silty shale bedrock (Carbondale Formation). These materials have been categorized into three hydrostratigraphic units presented below in descending order:

- **Uppermost Aquifer:** At the GMF Pond this unit includes the Peoria/Roxanna Loess, the upper Radnor Till, and the shallow sands. These units are hydraulically connected and underlain by a thick till sequence of the Radnor Till (Natural Resource Technology, an OBG Company [NRT/OBG], 2017a). The shallow sands are laterally extensive across the site, vary in thickness from less than 1 to 18 feet, and are generally located at an elevation of 570 to 590 feet above mean sea level (msl). The shallow sand is saturated. During construction of the GMF Pond, sand was completely removed everywhere it was encountered (mainly the

northeast corner and southwest corner of the pond), putting the base of liner in contact with clay of the lower Radnor Till. Sand outside the GMF Pond footprint remains in place.

- **Lower Radnor Till/Lower Confining Unit:** Underlying the uppermost aquifer, the lower Radnor Till is approximately 42 to 58 feet thick.
- **Bedrock Confining Unit:** The thick and low permeability shaley siltstone, silty shale, and coal beds of the Carbondale Formation, are estimated to have a thickness of approximately 300 to 400 feet.

The Peoria/Roxanna Loess within the uppermost aquifer has also been identified as a potential migration pathway (PMP) for contaminant migration. While the primary migration pathway is the shallow sand of the uppermost aquifer, the groundwater within the overlying Peoria/Roxanna Loess has the potential to be impacted and is considered a PMP.

Groundwater migrates downward through the loess and upper Radnor Till into the shallow sands of the uppermost aquifer. Groundwater flow in the sands is generally in a northwest to southeast direction. Seasonal variation of groundwater levels at the GMF Pond are present and may fluctuate approximately 1 to 10 feet. There is no observable seasonal variation of groundwater flow direction at the GMF Pond associated with the elevation changes. Groundwater flows toward the Duck Creek Cooling Pond located approximately 2,100 feet east of the GMF Pond. The surface water elevation of the Cooling Pond is estimated from 562.5 to 565 feet North American Vertical Datum of 1988 (NAVD88). Which is approximately 20 feet lower than downgradient groundwater at the GMF Pond.

Part 845 parameters were monitored in uppermost aquifer and PMP monitoring wells as part of groundwater quality evaluations performed from 2015 to 2021. These data were supplemented with installation and sampling of additional locations in 2021. The results indicate that the following parameters were detected at concentrations greater than the applicable 35 I.A.C. § 845.600 groundwater protection standards (GWPSs) and are considered potential exceedances:

- Antimony, arsenic, cobalt, lead, pH, sulfate, and thallium were detected at least once at concentrations greater than the GWPS in downgradient uppermost aquifer wells (including PMP wells). Lead, mercury, pH, and thallium were detected at concentrations greater than the GWPS in upgradient uppermost aquifer wells. Radium 226 and 228 combined was detected once at concentrations greater than the GWPS in the bedrock confining unit well.

Concentration results for the above parameters were compared directly to 35 I.A.C. § 845.600 GWPS to determine potential exceedances. Potential exceedances include results reported during the background groundwater monitoring or prior period that are greater than the GWPS. The results are considered potential exceedances because the results were compared directly to the standard and did not include an evaluation of background groundwater quality or the statistical methodologies proposed in the groundwater monitoring plan (GMP) provided in the Operating Permit application. Exceedances will be determined following IEPA approval of the GMP.

TABLE ES-1. PART 845 REQUIREMENTS CHECKLIST
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Part 845 Reference	Part 845 Components	Location of Information in HCR
845.620(b)	**The hydrogeologic site characterization shall include but not be limited to the following:**	--
845.620(b)(1)	Geologic well logs/boring logs;	Table 3-1 Figure 3-1 Appendix B
845.620(b)(2)	Climatic aspects of the site, including seasonal and temporal fluctuations in groundwater flow;	Sections 3.2.4 & 3.3.1 Figures 3-2 to 3-5
845.620(b)(3)	Identification of nearby surface water bodies and drinking water intakes;	Sections 3.3.2 & 5.2 Appendix A
845.620(b)(4)	Identification of nearby pumping wells and associated uses of the groundwater;	Section 5.1 Appendix A
845.620(b)(5)	Identification of nearby dedicated nature preserves;	Section 5.3 Appendix A
845.620(b)(6)	Geologic setting;	Section 2 Figures 2-1 to 2-4
845.620(b)(7)	Structural characteristics;	Section 2.4.3 Figure 2-5
845.620(b)(8)	Geologic cross-sections;	Figures 2-7 and 2-8
845.620(b)(9)	Soil characteristics;	Section 2.3 Figure 2-2 Tables 2-1 & 2-4

TABLE ES-1. PART 845 REQUIREMENTS CHECKLIST
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Part 845 Reference	Part 845 Components	Location of Information in HCR
845.620(b)(10)	Identification of confining layers;	Section 3.2.1
845.620(b)(11)	Identification of potential migration pathways;	Section 3.2.1 & 3.2.3
845.620(b)(12)	Groundwater quality data;	Section 4.2 Table 4-1 & 4-2
845.620(b)(13)	Vertical and horizontal extent of the geologic layers to a minimum depth of 100 feet below land surface, including lithology and stratigraphy;	Section 2.5 Figures 2-7 through 2-9 Appendix B
845.620(b)(14)	A map displaying any known underground mines beneath a CCR surface impoundment;	Section 2.4.5 Appendix A
845.620(b)(15)	Chemical and physical properties of the geologic layers to a minimum depth of 100 feet below land surface;	Section 2.5 Tables 2-1, 2-2, & 2-4 Appendices B & C
845.620(b)(16)	Hydraulic characteristics of the geologic layers identified as migration pathways and geologic layers that limit migration, including:	Sections 3.2.4.1, 3.2.5, & 3.2.6 Tables 3-2 to 3-4 Appendices C & E
845.620(b)(16)(A)	water table depth;	Section 3.2.4 Figures 3-3 to 3-5
845.620(b)(16)(B)	hydraulic conductivities;	Section 3.2.5 Tables 2-1 & 3-3 Appendix E
845.620(b)(16)(C)	effective and total porosities;	Sections 2.5.1 Table 2-1

TABLE ES-1. PART 845 REQUIREMENTS CHECKLIST
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Part 845 Reference	Part 845 Components	Location of Information in HCR
845.620(b)(16)(D)	direction and velocity of groundwater flow; and	Sections 3.2.4 & 3.2.6 Tables 3-2, 3-4, & 4-2 Figures 3-3 to 3-5 Appendix D
845.620(b)(16)(E)	map of the potentiometric surface;	Figures 3-2 through 3-5
845.620(b)(17)	Groundwater classification pursuant to 35 I.A.C. § 620	Section 3.2.7

[O: EDP 08/24/21, C: LDC 09/16/21]

Notes:
35 I.A.C. § 620 = Title 35 of the Illinois Administrative Code, Part 620
HCR = Hydrogeologic Characterization Report
-- = reference to main regulation

1. INTRODUCTION

1.1 Overview

In accordance with requirements of the Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments: 35 I.A.C. § 845 (Part 845) (IEPA, April 15, 2021), Ramboll Americas Engineering Solutions, Inc. (Ramboll) has prepared this HCR on behalf of DCPP (**Figure 1-1**), operated by Illinois Power Resources Generating, LLC (IPRG). This report will apply specifically to the CCR Unit referred to as the GMF Pond. However, information gathered to evaluate other CCR units in the vicinity regarding geology, hydrogeology, and groundwater quality is included, where appropriate. The GMF Pond consists of a 1,500-foot by 900-foot earthen berm with 3.5:1 side slopes, a maximum elevation of 620 feet, a double geomembrane liner consisting of a 60-millimeter (mil) high-density polyethylene (HDPE) geomembrane liner, 12-inch clay cushion, 4 ounce per square yard (oz/yd^2) non-woven geotextile filter fabric, 12-inch highly permeable granular drainage (sand), 10 oz/yd^2 non-woven geotextile filter fabric, 60-mil HDPE geomembrane liner, reinforced bentonite mat, 36-inch compacted clay, all installed over in-situ foundation soil, and all pipes, pumps, and appurtenances necessary for the storage of approximately 3.6 million tons of gypsum at a maximum elevation of 715 feet with discharge to the GMF Recycle Pond. This HCR includes Part 845 content requirements specific to 35 I.A.C. § 845.620(b) (Hydrogeologic Site Characterization) for the GMF Pond at the DCPP.

1.2 Part 845 Description

CCR is commonly referred to as coal ash, and CCR SIs are commonly referred to as coal ash ponds. Part 845 contains comprehensive rules for the design, construction, operation, corrective action, closure, and post closure care of these SIs. This rule includes GWPSs applicable at the waste boundary at each CCR SI and requires each owner or operator to monitor groundwater. IEPA's rule includes a permitting program as well as all federal standards for CCR SIs promulgated by the United States Environmental Protection Agency (USEPA). In addition, the rules include procedures for public participation, closure alternatives analyses, and closure prioritization, and provides access to records via public website. The rules also include financial assurance requirements for CCR SIs.

A checklist which identifies the specific requirements of 35 I.A.C. § 845.620 is included in **Table ES-1**. The table provides references to sections, tables, and figures included in this document to locate the information that meets specific requirements of 35 I.A.C. § 845.620.

1.3 Previous Investigations and Reports

Numerous hydrogeologic investigations have been performed concerning the CCR Units at the DCPP. The information presented in this HCR includes data collected in support of the monitoring well network established for development of the GMP and supplements comprehensive data collection and evaluations from prior hydrogeologic investigation reports (recent to oldest), including, but not limited to, the following:

- ***Hanson Professional Services, Inc. (Hanson), March 25, 2021. First Quarter 2021 Groundwater Report, Duck Creek Power Station, Gypsum Stack and Recycle Pond, WPC Permit No. 2017-EO-62640, Fulton County.***
  Quarterly comparison of groundwater monitoring results to the relevant groundwater standard and submittal of the quarterly sample results.

- ***Natural Resource Technology, an OBG Company (NRT/OBG), October 17, 2017. Hydrogeologic Monitoring Plan, Duck Creek GMF Pond – CCR Unit ID 203, Duck Creek Landfill – CCR Unit ID 204, Duck Creek Power Station, Canton, Illinois.***
  Hydrogeologic Monitoring Plan (HMP) prepared to provide background information necessary to support the groundwater monitoring system established to comply with Title 40 of the Code of Federal Regulations (40 C.F.R.) § 257.91 to regulate the disposal of CCR as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) [40 C.F.R. § 257 Subpart D; published in 80 FR 21302-21501, April 17, 2015] for the DCPP located in Canton, Illinois.
- ***AECOM, October 2016. History of Construction, USEPA Final CCR Rule, 40 C.F.R. § 257.739(c), Duck Creek Power Station, Canton, Illinois.***
  History of construction for the Ash Pond No. 1, Ash Pond No. 2, and GMF Pond at the DCPP in accordance with 40 C.F.R. § 257.73(c).
- ***Hanson, March 2016. Clay Liner Evaluation Report, Illinois Power Resources Generating LLC, Duck Creek Power Station, Fulton County, Illinois.***
  Evaluation prepared to show that the existing liner in the GMF Pond meets the minimum requirements of the 40 C.F.R. § 257 regulations. Conclusion indicated that the as built liner exceeds the performance standard set by 40 C.F.R. § 257.70(b). Construction Quality Assurance (CQA) documents are presented to verify the integrity of the liner components.
- ***Natural Resource Technology, Inc. (NRT), March 31, 2016. Supplemental Hydrogeologic Site Characterization and Groundwater Monitoring Plan, Duck Creek Ash Ponds 1 and 2, Duck Creek Energy Center, Canton, Illinois.***
  This Supplemental Hydrogeologic Site Characterization and Groundwater Monitoring Plan was prepared to develop hydrogeologic information in support of a Closure Plan for the Duck Creek Energy Center Ash Ponds 1 and 2.
- ***Hanson, February 29, 2016. Ash Pond 1 and Ash Pond 2, Aquifer Evaluation in the Surface (Strip) Mining Area, Duck Creek Power Station, Illinois Power Resources Generating, LLC, Fulton County, IL.***
  Characterization of strip mining areas adjacent to Ash Ponds 1 and 2 at the DCPP.
- ***Hanson, March 2010. Hydrogeologic Report, Ameren Duck Creek Power Generating Station Solid Waste Disposal System (Ash Pond 1, Ash Pond 2, and Recycle Pond).***
  Hydrogeologic site characterization report for multiple ponds at the DCPP.
- ***Hanson, 2009. Section 3 – Hydrogeologic Report, in Support Document for Permit Application, Duck Creek Power Generating Station, Gypsum Management Facility, Springfield, Fulton County, Illinois.***
  An overview prepared to illustrate regional climate, geology, and hydrogeology and site-specific information related to geotechnical, hydrogeological, and geochemical characteristics found at the site.

A GMP is being prepared for the GMF Pond in conjunction with this report and is included in the Operating Permit to which this Report is attached.

1.4 Site Location and Background

The DCPP is located in Fulton County, Illinois and approximately 6 miles southeast of the town of Canton. The GMF Pond is located north of the power plant in Section 18 of Township 6 North,

Range 5 East (**Figure 1-1**). The GMF Recycle Pond is located just south of the GMF Pond (**Figure 1-2**). The DCPP is located near the Duck Creek Cooling Pond, which was used as a source of cooling water for the power plant when it was active, and several small ponds which are remnants of the area's surface mining history. The Landfill is located due north of the GMF Pond and the closed units, Ash Pond No. 1 and Ash Pond No 2, are located south of the GMF Recycle Pond. Prior to construction of the power plant and associated facilities, strip mining of coal took place within the property boundary of the DCPP (**Figure 1-1**). Currently, land use adjacent to the DCPP is agriculture, pasture, and forest with minimal development.

1.5 Site History and Unit Description

Surface preparation for the GMF Pond began in 2007 and construction took place from 2008 to 2009. The GMF Recycle Pond was constructed at the same time.

The GMF Pond, also referred to as the gypsum stack/management system, operates under an IEPA permit (#2017-E0-62640) issued in December 2017. It consists of a 1,500-foot by 900-foot earthen berm with 3.5:1 side slopes, a maximum elevation of 620 feet, a double geomembrane liner consisting of a 60-mil HDPE geomembrane liner, 12-inch clay cushion, 4 oz/yd^2 non-woven geotextile filter fabric, 12-inch highly permeable granular drainage (sand), 10 oz/yd^2 non-woven geotextile filter fabric, 60-mil HDPE geomembrane liner, reinforced bentonite mat, 36-inch compacted clay, all installed over in-situ foundation soil, and all pipes, pumps, and appurtenances necessary for the storage of approximately 3.6 million tons of gypsum at a maximum elevation of 715 feet with discharge to the GMF Recycle Pond.

The GMF Pond decant water discharges to the GMF Recycle Pond, which has a capacity of 32.6 million gallons. The GMF Recycle Pond is lined with a 60-mil HDPE geomembrane liner, reinforced bentonite mat and 36 inches of compacted clay.

2. REGIONAL AND LOCAL GEOLOGY

2.1 Topography

Topography within the DCPP property (**Figure 1-1**) is significantly influenced by the history of mining in the area. Strip mining has occurred in this area since the 1930s prior to mine reclamation laws; and, where present, has completely disrupted the natural stratigraphy down to the Springfield (No. 5) Coal unit. The strip mining activity has produced rough topography from soil piles and depressions, often ponded with water (Hanson, 2009). As discussed later in this document, soils in the immediate vicinity of the GMF Pond and GMF Recycle Pond do not appear to have been disturbed by surface mining activities; however, areas surrounding these ponds have been disturbed. Topography adjacent to the GMF Pond is provided in **Figure 2-1**.

2.2 Regional Geomorphology

The DCPP lies near the east edge of Fulton County in north central Illinois. The study area lies along the southeast edge of the Galesburg Plain Division of the Central Lowland Physiographic Province. The area consists of flat to gently rolling uplands that are dissected by many, deeply incised streams that are tributaries to major river systems. The erosional landforms have developed primarily within deposits of glacial drift that blanket Pennsylvanian-aged bedrock. The Pennsylvanian bedrock generally controls the landforms, particularly drainage ways and rivers in the area (Hanson, 2009).

The Illinois River delineates the southeast border of the Galesburg Plain and is the main drainage for the region. The physiography of many areas in the Galesburg Plain has been affected by strip mining of coal. Strip mines have altered the natural landforms and drainage systems. Unreclaimed strip mine areas are usually very hummocky with mine spoils and are pocked with ponds and depressions (Hanson, 2009).

2.3 Soils

Surficial soils at the Site and vicinity are shown on **Figure 2-2**, based on the soil survey performed in Fulton County in 1994 available in the Soil Survey Geographic database (SSURGO) by the United States Department of Agriculture Natural Resources Conservation Service (NRCS) provided by the Environmental Systems Research Institute (ESRI) web-hosted layer (NRCS, 1997).

Former soils underlying the Site are identified as Fayette Silt Loam (#280E2 and #280gD2), Keomah Silt Loam (#17A), and Rozetta Silt Loam (#279B and #279C2). The Fayette series consists of well drained loess on sideslopes along upland drainageways. This soil is well suited for and used as habitat for openland and woodland wildlife. These soils are moderately suitable for cultivated crops due to crusting and water erosion and unsuitable for dwellings due to flooding. The Keomah series consists of somewhat poorly drained loess in interfluvial areas. This soil is well suited for and used as habitat for openland wildlife. These soils are moderately suitable for cultivated crops due to crusting and flooding and only moderately suitable to unsuitable for dwellings due to slope. The Rozetta series consists of well drained loess in interfluvial areas, head slopes, and sideslopes along upland drainageways. This soil is well suited for and used as habitat for openland and woodland wildlife. These soils are moderately suitable for cultivated crops due to crusting and water erosion and only moderately suitable for dwellings due to flooding.

Areas surrounding the GMF Pond are classified as Hickory Silt Loam (#8cF), Elco Silt Loam (#119E2), and Clarksdale Silt Loam (#257A). The Hickory series consists of well-drained till. These soils formed on sideslopes along upland drainageways. Most areas of this association are moderately unsuitable for cultivated crops due to frost heave, low pH, and water erosion. The Elco series consists of moderately well drained loess and underlying paleosol. These soils formed in loess and till on sideslopes along upland drainageways. Most areas of this association are moderately suitable for cultivated crops due to frost heave, low pH, and water erosion. The Clarksdale series consists of somewhat poorly drained loess. These soils formed in interfluvial areas. Most areas of this association are moderately suitable for cultivated crops due to frost heave, low pH, and wetness.

2.4 Regional Geology

Regionally, the DCPP is positioned on the glacial uplands above the Illinois River in the Ancient Illinois Floodplain of the Till Plains Section of the Central Lowland Province.

2.4.1 Regional Unlithified Geology

Upper unlithified materials consist of Wisconsinan Stage materials overlying Illinoian Stage deposits. The undisturbed unlithified materials consist of loess, diamictons, and lacustrine/alluvial deposits. The area is flat to gently rolling uplands that are dissected by deeply incised streams that are tributaries to major river systems. The erosional landforms have developed primarily within deposits of glacial drift that blanket Pennsylvanian-aged bedrock (NRT/OBG, 2017a).

Areas near the GMF Pond are part of several large surface coal mines (**Figure 2-3**) where unlithified materials are present in the excavated strip mine spoils, but have been mixed due to the surface mining activities. Mining operations in the area have ceased (NRT/OBG, 2017a).

The Radnor Till is the only surficial Quaternary geologic deposit regionally mapped in the vicinity of the GMF Pond and is shown on **Figure 2-4**.

2.4.2 Regional Bedrock Geology

The uppermost bedrock stratum in the area is the Carbondale Formation of the Kewanee Group of the Pennsylvanian System. The Carbondale Formation consists of interbedded sequences of shale, sandstone, limestone, and coal with associated underclay. These sediments were deposited in shallow marine, deltaic, and swamp environments. Some of the shales are fossiliferous (containing either plant or marine fossils), and some contain sideritic nodules and bands. The sandstones are mostly subgraywackes and occur in elongated channel facies. The limestones are generally gray to dark gray, argillaceous, and normally fossiliferous. Thin black fissile shales are commonly associated with the limestones. The Carbondale Formation includes the principle Illinois economic coals: the Herrin (No. 6), the Springfield (No. 5), the Colchester (No. 2), and the Danville (No. 7). Underclays occur at the base of the coal seams. Strip mining in the site vicinity extracted coal from the Springfield (No. 5) coal seam (Hanson, 2009).

2.4.3 Structure

The bedrock surface in the site area has been mapped at about elevation 560 feet NAVD88. The bedrock mapping indicates the beds dip to the east-southeast at about 60 feet per mile. The St. Davis anticline occurs within the Pennsylvanian sequence and passes through the landfill area which explains the lack of strip mining activity in this portion of the DCPP (Hanson, 2005).

2.4.4 Seismic Setting

The major geologic structural features within Illinois are depicted on **Figure 2-5**. Fulton County is not located in a seismic impact zone. The nearest areas of present-day fault-related, seismic activity are the Northern Illinois Seismic Source Zone and the Wabash Valley Fault Zone near southwestern Indiana and the New Madrid Fault Zone along the Ohio and Mississippi River Valleys in southeastern Illinois. Records dating from 1811 indicate that earthquakes greater than a Richter Scale Magnitude 6.0 occurred in or near the New Madrid Fault line. Away from the fault, all earthquakes have been a 5.9 magnitude or less. The earthquake epicenters appear to be the result of modern regional stress fields and are not related to the nearby inactive faults (Hanson, 2009).

2.4.5 Mining Activities

Strip mining has occurred in this area since the 1930s. Strip mining in the site vicinity extracted coal from the Springfield (No. 5) Coal seam. Mining operations in the area have ceased. As indicated above, strip mining has completely disrupted the natural stratigraphy down to the Springfield (No. 5) Coal unit at some portions of the Site. Previous investigations completed outside of the GMF Pond at the Site also indicated that bedrock in the area is overlain by mine spoil ranging in thickness from approximately 10 to 75 feet (as observed at monitoring well OM24D and OM15 near the ash ponds). The mine spoil consists of excavated bedrock (weathered shale, shale fragments, and some coal fines) mixed with the sand, silts and silty clays of the unconsolidated glacial and aeolian deposits. The GMF Pond is located immediately adjacent to several former large surface mining areas (**Figure 2-3** and **Appendix A**).

2.5 Site Geology

A field investigation was performed in 2021 to collect additional data for the discussion of vertical and horizontal lithology, stratigraphy, chemical properties, and physical properties of geologic layers to a minimum of 100 feet below ground surface (bgs) as specified in 35 I.A.C. § 845.620(b). Field investigation locations from 2021 are shown on **Figure 2-6**. The major geomorphic features occurring within and nearby the GMF Pond include Peoria/Roxanna Loess overlying Glasford Formation clayey diamictons (till).

2.5.1 Site-Specific Unlithified Geology

The unlithified stratigraphy within and immediately surrounding the GMF Pond consists of the following in descending order: fill material and CCR; silt and clayey silt loess (Peoria/Roxanna Loess); weathered till (upper Radnor Till); shallow, medium-grained sand to silt zone within the Radnor Till; and till (lower Radnor Till). The unlithified units overlay Pennsylvanian-age shaley siltstone and silty shale bedrock (Carbondale Formation). Boring logs and monitoring well and piezometer construction forms obtained from investigations at the GMF Pond are provided in **Appendix B**. Cross-sections showing the subsurface materials encountered at the GMF Pond are included in **Figures 2-7 and 2-8**. Samples for geotechnical analysis were collected from interpreted geologic units and composited to obtain a representative sample of the entire geologic unit prior to submittal (**Table 2-1**).

2.5.1.1 Fill and CCR

Gypsum is present within the GMF Pond at a maximum thickness of approximately 22 feet, as estimated from topography and the elevation of the base of the liner from available construction details (**Figure 2-9**). The range of gypsum thickness is estimated from less than 1 to 22 feet.

The thickest areas of gypsum are to the north and west within the GMF Pond and thin toward the south end of the GMF Pond. The base of the liner rests on top of the lower Radnor Till.

Geotechnical analysis results from two grab samples (sample IDs Gypsum and LSN-3781/Gypsum) collected from the GMF Pond near XTPW01 are summarized in **Table 2-1**. Sample locations are shown on **Figure 2-6**, and geotechnical laboratory reports are included in **Appendix C**. Geotechnical results from grab samples near XTPW01 indicated the following:

- Average moisture content of 30.7 percent, with a range of 28.8 to 32.5 percent.
- Total porosity (calculated) of 56.1 percent.
- Dry density of 73.9 pounds per cubic foot (pcf).
- Average specific gravity of 2.51, with a range of 2.310 to 2.700.
- Grain size composition of 0 percent gravel, 4 percent sand, and 96 percent fines (silt and clay).
- Vertical hydraulic conductivity of 6.7×10^{-4} centimeters per second (cm/s).

Solid samples were collected from grab samples near XTPW01 in 2021 for chemical analysis. The results of solid samples collected from within the gypsum are summarized in **Table 2-2**.

To sample porewater, a piezometer (pre-pack well, XTPW02) was installed by Golder Associates, Inc. 5.5 feet into the gypsum on June 23, 2021. XTPW02 is located approximately 132 feet east of the western edge of the GMF Pond and is shown on **Figure 2-6**. The piezometer was installed using hand tools (no drilling log). A porewater sample was collected from XTPW02 on June 23, 2021. The results of porewater sample are summarized in **Table 2-3.**

2.5.1.2 Peoria/Roxanna Loess

The Wisconsinan Stage Peoria/Roxanna Loess extends from beneath the topsoil developed in the loess to depths ranging from 11 to 21 feet. The loess consists predominantly of silt and clayey silt with minor amounts of sand. The loess exhibits iron staining, concretions, and some fracturing. The Loess Unit is saturated below depths varying from approximately 3.5 to 11 feet.

Geotechnical analysis results from samples collected from Peoria/Roxanna Loess yielded Unified Soil Classification System (USCS) soil classifications of lean clay. Sample locations are shown on **Figure 2-6,** the geotechnical results from the most recent investigation are summarized in **Table 2-1**, and geotechnical laboratory reports are included in **Appendix C**. Geotechnical results indicated the following:

- Average moisture content of 22.0 percent, with a range of 18.6 to 25.9 percent.
- Average total porosity (calculated) of 37 percent, with a range of 32.4 to 41.8 percent.
- Average dry density of 103.8 pcf, with a range of 97.3 to 113.1 pcf.
- Average specific gravity of 2.67, with a range of 2.650 to 2.680.
- Average grain size composition of 0.1 percent gravel, 8.6 percent sand, and 91.4 percent fines (silt and clay). The fines content ranged from 88.2 to 97.4 percent, with a median value of 88.5 percent.

- Geometric mean vertical hydraulic conductivity of 2.1 x 10^{-7} cm/s and ranged from 7.1 x 10^{-8} to 6.3 x 10^{-7} cm/s.

Solid samples were also collected in 2021 for chemical analysis. The results of solid samples collected from the loess are summarized in **Table 2-4**.

2.5.1.3 Upper Radnor Till

The loess is generally underlain by a relatively thin till sequence consisting of the Berry Clay (where present) and the Illinoian Stage upper Radnor Till. The till sequence ranges in thickness from 9 to 21 feet in the area of the GMF Pond. This shallow till is generally weathered and exhibits signs of oxidation and fracturing. The till is primarily clayey silt with minor amounts of sand and gravel.

Geotechnical analysis results from samples collected from the upper Radnor Till yielded USCS soil classifications of lean clay. Sample locations are shown on **Figure 2-6,** the geotechnical results from the most recent investigation are summarized in **Table 2-1**, and geotechnical laboratory reports are included in **Appendix C**. Geotechnical results indicated the following:

- Average moisture content of 22.4 percent, with a range of 21.1 to 24.6 percent.
- Average total porosity (calculated) of 36.8 percent, with a range of 30.7 to 41.4 percent.
- Average dry density of 106.1 pcf, with a range of 98.0 to 116.7 pcf.
- Average specific gravity of 2.69, with a range of 2.680 to 2.700.
- Average grain size composition of 1.5 percent gravel, 22.6 percent sand, and 75.9 percent fines (silt and clay). The fines content ranged from 77 to 80.6 percent, with a median value of 75.4 percent.
- Geometric mean vertical hydraulic conductivity of 7.7 x 10^{-7} cm/s and ranged from 2.6 x 10^{-7} to 2.3 x 10^{-6} cm/s.

Solid samples were also collected in 2021 for chemical analysis. The results of solid samples collected from the upper Radnor Till are summarized in **Table 2-4**.

2.5.1.4 Shallow Sand Zone

The Shallow Sand Zone is laterally extensive within the Radnor Till across the site and varies in thickness from less than 1 to 18 feet near the GMF Pond. The top of the Shallow Sand Zone is generally located at an elevation of 570 to 590 feet msl. The Shallow Sand Zone exhibits lateral facies changes across the site and varies from a medium-grained sand to a silt and often contains intercalated till seams, as shown in the hydrogeologic cross sections (**Figures 2-7 and 2-8**). The Shallow Sand Zone is saturated. The Shallow Sand Zone is the most laterally extensive at the GMF Pond, with other zones having either an unsaturated component, intermittent presence, or entirely absent.

During construction, shallow sand was encountered and completely removed from underneath the northeast corner and southwest corner of the GMF Pond, putting the liner in contact with clay of the lower Radnor Till (**Figures 2-7 and 2-8**). Sand outside the GMF Pond footprint remains.

Geotechnical analysis results from samples collected from the Shallow Sand Zone yielded USCS soil classifications of silty lean clay and lean clay. These USCS classifications contain more fines

than expected, and are likely a result of difficulty targeting a thin sand zone within largely fine-grained materials. Sample locations are shown on **Figure 2-6**, the geotechnical results from the most recent investigation are summarized in **Table 2-1**, and geotechnical laboratory reports are included in **Appendix C**. Geotechnical results indicated the following:

- Average moisture content of 17.5 percent, with a range of 14.5 to 21.9 percent.
- Average total porosity (calculated) of 29.5 percent, with a range of 27.4 to 31.4 percent.
- Average dry density of 115.0 pcf, with a range of 105.1 to 122.3 pcf.
- Average specific gravity of 2.663, with a range of 2.640 to 2.700.
- Average grain size composition of 5.7 percent gravel, 27.1 percent sand, and 67.2 percent fines (silt and clay). The fines content ranged from 63.6 to 73.7 percent, with a median value of 64.4 percent.
- Geometric mean vertical hydraulic conductivity of 9.0×10^{-7} cm/s and ranged from 7.5×10^{-7} to 1.1×10^{-6} cm/s.

Solid samples were also collected in 2021 for chemical analysis. The results of solid samples collected from the Shallow Sand Zone are summarized in **Table 2-4**.

2.5.1.5 Lower Radnor Till

Till sequences underlying the Shallow Sand Zone consist of clay, silt, and sand of the Illinoian Stage lower Radnor Till. The till ranges in thickness from 42 to 58 feet. In some areas of the site, including the area near the GMF Pond, the till sequences typically extend from the base of the shallow sand to the bedrock surface. In other areas of the site, the till sequences extend to intermediate or deep sands. The till sequences are typically high in silt content with varying amounts of clay, sand, and gravel, and are often calcareous.

Geotechnical analysis results from samples collected from the lower Radnor Till at soil borings yielded USCS soil classifications of silty clayey sand, silty lean clay, and lean clay. Sample locations are shown on **Figure 2-6**, the geotechnical results from the most recent investigation are summarized in **Table 2-1**, and geotechnical laboratory reports are included in **Appendix C**. Geotechnical results indicated the following:

- Average moisture content of 10.5 percent, with a range of 7.7 to 12.6 percent.
- Average total porosity (calculated) of 22.3 percent, with a range of 20.6 to 23.5 percent.
- Average dry density of 127.5 pcf, with a range of 123.2 to 133.8 pcf.
- Average specific gravity of 2.670, with a range of 2.640 to 2.700.
- Average grain size composition of 7.7 percent gravel, 38.2 percent sand, and 54 percent fines (silt and clay). The fines content ranged from 49.3 to 56.5 percent, with a median value of 64.4 percent.
- Geometric mean vertical hydraulic conductivity of 4.7×10^{-7} cm/s and ranged from 4.1×10^{-8} to 5.4×10^{-6} cm/s.

Solid samples were also collected in 2021 for chemical analysis. The results of solid samples collected from the lower Radnor Till are summarized in **Table 2-4**.

2.5.2 Site Specific Bedrock Geology

Pennsylvanian bedrock was encountered at greatly varying depths across the site. Bedrock depths ranged from a minimum of 52 feet to a maximum of 108 feet. Bedrock was encountered at boring locations B-54, B-60, and G54C at 84 feet bgs, 88 feet bgs, and 90 feet bgs, respectively, in the vicinity of the GMF Pond (**Appendix D** for boring locations). The bedrock shows little compositional variation across the site and consists primarily of shaley siltstone and silty shale. The shale bedrock unit is typically weathered near the surface, has low hydraulic conductivity, and underlies the glacial till sequences. These units often contain thin dolomite ledges and nodules and some fractures.

3. REGIONAL AND LOCAL HYDROGEOLOGY

3.1 Regional Hydrogeology

As discussed in **Section 2**, unlithified materials consist of Wisconsinan Stage materials overlying Illinoian Stage deposits. The undisturbed unlithified materials consist of loess, diamictons, and lacustrine/alluvial deposits overlying Pennsylvanian-aged bedrock. The area is flat to gently rolling uplands that are dissected by deeply incised streams that are tributaries to major river systems in areas that have not been disturbed by strip mining activity.

Available records of wells within one mile of the site indicate potable water may be obtained from unconsolidated materials or from deep bedrock. Estimated specific capacity (used to approximate the transmissivity of a formation) indicated shallow sands near the GMF Pond provide a very modest specific capacity and groundwater yield (Hanson, 2009).

3.2 Site Hydrogeology

Wells used for groundwater monitoring at the GMF Pond have been constructed in phases since 2008. Prior to 2021, there were more than 30 wells used to monitor the GMF Pond. In 2021, one additional well (G54C) was installed in bedrock to provide information to meet the requirements of Part 845. Construction details for monitoring wells and piezometers associated with the GMF Pond are provided in **Table 3-1** and depicted in **Figure 3-1**. Boring logs, monitoring well and piezometer construction forms are provided in **Appendix B**.

3.2.1 Hydrostratigraphic Units

Three distinct water-bearing layers have been identified at the Site based on stratigraphic relationships and common hydrogeologic characteristics which are summarized and discussed in subsequent sections:

- **The Uppermost Aquifer**: At the GMF Pond this unit includes the Peoria/Roxanna Loess, the upper Radnor Till, and the shallow sands described in detail in **Section 2.5.1**. These units are hydraulically connected and underlain by a thick till sequence of the Radnor Till (NRT/OBG, 2017a). The shallow sands are laterally extensive across the site, vary in thickness from less than 1 to 18 feet, and are generally located at an elevation of 570 to 590 feet msl. The shallow sand is saturated. During construction of the GMF Pond, sand was completely removed everywhere it was encountered (mainly the northeast corner and southwest corner of the pond), putting the base of liner in contact with clay of the lower Radnor Till. Sand outside the GMF Pond footprint remains in place.
- **Lower Radnor Till/Lower Confining Unit**: Underlying the uppermost aquifer, the lower Radnor Till is approximately 42 to 58 feet thick. Previous hydrogeologic studies indicate discontinuous sand lenses observed within the till are not hydraulically connected to the shallow sand unit (NRT/OBG, 2017a).
- **Bedrock Confining Unit**: The thick and low permeability shaley siltstone, silty shale, and coal beds of the Carbondale Formation, are estimated to have a thickness of approximately 300 to 400 feet. The boring for monitoring well G54C extends 11.5 feet into the bedrock. Additional bedrock detail is provided in **Section 2.5.2**.

3.2.2 Uppermost Aquifer

As stated above, this unit includes the Peoria/Roxanna Loess, the upper Radnor Till, and the shallow sand zone. The shallow sand zone is the primary migration pathway within these hydraulically connected formations. In places where the shallow sand unit is absent (such as beneath the GMF Pond Liner) the uppermost aquifer may be functionally absent, as the liner is in contact with clay till. Groundwater monitoring is focused in the shallow sand unit because it is the most permeable and laterally continuous unit at the Site. The top of the uppermost aquifer is presented in **Figure 3-2.** The base of the uppermost aquifer is the lower confining unit (the lower Radnor Till).

3.2.3 Potential Migration Pathway

The Peoria/Roxanna Loess within the uppermost aquifer has also been identified as a PMP. While the primary migration pathway is the shallow sand of the uppermost aquifer, impacts have the potential to migrate within groundwater in the overlying Peoria/Roxanna Loess. The PMP is saturated at depths of 3.5 to 11 feet bgs. While the PMP and uppermost aquifer are hydraulically connected, groundwater flow in the PMP is expected to be primarily vertical, with the majority of the horizontal migration expected to occur within the uppermost aquifer. Monitoring wells with the suffix "L" are screened within the loess and provide representative data on the hydraulic properties and groundwater quality of the PMP.

3.2.4 Water Table Elevation and Groundwater Flow Direction

Groundwater flow across the GMF Pond within the uppermost aquifer is consistently in a southeast direction toward the Duck Creek Cooling Pond (**Figures 3-3 and 3-4**). Groundwater elevations of the uppermost aquifer vary seasonally although flow directions are generally consistent (additional contour maps are included in **Appendix D**).

Groundwater elevations in the PMP wells are generally higher than those in the uppermost aquifer and reflect the groundwater flow in the underlying uppermost aquifer wells. Surface water elevations within the GMF Pond are higher than the groundwater.

3.2.4.1 Vertical Hydraulic Gradients

Vertical hydraulic gradients were calculated using available groundwater elevation data from April to August 2021 at wells screened in the PMP, uppermost aquifer, and bedrock (**Table 3-2**). The results of the vertical hydraulic gradient calculations between these hydrostratigraphic units are summarized below:

- Uppermost aquifer to PMP:
  - Vertical hydraulic gradients between wells G51L (PMP) and G51S (uppermost aquifer) ranged from -0.01 to -0.03 feet per feet (ft/ft), upward, averaging 0.02 ft/ft upward
  - G54L (PMP) and G54S (uppermost aquifer) ranged from 0.01 to 0.09 ft/ft downward, averaging 0.04 ft/ft downward
  - G57L (PMP) and G57S (uppermost aquifer) ranged from -0.04 ft/ft upward to 0.12 ft/ft downward, averaging 0.02 ft/ft downward
  - G60L (PMP) and G60S (uppermost aquifer) ranged from 1.2 to 1.6 ft/ft downward, averaging 1.3 ft/ft downward

- Bedrock confining unit to uppermost aquifer:
  - Vertical hydraulic gradients between wells G54C (bedrock confining unit) and G54S (uppermost aquifer) ranged from 0.17 to 0.27 ft/ft, downward, averaging a downward vertical gradient of 0.20 ft/ft

The downward gradients observed between downgradient wells G54L and G54S, and G60L and G60S, are consistent with vertical gradients reported by Hanson in 2009. The slightly upward gradient between upgradient wells G51L and G51S, and the variable gradients between downgradient wells G57L and G57S did not have a comparable measurement from previous studies.

3.2.4.2 Impact of Existing Ponds and Ash Saturation

The GMF Pond is lined, as described in **Section 1.5,** and the shallow sands of the uppermost aquifer were removed from within the footprint of the pond. The phreatic surface measured from a transducer at location X301 within the GMF Pond ranges from approximately 613 to 617 feet NAVD88 with an average around 614 feet (**Appendix D**), whereas groundwater elevations measured in monitoring wells located around the GMF Pond and screened within the uppermost aquifer range from approximately 590 to 578 feet NAVD88. Groundwater elevation contours indicate groundwater generally flow to the southeast, with no indication of radial flow. The elevation difference between the phreatic surface and groundwater elevations, in addition to no observations of radial flow, provide evidence that the GMF Pond does not impact groundwater flow directions via recharge to groundwater. Given the low permeability of the liner system, it is more likely that the GMF Pond is a barrier to groundwater flow within the uppermost aquifer, deflecting flow from upgradient areas around the perimeter of the pond toward the downgradient areas.

With the relatively stable phreatic surface elevation within the pond around 614 feet, the thickness of saturated CCR (gypsum) in the pond will correspond with the thickness of gypsum in the pond. Thicker accumulations of gypsum are present in the north end of the pond and thin to the south.

3.2.4.3 Impact of Surface Water Bodies

The nearest surface water body to the GMF Pond is the Duck Creek Cooling Pond, which is located approximately 2,100 feet east of the GMF Pond. The surface water elevation of the Cooling Pond is estimated to be from 562.5 to 565 feet NAVD88. Which is approximately 20 feet lower than downgradient groundwater at the GMF Pond, indicating that groundwater in the vicinity of the GMF Pond is flowing toward the Cooling Pond. The shoreline of the Cooling Pond is very irregular (**Figure 1-1**) as it occupies the former surface water drainage features associated with Duck Creek (which was impounded to create the Cooling Pond).

3.2.5 Hydraulic Conductivities

3.2.5.1 Field Hydraulic Conductivities

Field hydraulic conductivity tests were performed in the uppermost aquifer by Hanson in 2021. Hydraulic conductivity test analyses and results are summarized in **Table 3-3** and provided in **Appendix E**. Field hydraulic conductivity tests from monitoring wells G50L, G51L, G53L, G54L, G60L, G50S, G51S, G53S, G54S, G57S, G60S, and G63S indicated hydraulic conductivities from 3.0×10^{-5} to 3.9×10^{-3} cm/s with a geometric mean of 3.6×10^{-4} cm/s.

Results of field hydraulic conductivity tests conducted in 2021 in the bedrock confining unit by Hanson at monitoring well G54C ranged from 1.4 x 10^{-4} to 1.6 x10^{-4} cm/s, with a geometric mean of 1.5 x 10^{-4} cm/s. This is higher in comparison to the horizontal hydraulic conductivity range of 1.3 x 10^{-6} cm/s to 1.3 x 10^{-9} cm/s, established by Hanson in 2015, which used pressure testing on borehole OM32. The higher values observed at G54C are attributed to the highly weathered nature of the bedrock in the screen interval which is supported by the low rock quality designation (RQD) N values ranging from 14-22 (lower numbers indicating lower percentage of intact rock core recovered).

3.2.5.2 Laboratory Hydraulic Conductivities

Falling head permeability tests (ASTM D5084 Method F) were performed in the laboratory on samples collected during the 2021 investigations. Sample locations are shown on **Figure 2-6**. The geotechnical laboratory report from the most recent investigation and previous investigations (AECOM, 2016) are provided in **Appendix C**. The results are summarized in **Table 2-1** and discussed below.

- One CCR sample (LSN-3781) was collected from gypsum boring XTPW01. Laboratory falling head permeability test results in the CCR indicated a vertical hydraulic conductivity of 6.7 x 10^{-4} cm/s.
- Two samples were collected from the lower Radnor Till from soil boring G54C. Laboratory falling head permeability test results in the lower Radnor Till indicated a vertical hydraulic conductivity ranging from 4.1 x 10^{-8} to 5.4 x 10^{-6} cm/s.
- Seven samples were collected from the uppermost aquifer from soil borings G54C, SB50, and SB62. Laboratory falling head permeability test results in the uppermost aquifer indicated vertical hydraulic conductivities ranging from 7.1 x 10^{-8} to 1.1 x 10^{-6} cm/s, and a geometric mean vertical hydraulic conductivity of 4.6 x 10^{-7} cm/s.

3.2.6 Horizontal Groundwater Gradients and Flow Velocities

Groundwater flow around the GMF is generally in a southeast direction (**Figures 3-3 through 3-4**). Seasonal variation of groundwater levels at the GMF Pond are indicated in the series of 2015 to 2020 groundwater elevation contour maps and groundwater elevation table (**Appendix D**). Observed groundwater elevations may fluctuate seasonally by 1 to 10 feet. There is no observable seasonal variation of groundwater flow direction at the GMF Pond.

Horizontal hydraulic gradients and groundwater velocities for the uppermost aquifer were calculated based upon groundwater elevation measurements from April through August 2021 between G50S and G60S, G51S and G54S, and G50S and G64S (**Table 3-4**). Horizontal hydraulic gradients are slight across the GMF Pond and ranged from 0.0111 ft/ft between G50S and G64S in August 2021 to 0.0225 ft/ft between G51S and G54S in May 2021. The hydraulic gradients are consistent with previous calculations of horizontal gradients at upgradient locations (NRT/OBG, 2017a).

Horizontal hydraulic gradients calculated to the north of the GMF Pond, between G50S and G64S, were on average 0.0121 ft/ft with an average groundwater velocity of 0.045 feet per day (ft/day). Horizontal hydraulic gradients calculated through the center of the GMF Pond, between G50S and G60S, were on average 0.0172 ft/ft with an average groundwater velocity of 0.625 ft/day. Horizontal hydraulic gradients calculated to the south of the GMF Pond, between G51S

and G54S, were on average 0.0199 ft/ft, with an average groundwater velocity of 0.041 ft/day. From April to June 2021, average groundwater flow velocities at the GMF Pond were 0.024 ft/day and from July to August 2021, groundwater flow velocities at the GMF Pond were on average 0.023 ft/day. Horizontal hydraulic gradients and groundwater flow velocities are presented in **Table 3-4**.

3.2.7 Groundwater Classification

Per 35 I.A.C. § 620.210, groundwater within the uppermost aquifer at the GMF Pond meets the definition of a Class I – Potable Resource Groundwater based on the following criteria:

- Groundwater in the uppermost aquifer extends 10 feet or more below the land surface.
- Hydraulic conductivity exceeds the 1×10^{-4} cm/s criterion (**Table 3-3**).

Field hydraulic conductivity tests performed on the unlithified geologic materials that include loess, shallow sand, and intermediate sand at the GMF Pond had geometric mean hydraulic conductivities exceeding 1×10^{-4} cm/s. Based on this information groundwater is classified as Class I – Potable Resource Groundwater.

However, background (upgradient) groundwater originates from areas north and west of the GMF Pond that have been surface mined and present a significant alternative source for groundwater impacts.

3.3 Surface Water Hydrology

Surface water drainage over much of the site flows east or southeast into the Duck Creek Cooling Pond. The Duck Creek Cooling Pond was formed by damming a portion of Duck Creek, a minor tributary of the Illinois River, and was used for thermal treatment of cooling water discharged from the DCPP.

3.3.1 Climate

The climate in Canton is humid and annual precipitation generally exceeds evapotranspiration. Illinois State Water Survey (ISWS) records from 1989 through 2020 at Peoria, Illinois, which is located approximately 35 miles northeast of the DCPP, indicates precipitation averages 35.3 inches per year. Monthly precipitation averages higher than 3 inches from April through August, and 1 to 3 inches in September through March. On average 16 inches of precipitation occur as snowfall.

As shown in **Table A** below, ISWS temperature records show average maximum daily temperatures for 1989 to 2020 ranging from above 70 degrees Fahrenheit (°F) in May through September and minimum average daily temperatures that are below freezing December through March.

Table A. Average Monthly Temperature Extremes and Precipitation for Peoria, Illinois

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Maximum Temperature (ºF)	33.3	37.6	49.9	62.5	72.6	81.3	84.4	82.5	76.9	64.5	50.1	37.2	61.2
Minimum Temperature (ºF)	18.3	21.5	31.6	41.8	52.2	61.7	65.4	63.2	55.4	44.1	33.3	22.7	42.7
Precipitation (inches)	1.71	1.60	2.08	3.42	3.93	3.18	3.02	3.10	2.97	2.64	2.35	1.84	35.3
https://www.isws.illinois.edu/warm/stationmeta.asp?site=ICC&from=wx													

3.3.2 Surface Waters

Duck Creek formerly bordered the east perimeter of the DCPP. In this area, Duck Creek has been dammed for use for thermal treatment of cooling water discharge from the DCPP and is now the predominant surface water body in the vicinity of the GMF Pond. Surface water elevations of the Cooling Pond are from 562.5 to 565 feet NAVD88. Other surface waters in the vicinity include Buckheart Creek to the west, and Rice Lake, Miserable Lake, Big Lake, and Goose Lake to the east, all of which are backwater lakes located between Duck Creek and the Illinois River. The distance between the GMF Pond and the Illinois River is sufficient to eliminate influence on local flow conditions at the site; therefore, site-specific flow conditions are not subject to surface water conditions of the Illinois River. Other surface waters in the vicinity of the GMF Pond include freshwater emergent wetland to the east, and various freshwater ponds to the northeast, south, southeast, and southwest.

4. GROUNDWATER QUALITY

4.1 Summary of Groundwater Monitoring Activities

Groundwater monitoring programs are currently being conducted at the GMF Pond as required by USEPA and IEPA. Additional monitoring was completed in 2021 for development of the Part 845 monitoring program. These programs are summarized below.

4.1.1 40 C.F.R. § 257 Program Monitoring and Well Network

The 40 C.F.R. § 257 Well Network consists of seven monitoring wells screened in the uppermost aquifer nearby and adjacent to the GMF Pond including: three background monitoring wells (G02S, G50S, and G51S) and four compliance monitoring wells (G54S, G57S, G60S, and G64S). The boring logs, well construction forms, and other related monitoring well forms for the GMF Pond 40 C.F.R. § 257 Well Network are included in **Appendix B** of this HCR. The well locations are shown on **Figure 3-1**.

Groundwater is being monitored at the GMF Pond in accordance with the Detection Monitoring Program requirements specified in 40 C.F.R. § 257.94. Details of the procedures and techniques used to fulfill the groundwater sampling and analysis program requirements are found in the Sampling and Analysis Plan for the GMF Pond (NRT/OBG, 2017b). Results are discussed in **Section 4.2**.

The 40 C.F.R. § 257 groundwater samples are collected semi-annually and analyzed for the field and laboratory parameters from Appendix III of 40 C.F.R. § 257, summarized in **Table B** below.

Table B. 40 C.F.R. § 257 Groundwater Monitoring Program Parameters

Field Parameters[1]		
pH	Groundwater Elevation	
Appendix III Parameters (Total, except total dissolved solids [TDS])		
Boron	Chloride	Sulfate
Calcium	Fluoride	TDS

[1]Dissolved oxygen, temperature, specific conductance, oxidation/reduction potential, and turbidity were recorded during sample collection.

4.1.2 IEPA Groundwater Monitoring

Routine quarterly groundwater monitoring is completed at GMF Pond wells G50L/S, G51L/S, G52L/S, G53L/S, G54L/S, G55L/S, G56L/S, G57L/S, G58L/S, G59L/S, G60L/S, R61L/G61S, G62L, G63L/S, and G64L/S at the GMF Pond, in accordance with Water Pollution Control Permit No. 2017-E0-62640. This permit also requires sampling G65L/S, G66L/S, G67L/S, G70L, G71L/S, and G72L/S at the GMF Recycle Pond. The boring logs, well construction forms, and other related monitoring well forms for the GMF Pond well network are included in **Appendix B** of this HCR. The GMF Pond well locations are shown on **Figure 3-1**. Quarterly and annual samples are analyzed for the following field and laboratory parameters listed in **Table C** below.

Table C. IEPA Groundwater Monitoring Program Parameters

Field Parameters			
pH	Temperature	Specific Conductance	
Groundwater Elevation	Depth to Water (bmp)	Bottom of Well Elevation	
Quarterly Parameters (Dissolved)			
Arsenic	Cadmium	Lead	Sulfate
Boron	Chloride	Manganese	TDS
Annual Parameters (Dissolved)			
Alkalinity, bicarbonate	Chromium	Mercury	Selenium
Alkalinity, carbonate	Cobalt	Nickel	Sodium
Ammonia as Nitrogen	Iron	Nitrate nitrogen	Zinc
Calcium	Magnesium	Potassium	

4.1.3 Part 845 Well Installation and Groundwater Monitoring

In 2021, one additional monitoring well (G54C) was installed between the GMF Pond and the Gypsum Recycling Pond to assess the vertical and horizontal lithology, stratigraphy, chemical properties, and physical properties of geologic layers to a minimum of 100 feet bgs as specified in 35 I.A.C. § 845.620(b). Additionally, a porewater sample was collected from temporary leachate monitoring location (XTPW02) installed within the GMF Pond to characterize the CCR materials.

Prospective Part 845 monitoring wells were sampled for eight rounds from February to August 2021 and the results were assessed for selection of the GMF Pond Part 845 monitoring well network presented in the groundwater monitoring plan. Samples were collected from the new monitoring points and analyzed for 35 I.A.C. § 845.600 parameters summarized in **Table D** below. Part 845 groundwater monitoring results are included below in **Section 4.2**.

Table D. Part 845 Groundwater Monitoring Program Parameters

Field Parameters[1]			
pH	Turbidity	Groundwater Elevation	
Metals (Total)			
Antimony	Boron	Cobalt	Molybdenum
Arsenic	Cadmium	Lead	Selenium
Barium	Calcium	Lithium	Thallium
Beryllium	Chromium	Mercury	
Inorganics (Total)			
Fluoride	Sulfate	Chloride	TDS
Other (Total)			
Radium 226 and 228 combined			

[1]Dissolved oxygen, temperature, specific conductance, and oxidation/reduction potential were recorded during sample collection.

4.2 Groundwater Monitoring Results and Analysis

Groundwater data collected from the GMF Pond 40 C.F.R. § 257 network monitoring wells from 2015 to 2021 were supplemented with sampling of additional locations in 2021 and evaluated with respect to standards included in 35 I.A.C. § 845.600(a)(1). This data set was selected because it includes parameters (total metals) consistent with the parameter list in 35 I.A.C. § 845.600(a)(1). The groundwater analytical results are summarized in **Table 4-1** and discussed in the subsections below. Field parameters are included in **Table 4-2**. Results indicate that the parameters discussed in the following sections were detected at concentrations greater than the applicable 35 I.A.C. § 845.600(a)(1) standards and are considered potential exceedances[1].

4.2.1 Total Antimony

Total antimony was detected greater than the GWPS (0.006 milligrams per liter [mg/L]) in one of eight samples collected from downgradient well G57S. The other seven samples were non-detect. No other exceedances for total antimony were observed.

4.2.2 Total Arsenic

Total arsenic was detected greater than the GWPS (0.01 mg/L) in eleven downgradient wells G52S, G35S, G54L, G56S, G57L, G58L, G59L, G59S, G60S, G64S and P60. Total arsenic concentrations ranged from 0.001 to 0.051 mg/L. G52S is commonly in a side-gradient or upgradient position.

4.2.3 Total Cobalt

Total cobalt was detected greater than the GWPS (0.006 mg/L) in one of eight samples collected from downgradient well 60L. The other seven samples ranged from non-detect to 0.0052 mg/L. No other exceedances of total cobalt were observed.

4.2.4 Total Lead

Total lead was detected greater than the GWPS (0.0075 mg/L) in nine downgradient wells (G52S, G55S, G56S, G58L, G58S, G59L, G59S, G60S, G63L, and P60); and one background well G51S. Total lead concentrations in downgradient wells ranged from non-detect to 0.041 mg/L. Total lead concentrations in the upgradient well ranged from non-detect to 0.015 mg/L. G52S is commonly in a side-gradient or upgradient position.

4.2.5 Total Mercury

Total mercury was detected greater than the GWPS (0.002 mg/L) in one of 16 samples collected from upgradient well G02S. The other 15 samples were non-detect. No other exceedances for total mercury were observed.

[1] Potential exceedances include results reported during the eight rounds of baseline groundwater monitoring that are greater than the applicable 35 I.A.C. § 845.600(a)(1) standards. The results are considered potential exceedances because they were compared directly to the standard and did not include an evaluation of background groundwater quality or apply the statistical methodologies proposed in the Groundwater Monitoring Plan (GMP). For simplicity, "GWPS" will be used hereafter in discussing potential exceedances. Exceedances will be determined following IEPA approval of the GMP.

4.2.6 pH (Lower Limit)

The GWPS lower standard for pH (6.5 standard units [SU]) was exceeded at four downgradient wells (G52L, G54L, G60L, and P60); and one background well G02S. Measurements of pH ranged from 6 to 7.1 SU in downgradient wells. Measurements ranged from 6.4 to 7.1 SU in the background well. G52L is commonly in a side-gradient or upgradient position.

4.2.7 Radium 226 and 228 Combined

Radium 226 and 228 combined was detected greater than the GWPS (5 picocuries per liter [pCi/L]) in one of five samples collected from bedrock well G54C. Observations ranged from non-detect to 5.38 pCi/L. No other exceedances for radium 226 and 228 combined were observed.

4.2.8 Total Sulfate

Sulfate can be a primary indicator parameter of CCR leachate impacts on groundwater quality. Total sulfate has been detected greater than the GWPS (400 mg/L) at downgradient well G58S in two of four samples. Total sulfate concentrations ranged from 250 to 540 mg/L. No other exceedances of total sulfate were observed.

4.2.9 Total Thallium

Total thallium was detected greater than the GWPS (0.002 mg/L) in one downgradient well (G57S); and one background well G51S. One of eight samples collected for total thallium from downgradient well G57S exceeded the GWPS; the other seven samples were non-detect. One of 16 samples collected for total thallium from background well G51S exceeded the GWPS; the other 15 samples were non-detect. No other exceedances for total thallium were observed.

5. EVALUATION OF POTENTIAL RECEPTORS

5.1 Water Well Survey

A water well survey was conducted for a 1,000 meter radius of the GMF Pond (Hanson, 2021; Ramboll, 2021). Additionally, a potable water well inventory was completed in 2021 utilizing federal and state databases to assess nearby pumping wells, drinking water receptors, and other uses of water in the vicinity of the GMF Pond. The following sources of information were queried to identify well locations, drinking water receptors, and other uses of water within 1,000 meters of the GMF Pond boundary:

- United States Geological Survey (USGS) National Groundwater Monitoring Network (NGWMN)[1]
- Illinois State Geological Survey (ISGS) Illinois Water and Related Wells (ILWATER) Map[2]
- USEPA Safe Drinking Water Information System (SDWIS)[3]
- IEPA Illinois Drinking Water Watch (DWW)[4]

According to the ISGS ILWATER Map, USEPA SDWIS, and IEPA DWW available records, there is one private well located southwest of the GMF Pond and within 1,000-meters of the GMF Pond. There is no data for Fulton County available from USGS NGWMN.

5.2 Surface Water

A search was performed utilizing the United States Fish and Wildlife Service (USFWS) Wetlands Mapper[5] and the USGS National Map[6] for surface water bodies within 1,000 meters of the GMF Pond.

As indicated on the USFWS Wetlands Mapper and USGS National Map, various surface water features were identified within a 1,000-meter radius of the GMF Pond. Surface waters in the vicinity of the GMF Pond include freshwater emergent wetland to the east, and various freshwater ponds to the northeast, south, southeast, and southwest (**Appendix A**).

The predominant surface water body in the region is the Illinois River and associated lowland backwater lakes. Duck Creek, a minor tributary of the Illinois River, formerly bordered the east perimeter of the DCPP. In this area, Duck Creek has been dammed for use for thermal treatment of cooling water discharge from the DCPP and is now the predominant surface water body in the vicinity of the GMF Pond. The distance between the GMF Pond and the Illinois River is sufficient to eliminate influence on local flow conditions at the site; therefore, site-specific flow conditions are not subject to surface water conditions of the Illinois River. Other surface waters in the vicinity of the GMF Pond include freshwater emergent wetland to the east, and various freshwater ponds to the northeast, south, southeast, and southwest. The USGS National Map places the DCPP within the lower Illinois-Lake Chautauqua watershed subbasin (Hydrologic Unit Code [HUC] 07130003) (**Appendix A**).

[1] USGS NGWMN: https://cida.usgs.gov/ngwmn/index.jsp
[2] ISGS ILWATER Map: https://prairieresearch.maps.arcgis.com/apps/webappviewer/index.html?id=e06b64ae0c814ef3a4e43a191cb57f87
[3] USEPA SDWIS: https://www.epa.gov/enviro/sdwis-search
[4] IEPA Illinois DWW: http://water.epa.state.il.us/dww/index.jsp
[5] USFWS Wetlands Mapper: https://www.fws.gov/wetlands/data/mapper.html
[6] USGS National Map: https://apps.nationalmap.gov/viewer/

A Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map for Fulton County Unincorporated Areas, Illinois (Map No. 17057C0375E, effective on 02/04/2011) is attached in **Appendix F**. The flood hazard areas to the east of the DCPP are defined as those areas subject to inundation by the 1 percent annual chance flood (*i.e.,* 100-year flood), also known as the base flood, that has a 1 percent chance of being equaled or exceeded in any given year.

5.3 Nature Preserves, Historic Sites, Endangered/Threatened Species

A search of the Illinois Department of Natural Resources (IDNR) Natural Heritage Database[7] for natural areas and protected areas within 1,000 meters of the GMF Pond was performed. According to the IDNR Natural Heritage Database, there are 15 Natural Areas in Fulton County, including two Category III - Nature Preserves (Harper-Rector Woods Nature Preserve [34.67 acres] and Kedzior Woodlands Land and Water Reserve [163.64 acres]). No natural areas were identified within 1,000 meters of the GMF Pond.

The IDNR Natural Heritage Database Threatened and Endangered Species by County[8] lists 11 state threatened and 12 state endangered species in Fulton County. The USFWS Environmental Conservation Online System[9] lists three federally threatened and one federally endangered species in Fulton County (**Appendix A**).

Additionally, a search of the IDNR Historic Preservation Division[10] database for historic sites in the vicinity of the Site yielded no results within 1,000 meters of the GMF Pond. The Illinois State Archaeological Survey (ISAS)[11] databases that do not require credentials to access were also searched and yielded no results within 1,000 meters of the GMF Pond.

[7] IDNR Natural Heritage Database: https://www2.illinois.gov/dnr/conservation/NaturalHeritage/Pages/NaturalHeritageDatabase.aspx
[8] Illinois Threatened and Endangered Species by County: https://www2.illinois.gov/dnr/ESPB/Documents/ET_by_County.pdf
[9] Illinois Threatened and Endangered Species by County: https://www2.illinois.gov/dnr/ESPB/Documents/ET_by_County.pdf
[10] IDNR Historic Preservation Division: https://www2.illinois.gov/dnrhistoric/Pages/default.aspx
[11] ISAS: https://www.isas.illinois.edu/

6. CONCLUSIONS

Hydrogeologic characterization of the GMF Pond was originally developed as part of the *Hydrogeologic Report, in Support Document for Permit Application, Duck Creek Power Generating Station, Gypsum Management Facility, Fulton County, Illinois* (Hanson, 2009) and most recently updated for this HCR. Results of these hydrogeologic studies were reintroduced in this HCR and updated to include geologic, hydrogeologic, and groundwater quality data collected with a focus on the GMF Pond (Part 845 regulated) CCR Unit.

The data were summarized and evaluated for changes in groundwater conditions since the previous investigations; available groundwater quality data for the GMF Pond was compared to the Part 845 Standards.

The results of the hydrogeologic and groundwater quality evaluation are:

- The unlithified stratigraphy within and immediately surrounding the GMF Pond consists of the following in descending order: fill material and CCR (gypsum); silt and clayey silt loess (Peoria/Roxanna Loess); weathered till (upper Radnor Till); shallow, medium-grained sand to silt zone; and till (lower Radnor Till).
- The unlithified units overlay Pennsylvanian-age shaley siltstone and silty shale bedrock (Carbondale Formation). Bedrock was encountered approximately 90 feet bgs at the GMF Pond.
- Strip mining has occurred in this area since the 1930s. Strip mining in the site vicinity extracted coal from the Springfield (No. 5) Coal seam. Mining operations in the area have ceased. Strip mining has completely disrupted the natural stratigraphy down to the Springfield (No. 5) Coal unit at some portions of the DCPP property. Previous investigations completed outside of the GMF Pond indicated that bedrock in the area is overlain by mine spoil ranging in thickness from approximately 10 to 75 feet. The mine spoil consists of excavated bedrock (weathered shale, shale fragments, and some coal fines) mixed with the sand, silts and silty clays of the unconsolidated glacial and aeolian deposits. The GMF Pond is located immediately adjacent to and downgradient of several former large surface mining areas.
- Three distinct water-bearing layers have been identified at the Site based on stratigraphic relationships and common hydrogeologic characteristics:
  - **Uppermost Aquifer:** At the GMF Pond this unit includes the Peoria/Roxanna Loess, the upper Radnor Till, and the Shallow Sand Zone. These units are hydraulically connected and underlain by a thick till sequence of the Radnor Till (NRT/OBG, 2017a). The shallow sands are laterally extensive across the site, vary in thickness from less than 1 to 18 feet, and are generally located at an elevation of 570 to 590 feet msl. The shallow sand is saturated. During construction of the GMF Pond, sand was completely removed everywhere it was encountered (mainly the northeast corner and southwest corner of the pond), putting the base of the liner in contact with clay of the lower Radnor Till. Sand outside the GMF Pond footprint remains in place.
  - **Lower Radnor Till/Lower Confining Unit:** Underlying the uppermost aquifer, the lower Radnor Till is approximately 42 to 58 feet thick.

  - **Bedrock Confining Unit:** The thick and low permeability shaley siltstone, silty shale, and coal beds of the Carbondale Formation, are estimated to have a thickness of approximately 300 to 400 feet.

- Groundwater flow around the GMF Pond is generally in a southeast direction. Seasonal variation of groundwater levels at the GMF Pond are present and may fluctuate approximately 1 to 10 feet. There is no observable seasonal variation of groundwater flow direction at the GMF Pond associated with the elevation changes.
- Surface water drainage over much of the site flows east or southeast into the Duck Creek Cooling Pond. The Duck Creek Cooling Pond was formed by damming a portion of Duck Creek, a minor tributary of the Illinois River.
- The nearest surface water body to the GMF Pond is the Duck Creek Cooling Pond, which is located approximately 2,100 feet east of the GMF Pond. The surface water elevation of the Cooling Pond is estimated from 562.5 to 565 feet NAVD88. Which is approximately 20 feet lower than downgradient groundwater at the GMF Pond, indicating that groundwater in the vicinity of the GMF Pond is flowing toward the Cooling Pond.
- Groundwater flow velocities in the uppermost aquifer are estimated from 3.1×10^{-2} to 6.5×10^{-1} ft/day.
- The GMF Pond is lined and the shallow sands of the uppermost aquifer were removed from within the footprint of the pond during construction. The GMF Pond does not appear to impact groundwater flow directions via recharge to groundwater. Given the low permeability of the liner system and the removal of sand below the unit, it is more likely that the GMF Pond is a barrier to groundwater flow within the uppermost aquifer deflecting flow from upgradient areas around the perimeter of the pond toward the downgradient areas south and east of the pond toward the Cooling Pond.
- Based on the detailed geologic information provided, and the hydrogeologic and groundwater quality data, groundwater within the uppermost aquifer at the GMF Pond is classified as Class I – Potable Resource Groundwater. However, background (upgradient) groundwater originates from areas north and west of the GMF Pond that have been extensively surface mined and present a significant alternative source for groundwater impacts.
- Antimony, arsenic, cobalt, lead, pH, sulfate, and thallium were detected at least once at concentrations greater than the GWPS in downgradient uppermost aquifer wells (including PMP wells). Lead, mercury, pH, and thallium were detected at concentrations greater than the GWPS in upgradient uppermost aquifer wells. Radium 226 and 228 combined was detected once at concentrations greater than the GWPS in the bedrock confining unit well.

Groundwater results are considered potential exceedances because they were compared directly to the standard and did not include an evaluation of background groundwater quality or apply the statistical methodologies proposed in the GMP.

This HCR satisfies Part 845 content requirements specific to 35 I.A.C. § 845.620(b) (Hydrogeologic Site Characterization) for the GMF Pond at the DCPP.

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TABLES

TABLE 2-1. GEOTECHNICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample ID	Field Location ID	Top of Sample (ft bgs)	Bottom of Sample (ft bgs)	Moisture Content (%)	Dry Density (pcf)	Specific Gravity	Total Porosity[1] (%)	Vertical Hydraulic Conductivity (cm/s)	LL	PL	PI	Laboratory USCS	Gravel (%)	Sand (%)	Fines (%)
Peoria/Roxana Loess															
G54C-Comp 1	G54C	7	19	18.6	113.1	2.680	32.4	--	35	22	13	CL	0.2	11.6	88.2
G54C-ST14-16	G54C	14	16	22.2	104.0	--	--	7.10E-08	--	--	--	--	--	--	--
SB50/ST10-12	SB50	10	12	25.9	98.0	--	--	6.30E-07	--	--	--	--	--	--	--
SB50-Comp 1	SB50	5	19	24.9	97.3	2.680	41.8	--	32	23	9	CL	0.0	2.6	97.4
SB62/ST12-14	SB62	12	14	21.1	105.5	--	--	1.90E-07	--	--	--	--	--	--	--
SB62-Comp 1	SB62	7	19	19.3	104.7	2.650	36.7	--	35	22	13	CL	0.0	11.5	88.5
Upper Radnor Till															
G54C-Comp 2	G54C	25	33	24.6	98.0	2.680	41.4	--	40	18	22	CL	1.0	18.4	80.6
SB50/ST22-24	SB50	22	24	21.8	106.3	--	--	2.60E-07	--	--	--	--	--	--	--
SB50-Comp 2	SB50	21	31	21.1	116.7	2.700	30.7	--	28	18	10	CL	3.4	26.5	70.1
SB62/ST26-28	SB62	26	28	23.2	105.3	--	--	2.30E-06	--	--	--	--	--	--	--
SB62-Comp 2	SB62	23	33	21.5	104.1	2.700	38.2	--	29	17	12	CL	0.0	23	77
Shallow Sand Zone															
G54C-Comp 3	G54C	35	41	18.2	113.0	2.640	31.4	--	24	19	5	CL-ML	10.6	25.8	63.6
G54C-ST32-34	G54C	32	34	21.9	105.1	--	--	7.50E-07	--	--	--	--	--	--	--
SB50-Comp 3	SB50	31	39	17.1	122.3	2.700	27.4	--	27	18	9	CL	3.6	32	64.4
SB62/ST38-40	SB62	38	40	15.6	118.4	--	--	1.10E-06	--	--	--	--	--	--	--
SB62-Comp 3	SB62	33	39	14.5	116.1	2.650	29.8	--	26	19	7	CL-ML	2.9	23.4	73.7
Lower Radnor Till															
G54C-Comp 4	G54C	47	73	9.8	128.4	2.670	22.9	--	21	13	8	CL	7.4	36.3	56.3
G54C-ST44-46	G54C	44	46	12.2	126.1	--	--	5.40E-06	--	--	--	--	--	--	--
G54C-ST76-78	G54C	76	78	12.6	123.2	--	--	4.10E-08	--	--	--	--	--	--	--
SB50-Comp 4	SB50	41	51	7.7	133.8	2.700	20.6	--	21	15	6	SC-SM	12.9	37.8	49.3
SB62-Comp 4	SB62	41	51	10.0	126.1	2.640	23.5	--	21	15	6	CL-ML	2.8	40.7	56.5
CCR															
Gypsum	XTPW01[2]	grab	grab	32.5	--	2.310	--	--	--	--	--	Gypsum	0.0	4	96
LSN-3781/Gypsum	XTPW01[2]	grab	grab	28.8	73.9	2.700	56.1	6.70E-04	--	--	--	--	--	--	--

[O:FPO 7/13/21, U: EDP 8/25/21, C:LDC 09/07/21, C:SSW 09/16/21]

Notes:
[1] Porosity calculated as relationship of bulk density (p_b) to particle density (p_d) (n = 100[1- (p_b/p_d)])
[2] Gypsum grab samples were collected near location XTPW01
-- = Not Analyzed
% = Percent
bgs = below ground surface
CCR = coal combustion residuals
cm/s = centimeters per second
ft = foot/feet
GMF = Gypsum Management Facilty
LL = Liquid limit
pcf = pounds per cubic foot
PI = Plasticity Index
PL = Plastic Limit

USCS = Unified Soil Classification System
CL = lean clay
CL-ML = silty lean clay
SC-SM = Silty Clayey Sand

HSU = Hydrostratigraphic Unit
LCU = lower confining unit
UA = uppermost aquifer

RAMBOLL

TABLE 2-2. CCR ANALYTICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Plant	Sample Location	Sample Depth (ft)	Sample Date	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Boron (mg/kg)	Cadmium (mg/kg)	Calcium (mg/kg)	Chloride (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Fluoride (mg/kg)	Lead (mg/kg)	Lithium (mg/kg)	Molybdenum (mg/kg)	Selenium (mg/kg)	Sulfate (mg/kg)	Thallium (mg/kg)
DC	GMF Gypsum	0-0	03/08/2021	<3	<1	6	<1	16	<1	100000	64	<4	<2	20	<1	<5	2.9	2.3	14000	<1

Notes:
-- = data not available
< = concentration is less than the concentration shown, which corresponds to the reporting limit for the method.
ft = feet
mg/kg = milligrams per kilogram

TABLE 2-3. POREWATER ANALYTICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Sample Date	Antimony, total (mg/L)	Arsenic, total (mg/L)	Barium, total (mg/L)	Beryllium, total (mg/L)	Boron, total (mg/L)	Cadmium, total (mg/L)	Calcium, total (mg/L)	Chloride, total (mg/L)	Chromium, total (mg/L)	Cobalt, total (mg/L)	Fluoride, total (mg/L)	Lead, total (mg/L)	Lithium, total (mg/L)	Mercury, total (mg/L)	Molybdenum, total (mg/L)	pH (field) (SU)	Radium 226 and 228 combined (pCi/L)	Selenium, total (mg/L)	Sulfate, total (mg/L)	Thallium, total (mg/L)
XTPW02	06/23/2021	<0.003	0.0026	0.059	<0.001	63	0.0066	750	3900	<0.004	0.0064	22.6	<0.001	0.26	0.00054	1.4	6.6	2.65	2.1	4300	0.0015

Notes:
Field readings are reported with as many significant figures as provided by analytical laboratory.
< = concentration is less than the concentration shown, which corresponds to the reporting limit for the method.
mg/L = milligrams per liter
pCi/L = picocuries per liter
SU = standard units

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TABLE 2-4. SOIL ANALYTICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Geologic Unit	Sample Depth (ft BGS)	Sample Date	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Boron (mg/kg)	Cadmium (mg/kg)	Chloride (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Fluoride (mg/kg)	Lead (mg/kg)	Lithium (mg/kg)	Mercury (mg/kg)	Molybdenum (mg/kg)	Selenium (mg/kg)	Sulfate (mg/kg)	Thallium (mg/kg)
SB-50	Peoria/Roxana Loess	4-18	02/02/2021	<2.8	<0.95	75	<0.95	<9.5	<0.95	<1	18	4	<0.25	6.7	6.7	<0.19	<0.95	<0.95	3	<0.95
SB-50	Upper Radnor Till	20-30	02/02/2021	<2.7	1.6	36	<0.91	<9.1	<0.91	<1	12	6.3	<0.25	10	12	<0.18	<0.91	<0.91	<1	<0.91
SB-50	Shallow Sand Zone	30-38	02/02/2021	<3	8.1	29	<1	<10	<1	<1	8.8	5.4	<0.25	7	11	<0.2	1.8	<1	<1	<1
SB-50	Lower Radnor Till	40-50	02/02/2021	<3	3.1	17	<1	<10	<1	<10	6.1	3.5	<2.5	4.3	14	<0.2	<1	<1	270	<1
SB-62	Peoria/Roxana Loess	6-18	02/03/2021	<3	4.6	87	<1	<10	<1	<10	16	3.5	<2.5	7.2	6.4	<0.2	<1	<1	27	<1
SB-62	Upper Radnor Till	22-32	02/03/2021	<3	3.2	30	<1	<10	<1	<10	8.3	4.3	<2.5	6.6	9.5	<0.2	<1	<1	12	<1
SB-62	Shallow Sand Zone	32-38	02/03/2021	<3	3.2	26	<1	<10	<1	<10	8.1	5.4	<2.5	7.2	9.3	<0.2	<1	<1	11	<1
SB-62	Lower Radnor Till	40-50	02/03/2021	<3.3	2.3	20	<1.1	12	<1.1	<11	6	2.7	<2.7	5	20	<0.22	<1.1	<1.1	130	<1.1
G54C	Peoria/Roxana Loess	6-18	02/03/2021	<2.8	2.5	100	<0.93	<9.3	<0.93	10	17	4.1	3	6.6	9.4	<0.19	<0.93	<1.9	37	<0.93
G54C	Upper Radnor Till	24-32	02/03/2021	<3	1.7	21	<1	<10	<1	<10	9.1	5.6	3.7	9.5	8.5	<0.2	<1	<1	11	<1
G54C	Shallow Sand Zone	34-40	02/04/2021	<2.4	3	33	<0.79	<7.9	<0.79	<10	9	5	<2.5	6	11	<0.16	1.7	<0.79	13	<0.79
G54C	Lower Radnor Till	46-80	02/04/2021	<2.1	9.4	86	0.87	<7.2	<0.72	<10	13	7	5.7	11	7	<0.14	<0.72	<0.72	<10	<0.72

Notes:
< = concentration is less than the concentration shown, which corresponds to the reporting limit for the method.
BGS = below ground surface
ft = foot or feet
mg/kg = milligrams per kilogram

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TABLE 3-1. MONITORING WELL LOCATIONS AND CONSTRUCTION DETAILS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Well Number	HSU	Date Constructed	Top of PVC Elevation (ft)	Measuring Point Elevation (ft)	Measuring Point Description	Ground Elevation (ft)	Screen Top Depth (ft BGS)	Screen Bottom Depth (ft BGS)	Screen Top Elevation (ft)	Screen Bottom Elevation (ft)	Well Depth (ft BGS)	Bottom of Boring Elevation (ft)	Screen Length (ft)	Screen Diameter (inches)	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
G02L	--	12/10/2003	--	621.94	Top of Disk	619.50	10.00	15.00	609.50	604.50	15.00	603.50	5	2	40.512901	-89.991114
G02S	UA	09/29/2003	--	621.66	Top of Disk	619.18	23.00	28.00	596.18	591.18	28.00	589.20	5	2	40.512879	-89.991105
G50L	UA/PMP	03/13/2007	623.52	623.52	Top of Riser	620.85	11.61	16.32	609.24	604.53	16.70	604.10	4.7	2	40.508688	-89.990606
G50S	UA	03/13/2007	623.65	623.65	Top of Riser	620.83	29.17	33.98	591.66	586.85	34.30	586.50	4.8	2	40.508672	-89.990607
G51L	UA/PMP	01/28/2008	619.74	619.74	Top of Riser	616.84	12.04	16.83	604.80	600.01	17.21	599.10	4.8	2	40.506573	-89.990864
G51S	UA	01/28/2008	619.66	619.66	Top of Riser	616.83	24.01	28.79	592.82	588.04	29.16	587.70	4.8	2	40.50656	-89.990864
G52L	UA/PMP	01/22/2008	619.55	619.55	Top of Riser	616.70	29.21	33.80	587.49	582.90	34.17	582.50	4.6	2	40.504515	-89.990871
G52S	UA	01/22/2008	619.62	619.62	Top of Riser	616.56	39.15	43.93	577.41	572.63	44.20	570.60	4.8	2	40.504502	-89.990869
G53L	UA/PMP	02/05/2009	623.24	623.24	Top of Riser	620.34	16.97	26.32	603.37	594.02	26.79	593.60	9.4	2	40.508739	-89.988768
G53S	UA	02/05/2009	623.05	623.05	Top of Riser	620.36	30.64	35.13	589.72	585.23	35.56	584.30	4.5	2	40.508739	-89.988753
G54C	BR	02/05/2021	622.72	622.72	Top of PVC	619.59	91.59	101.50	528.00	518.09	102.00	517.59	9.07	2	40.504533	-89.988975
G54L	UA/PMP	02/12/2009	622.95	622.95	Top of Riser	620.18	27.32	36.75	592.86	583.43	37.22	583.00	9.4	2	40.504524	-89.988927
G54S	UA	02/12/2009	622.98	622.98	Top of Riser	620.25	43.50	47.97	576.75	572.28	48.41	571.80	4.5	2	40.504525	-89.98894
G55L	UA/PMP	02/19/2009	623.20	623.20	Top of Riser	620.45	36.12	36.60	584.33	583.85	36.60	583.90	0.5	2	40.504532	-89.988061
G55S	UA	02/19/2009	622.89	622.89	Top of Riser	620.11	41.04	45.49	579.07	574.62	45.96	574.20	4.5	2	40.504522	-89.988062
G56L	UA/PMP	02/16/2009	622.42	622.42	Top of Riser	619.96	13.77	22.11	606.19	597.85	22.89	597.10	8.3	2	40.504643	-89.987075
G56S	UA	02/16/2009	622.71	622.71	Top of Riser	619.84	33.17	37.66	586.67	582.18	38.29	579.80	4.5	2	40.504633	-89.987076
G57L	UA/PMP	01/30/2009	622.90	622.90	Top of Riser	620.22	16.17	25.62	604.05	594.60	26.00	594.20	9.5	2	40.50562	-89.987044
G57S	UA	01/30/2009	622.76	622.76	Top of Riser	620.20	29.65	34.18	590.55	586.02	34.62	582.20	4.5	2	40.505608	-89.987043
G58L	UA/PMP	01/26/2009	622.95	622.95	Top of Riser	620.17	20.69	30.10	599.48	590.07	30.56	589.60	9.4	2	40.506004	-89.987036
G58S	UA	01/26/2009	622.93	622.93	Top of Riser	620.06	31.32	35.80	588.74	584.26	36.43	583.60	4.5	2	40.505993	-89.987033
G59L	UA/PMP	01/23/2009	622.35	622.35	Top of Riser	620.11	22.91	32.33	597.20	587.78	33.03	587.10	9.4	2	40.506386	-89.987023
G59S	UA	01/23/2009	622.79	622.79	Top of Riser	620.11	37.38	41.88	582.73	578.23	42.49	577.60	4.5	2	40.506375	-89.987023

TABLE 3-1. MONITORING WELL LOCATIONS AND CONSTRUCTION DETAILS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Well Number	HSU	Date Constructed	Top of PVC Elevation (ft)	Measuring Point Elevation (ft)	Measuring Point Description	Ground Elevation (ft)	Screen Top Depth (ft BGS)	Screen Bottom Depth (ft BGS)	Screen Top Elevation (ft)	Screen Bottom Elevation (ft)	Well Depth (ft BGS)	Bottom of Boring Elevation (ft)	Screen Length (ft)	Screen Diameter (inches)	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
G60L	UA/PMP	01/17/2008	615.39	615.39	Top of Riser	612.69	20.12	24.91	592.57	587.78	25.28	587.40	4.8	2	40.506745	-89.986816
G60S	UA	01/16/2008	615.03	615.03	Top of Riser	612.33	31.12	35.91	581.21	576.42	36.29	574.30	4.8	2	40.506732	-89.986815
G61S	UA	01/21/2009	622.58	622.58	Top of Riser	620.11	30.19	34.63	589.92	585.48	35.26	582.10	4.4	2	40.507213	-89.987013
G62L	UA/PMP	01/22/2009	623.48	623.48	Top of Riser	620.37	20.31	29.66	600.06	590.71	30.12	582.40	9.4	2	40.507597	-89.987012
G63L	UA/PMP	02/02/2009	623.03	623.03	Top of Riser	620.27	18.47	27.89	601.80	592.38	28.36	591.90	9.4	2	40.507992	-89.987
G63S	UA	02/02/2009	623.00	623.00	Top of Riser	619.98	34.52	39.01	585.46	580.97	39.47	580.00	4.5	2	40.50798	-89.986998
G64L	UA/PMP	01/22/2009	622.46	622.46	Top of Riser	620.24	18.12	27.48	602.12	592.76	27.95	592.30	9.4	2	40.508378	-89.987007
G64S	UA	01/22/2009	623.06	623.06	Top of Riser	620.25	34.50	38.99	585.75	581.26	39.48	580.30	4.5	2	40.508365	-89.987011
G65L	UA/PMP	01/15/2008	612.76	612.76	Top of Riser	610.29	17.28	22.08	593.01	588.21	22.45	587.80	4.8	2	40.50266	-89.987293
G65S	UA	01/15/2008	612.94	612.94	Top of Riser	610.09	26.92	31.70	583.17	578.39	32.08	577.40	4.8	2	40.502657	-89.987313
G66L	UA/PMP	02/04/2009	617.93	617.93	Top of Riser	614.98	9.84	19.27	605.14	595.71	19.74	595.20	9.4	2	40.503359	-89.987127
G66S	UA	02/04/2009	617.83	617.83	Top of Riser	615.04	35.10	39.59	579.94	575.45	40.59	574.50	4.5	2	40.503346	-89.987129
G67L	--	02/03/2009	617.26	617.26	Top of Riser	614.77	7.36	16.72	607.41	598.05	17.18	597.60	9.4	2	40.504146	-89.987257
G67S	--	02/03/2009	617.77	617.77	Top of Riser	614.81	31.09	35.58	583.72	579.23	36.21	576.80	4.5	2	40.504154	-89.98727
G68L	--	02/09/2009	616.31	616.31	Top of Riser	614.28	15.48	24.85	598.80	589.43	25.31	589.00	9.4	2	40.504213	-89.988407
G68S	--	02/09/2009	616.93	616.93	Top of Riser	614.24	34.75	39.22	579.49	575.02	39.88	568.20	4.5	2	40.50421	-89.988421
G69L	--	02/10/2009	616.95	616.95	Top of Riser	614.56	15.31	24.68	599.25	589.88	25.15	589.40	9.4	2	40.504194	-89.989567
G69S	--	02/10/2009	617.65	617.65	Top of Riser	614.68	36.08	40.58	578.60	574.10	41.01	573.70	4.5	2	40.504194	-89.989552
G70L	--	11/18/2008	617.76	617.76	Top of Riser	615.08	20.19	29.54	594.89	585.54	30.00	585.10	9.4	2	40.503721	-89.990033
G71L	--	11/20/2008	617.52	617.52	Top of Riser	615.13	19.80	29.29	595.33	585.84	30.20	584.90	9.5	2	40.502994	-89.989596
G71S	--	11/20/2008	617.81	617.81	Top of Riser	615.24	33.96	37.96	581.28	577.28	38.40	575.20	4	2	40.503005	-89.989603
G72L	--	11/19/2008	617.71	617.71	Top of Riser	614.86	14.65	24.01	600.21	590.85	24.79	590.10	9.4	2	40.502439	-89.988767
G72S	--	11/19/2008	617.61	617.61	Top of Riser	615.03	30.16	34.64	584.87	580.39	35.09	575.60	4.5	2	40.502439	-89.988785

TABLE 3-1. MONITORING WELL LOCATIONS AND CONSTRUCTION DETAILS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Well Number	HSU	Date Constructed	Top of PVC Elevation (ft)	Measuring Point Elevation (ft)	Measuring Point Description	Ground Elevation (ft)	Screen Top Depth (ft BGS)	Screen Bottom Depth (ft BGS)	Screen Top Elevation (ft)	Screen Bottom Elevation (ft)	Well Depth (ft BGS)	Bottom of Boring Elevation (ft)	Screen Length (ft)	Screen Diameter (inches)	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
G73L	--	02/06/2009	617.64	617.64	Top of Riser	614.78	24.63	33.98	590.15	580.80	34.76	580.00	9.4	2	40.502492	-89.987727
P60	UA/PMP	03/15/2017	622.22	622.22	Top of Riser	619.82	29.55	34.14	590.27	585.68	34.60	585.20	4.6	2	40.506753	-89.987023
P61	UA/PMP	09/23/2021	613.96	613.96	Top of PVC	611.09	7.55	18.37	602.38	592.72	18.76	591.09	9.66	2	40.507167	-89.986146
P62	UA/PMP	09/23/2021	613.54	613.54	Top of PVC	610.81	11.18	15.78	599.63	595.03	16.30	594.51	4.6	2	40.507762	-89.986782
P63	UA/PMP	09/23/2021	614.47	614.47	Top of PVC	612.33	13.04	17.63	599.29	594.70	18.25	594.08	4.59	2	40.508145	-89.986768
P64	UA/PMP	09/23/2021	616.47	616.47	Top of PVC	614.04	6.17	15.96	607.87	598.08	16.47	597.57	9.79	2	40.508911	-89.986794
R61L	PMP	03/14/2017	622.39	622.39	Top of Riser	619.66	18.54	28.17	601.12	591.49	28.70	591.00	9.6	2	40.507228	-89.987014
R72S	--	11/09/2016	617.57	617.57	Top of Riser	614.81	29.83	34.49	584.98	580.32	35.00	579.90	4.7	2	40.502442	-89.988803
X301	S	--	--	--	--	--	--	--	--	--	--	--	--	--	40.504777	-89.990046
XTPW02	CCR	06/23/2021	617.20	617.20	Top of PVC Casing	615.00	3.02	5.02	611.98	609.98	5.14	609.50	2	1	40.519976	-89.98991

Notes:
All elevation data are presented relative to the North American Vertical Datum 1988 (NAVD88), GEOID 12A
-- = data not available
BGS = below ground surface
BR = bedrock
CCR = coal combustion residuals
ft = foot or feet
HSU = Hydrostratigraphic Unit
PMP = potential migration pathway
PVC = polyvinyl chloride
S = source water
UA = uppermost aquifer
UA/PMP = uppermost aquifer/potential migration pathway

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TABLE 3-2. VERTICAL HYDRAULIC GRADIENTS

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT

DUCK CREEK POWER PLANT

GMF POND

CANTON, ILLINOIS

Date	G51L Groundwater Elevation (ft NAVD88)	G51S Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	PMP	UA				
4/14/2021	610.50	610.69	-0.19	12.68	-0.01	up
4/28/2021	609.12	609.35	-0.23	12.68	-0.02	up
5/10/2021	610.72	610.93	-0.21	12.68	-0.02	up
6/1/2021	609.14	609.44	-0.30	12.68	-0.02	up
6/10/2021	606.57	606.98	-0.41	12.68	-0.03	up
6/21/2021	608.97	609.37	-0.40	12.68	-0.03	up
7/12/2021	610.66	610.91	-0.25	12.68	-0.02	up
7/26/2021	608.51	608.84	-0.33	12.68	-0.03	up
8/5/2021	605.95	606.34	-0.39	12.68	-0.03	up
			Middle of screen elevation G51L			602.4
			Middle of screen elevation G51S			589.7

Date	G54L Groundwater Elevation (ft NAVD88)	G54S Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	PMP	UA				
4/14/2021	591.47	590.44	1.03	16.97	0.06	down
4/28/2021	591.11	590.52	0.59	16.61	0.04	down
5/10/2021	591.22	590.53	0.69	16.72	0.04	down
6/1/2021	591.52	590.80	0.72	17.02	0.04	down
6/10/2021	591.78	591.07	0.71	17.28	0.04	down
6/21/2021	592.11	591.23	0.88	17.61	0.05	down
7/12/2021	592.97	591.76	1.21	13.66	0.09	down
7/26/2021	592.50	591.98	0.52	18.00	0.03	down
8/5/2021	592.79	592.55	0.24	18.29	0.01	down
			Middle of screen elevation G54L			588.2
			Middle of screen elevation G54S			574.5

RAMBOLL

TABLE 3-2. VERTICAL HYDRAULIC GRADIENTS

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT

DUCK CREEK POWER PLANT

GMF POND

CANTON, ILLINOIS

Date	G54S Groundwater Elevation (ft NAVD88)	G54C Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	UA	BCU				
4/14/2021	590.44	581.99	8.45	51.04	0.17	down
4/28/2021	590.52	581.10	9.42	51.04	0.18	down
5/10/2021	590.53	580.11	10.42	51.04	0.20	down
6/1/2021	590.80	581.00	9.80	51.04	0.19	down
6/10/2021	591.07	580.47	10.60	51.04	0.21	down
6/21/2021	591.23	579.83	11.40	51.04	0.22	down
7/12/2021	591.76	582.36	9.40	51.04	0.18	down
7/26/2021	591.98	581.64	10.34	51.04	0.20	down
8/5/2021	592.55	578.99	13.56	51.04	0.27	down
			Middle of screen elevation G54S			574.5
			Middle of screen elevation G54C			523.5

Date	G57L Groundwater Elevation (ft NAVD88)	G57S Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	PMP	UA				
4/14/2021	603.07	601.83	1.24	13.35	0.09	down
4/28/2021	602.15	601.99	0.16	12.43	0.01	down
5/10/2021	604.41	602.61	1.80	14.69	0.12	down
6/1/2021	603.88	603.89	-0.01	14.16	0.00	flat
6/10/2021	603.17	603.20	-0.03	13.45	0.00	up
6/21/2021	602.45	602.52	-0.07	12.73	-0.01	up
7/12/2021	604.81	604.68	0.13	12.68	0.01	down
7/26/2021	604.43	604.41	0.02	14.71	0.00	flat
8/5/2021	603.00	603.51	-0.51	13.28	-0.04	up
			Middle of screen elevation G57L			602.4
			Middle of screen elevation G57S			589.7

TABLE 3-2. VERTICAL HYDRAULIC GRADIENTS

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT

DUCK CREEK POWER PLANT

GMF POND

CANTON, ILLINOIS

Date	G60L Groundwater Elevation (ft NAVD88)	G60S Groundwater Elevation (ft NAVD88)	Head Change (ft)	Distance Change [1] (ft)	Vertical Hydraulic Gradient [2] (dh/dl)	
	PMP	UA				
4/14/2021	606.78	590.16	16.62	11.36	1.5	down
4/28/2021	603.75	589.76	13.99	11.36	1.2	down
5/10/2021	606.16	590.34	15.82	11.36	1.4	down
6/1/2021	605.20	590.54	14.66	11.36	1.3	down
6/10/2021	603.76	590.02	13.74	11.36	1.2	down
6/21/2021	603.43	589.48	13.95	11.36	1.2	down
7/12/2021	609.27	591.02	18.25	11.36	1.6	down
7/26/2021	605.97	590.71	15.26	11.36	1.3	down
8/5/2021	604.40	590.05	14.35	11.36	1.3	down
			Middle of screen elevation G60L			590.2
			Middle of screen elevation G60S			578.8

[O:EDP 8/26/21 U: LDC 09/09/21, C: SSW 09/17/21]

Notes:

1. Distance change was calculated using the midpoint of the piezometer screen and water table surface. If the water table surface was above the top of the monitoring well screen, then distance change was calculated using the midpoint of both screens.
2. Vertical gradients between ±0.0015 are considered flat, and typically have less than 0.02 foot difference in groundwater elevation between wells.

-- = Not calculated
BCU = bedrock confining unit
dh = head change
dl = distance change
ft = feet
NAVD88 = North American Vertical Datum of 1988
PMP = potential migration pathway
UA = uppermost aquifer

TABLE 3-3. FIELD HYDRAULIC CONDUCTIVITIES
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Well ID	Gradient Position	Bottom of Screen Elevation (ft NAVD88)	Screen Length [1] (ft)	Field Identified Screened Material	Slug Type	Analysis Method	Falling Head (Slug In) K (cm/s)	Rising Head (Slug Out) K (cm/s)	Minimum Hydraulic Conductivity (cm/s)	Maximum Hydraulic Conductivity (cm/s)	Hydraulic Conductivity Geometric Mean (cm/s)
Uppermost Aquifer (Peoria/Roxana Loess, Upper Radnor Till, Shallow Sand)											
G50L	U	604.53	4.70	ML/CL	Solid	KGS Model	2.30E-03	2.10E-03	3.00E-05	3.90E-03	3.6E-04
G51L	U	600.01	4.80	ML/CL	Solid	KGS Model	3.00E-05	---			
G53L	D	594.02	9.40	CL/ML	Solid	KGS Model	1.10E-04	1.10E-04			
G54L	D	583.43	9.40	CL/ML	Solid	Bouwer-Rice	4.90E-05	2.20E-04			
G60L	D	587.78	4.80	CL/ML	Solid	KGS Model	2.30E-04	2.60E-04			
G50S	U	586.85	4.80	S(ML), CL/ML	Solid	KGS Model	6.50E-05	1.50E-04			
G51S	U	588.04	4.80	CL/ML, SP	Solid	Bouwer-Rice / KGS Model	7.20E-05	1.10E-04			
G53S	D	585.23	4.50	ML/CL, SP	Solid	KGS Model	3.80E-03	3.20E-03			
G54S	D	572.28	4.50	ML/CL, SP	Solid	Bouwer-Rice	1.20E-04	2.10E-04			
G57S	D	586.02	4.50	SP, S(CL), ML/CL	Solid	KGS Model	2.60E-03	6.80E-04			
G60S	D	576.42	4.80	ML/CL, SP	Solid	KGS Model	3.90E-03	3.50E-03			
G63S	D	580.97	4.50	ML, ML/CL, SP	Solid	KGS Model	3.00E-04	2.90E-04			
Bedrock Confining Unit											
G54C	D	518.09	9.07	Shale	Solid	Hvorslev	1.60E-04	1.40E-04	1.40E-04	1.60E-04	1.50E-04

[O: EDP 8/25/21, C: SSW 09/17/21]

Notes:
1. All wells are constructed from 2 inch PVC with 0.01 inch slotted screens.
- - - = no data collected on date / no vertical gradient calculated
CL/ML = Silty clay
cm/s = centimeters per second
D = downgradient
GMF = Gypsum Management Facility
ft = foot/feet
K = hydraulic conductivity
KGS = Kansas Geological Survey
ML = Silt
NAVD88 = North American Vertical Datum of 1988
U = upgradient

USCS = Unified Soil Classification System
ML/CL = Clayey silt
S(CL) = Sandy clay
S(ML) = Sandy silt
SM = Silty sand
SP= Poorly graded sand

TABLE 3-4. HORIZONTAL HYDRAULIC GRADIENTS AND GROUNDWATER FLOW VELOCITIES
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

$\mathbf{V = K\,i\ /\ n_e}$ V = Groundwater Velocity
K = Hydraulic Conductivity [1]
i = hydraulic gradient
n_e = Effective Porosity [2]

Northern GMF Pond Uppermost Aquifer (G50S to G64S)

Distance between Wells (ft): 1008
Hydraulic Conductivity (ft/day): 0.66
Effective Porosity (%): 17.5 Assumes: clay/sand

Date	G50S Groundwater Elevation (ft NAVD88)	G64S Groundwater Elevation (ft NAVD88)	Change in Elevation (ft)	Horizontal Gradient (ft/ft)	Velocity (ft/day)
	UA	UA			
4/14/2021	612.98	599.04	13.94	0.0138	0.052
4/28/2021	611.54	599.38	12.16	0.0121	0.045
5/10/2021	612.71	599.64	13.07	0.0130	0.049
6/1/2021	611.87	600.28	11.59	0.0115	0.043
6/10/2021	611.15	599.97	11.18	0.0111	0.042
6/21/2021	611.57	599.51	12.06	0.0120	0.045
7/12/2021	613.25	600.50	12.75	0.0126	0.048
7/26/2021	612.06	600.60	11.46	0.0114	0.043
8/5/2021	611.21	600.04	11.17	0.0111	0.042
			Average	0.0121	0.045

Central GMF Pond Uppermost Aquifer (G50S to G60S)

Distance between Wells (ft): 1269
Hydraulic Conductivity (ft/day): 5.46
Effective Porosity (%): 15 Assumes: silt/sand

Date	G50S Groundwater Elevation (ft NAVD88)	G60S Groundwater Elevation (ft NAVD88)	Change in Elevation (ft)	Horizontal Gradient (ft/ft)	Velocity (ft/day)
	UA	UA			
4/14/2021	612.98	590.16	22.82	0.0180	0.654
4/28/2021	611.54	589.76	21.78	0.0172	0.624
5/10/2021	612.71	590.34	22.37	0.0176	0.641
6/1/2021	611.87	590.54	21.33	0.0168	0.611
6/10/2021	611.15	590.02	21.13	0.0167	0.606
6/21/2021	611.57	589.48	22.09	0.0174	0.633
7/12/2021	613.25	591.02	22.23	0.0175	0.637
7/26/2021	612.06	590.71	21.35	0.0168	0.612
8/5/2021	611.21	590.05	21.16	0.0167	0.606
			Average	0.0172	0.625

TABLE 3-4. HORIZONTAL HYDRAULIC GRADIENTS AND GROUNDWATER FLOW VELOCITIES
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Southern GMF Pond Uppermost Aquifer (G51S to G54S)

Distance between Wells (ft): 906
Hydraulic Conductivity (ft/day): 0.36
Effective Porosity (%): 17.5 Assumes: clay/sand

Date	G51S Groundwater Elevation (ft NAVD88)	G54S Groundwater Elevation (ft NAVD88)	Change in Elevation (ft)	Horizontal Gradient (ft/ft)	Velocity (ft/day)
	UA	UA			
4/14/2021	610.69	590.44	20.25	0.0224	0.046
4/28/2021	609.35	590.52	18.83	0.0208	0.042
5/10/2021	610.93	590.53	20.40	0.0225	0.046
6/1/2021	609.44	590.80	18.64	0.0206	0.042
6/10/2021	606.98	591.07	15.91	0.0176	0.036
6/21/2021	609.37	591.23	18.14	0.0200	0.041
7/12/2021	610.91	591.76	19.15	0.0211	0.043
7/26/2021	608.84	591.98	16.86	0.0186	0.038
8/5/2021	606.34	592.55	13.79	0.0152	0.031
			Average	0.0199	0.041

[O: EDP 8/28/21, C: LDC 09/17/21]

Notes:
[1] Hydraulic conductivity values used above are the geometric mean of hydrostratigraphic unit hydraulic conductivity values calculated from slug tests completed in April 2021 by Ramboll.
[2] Effective porosity used in these calculations was derived from an average between estimated values of 0.20 for silt material, 0.267 for gravel, 0.07 for clay, and 0.28 for sand from Morris, D.A and A.I. Johnson, 1967. Summary of hydrologic and physical properties of rock and soil materials as analyzed by the Hydrologic Laboratory of the U.S. Geological Survey. U.S. Geological Survey Water-Supply Paper 1839-D, 42p. and Heath, R.C., 1983. Basic ground-water hydrology, U.S. Geological Survey Water-Supply Paper 2220, 86p. Effective porosity may be as high as maximum total porosity (56%) calculated in Table 2-1.
% = percent
ft/day = feet per day
ft/ft = feet per feet
ft= feet
NAVD88 = North American Vertical Datum of 1988
UA = uppermost aquifer

TABLE 4-1. GROUNDWATER ANALYTICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Location	Sample Date	Antimony, total (mg/L)	Arsenic, total (mg/L)	Barium, total (mg/L)	Beryllium, total (mg/L)	Boron, total (mg/L)	Cadmium, total (mg/L)	Calcium, total (mg/L)	Chloride, total (mg/L)	Chromium, total (mg/L)	Cobalt, total (mg/L)	Fluoride, total (mg/L)	Lead, total (mg/L)	Lithium, total (mg/L)	Mercury, total (mg/L)	Molybdenum, total (mg/L)	pH (field) (SU)	Radium 226 and 228 combined (pCi/L)	Selenium, total (mg/L)	Sulfate, total (mg/L)	Thallium, total (mg/L)	Total Dissolved Solids (mg/L)
35 I.A.C. 845.600	Lower	0	0	0	0	0	0	--	0	0	0	0	0	0	0	0	6.5	0	0	0	0	0
	Upper	0.006	0.010	2.0	0.004	2	0.005	--	200	0.1	0.006	4.0	0.0075	0.04	0.002	0.1	9.0	5	0.05	400	0.002	1200
G02S	12/02/2015	<0.003	0.0077	0.2	<0.001	0.13	<0.001	97	3.2	<0.004	<0.002	0.359	0.0015	<0.01	<0.0002	<0.001	6.6	1.86	<0.001	<1	<0.001	400
G02S	02/03/2016	<0.003	0.0071	0.22	<0.001	0.044	<0.001	92	3	0.0046	<0.002	0.274	0.002	<0.01	<0.0002	0.0042	6.6	0.371	<0.001	<1	<0.001	390
G02S	04/20/2016	<0.003	0.0059	0.23	<0.001	0.039	<0.001	110	2.7	<0.004	<0.002	0.365	0.0011	<0.01	<0.0002	<0.001	6.6	0.827	<0.001	<1	<0.001	600
G02S	08/18/2016	<0.003	0.0041	0.17	<0.001	0.03	<0.001	98	2.6	<0.004	<0.002	0.33	0.0012	<0.01	<0.0002	<0.001	6.8	2.26	<0.001	<1	<0.001	350
G02S	10/19/2016	<0.003	0.0069	0.19	<0.001	0.034	<0.001	97	2.5	<0.004	<0.002	0.366	0.0011	<0.01	<0.0002	<0.001	6.9	0.191	<0.001	<1	<0.001	400
G02S	01/12/2017	<0.003	0.0077	0.22	<0.001	0.039	<0.001	94	3.7	<0.004	<0.002	0.564	<0.001	<0.01	<0.0002	<0.001	6.9	1.18	<0.001	<1	<0.001	420
G02S	04/22/2017	<0.003	0.0051	0.16	<0.001	0.04	<0.001	89	2.9	<0.004	<0.002	0.315	<0.001	<0.01	0.0024	<0.001	6.8	0.347	<0.001	<1	<0.001	440
G02S	06/28/2017	<0.003	0.0067	0.22	<0.001	0.042	<0.001	89	2.6	<0.004	<0.002	0.374	<0.001	<0.01	<0.0002	<0.001	6.8	0.761	<0.001	<1	<0.001	370
G02S	11/10/2017	--	--	--	--	0.036	--	95	3.1	--	--	0.41	--	--	--	--	6.9	--	--	2.9	--	390
G02S	01/17/2018	--	--	--	--	--	--	--	2.7	--	--	--	--	--	--	--	6.9	--	--	--	--	--
G02S	06/06/2018	--	--	--	--	0.042	--	95	2.4	--	--	0.369	--	--	--	--	6.9	--	--	<1	--	340
G02S	07/06/2018	--	--	--	--	--	--	--	2.9	--	--	--	--	--	--	--	7.0	--	--	--	--	--
G02S	10/04/2018	--	--	--	--	0.046	--	97	2.7	--	--	0.285	--	--	--	--	7.1	--	--	<1	--	340
G02S	02/06/2019	--	--	--	--	0.048	--	99	2.5	--	--	0.379	--	--	--	--	7.0	--	--	<1	--	400
G02S	07/08/2019	--	--	--	--	0.05	--	96	<5	--	--	0.394	--	--	--	--	7.0	--	--	<1	--	420
G02S	01/06/2020	--	--	--	--	0.044	--	100	<5	--	--	0.476	--	--	--	--	6.6	--	--	<1	--	440
G02S	08/11/2020	--	--	--	--	0.049	--	97	<5	--	--	0.27	--	--	--	--	6.4	--	--	<1	--	420
G02S	02/19/2021	--	--	--	--	0.037	--	95	2.6	--	--	0.411	--	--	--	--	6.5	--	--	<1	--	340
G02S	04/14/2021	<0.003	0.0092	0.29	<0.001	0.11	<0.001	89	2.3	<0.004	<0.002	0.336	<0.001	<0.02	<0.0002	<0.001	6.7	0.992	<0.001	<1	<0.001	380
G02S	04/29/2021	<0.003	0.0059	0.16	<0.001	0.047	<0.001	96	1.6	<0.004	<0.002	<0.25	<0.001	<0.02	<0.0002	<0.001	6.8	0.194	<0.001	<1	<0.001	370
G02S	05/12/2021	<0.003	0.0061	0.15	<0.001	0.091	<0.001	96	2.5	<0.004	<0.002	0.35	<0.001	<0.02	<0.0002	<0.001	6.7	0	<0.001	<1	<0.001	290
G02S	06/01/2021	<0.003	0.0069	0.17	<0.001	0.12	<0.001	94	8.2	<0.004	<0.002	0.358	<0.001	<0.02	<0.0002	<0.001	6.8	0.0133	<0.001	2.7	<0.001	450

TABLE 4-1. GROUNDWATER ANALYTICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Location	Sample Date	Antimony, total (mg/L)	Arsenic, total (mg/L)	Barium, total (mg/L)	Beryllium, total (mg/L)	Boron, total (mg/L)	Cadmium, total (mg/L)	Calcium, total (mg/L)	Chloride, total (mg/L)	Chromium, total (mg/L)	Cobalt, total (mg/L)	Fluoride, total (mg/L)	Lead, total (mg/L)	Lithium, total (mg/L)	Mercury, total (mg/L)	Molybdenum, total (mg/L)	pH (field) (SU)	Radium 226 and 228 combined (pCi/L)	Selenium, total (mg/L)	Sulfate, total (mg/L)	Thallium, total (mg/L)	Total Dissolved Solids (mg/L)
35 I.A.C. 845.600	Lower	0	0	0	0	0	0	--	0	0	0	0	0	0	0	0	6.5	0	0	0	0	0
	Upper	0.006	0.010	2.0	0.004	2	0.005	--	200	0.1	0.006	4.0	0.0075	0.04	0.002	0.1	9.0	5	0.05	400	0.002	1200
G02S	06/15/2021	<0.003	0.0078	0.18	<0.001	0.064	<0.001	100	4	<0.004	<0.002	0.307	<0.001	<0.02	<0.0002	<0.001	6.8	0.618	<0.001	2.1	<0.001	390
G02S	06/21/2021	<0.003	0.0063	0.17	<0.001	0.11	<0.001	98	3.5	<0.004	<0.002	0.498	<0.001	<0.02	<0.0002	<0.001	6.8	0.268	<0.001	1.1	<0.001	440
G02S	07/12/2021	<0.003	0.0064	0.18	<0.001	0.043	<0.001	96	1.9	<0.004	<0.002	0.322	<0.001	<0.02	<0.0002	<0.001	6.7	0.372	<0.001	<1	<0.001	420
G02S	07/28/2021	<0.003	0.0059	0.17	<0.001	0.17	<0.001	99	1.4	<0.004	<0.002	0.324	<0.001	<0.02	<0.0002	<0.001	6.9	2	0.0012	<1	<0.001	440
G50S	01/30/2015	--	0.0016	--	--	0.021	--	94	4.5	--	--	--	0.0011	--	--	--	6.8	--	--	25	--	--
G50S	04/17/2015	--	<0.001	--	--	0.02	--	91	4.6	--	--	--	<0.001	--	--	--	7.3	--	--	23	--	--
G50S	07/24/2015	--	0.0012	--	--	0.015	--	96	5.4	--	--	--	0.0014	--	--	--	7.4	--	--	23	--	--
G50S	10/15/2015	--	<0.001	--	--	0.025	--	85	5.2	--	--	--	<0.001	--	--	--	7.4	--	--	19	--	--
G50S	12/03/2015	<0.003	0.005	0.12	<0.001	0.022	<0.001	98	6	<0.004	<0.002	0.311	0.0015	<0.01	<0.0002	0.001	6.9	0.865	<0.001	22	<0.001	340
G50S	01/29/2016	<0.003	<0.001	0.072	<0.001	0.024	<0.001	77	5.4	<0.004	<0.002	<0.25	<0.001	<0.01	<0.0002	<0.001	7.4	0.652	<0.001	21	<0.001	300
G50S	04/25/2016	<0.003	<0.001	0.063	<0.001	0.025	<0.001	81	5.3	<0.004	<0.002	0.373	<0.001	<0.01	<0.0002	<0.001	7.3	0.325	<0.001	21	<0.001	360
G50S	08/10/2016	<0.003	<0.001	0.074	<0.001	0.017	<0.001	86	6.3	<0.004	<0.002	0.284	<0.001	<0.01	0.00031	<0.001	7.3	0.455	<0.001	22	<0.001	320
G50S	10/21/2016	<0.003	<0.001	0.073	<0.001	<0.01	<0.001	76	5.9	<0.004	<0.002	0.297	<0.001	<0.01	<0.0002	<0.001	7.3	0.733	<0.001	23	<0.001	280
G50S	01/21/2017	<0.003	<0.001	0.07	<0.001	0.018	<0.001	60	6	<0.004	<0.002	0.261	<0.001	<0.01	<0.0002	<0.001	7.3	0.0182	<0.001	23	<0.001	340
G50S	04/07/2017	<0.003	0.0016	0.089	<0.001	0.011	<0.001	90	5.6	0.0058	<0.002	0.284	0.0016	<0.01	<0.0002	0.001	7.3	0.529	<0.001	24	<0.001	340
G50S	06/28/2017	<0.003	<0.001	0.08	<0.001	<0.01	<0.001	75	6.6	<0.004	<0.002	0.255	0.0017	<0.01	<0.0002	0.0015	7.1	0.371	<0.001	26	0.001	330
G50S	11/08/2017	--	--	--	--	0.012	--	83	5.9	--	--	0.369	--	--	--	--	7.1	--	--	22	--	310
G50S	06/04/2018	--	--	--	--	0.067	--	87	7.3	--	--	0.301	--	--	--	--	7.1	--	--	33	--	320
G50S	07/13/2018	--	--	--	--	0.018	--	88	--	--	--	0.333	--	--	--	--	7.1	--	--	--	--	350
G50S	10/11/2018	--	--	--	--	0.018	--	97	9.6	--	--	0.264	--	--	--	--	7.2	--	--	34	--	340
G50S	02/05/2019	--	--	--	--	0.016	--	86	7.6	--	--	<0.25	--	--	--	--	7.1	--	--	27	--	360
G50S	07/08/2019	--	--	--	--	0.018	--	88	9.6	--	--	0.351	--	--	--	--	7.4	--	--	34	--	420

TABLE 4-1. GROUNDWATER ANALYTICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Location	Sample Date	Antimony, total (mg/L)	Arsenic, total (mg/L)	Barium, total (mg/L)	Beryllium, total (mg/L)	Boron, total (mg/L)	Cadmium, total (mg/L)	Calcium, total (mg/L)	Chloride, total (mg/L)	Chromium, total (mg/L)	Cobalt, total (mg/L)	Fluoride, total (mg/L)	Lead, total (mg/L)	Lithium, total (mg/L)	Mercury, total (mg/L)	Molybdenum, total (mg/L)	pH (field) (SU)	Radium 226 and 228 combined (pCi/L)	Selenium, total (mg/L)	Sulfate, total (mg/L)	Thallium, total (mg/L)	Total Dissolved Solids (mg/L)
35 I.A.C. 845.600	Lower	0	0	0	0	0	0	--	0	0	0	0	0	0	0	0	6.5	0	0	0	0	0
	Upper	0.006	0.010	2.0	0.004	2	0.005	--	200	0.1	0.006	4.0	0.0075	0.04	0.002	0.1	9.0	5	0.05	400	0.002	1200
G50S	01/13/2020	--	--	--	--	0.018	--	97	8.6	--	--	0.311	--	--	--	--	6.9	--	--	30	--	360
G50S	08/10/2020	--	--	--	--	0.016	--	91	8.5	--	--	0.28	--	--	--	--	6.8	--	--	38	--	370
G50S	11/18/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0	--	--	--	--	--
G50S	02/19/2021	--	--	--	--	0.015	--	95	12	--	--	0.335	--	--	--	--	7.0	--	--	41	--	330
G50S	04/14/2021	<0.003	<0.001	0.071	<0.001	0.034	<0.001	88	15	<0.004	<0.002	0.279	<0.001	<0.02	<0.0002	<0.001	7.2	0.644	<0.001	52	<0.001	400
G50S	04/29/2021	<0.003	<0.001	0.071	<0.001	0.025	<0.001	98	14	<0.004	<0.002	<0.25	<0.001	<0.02	<0.0002	<0.001	7.1	0.0455	<0.001	50	<0.001	350
G50S	05/13/2021	<0.003	0.0011	0.076	<0.001	0.016	<0.001	95	13	<0.004	<0.002	<0.25	<0.001	<0.02	<0.0002	<0.001	7.2	0	<0.001	47	<0.001	380
G50S	06/01/2021	<0.003	<0.001	0.066	<0.001	0.041	<0.001	93	12	<0.004	<0.002	0.3	<0.001	<0.02	<0.0002	0.0023	7.0	0.798	<0.001	49	<0.001	410
G50S	06/10/2021	<0.003	<0.001	0.068	<0.001	0.016	<0.001	93	16	<0.004	<0.002	<0.25	<0.001	<0.02	<0.0002	<0.001	7.2	0.342	<0.001	48	<0.001	390
G50S	06/21/2021	<0.003	<0.001	0.071	<0.001	0.04	<0.001	94	11	<0.004	<0.002	0.372	<0.001	<0.02	<0.0002	<0.001	7.1	0	<0.001	44	<0.001	430
G50S	07/13/2021	<0.003	<0.001	0.071	<0.001	0.023	<0.001	92	13	<0.004	<0.002	<0.25	<0.001	<0.02	<0.0002	<0.001	7.2	0.884	<0.001	46	<0.001	420
G50S	07/28/2021	<0.003	<0.001	0.071	<0.001	0.015	<0.001	95	13	<0.004	<0.002	0.323	<0.001	<0.02	<0.0002	<0.001	7.1	1.13	<0.001	46	<0.001	390
G51L	01/30/2015	--	<0.001	--	--	0.18	--	130	18	--	--	--	<0.001	--	--	--	6.9	--	--	130	--	--
G51L	04/17/2015	--	<0.001	--	--	0.14	--	120	15	--	--	--	<0.001	--	--	--	7.0	--	--	120	--	--
G51L	07/24/2015	--	0.0042	--	--	0.047	--	98	17	--	--	--	<0.001	--	--	--	7.1	--	--	110	--	--
G51L	10/15/2015	--	<0.001	--	--	0.17	--	100	15	--	--	--	<0.001	--	--	--	7.1	--	--	95	--	--
G51L	11/18/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.9	--	--	--	--	--
G51L	02/19/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.8	--	--	--	--	--
G51S	01/30/2015	--	0.0061	--	--	0.015	--	100	11	--	--	--	<0.001	--	--	--	7.0	--	--	53	--	--
G51S	04/17/2015	--	0.0094	--	--	0.017	--	100	9.1	--	--	--	<0.001	--	--	--	7.2	--	--	51	--	--
G51S	07/24/2015	--	0.0085	--	--	<0.01	--	92	11	--	--	--	<0.001	--	--	--	7.1	--	--	40	--	--
G51S	10/15/2015	--	0.0051	--	--	0.021	--	91	8.5	--	--	--	<0.001	--	--	--	7.2	--	--	38	--	--

TABLE 4-1. GROUNDWATER ANALYTICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Location	Sample Date	Antimony, total (mg/L)	Arsenic, total (mg/L)	Barium, total (mg/L)	Beryllium, total (mg/L)	Boron, total (mg/L)	Cadmium, total (mg/L)	Calcium, total (mg/L)	Chloride, total (mg/L)	Chromium, total (mg/L)	Cobalt, total (mg/L)	Fluoride, total (mg/L)	Lead, total (mg/L)	Lithium, total (mg/L)	Mercury, total (mg/L)	Molybdenum, total (mg/L)	pH (field) (SU)	Radium 226 and 228 combined (pCi/L)	Selenium, total (mg/L)	Sulfate, total (mg/L)	Thallium, total (mg/L)	Total Dissolved Solids (mg/L)
35 I.A.C. 845.600	Lower	0	0	0	0	0	0	--	0	0	0	0	0	0	0	0	6.5	0	0	0	0	0
	Upper	0.006	0.010	2.0	0.004	2	0.005	--	200	0.1	0.006	4.0	0.0075	0.04	0.002	0.1	9.0	5	0.05	400	0.002	1200
G51S	12/03/2015	<0.003	0.0086	0.13	<0.001	0.02	<0.001	110	10	<0.004	<0.002	0.277	0.002	<0.01	<0.0002	0.0023	7.0	1.28	<0.001	39	<0.001	400
G51S	01/29/2016	<0.003	0.0042	0.097	<0.001	0.02	<0.001	89	11	<0.004	<0.002	<0.25	<0.001	<0.01	0.0004	0.0021	7.0	1.21	<0.001	52	<0.001	380
G51S	04/25/2016	<0.003	0.0048	0.096	<0.001	<0.01	<0.001	92	13	<0.004	<0.002	0.337	<0.001	<0.01	<0.0002	0.0016	7.1	0.517	<0.001	45	<0.001	400
G51S	08/10/2016	<0.003	0.0047	0.11	<0.001	0.014	<0.001	92	25	<0.004	<0.002	0.29	<0.001	<0.01	<0.0002	<0.001	7.1	0.921	<0.001	97	<0.001	350
G51S	10/21/2016	<0.003	0.0054	0.11	<0.001	<0.01	<0.001	89	13	<0.004	<0.002	0.27	<0.001	<0.01	<0.0002	0.0012	7.4	1.46	<0.001	44	<0.001	300
G51S	01/21/2017	<0.003	0.0034	0.083	<0.001	<0.01	<0.001	67	13	<0.004	<0.002	<0.25	<0.001	<0.01	<0.0002	0.0017	7.3	0.719	<0.001	48	<0.001	380
G51S	04/07/2017	<0.003	0.0029	0.089	<0.001	0.01	<0.001	94	13	<0.004	<0.002	<0.25	<0.001	<0.01	<0.0002	0.002	7.0	0.313	<0.001	50	<0.001	380
G51S	06/28/2017	<0.003	0.005	0.11	0.0013	<0.01	<0.001	82	14	<0.004	<0.002	<0.25	0.0015	<0.01	0.00034	0.0029	6.8	1.11	0.0014	41	0.0028	400
G51S	11/08/2017	--	--	--	--	0.013	--	96	12	--	--	0.368	--	--	--	--	7.1	--	--	34	--	320
G51S	06/04/2018	--	--	--	--	0.039	--	97	11	--	--	0.266	--	--	--	--	7.0	--	--	52	--	380
G51S	07/13/2018	--	--	--	--	0.014	--	96	--	--	--	0.31	--	--	--	--	6.9	--	--	--	--	390
G51S	10/11/2018	--	--	--	--	0.015	--	99	13	--	--	0.264	--	--	--	--	7.1	--	--	51	--	380
G51S	02/05/2019	--	--	--	--	0.012	--	90	14	--	--	0.33	--	--	--	--	6.8	--	--	50	--	380
G51S	07/08/2019	--	--	--	--	0.039	--	100	16	--	--	0.332	--	--	--	--	7.0	--	--	48	--	460
G51S	01/14/2020	--	--	--	--	0.016	--	100	13	--	--	<0.25	--	--	--	--	7.1	--	--	53	--	440
G51S	08/10/2020	--	--	--	--	0.01	--	99	8.2	--	--	<0.25	--	--	--	--	6.9	--	--	26	--	390
G51S	11/18/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0	--	--	--	--	--
G51S	02/19/2021	--	--	--	--	0.022	--	100	19	--	--	0.316	--	--	--	--	7.2	--	--	52	--	410
G51S	04/14/2021	<0.003	0.0042	0.1	<0.001	0.017	<0.001	88	14	<0.004	<0.002	0.258	0.012	<0.02	<0.0002	0.0012	7.1	0	<0.001	51	<0.001	380
G51S	04/29/2021	<0.003	0.0038	0.11	<0.001	0.019	<0.001	100	15	0.0059	<0.002	0.25	0.015	<0.02	<0.0002	0.0013	7.1	0.825	<0.001	51	<0.001	400
G51S	05/13/2021	<0.003	0.0012	0.089	<0.001	0.013	<0.001	94	15	<0.004	<0.002	<0.25	<0.001	<0.02	<0.0002	<0.001	7.2	0	<0.001	55	<0.001	350
G51S	06/01/2021	<0.003	0.0017	0.091	<0.001	0.022	<0.001	94	17	<0.004	<0.002	0.292	0.0046	<0.02	<0.0002	0.002	7.2	0.655	<0.001	51	<0.001	400

TABLE 4-1. GROUNDWATER ANALYTICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Location	Sample Date	Antimony, total (mg/L)	Arsenic, total (mg/L)	Barium, total (mg/L)	Beryllium, total (mg/L)	Boron, total (mg/L)	Cadmium, total (mg/L)	Calcium, total (mg/L)	Chloride, total (mg/L)	Chromium, total (mg/L)	Cobalt, total (mg/L)	Fluoride, total (mg/L)	Lead, total (mg/L)	Lithium, total (mg/L)	Mercury, total (mg/L)	Molybdenum, total (mg/L)	pH (field) (SU)	Radium 226 and 228 combined (pCi/L)	Selenium, total (mg/L)	Sulfate, total (mg/L)	Thallium, total (mg/L)	Total Dissolved Solids (mg/L)
35 I.A.C. 845.600	Lower	0	0	0	0	0	0	--	0	0	0	0	0	0	0	0	6.5	0	0	0	0	0
	Upper	0.006	0.010	2.0	0.004	2	0.005	--	200	0.1	0.006	4.0	0.0075	0.04	0.002	0.1	9.0	5	0.05	400	0.002	1200
G51S	06/15/2021	<0.003	0.0023	0.11	<0.001	0.022	<0.001	110	12	<0.004	<0.002	<0.25	0.0019	<0.02	<0.0002	<0.001	7.0	0.0656	<0.001	54	<0.001	410
G51S	06/21/2021	<0.003	0.0013	0.092	<0.001	0.037	<0.001	96	14	<0.004	<0.002	0.415	0.0017	<0.02	<0.0002	<0.001	7.1	0	<0.001	53	<0.001	410
G51S	07/12/2021	<0.003	0.0055	0.11	<0.001	0.014	<0.001	95	16	<0.004	<0.002	<0.25	0.0056	<0.02	<0.0002	0.0013	7.0	0.75	<0.001	51	<0.001	460
G51S	07/27/2021	<0.003	0.002	0.12	<0.001	0.016	<0.001	85	14	<0.004	<0.002	0.265	0.0017	<0.02	0.00098	<0.001	7.1	0.281	<0.001	51	<0.001	360
G52L	01/30/2015	--	<0.001	--	--	0.03	--	190	27	--	--	--	<0.001	--	--	--	6.6	--	--	160	--	--
G52L	04/17/2015	--	0.0015	--	--	0.021	--	230	22	--	--	--	<0.001	--	--	--	6.6	--	--	140	--	--
G52L	07/24/2015	--	<0.001	--	--	0.011	--	220	23	--	--	--	<0.001	--	--	--	6.6	--	--	120	--	--
G52L	10/15/2015	--	<0.001	--	--	0.026	--	220	22	--	--	--	<0.001	--	--	--	7.1	--	--	120	--	--
G52L	11/18/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.5	--	--	--	--	--
G52L	02/19/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.4	--	--	--	--	--
G52S	01/30/2015	--	0.019	--	--	0.04	--	150	14	--	--	--	0.041	--	--	--	6.8	--	--	110	--	--
G52S	04/17/2015	--	0.023	--	--	1.9	--	180	11	--	--	--	0.041	--	--	--	6.9	--	--	95	--	--
G52S	07/24/2015	--	0.012	--	--	0.019	--	160	12	--	--	--	0.023	--	--	--	6.9	--	--	97	--	--
G52S	10/15/2015	--	0.0083	--	--	0.036	--	150	9.7	--	--	--	0.01	--	--	--	6.9	--	--	89	--	--
G53L	01/30/2015	--	<0.001	--	--	0.12	--	110	65	--	--	--	<0.001	--	--	--	6.8	--	--	120	--	--
G53L	04/16/2015	--	<0.001	--	--	0.097	--	110	72	--	--	--	<0.001	--	--	--	6.9	--	--	140	--	--
G53L	07/24/2015	--	<0.001	--	--	0.11	--	110	70	--	--	--	<0.001	--	--	--	6.9	--	--	120	--	--
G53L	10/16/2015	--	<0.001	--	--	0.17	--	110	75	--	--	--	<0.001	--	--	--	6.9	--	--	140	--	--
G53L	11/18/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.6	--	--	--	--	--
G53L	02/22/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.8	--	--	--	--	--
G53S	01/30/2015	--	0.03	--	--	0.027	--	110	15	--	--	--	0.0049	--	--	--	7.0	--	--	79	--	--
G53S	04/16/2015	--	0.022	--	--	0.02	--	110	16	--	--	--	0.0056	--	--	--	7.1	--	--	86	--	--

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HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Location	Sample Date	Antimony, total (mg/L)	Arsenic, total (mg/L)	Barium, total (mg/L)	Beryllium, total (mg/L)	Boron, total (mg/L)	Cadmium, total (mg/L)	Calcium, total (mg/L)	Chloride, total (mg/L)	Chromium, total (mg/L)	Cobalt, total (mg/L)	Fluoride, total (mg/L)	Lead, total (mg/L)	Lithium, total (mg/L)	Mercury, total (mg/L)	Molybdenum, total (mg/L)	pH (field) (SU)	Radium 226 and 228 combined (pCi/L)	Selenium, total (mg/L)	Sulfate, total (mg/L)	Thallium, total (mg/L)	Total Dissolved Solids (mg/L)
35 I.A.C. 845.600	Lower	0	0	0	0	0	0	--	0	0	0	0	0	0	0	0	6.5	0	0	0	0	0
	Upper	0.006	0.010	2.0	0.004	2	0.005	--	200	0.1	0.006	4.0	0.0075	0.04	0.002	0.1	9.0	5	0.05	400	0.002	1200
G53S	07/24/2015	--	0.0096	--	--	0.012	--	120	12	--	--	--	0.003	--	--	--	7.0	--	--	71	--	--
G53S	10/16/2015	--	0.02	--	--	0.024	--	110	11	--	--	--	0.0011	--	--	--	7.2	--	--	75	--	--
G53S	11/18/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.9	--	--	--	--	--
G53S	02/22/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.8	--	--	--	--	--
G54C	04/14/2021	<0.003	0.0038	0.43	<0.001	0.16	<0.001	110	2.9	0.0081	0.0026	0.41	0.0014	<0.02	<0.0002	0.041	7.3	0.714	<0.001	50	<0.001	660
G54C	04/29/2021	<0.003	0.002	0.39	<0.001	0.13	<0.001	110	2.7	<0.004	<0.002	0.384	<0.001	<0.02	<0.0002	0.032	7.3	1.32	<0.001	45	<0.001	640
G54C	05/12/2021	<0.003	0.0029	0.47	<0.001	0.35	<0.001	110	2.9	<0.004	<0.002	0.465	0.0011	<0.02	<0.0002	0.035	7.2	0	0.0018	55	<0.001	630
G54C	06/01/2021	<0.003	0.0046	0.37	<0.001	0.12	<0.001	110	1.8	<0.004	<0.002	0.404	<0.001	<0.02	<0.0002	0.03	7.3	0.51	<0.001	47	<0.001	650
G54C	06/14/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.38	--	--	--	--
G54L	10/14/2015	--	0.028	--	--	0.041	--	180	11	--	--	--	0.0035	--	--	--	6.6	--	--	1.2	--	--
G54L	11/17/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.5	--	--	--	--	--
G54L	02/22/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.6	--	--	--	--	--
G54L	04/14/2021	<0.003	0.0058	0.18	<0.001	0.022	<0.001	150	21	<0.004	0.0044	<0.25	<0.001	<0.02	<0.0002	0.0027	6.6	0.299	<0.001	95	<0.001	900
G54L	04/29/2021	<0.003	0.01	0.21	<0.001	0.023	<0.001	170	20	<0.004	0.0026	<0.25	<0.001	<0.02	<0.0002	0.0011	6.6	0.516	<0.001	81	<0.001	800
G54L	05/12/2021	<0.003	0.014	0.24	<0.001	0.031	<0.001	160	21	0.0079	<0.002	<0.25	<0.001	<0.02	<0.0002	0.002	6.5	0.873	<0.001	70	<0.001	520
G54L	06/01/2021	<0.003	0.0069	0.16	<0.001	0.024	<0.001	160	21	<0.004	0.0029	<0.25	<0.001	<0.02	<0.0002	<0.001	6.6	0.508	<0.001	65	<0.001	780
G54L	06/14/2021	<0.003	0.006	0.16	<0.001	0.018	<0.001	160	22	<0.004	0.0021	<0.25	<0.001	<0.02	<0.0002	<0.001	6.7	0.766	<0.001	55	<0.001	750
G54L	06/21/2021	<0.003	0.0056	0.19	<0.001	0.03	<0.001	160	19	<0.004	0.0022	0.383	<0.001	<0.02	<0.0002	<0.001	6.5	1.21	<0.001	46	<0.001	700
G54L	07/13/2021	<0.003	0.0033	0.13	<0.001	0.023	<0.001	140	23	<0.004	0.0029	<0.25	<0.001	<0.02	<0.0002	0.002	6.4	0.246	<0.001	97	<0.001	850
G54L	07/27/2021	<0.003	0.0017	0.15	<0.001	0.027	<0.001	120	5.2	<0.004	<0.002	<0.25	<0.001	<0.02	0.00027	0.0047	6.6	1.65	<0.001	100	<0.001	720
G54S	01/30/2015	--	0.0013	--	--	0.045	--	120	<5	--	--	--	<0.001	--	--	--	6.8	--	--	47	--	--
G54S	04/16/2015	--	0.0014	--	--	0.029	--	140	2.2	--	--	--	<0.001	--	--	--	6.8	--	--	51	--	--

TABLE 4-1. GROUNDWATER ANALYTICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Location	Sample Date	Antimony, total (mg/L)	Arsenic, total (mg/L)	Barium, total (mg/L)	Beryllium, total (mg/L)	Boron, total (mg/L)	Cadmium, total (mg/L)	Calcium, total (mg/L)	Chloride, total (mg/L)	Chromium, total (mg/L)	Cobalt, total (mg/L)	Fluoride, total (mg/L)	Lead, total (mg/L)	Lithium, total (mg/L)	Mercury, total (mg/L)	Molybdenum, total (mg/L)	pH (field) (SU)	Radium 226 and 228 combined (pCi/L)	Selenium, total (mg/L)	Sulfate, total (mg/L)	Thallium, total (mg/L)	Total Dissolved Solids (mg/L)
35 I.A.C. 845.600	Lower	0	0	0	0	0	0	--	0	0	0	0	0	0	0	0	6.5	0	0	0	0	0
	Upper	0.006	0.010	2.0	0.004	2	0.005	--	200	0.1	0.006	4.0	0.0075	0.04	0.002	0.1	9.0	5	0.05	400	0.002	1200
G54S	07/23/2015	--	0.0011	--	--	0.05	--	130	2.3	--	--	--	<0.001	--	--	--	6.9	--	--	40	--	--
G54S	10/14/2015	--	0.0021	--	--	0.048	--	140	2.3	--	--	--	<0.001	--	--	--	6.9	--	--	41	--	--
G54S	12/04/2015	<0.003	<0.001	0.2	<0.001	0.027	<0.001	130	4.5	<0.004	<0.002	<0.25	<0.001	0.01	<0.0002	0.0016	6.5	1.28	<0.001	43	<0.001	600
G54S	01/29/2016	<0.003	0.0014	0.25	<0.001	0.046	<0.001	130	2.6	<0.004	<0.002	<0.25	<0.001	0.01	<0.0002	0.0019	6.9	0.787	<0.001	47	<0.001	570
G54S	05/02/2016	<0.003	<0.001	0.23	<0.001	0.036	<0.001	140	3	<0.004	<0.002	<0.25	<0.001	<0.01	<0.0002	0.0019	6.7	1.01	<0.001	45	<0.001	520
G54S	08/12/2016	<0.003	0.002	0.24	<0.001	0.03	<0.001	120	2.3	<0.004	<0.002	0.269	<0.001	0.012	<0.0002	0.0019	7.1	0.476	<0.001	43	<0.001	480
G54S	10/21/2016	<0.003	0.0023	0.27	<0.001	0.022	<0.001	120	2.5	<0.004	<0.002	0.259	<0.001	<0.01	0.00021	0.0023	7.2	1.27	<0.001	43	<0.001	520
G54S	01/24/2017	<0.003	0.0017	0.25	<0.001	0.03	<0.001	120	2	<0.004	<0.002	<0.25	<0.001	<0.01	<0.0002	0.0017	7.5	0.661	<0.001	44	<0.001	550
G54S	04/07/2017	<0.003	0.001	0.22	<0.001	0.028	<0.001	120	2.6	<0.004	<0.002	<0.25	<0.001	<0.01	<0.0002	0.0017	6.9	0.44	<0.001	45	<0.001	540
G54S	06/28/2017	<0.003	0.0059	0.28	<0.001	0.022	<0.001	110	2.5	<0.004	<0.002	<0.25	<0.001	<0.01	<0.0002	0.0025	7.1	1.19	<0.001	43	<0.001	520
G54S	11/08/2017	--	--	--	--	0.035	--	130	2.2	--	--	0.342	--	--	--	--	7.1	--	--	42	--	480
G54S	01/18/2018	--	--	--	--	0.052	--	120	--	--	--	--	--	--	--	--	6.9	--	--	--	--	380
G54S	06/04/2018	--	--	--	--	0.059	--	130	2.3	--	--	<0.25	--	--	--	--	7.1	--	--	43	--	500
G54S	07/13/2018	--	--	--	--	0.033	--	130	--	--	--	0.29	--	--	--	--	7.1	--	--	--	--	540
G54S	10/16/2018	--	--	--	--	0.037	--	130	2.5	--	--	<0.25	--	--	--	--	7.2	--	--	44	--	460
G54S	02/05/2019	--	--	--	--	0.032	--	130	2.3	--	--	0.283	--	--	--	--	7.1	--	--	44	--	590
G54S	07/15/2019	--	--	--	--	0.057	--	130	1.5	--	--	<0.25	--	--	--	--	7.1	--	--	46	--	590
G54S	01/14/2020	--	--	--	--	0.043	--	150	2.6	--	--	<0.25	--	--	--	--	6.9	--	--	45	--	620
G54S	08/10/2020	--	--	--	--	0.034	--	140	1.1	--	--	<0.25	--	--	--	--	6.8	--	--	21	--	460
G54S	11/17/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.7	--	--	--	--	--
G54S	02/22/2021	--	--	--	--	0.045	--	120	2.5	--	--	<0.25	--	--	--	--	6.8	--	--	39	--	500
G54S	06/21/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0	--	--	--	--	590

TABLE 4-1. GROUNDWATER ANALYTICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Location	Sample Date	Antimony, total (mg/L)	Arsenic, total (mg/L)	Barium, total (mg/L)	Beryllium, total (mg/L)	Boron, total (mg/L)	Cadmium, total (mg/L)	Calcium, total (mg/L)	Chloride, total (mg/L)	Chromium, total (mg/L)	Cobalt, total (mg/L)	Fluoride, total (mg/L)	Lead, total (mg/L)	Lithium, total (mg/L)	Mercury, total (mg/L)	Molybdenum, total (mg/L)	pH (field) (SU)	Radium 226 and 228 combined (pCi/L)	Selenium, total (mg/L)	Sulfate, total (mg/L)	Thallium, total (mg/L)	Total Dissolved Solids (mg/L)
35 I.A.C. 845.600	Lower	0	0	0	0	0	0	--	0	0	0	0	0	0	0	0	6.5	0	0	0	0	0
	Upper	0.006	0.010	2.0	0.004	2	0.005	--	200	0.1	0.006	4.0	0.0075	0.04	0.002	0.1	9.0	5	0.05	400	0.002	1200
G55L	01/30/2015	--	<0.001	--	--	0.018	--	100	17	--	--	--	<0.001	--	--	--	6.8	--	--	56	--	--
G55L	04/16/2015	--	<0.001	--	--	<0.01	--	130	23	--	--	--	<0.001	--	--	--	6.8	--	--	67	--	--
G55L	07/23/2015	--	<0.001	--	--	0.02	--	130	20	--	--	--	<0.001	--	--	--	6.9	--	--	59	--	--
G55L	10/14/2015	--	<0.001	--	--	0.02	--	130	18	--	--	--	<0.001	--	--	--	6.9	--	--	63	--	--
G55L	11/17/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.5	--	--	--	--	--
G55L	02/22/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.7	--	--	--	--	--
G55S	01/30/2015	--	0.0053	--	--	0.046	--	130	5.1	--	--	--	0.0075	--	--	--	6.9	--	--	33	--	--
G55S	04/16/2015	--	0.0086	--	--	0.05	--	150	5.1	--	--	--	0.015	--	--	--	7.0	--	--	37	--	--
G55S	07/23/2015	--	0.0033	--	--	0.046	--	140	4.8	--	--	--	0.0047	--	--	--	7.1	--	--	27	--	--
G55S	10/14/2015	--	0.0033	--	--	0.031	--	130	5.5	--	--	--	0.0042	--	--	--	7.0	--	--	28	--	--
G55S	11/17/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.6	--	--	--	--	--
G55S	02/22/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.8	--	--	--	--	--
G56L	07/22/2015	--	<0.001	--	--	0.062	--	130	29	--	--	--	0.0012	--	--	--	6.9	--	--	46	--	--
G56L	10/16/2015	--	0.0047	--	--	0.028	--	130	27	--	--	--	0.0062	--	--	--	7.0	--	--	44	--	--
G56L	11/17/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.7	--	--	--	--	--
G56L	02/22/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.6	--	--	--	--	--
G56S	02/04/2015	--	0.014	--	--	0.049	--	120	--	--	--	--	0.0057	--	--	--	7.2	--	--	58	--	--
G56S	04/16/2015	--	0.013	--	--	0.019	--	190	17	--	--	--	0.014	--	--	--	6.8	--	--	65	--	--
G56S	07/22/2015	--	0.051	--	--	0.053	--	150	13	--	--	--	0.0086	--	--	--	6.9	--	--	57	--	--
G56S	10/16/2015	--	0.012	--	--	0.022	--	130	11	--	--	--	0.0046	--	--	--	6.9	--	--	56	--	--
G56S	11/17/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.7	--	--	--	--	--
G56S	02/22/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.6	--	--	--	--	--

TABLE 4-1. GROUNDWATER ANALYTICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Location	Sample Date	Antimony, total (mg/L)	Arsenic, total (mg/L)	Barium, total (mg/L)	Beryllium, total (mg/L)	Boron, total (mg/L)	Cadmium, total (mg/L)	Calcium, total (mg/L)	Chloride, total (mg/L)	Chromium, total (mg/L)	Cobalt, total (mg/L)	Fluoride, total (mg/L)	Lead, total (mg/L)	Lithium, total (mg/L)	Mercury, total (mg/L)	Molybdenum, total (mg/L)	pH (field) (SU)	Radium 226 and 228 combined (pCi/L)	Selenium, total (mg/L)	Sulfate, total (mg/L)	Thallium, total (mg/L)	Total Dissolved Solids (mg/L)
35 I.A.C. 845.600	Lower	0	0	0	0	0	0	--	0	0	0	0	0	0	0	0	6.5	0	0	0	0	0
	Upper	0.006	0.010	2.0	0.004	2	0.005	--	200	0.1	0.006	4.0	0.0075	0.04	0.002	0.1	9.0	5	0.05	400	0.002	1200
G57L	02/04/2015	--	0.018	--	--	0.05	--	120	19	--	--	--	0.0047	--	--	--	7.2	--	--	320	--	--
G57L	02/25/2015	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.2	--	--	--	--	--
G57L	04/16/2015	--	0.0069	--	--	0.019	--	150	22	--	--	--	0.0026	--	--	--	6.9	--	--	300	--	--
G57L	07/22/2015	--	0.0034	--	--	0.083	--	97	13	--	--	--	0.0026	--	--	--	6.9	--	--	96	--	--
G57L	10/16/2015	--	0.0054	--	--	0.042	--	100	13	--	--	--	0.0026	--	--	--	6.7	--	--	110	--	--
G57L	11/17/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0	--	--	--	--	--
G57L	02/22/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.8	--	--	--	--	--
G57S	02/04/2015	--	<0.001	--	--	0.019	--	100	19	--	--	--	<0.001	--	--	--	7.1	--	--	53	--	--
G57S	04/16/2015	--	<0.001	--	--	<0.01	--	130	23	--	--	--	<0.001	--	--	--	7.2	--	--	64	--	--
G57S	07/22/2015	--	0.0019	--	--	0.05	--	140	18	--	--	--	0.0058	--	--	--	7.0	--	--	53	--	--
G57S	10/16/2015	--	<0.001	--	--	0.013	--	110	17	--	--	--	<0.001	--	--	--	7.1	--	--	56	--	--
G57S	12/04/2015	<0.003	<0.001	0.14	<0.001	<0.01	<0.001	130	18	<0.004	<0.002	<0.25	0.0012	<0.01	<0.0002	<0.001	6.8	0.804	<0.001	54	<0.001	570
G57S	01/29/2016	<0.003	<0.001	0.13	<0.001	0.021	<0.001	110	19	<0.004	<0.002	<0.25	<0.001	<0.01	<0.0002	<0.001	6.8	0.194	<0.001	58	<0.001	510
G57S	05/02/2016	<0.003	<0.001	0.13	<0.001	<0.01	<0.001	120	20	<0.004	<0.002	0.277	<0.001	<0.01	<0.0002	<0.001	6.9	0.471	<0.001	56	<0.001	500
G57S	08/12/2016	<0.003	<0.001	0.13	<0.001	<0.01	<0.001	120	20	<0.004	<0.002	0.304	<0.001	<0.01	<0.0002	<0.001	7.0	0.302	<0.001	58	<0.001	480
G57S	10/28/2016	<0.003	<0.001	0.14	<0.001	0.019	<0.001	100	19	<0.004	<0.002	0.321	<0.001	<0.01	<0.0002	<0.001	7.1	0.124	<0.001	55	<0.001	550
G57S	02/03/2017	<0.003	<0.001	0.13	<0.001	<0.01	<0.001	120	20	<0.004	<0.002	0.268	<0.001	<0.01	<0.0002	<0.001	7.2	1.32	<0.001	52	<0.001	530
G57S	05/01/2017	0.0064	<0.001	0.13	0.0027	<0.01	0.0016	110	18	<0.004	<0.002	0.284	0.0032	<0.01	<0.0002	0.0034	7.1	0.0112	<0.001	52	0.0033	510
G57S	06/28/2017	<0.003	<0.001	0.13	<0.001	<0.01	<0.001	130	22	<0.004	<0.002	0.276	<0.001	<0.01	<0.0002	<0.001	7.3	0.607	<0.001	53	<0.001	520
G57S	11/08/2017	--	--	--	--	<0.01	--	120	19	--	--	0.39	--	--	--	--	7.0	--	--	51	--	450
G57S	01/18/2018	--	--	--	--	--	--	180	--	--	--	<0.25	--	--	--	--	7.1	--	--	--	--	370
G57S	06/04/2018	--	--	--	--	0.027	--	120	19	--	--	0.28	--	--	--	--	7.2	--	--	52	--	500

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HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Location	Sample Date	Antimony, total (mg/L)	Arsenic, total (mg/L)	Barium, total (mg/L)	Beryllium, total (mg/L)	Boron, total (mg/L)	Cadmium, total (mg/L)	Calcium, total (mg/L)	Chloride, total (mg/L)	Chromium, total (mg/L)	Cobalt, total (mg/L)	Fluoride, total (mg/L)	Lead, total (mg/L)	Lithium, total (mg/L)	Mercury, total (mg/L)	Molybdenum, total (mg/L)	pH (field) (SU)	Radium 226 and 228 combined (pCi/L)	Selenium, total (mg/L)	Sulfate, total (mg/L)	Thallium, total (mg/L)	Total Dissolved Solids (mg/L)
35 I.A.C. 845.600	Lower	0	0	0	0	0	0	--	0	0	0	0	0	0	0	0	6.5	0	0	0	0	0
	Upper	0.006	0.010	2.0	0.004	2	0.005	--	200	0.1	0.006	4.0	0.0075	0.04	0.002	0.1	9.0	5	0.05	400	0.002	1200
G57S	07/21/2018	--	--	--	--	0.024	--	110	--	--	--	<0.25	--	--	--	--	7.2	--	--	--	--	540
G57S	10/17/2018	--	--	--	--	0.014	--	130	22	--	--	<0.25	--	--	--	--	7.3	--	--	53	--	470
G57S	02/06/2019	--	--	--	--	0.016	--	130	23	--	--	0.349	--	--	--	--	7.2	--	--	54	--	520
G57S	07/15/2019	--	--	--	--	0.055	--	140	18	--	--	0.327	--	--	--	--	7.1	--	--	55	--	680
G57S	01/14/2020	--	--	--	--	0.011	--	150	20	--	--	<0.25	--	--	--	--	6.8	--	--	55	--	700
G57S	08/10/2020	--	--	--	--	<0.01	--	150	15	--	--	0.292	--	--	--	--	6.6	--	--	51	--	600
G57S	11/17/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0	--	--	--	--	590
G57S	02/22/2021	--	--	--	--	0.013	--	120	1.8	--	--	0.313	--	--	--	--	6.9	--	--	54	--	680
G58L	04/15/2015	--	0.026	--	--	0.016	--	150	27	--	--	--	0.0072	--	--	--	6.9	--	--	320	--	--
G58L	07/22/2015	--	0.0027	--	--	0.051	--	120	29	--	--	--	0.0023	--	--	--	7.0	--	--	180	--	--
G58L	10/14/2015	--	0.013	--	--	0.024	--	140	23	--	--	--	0.012	--	--	--	7.0	--	--	190	--	--
G58L	11/18/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0	--	--	--	--	--
G58L	02/22/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.8	--	--	--	--	--
G58S	02/04/2015	--	<0.001	--	--	0.018	--	180	20	--	--	--	<0.001	--	--	--	6.8	--	--	520	--	--
G58S	04/15/2015	--	<0.001	--	--	0.014	--	190	21	--	--	--	<0.001	--	--	--	6.6	--	--	540	--	--
G58S	07/22/2015	--	0.0092	--	--	0.044	--	180	19	--	--	--	0.018	--	--	--	6.8	--	--	250	--	--
G58S	10/14/2015	--	0.0025	--	--	0.18	--	170	17	--	--	--	0.0033	--	--	--	6.9	--	--	300	--	--
G58S	11/18/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.6	--	--	--	--	--
G58S	02/22/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.6	--	--	--	--	--
G59L	07/22/2015	--	0.0029	--	--	0.057	--	100	<25	--	--	--	0.0023	--	--	--	6.7	--	--	110	--	--
G59L	10/14/2015	--	0.013	--	--	0.043	--	110	19	--	--	--	0.014	--	--	--	7.0	--	--	84	--	--
G59L	11/18/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.8	--	--	--	--	--

TABLE 4-1. GROUNDWATER ANALYTICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Location	Sample Date	Antimony, total (mg/L)	Arsenic, total (mg/L)	Barium, total (mg/L)	Beryllium, total (mg/L)	Boron, total (mg/L)	Cadmium, total (mg/L)	Calcium, total (mg/L)	Chloride, total (mg/L)	Chromium, total (mg/L)	Cobalt, total (mg/L)	Fluoride, total (mg/L)	Lead, total (mg/L)	Lithium, total (mg/L)	Mercury, total (mg/L)	Molybdenum, total (mg/L)	pH (field) (SU)	Radium 226 and 228 combined (pCi/L)	Selenium, total (mg/L)	Sulfate, total (mg/L)	Thallium, total (mg/L)	Total Dissolved Solids (mg/L)
35 I.A.C. 845.600	Lower	0	0	0	0	0	0	--	0	0	0	0	0	0	0	0	6.5	0	0	0	0	0
	Upper	0.006	0.010	2.0	0.004	2	0.005	--	200	0.1	0.006	4.0	0.0075	0.04	0.002	0.1	9.0	5	0.05	400	0.002	1200
G59L	02/22/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.7	--	--	--	--	--
G59S	02/04/2015	--	0.02	--	--	0.038	--	210	8.8	--	--	--	0.016	--	--	--	6.9	--	--	110	--	--
G59S	04/15/2015	--	0.011	--	--	0.026	--	190	9.3	--	--	--	0.012	--	--	--	6.9	--	--	110	--	--
G59S	07/22/2015	--	0.0061	--	--	0.071	--	150	15	--	--	--	0.0046	--	--	--	6.9	--	--	150	--	--
G59S	10/14/2015	--	0.021	--	--	0.056	--	230	12	--	--	--	0.014	--	--	--	7.1	--	--	95	--	--
G59S	11/18/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.7	--	--	--	--	--
G59S	02/22/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.8	--	--	--	--	--
G60L	11/17/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.3	--	--	--	--	--
G60L	02/23/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.2	--	--	--	--	--
G60L	04/14/2021	<0.003	<0.001	0.019	<0.001	0.034	<0.001	110	19	<0.004	0.0052	<0.25	<0.001	<0.02	<0.0002	<0.001	6.2	1.14	<0.001	<250	<0.001	550
G60L	04/29/2021	<0.003	<0.001	0.017	<0.001	0.029	<0.001	120	19	<0.004	0.0038	<0.25	<0.001	<0.02	<0.0002	<0.001	6.1	0.0999	<0.001	160	<0.001	580
G60L	05/13/2021	<0.003	<0.001	0.017	<0.001	0.025	<0.001	110	19	<0.004	0.0023	<0.25	<0.001	<0.02	<0.0002	<0.001	6.2	0	<0.001	180	<0.001	580
G60L	06/01/2021	<0.003	<0.001	0.014	<0.001	0.029	<0.001	110	20	<0.004	<0.002	<0.25	<0.001	<0.02	<0.0002	<0.001	6.3	1.08	<0.001	170	<0.001	560
G60L	06/15/2021	<0.003	<0.001	0.015	<0.001	0.029	<0.001	110	16	<0.004	<0.002	<0.25	<0.001	<0.02	<0.0002	<0.001	6.2	0.347	<0.001	180	<0.001	530
G60L	06/21/2021	<0.003	<0.001	0.018	<0.001	0.068	<0.001	110	18	<0.004	0.0031	<0.25	<0.001	<0.02	<0.0002	<0.001	6.2	0.8	<0.001	180	<0.001	580
G60L	07/12/2021	<0.003	<0.001	0.027	<0.001	0.027	<0.001	110	18	<0.004	0.008	<0.25	<0.001	<0.02	<0.0002	<0.001	6.0	0.168	<0.001	180	<0.001	580
G60L	07/28/2021	<0.003	<0.001	0.019	<0.001	0.022	<0.001	110	15	<0.004	0.0039	<0.25	<0.001	<0.02	<0.0002	<0.001	6.2	2.36	<0.001	160	<0.001	530
G60S	02/04/2015	--	0.0042	--	--	0.024	--	120	12	--	--	--	0.0046	--	--	--	6.8	--	--	62	--	--
G60S	04/15/2015	--	0.018	--	--	0.028	--	250	11	--	--	--	0.022	--	--	--	6.8	--	--	63	--	--
G60S	07/22/2015	--	0.0032	--	--	0.035	--	150	9.6	--	--	--	0.003	--	--	--	6.8	--	--	58	--	--
G60S	10/14/2015	--	0.002	--	--	0.064	--	130	8.6	--	--	--	<0.001	--	--	--	7.1	--	--	60	--	--
G60S	12/04/2015	<0.003	0.0097	0.24	<0.001	0.024	<0.001	180	8.4	0.012	0.0049	0.264	0.0099	0.018	<0.0002	0.0016	6.6	1.74	0.0031	61	<0.001	610

TABLE 4-1. GROUNDWATER ANALYTICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Location	Sample Date	Antimony, total (mg/L)	Arsenic, total (mg/L)	Barium, total (mg/L)	Beryllium, total (mg/L)	Boron, total (mg/L)	Cadmium, total (mg/L)	Calcium, total (mg/L)	Chloride, total (mg/L)	Chromium, total (mg/L)	Cobalt, total (mg/L)	Fluoride, total (mg/L)	Lead, total (mg/L)	Lithium, total (mg/L)	Mercury, total (mg/L)	Molybdenum, total (mg/L)	pH (field) (SU)	Radium 226 and 228 combined (pCi/L)	Selenium, total (mg/L)	Sulfate, total (mg/L)	Thallium, total (mg/L)	Total Dissolved Solids (mg/L)
35 I.A.C. 845.600	Lower	0	0	0	0	0	0	--	0	0	0	0	0	0	0	0	6.5	0	0	0	0	0
	Upper	0.006	0.010	2.0	0.004	2	0.005	--	200	0.1	0.006	4.0	0.0075	0.04	0.002	0.1	9.0	5	0.05	400	0.002	1200
G60S	01/29/2016	<0.003	0.0016	0.14	<0.001	0.024	<0.001	120	8.8	<0.004	<0.002	<0.25	0.0012	<0.01	<0.0002	<0.001	6.7	0.987	<0.001	65	<0.001	500
G60S	05/02/2016	<0.003	0.0032	0.17	<0.001	0.015	<0.001	160	7.9	0.0052	<0.002	0.276	0.0024	<0.01	<0.0002	<0.001	6.7	0.34	<0.001	64	<0.001	550
G60S	08/20/2016	<0.003	<0.001	0.14	<0.001	<0.01	<0.001	130	8.6	<0.004	<0.002	0.307	<0.001	<0.01	<0.0002	<0.001	6.7	0.876	<0.001	62	<0.001	560
G60S	10/28/2016	<0.003	0.004	0.18	<0.001	0.029	<0.001	120	8.1	<0.004	<0.002	0.331	<0.001	<0.01	<0.0002	0.001	6.6	1.29	<0.001	64	<0.001	540
G60S	02/03/2017	<0.003	<0.001	0.13	<0.001	0.011	<0.001	130	11	<0.004	<0.002	0.268	<0.001	<0.01	<0.0002	<0.001	6.5	1.27	<0.001	60	<0.001	580
G60S	04/25/2017	<0.003	<0.001	0.14	<0.001	0.01	<0.001	120	8.7	<0.004	<0.002	0.287	<0.001	<0.01	<0.0002	<0.001	6.8	0.946	<0.001	61	<0.001	580
G60S	06/29/2017	<0.003	0.0021	0.15	<0.001	<0.01	<0.001	110	10	<0.004	<0.002	0.328	<0.001	<0.01	<0.0002	<0.001	7.0	1.54	<0.001	68	<0.001	580
G60S	11/08/2017	--	--	--	--	0.01	--	120	11	--	--	0.351	--	--	--	--	6.9	--	--	67	--	460
G60S	01/19/2018	--	--	--	--	--	--	100	--	--	--	0.313	--	--	--	--	6.9	--	--	--	--	520
G60S	06/04/2018	--	--	--	--	0.035	--	150	11	--	--	0.316	--	--	--	--	6.9	--	--	73	--	490
G60S	07/21/2018	--	--	--	--	0.022	--	120	--	--	--	<0.25	--	--	--	--	7.0	--	--	--	--	540
G60S	10/17/2018	--	--	--	--	0.018	--	120	12	--	--	<0.25	--	--	--	--	6.9	--	--	72	--	440
G60S	02/06/2019	--	--	--	--	0.04	--	270	19	--	--	0.327	--	--	--	--	7.0	--	--	200	--	760
G60S	04/08/2019	--	--	--	--	--	--	160	13	--	--	--	--	--	--	--	7.0	--	--	240	--	860
G60S	07/15/2019	--	--	--	--	0.024	--	140	10	--	--	0.319	--	--	--	--	6.8	--	--	190	--	800
G60S	01/14/2020	--	--	--	--	0.026	--	150	11	--	--	<0.25	--	--	--	--	6.7	--	--	200	--	790
G60S	08/10/2020	--	--	--	--	0.015	--	140	6.8	--	--	<0.25	--	--	--	--	6.6	--	--	120	--	600
G60S	11/17/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.8	--	--	110	--	630
G60S	02/23/2021	--	--	--	--	0.019	--	130	9.1	--	--	<0.25	--	--	--	--	6.6	--	--	67	--	620
G61S	02/04/2015	--	0.002	--	--	0.051	--	150	22	--	--	--	0.003	--	--	--	7.0	--	--	330	--	--
G61S	04/15/2015	--	0.0022	--	--	0.034	--	120	22	--	--	--	0.0028	--	--	--	7.0	--	--	220	--	--
G61S	07/21/2015	--	0.0012	--	--	0.029	--	120	18	--	--	--	0.0012	--	--	--	6.9	--	--	140	--	--

TABLE 4-1. GROUNDWATER ANALYTICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Location	Sample Date	Antimony, total (mg/L)	Arsenic, total (mg/L)	Barium, total (mg/L)	Beryllium, total (mg/L)	Boron, total (mg/L)	Cadmium, total (mg/L)	Calcium, total (mg/L)	Chloride, total (mg/L)	Chromium, total (mg/L)	Cobalt, total (mg/L)	Fluoride, total (mg/L)	Lead, total (mg/L)	Lithium, total (mg/L)	Mercury, total (mg/L)	Molybdenum, total (mg/L)	pH (field) (SU)	Radium 226 and 228 combined (pCi/L)	Selenium, total (mg/L)	Sulfate, total (mg/L)	Thallium, total (mg/L)	Total Dissolved Solids (mg/L)
35 I.A.C. 845.600	Lower	0	0	0	0	0	0	--	0	0	0	0	0	0	0	0	6.5	0	0	0	0	0
	Upper	0.006	0.010	2.0	0.004	2	0.005	--	200	0.1	0.006	4.0	0.0075	0.04	0.002	0.1	9.0	5	0.05	400	0.002	1200
G61S	10/13/2015	--	0.0012	--	--	0.027	--	140	20	--	--	--	<0.001	--	--	--	7.0	--	--	160	--	--
G61S	11/18/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.6	--	--	--	--	--
G61S	02/23/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.5	--	--	--	--	--
G62L	02/04/2015	--	0.0031	--	--	0.083	--	120	19	--	--	--	0.0029	--	--	--	6.8	--	--	89	--	--
G62L	04/15/2015	--	0.0025	--	--	0.068	--	160	20	--	--	--	0.0015	--	--	--	6.9	--	--	150	--	--
G62L	07/22/2015	--	0.0016	--	--	0.13	--	68	9.2	--	--	--	0.0011	--	--	--	7.0	--	--	57	--	--
G62L	10/13/2015	--	0.0018	--	--	0.12	--	140	12	--	--	--	0.0023	--	--	--	7.2	--	--	87	--	--
G62L	11/18/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.8	--	--	--	--	--
G62L	02/24/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.7	--	--	--	--	--
G63L	04/15/2015	--	0.0033	--	--	0.03	--	210	26	--	--	--	0.0035	--	--	--	6.9	--	--	350	--	--
G63L	07/22/2015	--	0.0021	--	--	0.091	--	190	13	--	--	--	0.0011	--	--	--	6.9	--	--	230	--	--
G63L	10/13/2015	--	0.0063	--	--	0.04	--	210	24	--	--	--	0.0083	--	--	--	7.2	--	--	270	--	--
G63L	11/18/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0	--	--	--	--	--
G63L	02/24/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.7	--	--	--	--	--
G63S	02/04/2015	--	0.003	--	--	0.023	--	110	3.6	--	--	--	0.0016	--	--	--	7.1	--	--	40	--	--
G63S	04/15/2015	--	<0.001	--	--	0.017	--	110	3.2	--	--	--	<0.001	--	--	--	7.0	--	--	36	--	--
G63S	07/22/2015	--	0.0018	--	--	0.036	--	110	3.4	--	--	--	<0.001	--	--	--	7.2	--	--	38	--	--
G63S	10/13/2015	--	0.0013	--	--	0.02	--	110	3.7	--	--	--	<0.001	--	--	--	7.3	--	--	45	--	--
G63S	11/18/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0	--	--	--	--	--
G63S	02/24/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0	--	--	--	--	--
G64L	02/04/2015	--	0.0019	--	--	0.014	--	100	3.1	--	--	--	0.0023	--	--	--	6.9	--	--	26	--	--
G64L	04/15/2015	--	<0.001	--	--	0.012	--	96	2.9	--	--	--	<0.001	--	--	--	7.1	--	--	25	--	--

TABLE 4-1. GROUNDWATER ANALYTICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Location	Sample Date	Antimony, total (mg/L)	Arsenic, total (mg/L)	Barium, total (mg/L)	Beryllium, total (mg/L)	Boron, total (mg/L)	Cadmium, total (mg/L)	Calcium, total (mg/L)	Chloride, total (mg/L)	Chromium, total (mg/L)	Cobalt, total (mg/L)	Fluoride, total (mg/L)	Lead, total (mg/L)	Lithium, total (mg/L)	Mercury, total (mg/L)	Molybdenum, total (mg/L)	pH (field) (SU)	Radium 226 and 228 combined (pCi/L)	Selenium, total (mg/L)	Sulfate, total (mg/L)	Thallium, total (mg/L)	Total Dissolved Solids (mg/L)
35 I.A.C. 845.600	Lower	0	0	0	0	0	0	--	0	0	0	0	0	0	0	0	6.5	0	0	0	0	0
	Upper	0.006	0.010	2.0	0.004	2	0.005	--	200	0.1	0.006	4.0	0.0075	0.04	0.002	0.1	9.0	5	0.05	400	0.002	1200
G64L	07/22/2015	--	<0.001	--	--	0.034	--	110	4.5	--	--	--	<0.001	--	--	--	7.0	--	--	120	--	--
G64L	10/13/2015	--	0.0031	--	--	0.11	--	110	3.9	--	--	--	0.0037	--	--	--	7.1	--	--	93	--	--
G64L	11/18/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.1	--	--	--	--	--
G64L	02/25/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0	--	--	--	--	--
G64S	02/04/2015	--	0.0033	--	--	0.023	--	100	4.1	--	--	--	0.0034	--	--	--	7.1	--	--	28	--	--
G64S	04/15/2015	--	0.0038	--	--	0.018	--	110	3.9	--	--	--	0.0033	--	--	--	7.0	--	--	25	--	--
G64S	07/22/2015	--	0.011	--	--	0.037	--	120	3.7	--	--	--	0.0049	--	--	--	7.0	--	--	27	--	--
G64S	10/13/2015	--	0.0037	--	--	0.022	--	110	4.4	--	--	--	<0.001	--	--	--	7.1	--	--	77	--	--
G64S	12/04/2015	<0.003	0.004	0.2	<0.001	0.017	<0.001	110	3.6	<0.004	<0.002	0.3	0.0017	<0.01	<0.0002	0.0019	6.8	0.607	0.0013	25	<0.001	500
G64S	01/29/2016	<0.003	0.0031	0.17	<0.001	0.03	<0.001	98	4.1	<0.004	<0.002	<0.25	0.0033	<0.01	<0.0002	0.0018	7.0	0.634	<0.001	27	<0.001	420
G64S	05/02/2016	<0.003	0.0017	0.17	<0.001	0.017	<0.001	110	4.1	<0.004	<0.002	0.303	0.0015	<0.01	<0.0002	0.0018	7.1	1.43	<0.001	27	<0.001	400
G64S	08/20/2016	<0.003	0.0035	0.21	<0.001	0.011	<0.001	110	4	0.015	<0.002	0.317	0.0028	<0.01	<0.0002	0.0023	7.1	0.782	<0.001	26	<0.001	430
G64S	10/28/2016	<0.003	0.0045	0.22	<0.001	0.036	<0.001	92	3.7	<0.004	<0.002	0.375	0.0051	<0.01	<0.0002	0.002	7.2	1.08	<0.001	28	<0.001	440
G64S	02/03/2017	<0.003	0.0023	0.18	<0.001	0.015	<0.001	99	3.6	<0.004	<0.002	0.314	<0.001	<0.01	<0.0002	0.0016	7.2	1.11	<0.001	26	<0.001	460
G64S	05/01/2017	0.0037	0.0037	0.2	<0.001	0.015	<0.001	100	3.7	<0.004	<0.002	0.32	<0.001	<0.01	<0.0002	0.0023	6.9	0.748	<0.001	32	<0.001	450
G64S	06/29/2017	<0.003	0.0028	0.17	<0.001	<0.01	<0.001	80	3.7	<0.004	<0.002	0.376	<0.001	<0.01	<0.0002	0.0013	6.8	1.19	<0.001	26	<0.001	460
G64S	11/08/2017	--	--	--	--	0.014	--	95	3.5	--	--	0.401	--	--	--	--	6.8	--	--	25	--	380
G64S	01/19/2018	--	--	--	--	--	--	--	--	--	--	0.367	--	--	--	--	6.9	--	--	--	--	--
G64S	06/04/2018	--	--	--	--	0.029	--	91	3.6	--	--	0.316	--	--	--	--	6.9	--	--	25	--	380
G64S	07/21/2018	--	--	--	--	0.019	--	83	--	--	--	0.318	--	--	--	--	6.9	--	--	--	--	390
G64S	10/20/2018	--	--	--	--	0.021	--	98	3.8	--	--	0.256	--	--	--	--	6.9	--	--	28	--	420
G64S	02/06/2019	--	--	--	--	0.024	--	140	4.1	--	--	0.38	--	--	--	--	6.8	--	--	25	--	420

TABLE 4-1. GROUNDWATER ANALYTICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Location	Sample Date	Antimony, total (mg/L)	Arsenic, total (mg/L)	Barium, total (mg/L)	Beryllium, total (mg/L)	Boron, total (mg/L)	Cadmium, total (mg/L)	Calcium, total (mg/L)	Chloride, total (mg/L)	Chromium, total (mg/L)	Cobalt, total (mg/L)	Fluoride, total (mg/L)	Lead, total (mg/L)	Lithium, total (mg/L)	Mercury, total (mg/L)	Molybdenum, total (mg/L)	pH (field) (SU)	Radium 226 and 228 combined (pCi/L)	Selenium, total (mg/L)	Sulfate, total (mg/L)	Thallium, total (mg/L)	Total Dissolved Solids (mg/L)
35 I.A.C. 845.600	Lower	0	0	0	0	0	0	--	0	0	0	0	0	0	0	0	6.5	0	0	0	0	0
	Upper	0.006	0.010	2.0	0.004	2	0.005	--	200	0.1	0.006	4.0	0.0075	0.04	0.002	0.1	9.0	5	0.05	400	0.002	1200
G64S	07/15/2019	--	--	--	--	0.023	--	100	3.2	--	--	0.333	--	--	--	--	7.2	--	--	25	--	490
G64S	01/15/2020	--	--	--	--	0.024	--	110	3.4	--	--	0.34	--	--	--	--	6.8	--	--	21	--	480
G64S	08/11/2020	--	--	--	--	0.019	--	100	3.7	--	--	0.287	--	--	--	--	7.0	--	--	26	--	440
G64S	11/18/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0	--	--	--	--	--
G64S	02/24/2021	--	--	--	--	0.021	--	100	3.6	--	--	0.385	--	--	--	--	7.0	--	--	22	--	500
G64S	06/21/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.1	--	--	--	--	450
P60	02/24/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.3	--	--	--	--	--
P60	03/24/2021	--	0.02	--	--	0.056	<0.001	150	32	--	--	--	0.036	--	--	--	6.6	--	--	53	--	--
R61L	11/18/2020	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.7	--	--	--	--	--
R61L	02/23/2021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.6	--	--	--	--	--

Notes:
Detected at concentration greater than the GWPS
-- = data not available
GWPS = Groundwater Protection Standard
mg/L = milligrams per liter
pCi/L = picocuries per liter
SU = standard units
< = concentration is less than the concentration shown, which corresponds to the reporting limit for the method. Estimated concentrations below the reporting limit and associated qualifiers are not provided since they are not utilized in statistics to determine exceedances above Part 845 standards.
35 I.A.C. 845.600 = Residuals in Surface Impoundments: Title 35 of the Illinois Administrative Code § 845

TABLE 4-2. GROUNDWATER FIELD PARAMETERS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (field) (SU)	Specific Conductance (micromhos/cm)	Temperature (deg. C)	Turbidity (NTU)
G02S	12/02/2015	0	-103	6.6	785	12.7	226
G02S	02/03/2016	0	-90	6.6	750	11.4	495
G02S	04/20/2016	0	-105	6.6	812	13.2	1000
G02S	08/18/2016	0	-101	6.8	922	16.5	1000
G02S	10/19/2016	0	-126	6.9	829	15.8	1000
G02S	01/12/2017	0	-148	6.9	920	13.0	1000
G02S	04/22/2017	0	-154	6.8	957	13.9	1000
G02S	06/28/2017	0	-137	6.8	892	18.8	1000
G02S	11/10/2017	0	-146	6.9	917	12.9	1000
G02S	01/17/2018	0	-115	6.9	961	10.8	1000
G02S	06/06/2018	0	-118	6.9	1060	16.2	792
G02S	07/06/2018	0	-119	7.0	1020	14.1	779
G02S	10/04/2018	0	-120	7.1	1080	16.3	790
G02S	02/06/2019	0	-122	7.0	1028	12.0	104
G02S	07/08/2019	0	-128	7.0	1028	16.3	97.9
G02S	01/06/2020	0.12	-144	6.6	792.1	10.8	39.7
G02S	08/11/2020	1.00	-54.7	6.4	801	14.2	70.7
G02S	02/19/2021	0.08	-53.1	6.5	766.2	8.3	116
G02S	04/14/2021	0.32	-79.8	6.7	788.2	11.8	85.6
G02S	04/29/2021	1.00	-83.5	6.8	697	13.0	19.5
G02S	05/12/2021	0.16	-64.1	6.6	789	14.5	38.9
G02S	06/01/2021	0.02	-123	6.8	789	15.4	7.5
G02S	06/15/2021	0.34	-116	6.8	673	13.7	6.07
G02S	06/21/2021	0.09	-125	6.8	788.8	12.8	5.68
G02S	07/12/2021	0.14	-108	6.7	796	17.7	0
G02S	07/28/2021	0.58	-88.5	6.9	766	16.8	20.7
G50S	01/30/2015	--	--	6.8	704	--	--
G50S	04/17/2015	--	--	7.3	1118	--	--
G50S	07/24/2015	--	--	7.4	622	--	--
G50S	10/15/2015	--	--	7.4	718	--	--
G50S	12/03/2015	0	-76	6.9	622	13.1	38.7
G50S	01/29/2016	0	-70	7.4	710	11.3	49.3
G50S	04/25/2016	0	-77	7.3	841	13.3	62.1
G50S	08/10/2016	0	-95	7.3	930	17.0	46.1
G50S	10/21/2016	0	-92	7.3	860	15.7	48.5
G50S	01/21/2017	0	-101	7.3	935	14.2	59
G50S	04/07/2017	0	-79	7.3	701	13.4	38.8
G50S	06/28/2017	0	-87	7.1	796	19.2	50.1
G50S	11/08/2017	0	-84	7.1	782	12.5	8.5
G50S	06/04/2018	0	-77	7.1	790	15.3	57.1
G50S	07/13/2018	0	-78	7.1	820	15.0	48
G50S	10/11/2018	0	-86	7.2	780	15.4	34.3
G50S	02/05/2019	0	-90	7.1	819	12.0	47.1
G50S	07/08/2019	0	-64	7.4	654	16.0	48.1

TABLE 4-2. GROUNDWATER FIELD PARAMETERS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (field) (SU)	Specific Conductance (micromhos/cm)	Temperature (deg. C)	Turbidity (NTU)
G50S	01/13/2020	0.95	67.2	6.9	707.5	11.4	69
G50S	08/10/2020	2.30	80.1	6.8	720	16.1	9.83
G50S	11/18/2020	--	--	7.0	656	--	--
G50S	02/19/2021	1.20	50.7	7.0	573.7	9.4	304
G50S	04/14/2021	4.00	119	7.2	699.8	12.4	27.8
G50S	04/29/2021	6.20	41.3	7.1	738.9	13.5	4.44
G50S	05/13/2021	5.00	112	7.2	677	15.0	54.5
G50S	06/01/2021	4.20	78.7	7.0	702.4	14.9	4.89
G50S	06/10/2021	3.60	109	7.2	699	18.6	60.2
G50S	06/21/2021	2.50	53.8	7.1	611	14.9	0.46
G50S	07/13/2021	2.50	82.5	7.2	575	17.2	15.2
G50S	07/28/2021	3.00	73.4	7.1	737	22.1	6.7
G51L	01/30/2015	--	--	6.9	942	--	--
G51L	04/17/2015	--	--	7.0	1390	--	--
G51L	07/24/2015	--	--	7.1	772	--	--
G51L	10/15/2015	--	--	7.1	823	--	--
G51L	11/18/2020	--	--	6.9	845	--	--
G51L	02/19/2021	--	--	6.8	566	--	--
G51S	01/30/2015	--	--	7.0	766	--	--
G51S	04/17/2015	--	--	7.2	1061	--	--
G51S	07/24/2015	--	--	7.1	720	--	--
G51S	10/15/2015	--	--	7.2	758	--	--
G51S	12/03/2015	0	-95	7.0	700	12.7	738
G51S	01/29/2016	0	-69	7.0	780	11.9	539
G51S	04/25/2016	0	-60	7.1	870	12.8	1000
G51S	08/10/2016	0	-67	7.1	863	17.3	1000
G51S	10/21/2016	0	-92	7.4	928	14.9	1000
G51S	01/21/2017	0	-82	7.3	935	14.5	1000
G51S	04/07/2017	0	-72	7.0	852	13.3	8.5
G51S	06/28/2017	0	-74	6.8	880	17.6	3.8
G51S	11/08/2017	0	-61	7.1	848	12.9	4.2
G51S	06/04/2018	0	-42	7.0	902	16.1	8.9
G51S	07/13/2018	0	-71	6.9	910	14.2	11
G51S	10/11/2018	8.60	-110	7.1	812	15.3	22.1
G51S	02/05/2019	0	-59	6.8	900	11.9	14.1
G51S	07/08/2019	0	-60	7.0	716	16.3	52.1
G51S	01/14/2020	4.40	62.7	7.1	686.6	11.4	111
G51S	08/10/2020	2.30	-9.5	6.9	752.8	20.7	42.5
G51S	11/18/2020	--	--	7.0	673	--	--
G51S	02/19/2021	5.80	-9	7.2	686.9	9.3	299
G51S	04/14/2021	1.90	-8.3	7.1	559	15.1	48.5
G51S	04/29/2021	1.80	4.3	7.1	728.8	17.0	17.9
G51S	05/13/2021	2.20	-5.8	7.2	720	13.8	10.6
G51S	06/01/2021	1.10	50.1	7.2	720.1	16.2	25.6

TABLE 4-2. GROUNDWATER FIELD PARAMETERS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (field) (SU)	Specific Conductance (micromhos/cm)	Temperature (deg. C)	Turbidity (NTU)
G51S	06/15/2021	1.90	-29.4	7.0	747	15.4	19.6
G51S	06/21/2021	0.30	-38.8	7.1	713	14.2	26
G51S	07/12/2021	0.36	-59.4	7.0	720	16.6	72.7
G51S	07/27/2021	1.60	53.9	7.1	688	19.8	20.2
G52L	01/30/2015	--	--	6.6	1807	--	--
G52L	04/17/2015	--	--	6.6	2220	--	--
G52L	07/24/2015	--	--	6.5	1277	--	--
G52L	10/15/2015	--	--	7.1	922	--	--
G52L	11/18/2020	--	--	6.5	1642	--	--
G52L	02/19/2021	--	--	6.4	1444	--	--
G52S	01/30/2015	--	--	6.8	1064	--	--
G52S	04/17/2015	--	--	6.9	1099	--	--
G52S	07/24/2015	--	--	6.9	873	--	--
G52S	10/15/2015	--	--	6.9	845	--	--
G53L	01/30/2015	--	--	6.8	942	--	--
G53L	04/16/2015	--	--	6.9	890	--	--
G53L	07/24/2015	--	--	6.9	858	--	--
G53L	10/16/2015	--	--	6.9	952	--	--
G53L	11/18/2020	--	--	6.6	1312	--	--
G53L	02/22/2021	--	--	6.8	1235	--	--
G53S	01/30/2015	--	--	7.0	903	--	--
G53S	04/16/2015	--	--	7.1	814	--	--
G53S	07/24/2015	--	--	7.0	763	--	--
G53S	10/16/2015	--	--	7.2	893	--	--
G53S	11/18/2020	--	--	6.9	988	--	--
G53S	02/22/2021	--	--	6.8	698	--	--
G54C	04/14/2021	0.99	-103	7.3	1158	13.3	167
G54C	04/29/2021	0.50	-79.9	7.3	1200	14.5	76.7
G54C	05/12/2021	1.60	-66.9	7.2	1172	15.8	39.2
G54C	06/01/2021	1.60	-70.3	7.3	1200	16.8	27.6
G54L	10/14/2015	--	--	6.6	992	--	--
G54L	11/17/2020	--	--	6.5	1290	--	--
G54L	02/22/2021	--	--	6.6	1216	--	--
G54L	04/14/2021	0.64	-14	6.6	1508	14.1	35.7
G54L	04/29/2021	0.71	-32.1	6.6	1426	15.9	16
G54L	05/12/2021	2.20	-40.2	6.5	1423	19.5	26.6
G54L	06/01/2021	1.20	-72.4	6.6	1370	21.7	5.74
G54L	06/14/2021	1.80	-82.6	6.7	1344	20.8	16.4
G54L	06/21/2021	1.60	-44.6	6.5	1329	15.3	25.8
G54L	07/13/2021	2.00	-23.9	6.4	1351	25.1	33
G54L	07/27/2021	2.20	37.9	6.6	1383	16.4	24.7
G54S	01/30/2015	--	--	6.8	1044	--	--
G54S	04/16/2015	--	--	6.8	936	--	--
G54S	07/23/2015	--	--	6.9	885	--	--

TABLE 4-2. GROUNDWATER FIELD PARAMETERS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (field) (SU)	Specific Conductance (micromhos/cm)	Temperature (deg. C)	Turbidity (NTU)
G54S	10/14/2015	--	--	6.9	806	--	--
G54S	12/04/2015	0	-15	6.5	992	12.6	8.4
G54S	01/29/2016	0	-17	6.9	925	11.6	8.5
G54S	05/02/2016	0	-21	6.7	951	13.1	7.3
G54S	08/12/2016	0	-29	7.1	980	17.7	12.8
G54S	10/21/2016	0	-52	7.2	970	16.0	11.4
G54S	01/24/2017	0	-60	7.5	1115	15.6	25.1
G54S	04/07/2017	0	-63	6.9	840	13.5	14.2
G54S	06/28/2017	0	-58	7.1	913	19.2	17.9
G54S	11/08/2017	0	-61	7.1	799	13.3	19.4
G54S	01/18/2018	0	-72	6.9	855	11.3	24.2
G54S	06/04/2018	0	-52	7.1	930	15.6	15
G54S	07/13/2018	0	-58	7.1	910	14.8	25.4
G54S	10/16/2018	0	-59	7.2	898	14.1	17.8
G54S	02/05/2019	0	-61	7.1	892	12.0	20.3
G54S	07/15/2019	0	-71	7.1	960	15.9	15.2
G54S	01/14/2020	4.80	27.7	6.9	1010	10.8	111
G54S	08/10/2020	1.90	-12.8	6.8	1046	20.6	28.7
G54S	11/17/2020	--	--	6.7	999	--	--
G54S	02/22/2021	1.00	-10	6.8	961.2	12.2	43.3
G54S	06/21/2021	0.39	-23.6	7.0	875	15.0	17.1
G55L	01/30/2015	--	--	6.8	956	--	--
G55L	04/16/2015	--	--	6.8	663	--	--
G55L	07/23/2015	--	--	6.9	843	--	--
G55L	10/14/2015	--	--	6.9	747	--	--
G55L	11/17/2020	--	--	6.5	1023	--	--
G55L	02/22/2021	--	--	6.7	1020	--	--
G55S	01/30/2015	--	--	6.9	893	--	--
G55S	04/16/2015	--	--	7.0	808	--	--
G55S	07/23/2015	--	--	7.1	788	--	--
G55S	10/14/2015	--	--	7.0	696	--	--
G55S	11/17/2020	--	--	6.6	801	--	--
G55S	02/22/2021	--	--	6.8	843	--	--
G56L	07/22/2015	--	--	6.9	885	--	--
G56L	10/16/2015	--	--	7.0	803	--	--
G56L	11/17/2020	--	--	6.7	1266	--	--
G56L	02/22/2021	--	--	6.5	1253	--	--
G56S	02/04/2015	--	--	7.2	918	--	--
G56S	04/16/2015	--	--	6.8	855	--	--
G56S	07/22/2015	--	--	6.9	760	--	--
G56S	10/16/2015	--	--	6.9	885	--	--
G56S	11/17/2020	--	--	6.7	878	--	--
G56S	02/22/2021	--	--	6.6	900	--	--
G57L	02/04/2015	--	--	7.2	570	--	--

TABLE 4-2. GROUNDWATER FIELD PARAMETERS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (field) (SU)	Specific Conductance (micromhos/cm)	Temperature (deg. C)	Turbidity (NTU)
G57L	02/25/2015	--	--	7.2	570	--	--
G57L	04/16/2015	--	--	6.9	908	--	--
G57L	07/22/2015	--	--	6.9	825	--	--
G57L	10/16/2015	--	--	6.7	932	--	--
G57L	11/17/2020	--	--	7.0	797	--	--
G57L	02/22/2021	--	--	6.8	978	--	--
G57S	02/04/2015	--	--	7.1	973	--	--
G57S	04/16/2015	--	--	7.2	920	--	--
G57S	07/22/2015	--	--	7.0	803	--	--
G57S	10/16/2015	--	--	7.1	888	--	--
G57S	12/04/2015	10.00	13	6.8	925	13.0	7.6
G57S	01/29/2016	0	19	6.8	880	12.9	9.1
G57S	05/02/2016	0	30	6.9	930	13.4	11.9
G57S	08/12/2016	0	56	7.0	970	18.9	19.2
G57S	10/28/2016	0	75	7.1	1046	14.6	19.4
G57S	02/03/2017	0	69	7.2	1005	14.8	18
G57S	05/01/2017	0	62	7.1	932	14.2	12.1
G57S	06/28/2017	0	79	7.3	1040	18.3	15.9
G57S	11/08/2017	0	78	7.0	1020	13.1	12.1
G57S	01/18/2018	0	64	7.1	895	12.7	16
G57S	06/04/2018	0	89	7.2	1100	17.0	14.3
G57S	07/21/2018	0	73	7.2	1005	15.0	38.1
G57S	10/17/2018	0	71	7.3	1060	14.0	17
G57S	02/06/2019	0	79	7.2	1033	11.7	18.5
G57S	07/15/2019	0	-60	7.1	1096	16.1	18.6
G57S	01/14/2020	0.83	159	6.8	1115	12.0	128
G57S	08/10/2020	0.67	60.8	6.6	1161	16.3	18.3
G57S	11/17/2020	2.30	56.9	7.0	1029	12.8	3.86
G57S	02/22/2021	2.10	12.5	6.9	1236	11.0	10.9
G58L	04/15/2015	--	--	6.9	1294	--	--
G58L	07/22/2015	--	--	7.0	935	--	--
G58L	10/14/2015	--	--	7.0	955	--	--
G58L	11/18/2020	--	--	7.0	1063	--	--
G58L	02/22/2021	--	--	6.8	1087	--	--
G58S	02/04/2015	--	--	6.8	1487	--	--
G58S	04/15/2015	--	--	6.5	1450	--	--
G58S	07/22/2015	--	--	6.8	946	--	--
G58S	10/14/2015	--	--	6.9	996	--	--
G58S	11/18/2020	--	--	6.6	949	--	--
G58S	02/22/2021	--	--	6.6	974	--	--
G59L	07/22/2015	--	--	6.7	871	--	--
G59L	10/14/2015	--	--	7.0	1043	--	--
G59L	11/18/2020	--	--	6.8	983	--	--
G59L	02/22/2021	--	--	6.6	971	--	--

TABLE 4-2. GROUNDWATER FIELD PARAMETERS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (field) (SU)	Specific Conductance (micromhos/cm)	Temperature (deg. C)	Turbidity (NTU)
G59S	02/04/2015	--	--	6.9	949	--	--
G59S	04/15/2015	--	--	6.9	967	--	--
G59S	07/22/2015	--	--	6.9	877	--	--
G59S	10/14/2015	--	--	7.1	1032	--	--
G59S	11/18/2020	--	--	6.7	842	--	--
G59S	02/22/2021	--	--	6.8	913	--	--
G60L	11/17/2020	--	--	6.3	998	--	--
G60L	02/23/2021	--	--	6.2	1069	--	--
G60L	04/14/2021	2.50	144	6.2	959.1	11.5	55.1
G60L	04/29/2021	2.10	111	6.1	974	12.4	60.6
G60L	05/13/2021	1.70	86	6.2	899.4	15.2	1.97
G60L	06/01/2021	2.40	111	6.3	917	14.6	1.01
G60L	06/15/2021	1.30	90.1	6.2	908	15.9	1.28
G60L	06/21/2021	0.97	87.7	6.2	914.4	13.8	11.8
G60L	07/12/2021	0.42	64.1	6.0	937	17.3	11.5
G60L	07/28/2021	0.63	106	6.2	840	17.0	22.4
G60S	02/04/2015	--	--	6.8	973	--	--
G60S	04/15/2015	--	--	6.8	999	--	--
G60S	07/22/2015	--	--	6.8	804	--	--
G60S	10/14/2015	--	--	7.1	849	--	--
G60S	12/04/2015	0	-41	6.6	958	12.3	75.9
G60S	01/29/2016	0	-65	6.7	990	12.1	38.9
G60S	05/02/2016	0	-42	6.7	1040	12.7	63.6
G60S	08/20/2016	0	-51	6.7	1015	18.0	56
G60S	10/28/2016	0	-45	6.6	916	14.1	70.8
G60S	02/03/2017	0	-47	6.5	948	14.4	70.2
G60S	04/25/2017	0	-62	6.8	735	14.1	30.5
G60S	06/29/2017	0	-58	7.0	710	17.5	36.4
G60S	11/08/2017	0	-52	6.9	718	13.6	27.4
G60S	01/19/2018	0	-60	6.9	701	12.6	39.7
G60S	06/04/2018	0	-68	6.9	802	15.9	43.4
G60S	07/21/2018	0	-60	7.0	724	15.2	41.8
G60S	10/17/2018	0	-51	6.9	764	14.4	38.4
G60S	02/06/2019	0	-65	7.0	698	12.0	42.4
G60S	04/08/2019	0	-60	7.0	1030	14.5	41.7
G60S	07/15/2019	0	-60	6.8	1150	15.8	14
G60S	01/14/2020	0.57	122	6.6	1226	12.2	33.5
G60S	08/10/2020	1.90	57.4	6.6	1110	21.0	1230
G60S	11/17/2020	0.99	-0.6	6.8	978	11.8	75.3
G60S	02/23/2021	1.20	-2.1	6.6	937.2	11.9	15.7
G61S	02/04/2015	--	--	7.0	1679	--	--
G61S	04/15/2015	--	--	7.0	1533	--	--
G61S	07/21/2015	--	--	6.9	1059	--	--
G61S	10/13/2015	--	--	7.0	1095	--	--

TABLE 4-2. GROUNDWATER FIELD PARAMETERS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (field) (SU)	Specific Conductance (micromhos/cm)	Temperature (deg. C)	Turbidity (NTU)
G61S	11/18/2020	--	--	6.6	1514	--	--
G61S	02/23/2021	--	--	6.5	1511	--	--
G62L	02/04/2015	--	--	6.8	1356	--	--
G62L	04/15/2015	--	--	6.9	1507	--	--
G62L	07/22/2015	--	--	7.0	643	--	--
G62L	10/13/2015	--	--	7.2	790	--	--
G62L	11/18/2020	--	--	6.8	1578	--	--
G62L	02/24/2021	--	--	6.7	1275	--	--
G63L	04/15/2015	--	--	6.9	1767	--	--
G63L	07/22/2015	--	--	6.9	1117	--	--
G63L	10/13/2015	--	--	7.2	852	--	--
G63L	11/18/2020	--	--	7.0	1615	--	--
G63L	02/24/2021	--	--	6.7	1123	--	--
G63S	02/04/2015	--	--	7.1	866	--	--
G63S	04/15/2015	--	--	7.0	890	--	--
G63S	07/22/2015	--	--	7.2	718	--	--
G63S	10/13/2015	--	--	7.3	919	--	--
G63S	11/18/2020	--	--	7.0	548	--	--
G63S	02/24/2021	--	--	7.0	918	--	--
G64L	02/04/2015	--	--	6.9	818	--	--
G64L	04/15/2015	--	--	7.1	818	--	--
G64L	07/22/2015	--	--	7.0	858	--	--
G64L	10/13/2015	--	--	7.1	955	--	--
G64L	11/18/2020	--	--	7.1	1054	--	--
G64L	02/25/2021	--	--	7.0	1009	--	--
G64S	02/04/2015	--	--	7.1	819	--	--
G64S	04/15/2015	--	--	7.0	881	--	--
G64S	07/22/2015	--	--	7.0	807	--	--
G64S	10/13/2015	--	--	7.1	870	--	--
G64S	12/04/2015	2.80	-60	6.8	773	12.7	234
G64S	01/29/2016	0	-57	7.0	788	11.3	296
G64S	05/02/2016	0	-79	7.1	695	13.1	124
G64S	08/20/2016	0	-70	7.1	688	18.9	97.3
G64S	10/28/2016	0	-84	7.2	731	15.0	110
G64S	02/03/2017	0	-62	7.2	710	14.5	101
G64S	05/01/2017	0	-65	6.9	859	14.3	15.3
G64S	06/29/2017	0	-90	6.8	818	19.2	21.6
G64S	11/08/2017	0	-79	6.8	798	13.9	21.9
G64S	01/19/2018	0	-72	6.9	825	12.6	21.7
G64S	06/04/2018	0	-68	6.9	851	16.1	21.4
G64S	07/21/2018	0	-91	6.9	840	15.4	25.1
G64S	10/20/2018	0	-74	6.9	855	13.7	24.5
G64S	02/06/2019	0	-91	6.8	802	11.8	27.5
G64S	07/15/2019	0	70	7.2	750	16.0	14.7

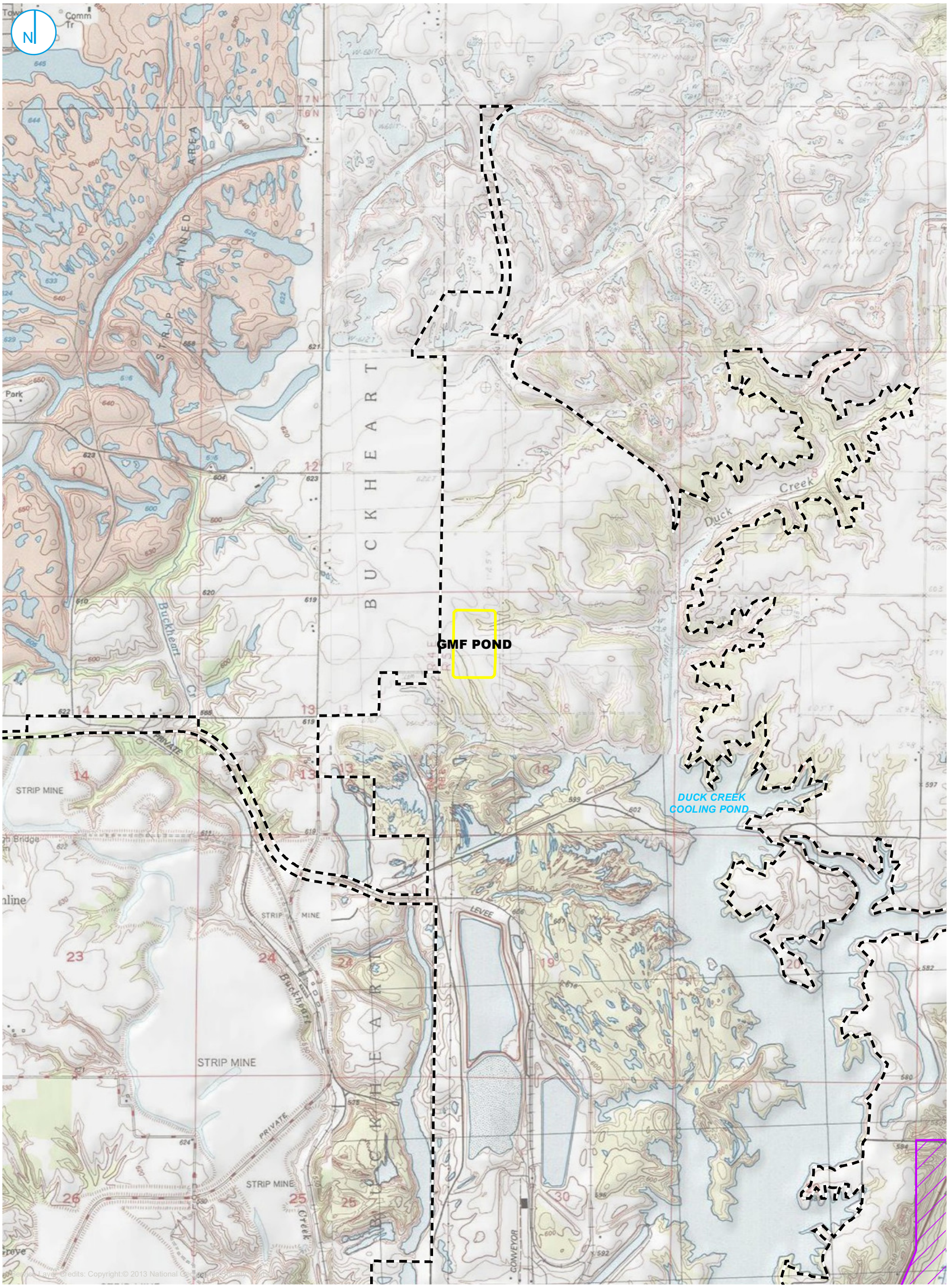
TABLE 4-2. GROUNDWATER FIELD PARAMETERS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (field) (SU)	Specific Conductance (micromhos/cm)	Temperature (deg. C)	Turbidity (NTU)
G64S	01/15/2020	0.83	-12.3	6.8	781.2	11.4	41.4
G64S	08/11/2020	4.30	-1.3	7.0	688.9	18.5	42.8
G64S	11/18/2020	--	--	7.0	769	--	--
G64S	02/24/2021	3.00	-55.9	7.0	727.4	11.4	60.7
G64S	06/21/2021	0.76	-57.1	7.1	761	16.2	21.3
P60	02/24/2021	3.40	54	6.3	830	16.4	236
P60	03/24/2021	3.60	41.4	6.6	862	--	1620
R61L	11/18/2020	--	--	6.7	1162	--	--
R61L	02/23/2021	--	--	6.6	1058	--	--

Notes:
Field readings are reported with as many significant figures as provided by analytical laboratory.
-- = data not available
cm = centimeter
deg. C = degrees Celsius
mg/L = milligrams per liter
mV = millivolts
NTU = nephelometric turbidity units
SU = standard units

generated 10/06/2021, 3:14:31 PM CDT

FIGURES



PART 845 REGULATED UNIT (SUBJECT UNIT)
PROPERTY BOUNDARY
COFFEEN LAKE STATE FISH AND WILDLIFE AREA

0 1,000 2,000 Feet

SITE LOCATION MAP

FIGURE 1-1

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY

0 150 300 Feet

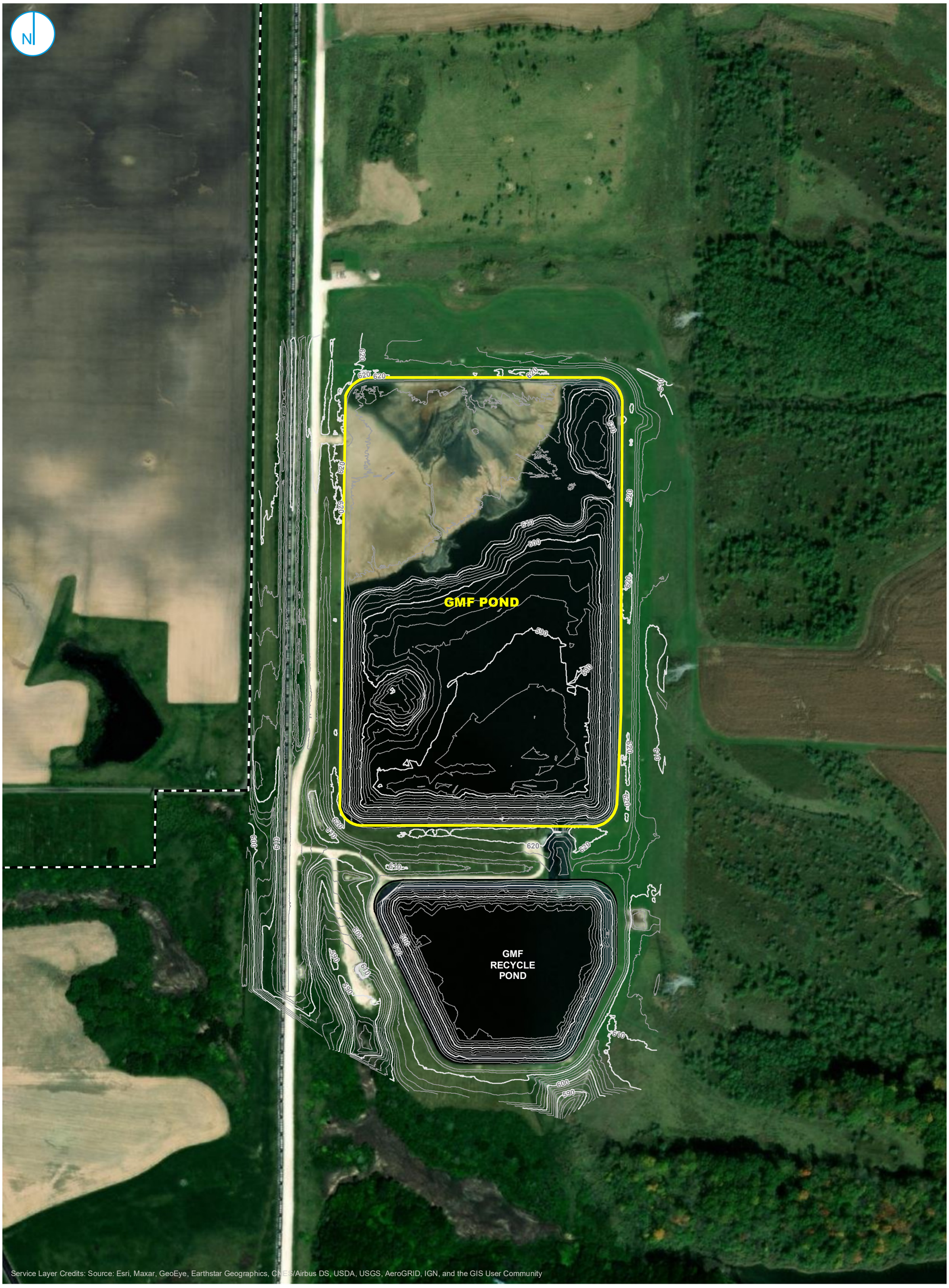
SITE MAP

FIGURE 1-2

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



10 FOOT ELEVATION CONTOUR (NAVD88)
2 FOOT ELEVATION CONTOUR (NAVD88)
PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY

0 150 300 Feet

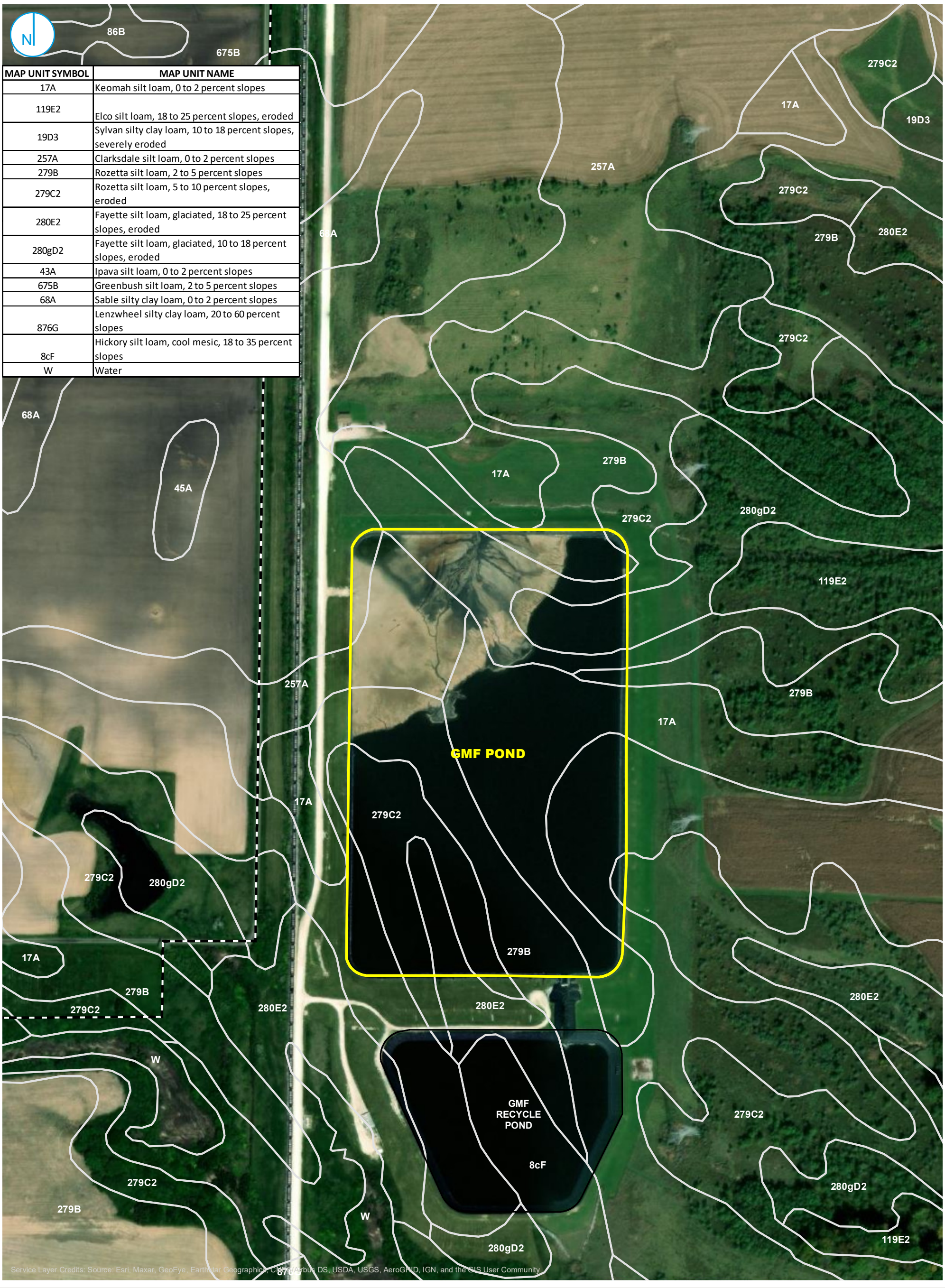
SITE TOPOGRAPHIC MAP

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

FIGURE 2-1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



MAP UNIT SYMBOL	MAP UNIT NAME
17A	Keomah silt loam, 0 to 2 percent slopes
119E2	Elco silt loam, 18 to 25 percent slopes, eroded
19D3	Sylvan silty clay loam, 10 to 18 percent slopes, severely eroded
257A	Clarksdale silt loam, 0 to 2 percent slopes
279B	Rozetta silt loam, 2 to 5 percent slopes
279C2	Rozetta silt loam, 5 to 10 percent slopes, eroded
280E2	Fayette silt loam, glaciated, 18 to 25 percent slopes, eroded
280gD2	Fayette silt loam, glaciated, 10 to 18 percent slopes, eroded
43A	Ipava silt loam, 0 to 2 percent slopes
675B	Greenbush silt loam, 2 to 5 percent slopes
68A	Sable silty clay loam, 0 to 2 percent slopes
876G	Lenzwheel silty clay loam, 20 to 60 percent slopes
8cF	Hickory silt loam, cool mesic, 18 to 35 percent slopes
W	Water

PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY
NRCS SOIL SURVEY MAP UNIT BOUNDARY

0 150 300 Feet

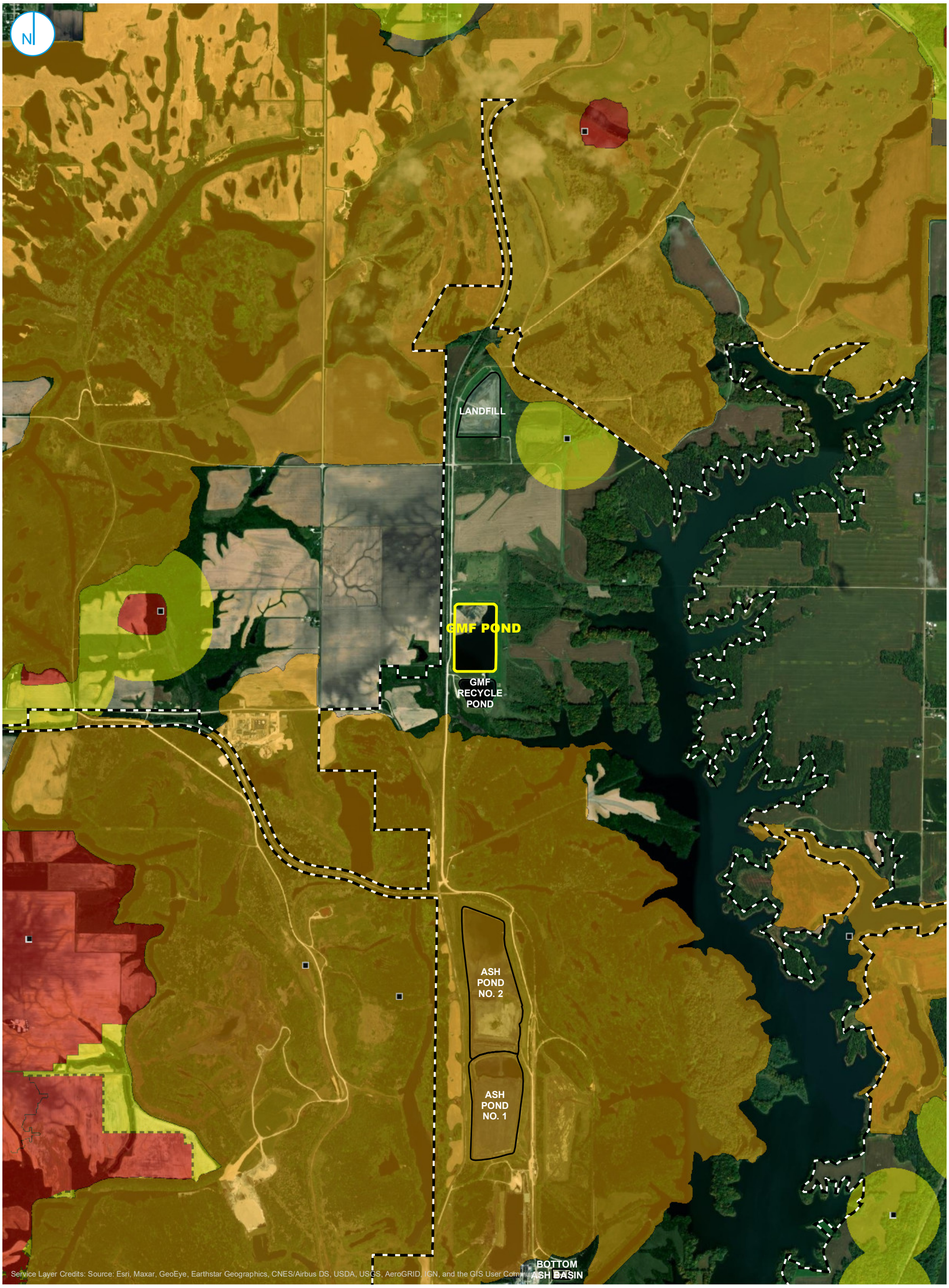
SOIL SURVEY MAP

FIGURE 2-2

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



- COAL MINE SHAFT
- SURFACE COAL MINE
- UNDERGROUND COAL MINE
- UNDERGROUND MINE BUFFER REGION
- PART 845 REGULATED UNIT (SUBJECT UNIT)
- SITE FEATURE
- PROPERTY BOUNDARY

0 1,000 2,000 Feet

COAL MINE COVERAGE AREA

FIGURE 2-3

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY
RADNOR TILL MEMBER

0 150 300 Feet

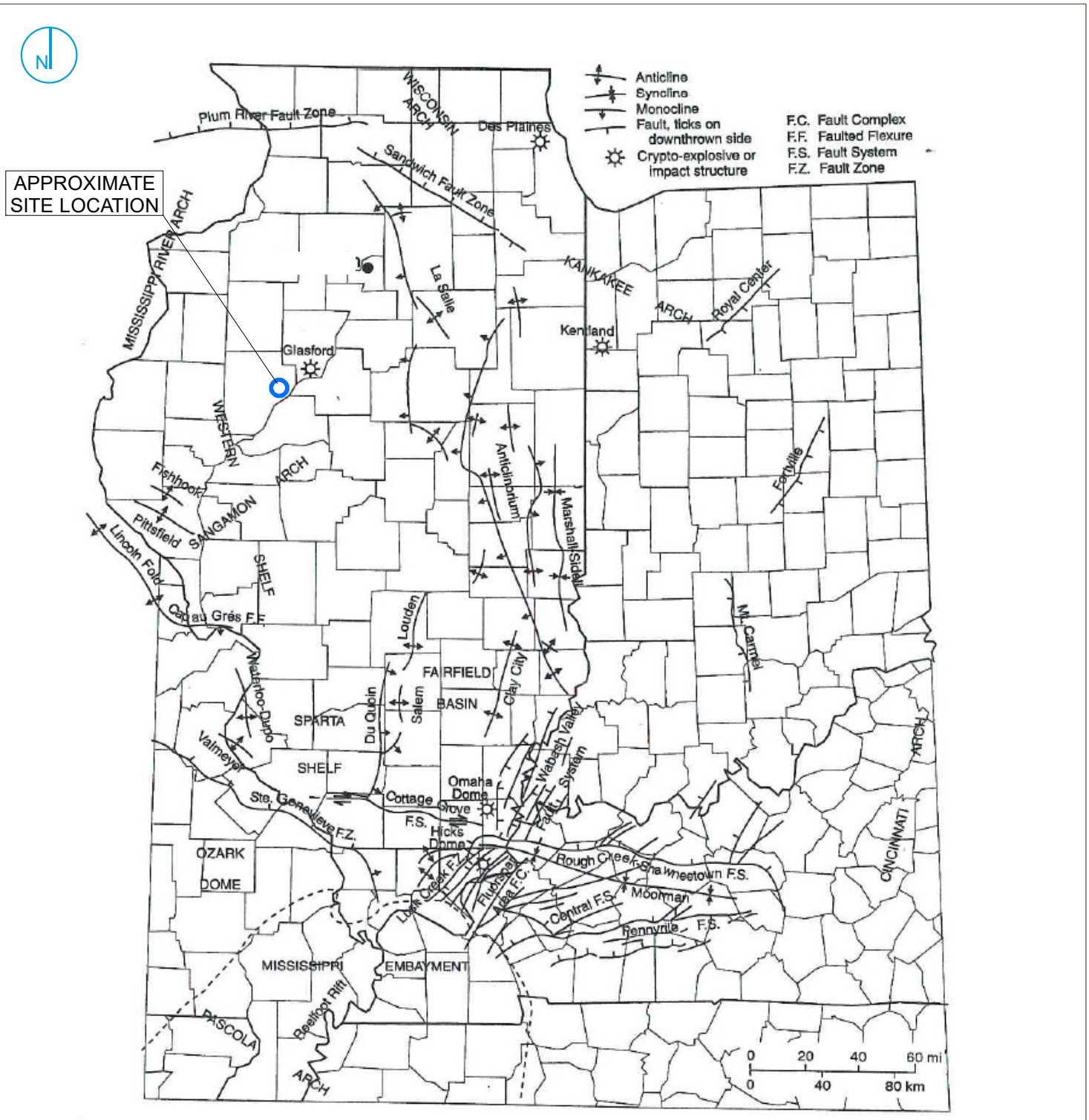
SURFICIAL GEOLOGIC DEPOSITS

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

FIGURE 2-4

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



SOURCE NOTE: MODIFIED FROM "NELSON, W.J. 1995, STRUCTURAL FEATURES IN ILLINOIS, ILLINOIS STATE GEOLOGICAL SURVEY, BULLETIN 100, CHAMPAIGN, ILLINOIS."

Service Layer Credits:

Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Duck_Creek\GMF_Pond\Figure 2-5_Major Structural Features of Illinois.mxd

PROJECT: 169000XXXX | DATED: 9/17/2021 | DESIGNER: STOLZSD

MAJOR STRUCTURAL FEATURES OF ILLINOIS

FIGURE 2-5

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

MONITORING WELL
SOLID SAMPLE LOCATION
PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY

0 150 300 Feet

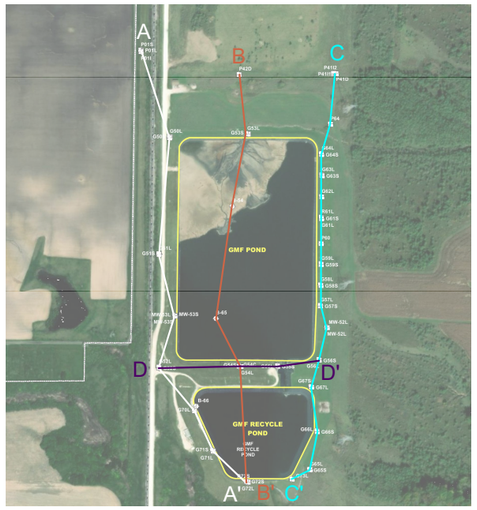
FIELD INVESTIGATION LOCATION MAP

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

FIGURE 2-6

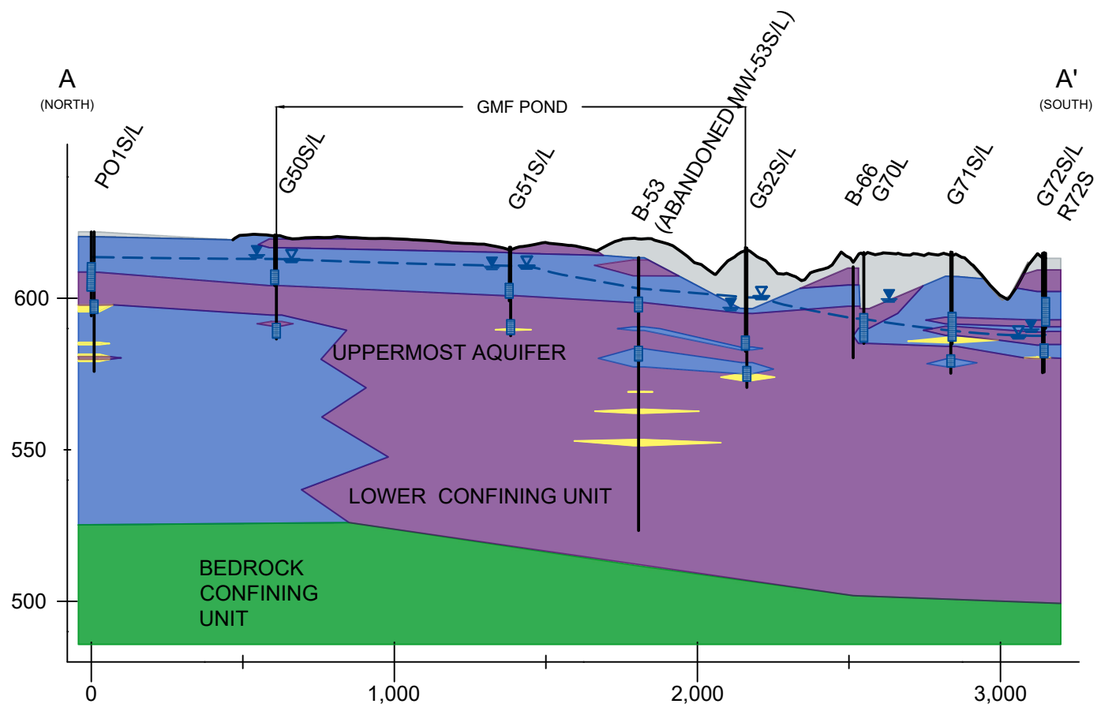
RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

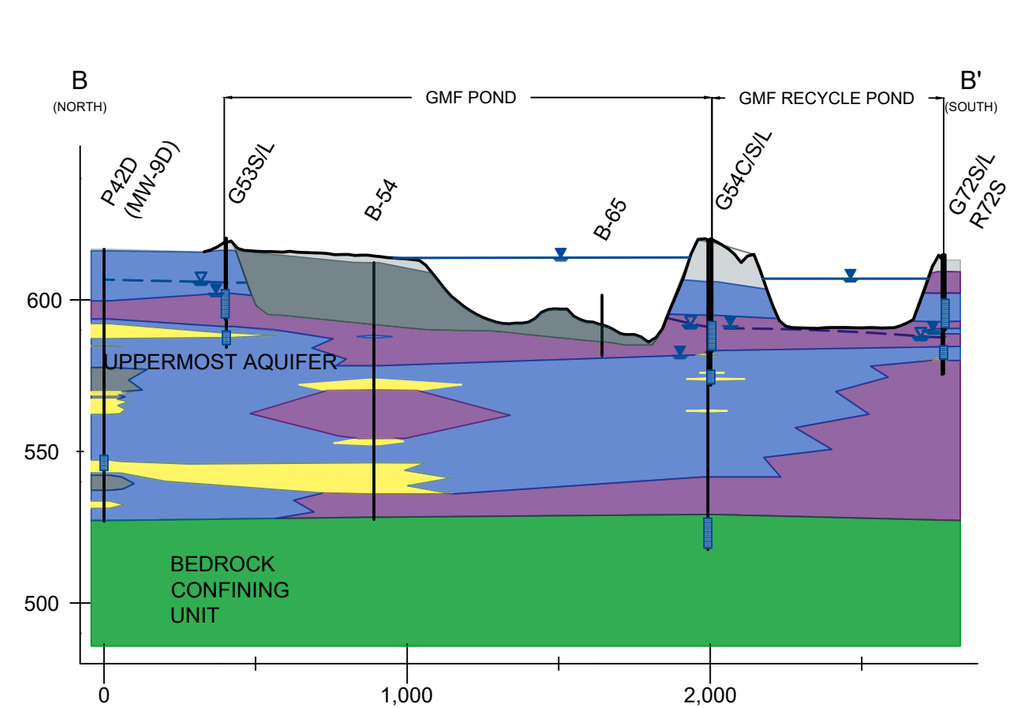
RAMBOLL



NOTES

1. This profile was developed by interpolation between widely spaced boreholes. Only at the borehole location should it be considered as an approximately accurate representation and then only to the degree implied by the notes on the borehole logs.
2. Scale is approximate.
3. Vertical scale is exaggerated 10X.
4. Groundwater elevations measured on April 14, 2021.





LEGEND

- COAL COMBUSTION RESIDUAL (CCR) (GYPSUM)
- FILL
- CLAY (CL/CH)
- SILT (ML)
- SAND (SP/SM/SW)
- BEDROCK / WEATHERED BEDROCK (INTERBEDDED SHALE, LIMESTONE, SANDSTONE, V. LITTLE SS)
- WELL SCREEN INTERVAL
- UPPERMOST AQUIFER POTENTIOMETRIC SURFACE
- UPPER AQUIFER GROUNDWATER ELEVATION
- BEDROCK GROUNDWATER / OTHER GROUNDWATER / SURFACE WATER ELEVATION(S)
- SURFACE WATER

50' 0 500'

GEOLOGIC CROSS SECTIONS
A-A' & B-B'

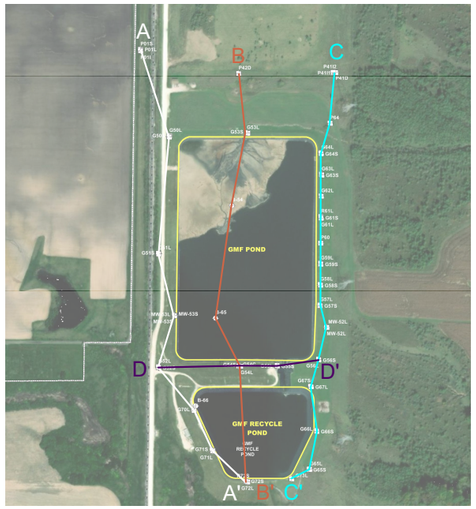
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

FIGURE 2-7

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

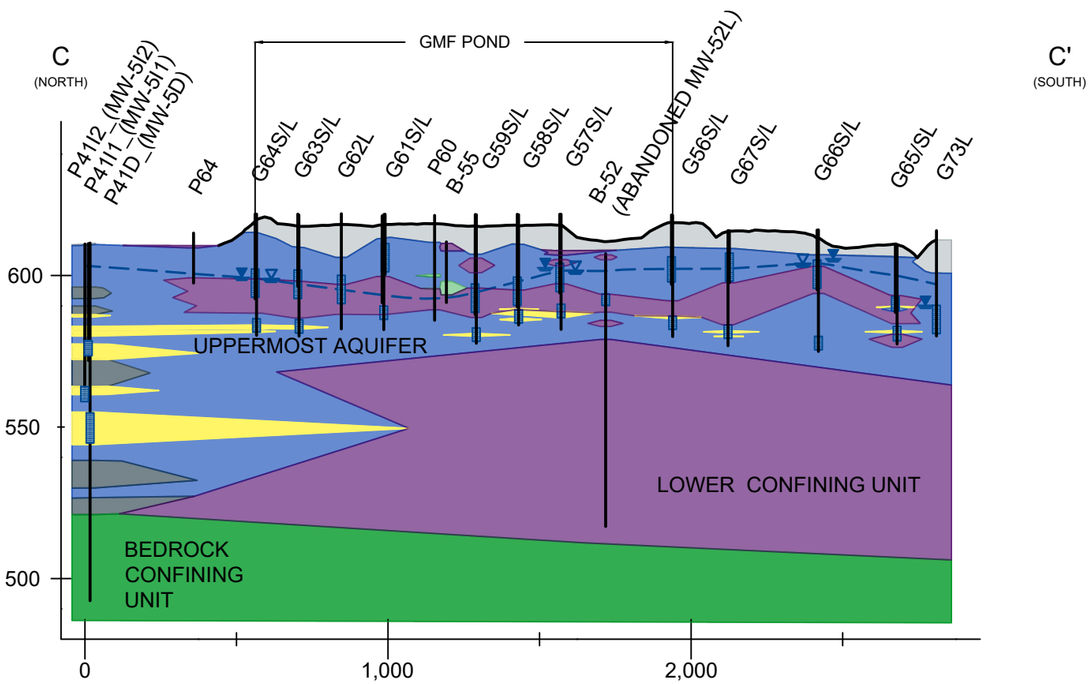
RAMBOLL

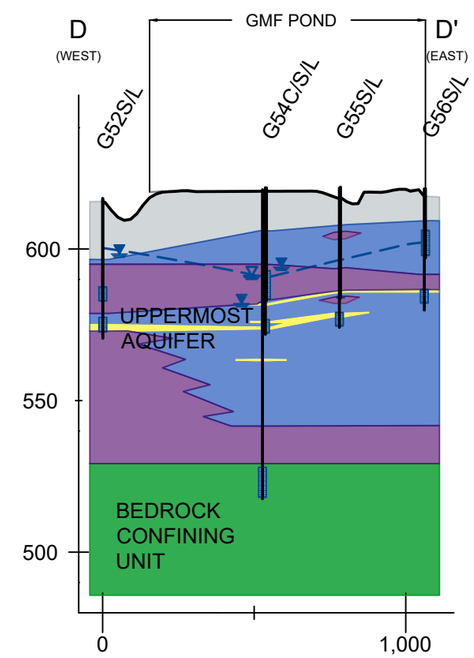
PROJECT: 1940100806 \\ramboll.sharepoint.com@SSL\DavWWWRoot\sites\vistra\Shared Documents\-CCR GW\Deliverables\Part 845 Operating Permits\Sites\Duck Creek\EVS\working files\CAD\Cross Sections\DC-GMF cross sections.dwg



NOTES

1. This profile was developed by interpolation between widely spaced boreholes. Only at the borehole location should it be considered as an approximately accurate representation and then only to the degree implied by the notes on the borehole logs.
2. Scale is approximate.
3. Vertical scale is exaggerated 10X.
4. Groundwater elevations measured on April 14, 2021.





LEGEND

- COAL COMBUSTION RESIDUAL (CCR) (GYPSUM)
- FILL
- CLAY (CL/CH)
- SILT (ML)
- SAND (SP/SM/SW)
- BEDROCK / WEATHERED BEDROCK (INTERBEDDED SHALE, LIMESTONE, SANDSTONE, V. LITTLE SS)
- PEAT
- WELL SCREEN INTERVAL
- UPPERMOST AQUIFER POTENTIOMETRIC SURFACE
- UPPER AQUIFER GROUNDWATER ELEVATION
- BEDROCK GROUNDWATER / OTHER GROUNDWATER / SURFACE WATER ELEVATION(S)

50' 0 500'

GEOLOGIC CROSS SECTIONS
C-C' & D-D'

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

FIGURE 2-8

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

PROJECT:1940100806 \\ramboll-sharepoint.com@SSL\DavWWWRoot\sites\vistra\Shared Documents\-CCR GW\Deliverables\Part 845 Operating Permits\Sites\Duck Creek\EVS\working files\CAD\Cross Sections\DC-GMF cross sections.dwg

10 FOOT CONSTRUCTION ELEVATION CONTOUR
2 FOOT CONSTRUCTION ELEVATION CONTOUR
PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY

0 150 300 Feet

BOTTOM OF CCR MAP

FIGURE 2-9

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

- BACKGROUND WELL
- MONITORING WELL
- SOURCE SAMPLE LOCATION
- PART 845 REGULATED UNIT (SUBJECT UNIT)
- SITE FEATURE
- PROPERTY BOUNDARY

0 150 300 Feet

MONITORING WELL LOCATION MAP

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

FIGURE 3-1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

UPPERMOST AQUIFER ELEVATION, TOP OF SAND (2-FOOT CONTOUR)

INFERRED UPPERMOST AQUIFER ELEVATION, TOP OF SAND (2-FOOT CONTOUR)

PART 845 REGULATED UNIT (SUBJECT UNIT)

SITE FEATURE

PROPERTY BOUNDARY

0 150 300 Feet

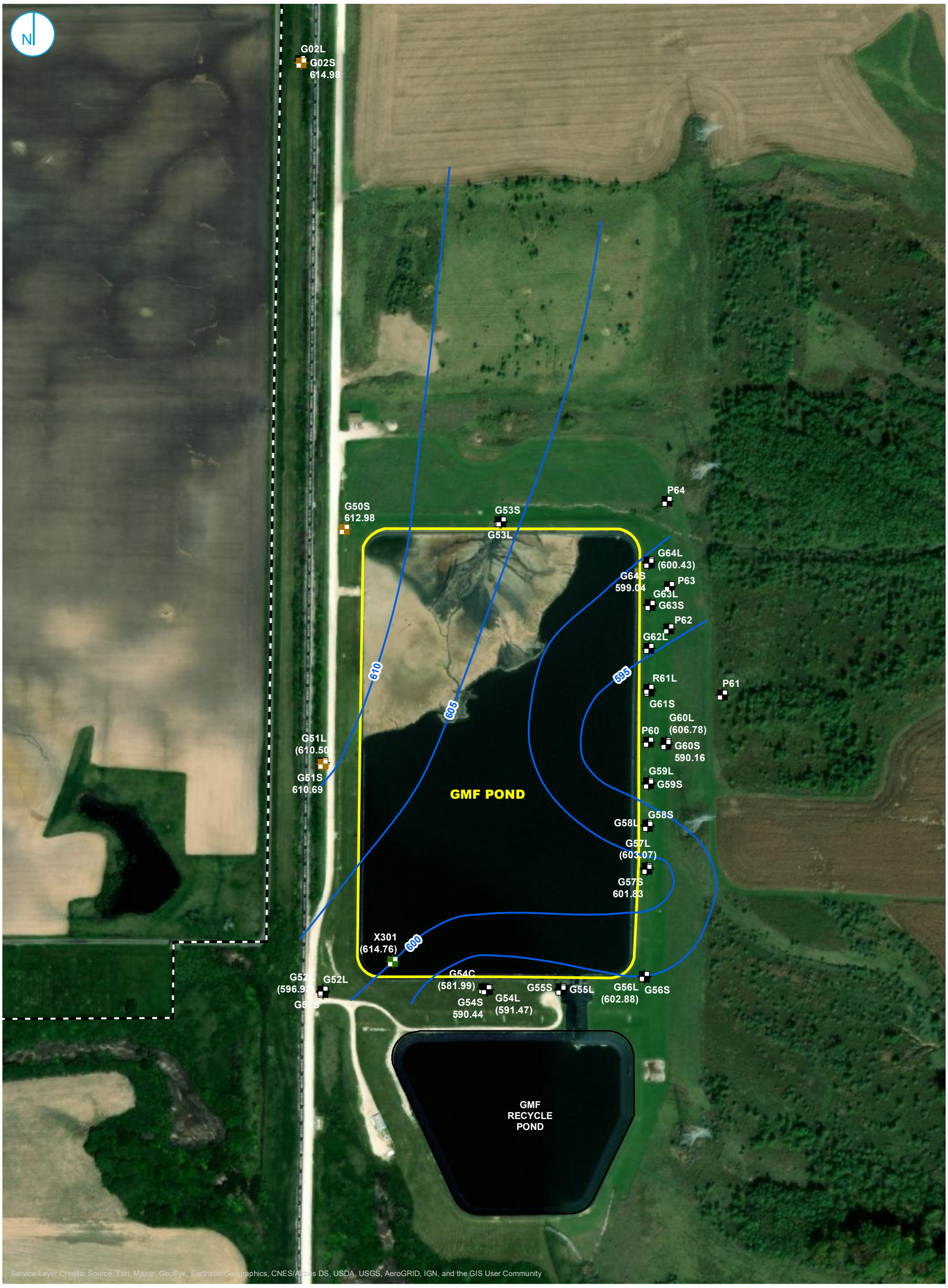
TOP OF UPPERMOST AQUIFER

FIGURE 3-2

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



BACKGROUND WELL
MONITORING WELL
SOURCE SAMPLE LOCATION
GROUNDWATER ELEVATION CONTOUR (5-FT CONTOUR INTERVAL, NAVD88)
PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY

0 150 300 Feet

UPPERMOST AQUIFER GROUNDWATER ELEVATION CONTOURS APRIL 14, 2021

FIGURE 3-3

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

BACKGROUND WELL
MONITORING WELL
SOURCE SAMPLE LOCATION
GROUNDWATER ELEVATION CONTOUR (5-FT CONTOUR INTERVAL, NAVD88)
PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY

0 150 300 Feet

UPPERMOST AQUIFER GROUNDWATER ELEVATION CONTOURS MAY 10, 2021

FIGURE 3-4

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

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APPENDICES

APPENDIX A
INFORMATION PERTINENT TO 35 I.A.C. § 845.220(a)(3)

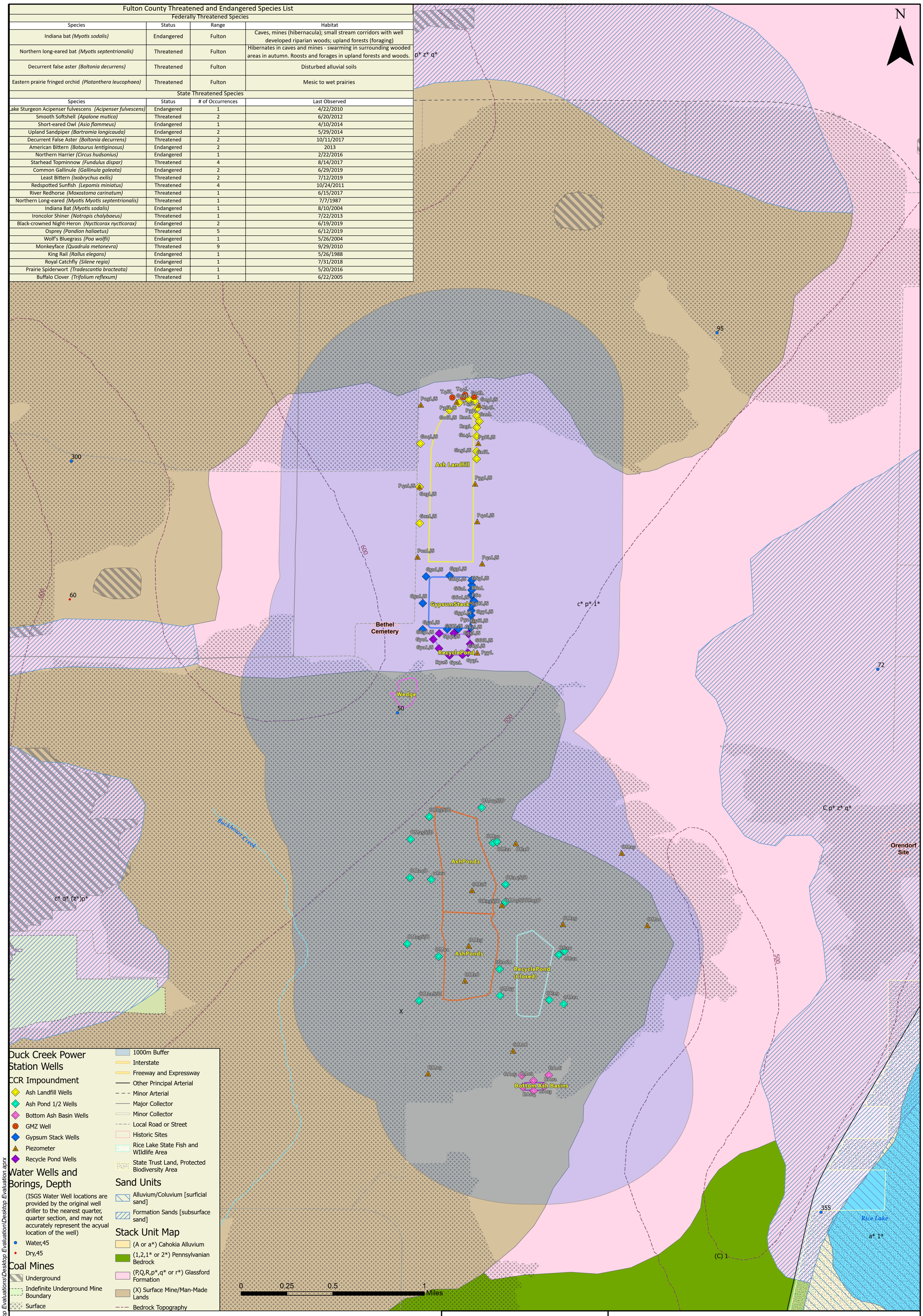
Fulton County Threatened and Endangered Species List

Federally Threatened Species

Species	Status	Range	Habitat
Indiana bat *(Myotis sodalis)*	Endangered	Fulton	Caves, mines (hibernacula); small stream corridors with well developed riparian woods; upland forests (foraging)
Northern long-eared bat *(Myotis septentrionalis)*	Threatened	Fulton	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. Roosts and forages in upland forests and woods.
Decurrent false aster *(Boltonia decurrens)*	Threatened	Fulton	Disturbed alluvial soils
Eastern prairie fringed orchid *(Platanthera leucophaea)*	Threatened	Fulton	Mesic to wet prairies

State Threatened Species

Species	Status	# of Occurrences	Last Observed
Lake Sturgeon Acipenser fulvescens *(Acipenser fulvescens)*	Endangered	1	4/22/2010
Smooth Softshell *(Apalone mutica)*	Threatened	2	6/20/2012
Short-eared Owl *(Asio flammeus)*	Endangered	1	4/10/2014
Upland Sandpiper *(Bartramia longicauda)*	Endangered	2	5/29/2014
Decurrent False Aster *(Boltonia decurrens)*	Threatened	2	10/11/2017
American Bittern *(Botaurus lentiginosus)*	Endangered	2	2013
Northern Harrier *(Circus hudsonius)*	Endangered	1	2/22/2016
Starhead Topminnow *(Fundulus dispar)*	Threatened	4	8/14/2017
Common Gallinule *(Gallinula galeata)*	Endangered	2	6/29/2019
Least Bittern *(Ixobrychus exilis)*	Threatened	2	7/12/2019
Redspotted Sunfish *(Lepomis miniatus)*	Threatened	4	10/24/2011
River Redhorse *(Moxostoma carinatum)*	Threatened	1	6/15/2017
Northern Long-eared *(Myotis Myotis septentrionalis)*	Threatened	1	7/7/1987
Indiana Bat *(Myotis sodalis)*	Endangered	1	8/10/2004
Ironcolor Shiner *(Notropis chalybaeus)*	Threatened	1	7/22/2013
Black-crowned Night-Heron *(Nycticorax nycticorax)*	Endangered	2	6/19/2019
Osprey *(Pandion haliaetus)*	Threatened	5	6/12/2019
Wolf's Bluegrass *(Poa wolfii)*	Endangered	1	5/26/2004
Monkeyface *(Quadrula metanevra)*	Threatened	9	9/29/2010
King Rail *(Rallus elegans)*	Endangered	1	5/26/1988
Royal Catchfly *(Silene regia)*	Endangered	1	7/31/2018
Prairie Spiderwort *(Tradescantia bracteata)*	Endangered	1	5/20/2016
Buffalo Clover *(Trifolium reflexum)*	Threatened	1	6/22/2005



HANSON®
Hanson Professional Services Inc.

Duck Creek Power Station

Work Plan Desktop Evaluation
Fulton County
Canton, Illinois

Job Number: 20E0111A

Sheet 1

I:\20jobs\20E0111A\CAD\GIS\Projects\Desktop Evaluations\Desktop Evaluation\Desktop Evaluation.aprx

APPENDIX B
BORING LOGS AND WELL CONSTRUCTION LOGS

BORING AND WELL LOCATIONS MAP

- BACKGROUND WELL
- MONITORING WELL
- SOURCE SAMPLE LOCATION
- PART 845 REGULATED UNIT (SUBJECT UNIT)
- SITE FEATURE
- PROPERTY BOUNDARY

0 150 300 Feet

SOIL BORING AND WELL LOCATION MAP

FIGURE B-1

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

BORING LOGS

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/3/2021
Finish: 2/5/2021
WEATHER: Overcast, cold (lo-20's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Al
Eng/Geo: T. Gass

BOREHOLE ID: G54C
Well ID: G54C
Surface Elev: 619.59 ft. MSL
Completion: 102.00 ft. BGS
Station: 1,384,885.21N
2,348,250.14E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	18/24 75%	SS	2-2 4-5 N=6			1.5		Fill - Yellowish brown (10YR5/4) with 15% gray (10YR6/1) and 5% yellowish brown (10YR4/6) mottles, moist SILT with little clay, trace roots, and trace sand.	618	
	21/24 88%	SS	2-5 6-7 N=11			2.0	2	Fill - Yellowish brown (10YR5/6) with 30% light brownish gray (10YR6/2) mottles, moist, soft SILT with little clay, trace sand, and trace gravel.	616	
	22/24 92%	SS	2-7 10-12 N=17			2.5	4	Fill - Yellowish brown (10YR5/4) with 10% dark yellowish brown (10YR4/6) mottles, moist, firm SILT with little clay and trace sand.	614	
	19/24 79%	SS	3-7 9-11 N=16			4.5	6	Fill - Yellowish brown (10YR5/4) firm SILT with little clay, trace sand, and trace gravel.	612	
	20/24 83%	SS	3-7 9-10 N=16			4.5	8	Grayish brown (10YR5/2) firm SILT with little clay, trace sand, and trace gravel.	610	
	21/24 88%	SS	3-4 7-10 N=11			4.5	10	Grayish brown (10YR5/2) with 30% yellowish brown (10YR5/6) mottles, firm SILT with little clay, trace sand, and trace gravel.	608	
	21/24 88%	SS	3-7 12-15 N=19			4.5	12	Yellowish brown (10YR5/4) firm SILT with little clay, trace sand, and trace gravel.	606	
ST8	20/24 83%	SH				4.0	14		604	
	18/24 75%	SS	1-4 4-5 N=8			0.5	16	Yellowish brown (10YR5/6) with 10% gray (10YR6/1) mottles, moist, soft SILT with little clay.	602	
	19/24 79%	SS	1-3 4-4 N=7			1.0	18		600	
							20			

Borehole Detail

NOTE(S):

FIELD BORING LOG

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/3/2021
Finish: 2/5/2021
WEATHER: Overcast, cold (lo-20's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Al
Eng/Geo: T. Gass

BOREHOLE ID: G54C
Well ID: G54C
Surface Elev: 619.59 ft. MSL
Completion: 102.00 ft. BGS
Station: 1,384,885.21N
2,348,250.14E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	18/24 75%	SS	1-2 4-5 N=6			1.0				
	20/24 83%	SS	1-3 4-7 N=7			1.0	22	Gray (10YR6/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, soft SILT with little clay.	598	
	19/24 79%	SS	1-3 3-4 N=6			1.5	24	Gray (10YR5/1) with 30% dark gray (10YR4/1) mottles, moist, soft SILT with little clay.	596	
	22/24 92%	SS	woh-1 3-3 N=4			1.5	26	Grayish brown (10YR5/2) moist, soft, CLAY with little silt.	594	
	21/24 88%	SS	1-2 3-4 N=5			1.0	28	Gray (10YR5/1) moist, soft, CLAY with little silt.	592	
	22/24 92%	SS	1-3 5-5 N=8			2.0	30	Gray (10YR5/1) with 30% yellowish brown (10YR5/8) soft CLAY with little silt.	590	
ST17	24/24 100%	SH				0.5	32		588	
	21/24 88%	SS	2-3 4-3 N=7			1.0	34		586	
	21/24 88%	SS	1-4 5-8 N=9			1.5	36	Gray (10YR6/1) wet, soft CLAY with little silt and trace sand.	584	
	20/24 83%	SS	woh-1 3-4 N=4			1.0	38	Dark gray (10YR4/1) wet, fine SAND with trace silt.	582	
							40	Dark gray (10YR4/1) very moist, soft SILT with little clay and trace sand.	580	

NOTE(S):

FIELD BORING LOG

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/3/2021
Finish: 2/5/2021
WEATHER: Overcast, cold (lo-20's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Al
Eng/Geo: T. Gass

BOREHOLE ID: G54C
Well ID: G54C
Surface Elev: 619.59 ft. MSL
Completion: 102.00 ft. BGS
Station: 1,384,885.21N
2,348,250.14E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
	4/24 17%	SS	1-2 5-10 N=7			
	23/24 96%	SS	2-6 12-11 N=18			3.0
ST23	23/24 96%	SH				4.5
	24/24 100%	SS	3-6 8-14 N=14			4.5
	24/24 100%	SS	3-8 13-20 N=21			4.5
	24/24 100%	SS	3-10 14-19 N=24			4.5
	24/24 100%	SS	6-9 15-16 N=24			4.5
	24/24 100%	SS	4-10 28-50/3" N=38			4.5
	24/24 100%	SS	10-47 50/3.25-50/1.25			2.5
	24/24 100%	SS	19-29 44-72 N=73			4.5

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark gray (10YR4/1) very moist, soft SILT with little clay and trace sand. *[Continued from previous page]*	578
42		
44	Dark grayish brown (10YR4/2) moist, firm SILT with little clay, trace sand, and trace gravel.	576
		574
46		
48		572
50	Dark gray (10YR4/1) moist, firm SILT with little clay, trace sand, and trace gravel.	570
52		568
54		566
	Dark gray (10YR4/1) moist, firm SILT with little clay, trace sand, and trace gravel.	564
56	Dark gray (10YR4/1) wet, soft SAND with little clay and trace silt.	
58	Dark gray (10YR4/1) moist, firm SILT with little clay, trace sand, and trace gravel.	562
60		560

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/3/2021
Finish: 2/5/2021
WEATHER: Overcast, cold (lo-20's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Al
Eng/Geo: T. Gass

BOREHOLE ID: G54C
Well ID: G54C
Surface Elev: 619.59 ft. MSL
Completion: 102.00 ft. BGS
Station: 1,384,885.21N
2,348,250.14E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
	24/24 100%	SS	14-29 42-54 N=71			4.5					
	23/24 96%	SS	12-14 30-48 N=44			4.5	62	Dark gray (10YR4/1) moist, firm SILT with little clay, trace sand, and trace gravel. *[Continued from previous page]*		558	
	23/24 96%	SS	10-22 25-34 N=47			4.5	64			556	
	24/24 100%	SS	10-19 26-34 N=45			4.5	66			554	
	24/24 100%	SS	11-19 24-33 N=43			4.5	68			552	
	23/24 96%	SS	11-22 22-34 N=44			4.5	70	Dark gray (10YR4/1) firm SILT with little clay, trace sand, and trace gravel.		550	
	24/24 100%	SS	9-13 20-22 N=33			4.5	72			548	
	24/24 100%	SS	6-8 12-15 N=20			4.5	74			546	
ST39	11/24 46%	SH				4.5	76	Dark grayish olive (10Y4/2) firm, slick CLAY with trace silt.		544	
	14/24 58%	SS	7-10 17-20 N=27			4.5	78	Dark grayish olive (10Y4/2) firm, slick CLAY with trace silt and gravel.		542	
							80			540	

NOTE(S):

FIELD BORING LOG

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/3/2021
Finish: 2/5/2021
WEATHER: Overcast, cold (lo-20's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Al
Eng/Geo: T. Gass

BOREHOLE ID: G54C
Well ID: G54C
Surface Elev: 619.59 ft. MSL
Completion: 102.00 ft. BGS
Station: 1,384,885.21N
2,348,250.14E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	24/24 100%	SS	6-8 11-15 N=19			4.5		Dark grayish olive (10Y4/2) firm, slick CLAY with trace silt and gravel. *[Continued from previous page]*		
	24/24 100%	SS	3-7 9-10 N=16			4.5	82	Dark gray (10YR4/1) firm CLAY with trace silt and gravel.	538	
	24/24 100%	SS	4-8 12-15 N=20			4.5	84	Dark gray (10YR4/1) with 5% gray (10YR5/1) mottles, firm, CLAY with little silt, trace sand, and trace gravel.	536	
	24/24 100%	SS	5-7 11-14 N=18			4.0	86		534	
	24/24 100%	SS	5-8 11-14 N=19			4.5	88	Dark gray (10YR4/1) CLAY with little silt, trace sand, and trace gravel.	532	
	24/24 100%	SS	5-9 13-15 N=22			4.5	90		530	
	24/24 100%	SS	4-7 10-13 N=17			4.5	92	Grayish green (5GY5/2) with 30% dark grayish green (5GY4/2) mottles, firm, CLAY with trace silt and gravel. (WEATHERED SHALE)	528	
	24/24 100%	SS	3-6 8-11 N=14			4.0	94		526	
	24/24 100%	SS	4-8 11-13 N=19			3.0	96	Very dark grayish green (5GY3/2) firm, CLAY with trace silt. (WEATHERED SHALE)	524	
	21/24 88%	SS	5-7 10-12 N=17			3.0	98	Very dark grayish green (5GY3/2) firm, CLAY with trace silt and gravel. (WEATHERED SHALE)	522	
							100		520	

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/3/2021
Finish: 2/5/2021
WEATHER: Overcast, cold (lo-20's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Al
Eng/Geo: T. Gass

BOREHOLE ID: G54C
Well ID: G54C
Surface Elev: 619.59 ft. MSL
Completion: 102.00 ft. BGS
Station: 1,384,885.21N
2,348,250.14E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Water Content (%)	Dry Density (lb/ft^3)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
	24/24 *100%*	ss	*3-7* *9-11* N=16			*2.5*		Very dark grayish green (5GY3/2) firm, CLAY with trace silt and gravel. (WEATHERED SHALE) *[Continued from previous page]*		518	
							102	**End of boring = 102 feet**			

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/24/2021
Finish: 2/24/2021
WEATHER: Sunny, cool (lo-40's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Doug
Eng/Geo: R. Hasenyager

BOREHOLE ID: P61
Well ID: P61
Surface Elev: 611.09 ft. MSL
Completion: 20.00 ft. BGS
Station: 1,398,670.81N
2,346,779.33E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▽ = 8.00 - durring drilling
▼ =
▼ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	0/24 *0%*	SS	--- ---					Yellowish brown (10YR5/6), moist, medium, CLAY with some silt and trace sand.	610	
2A	19/24 *79%*	SS	*1-3* *3-3* N=6				2	Yellowish brown (10YR5/6) with 5% gray (10YR5/1) mottles, moist, medium CLAY with some silt and trace sand.	608	
3A	21/24 *88%*	SS	*2-4* *4-5* N=8				4	Yellowish brown (10YR5/6) with 25% gray (10YR5/1) mottles, moist, medium, SILT with few clay and trace sand.	606	
4A	19/24 *79%*	SS	*woh-2* *4-4* N=6				6	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, soft, SILT with few clay and trace sand.	604	
5A	10/24 *42%*	SS	*1-2* *2-3* N=4				▽ 8	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, wet, soft, SILT with few clay and trace sand.	602	
6A	17/24 *71%*	SS	*2-2* *3-3* N=5				10	Yellowish brown (10YR5/8), moist, soft, SILT with few clay and trace sand. Gray (10YR5/1) with 25% yellowish brown (10YR5/8) mottles, wet, soft, SILT with few clay and trace sand.	600	
7A	24/24 *100%*	SS	*woh-1* *2-2* N=3				12	Brown (10YR4/3), wet, soft, SILT with few clay and trace sand.	598	
8A	24/24 *100%*	SS	*1-2* *3-3* N=5				14	Black (10YR2/1), moist, medium, CLAY with few silt and trace sand.	596	
9A	24/24 *100%*	SS	*1-3* *3-4* N=6				16		594	
10A	24/24 *100%*	SS	*1-1* *3-3* N=4				18	Gray (10YR5/1), moist, medium CLAY with some silt and trace sand.	592	
							20	**End of boring = 20 ft.**		

NOTE(S):

FIELD BORING LOG

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/24/2021
Finish: 2/24/2021
WEATHER: Sunny, cool (lo-40's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Doug
Eng/Geo: R. Hasenyager

BOREHOLE ID: P62
Well ID: P62
Surface Elev: 610.81 ft. MSL
Completion: 16.30 ft. BGS
Station: 1,398,887.32N
2,346,602.30E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
= Dry - durring drilling
=
=

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	0/24 0%	SS	--- ---					Yellowish brown (10YR5/6), moist, medium, SILT with some clay and trace sand.	610	
							2	Yellowish brown (10YR5/6), moist, hard, CLAY with some silt, trace sand, and trace gravel.		
2A	23/24 96%	SS	1-7 9-9 N=16					Yellowish brown (10YR5/6), moist, hard, SILT with few clay, trace sand, and trace gravel.	608	
							4			
3A	24/24 100%	SS	2-5 5-6 N=10					Gray (10YR5/1), moist, medium, SILT with few clay, trace sand, and trace gravel.	606	
							6			
4A	24/24 100%	SS	4-4 7-8 N=11						604	
							8	Yellowish brown (10YR5/6), moist, medium, SILT with few clay and trace sand.		
5A	24/24 100%	SS	2-5 5-6 N=10						602	
							10			
6A	24/24 100%	SS	3-4 6-10 N=10					Yellowish brown (10YR5/6) with 15% gray (10YR5/1) mottles, moist, medium, SILT with few clay and trace sand.	600	
							12			
7A	23/24 96%	SS	2-3 5-6 N=8					Dark yellowish brown (10YR4/6), moist, medium, SILT with few clay and trace sand.	598	
							14			
8A	24/24 100%	SS	1-2 3-4 N=5					Gray (10YR5/1) with 5% yellowish brown (10YR5/8) mottles, moist, soft, CLAY with some silt, trace sand, and trace gravel	596	
	0/4 0%	BD					16			

Borehole Detail

End of boring = 16.3 ft.

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/24/2021
Finish: 2/24/2021
WEATHER: Sunny, cool (lo-40's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Doug
Eng/Geo: R. Hasenyager

BOREHOLE ID: P63
Well ID: P63
Surface Elev: 612.33 ft. MSL
Completion: 18.25 ft. BGS
Station: 1,399,026.62N
2,346,605.85E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▽ = 8.00 - durring drilling
▼ =
▼ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	0/24 *0%*	SS	--- ---					Grayish brown (10R5/2), moist, medium, CLAY with some silt, trace sand, and trace gravel.	612	
2A	24/24 *100%*	SS	*3-7* *7-10* N=14				2	Yellowish brown (10YR5/6), moist, hard, CLAY with some silt, trace sand, and trace gravel.	610	
3A	24/24 *100%*	SS	*2-4* *4-4* N=8				4	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, medium, CLAY with some silt and trace sand.	608	
4A	22/24 *92%*	SS	*1-1* *4-5* N=5				6	Yellowish brown (10YR5/8) with 25% gray (10YR5/1) mottles, moist, soft, SILT with few clay and trace sand.	606	
5A	21/24 *88%*	SS	*2-2* *3-4* N=5				▽ 8		604	
6A	23/24 *96%*	SS	*2-3* *3-5* N=6				10	Yellowish brown (10YR5/8) with 25% gray (10YR5/1) mottles, wet, soft, SILT with few clay and trace sand.	602	
7A	20/24 *83%*	SS	*2-2* *3-4* N=5				12	Dark yellowish brown (10YR3/4), moist, medium SILT with few clay and trace sand.	600	
8A	24/24 *100%*	SS	*2-2* *3-3* N=5				14	Gray (10YR5/1) with 35% yellowish brown (10YR5/6) mottles, wet, soft, SILT with few clay and trace sand.	598	
9A	24/24 *100%*	SS	*1-2* *3-3* N=5				16	Yellowish brown(10YR5/6), moist, soft, CLAY with some silt, trace sand, and trace gravel.	596	
	0/4 *0%*	BD					18			

End of boring = 18.25 ft.

NOTE(S):

FIELD BORING LOG

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/25/2021
Finish: 2/25/2021
WEATHER: Sunny, cool (lo-40's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Doug
Eng/Geo: R. Hasenyager

BOREHOLE ID: P64
Well ID: P64
Surface Elev: 614.04 ft. MSL
Completion: 16.47 ft. BGS
Station: 1,399,305.91N
2,346,597.96E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▽ = 6.70 - durring drilling
▽ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	0/24 0%	SS	--- ---					Yellowish brown (10YR5/6), medium CLAY with some silt and trace sand.		
2A	23/24 96%	SS	2-4 4-5 N=8				2	Yellowish brown (10YR5/6) with 10% gray (10YR5/1) mottles, moist, medium, CLAY with some silt and trace sand.	612	
3A	23/24 96%	SS	2-2 2-3 N=4				4	Yellowish brown (10YR5/6) with 15% gray (10YR5/1) mottles, moist, soft, SILT with few clay, trace sand, and trace wood fragments.	610	
4A	20/24 83%	SS	1-2 4-4 N=6				6 ▽	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, wet, soft, SILT with few clay and trace sand.	608	
5A	15/24 63%	SS	1-2 2-3 N=4				8		606	
6A	19/24 79%	SS	1-2 2-3 N=4				10		604	
7A	24/24 100%	SS	1-1 2-3 N=3				12	Yellowish brown (10YR5/6), moist, soft, SILT with some clay and trace sand.	602	
8A	24/24 100%	SS	1-2 2-3 N=4				14	Yellowish brown (10YR5/6) with 25% gray (10YR5/1) mottles, moist, soft, CLAY with some silt and trace sand.	600	
	0/6 0%	BD					16		598	

End of boring = 16.5 ft.

NOTE(S):

FIELD BORING LOG

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/2/2021
Finish: 2/2/2021
WEATHER: Overcast, cold (lo-20's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Al
Eng/Geo: T. Gass

BOREHOLE ID: SB50
Well ID: n/a
Surface Elev: 620.9 ft. MSL
Completion: 50.0 ft. BGS
Station: 1,399,205.58N
2,345,536.13E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	20/24 83%	SS	1-4 5-6 N=9			2.5		Very dark brown (10YR2/2) with 15% brownish yellow (10YR6/8) mottles, soft, SILT with trace roots, and gravel.	620	
	15/24 63%	SS	1-5 5-6 N=10			3.5	2	Very dark brown (10YR2/2) with 50% yellowish brown (10YR5/8) mottles, soft, CLAY with little silt and trace roots.	618	
	22/24 92%	SS	2-2 3-4 N=5			2.5	4	Yellowish brown (10YR6/8) with 30% light brownish gray (10YR6/2) mottles, firm SILT with little clay.	616	
	17/24 71%	SS	0-2 3-4 N=5			1.0	6	Light brownish gray (10YR6/2) with 30% yellowish brown (10YR6/8) mottles, firm, wet CLAY with little silt and trace black oxidation.	614	
	14/24 58%	SS	1-3 2-4 N=5			1.0	8		612	
ST6	23/24 96%	SH				1.0	10	Grayish brown (10YR5/2) with 30% yellowish brown (10YR6/8) mottles, firm SILT with little clay and trace black oxidation.	610	
	20/24 83%	SS	1-2 3-4 N=5			1.5	12	Light brownish gray (10YR6/2) with 15% brownish yellow (10YR6/1) mottles, firm, wet, SILT with little clay and trace black oxidation.	608	
	24/24 100%	SS	1-2 3-3 N=5			1.0	14	Brown (10YR5/3) firm, moist SILT with little clay and trace black oxidation.	606	
	24/24 100%	SS	1-2 2-3 N=4			1.0	16	Yellowish brown (10YR5/4) firm, moist SILT with little clay and trace black oxidation.	604	
	24/24 100%	SS	1-2 3-4 N=5			2.0	18	Yellowish brown (10YR5/4) with 15% yellowish brown (10YR5/8) mottles, firm, moist CLAY.	602	
							20			

Borehole Detail

NOTE(S): Borehole sealed with high solids bentonite grout.

FIELD BORING LOG

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/2/2021
Finish: 2/2/2021
WEATHER: Overcast, cold (lo-20's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Al
Eng/Geo: T. Gass

BOREHOLE ID: SB50
Well ID: n/a
Surface Elev: 620.9 ft. MSL
Completion: 50.0 ft. BGS
Station: 1,399,205.58N
2,345,536.13E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
	24/24 100%	SS	2-2 3-4 N=5			1.8				600	
							22	Dark gray (10YR4/1), wet, CLAY with trace gravel.			
ST12	23/24 96%	SH				1.5				598	
							24				
	24/24 100%	SS	1-1 1-4 N=2			0.5		Gray (10YR6/1) with 30% brownish yellow (10YR6/6) mottles, firm, wet CLAY		596	
								Brownish yellow (10YR6/6) firm, wet CLAY with little silt.			
							26				
	24/24 100%	SS	woh-3 3-5 N=6			1.0		Brownish yellow (10YR6/6) firm, wet CLAY with trace gravel.		594	
							28				
	23/24 96%	SS	1-5 6-6 N=11			3.5		Brownish yellow (10YR6/8) with 15% gray (10YR6/1) mottles, firm CLAY with trace gravel.		592	
							30				
	23/24 96%	SS	1-3 7-8 N=10			4.5				590	
								Grayish brown (10YR5/2) firm CLAY.			
								Dark gray (10YR4/1) wet, firm CLAY with trace gravel.			
							32				
	18/24 75%	SS	1-2 2-4 N=4			1.5		Dark gray (10YR4/1) wet, firm CLAY with little silt and trace gravel.		588	
							34				
	22/24 92%	SS	3-5 10-16 N=15			4.0		Gray (10YR5/1) firm CLAY with trace gravel.		586	
							36				
	21/24 88%	SS	4-8 12-17 N=20			4.5		Gray (10YR5/1) firm CLAY with trace sand and trace gravel.		584	
							38				
	20/24 83%	SS	4-17 29-50 N=46			4.5		Dark grayish brown (10YR4/2) hard SILT with little clay, trace sand, and trace gravel.		582	
							40				

NOTE(S): Borehole sealed with high solids bentonite grout.

FIELD BORING LOG

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/2/2021
Finish: 2/2/2021
WEATHER: Overcast, cold (lo-20's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Al
Eng/Geo: T. Gass

BOREHOLE ID: SB50
Well ID: n/a
Surface Elev: 620.9 ft. MSL
Completion: 50.0 ft. BGS
Station: 1,399,205.58N
2,345,536.13E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Water Content (%)	Dry Density (lb/ft^3)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	24/24 *100%*	ss	*7-35* *40-42* N=75			*4.5*		Grayish brown (10YR5/2) with 5% brownish yellow (10YR6/6) mottles, hard SILT with little clay, trace sand, and trace gravel.	580	
							42			
	24/24 *100%*	ss	*9-24* *32-40* N=56			*4.5*		Gray (10YR5/1) hard SILT with little clay, trace sand, and trace gravel.	578	
							44			
	24/24 *100%*	ss	*12-35* *41-43* N=76			*4.5*		Dark gray (10YR4/1) hard SILT with little clay, trace sand, and trace gravel.	576	
							46			
	24/23 *104%*	ss	*7-22* *50-50* N=72			*4.5*			574	
							48	Grayish brown (10YR5/2) hard SILT with little clay, trace sand, and trace gravel.		
	24/24 *100%*	ss	*6-21* *26-36* N=47			*4.5*			572	
							50			

End of boring = 50 feet

NOTE(S): Borehole sealed with high solids bentonite grout.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/3/2021
Finish: 2/3/2021
WEATHER: Overcast, cold (lo-20's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Al
Eng/Geo: T. Gass

BOREHOLE ID: SB62
Well ID: n/a
Surface Elev: 619.8 ft. MSL
Completion: 50.0 ft. BGS
Station: 1,398,819.94N
2,346,534.64E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	16/24 67%	SS	2-3 5-4 N=8			2.0	2	Fill - Yellowish brown (10YR5/6) with 5% Gray (10YR6/1) and 15% dark yellowish brown (10YR4/6) mottles, soft SILT with little clay, and trace roots.	618	
	19/24 79%	SS	1-6 9-10 N=15			2.5	4		616	
	23/24 96%	SS	4-9 10-9 N=19			4.5	6	Fill - Dark yellowish brown (10YR4/6) with 5% light brownish gray (10YR6/2) mottles, soft SILT with little clay, trace sand, and trace gravel.	614	
	23/24 96%	SS	3-6 7-9 N=13			3.5	8	Fill - Yellowish brown (10YR5/4) with 10% light brownish gray (10YR6/2) mottles, firm SILT with little clay, trace sand, and trace gravel.	612	
	23/24 96%	SS	2-5 7-8 N=12			2.5	10		610	
	23/24 96%	SS	2-5 7-8 N=12			3.0	12	Grayish brown (10YR5/2) firm SILT with little clay, trace sand, and trace gravel.	608	
ST7	15/24 63%	SH				2.5	14		606	
	21/24 88%	SS	1-4 8-12 N=12			3.0	16	Grayish brown (10YR5/2) with 30% dark yellowish brown(10YR4/6) mottles, hard SILT with little clay and trace gravel.	604	
	22/24 92%	SS	6-11 7-7 N=18			1.0	18	Gray (10YR6/1) with 25% dark yellowish brown (10YR4/6) mottles, slightly moist, soft SILT with little clay.	602	
	19/24 79%	SS	1-3 4-3 N=7			1.0	20		600	

NOTE(S): Borehole sealed with high solids bentonite grout

FIELD BORING LOG

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/3/2021
Finish: 2/3/2021
WEATHER: Overcast, cold (lo-20's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Al
Eng/Geo: T. Gass

BOREHOLE ID: SB62
Well ID: n/a
Surface Elev: 619.8 ft. MSL
Completion: 50.0 ft. BGS
Station: 1,398,819.94N
2,346,534.64E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
	24/24 100%	SS	1-3 4-4 N=7			1.5
	21/24 88%	SS	1-2 2-4 N=4			1.0
	24/24 100%	SS	1-2 2-3 N=4			1.0
ST14	23/24 96%	SH				1.5
	24/24 100%	SS	1-3 2-3 N=5			1.0
	24/24 100%	SS	woh-1 1-2 N=2			1.0
	21/24 88%	SS	2-2 4-6 N=6			2.0
	24/24 100%	SS	3-5 7-9 N=12			4.5
	24/24 100%	SS	3-6 7-10 N=13			4.5
ST20	16/24 67%	SH				4.5

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
22	Gray (10YR5/1) with 10% dark gray (10YR4/1) mottles, slightly moist, soft SILT with little clay.	598	
24	Dark grayish brown (10YR4/2) CLAY with little silt and trace gravel.	596	
26	Dark gray (10YR4/1) with 3% reddish yellow (10YR6/8) mottles, soft CLAY with little silt and trace gravel	594	
28		592	
30	Gray (10YR6/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft CLAY with little silt, trace sand, and trace gravel.	590	
32	Gray (10YR6/1) with 15% dark yellowish brown (10YR4/6) mottles, wet, soft CLAY with little silt, trace sand, and trace gravel.	588	
34	Grayish green (5GY5/2) with 5% olive gray (5Y4/2) soft CLAY with little silt, trace sand, and trace gravel.	586	
36	Dark gray (10YR4/1) hard SILT with little clay, trace sand, and trace gravel.	584	
38		582	
40		580	

NOTE(S): Borehole sealed with high solids bentonite grout

FIELD BORING LOG

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/3/2021
Finish: 2/3/2021
WEATHER: Overcast, cold (lo-20's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Al
Eng/Geo: T. Gass

BOREHOLE ID: SB62
Well ID: n/a
Surface Elev: 619.8 ft. MSL
Completion: 50.0 ft. BGS
Station: 1,398,819.94N
2,346,534.64E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Water Content (%)	Dry Density (lb/ft^3)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	23/24 *96%*	ss	*3-12* *21-19* N=33			*4.0*		Gray (10YR5/1) hard SILT with little clay, trace sand, and trace gravel.		
								Gray (10YR5/1) wet, fine SAND with trace silt.	578	
							42			
	23/24 *96%*	ss	*6-11* *12-18* N=23			*4.5*		Gray (10YR5/1) moist, hard SILT with little clay, trace sand, and trace gravel.		
									576	
							44			
	24/24 *100%*	ss	*4-18* *19-23* N=37			*4.5*		Gray (10YR5/1) with 15% grayish olive (10Y5/2) mottles, moist, hard SILT with little clay, trace sand, and trace gravel.		
									574	
							46			
	24/24 *100%*	ss	*8-24* *39-48* N=63			*4.5*		Gray (10YR5/1) with 40% grayish olive (10Y5/2) mottles, hard SILT with little clay, trace sand, and trace gravel.		
									572	
							48			
	20/24 *83%*	ss	*5-25* *50-50/5"* N=75			*4.5*		Dark grayish brown (10YR4/2) hard SILT with little clay, trace sand, and trace gravel.		
									570	
							50			

End of boring = 50 feet

NOTE(S): Borehole sealed with high solids bentonite grout

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/14/2007
Finish: 3/20/2007
WEATHER: Overcast, rainy, cool

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-52
Well ID: hole abandoned
Surface Elev: 607.19 ft. MSL
Completion: 90.00 ft. BGS
Station: 14,919.6N
1,033.2E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 16.00 - during drilling
▼ = 18.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	24/24 100%	SS	2-3 3-4 N=6	24		2.52 B
1B				27		
	20/24 83%	SS	3-3 5-6 N=8			
2A				22		1.75 BSh
	20/24 83%	SS	3-7 6-6 N=13			
3A				23		1.96 Sh
	22/24 92%	SS	6-6 6-5 N=12			
4A				29		1.24 B
	18/24 75%	SH				
	20/24 83%	SS	1-2 3-3 N=5			
6A				23		2.27 B
	24/24 100%	SS	5-5 6-7 N=11			
7A				25		1.75 B
7B				25		1.35 B
	24/24 100%	SS	1-3 4-5 N=7			
8A				23		1.31 B
9A	24/24 100%	SS	4-6 6-7 N=12	20		2.27 BSh
9B				19		1.24 BSh
10A	24/24 100%	SS	1-3 4-5 N=7	16		1.75 BSh
10B				13		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Very dark brown (10YR2/2) clayey SILT, trace sand	
	Grayish brown (10YR5/2) with 30% yellowish brown (10YR5/8) mottles, silty CLAY, trace sand	606
2	Yellowish brown (10YR5/8) with 40% dark yellowish brown (10YR4/6) mottles, very silty CLAY, trace sand	
	Gray (10YR6/1) with 40% yellowish brown (10YR5/8) mottles, clayey SILT, trace sand	604
4	Light brownish gray (10YR6/2) with 15% yellowish brown (10YR5/8) mottles, clayey SILT, trace sand	
		602
6	Dark yellowish brown (10YR4/6) with 5% very dark brown (10YR2/2) mottles, clayey SILT, trace sand	
		600
8		
	Dark grayish brown (10YR4/2) with 45% yellowish brown (10YR5/6) mottles, clayey SILT, trace sand	598
10		
	Grayish brown (10YR5/2) with 50% yellowish brown (10YR5/8)mottles, clayey SILT, trace sand	596
12		
	Yellowish brown (10YR5/8) with 10% grayish brown (10YR5/2) mottles, clayey SILT, trace sand	594
14	Grayish brown (10YR5/2) with 50% yellowish brown (10YR5/8) silty CLAY, trace sand	
		592
16	Dark grayish brown (10YR4/2) with 20% yellowish brown (10YR5/8) mottles, silty CLAY, trace sand and gravel	
		590
18	Dark greenish gray (10GY4/1) with 10% grayish green (5G4/1) mottles, silty CLAY, trace sand and gravel	
		588
20	Greenish gray (10Y5/1), clayey SILT, little sand and gravel	

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/14/2007
Finish: 3/20/2007
WEATHER: Overcast, rainy, cool

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-52
Well ID: hole abandoned
Surface Elev: 607.19 ft. MSL
Completion: 90.00 ft. BGS
Station: 14,919.6N
1,033.2E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 16.00 - during drilling
▼ = 18.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
11-1						
11-2	19/24 79%	SH		17		
11-3						
	24/24 100%	SS	4-5 8-9 N=13			
12A				13		5.77 B
	24/24 100%	SS	4-10 8-8 N=18			
13A				12		6.30 Sh
	24/24 100%	SS	5-6 9-9 N=15			
14A				25		3.30 SP
	24/24 100%	SS	5-7 13-16 N=20			
15A				11		11.56 Sh
	48/60 80%	CS				
16A				13		
	3/60 5%	CS				
17A				11		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Greenish gray (10Y5/1), clayey SILT, little sand and gravel *[Continued from previous page]*	
	Dark greenish gray (10Y4/1), clayey SILT, little sand and gravel	586
22	Dark gray (N4/1), silty CLAY, trace sand and gravel	584
24	Dark gray (N4/1), clayey SILT, little sand and gravel	582
26	Dark gray (N4/1), clayey SILT, trace sand and gravel	580
28	Dark gray (N4/1), silty CLAY, trace sand, gravel and cobbles	578
30		576
32		574
34		572
36	Very dark greenish gray (10Y3/1), silty CLAY, trace sand and gravel	570
38		568
40		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/14/2007
Finish: 3/20/2007
WEATHER: Overcast, rainy, cool

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-52
Well ID: hole abandoned
Surface Elev: 607.19 ft. MSL
Completion: 90.00 ft. BGS
Station: 14,919.6N
1,033.2E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 16.00 - during drilling
▼ = 18.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
	0/24 *0%*	ss	*27-38 37-54* N=75			
18A				13		13.52 *Sh*
	0/24 *0%*	ss	*18-28 47-56* N=75			
19A				14		16.00 *None*
20A						
	24/24 *100%*	ss	*30-39 48-59* N=87			
	24/24 *100%*	ss	*25-19 33-40* N=52			
21A				17		8.24 *BSh*
	24/24 *100%*	ss	*4-8 16-22* N=24			
22A				12		11.56 *Sh*
	24/24 *100%*	ss	*10-12 14-19* N=26			
23A				15		9.16 *Sh*
	24/24 *100%*	ss				
24A				15		10.72 *B*
	24/24 *100%*	ss				
25A				12		14.02 *Sh*
	24/24 *100%*	ss				
26A				9		
	24/24 *100%*	ss				
27A				17		

Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
42			566	
44			564	
46			562	
48			560	
50	Very dark greenish gray (10Y3/1), silty CLAY, trace sand and gravel *[Continued from previous page]*		558	
52			556	
54			554	
56			552	
58			550	
60			548	

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/14/2007
Finish: 3/20/2007
WEATHER: Overcast, rainy, cool

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-52
Well ID: hole abandoned
Surface Elev: 607.19 ft. MSL
Completion: 90.00 ft. BGS
Station: 14,919.6N
1,033.2E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 16.00 - during drilling
▼ = 18.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	24/24 100%	ss	6-6 11-14 N=17						546	
28A							62	Dark greenish gray (10Y3/1) with 35% dark greenish gray (5G3/1) mottles, silty CLAY, trace sand and gravel		
	24/24 100%	ss							544	
29A							64			
	24/24 100%	ss							542	
30A							66	Dark green gray (10GY4/1) with 15% dark yellowish brown (10YR3/4) mottles, silty CLAY, trace sand and gravel		
	24/24 100%	ss							540	
31A							68			
	24/24 100%	ss							538	
32A							70	Dark green gray (10GY4/1) with 50% dark yellowish brown (10YR3/4) mottles, silty CLAY, trace sand and gravel		
	24/24 100%	ss							536	
33A							72			
	24/24 100%	ss						Dark yellowish brown (10YR3/4) with 20% dark greenish gray (10GY4/1) mottles, silty CLAY, trace sand and gravel	534	
34A							74			
	24/24 100%	ss							532	
35A							76			
	24/24 100%	ss						Very dark gray (N3/1), silty CLAY, trace sand and gravel	530	
36A							78			
	24/24 100%	ss						Dark yellowish brown (10YR3/4) with 30% dark greenish gray (10GY4/1) mottles, silty CLAY, trace sand and gravel	528	
37A							80			

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/14/2007
Finish: 3/20/2007
WEATHER: Overcast, rainy, cool

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-52
Well ID: hole abandoned
Surface Elev: 607.19 ft. MSL
Completion: 90.00 ft. BGS
Station: 14,919.6N
1,033.2E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 16.00 - during drilling
▼ = 18.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
38A	24/24 100%	ss					82	Dark yellowish brown (10YR3/4) with 30% dark greenish gray (10GY4/1) mottles, silty CLAY, trace sand and gravel *[Continued from previous page]*		526	
39A	24/24 100%	ss					84			524	
40A	24/24 100%	ss					86	Dark greenish gray (10Y4/1) with 15% dark yellowish brown (10YR3/4) mottles, silty CLAY, trace sand and gravel		522	
41A	24/24 100%	ss					88	Dark greenish gray (10Y4/1), silty CLAY, trace sand and gravel		520	
42A	24/24 100%	ss					90	Very dark gray (N3/1), silty CLAY, trace sand and gravel		518	

End of Boring = 90.0 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/20/2007
Finish: 3/22/2007
WEATHER: sunny, windy, mild

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-53
Well ID: hole abandoned
Surface Elev: 613.36 ft. MSL
Completion: 90.00 ft. BGS
Station: 14,987.8N
30.2E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 10.00 - during drilling
▼ = 21.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	22/24 92%	SS	2-2 4-4 N=6	20		3.49 BSh
1B				25		3.71 Sh
2A	24/24 100%	SS	2-4 5-5 N=9	25		3.27 BSh
2B				27		1.85 B
3A	20/24 83%	SS	3-7 6-6 N=13	24		2.47 B
4A	24/24 100%	SS	2-4 4-3 N=8	25		2.06 B
	24/24 100%	SH				
6A	19/24 79%	SS	2-2 3-4 N=5	25		
6B				25		
7A	19/24 79%	SS	4-4 4-4 N=8	26		2.18 BSh
7B				25		2.52 BSh
8A	24/24 100%	SS	1-2 3-3 N=5	25		2.27 B
8B				26		2.13 B
9A	24/24 100%	SS	3-4 5-6 N=9	25		2.13 B
10A	22/24 92%	SS	1-3 3-5 N=6	25		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Very dark brown (10YR2/2), clayey SILT, trace sand	
	Dark grayish brown (10YR4/2), silty CLAY, trace sand	612
2	Light brownish gray (10YR6/2) with 30% yellowish brown (10YR5/8) mottles, silty CLAY, trace sand	
	Light brownish gray (10YR6/2) with 30% yellowish brown (10YR5/8) and trace very dark gray (10YR3/1) mottles, silty CLAY, trace sand	610
4		
	Brownish yellow (10YR6/8) with 20% light gray (10YR7/1) mottles, very silty CLAY, trace sand	608
6		
		606
8	Yellowish brown (10YR5/8) with trace light gray (10YR7/1) mottles, clayey SILT, trace sand	
		604
▼ 10		
		602
12		
	Light gray (10YR7/1) with 50% yellowish brown (10YR5/8)mottles, clayey SILT, trace sand	
		600
	Dark grayish brown (10YR4/2), clayey SILT, trace sand	
14	Dark yellowish brown (10YR4/6) with 50% brown (10YR4/3) mottles, clayey SILT, trace sand	
		598
16	Grayish brown (10YR5/2) with 5% yellowish brown (10YR5/6) mottles, silty CLAY, trace sand	
		596
18		
	Dark grayish brown (10YR4/2) with 50% dark yellowish brown (10YR4/6) mottles, silty CLAY, trace sand and gravel	594
20		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/20/2007
Finish: 3/22/2007
WEATHER: sunny, windy, mild

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-53
Well ID: hole abandoned
Surface Elev: 613.36 ft. MSL
Completion: 90.00 ft. BGS
Station: 14,987.8N
30.2E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 10.00 - during drilling
▼ = 21.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
	24/24 100%	SH				
12A	24/24 100%	SS	3-4 5-6 N=9	21		0.39 B
12B				16		1.75 BSh
	22/24 92%	SS	3-3 3-4 N=6			
13A				17		2.13 B
13B				13		7.20 BSh
	24/24 100%	SS	1-2 3-4 N=5			
14A				17		3.50 B
	24/24 100%	SS	4-6 6-8 N=12			
15A				14		5.24 B
	24/24 100%	SS	2-3 3-3 N=6			
16A				30		1.16 B
	8/24 33%	SH				
17-1						
17-2				440		
	24/24 100%	SS	3-4 7-9 N=11			
18A				13		5.04 B
	20/24 83%	SS	2-3 7-9 N=10			
19A				14		5.24 B
	15/24 63%	SS	3-3 5-6 N=8			
20A				13		7.86

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark grayish brown (10YR4/2) with 50% dark yellowish brown (10YR4/6) mottles, silty CLAY, trace sand and gravel *[Continued from previous page]*	592
22	Dark greenish gray (5GY4/1), silty CLAY, trace sand and gravel	
	Greenish gray (10Y5/1), sandy SILT, trace clay	590
24	Greenish gray (5GY6/1), sandy CLAY, trace silt	
	Dark greenish gray (10Y4/1), sandy CLAY, trace gravel	588
26		
		586
28	Very dark greenish gray (10Y3/1), sandy CLAY, trace gravel	
		584
30		
		582
32	Dark gray (10YR4/1), sandy SILT, trace gravel	
		580
34		
	Dark green gray (10Y4/1), sandy SILT, trace clay	578
36		
		576
38	Dark green gray (10Y4/1), sandy CLAY, trace gravel	
		574
40		

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/20/2007
Finish: 3/22/2007
WEATHER: sunny, windy, mild

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-53
Well ID: hole abandoned
Surface Elev: 613.36 ft. MSL
Completion: 90.00 ft. BGS
Station: 14,987.8N
30.2E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 10.00 - during drilling
▼ = 21.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
						Sh
	47/60 *78%*	CS				
21A				18		
21B				14		
21C				12		
22A	53/60 *88%*	CS		12		4.83 *B*
22B				9		4.48 *B*
23A				16		
	44/48 *92%*	CS				
23B				11		6.40 *Sh*
23C						
	24/24 *100%*	SS				
24A				11		13.52 *Sh*
	24/24 *100%*	SS				
25A				10		11.78 *None*
	24/24 *100%*	SS				
26A				11		8.73

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark green gray (10Y4/1), sandy CLAY, trace gravel	
42	Dark green gray (10Y4/1), sandy CLAY, trace gravel *[Continued from previous page]*	572
		570
44	Dark green gray (10Y4/1), silty, fine to medium SAND	
		568
46	Dark greenish gray (10Y4/1), sandy CLAY, trace gravel	
		566
48		
		564
50	Gray (10Y4/1), fine to medium SAND, trace silt	
		562
52	Dark green gray (10Y4/1), sandy CLAY, trace silt and gravel	
		560
54	Dark gray (10YR4/1), silty CLAY, little sand, trace gravel	
		558
56		
		556
58		
		554
60		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/20/2007
Finish: 3/22/2007
WEATHER: sunny, windy, mild

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-53
Well ID: hole abandoned
Surface Elev: 613.36 ft. MSL
Completion: 90.00 ft. BGS
Station: 14,987.8N
30.2E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 10.00 - during drilling
▼ = 21.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
						BSh				
	16/24 67%	ss						Dark gray (10YR4/1), silty, fine to medium SAND	552	
27A				20			62			
	19/24 79%	ss							550	
28A				14		9.16 BSh	64			
	22/24 92%	ss							548	
29A				17		8.07 BSh	66			
	24/24 100%	ss							546	
30A				15		11.33 B	68			
	24/24 100%	ss							544	
31A				15		6.59 B	70			
	24/24 100%	ss						Dark gray (10YR4/1) with 15% dark greenish gray (5GY4/1) mottles, silty CLAY, trace sand and gravel	542	
32A				17		4.85 B	72			
	24/24 100%	ss							540	
33A				19		5.43 B	74			
	24/24 100%	ss							538	
34A				15		5.43 B	76			
	24/24 100%	ss							536	
35A				15		7.76 B	78			
	24/24 100%	ss							534	
36A				15		6.59	80			

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/20/2007
Finish: 3/22/2007
WEATHER: sunny, windy, mild

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-53
Well ID: hole abandoned
Surface Elev: 613.36 ft. MSL
Completion: 90.00 ft. BGS
Station: 14,987.8N
30.2E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 10.00 - during drilling
▼ = 21.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
						B					
	24/24 *100%*	ss								532	
37A				16		8.53 *BSh*	82	Dark gray (10YR4/1), silty CLAY, trace sand and gravel			
	24/24 *100%*	ss								530	
38A				19		6.59 *BSh*	84				
	24/24 *100%*	ss								528	
39A				17		5.04 *BSh*	86				
	24/24 *100%*	ss						Dark gray (10YR4/1) with trace yellowish brown (10YR5/6) mottles, silty CLAY, trace sand and gravel		526	
40A				17		4.12 *BSh*	88				
	24/24 *100%*	ss								524	
41A				15		8.92 *B*	90				

End of Boring = 83.3 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/29/2007
Finish: 3/29/2007
WEATHER: Overcast, cool

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-54
Well ID: hole abandoned
Surface Elev: 617.28 ft. MSL
Completion: 84.67 ft. BGS
Station: 15,718.2N
404.6E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 7.00 - during drilling
▼ = 13.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	24/24 100%	ss	1-3 2-3 N=5	24		
1B				30		2.33 B
2A	24/24 100%	ss	2-3 2-6 N=5	32		2.13 B
2B				28		1.94 B
	24/24 100%	ss	2-2 2-3 N=4			
3A				30		0.58 B
	18/24 75%	ss	3-4 4-5 N=8			
4A				24		1.55 B
	20/24 83%	ss	1-2 3-3 N=5			
5A				25		
	20/24 83%	ss	0-2 3-3 N=5			
6A				31		1.75 B
7A	21/24 88%	ss	3-4 4-4 N=8	28		4.07 BSh
7B				39		1.36 B
8A	24/24 100%	ss	1-2 3-5 N=5	25		1.16 B
8B				25		1.75 B
	24/24 100%	ss	2-4 3-3 N=7			
9A				28		1.16 B
10A	24/24 100%	ss	2-3 3-4 N=6	29		2.18 B
10B				27		1.36

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Very dark grayish brown (10YR3/2) with 15% very dark gray (10YR3/1)mottles, silty CLAY, trace sand	
2	Brown (10YR4/3) with 40% very dark grayish brown (10YR3/2) mottles, silty CLAY, trace sand	616
4	Yellowish brown (10YR5/8) with 30% gray (10YR6/1) and 15% dark gray brown (10YR4/2) mottles, silty CLAY, trace sand	614
6	Brownish yellow (10YR6/8) with 40% light brownish gray (10YR6/2) mottles, clayey SILT, trace sand	612
8		610
10	Dark yellowsih brown (10YR4/6) with 30% gray (10YR6/1) mottles, clayey SILT, trace sand	608
12	Gray (10YR6/1) with 10% yellowish brown (10YR5/8) mottles, clayey SILT, trace sand	606
	Grayish brown (10YR5/2) with 15% yellowish brown (10YR5/8) mottles, very silty CLAY, trace sand	604
14	Black (10YR2/1) with 40% dark yellowish brown (10YR4/4) mottles, clayey SILT, trace sand	
	Dark grayish brown (10YR4/2) with trace yellowish brown (10YR5/6) mottles, very silty CLAY, trace sand	602
16	Dark grayish brown (10YR4/2), silty CLAY, trace sand	600
18	Dark gray (10YR4/1) with 35% dark yellowish brown (10YR3/6) mottles, silty CLAY, trace sand	
20	Dark gray (10YR4/1), silty CLAY, trace sand	598

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/29/2007
Finish: 3/29/2007
WEATHER: Overcast, cool

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-54
Well ID: hole abandoned
Surface Elev: 617.28 ft. MSL
Completion: 84.67 ft. BGS
Station: 15,718.2N
404.6E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 7.00 - during drilling
▼ = 13.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
						B
	24/24 100%	ss	0-0 5-2 N=5			
11A				22		0.58 B
	24/24 100%	ss	0-0 1-2 N=1			
12A				18		
13A	24/24 100%	ss	2-2 4-5 N=6	21		
13B				17		3.10 B
	24/24 100%	ss	3-3 4-4 N=7			
14A				15		1.55 B
15A	20/24 83%	ss	2-3 3-5 N=6	18		2.83 B
15B				17		3.49 BSh
	24/24 100%	ss				
16A				17		5.36 BSh
	24/24 100%	ss				
17A				17		4.65 B
	22/24 92%	ss				
18A				21		3.49 B
	21/24 88%	ss				
19A				12		
	6/24 25%	ss				
20A				14		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Greenish gray (5G5/1) with 50% greenish gray (10Y5/1) mottles, sandy CLAY, trace gravel	596
22	Greenish gray (5GY5/1), sandy CLAY, little silt, trace gravel	594
24	Green gray (10Y6/1), sandy SILT	
	Green gray (5G6/1), sandy CLAY, trace gravel	592
26	Dark gray (N4/1), very silty CLAY, trace sand and gravel	590
28	Greenish gray (10Y5/1), sandy CLAY, trace gravel	588
30	Dark greenish gray (10Y4/1), very silty CLAY, trace sand and gravel	586
32		584
34	Dark greenish gray (10Y4/1), sandy SILT	582
36	Dark greenish gray (10Y4/1) with 20% pale red (10R6/3) mottles, sandy SILT, trace gravel	580
38	Gray (10Y4/1), fine to coarse SAND, trace gravel and silt	578
40		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/29/2007
Finish: 3/29/2007
WEATHER: Overcast, cool

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-54
Well ID: hole abandoned
Surface Elev: 617.28 ft. MSL
Completion: 84.67 ft. BGS
Station: 15,718.2N
404.6E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 7.00 - during drilling
▼ = 13.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
	3/24 *13%*	ss				
21A				11		
	24/24 *100%*	ss				
22A				16		6.21 *BSh*
	24/24 *100%*	ss				
23A				14		8.34 *B*
	24/24 *100%*	ss				
24A				19		7.56 *BSh*
	24/24 *100%*	ss				
25A				14		
	24/24 *100%*	ss				
26A				17		5.36 *BSh*
	22/24 *92%*	ss				
27A				14		3.93 *Sh*
	23/24 *96%*	ss				
28A				16		4.27 *BSh*
	16/24 *67%*	ss				
29A				19		
	4/24 *17%*	ss				
30A				17		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Gray (10Y4/1), fine to coarse SAND, trace gravel and silt *[Continued from previous page]*	576
42		
		574
44		
		572
46		
		570
48		
		568
50	Dark gray (N4/1), silty CLAY, trace sand and gravel	
		566
52		
		564
54		
		562
56		
		560
58		
	Gray (10Y4/1), silty fine to medium SAND	558
60		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/29/2007
Finish: 3/29/2007
WEATHER: Overcast, cool

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-54
Well ID: hole abandoned
Surface Elev: 617.28 ft. MSL
Completion: 84.67 ft. BGS
Station: 15,718.2N
404.6E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 7.00 - during drilling
▼ = 13.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
31A	8/8 100%	ss	31-50/2"	12		
32A	12/12 100%	ss	33-50/6"	9		7.37 B
33A	7/7 100%	ss	39-50/1"	12		
34A	20/24 83%	ss		18		
35A	18/24 75%	ss		19		
36A	15/24 63%	ss		21		
37A	15/24 63%	ss		21		
38A	16/24 67%	ss		19		
39A	10/24 42%	ss		14		
40A	18/24 75%	ss		11		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Green gray (10Y5/1) with trace yellowish brown (10YR5/6) mottles, sandy SILT, trace clay and gravel	556
62		
	Green gray (10Y5/1), sandy SILT, trace gravel and clay	554
64		
		552
66		
	Greenish gray (10Y5/1), silty, fine SAND	550
68		
		548
70		
		546
72		
		544
74		
	Greenish gray (10Y5/1), silty, fine to medium SAND	542
76		
	Greenish gray (10GY5/1), sandy CLAY, trace gravel	540
78		
	Dark gray (10YR4/1), sandy CLAY, trace gravel	538
80		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/29/2007
Finish: 3/29/2007
WEATHER: Overcast, cool

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-54
Well ID: hole abandoned
Surface Elev: 617.28 ft. MSL
Completion: 84.67 ft. BGS
Station: 15,718.2N
404.6E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 7.00 - during drilling
▼ = 13.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
	14/24 58%	ss								536	
41A				9			82	Dark gray (10YR4/1), sandy CLAY, trace gravel *[Continued from previous page]*			
	10/24 42%	ss								534	
42A						6.55 BSh	84				
43A	8/8 100%	ss				6.33 BSh		Gray (N6/1), SHALE			

End of Boring = 84.7 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 4/1/407
Finish: 4/4/2007
WEATHER: Overcast, cool

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-55
Well ID: hole abandoned
Surface Elev: 611.07 ft. MSL
Completion: 20.00 ft. BGS
Station: 15,438.7N
987.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 13.00 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	15/18 83%	ss	2-3 3 N=6	29		1.75 B
2A	16/18 89%	ss	3-4 5 N=9	22		0.78 BSh
3A	16/18 89%	ss	3-4 4 N=8	26		
4A	15/18 83%	ss	3-4 5 N=9	26		1.94 BSh
5A	18/18 100%	ss	2-3 4 N=7	33		1.32 B
6A	18/18 100%	ss	3-4 5 N=9	20		1.16 BSh

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark brown, clayey TOPSOIL (OL)	
2	Brown-gray, silty CLAY, trace sand (CL)	610
4	Brown-gray, clayey SILT, trace sand (ML)	608
6		606
8		604
10	Gray-brown, clayey SILT, trace sand (ML)	602
12		600
▼ 14	Black, PEAT (PT)	598
16		596
18	Gray, silty CLAY, trace sand and gravel (CL)	594
20	**End of Boring = 20.0 ft. BGS**	592

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 4/5/2007
Finish: 4/5/2007
WEATHER: Ptly sunny, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-65
Well ID: hole abandoned
Surface Elev: 601.57 ft. MSL
Completion: 20.00 ft. BGS
Station: 14,972.6N
301.1E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 5.50 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	16/18 89%	ss	0-0 2 N=2	30		1.16 B
2A	12/18 67%	ss	3-3 3 N=6	37		
3A	18/18 100%	ss	2-3 4 N=7	27		1.55 B
4A	14/18 78%	ss	3-4 4 N=8	26		2.06 B
5A	16/18 89%	ss	3-3 7 N=10	19		
6A	15/18 83%	ss	4-6 10 N=16	15		9.16 Sh

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark brown, clayey TOPSOIL (OL)	
2	Dark brown-brown, very silty CLAY, trace sand (CL)	600
4	Dark brown, clayey SILT, trace sand, (ML)	598
6	Gray-brown, silty CLAY, trace sand (CL)	596
8	Brown-gray, silty CLAY, trace sand (CL)	594
10		592
12		590
14	Gray-brown, silty, fine SAND, little medium to coarse sand, trace gravel (SM)	588
16		586
18	Gray, very silty CLAY, trace sand and gravel (CL)	584
20		582

End of Boring = 20.0 ft. BGS

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 4/5/2007
Finish: 4/5/2007
WEATHER: Ptly sunny, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-66
Well ID: hole abandoned
Surface Elev: 610.34 ft. MSL
Completion: 30.00 ft. BGS
Station: 14,397.6N
173.1E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 16.00 - during drilling
▼ = 5.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	14/18 78%	ss	2-3 4 N=7	27		2.89 BSh
2A	18/18 100%	ss	2-2 3 N=5	29		1.16 B
3A	13/18 72%	ss	2-4 5 N=9	28		2.47 Sh
4A	16/18 89%	ss	2-2 3 N=5	28		2.68 Sh
5A	15/18 83%	ss	1-2 3 N=5	27		1.75 B
6A	15/18 83%	ss	2-3 4 N=7	21		1.55

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark brown, clayey TOPSOIL (OL)	610
2	Brown-gray, silty CLAY, trace sand (CL)	608
4 ▼	Brown-gray-black, very silty CLAY, trace sand (CL)	606
6	Brown-gray, clayey SILT, trace sand (ML)	604
8		602
10	Gray-brown, clayey SILT, trace sand (ML)	600
12		598
14	Brown, very silty CLAY, trace sand (CL)	596
16 ▼		594
18	Brown-gray, silty CLAY, trace sand and gravel (CL)	592
20		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 4/5/2007
Finish: 4/5/2007
WEATHER: Ptly sunny, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-66
Well ID: hole abandoned
Surface Elev: 610.34 ft. MSL
Completion: 30.00 ft. BGS
Station: 14,397.6N
173.1E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 16.00 - during drilling
▼ = 5.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
						B		Brown-gray, silty CLAY, trace sand and gravel (CL) *[Continued from previous page]*	590	
							22			
									588	
	18/18 *100%*	SS	*3-5* *6* N=11				24	Gray-brown, very silty CLAY, little sand, trace gravel (CL)	586	
7A				15		2.13 *B*				
							26		584	
							28	Gray, very silty CLAY, trace sand and gravel (CL)	582	
	18/18 *100%*	SS	*3-4* *5* N=9							
8A				18		4.65 *B*	30			

End of Boring = 30.0 ft. BGS

NOTE(S):

G02L (MW-4L)

HANSON

RECORD OF SOIL EXPLORATION

Project Name	Ameren Duck Creek	Sheet	1 of 3
Job #	03S5010	Boring #	B-10/MW-4
Location	CCB Landfill - Phase II Site Invest.	Station	-
Driller	Western Environmental Drilling Inc.	Surface Elevation	619.4
Foreman	Randy Howard	Drilling Method	HSA
Engineer/Geologist	OMI	Sampling Method	SS/Core
Weather & Temp.	Upper 60's, Cloudy	Hammer Type	Auto
Date: Start	9/22/2003 0900	Water Depth: DD	25
Finish	9/23/2003 1605	AAR	-
		Delayed	-

STRATUM DEPTH From	STRATUM DEPTH To	SOIL CLASSIFICATION	SAMPLE NUMBER	SAMPLE DEPTH From	SAMPLE DEPTH To	STD. PENETRATION TEST BLOWS / 6 INCHES P=Penetrometer
0.0	2.0	Top soil, brn. silt w/clay, moist.	SS-1	1.5	3.5	2-3-5-6 Rec = 18" Qp = 2.0
2.0	4.0	Brn. and gray clayey silt and silty clay, so sand.	SS-2	4.0	6.0	1-2-2-2 Rec = 24" Qp = 0.25
4.0	7.8	Reddish brn and gray silty clay, soft.	SS-3	6.5	8.5	0-2-2-2 Rec = 19.5" Qp = -
7.8	9.8	Reddish brn. and gray clayey silt, v. soft.	SS-4	9.0	11.0	1-2-3-4 Rec = 22" Qp = 3.0
9.8	12.1	Gray (sl. red) silt, tr. clay, stiff, moist.	SS-5	11.5	13.5	1-1-2-4 Rec = 24" Qp = -
12.1	15.0	Dk. brn. silty sand w/ small wood pieces, moist.	SS-6	14.0	16.0	3-3-6-5 Rec = 24" Qp = 3.0
15.0	16.5	Dk. brn. sandy silty clay (till) to sandy clayey silt, moist.	SS-7	16.5	18.5	1-1-2-2 Rec = 24" Qp = -
16.5	19.8	Dk. brn. clay, w/ so. sand and silt, soft.	SS-8	19.0	21.0	1-2-2-2 Rec = 24" Qp = 0.25
19.8	24.6	Gray sandy clay, so. silt, v. soft and moist. More sand at 21.5' (gets coarser w/ depth).	SS-9	21.5	23.5	1-2-3-5 Rec = Qp = 0.75
24.6	25.0	Gray v. coarse sand w/ clay, wet.	SS-10	24.0	26.0	1-2-2-3 Rec = 23" Qp = -
25.0	26.9	Gray sandy clayey silt (till), wet.	SS-11	26.5	28.5	1-2-2-4 Rec = 24" Qp = 3.0 (in cohesive)

General Remarks:

Project Name Ameren Duck Creek - Phase II Site Invest. **Boring #** B-10/MW-4

Sheet 2 of 3

STRATUM DEPTH From	STRATUM DEPTH To	SOIL CLASSIFICATION	SAMPLE NUMBER	SAMPLE DEPTH From	SAMPLE DEPTH To	STD. PENETRATION TEST BLOWS / 6 INCHES P=Penetrometer
26.9	28.2	Gray v. coarse sand w/gravel, wet.	SS-12	29.0	31.0	1-2-4-7 Rec = 24" Qp = 3.0
28.2	31.5	Gray sandy clayey silt (till), wet.	SS-13	31.5	33.5	3-6-8-10 Rec = 24" Qp = 4.5
31.5	36.2	Gray sandy silt, tr. gravel, v. stiff.	SS-14	34.0	36.0	2-4-6-8 Rec = 24" Qp = 4.5+
36.2	36.8	Red and gray clayey silty sand.	SS-15	36.5	38.5	4-7-9-13 Rec = 24" Qp = 0.5 to 4.5+
36.8	46.5	Gray sandy silt, tr. gravel, v stiff, more sand and gravel from 41.5' to 44.1'.	SS-16	39.0	41.0	3-6-10-13 Rec = 24" Qp = 3.5
46.5	52.0	Gray silt w/gravel, sl. dry w/rough surface structure, breaks down w/small pressure.	SS-17	41.5	43.5	3-4-9-11 Rec = 24" Qp = 4.0
52.0	54.8	Brn. and gray sandy clayey silt, tr. gravel, reddish brown at bottom, sl. moist.	SS-18	44.0	46.0	6-9-15-20 Rec = 24" Qp = 4.5+
54.8	56.5	Gray v. coarse sand w/gravel, v. dense, wet.	SS-19	46.5	48.5	11-21-29-40 Rec = 24" Qp = -
56.5	57.0	Gray v.f. sand, medium dense, moist.	SS-20	49.0	50.5	19-47-50/5" Rec = Qp = -
57.0	57.5	V. coarse sand w/gravel, wet.	SS-21	51.5	53.5	22-42-31-43 Rec = Qp = 2.5
57.5	61.5	Gray v.f. sand, so. gravel, v. dense, moist. No gravel from 58.6'.	SS-22	54.0	55.75	20-42-47-50/3" Rec = 24" Qp = -
61.5	64.9	Gray v.f. sandy silt, v. dense, so. gravel from 64.5' to 64.9', wet.	SS-23	56.5	57.8	13-28-50/4" Rec = 24" Qp = -
64.9	68.4	Gray silty clay and clayey silt, v. stiff, moist. So. gravel from 66.5' to 68.4'.	SS-24	59.0	60.3	15-29-50/4" Rec = 15" Qp = -
68.4	68.5	Limestone fragments.	SS-25	61.5	62.8	20-45-50/4" Rec = 15" Qp = -
68.5	77.5	Gray clayey sandy silt w/gravel, v. stiff.	SS-26	64.0	66.0	20-16-20-31 Rec = 24" Qp = 4.5

General Remarks:

Project Name Ameren Duck Creek - Phase II Site Invest.

Boring # B-10/MW-4

Sheet 3 of 3

STRATUM DEPTH From	STRATUM DEPTH To	SOIL CLASSIFICATION	SAMPLE NUMBER	SAMPLE DEPTH From	SAMPLE DEPTH To	STD. PENETRATION TEST BLOWS / 6 INCHES P=Penetrometer
77.5	80.5	Dk. gray silty sand.	SS-27	66.5	68.5	11-15-21-33 Rec = 24" Qp = 4.5+
80.5	81.5	Gray sandy silt, stiff, moist.	SS-28	69.0	71.0	15-20-37-50/5" Rec = 24" Qp = 4.5+
81.5	85.0	Gray silty sand, moist. Coal at 83.4'.	SS-29	71.5	73.5	16-29-33-38 Rec = 24" Qp = 4.5+
85.0	89.0	V. coarse sand w/rock fragments.	SS-30	74.0	76.0	12-23-32-50 Rec = 24" Qp = 4.5+
89.0	91.5	Gray siltstone, hard, moist. Auger refusal. Will core using a tricone to 91.5' and try to get another sample. SPT refusal at 91.5'.	SS-31	76.5	78.5	12-18-27-31 Rec = 24" Qp = -
		Begin Coring at 91.5'.	SS-32	79.0	81.0	12-24-35-50 Rec = 24" Qp = 2.0 (in silt)
			SS-33	81.5	83.5	9-19-28-34 Rec = 24" Qp = -
			SS-34	84.0	86.0	34-32-21-42 Rec = 18" Qp = -
			SS-35	86.5	88.5	11-13-26-20 Rec = 17" Qp = -
			SS-36	89.0	89.3	50/3" Rec = 2" Qp = -
			SS-37	91.5	91.7	50/2" Rec = Qp = -

General Remarks:

HANSON

BORING NO.	B-10/MW-4
PROJECT No. 03S5010	SHEET 1 OF 2

PROJECT NAME:	DATE	Engineer/Geologist:
Ameren Duck Creek	9/23/2003	Brett Carney

Depth In Feet	ROCK, COLOR, HARDNESS, WEATHERING, GRAIN OR CRYSTALLINITY, BEDDING, VOIDS (OTHER: THICKNESS & LOCATION OF CLAY/SHALE SEAMS)	Sample or Run Number	% REC -------- % RQD	Box Number	Time	DWR %	DWRC	Down Pressure	Depth In Feet
	Start Coring at 91.5 ft.	1	100% ------- 89%	1		100%	Dk. Gray	490	
92.5	Gray silty shale; thin bedded; v. soft and weathered 91.5 - 91.9 (may be slough); mod. soft; micaceous; so. plant fossils.								
93.5	Gray shaley sandstone, w/so. lt. gray partings below 91.9 ft.								
94.5									
95.5									
96.5									
97.5									
98.5		98.5'							
	Same as above.	2	100% ------- 99%		1' 26"	100%		500	
99.5	Core barrel plugged as soon as we resumed at 98.5 ft.							600 @ 105.5 ft	
	Temporarily plugged at 103.7 ft.				1' 30"				
100.5	Lost 2.7 ft of core (likely fell out the bottom upon retrieval). Recovered remaining 2.7 ft as part of Run #3. RQD & REC includes recovery in Run #3.			100.8' / 2	1' 51"				
101.5									

HANSON

BORING NO.	B-10/MW-4
PROJECT No. 03S5010	SHEET 2 OF 2

PROJECT NAME:	DATE	Engineer/Geologist:
Ameren Duck Creek	9/23/2003	Brett Carney

Depth In Feet	ROCK, COLOR, HARDNESS, WEATHERING, GRAIN OR CRYSTALLINITY, BEDDING, VOIDS (OTHER: THICKNESS & LOCATION OF CLAY/SHALE SEAMS)	Sample or Run Number	% REC -------- % RQD	Box Number	Time	DWR %	DWRC	Down Pressure	Depth In Feet
	Same as above.	2		1					
					1' 42"				
102.5									
					1' 25"				
103.5									
					4' 10"				
104.5									
					47"				
105.5									
					47"				
106.5									
					45"				
107.5									
					50"				
108.5		108.5'							
		3	100% ------- 100%	2	1' 23"	100%	Dk Gray	500	
109.5									
					1' 10"				
110.5									
					1' 14"				
111.5	End Run #3 @ 111.5 ft. E.O.B. @ 111.5 ft.								

G02S (P02S, MW-4S)

HANSON

RECORD OF SOIL EXPLORATION

Project Name	Ameren Duck Creek	Sheet	1 of 3
Job #	03S5010	Boring #	B-10/MW-4 G02S
Location	CCB Landfill - Phase II Site Invest.	Station	-
Driller	Western Environmental Drilling Inc.	Surface Elevation	619.4
Foreman	Randy Howard	Drilling Method	HSA
Engineer/Geologist	OMI	Sampling Method	SS/Core
Weather & Temp.	Upper 60's, Cloudy	Hammer Type	Auto
Date: Start	9/22/2003 0900	Water Depth: DD	25
Finish	9/23/2003 1605	AAR	-
		Delayed	-

STRATUM DEPTH From	STRATUM DEPTH To	SOIL CLASSIFICATION	SAMPLE NUMBER	SAMPLE DEPTH From	SAMPLE DEPTH To	STD. PENETRATION TEST BLOWS / 6 INCHES P=Penetrometer
0.0	2.0	Top soil, brn. silt w/clay, moist.	SS-1	1.5	3.5	2-3-5-6 Rec = 18" Qp = 2.0
2.0	4.0	Brn. and gray clayey silt and silty clay, so sand.	SS-2	4.0	6.0	1-2-2-2 Rec = 24" Qp = 0.25
4.0	7.8	Reddish brn and gray silty clay, soft.	SS-3	6.5	8.5	0-2-2-2 Rec = 19.5" Qp = -
7.8	9.8	Reddish brn. and gray clayey silt, v. soft.	SS-4	9.0	11.0	1-2-3-4 Rec = 22" Qp = 3.0
9.8	12.1	Gray (sl. red) silt, tr. clay, stiff, moist.	SS-5	11.5	13.5	1-1-2-4 Rec = 24" Qp = -
12.1	15.0	Dk. brn. silty sand w/ small wood pieces, moist.	SS-6	14.0	16.0	3-3-6-5 Rec = 24" Qp = 3.0
15.0	16.5	Dk. brn. sandy silty clay (till) to sandy clayey silt, moist.	SS-7	16.5	18.5	1-1-2-2 Rec = 24" Qp = -
16.5	19.8	Dk. brn. clay, w/ so. sand and silt, soft.	SS-8	19.0	21.0	1-2-2-2 Rec = 24" Qp = 0.25
19.8	24.6	Gray sandy clay, so. silt, v. soft and moist. More sand at 21.5' (gets coarser w/ depth).	SS-9	21.5	23.5	1-2-3-5 Rec = Qp = 0.75
24.6	25.0	Gray v. coarse sand w/ clay, wet.	SS-10	24.0	26.0	1-2-2-3 Rec = 23" Qp = -
25.0	26.9	Gray sandy clayey silt (till), wet.	SS-11	26.5	28.5	1-2-2-4 Rec = 24" Qp = 3.0 (in cohesive)

General Remarks:

Project Name Ameren Duck Creek - Phase II Site Invest. **Boring #** B-10/MW-4

Sheet 2 of 3

STRATUM DEPTH From	STRATUM DEPTH To	SOIL CLASSIFICATION	SAMPLE NUMBER	SAMPLE DEPTH From	SAMPLE DEPTH To	STD. PENETRATION TEST BLOWS / 6 INCHES P=Penetrometer
26.9	28.2	Gray v. coarse sand w/gravel, wet.	SS-12	29.0	31.0	1-2-4-7 Rec = 24" Qp = 3.0
28.2	31.5	Gray sandy clayey silt (till), wet.	SS-13	31.5	33.5	3-6-8-10 Rec = 24" Qp = 4.5
31.5	36.2	Gray sandy silt, tr. gravel, v. stiff.	SS-14	34.0	36.0	2-4-6-8 Rec = 24" Qp = 4.5+
36.2	36.8	Red and gray clayey silty sand.	SS-15	36.5	38.5	4-7-9-13 Rec = 24" Qp = 0.5 to 4.5+
36.8	46.5	Gray sandy silt, tr. gravel, v stiff, more sand and gravel from 41.5' to 44.1'.	SS-16	39.0	41.0	3-6-10-13 Rec = 24" Qp = 3.5
46.5	52.0	Gray silt w/gravel, sl. dry w/rough surface structure, breaks down w/small pressure.	SS-17	41.5	43.5	3-4-9-11 Rec = 24" Qp = 4.0
52.0	54.8	Brn. and gray sandy clayey silt, tr. gravel, reddish brown at bottom, sl. moist.	SS-18	44.0	46.0	6-9-15-20 Rec = 24" Qp = 4.5+
54.8	56.5	Gray v. coarse sand w/gravel, v. dense, wet.	SS-19	46.5	48.5	11-21-29-40 Rec = 24" Qp = -
56.5	57.0	Gray v.f. sand, medium dense, moist.	SS-20	49.0	50.5	19-47-50/5" Rec = Qp = -
57.0	57.5	V. coarse sand w/gravel, wet.	SS-21	51.5	53.5	22-42-31-43 Rec = Qp = 2.5
57.5	61.5	Gray v.f. sand, so. gravel, v. dense, moist. No gravel from 58.6'.	SS-22	54.0	55.75	20-42-47-50/3" Rec = 24" Qp = -
61.5	64.9	Gray v.f. sandy silt, v. dense, so. gravel from 64.5' to 64.9', wet.	SS-23	56.5	57.8	13-28-50/4" Rec = 24" Qp = -
64.9	68.4	Gray silty clay and clayey silt, v. stiff, moist. So. gravel from 66.5' to 68.4'.	SS-24	59.0	60.3	15-29-50/4" Rec = 15" Qp = -
68.4	68.5	Limestone fragments.	SS-25	61.5	62.8	20-45-50/4" Rec = 15" Qp = -
68.5	77.5	Gray clayey sandy silt w/gravel, v. stiff.	SS-26	64.0	66.0	20-16-20-31 Rec = 24" Qp = 4.5

General Remarks:

Project Name Ameren Duck Creek - Phase II Site Invest.

Boring # B-10/MW-4

Sheet 3 of 3

STRATUM DEPTH From	STRATUM DEPTH To	SOIL CLASSIFICATION	SAMPLE NUMBER	SAMPLE DEPTH From	SAMPLE DEPTH To	STD. PENETRATION TEST BLOWS / 6 INCHES P=Penetrometer
77.5	80.5	Dk. gray silty sand.	SS-27	66.5	68.5	11-15-21-33 Rec = 24" Qp = 4.5+
80.5	81.5	Gray sandy silt, stiff, moist.	SS-28	69.0	71.0	15-20-37-50/5" Rec = 24" Qp = 4.5+
81.5	85.0	Gray silty sand, moist. Coal at 83.4'.	SS-29	71.5	73.5	16-29-33-38 Rec = 24" Qp = 4.5+
85.0	89.0	V. coarse sand w/rock fragments.	SS-30	74.0	76.0	12-23-32-50 Rec = 24" Qp = 4.5+
89.0	91.5	Gray siltstone, hard, moist. Auger refusal. Will core using a tricone to 91.5' and try to get another sample. SPT refusal at 91.5'.	SS-31	76.5	78.5	12-18-27-31 Rec = 24" Qp = -
		Begin Coring at 91.5'.	SS-32	79.0	81.0	12-24-35-50 Rec = 24" Qp = 2.0 (in silt)
			SS-33	81.5	83.5	9-19-28-34 Rec = 24" Qp = -
			SS-34	84.0	86.0	34-32-21-42 Rec = 18" Qp = -
			SS-35	86.5	88.5	11-13-26-20 Rec = 17" Qp = -
			SS-36	89.0	89.3	50/3" Rec = 2" Qp = -
			SS-37	91.5	91.7	50/2" Rec = Qp = -

General Remarks:

HANSON

BORING NO.	B-10/MW-4
PROJECT No. 03S5010	SHEET 1 OF 2

PROJECT NAME:	DATE	Engineer/Geologist:
Ameren Duck Creek	9/23/2003	Brett Carney

Depth In Feet	ROCK, COLOR, HARDNESS, WEATHERING, GRAIN OR CRYSTALLINITY, BEDDING, VOIDS (OTHER: THICKNESS & LOCATION OF CLAY/SHALE SEAMS)	Sample or Run Number	% REC -------- % RQD	Box Number	Time	DWR %	DWRC	Down Pressure	Depth In Feet
	Start Coring at 91.5 ft.	1	100% ------- 89%	1		100%	Dk. Gray	490	
92.5	Gray silty shale; thin bedded; v. soft and weathered 91.5 - 91.9 (may be slough); mod. soft; micaceous; so. plant fossils.								
93.5	Gray shaley sandstone, w/so. lt. gray partings below 91.9 ft.								
94.5									
95.5									
96.5									
97.5									
98.5		98.5'							
	Same as above.	2	100% ------- 99%		1' 26"	100%		500	
99.5	Core barrel plugged as soon as we resumed at 98.5 ft.							600 @ 105.5 ft	
	Temporarily plugged at 103.7 ft.				1' 30"				
100.5	Lost 2.7 ft of core (likely fell out the bottom upon retrieval). Recovered remaining 2.7 ft as part of Run #3. RQD & REC includes recovery in Run #3.			100.8' / 2	1' 51"				
101.5									

HANSON

BORING NO.	B-10/MW-4
PROJECT No. 03S5010	SHEET 2 OF 2

PROJECT NAME:	DATE	Engineer/Geologist:
Ameren Duck Creek	9/23/2003	Brett Carney

Depth In Feet	ROCK, COLOR, HARDNESS, WEATHERING, GRAIN OR CRYSTALLINITY, BEDDING, VOIDS (OTHER: THICKNESS & LOCATION OF CLAY/SHALE SEAMS)	Sample or Run Number	% REC -------- % RQD	Box Number	Time	DWR %	DWRC	Down Pressure	Depth In Feet
	Same as above.	2		1					
					1' 42"				
102.5									
					1' 25"				
103.5									
					4' 10"				
104.5									
					47"				
105.5									
					47"				
106.5									
					45"				
107.5									
					50"				
108.5		108.5'							
		3	100% ------- 100%	2	1' 23"	100%	Dk Gray	500	
109.5									
					1' 10"				
110.5									
					1' 14"				
111.5	End Run #3 @ 111.5 ft. E.O.B. @ 111.5 ft.								

FIELD BORING LOG

G50L (MW51L)

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/13/2007
Finish: 3/13/2007
WEATHER: Sunny, windy, mild

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 4½" hollow stem auger - blind drilled within 10 ft of B-51

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: ~~B-51a~~
Well ID: ~~MW51L~~
Surface Elev: 620.84 ft. MSL
Completion: 16.71 ft. BGS
Station: 16,174.9N
-5.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 8.20 - during drilling
▼ = 5.57 - 3/29/2007
▽ =

SAMPLE			TESTING				Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Failure Type*					
								Very dark brown (10YR2/2), clayey SILT, trace sand		620	
							2	Yellowish brown (10YR5/6) with 40% very dark grayish brown (10YR2/3) mottles, silty CLAY, trace sand			
								Pale brown (10YR6/3) with 40% yellowish brown (10YR5/8) silty CLAY, trace sand		618	
							4			616	
							▽ 6			614	
							▼ 8	Pale brown (10YR6/3) and yellowish brown (10YR5/8) clayey SILT, trace sand		612	
							10			610	
							12			608	
								Grayish brown (10YR5/2), clayey SILT, trace sand			
							14			606	
								Brown (10YR4/3), clayey SILT, trace sand			
							16				

End of Boring = 16.7 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/12/2007
Finish: 3/13/2007
WEATHER: Sunny, windy, mild

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3½" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-51
Well ID: hole abandoned
Surface Elev: 620.84 ft. MSL
Completion: 80.00 ft. BGS
Station: 16,177.5N
-5.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 8.20 - during drilling
▼ = 7.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
	24/24 100%	ss	2-3 4-5 N=7			
1A				21		1.28 BSh
	22/24 92%	ss	6-3 5-6 N=8			
2A				30		1.78 BSh
2B				29		1.67 BSh
	18/24 75%	ss	1-3 3-3 N=6			
3A				24		
	24/24 100%	ss	5-4 5-6 N=9			
4A				22		1.71 B
	13/24 54%	ss	1-3 5-4 N=8			
5A				26		1.28 BSh
	15/24 63%	ss	0-1 3-3 N=4			
6A				27		1.36 BSh
	14/24 58%	ss	4-3 5-6 N=8			
7A				24		
	20/24 83%	ss	0-2 2-3 N=4			
8A				26		
	24/24 100%	ss	4-5 5-5 N=10			
9A				25		
	23/24 96%	ss	0-2 3-3 N=5			
10A				26		
	20/24		1-3			

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Very dark brown (10YR2/2), clayey SILT, trace sand	620
2	Yellowish brown (10YR5/6) with 40% very dark grayish brown (10YR2/3) mottles, silty CLAY, trace sand	
	Pale brown (10YR6/3) with 40% yellowish brown (10YR5/8) silty CLAY, trace sand	618
4		
		616
6		
▼		614
▼ 8	Pale brown (10YR6/3) and yellowish brown (10YR5/8) clayey SILT, trace sand	
		612
10		
		610
12		
		608
	Grayish brown (10YR5/2), clayey SILT, trace sand	
14		
		606
	Brown (10YR4/3), clayey SILT, trace sand	
16		
		604
	Dark yellowish brown (10YR4/4) with 30% yellowish brown (10YR5/6) mottles, very silty CLAY, trace sand	
18		
		602
	Dark grayish brown (10YR4/2) with 50% yellowish brown (10YR5/6) mottles, silty CLAY, trace sand and gravel	
20		
		600

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/12/2007
Finish: 3/13/2007
WEATHER: Sunny, windy, mild

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3½" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-51
Well ID: hole abandoned
Surface Elev: 620.84 ft. MSL
Completion: 80.00 ft. BGS
Station: 16,177.5N
-5.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 8.20 - during drilling
▼ = 7.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
	83%	SS	*3-4* N=6			
11A				27		
	22/24 *92%*	SS	*1-3* *4-4* N=7			
12A				24		
	20/24 *83%*	SS	*2-3* *5-2* N=8			
13A				28		
	19/24 *79%*	SS	*0-2* *2-2* N=4			
14A				19		
	20/24 *83%*	SS	*1-3* *5-6* N=8			
15A				15		
	24/60 *40%*	CS				
16A				13		4.29 *BSh*
	38/60 *63%*	CS				
17A				13		6.70 *None*

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
22	Dark grayish brown (10YR4/2) with 50% yellowish brown (10YR5/6) mottles, silty CLAY, trace sand and gravel *[Continued from previous page]*	
	Dark yellowish brown (10YR4/6) with 30% very dark grayish brown (10YR3/2) and 10% gray (10YR5/1) mottles, silty CLAY, trace sand and gravel	598
24		
	Greenish gray (5GY5/1) with 50% yellowish brown (10YR5/6) mottles, very silty CLAY, trace sand and gravel	596
26		
	Light brownish gray (10YR6/2) with 30% yellowish brown (10YR5/6) mottles, clayey SILT, trace sand and gravel	594
28		
	Dark gray (N4/1), very silty CLAY, trace sand and gravel	592
30		
	Dark gray (N4/1), sandy SILT, trace clay	590
32		
		588
34		
	Dark gray (N4/1), silty CLAY, trace sand and gravel	586
36		
		584
38	Brown (10YR4/3), silty, fine to medium SAND, little gravel	
		582
40		
	Brown (10YR4/3), silty, fine SAND	580
42		

Borehole Detail

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/12/2007
Finish: 3/13/2007
WEATHER: Sunny, windy, mild

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3½" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-51
Well ID: hole abandoned
Surface Elev: 620.84 ft. MSL
Completion: 80.00 ft. BGS
Station: 16,177.5N
-5.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 8.20 - during drilling
▼ = 7.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	19/60 32%	CS						Brown (10YR4/3), fine to medium SAND	578	
								Brown (10YR4/3), silty, fine to coarse SAND, little gravel		
							44	Dark yellow brown (10YR4/4), SANDSTONE		
18A				13		6.70 None			576	
							46	Very dark gray (N3/1), sandy SILT, trace clay and gravel		
									574	
	48/60 80%	CS					48			
								Dark gray (N4/1), SHALE	572	
19A				14		6.70 None	50			
									570	
								Very dark gray (N3/1), silty CLAY, trace sand and gravel		
							52			
	60/60 100%	CS							568	
							54			
20A				17		6.70 None			566	
							56	Very dark greenish gray (10Y3/1), silty CLAY, trace sand and gravel		
									564	
	60/60 100%	CS					58			
									562	
								Very dark greenish gray (10Y3/1), silty, fine to coarse SAND, little gravel		
21A				14			60			
22A				15						
22B	18/24 75%	SS	8-15 25-32 N=40	11				Very dark gray (N3/1), sandy CLAY, little gravel	560	
22C				15				Very dark gray (N3/1), silty, fine SAND, trace medium sand		
							62	Very dark gray (N3/1), sandy CLAY, trace gravel		
	24/24		15-31					Very dark gray (N3/1), silty, fine to medium SAND, trace gravel	558	

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/12/2007
Finish: 3/13/2007
WEATHER: Sunny, windy, mild

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3½" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-51
Well ID: hole abandoned
Surface Elev: 620.84 ft. MSL
Completion: 80.00 ft. BGS
Station: 16,177.5N
-5.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 8.20 - during drilling
▼ = 7.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
23A	100%	SS	29-19 N=60	15		5.24 BSh
24A	24/24 100%	SS	7-10 14-23 N=24	15		5.24 BSh
24B				15		3.30 B
	24/24 100%	SS	8-17 24-22 N=41			
25A				16		5.13 B
	24/24 100%	SS	7-9 16-15 N=25			
26A				12		2.57 BSP
	12/12 100%	CS				
27A				11		
	12/12 100%	CS				
28A				12		
	36/36 100%	CS				
29				12		
	60/60 100%	CS				
30A				19		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Very dark gray (N3/1), sandy CLAY, trace gravel *[Continued from previous page]*	
64	Very dark gray (N3/1), silty, fine to coarse SAND, trace gravel	556
66	Very dark gray (N3/1), silty CLAY, trace sand and gravel	554
68	Very dark gray (N3/1), sandy CLAY, trace gravel	552
70	Very dark gray (N3/1), sandy CLAY	550
72	Very dark gray (N3/1), silty, fine to coarse SAND, little gravel	548
74		546
76	Very dark gray (N3/1), silty, fine SAND, trace gravel	544
78		542
80		

End of Boring = 80.0 ft. BGS

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

G50S (MW51S)

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 3/13/2007
Finish: 3/13/2007
WEATHER: Sunny, windy, mild

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-650 Track Drill
Drilling Method: 4½" hollow stem auger - blind drilled within 10 ft of B-51
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: ~~B-51b~~
Well ID: ~~MW51S/G50S~~
Surface Elev: 620.84 ft. MSL
Completion: 34.32 ft. BGS
Station: 16,180.78N
-5.07E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 8.20 - during drilling
▼ = 5.86 - 3/29/2007
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) % *Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
								Very dark brown (10YR2/2), clayey SILT, trace sand	620	
							2	Yellowish brown (10YR5/6) with 40% very dark grayish brown (10YR2/3) mottles, silty CLAY, trace sand		
								Pale brown (10YR6/3) with 40% yellowish brown (10YR5/8) silty CLAY, trace sand	618	
							4			
									616	
							▽ 6			
									614	
							▼ 8	Pale brown (10YR6/3) and yellowish brown (10YR5/8) clayey SILT, trace sand		
									612	
							10			
									610	
							12			
									608	
								Grayish brown (10YR5/2), clayey SILT, trace sand		
							14			
									606	
								Brown (10YR4/3), clayey SILT, trace sand		
							16			
									604	
								Dark yellowish brown (10YR4/4) with 30% yellowish brown (10YR5/6) mottles, very silty CLAY, trace sand		
							18			
									602	
								Dark grayish brown (10YR4/2) with 50% yellowish brown (10YR5/6) mottles, silty CLAY, trace sand and gravel		
							20			
									600	

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 3/13/2007
Finish: 3/13/2007
WEATHER: Sunny, windy, mild

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-650 Track Drill
Drilling Method: 4½" hollow stem auger - blind drilled within 10 ft of B-51
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-51b
Well ID: MW51S/G50S
Surface Elev: 620.84 ft. MSL
Completion: 34.32 ft. BGS
Station: 16,180.78N
-5.07E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 8.20 - during drilling
▼ = 5.86 - 3/29/2007
▽ =

SAMPLE Number	Recov / Total (in) % *Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
							22	Dark grayish brown (10YR4/2) with 50% yellowish brown (10YR5/6) mottles, silty CLAY, trace sand and gravel *[Continued from previous page]*			
							24	Dark yellowish brown (10YR4/6) with 30% very dark grayish brown (10YR3/2) and 10% gray (10YR5/1) mottles, silty CLAY, trace sand and gravel		598	
							26	Greenish gray (5GY5/1) with 50% yellowish brown (10YR5/6) mottles, very silty CLAY, trace sand and gravel		596	
							28	Light brownish gray (10YR6/2) with 30% yellowish brown (10YR5/6) mottles, clayey SILT, trace sand and gravel		594	
							30	Dark gray (N4/1), very silty CLAY, trace sand and gravel		592	
							32	Dark gray (N4/1), sandy SILT, trace clay		590	
							34			588	

End of Boring = 34.3 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/12/2007
Finish: 3/13/2007
WEATHER: Sunny, windy, mild

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3½" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-51
Well ID: hole abandoned
Surface Elev: 620.84 ft. MSL
Completion: 80.00 ft. BGS
Station: 16,177.5N
-5.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 8.20 - during drilling
▼ = 7.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
	24/24 100%	ss	2-3 4-5 N=7			
1A				21		1.28 BSh
	22/24 92%	ss	6-3 5-6 N=8			
2A				30		1.78 BSh
2B				29		1.67 BSh
	18/24 75%	ss	1-3 3-3 N=6			
3A				24		
	24/24 100%	ss	5-4 5-6 N=9			
4A				22		1.71 B
	13/24 54%	ss	1-3 5-4 N=8			
5A				26		1.28 BSh
	15/24 63%	ss	0-1 3-3 N=4			
6A				27		1.36 BSh
	14/24 58%	ss	4-3 5-6 N=8			
7A				24		
	20/24 83%	ss	0-2 2-3 N=4			
8A				26		
	24/24 100%	ss	4-5 5-5 N=10			
9A				25		
	23/24 96%	ss	0-2 3-3 N=5			
10A				26		
	20/24		1-3			

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Very dark brown (10YR2/2), clayey SILT, trace sand	620
2	Yellowish brown (10YR5/6) with 40% very dark grayish brown (10YR2/3) mottles, silty CLAY, trace sand	
	Pale brown (10YR6/3) with 40% yellowish brown (10YR5/8) silty CLAY, trace sand	618
4		
		616
6		
▼		614
▼ 8	Pale brown (10YR6/3) and yellowish brown (10YR5/8) clayey SILT, trace sand	
		612
10		
		610
12		
		608
	Grayish brown (10YR5/2), clayey SILT, trace sand	
14		
		606
	Brown (10YR4/3), clayey SILT, trace sand	
16		
		604
	Dark yellowish brown (10YR4/4) with 30% yellowish brown (10YR5/6) mottles, very silty CLAY, trace sand	
18		
		602
	Dark grayish brown (10YR4/2) with 50% yellowish brown (10YR5/6) mottles, silty CLAY, trace sand and gravel	
20		
		600

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/12/2007
Finish: 3/13/2007
WEATHER: Sunny, windy, mild

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3½" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-51
Well ID: hole abandoned
Surface Elev: 620.84 ft. MSL
Completion: 80.00 ft. BGS
Station: 16,177.5N
-5.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 8.20 - during drilling
▼ = 7.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
	83%	SS	*3-4* N=6			
11A				27		
	22/24 *92%*	SS	*1-3* *4-4* N=7			
12A				24		
	20/24 *83%*	SS	*2-3* *5-2* N=8			
13A				28		
	19/24 *79%*	SS	*0-2* *2-2* N=4			
14A				19		
	20/24 *83%*	SS	*1-3* *5-6* N=8			
15A				15		
	24/60 *40%*	CS				
16A				13		4.29 *BSh*
	38/60 *63%*	CS				
17A				13		6.70 *None*

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
22	Dark grayish brown (10YR4/2) with 50% yellowish brown (10YR5/6) mottles, silty CLAY, trace sand and gravel *[Continued from previous page]*	
	Dark yellowish brown (10YR4/6) with 30% very dark grayish brown (10YR3/2) and 10% gray (10YR5/1) mottles, silty CLAY, trace sand and gravel	598
24		
	Greenish gray (5GY5/1) with 50% yellowish brown (10YR5/6) mottles, very silty CLAY, trace sand and gravel	596
26		
	Light brownish gray (10YR6/2) with 30% yellowish brown (10YR5/6) mottles, clayey SILT, trace sand and gravel	594
28		
	Dark gray (N4/1), very silty CLAY, trace sand and gravel	592
30		
	Dark gray (N4/1), sandy SILT, trace clay	590
32		
		588
34		
	Dark gray (N4/1), silty CLAY, trace sand and gravel	586
36		
		584
38	Brown (10YR4/3), silty, fine to medium SAND, little gravel	
		582
40		
	Brown (10YR4/3), silty, fine SAND	580
42		

Borehole Detail

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/12/2007
Finish: 3/13/2007
WEATHER: Sunny, windy, mild

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3½" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-51
Well ID: hole abandoned
Surface Elev: 620.84 ft. MSL
Completion: 80.00 ft. BGS
Station: 16,177.5N
-5.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 8.20 - during drilling
▼ = 7.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	19/60 32%	CS						Brown (10YR4/3), fine to medium SAND	578	
								Brown (10YR4/3), silty, fine to coarse SAND, little gravel		
							44	Dark yellow brown (10YR4/4), SANDSTONE		
18A				13		6.70 None			576	
							46	Very dark gray (N3/1), sandy SILT, trace clay and gravel		
									574	
	48/60 80%	CS					48			
								Dark gray (N4/1), SHALE	572	
19A				14		6.70 None	50			
									570	
								Very dark gray (N3/1), silty CLAY, trace sand and gravel		
							52			
	60/60 100%	CS							568	
							54			
20A				17		6.70 None			566	
							56	Very dark greenish gray (10Y3/1), silty CLAY, trace sand and gravel		
									564	
	60/60 100%	CS					58			
									562	
								Very dark greenish gray (10Y3/1), silty, fine to coarse SAND, little gravel		
21A				14			60			
22A				15						
22B	18/24 75%	SS	8-15 25-32 N=40	11				Very dark gray (N3/1), sandy CLAY, little gravel	560	
22C				15				Very dark gray (N3/1), silty, fine SAND, trace medium sand		
							62	Very dark gray (N3/1), sandy CLAY, trace gravel		
	24/24		15-31					Very dark gray (N3/1), silty, fine to medium SAND, trace gravel	558	

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 3/12/2007
Finish: 3/13/2007
WEATHER: Sunny, windy, mild

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3½" hollow stem auger w/split spoon and split barrel sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-51
Well ID: hole abandoned
Surface Elev: 620.84 ft. MSL
Completion: 80.00 ft. BGS
Station: 16,177.5N
-5.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 8.20 - during drilling
▼ = 7.00 - end of boring
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
23A	100%	SS	29-19 N=60	15		5.24 BSh
24A	24/24 100%	SS	7-10 14-23 N=24	15		5.24 BSh
24B				15		3.30 B
	24/24 100%	SS	8-17 24-22 N=41			
25A				16		5.13 B
	24/24 100%	SS	7-9 16-15 N=25			
26A				12		2.57 BSP
	12/12 100%	CS				
27A				11		
	12/12 100%	CS				
28A				12		
	36/36 100%	CS				
29				12		
	60/60 100%	CS				
30A				19		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Very dark gray (N3/1), sandy CLAY, trace gravel *[Continued from previous page]*	
64	Very dark gray (N3/1), silty, fine to coarse SAND, trace gravel	556
66	Very dark gray (N3/1), silty CLAY, trace sand and gravel	554
68	Very dark gray (N3/1), sandy CLAY, trace gravel	552
70	Very dark gray (N3/1), sandy CLAY	550
72	Very dark gray (N3/1), silty, fine to coarse SAND, little gravel	548
74		546
76	Very dark gray (N3/1), silty, fine SAND, trace gravel	544
78		542
80		

End of Boring = 80.0 ft. BGS

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/28/2008
Finish: 1/28/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 4¼" hollow stem auger - blind drilled within 10 ft of of BG51
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: ~~BG51b~~
Well ID: G51L
Surface Elev: 616.9 ft. MSL
Completion: 17.7 ft. BGS
Station: 15,409.75N
-75.67E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 9.30 - during drilling
▼ = 10.57 - 1/30/2008
▽ =

SAMPLE			TESTING				
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Failure Type*	

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	Dark gray (10YR4/2) silty CLAY, moist, trace sand	616	
	Light brown gray (10YR6/2) with 25% brown yellow (10YR6/6) mottles, moist, silty CLAY, trace sand		
2	Brown yellow (10YR6/6) with 50% light yellow brown (10YR6/4) mottles, moist, clayey SILT, trace sand	614	
4		612	
6		610	
8	Gray (10YR6/1) with 20% brown yellow (10YR6/6) mottles, moist, clayey SILT, trace sand	608	
▼ 10		606	
▽ 12		604	
14	Brown yellow (10YR5/4) with 30% yellow brown (10YR5/8) mottles, moist, clayey SILT, trace sand	602	
16	Brown (10YR5/3) with 30% yellow brown (10YR5/6) mottles, moist, silty CLAY, trace sand and gravel	600	

End of Boring = 17.72 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/23/2008
Finish: 1/23/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG51
Well ID: hole abandoned
Surface Elev: 616.8 ft. MSL
Completion: 46.0 ft. BGS
Station: 15,400.00N
-75.00E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 9.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	24/24 100%	ss	4-5 5-6 N=10	21		1.05 Sh
1B				31		0.81 Sh
	23/24 96%	ss	2-3 3-5 N=6			
2A				23		1.24 Sh
	21/24 88%	ss	1-3 2-3 N=5			
3A				27		0.74 BSh
	24/24 100%	ss	2-3 1-3 N=4			
4A				29		0.74 BSh
	22/24 92%	ss	1-2 3-3 N=5			
5A				30		0.78 B
	24/24 100%	ss	0-2 1-2 N=3			
6A				28		0.62 Sh
7A				28		0.81 BSh
	24/24 100%	ss	0-2 2-3 N=4			
	24/24 100%	ss	0-1 2-2 N=3			
8A				27		0.81 BSh
	23/24 96%	ss	1-2 3-4 N=5			
9A				26		1.09 BSh
	24/24 100%	ss	2-2 4-4 N=6			
10A				25		1.09

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark gray (10YR4/2) silty CLAY, moist, trace sand	616
	Light brown gray (10YR6/2) with 25% brown yellow (10YR6/6) mottles, moist, silty CLAY, trace sand	
2	Brown yellow (10YR6/6) with 50% light yellow brown (10YR6/4) mottles, moist, clayey SILT, trace sand	614
4		612
6		610
8	Gray (10YR6/1) with 20% brown yellow (10YR6/6) mottles, moist, clayey SILT, trace sand	608
10		606
12		604
14	Brown yellow (10YR5/4) with 30% yellow brown (10YR5/8) mottles, moist, clayey SILT, trace sand	602
16		600
18	Brown (10YR5/3) with 30% yellow brown (10YR5/6) mottles, moist, silty CLAY, trace sand and gravel	598
20		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/23/2008
Finish: 1/23/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG51
Well ID: hole abandoned
Surface Elev: 616.8 ft. MSL
Completion: 46.0 ft. BGS
Station: 15,400.00N
-75.00E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 9.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
						BSh
	24/24 100%	ss	1-2 2-3 N=4			
11A				22		
12A	24/24 100%	ss	3-4 3-4 N=7	26		0.39 B
12B				21		0.50 B
	24/24 100%	ss	0-2 3-3 N=5			
13A				20		1.75 B
14A	24/24 100%	ss	5-7 8-9 N=15	17		3.30 BSh
14B				18		
14C				15		
	24/24 100%	ss	1-5 6-9 N=11			
15A				19		4.07 Sh
	24/24 100%	ss	3-6 5-8 N=11			
16A				12		4.27 Sh
	24/24 100%	ss	6-8 9-9 N=17			
17A				16		4.27 BSh
18A	24/24 100%	ss	4-8 5-6 N=13	17		4.27 Sh
18B				15		
	21/24 88%	ss	4-4 6-5 N=10			
19A				37		0.81 B
	22/24 92%	ss	3-6 8-9 N=14			
20A				12		2.33 BSh
20B				13		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Brown (10YR5/3) with 30% yellow brown (10YR5/6) mottles, moist, silty CLAY, trace sand and gravel *[Continued from previous page]*	596
22		
	Olive yellow (2.5Y6/6) with 50% green gray (5GY6/1) mottles, wet, silty CLAY, trace sand and gravel	594
24		
	Olive (5Y5/3) with 50% green gray (5GY6/1) mottles, wet, very silty CLAY, trace sand and gravel	592
26		
	Brown yellow (10YR5/4), wet, fine to coarse SAND, little gravel	590
	Green gray (5GY6/1), moist, very silty CLAY, trace sand	
28		588
30	Very dark gray (N3/1), moist, silty CLAY, trace sand and gravel	586
32		584
34		582
36	Dark gray (10YR4/1) with 20% gray (10YR5/1) mottles, moist, clayey SILT, trace sand	580
38	Dark gray (10YR4/1) silty CLAY, moist, trace sand and gravel	578
	Dark gray (10YR4/1), wet, fine to coarse SAND, trace	
40		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: Ameren Energy Resources Generating Co.
CONTRACTOR: Testing Service Corporation
Site: Duck Creek Gypsum Managment Facility
Rig mfg/model: CME-650 Track Rig
Location: Canton, Fulton Co., Illinois
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
Project: 03S5010
DATES: Start: 1/23/2008
Finish: 1/23/2008
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager
WEATHER: Overcast, windy, cold

BOREHOLE ID: BG51
Well ID: hole abandoned
Surface Elev: 616.8 ft. MSL
Completion: 46.0 ft. BGS
Station: 15,400.00N
-75.00E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 9.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
20C				12		4.07 B		gravel			
	24/24 100%	ss	3-7 9-14 N=16							576	
21A				12		4.65 B	42				
	24/24 100%	ss	12-25 38-37 N=63					Dark gray (10YR4/1) silty CLAY, moist, trace sand and gravel *[Continued from previous page]*		574	
22A				10		7.18 Sh	44				
	24/24 100%	ss	11-19 21-26 N=40							572	
23A				11		5.43 Sh	46				

End of Boring = 46.0 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/28/2008
Finish: 1/28/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 4¼" hollow stem auger - blind drilled within 5 ft of BG51
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: ~~BG51a~~
Well ID: G51S
Surface Elev: 616.8 ft. MSL
Completion: 29.2 ft. BGS
Station: 15,405.35N
-75.27E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 9.30 - during drilling
▼ = 10.41 - 1/30/2008
▽ =

SAMPLE			TESTING							
Number	Recov / Total (in) % Recovery	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
								Dark gray (10YR4/2) silty CLAY, moist, trace sand	616	
							2	Light brown gray (10YR6/2) with 25% brown yellow (10YR6/6) mottles, moist, silty CLAY, trace sand		
								Brown yellow (10YR6/6) with 50% light yellow brown (10YR6/4) mottles, moist, clayey SILT, trace sand	614	
							4			
									612	
							6			
									610	
							8	Gray (10YR6/1) with 20% brown yellow (10YR6/6) mottles, moist, clayey SILT, trace sand		
									608	
							10			
									606	
							12			
									604	
							14	Brown yellow (10YR5/4) with 30% yellow brown (10YR5/8) mottles, moist, clayey SILT, trace sand		
									602	
							16			
									600	
							18	Brown (10YR5/3) with 30% yellow brown (10YR5/6) mottles, moist, silty CLAY, trace sand and gravel		
									598	
							20			

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/28/2008
Finish: 1/28/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 4¼" hollow stem auger - blind drilled within 5 ft of BG51
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG51a
Well ID: G51S
Surface Elev: 616.8 ft. MSL
Completion: 29.2 ft. BGS
Station: 15,405.35N
-75.27E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 9.30 - during drilling
▼ = 10.41 - 1/30/2008
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
							22	Brown (10YR5/3) with 30% yellow brown (10YR5/6) mottles, moist, silty CLAY, trace sand and gravel *[Continued from previous page]*	596
								Olive yellow (2.5Y6/6) with 50% green gray (5GY6/1) mottles, wet, silty CLAY, trace sand and gravel	594
							24	Olive (5Y5/3) with 50% green gray (5GY6/1) mottles, wet, very silty CLAY, trace sand and gravel	592
							26	Brown yellow (10YR5/4), wet, fine to coarse SAND, little gravel	590
								Green gray (5GY6/1), moist, very silty CLAY, trace sand	
							28	Very dark gray (N3/1), moist, silty CLAY, trace sand and gravel	588

End of Boring = 29.16 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/23/2008
Finish: 1/23/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG51
Well ID: hole abandoned
Surface Elev: 616.8 ft. MSL
Completion: 46.0 ft. BGS
Station: 15,400.00N
-75.00E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 9.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	24/24 100%	ss	4-5 5-6 N=10	21		1.05 Sh
1B				31		0.81 Sh
	23/24 96%	ss	2-3 3-5 N=6			
2A				23		1.24 Sh
	21/24 88%	ss	1-3 2-3 N=5			
3A				27		0.74 BSh
	24/24 100%	ss	2-3 1-3 N=4			
4A				29		0.74 BSh
	22/24 92%	ss	1-2 3-3 N=5			
5A				30		0.78 B
	24/24 100%	ss	0-2 1-2 N=3			
6A				28		0.62 Sh
7A				28		0.81 BSh
	24/24 100%	ss	0-2 2-3 N=4			
	24/24 100%	ss	0-1 2-2 N=3			
8A				27		0.81 BSh
	23/24 96%	ss	1-2 3-4 N=5			
9A				26		1.09 BSh
	24/24 100%	ss	2-2 4-4 N=6			
10A				25		1.09

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark gray (10YR4/2) silty CLAY, moist, trace sand	616
	Light brown gray (10YR6/2) with 25% brown yellow (10YR6/6) mottles, moist, silty CLAY, trace sand	
2	Brown yellow (10YR6/6) with 50% light yellow brown (10YR6/4) mottles, moist, clayey SILT, trace sand	614
4		612
6		610
8	Gray (10YR6/1) with 20% brown yellow (10YR6/6) mottles, moist, clayey SILT, trace sand	608
10		606
12		604
14	Brown yellow (10YR5/4) with 30% yellow brown (10YR5/8) mottles, moist, clayey SILT, trace sand	602
16		600
18	Brown (10YR5/3) with 30% yellow brown (10YR5/6) mottles, moist, silty CLAY, trace sand and gravel	598
20		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/23/2008
Finish: 1/23/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG51
Well ID: hole abandoned
Surface Elev: 616.8 ft. MSL
Completion: 46.0 ft. BGS
Station: 15,400.00N
-75.00E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 9.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
						BSh
	24/24 100%	ss	1-2 2-3 N=4			
11A				22		
12A	24/24 100%	ss	3-4 3-4 N=7	26		0.39 B
12B				21		0.50 B
	24/24 100%	ss	0-2 3-3 N=5			
13A				20		1.75 B
14A	24/24 100%	ss	5-7 8-9 N=15	17		3.30 BSh
14B				18		
14C				15		
	24/24 100%	ss	1-5 6-9 N=11			
15A				19		4.07 Sh
	24/24 100%	ss	3-6 5-8 N=11			
16A				12		4.27 Sh
	24/24 100%	ss	6-8 9-9 N=17			
17A				16		4.27 BSh
18A	24/24 100%	ss	4-8 5-6 N=13	17		4.27 Sh
18B				15		
	21/24 88%	ss	4-4 6-5 N=10			
19A				37		0.81 B
	22/24 92%	ss	3-6 8-9 N=14			
20A				12		2.33 BSh
20B				13		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Brown (10YR5/3) with 30% yellow brown (10YR5/6) mottles, moist, silty CLAY, trace sand and gravel *[Continued from previous page]*	596
22		
	Olive yellow (2.5Y6/6) with 50% green gray (5GY6/1) mottles, wet, silty CLAY, trace sand and gravel	594
24		
	Olive (5Y5/3) with 50% green gray (5GY6/1) mottles, wet, very silty CLAY, trace sand and gravel	592
26		
	Brown yellow (10YR5/4), wet, fine to coarse SAND, little gravel	590
	Green gray (5GY6/1), moist, very silty CLAY, trace sand	
28		588
30	Very dark gray (N3/1), moist, silty CLAY, trace sand and gravel	586
32		584
34		582
36	Dark gray (10YR4/1) with 20% gray (10YR5/1) mottles, moist, clayey SILT, trace sand	580
38	Dark gray (10YR4/1) silty CLAY, moist, trace sand and gravel	578
	Dark gray (10YR4/1), wet, fine to coarse SAND, trace	
40		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: Ameren Energy Resources Generating Co.
CONTRACTOR: Testing Service Corporation
Site: Duck Creek Gypsum Managment Facility
Rig mfg/model: CME-650 Track Rig
Location: Canton, Fulton Co., Illinois
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
Project: 03S5010
DATES: Start: 1/23/2008
Finish: 1/23/2008
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager
WEATHER: Overcast, windy, cold

BOREHOLE ID: BG51
Well ID: hole abandoned
Surface Elev: 616.8 ft. MSL
Completion: 46.0 ft. BGS
Station: 15,400.00N
-75.00E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 9.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
20C				12		4.07 B		gravel			
	24/24 100%	ss	3-7 9-14 N=16							576	
21A				12		4.65 B	42				
	24/24 100%	ss	12-25 38-37 N=63					Dark gray (10YR4/1) silty CLAY, moist, trace sand and gravel *[Continued from previous page]*		574	
22A				10		7.18 Sh	44				
	24/24 100%	ss	11-19 21-26 N=40							572	
23A				11		5.43 Sh	46				

End of Boring = 46.0 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/22/2008
Finish: 1/22/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 4¼" hollow stem auger - blind drilled within 5 ft of BG52
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: ~~BG52b~~
Well ID: BG52L
Surface Elev: 616.7 ft. MSL
Completion: 34.2 ft. BGS
Station: 14,660.08N
-76.47E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 32.80 - during drilling
▼ = 28.78 - 1/30/2008
▽ =

SAMPLE			TESTING				Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Failure Type*					
							2	FILL - Gray (10YR6/1) with 25% yellow brown (10YR5/6) mottles, moist, silty CLAY, trace sand		616	
							4			614	
							6			612	
							8	FILL - Yellow brown (10YR5/4) with 25% very pale brown (10YR7/4) and 10% very dark green gray (10Y3/1) mottles, moist, silty CLAY, trace sand		610	
							10	FILL - Very dark green gray (10Y3/1) with 25% yellow brown (10YR5/4), mottles, moist, silty CLAY, trace sand and gravel		608	
							12	FILL - Yellow brown (10YR5/4) with 20% very pale brown (10YR7/4) and 15% very dark green gray (10Y3/1) mottles, moist, silty CLAY, trace sand and gravel		606	
							14			604	
							16	FILL - Dark gray (5Y4/1), moist, very silty CLAY, trace sand		602	
							18	FILL - Olive gray (5Y5/2), moist, very silty CLAY, trace sand		600	
							20			598	

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/22/2008
Finish: 1/22/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 4¼" hollow stem auger - blind drilled within 5 ft of BG52
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

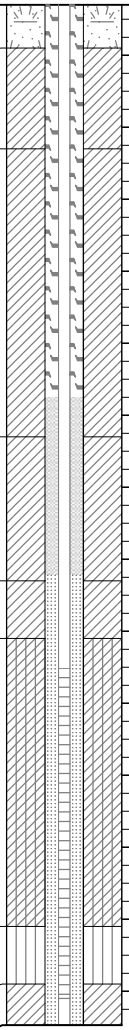
BOREHOLE ID: BG52b
Well ID: G52L
Surface Elev: 616.7 ft. MSL
Completion: 34.2 ft. BGS
Station: 14,660.08N
-76.47E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 32.80 - during drilling
▼ = 28.78 - 1/30/2008
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
								Very dark gray (10YR3/1), moist, clayey SILT, slight trace sand	596
								Dark gray brown (10YR4/2) with 20% yellow brown (10YR5/6) mottles, moist, silty CLAY, trace sand	
							22		594
							24	Gray (10YR5/1) with 30% yellow brown (10YR5/4) mottles, moist, silty CLAY, trace sand	592
							26		590
								Gray (10YR5/1) with 30% green gray (5GY5/1) mottle, moist, silty CLAY, trace sand and gravel	
							28	Brown yellow (10YR6/8) with 20% green gray (5GY5/1) mottles, very moist, silty CLAY, trace sand and gravel	588
							30	Brown yellow (10YR6/8) with 25% light gray (10YR7/2) mottle, very moist, very silty CLAY, little sand, trace gravel	586
							32		584
								Dark gray brown (10YR4/2) with 25% dark yellow brown (10YR4/6) mottles, wet, clayey SILT, little sand, trace gravel	
							34	Dark gray (10YR4/1), very moist, silty CLAY, trace sand and gravel	

Borehole Detail



End of Boring = 34.17 ft. BGS

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/21/2008
Finish: 1/22/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: ~~BG52~~
Well ID: G52S
Surface Elev: 616.5 ft. MSL
Completion: 46.0 ft. BGS
Station: 14,655.26N -76.07E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 32.80 - during drilling
▼ = 32.45 - 1/30/2008
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
	20/24 83%	ss	3-3 2-4 N=5			
1A				23		1.28 BSh
	24/24 100%	ss	3-3 4-4 N=7			
2A				16		2.13 Sh
	21/24 88%	ss	6-6 9-13 N=15			
3A				19		
	21/24 88%	ss	6-5 8-8 N=13			
4A				14		
	23/24 96%	ss	5-7 9-10 N=16			
5A				13		
	24/24 100%	ss	6-6 7-4 N=13			
6A				15		
	22/24 92%	ss	4-4 8-7 N=12			
7A				19		
	23/24 96%	ss	2-5 6-8 N=11			
8A				17		2.91 Sh
	21/24 88%	ss	2-3 3-4 N=6			
9A				25		
	24/24 100%	ss	2-5 5-5 N=10			
10A				28		1.59

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
2	FILL - Gray (10YR6/1) with 25% yellow brown (10YR5/6) mottles, moist, silty CLAY, trace sand	616, 614, 612
6	FILL - Yellow brown (10YR5/4) with 25% very pale brown (10YR7/4) and 10% very dark green gray (10Y3/1) mottles, moist, silty CLAY, trace sand	610
8	FILL - Very dark green gray (10Y3/1) with 25% yellow brown (10YR5/4), mottles, moist, silty CLAY, trace sand and gravel	608
10	FILL - Yellow brown (10YR5/4) with 20% very pale brown (10YR7/4) and 15% very dark green gray (10Y3/1) mottles, moist, silty CLAY, trace sand and gravel	606, 604, 602
16	FILL - Dark gray (5Y4/1), moist, very silty CLAY, trace sand	600
18	FILL - Olive gray (5Y5/2), moist, very silty CLAY, trace sand	598
20		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/21/2008
Finish: 1/22/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG52
Well ID: G52S
Surface Elev: 616.5 ft. MSL
Completion: 46.0 ft. BGS
Station: 14,655.26N -76.07E

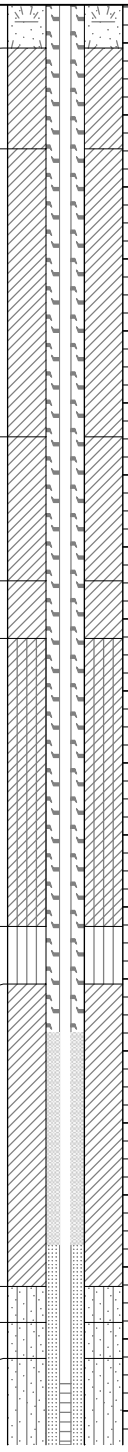
TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 32.80 - during drilling
▼ = 32.45 - 1/30/2008
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
11A	24/24 100%	ss	2-3 8-7 N=11	29		Sh
11B	24/24 100%	ss	5-5 7-9 N=12	23		3.30 BSh
12A	23/24 96%	ss	1-2 3-5 N=5	25		2.91 B
13A	24/24 100%	ss	5-6 7-6 N=13	25		2.13 B
14A				19		2.33 B
15A	24/24 100%	ss	1-2 2-3 N=4	27		0.78 B
15B	24/24 100%	ss	1-1 2-3 N=3	19		2.52 BSh
16A				22		1.24 B
17A	24/24 100%	ss	3-3 4-7 N=7	26		2.72 B
17B				26		
17C	24/24 100%	ss	2-5 6-8 N=11	17		
18A	24/24 100%	ss	9-10 10-11 N=20	16		5.24 Sh
19A				17		4.46 Sh
19B				25		
20A	24/24 100%	ss	5-7 5-6 N=12	25		
20B				30		3.69

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Very dark gray (10YR3/1), moist, clayey SILT, slight trace sand	596
	Dark gray brown (10YR4/2) with 20% yellow brown (10YR5/6) mottles, moist, silty CLAY, trace sand	
22		594
24	Gray (10YR5/1) with 30% yellow brown (10YR5/4) mottles, moist, silty CLAY, trace sand	592
26		590
	Gray (10YR5/1) with 30% green gray (5GY5/1) mottle, moist, silty CLAY, trace sand and gravel	
28	Brown yellow (10YR6/8) with 20% green gray (5GY5/1) mottles, very moist, silty CLAY, trace sand and gravel	588
30	Brown yellow (10YR6/8) with 25% light gray (10YR7/2) mottle, very moist, very silty CLAY, little sand, trace gravel	586
32		584
	Dark gray brown (10YR4/2) with 25% dark yellow brown (10YR4/6) mottles, wet, clayey SILT, little sand, trace gravel	
34		582
36	Dark gray (10YR4/1), very moist, silty CLAY, trace sand and gravel	580
38	Dark gray (10YR4/1), wet, sandy SILT	
	Gray (N6/1) with 30% gray (5Y5/1) mottles, wet, sandy SILT	578
40	Gray (10YR5/1), wet, sandy SILT	

Borehole Detail



Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/21/2008
Finish: 1/22/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG52
Well ID: G52S
Surface Elev: 616.5 ft. MSL
Completion: 46.0 ft. BGS
Station: 14,655.26N
-76.07E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 32.80 - during drilling
▼ = 32.45 - 1/30/2008
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
						Sh				
	22/24 92%	ss	2-3 5-12 N=8					Gray (10YR5/1), wet, sandy SILT *[Continued from previous page]*	576	
21A				35		1.32 Sh				
21B				12		1.40 Sh	42			
	24/24 100%	ss	12-18 18-8 N=36					Dark gray (10YR4/1), wet, SAND and GRAVEL	574	
22A				13						
22B				13			44			
	24/24 100%	ss	3-5 8-11 N=13					Dark greenish gray (10Y4/1), moist, silty CLAY, trace sand and gravel	572	
23A				14		4.46 B	46			

End of Boring = 46.0 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/21/2008
Finish: 1/22/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: ~~BG52~~
Well ID: G52S
Surface Elev: 616.5 ft. MSL
Completion: 46.0 ft. BGS
Station: 14,655.26N -76.07E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 32.80 - during drilling
▼ = 32.45 - 1/30/2008
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
	20/24 83%	ss	3-3 2-4 N=5			
1A				23		1.28 BSh
	24/24 100%	ss	3-3 4-4 N=7			
2A				16		2.13 Sh
	21/24 88%	ss	6-6 9-13 N=15			
3A				19		
	21/24 88%	ss	6-5 8-8 N=13			
4A				14		
	23/24 96%	ss	5-7 9-10 N=16			
5A				13		
	24/24 100%	ss	6-6 7-4 N=13			
6A				15		
	22/24 92%	ss	4-4 8-7 N=12			
7A				19		
	23/24 96%	ss	2-5 6-8 N=11			
8A				17		2.91 Sh
	21/24 88%	ss	2-3 3-4 N=6			
9A				25		
	24/24 100%	ss	2-5 5-5 N=10			
10A				28		1.59

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
2	FILL - Gray (10YR6/1) with 25% yellow brown (10YR5/6) mottles, moist, silty CLAY, trace sand	616, 614, 612
6	FILL - Yellow brown (10YR5/4) with 25% very pale brown (10YR7/4) and 10% very dark green gray (10Y3/1) mottles, moist, silty CLAY, trace sand	610
8	FILL - Very dark green gray (10Y3/1) with 25% yellow brown (10YR5/4), mottles, moist, silty CLAY, trace sand and gravel	608
10	FILL - Yellow brown (10YR5/4) with 20% very pale brown (10YR7/4) and 15% very dark green gray (10Y3/1) mottles, moist, silty CLAY, trace sand and gravel	606, 604, 602
16	FILL - Dark gray (5Y4/1), moist, very silty CLAY, trace sand	600
18	FILL - Olive gray (5Y5/2), moist, very silty CLAY, trace sand	598
20		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/21/2008
Finish: 1/22/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG52
Well ID: G52S
Surface Elev: 616.5 ft. MSL
Completion: 46.0 ft. BGS
Station: 14,655.26N -76.07E

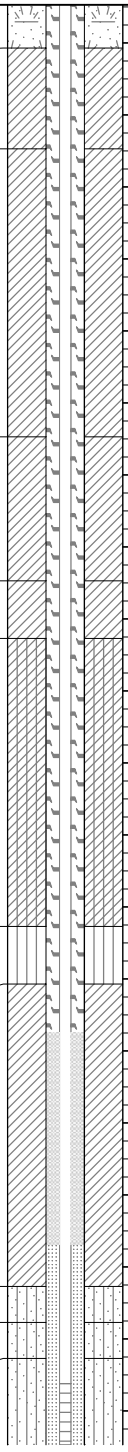
TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 32.80 - during drilling
▼ = 32.45 - 1/30/2008
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
11A	24/24 100%	ss	2-3 8-7 N=11	29		Sh
11B	24/24 100%	ss	5-5 7-9 N=12	23		3.30 BSh
12A	23/24 96%	ss	1-2 3-5 N=5	25		2.91 B
13A	24/24 100%	ss	5-6 7-6 N=13	25		2.13 B
14A				19		2.33 B
15A	24/24 100%	ss	1-2 2-3 N=4	27		0.78 B
15B	24/24 100%	ss	1-1 2-3 N=3	19		2.52 BSh
16A				22		1.24 B
17A	24/24 100%	ss	3-3 4-7 N=7	26		2.72 B
17B				26		
17C	24/24 100%	ss	2-5 6-8 N=11	17		
18A	24/24 100%	ss	9-10 10-11 N=20	16		5.24 Sh
19A				17		4.46 Sh
19B				25		
20A	24/24 100%	ss	5-7 5-6 N=12	25		
20B				30		3.69

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Very dark gray (10YR3/1), moist, clayey SILT, slight trace sand	596
	Dark gray brown (10YR4/2) with 20% yellow brown (10YR5/6) mottles, moist, silty CLAY, trace sand	
22		594
24	Gray (10YR5/1) with 30% yellow brown (10YR5/4) mottles, moist, silty CLAY, trace sand	592
26		590
	Gray (10YR5/1) with 30% green gray (5GY5/1) mottle, moist, silty CLAY, trace sand and gravel	
28	Brown yellow (10YR6/8) with 20% green gray (5GY5/1) mottles, very moist, silty CLAY, trace sand and gravel	588
30	Brown yellow (10YR6/8) with 25% light gray (10YR7/2) mottle, very moist, very silty CLAY, little sand, trace gravel	586
32		584
	Dark gray brown (10YR4/2) with 25% dark yellow brown (10YR4/6) mottles, wet, clayey SILT, little sand, trace gravel	
34		582
36	Dark gray (10YR4/1), very moist, silty CLAY, trace sand and gravel	580
38	Dark gray (10YR4/1), wet, sandy SILT	
	Gray (N6/1) with 30% gray (5Y5/1) mottles, wet, sandy SILT	578
40	Gray (10YR5/1), wet, sandy SILT	

Borehole Detail



Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/21/2008
Finish: 1/22/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG52
Well ID: G52S
Surface Elev: 616.5 ft. MSL
Completion: 46.0 ft. BGS
Station: 14,655.26N
-76.07E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 32.80 - during drilling
▼ = 32.45 - 1/30/2008
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
						Sh				
	22/24 92%	ss	2-3 5-12 N=8					Gray (10YR5/1), wet, sandy SILT *[Continued from previous page]*	576	
21A				35		1.32 Sh				
21B				12		1.40 Sh	42			
	24/24 100%	ss	12-18 18-8 N=36					Dark gray (10YR4/1), wet, SAND and GRAVEL	574	
22A				13						
22B				13			44			
	24/24 100%	ss	3-5 8-11 N=13					Dark greenish gray (10Y4/1), moist, silty CLAY, trace sand and gravel	572	
23A				14		4.46 B	46			

End of Boring = 46.0 ft. BGS

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/5/2009
Finish: 2/5/2009
WEATHER: cold, sunny, windy, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

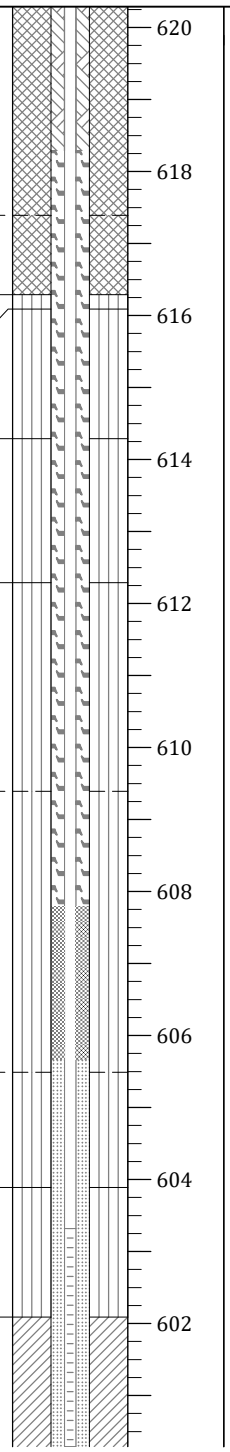
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: ~~G53a~~
Well ID: G53L
Surface Elev: 620.29 ft. MSL
Completion: 26.79 ft. BGS
Station: 16,199.98N
506.32E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 26.00 - during drilling
▼ =
▽ =

SAMPLE			TESTING					
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description
								FILL - Yellowish brown (10YR5/4) with 20% dark yellowish brown (10YR4/6) and 10% gray (10YR6/1) mottles, moist, firm, clayey SILT.
							2	
								FILL - Dark yellowish brown (10YR4/4) with 5% gray (10YR5/1) mottles, moist, firm, clayey SILT with slight trace sand.
							4	Dark gray (10YR4/1), moist, friable, clayey SILT with slight trace sand and gravel, trace roots.
								Dark yellowish brown (10YR4/6) with 10% gray (10YR6/1) mottles, moist, firm, clayey SILT with slight trace sand.
							6	
								Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT.
							8	
								Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.
							10	
							12	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.
							14	
							16	Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.
								Dark gray (10YR4/1), moist, soft, clayey SILT.
							18	
							20	Dark gray (10YR4/1) with 5% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with slight trace sand.



Depth ft. BGS	Elevation ft. MSL
	620
2	618
4	616
6	614
8	612
10	610
12	608
14	606
16	604
18	602
20	

NOTE(S): See G53S Boring log for sample and testing data.

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/5/2009
Finish: 2/5/2009
WEATHER: cold, sunny, windy, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: G53a
Well ID: G53L
Surface Elev: 620.29 ft. MSL
Completion: 26.79 ft. BGS
Station: 16,199.98N
506.32E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 26.00 - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
								Dark gray (10YR4/1) with 5% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with slight trace sand. *[Continued from previous page]*	600
							22		598
								Greenish gray (5GY5/1), moist, very soft, silty CLAY with trace sand and slight trace gravel.	
							24		596
								Greenish gray (5GY5/1), very moist, very soft, silty CLAY with sand and slight trace gravel.	
							▼ 26		594
								Greenish gray (5GY6/1), moist, soft, silty CLAY with trace sand and slight trace gravel.	

End of Boring = 26.79 ft bgs

Borehole Detail

Remarks

NOTE(S): See G53S Boring log for sample and testing data.

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/5/2009
Finish: 2/5/2009
WEATHER: cold, sunny, windy, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G53~~
Well ID: G53S
Surface Elev: 620.29 ft. MSL
Completion: 36.04 ft. BGS
Station: 16,199.56N
510.45E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 26.00 - during drilling
▼ = 31.20 - 02/05/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	20/24 83%	ss	12-3 4-3 N=7	21		
2A	22/24 92%	ss	5-3 3-6 N=6	22		
3A	18/24 75%	ss	2-3 6-7 N=9	27		
4A	24/24 100%	ss	5-4 7-11 N=11	26		
5A	12/24 50%	ss	1-2 4-3 N=6	24		
6A	17/24 71%	ss	1-2 4-4 N=6	23		
7A	19/24 79%	ss	6-5 4-4 N=9	25		
8A	19/24 79%	ss	1-2 2-3 N=4	26		
9A	24/24 100%	ss	3-6 5-5 N=11	25		
10A	19/24 79%	ss	1-1 3-4 N=4	24		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Yellowish brown (10YR5/4) with 20% dark yellowish brown (10YR4/6) and 10% gray (10YR6/1) mottles, moist, firm, clayey SILT.	620
2	FILL - Dark yellowish brown (10YR4/4) with 5% gray (10YR5/1) mottles, moist, firm, clayey SILT with slight trace sand.	618
4	Dark gray (10YR4/1), moist, friable, clayey SILT with slight trace sand and gravel, trace roots.	616
	Dark yellowish brown (10YR4/6) with 10% gray (10YR6/1) mottles, moist, firm, clayey SILT with slight trace sand.	
6	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT.	614
8	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	612
10		610
12	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	608
14		606
16	Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	604
	Dark gray (10YR4/1), moist, soft, clayey SILT.	
18	Dark gray (10YR4/1) with 5% dak yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with slight trace sand.	602
20		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/5/2009
Finish: 2/5/2009
WEATHER: cold, sunny, windy, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G53
Well ID: G53S
Surface Elev: 620.29 ft. MSL
Completion: 36.04 ft. BGS
Station: 16,199.56N
510.45E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 26.00 - during drilling
▼ = 31.20 - 02/05/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	19/24 79%	ss	woh-1 2-2 N=3	25		
12A	24/24 100%	ss	3-3 3-3 N=6	25		
12B				21		
13A	19/24 79%	ss	woh-1 1-1 N=2	23		
14A	23/24 96%	ss	woh-woh 3-4	20		
15A	22/24 92%	ss	1-3 6-8 N=9	16		
16A	18/24 75%	ss	woh-7 12-16 N=19	13		
16B				19		
17A	20/24 83%	ss	4-4 6-8 N=10	17		
17B				32		
18A	22/24 92%	ss	woh-3 3-9 N=6	30		
18B				20		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark gray (10YR4/1) with 5% dak yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with slight trace sand. *[Continued from previous page]*	600
22		598
	Greenish gray (5GY5/1), moist, very soft, silty CLAY with trace sand and slight trace gravel.	
24		596
	Greenish gray (5GY5/1), very moist, very soft, silty CLAY with sand and slight trace gravel.	
▼ 26		594
	Greenish gray (5GY6/1), moist, soft, silty CLAY with trace sand and slight trace gravel.	
28		592
	Dark gray (N4/1), moist, firm, clayey SILT with slight trace sand and gravel.	
30		590
▼	Brown (10YR5/3), wet, dense, silty very fine- to coarse-grained SAND.	
32		588
	Gray (10YR5/1), very moist, soft, clayey SILT.	
34		586
	Dark gray (N4/1), moist, firm, clayey SILT with slight trace sand and gravel. **End of Boring = 36.04 ft bgs**	
36		

Borehole Detail

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/5/2009
Finish: 2/5/2009
WEATHER: cold, sunny, windy, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G53~~
Well ID: G53S
Surface Elev: 620.29 ft. MSL
Completion: 36.04 ft. BGS
Station: 16,199.56N
510.45E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 26.00 - during drilling
▼ = 31.20 - 02/05/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	20/24 83%	ss	12-3 4-3 N=7	21		
2A	22/24 92%	ss	5-3 3-6 N=6	22		
3A	18/24 75%	ss	2-3 6-7 N=9	27		
4A	24/24 100%	ss	5-4 7-11 N=11	26		
5A	12/24 50%	ss	1-2 4-3 N=6	24		
6A	17/24 71%	ss	1-2 4-4 N=6	23		
7A	19/24 79%	ss	6-5 4-4 N=9	25		
8A	19/24 79%	ss	1-2 2-3 N=4	26		
9A	24/24 100%	ss	3-6 5-5 N=11	25		
10A	19/24 79%	ss	1-1 3-4 N=4	24		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Yellowish brown (10YR5/4) with 20% dark yellowish brown (10YR4/6) and 10% gray (10YR6/1) mottles, moist, firm, clayey SILT.	620
2	FILL - Dark yellowish brown (10YR4/4) with 5% gray (10YR5/1) mottles, moist, firm, clayey SILT with slight trace sand.	618
4	Dark gray (10YR4/1), moist, friable, clayey SILT with slight trace sand and gravel, trace roots.	616
	Dark yellowish brown (10YR4/6) with 10% gray (10YR6/1) mottles, moist, firm, clayey SILT with slight trace sand.	
6	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT.	614
8	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	612
10		610
12	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	608
14		606
16	Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	604
	Dark gray (10YR4/1), moist, soft, clayey SILT.	
18	Dark gray (10YR4/1) with 5% dak yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with slight trace sand.	602
20		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/5/2009
Finish: 2/5/2009
WEATHER: cold, sunny, windy, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G53
Well ID: G53S
Surface Elev: 620.29 ft. MSL
Completion: 36.04 ft. BGS
Station: 16,199.56N
510.45E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 26.00 - during drilling
▼ = 31.20 - 02/05/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	19/24 79%	ss	woh-1 2-2 N=3	25		
12A	24/24 100%	ss	3-3 3-3 N=6	25		
12B				21		
13A	19/24 79%	ss	woh-1 1-1 N=2	23		
14A	23/24 96%	ss	woh-woh 3-4	20		
15A	22/24 92%	ss	1-3 6-8 N=9	16		
16A	18/24 75%	ss	woh-7 12-16 N=19	13		
16B				19		
17A	20/24 83%	ss	4-4 6-8 N=10	17		
17B				32		
18A	22/24 92%	ss	woh-3 3-9 N=6	30		
18B				20		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark gray (10YR4/1) with 5% dak yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with slight trace sand. *[Continued from previous page]*	600
22		598
	Greenish gray (5GY5/1), moist, very soft, silty CLAY with trace sand and slight trace gravel.	
24		596
	Greenish gray (5GY5/1), very moist, very soft, silty CLAY with sand and slight trace gravel.	
▼ 26		594
	Greenish gray (5GY6/1), moist, soft, silty CLAY with trace sand and slight trace gravel.	
28		592
	Dark gray (N4/1), moist, firm, clayey SILT with slight trace sand and gravel.	
30		590
▼	Brown (10YR5/3), wet, dense, silty very fine- to coarse-grained SAND.	
32		588
	Gray (10YR5/1), very moist, soft, clayey SILT.	
34		586
	Dark gray (N4/1), moist, firm, clayey SILT with slight trace sand and gravel. **End of Boring = 36.04 ft bgs**	
36		

Borehole Detail

NOTE(S):

FIELD BORING LOG

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/3/2021
Finish: 2/5/2021
WEATHER: Overcast, cold (lo-20's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Al
Eng/Geo: T. Gass

BOREHOLE ID: G54C
Well ID: G54C
Surface Elev: 619.59 ft. MSL
Completion: 102.00 ft. BGS
Station: 1,384,885.21N
2,348,250.14E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
S1	18/24 75%	SS	2-2 4-5 N=6			1.5		Fill - Yellowish brown (10YR5/4) with 15% gray (10YR6/1) and 5% yellowish brown (10YR4/6) mottles, moist SILT with little clay, trace roots, and trace sand.	618
S2	21/24 88%	SS	2-5 6-7 N=11			2.0	2	Fill - Yellowish brown (10YR5/6) with 30% light brownish gray (10YR6/2) mottles, moist, soft SILT with little clay, trace sand, and trace gravel.	616
S3	22/24 92%	SS	2-7 10-12 N=17			2.5	4	Fill - Yellowish brown (10YR5/4) with 10% dark yellowish brown (10YR4/6) mottles, moist, firm SILT with little clay and trace sand.	614
S4	19/24 79%	SS	3-7 9-11 N=16			4.5	6	Fill - Yellowish brown (10YR5/4) firm SILT with little clay, trace sand, and trace gravel.	612
S5	20/24 83%	SS	3-7 9-10 N=16			4.5	8	Grayish brown (10YR5/2) firm SILT with little clay, trace sand, and trace gravel.	610
S6	21/24 88%	SS	3-4 7-10 N=11			4.5	10	Grayish brown (10YR5/2) with 30% yellowish brown (10YR5/6) mottles, firm SILT with little clay, trace sand, and trace gravel.	608
S7	21/24 88%	SS	3-7 12-15 N=19			4.5	12	Yellowish brown (10YR5/4) firm SILT with little clay, trace sand, and trace gravel.	606
ST8	20/24 83%	SH				4.0	14		604
S9	18/24 75%	SS	1-4 4-5 N=8			0.5	16	Yellowish brown (10YR5/6) with 10% gray (10YR6/1) mottles, moist, soft SILT with little clay.	602
S10	19/24 79%	SS	1-3 4-4 N=7			1.0	18		600
							20		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/3/2021
Finish: 2/5/2021
WEATHER: Overcast, cold (lo-20's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Al
Eng/Geo: T. Gass

BOREHOLE ID: G54C
Well ID: G54C
Surface Elev: 619.59 ft. MSL
Completion: 102.00 ft. BGS
Station: 1,384,885.21N
2,348,250.14E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
S11	18/24 75%	SS	1-2 4-5 N=6			1.0
S12	20/24 83%	SS	1-3 4-7 N=7			1.0
S13	19/24 79%	SS	1-3 3-4 N=6			1.5
S14	22/24 92%	SS	woh-1 3-3 N=4			1.5
S15	21/24 88%	SS	1-2 3-4 N=5			1.0
S16	22/24 92%	SS	1-3 5-5 N=8			2.0
ST17	24/24 100%	SH				0.5
S18	21/24 88%	SS	2-3 4-3 N=7			1.0
S19	21/24 88%	SS	1-4 5-8 N=9			1.5
S20	20/24 83%	SS	woh-1 3-4 N=4			1.0

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
22	Gray (10YR6/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, soft SILT with little clay.	598	
24	Gray (10YR5/1) with 30% dark gray (10YR4/1) mottles, moist, soft SILT with little clay.	596	
	Grayish brown (10YR5/2) moist, soft, CLAY with little silt.	594	
26	Gray (10YR5/1) moist, soft, CLAY with little silt.	592	
28	Gray (10YR5/1) with 30% yellowish brown (10YR5/8) soft CLAY with little silt.	590	
30		588	
32		586	
34	Gray (10YR6/1) wet, soft CLAY with little silt and trace sand.	584	
36		582	
38	Dark gray (10YR4/1) wet, fine SAND with trace silt.		
	Dark gray (10YR4/1) very moist, soft SILT with little clay and trace sand.	580	
40			

NOTE(S):

FIELD BORING LOG

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/3/2021
Finish: 2/5/2021
WEATHER: Overcast, cold (lo-20's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Al
Eng/Geo: T. Gass

BOREHOLE ID: G54C
Well ID: G54C
Surface Elev: 619.59 ft. MSL
Completion: 102.00 ft. BGS
Station: 1,384,885.21N
2,348,250.14E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
S21	4/24 17%	SS	1-2 5-10 N=7			
S22	23/24 96%	SS	2-6 12-11 N=18			3.0
ST23	23/24 96%	SH				4.5
S24	24/24 100%	SS	3-6 8-14 N=14			4.5
S25	24/24 100%	SS	3-8 13-20 N=21			4.5
S26	24/24 100%	SS	3-10 14-19 N=24			4.5
S27	24/24 100%	SS	6-9 15-16 N=24			4.5
S28	24/24 100%	SS	4-10 28-50/3" N=38			4.5
S29	24/24 100%	SS	10-47 50/3.25-50/1.25			2.5
S30	24/24 100%	SS	19-29 44-72 N=73			4.5

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark gray (10YR4/1) very moist, soft SILT with little clay and trace sand. *[Continued from previous page]*	578
42		
44	Dark grayish brown (10YR4/2) moist, firm SILT with little clay, trace sand, and trace gravel.	576
		574
46		
48		572
50	Dark gray (10YR4/1) moist, firm SILT with little clay, trace sand, and trace gravel.	570
52		568
54		566
	Dark gray (10YR4/1) moist, firm SILT with little clay, trace sand, and trace gravel.	564
56	Dark gray (10YR4/1) wet, soft SAND with little clay and trace silt.	
58	Dark gray (10YR4/1) moist, firm SILT with little clay, trace sand, and trace gravel.	562
60		560

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/3/2021
Finish: 2/5/2021
WEATHER: Overcast, cold (lo-20's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Al
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BOREHOLE ID: G54C
Well ID: G54C
Surface Elev: 619.59 ft. MSL
Completion: 102.00 ft. BGS
Station: 1,384,885.21N
2,348,250.14E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
S31	24/24 100%	SS	14-29 42-54 N=71			4.5
S32	23/24 96%	SS	12-14 30-48 N=44			4.5
S33	23/24 96%	SS	10-22 25-34 N=47			4.5
S34	24/24 100%	SS	10-19 26-34 N=45			4.5
S35	24/24 100%	SS	11-19 24-33 N=43			4.5
S36	23/24 96%	SS	11-22 22-34 N=44			4.5
S37	24/24 100%	SS	9-13 20-22 N=33			4.5
S38	24/24 100%	SS	6-8 12-15 N=20			4.5
ST39	11/24 46%	SH				4.5
S40	14/24 58%	SS	7-10 17-20 N=27			4.5

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
62	Dark gray (10YR4/1) moist, firm SILT with little clay, trace sand, and trace gravel. *[Continued from previous page]*	558
64		556
66	Dark gray (10YR4/1) firm SILT with little clay, trace sand, and trace gravel.	554
68		552
70		550
72		548
74		546
76	Dark grayish olive (10Y4/2) firm, slick CLAY with trace silt.	544
78		542
80	Dark grayish olive (10Y4/2) firm, slick CLAY with trace silt and gravel.	540

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/3/2021
Finish: 2/5/2021
WEATHER: Overcast, cold (lo-20's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Al
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BOREHOLE ID: G54C
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Surface Elev: 619.59 ft. MSL
Completion: 102.00 ft. BGS
Station: 1,384,885.21N
2,348,250.14E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
S41	24/24 100%	SS	6-8 11-15 N=19			4.5
S42	24/24 100%	SS	3-7 9-10 N=16			4.5
S43	24/24 100%	SS	4-8 12-15 N=20			4.5
S44	24/24 100%	SS	5-7 11-14 N=18			4.0
S45	24/24 100%	SS	5-8 11-14 N=19			4.5
S46	24/24 100%	SS	5-9 13-15 N=22			4.5
S47	24/24 100%	SS	4-7 10-13 N=17			4.5
S48	24/24 100%	SS	3-6 8-11 N=14			4.0
S49	24/24 100%	SS	4-8 11-13 N=19			3.0
S50	21/24 88%	SS	5-7 10-12 N=17			3.0

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	Dark grayish olive (10Y4/2) firm, slick CLAY with trace silt and gravel. *[Continued from previous page]*		
82	Dark gray (10YR4/1) firm CLAY with trace silt and gravel.	538	
84	Dark gray (10YR4/1) with 5% gray (10YR5/1) mottles, firm, CLAY with little silt, trace sand, and trace gravel.	536	
86	Dark gray (10YR4/1) CLAY with little silt, trace sand, and trace gravel.	534	
88		532	
90	Grayish green (5GY5/2) with 30% dark grayish green (5GY4/2) mottles, firm, CLAY with trace silt and gravel. (WEATHERED SHALE)	530	
92		528	
94	Very dark grayish green (5GY3/2) firm, CLAY with trace silt. (WEATHERED SHALE)	526	
96		524	
98	Very dark grayish green (5GY3/2) firm, CLAY with trace silt and gravel. (WEATHERED SHALE)	522	
100		520	

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/3/2021
Finish: 2/5/2021
WEATHER: Overcast, cold (lo-20's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Al
Eng/Geo: T. Gass

BOREHOLE ID: G54C
Well ID: G54C
Surface Elev: 619.59 ft. MSL
Completion: 102.00 ft. BGS
Station: 1,384,885.21N
2,348,250.14E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Water Content (%)	Dry Density (lb/ft^3)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
S51	24/24 *100%*	SS	*3-7* *9-11* N=16			*2.5*		Very dark grayish green (5GY3/2) firm, CLAY with trace silt and gravel. (WEATHERED SHALE) *[Continued from previous page]*		518	
							102	**End of boring = 102 feet**			

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/12/2009
Finish: 2/12/2009
WEATHER: cold, sunny, windy, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

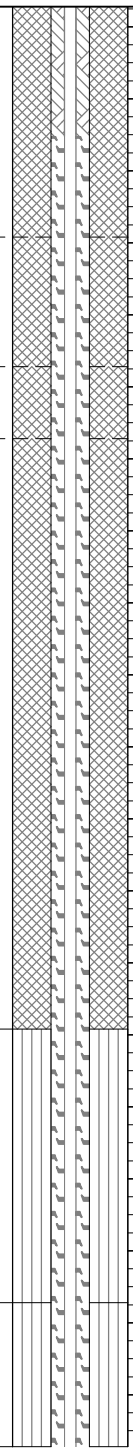
BOREHOLE ID: ~~G54a~~
Well ID: G54L
Surface Elev: 620.28 ft. MSL
Completion: 37.22 ft. BGS
Station: 14,664.37N
463.80E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
								FILL - Yellowish brown (10YR5/4) with 20% gray (10YR6/1) and 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand, trace roots.	620
							2		618
							4	FILL - Yellowish brown (10YR5/4) with 5% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand.	616
								FILL - Yellowish brown (10YR5/4) with 5% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT with slight trace sand.	
							6		614
							8		612
							10	FILL - Yellowish brown (10YR5/4), moist, firm, clayey SILT with trace sand and slight trace gravel.	610
							12		608
							14		606
							16	Dark yellowish brown (10YR4/4) with 20% gray (10YR6/1) mottles, moist, firm, clayey SILT with slight trace sand, trace roots.	604
							18		602
								Yellowish brown (10YR5/6) with 10% gray (10YR6/1) mottles, moist, friable, clayey SILT.	
							20		

Borehole Detail



Remarks

NOTE(S): See G54S Boring log for sample and testing data.

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/12/2009
Finish: 2/12/2009
WEATHER: cold, sunny, windy, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

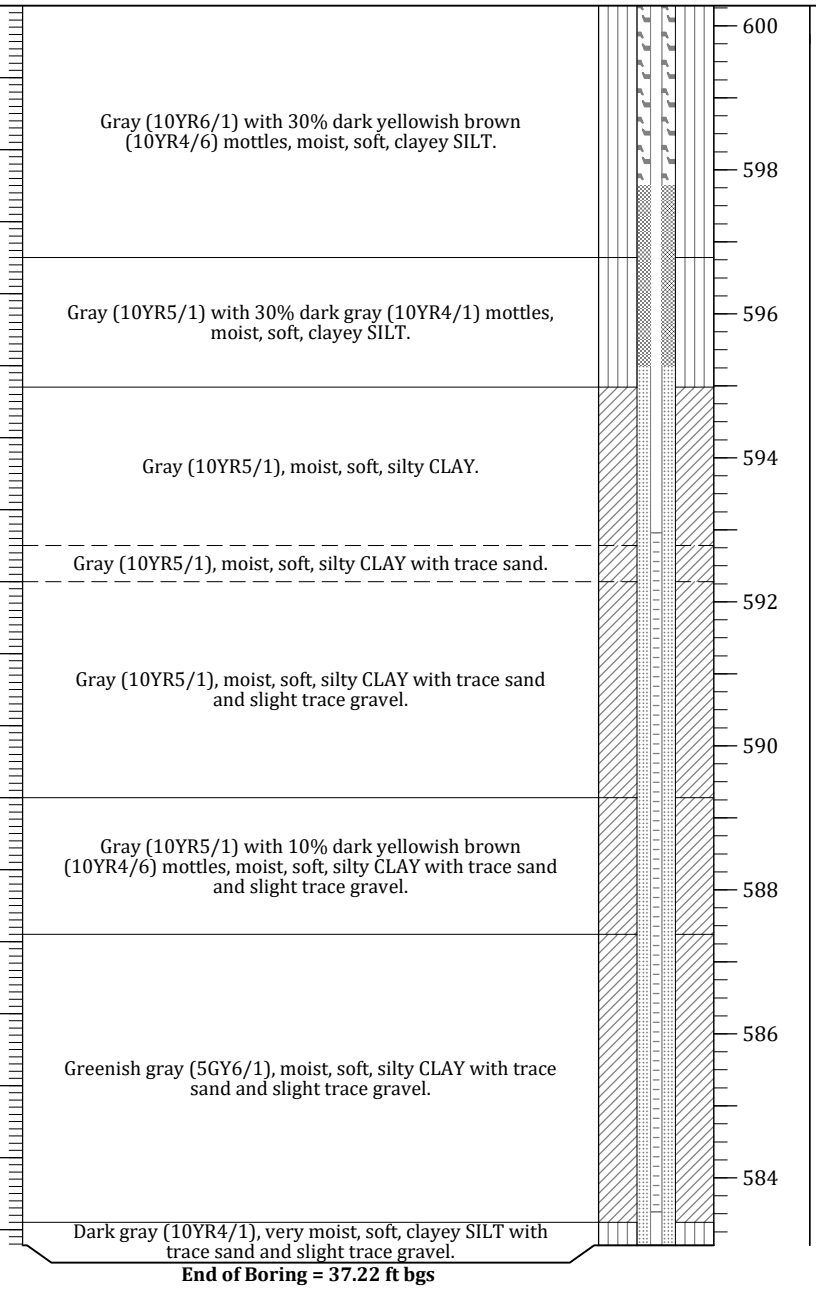
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: G54a
Well ID: G54L
Surface Elev: 620.28 ft. MSL
Completion: 37.22 ft. BGS
Station: 14,664.37N
463.80E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL



End of Boring = 37.22 ft bgs

Borehole Detail | Remarks

NOTE(S): See G54S Boring log for sample and testing data.

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/12/2009
Finish: 2/12/2009
WEATHER: cold, sunny, windy, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G54~~
Well ID: G54S
Surface Elev: 620.28 ft. MSL
Completion: 48.41 ft. BGS
Station: 14,664.84N
460.47E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 44.20 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	22/24 92%	ss	3-2 2-2 N=4	25		
2A	18/24 75%	ss	1-2 3-3 N=5	23		
3A	20/24 83%	ss	1-5 8-10 N=13	17		
4A	24/24 100%	ss	8-13 13-15 N=26	18		
5A	24/24 100%	ss	4-7 10-9 N=17	16		
6A	19/24 79%	ss	2-3 6-8 N=9	18		
7A	24/24 100%	ss	8-17 15-16 N=32	16		
8A	20/24 83%	ss	2-4 4-6 N=8	22		
9A	22/24 92%	ss	5-5 9-10 N=14	22		
10A	18/24 75%	ss	1-3 3-4 N=6	23		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
0–3.5	FILL - Yellowish brown (10YR5/4) with 20% gray (10YR6/1) and 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand, trace roots.	620 – 618
3.5–5.5	FILL - Yellowish brown (10YR5/4) with 5% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand.	618 – 616
5.5–6	FILL - Yellowish brown (10YR5/4) with 5% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT with slight trace sand.	616 – 614
6–14	FILL - Yellowish brown (10YR5/4), moist, firm, clayey SILT with trace sand and slight trace gravel.	614 – 606
14–18	Dark yellowish brown (10YR4/4) with 20% gray (10YR6/1) mottles, moist, firm, clayey SILT with slight trace sand, trace roots.	606 – 602
18–20	Yellowish brown (10YR5/6) with 10% gray (10YR6/1) mottles, moist, friable, clayey SILT.	602

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/12/2009
Finish: 2/12/2009
WEATHER: cold, sunny, windy, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G54
Well ID: G54S
Surface Elev: 620.28 ft. MSL
Completion: 48.41 ft. BGS
Station: 14,664.84N
460.47E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 44.20 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	19/24 79%	ss	1-2 1-3 N=3	28		
12A	20/24 83%	ss	4-5 5-4 N=10	25		
13A	19/24 79%	ss	2-2 3-4 N=5	23		
13B				24		
14A	20/24 83%	ss	4-4 4-5 N=8	27		
15A	14/24 58%	ss	woh-2 4-4 N=6	20		
16A	22/24 92%	ss	1-2 4-8 N=6	24		
17A	20/24 83%	ss	4-4 7-8 N=11	21		
18A	16/24 67%	ss	woh-1 2-3 N=3	14		
19A	14/24 58%	ss	woh-3 3-6 N=6	15		
20A	23/24 96%	ss	woh-3 4-5 N=7	13		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	600	
22		598	
24	Gray (10YR5/1) with 30% dark gray (10YR4/1) mottles, moist, soft, clayey SILT.	596	
26	Gray (10YR5/1), moist, soft, silty CLAY.	594	
28	Gray (10YR5/1), moist, soft, silty CLAY with trace sand.	592	
30	Gray (10YR5/1), moist, soft, silty CLAY with trace sand and slight trace gravel.	590	
32	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	588	
34	Greenish gray (5GY6/1), moist, soft, silty CLAY with trace sand and slight trace gravel.	586	
36		584	
38	Dark gray (10YR4/1), very moist, soft, clayey SILT with trace sand and slight trace gravel.	582	
40	Dark gray (10YR4/1), moist, soft, clayey SILT with trace sand and slight trace gravel.		

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/12/2009
Finish: 2/12/2009
WEATHER: cold, sunny, windy, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G54
Well ID: G54S
Surface Elev: 620.28 ft. MSL
Completion: 48.41 ft. BGS
Station: 14,664.84N
460.47E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 44.20 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
21A	20/24 83%	SS	1-3 5-7 N=8	14		
21B				32		
22A	20/24 83%	SS	5-7 7-9 N=14	28		
23A	20/24 83%	SS	2-4 8-7 N=12	16		
23B				12		
24A	22/24 92%	SS	7-10 13-17 N=23	19		
24B				13		
	0/5 0%	BD				

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	Dark gray (10YR4/1), moist, soft, clayey SILT with trace sand and slight trace gravel. *[Continued from previous page]*	580	
42	Dark gray (10YR4/1) with 20% gray (10YR5/1) mottles, very moist, soft, clayey SILT.	578	
	Dark gray (10YR4/1) with 20% gray (10YR5/1) mottles, moist, soft, clayey SILT.		
▼ 44	Dark gray (N4/1), wet, medium dense, silty fine- to coarse-grained SAND.	576	
	Dark gray (10YR4/1), moist, firm, clayey SILT with trace sand and slight trace gravel.		
46	Dark gray (N4/1), wet, medium dense, silty fine- to coarse-grained SAND.	574	
48	Dark gray (10YR4/1), moist, firm, clayey SILT with trace sand and slight trace gravel.	572	

End of Boring = 48.41 ft bgs

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/12/2009
Finish: 2/12/2009
WEATHER: cold, sunny, windy, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G54~~
Well ID: G54S
Surface Elev: 620.28 ft. MSL
Completion: 48.41 ft. BGS
Station: 14,664.84N
460.47E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 44.20 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	22/24 92%	ss	3-2 2-2 N=4	25		
2A	18/24 75%	ss	1-2 3-3 N=5	23		
3A	20/24 83%	ss	1-5 8-10 N=13	17		
4A	24/24 100%	ss	8-13 13-15 N=26	18		
5A	24/24 100%	ss	4-7 10-9 N=17	16		
6A	19/24 79%	ss	2-3 6-8 N=9	18		
7A	24/24 100%	ss	8-17 15-16 N=32	16		
8A	20/24 83%	ss	2-4 4-6 N=8	22		
9A	22/24 92%	ss	5-5 9-10 N=14	22		
10A	18/24 75%	ss	1-3 3-4 N=6	23		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
0–3.5	FILL - Yellowish brown (10YR5/4) with 20% gray (10YR6/1) and 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand, trace roots.	620 – 618
3.5–5.5	FILL - Yellowish brown (10YR5/4) with 5% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand.	618 – 616
5.5–6	FILL - Yellowish brown (10YR5/4) with 5% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT with slight trace sand.	616 – 614
6–14	FILL - Yellowish brown (10YR5/4), moist, firm, clayey SILT with trace sand and slight trace gravel.	614 – 606
14–18	Dark yellowish brown (10YR4/4) with 20% gray (10YR6/1) mottles, moist, firm, clayey SILT with slight trace sand, trace roots.	606 – 602
18–20	Yellowish brown (10YR5/6) with 10% gray (10YR6/1) mottles, moist, friable, clayey SILT.	602

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/12/2009
Finish: 2/12/2009
WEATHER: cold, sunny, windy, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G54
Well ID: G54S
Surface Elev: 620.28 ft. MSL
Completion: 48.41 ft. BGS
Station: 14,664.84N
460.47E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 44.20 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	19/24 79%	ss	1-2 1-3 N=3	28		
12A	20/24 83%	ss	4-5 5-4 N=10	25		
13A	19/24 79%	ss	2-2 3-4 N=5	23		
13B				24		
14A	20/24 83%	ss	4-4 4-5 N=8	27		
15A	14/24 58%	ss	woh-2 4-4 N=6	20		
16A	22/24 92%	ss	1-2 4-8 N=6	24		
17A	20/24 83%	ss	4-4 7-8 N=11	21		
18A	16/24 67%	ss	woh-1 2-3 N=3	14		
19A	14/24 58%	ss	woh-3 3-6 N=6	15		
20A	23/24 96%	ss	woh-3 4-5 N=7	13		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	600	
22		598	
24	Gray (10YR5/1) with 30% dark gray (10YR4/1) mottles, moist, soft, clayey SILT.	596	
26	Gray (10YR5/1), moist, soft, silty CLAY.	594	
28	Gray (10YR5/1), moist, soft, silty CLAY with trace sand.	592	
30	Gray (10YR5/1), moist, soft, silty CLAY with trace sand and slight trace gravel.	590	
32	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	588	
34	Greenish gray (5GY6/1), moist, soft, silty CLAY with trace sand and slight trace gravel.	586	
36		584	
38	Dark gray (10YR4/1), very moist, soft, clayey SILT with trace sand and slight trace gravel.	582	
40	Dark gray (10YR4/1), moist, soft, clayey SILT with trace sand and slight trace gravel.		

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/12/2009
Finish: 2/12/2009
WEATHER: cold, sunny, windy, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G54
Well ID: G54S
Surface Elev: 620.28 ft. MSL
Completion: 48.41 ft. BGS
Station: 14,664.84N
460.47E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 44.20 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
21A	20/24 83%	SS	1-3 5-7 N=8	14		
21B				32		
22A	20/24 83%	SS	5-7 7-9 N=14	28		
23A	20/24 83%	SS	2-4 8-7 N=12	16		
23B				12		
24A	22/24 92%	SS	7-10 13-17 N=23	19		
24B				13		
	0/5 0%	BD				

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	Dark gray (10YR4/1), moist, soft, clayey SILT with trace sand and slight trace gravel. *[Continued from previous page]*	580	
42	Dark gray (10YR4/1) with 20% gray (10YR5/1) mottles, very moist, soft, clayey SILT.	578	
	Dark gray (10YR4/1) with 20% gray (10YR5/1) mottles, moist, soft, clayey SILT.		
▼ 44	Dark gray (N4/1), wet, medium dense, silty fine- to coarse-grained SAND.	576	
	Dark gray (10YR4/1), moist, firm, clayey SILT with trace sand and slight trace gravel.		
46	Dark gray (N4/1), wet, medium dense, silty fine- to coarse-grained SAND.	574	
48	Dark gray (10YR4/1), moist, firm, clayey SILT with trace sand and slight trace gravel.	572	

End of Boring = 48.41 ft bgs

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/19/2009
Finish: 2/19/2009
WEATHER: cold, sunny, windy, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: ~~G55a~~
Well ID: G55L
Surface Elev: 619.78 ft. MSL
Completion: 36.60 ft. BGS
Station: 14,667.70N
705.07E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
							0	FILL - Yellowish brown (10YR5/4) with 15% dark yellowish brown (10YR4/6) and 5% gray (10YR6/1) mottles, moist, soft, clayey SILT with slight trace sand.	618
							2	FILL - Yellowish brown (10YR5/4) with 5% gray (10YR5/1) mottles, moist, soft, silty CLAY with slight trace sand and gravel.	616
							4		614
							6	FILL - Yellowish brown (10YR5/4) with 15% dark yellowish brown (10YR4/6) and 10% gray (10YR6/1) mottles, moist, firm, clayey SILT.	612
							8	FILL - Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	610
							10	FILL - Yellowish brown (10YR5/4) with 30% gray (10YR5/1) mottles, slightly moist, firm, clayey SILT with slight trace sand.	608
							12	FILL - Yellowish brown (10YR5/4) with 30% gray (10YR5/1) mottles, slightly moist, firm, clayey SILT with slight trace sand and gravel.	606
							14	Very dark grayish brown (10YR3/2), slightly moist, hard, clayey SILT with slight trace sand and trace roots.	604
							16	Yellowish brown (10YR5/6) with 10% gray (10YR5/1) mottles, moist, firm, silty CLAY.	602
							18	Light brownish gray (10YR6/2) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	600
							20	Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	

Borehole Detail

Remarks

NOTE(S): See G55S Boring log for sample and testing data.

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/19/2009
Finish: 2/19/2009
WEATHER: cold, sunny, windy, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: G55a
Well ID: G55L
Surface Elev: 619.78 ft. MSL
Completion: 36.60 ft. BGS
Station: 14,667.70N
705.07E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
							22	Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	598	
							24	Gray (10YR5/1) with 10% dark gray (10YR4/1) mottles, moist, soft, clayey SILT.	596	
							26		594	
							28	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with slight trace sand and gravel.	592	
							30		590	
							32	Greenish gray (5GY5/1), moist, soft, silty CLAY with trace sand and slight trace gravel.	588	
								Greenish gray (5GY6/1), moist, soft, sandy CLAY with slight trace gravel.		
								Medium light gray (N6/1), moist, soft, sandy CLAY with slight trace gravel.	586	
							34	Medium light gray (N6/1), wet, soft, silty, very fine- to medium-grained SAND.		
								Greenish gray (10Y6/1), very moist, soft, clayey SILT with slight trace sand and gravel.	584	
							36	Gray (N6/1), very moist, soft, sandy CLAY with slight trace gravel.		

End of Boring = 36.6 ft bgs

NOTE(S): See G55S Boring log for sample and testing data.

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/19/2009
Finish: 2/19/2009
WEATHER: cold, sunny, windy, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G55~~
Well ID: G55S
Surface Elev: 619.78 ft. MSL
Completion: 45.96 ft. BGS
Station: 14,663.87N
705.03E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 41.80 - during drilling
▼ = 39.43 - 02/19/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
1A	24/24 100%	ss	2-3 4-3 N=7	19			2	FILL - Yellowish brown (10YR5/4) with 15% dark yellowish brown (10YR4/6) and 5% gray (10YR6/1) mottles, moist, soft, clayey SILT with slight trace sand.	618	
2A	17/24 71%	ss	2-3 2-2 N=5	20			4	FILL - Yellowish brown (10YR5/4) with 5% gray (10YR5/1) mottles, moist, soft, silty CLAY with slight trace sand and gravel.	616	
3A	12/24 50%	ss	woh-2 3-4 N=5	15			6		614	
4A	24/24 100%	ss	6-8 12-11 N=20	15			8	FILL - Yellowish brown (10YR5/4) with 15% dark yellowish brown (10YR4/6) and 10% gray (10YR6/1) mottles, moist, firm, clayey SILT.	612	
5A	24/24 100%	ss	4-3 3-5 N=6	18				FILL - Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.		
5B				17			10	FILL - Yellowish brown (10YR5/4) with 30% gray (10YR5/1) mottles, slightly moist, firm, clayey SILT with slight trace sand.	610	
6A	22/24 92%	ss	1-2 6-8 N=8	19			12	FILL - Yellowish brown (10YR5/4) with 30% gray (10YR5/1) mottles, slightly moist, firm, clayey SILT with slight trace sand and gravel.	608	
7A	24/24 100%	ss	6-8 18-19 N=26	17			14	Very dark grayish brown (10YR3/2), slightly moist, hard, clayey SILT with slight trace sand and trace roots.	606	
8A	20/24 83%	ss	2-5 5-7 N=10	24			16	Yellowish brown (10YR5/6) with 10% gray (10YR5/1) mottles, moist, firm, silty CLAY.	604	
9A	22/24 92%	ss	10-9 11-11 N=20	24						
9B				23			18	Light brownish gray (10YR6/2) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	602	
10A	18/24 75%	ss	2-4 4-5 N=8	22			20	Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	600	

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/19/2009
Finish: 2/19/2009
WEATHER: cold, sunny, windy, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G55
Well ID: G55S
Surface Elev: 619.78 ft. MSL
Completion: 45.96 ft. BGS
Station: 14,663.87N
705.03E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 41.80 - during drilling
▼ = 39.43 - 02/19/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	18/24 75%	ss	1-2 2-4 N=4	25		
12A	23/24 96%	ss	4-4 5-5 N=9	26		
13A	17/24 71%	ss	woh-2 3-3 N=5	21		
14A	22/24 92%	ss	3-3 4-5 N=7	25		
15A	24/24 100%	ss	woh-2 2-3 N=4	30		
16A	20/24 83%	ss	woh-1 3-4 N=4	25		
16B				22		
17A				24		
17B	12/24 50%	ss	2-3 4-4 N=7	16		
18A	11/24 46%	ss	1-3 5-4 N=8	16		
19A	17/24 71%	ss	2-5 6-7 N=11	14		
20A	19/24 79%	ss	3-8 11-7 N=19	11		
20B				19		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
22	Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	598
24	Gray (10YR5/1) with 10% dark gray (10YR4/1) mottles, moist, soft, clayey SILT.	596
26		594
28	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with slight trace sand and gravel.	592
30		590
32	Greenish gray (5GY5/1), moist, soft, silty CLAY with trace sand and slight trace gravel.	588
	Greenish gray (5GY6/1), moist, soft, sandy CLAY with slight trace gravel.	
	Medium light gray (N6/1), moist, soft, sandy CLAY with slight trace gravel.	586
34	Medium light gray (N6/1), wet, soft, silty, very fine- to medium-grained SAND.	
	Greenish gray (10Y6/1), very moist, soft, clayey SILT with slight trace sand and gravel.	584
36	Gray (N6/1), very moist, soft, sandy CLAY with slight trace gravel.	582
38	Gray (N5/1), slightly moist, firm, clayey SILT with slight trace sand and gravel.	
▼	Gray (N5/1), moist, firm, SILT.	580
40		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/19/2009
Finish: 2/19/2009
WEATHER: cold, sunny, windy, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G55
Well ID: G55S
Surface Elev: 619.78 ft. MSL
Completion: 45.96 ft. BGS
Station: 14,663.87N
705.03E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 41.80 - during drilling
▼ = 39.43 - 02/19/09
▽ =

SAMPLE Number	Recov / Total (in) % *Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
21A	18/24 *75%*	ss	*5-8* *10-19* N=18	36				Gray (N5/1), moist, firm, SILT. *[Continued from previous page]*		
21B				16						
							42	Gray (N5/1), wet, dense, silty very fine- to medium-grained SAND.	578	
22A	18/24 *75%*	ss	*6-13* *21-15* N=34	11						
22B				10						
							44	Gray (N5/1), slightly moist, hard, clayey SILT with slight trace sand and gravel.	576	
23A	20/24 *83%*	ss	*6-9* *13-12* N=22	12						
									574	

End of Boring = 45.96 ft bgs

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/19/2009
Finish: 2/19/2009
WEATHER: cold, sunny, windy, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G55~~
Well ID: G55S
Surface Elev: 619.78 ft. MSL
Completion: 45.96 ft. BGS
Station: 14,663.87N
705.03E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 41.80 - during drilling
▼ = 39.43 - 02/19/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
1A	24/24 100%	ss	2-3 4-3 N=7	19			2	FILL - Yellowish brown (10YR5/4) with 15% dark yellowish brown (10YR4/6) and 5% gray (10YR6/1) mottles, moist, soft, clayey SILT with slight trace sand.	618	
2A	17/24 71%	ss	2-3 2-2 N=5	20			4	FILL - Yellowish brown (10YR5/4) with 5% gray (10YR5/1) mottles, moist, soft, silty CLAY with slight trace sand and gravel.	616	
3A	12/24 50%	ss	woh-2 3-4 N=5	15			6		614	
4A	24/24 100%	ss	6-8 12-11 N=20	15			8	FILL - Yellowish brown (10YR5/4) with 15% dark yellowish brown (10YR4/6) and 10% gray (10YR6/1) mottles, moist, firm, clayey SILT.	612	
5A	24/24 100%	ss	4-3 3-5 N=6	18				FILL - Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.		
5B				17			10	FILL - Yellowish brown (10YR5/4) with 30% gray (10YR5/1) mottles, slightly moist, firm, clayey SILT with slight trace sand.	610	
6A	22/24 92%	ss	1-2 6-8 N=8	19			12	FILL - Yellowish brown (10YR5/4) with 30% gray (10YR5/1) mottles, slightly moist, firm, clayey SILT with slight trace sand and gravel.	608	
7A	24/24 100%	ss	6-8 18-19 N=26	17			14	Very dark grayish brown (10YR3/2), slightly moist, hard, clayey SILT with slight trace sand and trace roots.	606	
8A	20/24 83%	ss	2-5 5-7 N=10	24			16	Yellowish brown (10YR5/6) with 10% gray (10YR5/1) mottles, moist, firm, silty CLAY.	604	
9A	22/24 92%	ss	10-9 11-11 N=20	24						
9B				23			18	Light brownish gray (10YR6/2) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	602	
10A	18/24 75%	ss	2-4 4-5 N=8	22			20	Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	600	

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/19/2009
Finish: 2/19/2009
WEATHER: cold, sunny, windy, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G55
Well ID: G55S
Surface Elev: 619.78 ft. MSL
Completion: 45.96 ft. BGS
Station: 14,663.87N
705.03E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 41.80 - during drilling
▼ = 39.43 - 02/19/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	18/24 75%	ss	1-2 2-4 N=4	25		
12A	23/24 96%	ss	4-4 5-5 N=9	26		
13A	17/24 71%	ss	woh-2 3-3 N=5	21		
14A	22/24 92%	ss	3-3 4-5 N=7	25		
15A	24/24 100%	ss	woh-2 2-3 N=4	30		
16A	20/24 83%	ss	woh-1 3-4 N=4	25		
16B				22		
17A				24		
17B	12/24 50%	ss	2-3 4-4 N=7	16		
18A	11/24 46%	ss	1-3 5-4 N=8	16		
19A	17/24 71%	ss	2-5 6-7 N=11	14		
20A	19/24 79%	ss	3-8 11-7 N=19	11		
20B				19		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
22	Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	598
24	Gray (10YR5/1) with 10% dark gray (10YR4/1) mottles, moist, soft, clayey SILT.	596
26		594
28	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with slight trace sand and gravel.	592
30		590
32	Greenish gray (5GY5/1), moist, soft, silty CLAY with trace sand and slight trace gravel.	588
	Greenish gray (5GY6/1), moist, soft, sandy CLAY with slight trace gravel.	
	Medium light gray (N6/1), moist, soft, sandy CLAY with slight trace gravel.	586
34	Medium light gray (N6/1), wet, soft, silty, very fine- to medium-grained SAND.	
	Greenish gray (10Y6/1), very moist, soft, clayey SILT with slight trace sand and gravel.	584
36	Gray (N6/1), very moist, soft, sandy CLAY with slight trace gravel.	582
38	Gray (N5/1), slightly moist, firm, clayey SILT with slight trace sand and gravel.	
▼	Gray (N5/1), moist, firm, SILT.	580
40		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/19/2009
Finish: 2/19/2009
WEATHER: cold, sunny, windy, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G55
Well ID: G55S
Surface Elev: 619.78 ft. MSL
Completion: 45.96 ft. BGS
Station: 14,663.87N
705.03E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 41.80 - during drilling
▼ = 39.43 - 02/19/09
▽ =

SAMPLE Number	Recov / Total (in) % *Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
21A	18/24 *75%*	ss	*5-8* *10-19* N=18	36				Gray (N5/1), moist, firm, SILT. *[Continued from previous page]*		
21B				16						
							42	Gray (N5/1), wet, dense, silty very fine- to medium-grained SAND.	578	
22A	18/24 *75%*	ss	*6-13* *21-15* N=34	11						
22B				10						
							44	Gray (N5/1), slightly moist, hard, clayey SILT with slight trace sand and gravel.	576	
23A	20/24 *83%*	ss	*6-9* *13-12* N=22	12						
									574	

End of Boring = 45.96 ft bgs

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/16/2009
Finish: 2/16/2009
WEATHER: cool, sunny, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: ~~G56a~~
Well ID: G56L
Surface Elev: 619.91 ft. MSL
Completion: 22.89 ft. BGS
Station: 14,708.56N
979.20E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
							2	FILL - Yellowish brown (10YR5/4) with 15% gray (10YR6/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand and gravel.	618	
							4		616	
							6		614	
							8	FILL - Yellowish brown (10YR5/4) with 15% gray (10YR6/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT with slight trace sand and gravel.	612	
							10		610	
							12	Grayish brown (10YR5/2) with 20% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT.	608	
							14	Light brownish gray (10YR6/2) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	606	
							16	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	604	
							18	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	602	
							20	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	600	

NOTE(S): See G56S Boring log for sample and testing data.

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/16/2009
Finish: 2/16/2009
WEATHER: cool, sunny, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: G56a
Well ID: G56L
Surface Elev: 619.91 ft. MSL
Completion: 22.89 ft. BGS
Station: 14,708.56N
979.20E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
								Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.			
							22	Dark grayish brown (10YR4/2), moist, soft, clayey SILT.		598	

End of Boring = 22.89 ft bgs

NOTE(S): See G56S Boring log for sample and testing data.

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/16/2009
Finish: 2/16/2009
WEATHER: cool, sunny, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G56~~
Well ID: G56S
Surface Elev: 619.91 ft. MSL
Completion: 40.00 ft. BGS
Station: 14,704.98N
978.76E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 33.20 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	22/24 92%	ss	3-3 4-6 N=7	20		
2A	24/24 100%	ss	6-6 6-7 N=12	16		
3A	20/24 83%	ss	1-4 7-7 N=11	15		
4A	22/24 92%	ss	9-10 11-13 N=21	19		
5A	20/24 83%	ss	1-4 6-8 N=10	19		
6A	22/24 92%	ss	2-4 8-8 N=12	27		
7A	24/24 100%	ss	9-15 13-13 N=28	26		
8A	16/24 67%	ss	1-1 2-3 N=3	30		
9A	22/24 92%	ss	3-3 5-6 N=8	23		
10A	19/24 79%	ss	1-3 3-2 N=6	24		
	22/24		1-3			

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
2	FILL - Yellowish brown (10YR5/4) with 15% gray (10YR6/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand and gravel.	618
4		616
6		614
8	FILL - Yellowish brown (10YR5/4) with 15% gray (10YR6/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT with slight trace sand and gravel.	612
10		610
12	Grayish brown (10YR5/2) with 20% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT.	608
14	Light brownish gray (10YR6/2) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	606
16	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	604
18	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	602
	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	
20	Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	600

Borehole Detail

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/16/2009
Finish: 2/16/2009
WEATHER: cool, sunny, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G56
Well ID: G56S
Surface Elev: 619.91 ft. MSL
Completion: 40.00 ft. BGS
Station: 14,704.98N
978.76E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 33.20 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	92%	ss	5-6 N=8	24		
12A	16/24 67%	ss	4-4 5-5 N=9	24		
13A	20/24 83%	ss	woh-2 2-3 N=4	23		
14A	18/24 75%	ss	woh-2 3-4 N=5	23		
15A	19/24 79%	ss	woh-1 2-3 N=3	20		
16A	18/24 75%	ss	woh-1 2-2 N=3	15		
17A	16/24 67%	ss	4-4 6-8 N=10	15		
18A	13/24 54%	ss	0-3 5-6 N=8	17		
19A	20/24 83%	ss	2-4 7-5 N=11	24		
20A	19/24 79%	ss	woh-4 7-7 N=11	11		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT. *[Continued from previous page]*	
22		598
	Dark grayish brown (10YR4/2), moist, soft, clayey SILT.	
24		596
	Grayish brown (10YR5/2) with 5% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand.	
26		594
28		592
	Dark greenish gray (5GY4/1), moist, soft, sandy CLAY with slight trace gravel.	
30		590
	Greenish gray (5GY5/1), moist, soft, sandy CLAY with slight trace gravel.	
32		588
▼	Gray (10YR5/1), wet, medium dense, silty fine- to coarse-grained SAND with slight trace gravel.	
34		586
	Greenish gray (10Y6/1), slightly moist, firm, clayey SILT with trace sand and slight trace gravel.	
36		584
	Greenish gray (10Y6/1), wet, medium dense, SILT with trace clay.	
38	Greenish gray (10Y6/1), slightly moist, firm, clayey SILT with trace sand and slight trace gravel.	582
	Gray (10YR5/1), slightly moist, firm, clayey SILT with trace sand and slight trace gravel.	
40		580

End of Boring = 40.0 ft bgs

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/16/2009
Finish: 2/16/2009
WEATHER: cool, sunny, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G56~~
Well ID: G56S
Surface Elev: 619.91 ft. MSL
Completion: 40.00 ft. BGS
Station: 14,704.98N
978.76E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 33.20 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	22/24 92%	ss	3-3 4-6 N=7	20		
2A	24/24 100%	ss	6-6 6-7 N=12	16		
3A	20/24 83%	ss	1-4 7-7 N=11	15		
4A	22/24 92%	ss	9-10 11-13 N=21	19		
5A	20/24 83%	ss	1-4 6-8 N=10	19		
6A	22/24 92%	ss	2-4 8-8 N=12	27		
7A	24/24 100%	ss	9-15 13-13 N=28	26		
8A	16/24 67%	ss	1-1 2-3 N=3	30		
9A	22/24 92%	ss	3-3 5-6 N=8	23		
10A	19/24 79%	ss	1-3 3-2 N=6	24		
	22/24		1-3			

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
2	FILL - Yellowish brown (10YR5/4) with 15% gray (10YR6/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand and gravel.	618
4		616
6		614
8	FILL - Yellowish brown (10YR5/4) with 15% gray (10YR6/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT with slight trace sand and gravel.	612
10		610
12	Grayish brown (10YR5/2) with 20% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT.	608
14	Light brownish gray (10YR6/2) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	606
16	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	604
18	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	602
	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	
20	Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	600

Borehole Detail

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/16/2009
Finish: 2/16/2009
WEATHER: cool, sunny, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G56
Well ID: G56S
Surface Elev: 619.91 ft. MSL
Completion: 40.00 ft. BGS
Station: 14,704.98N
978.76E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 33.20 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	92%	ss	5-6 N=8	24		
12A	16/24 67%	ss	4-4 5-5 N=9	24		
13A	20/24 83%	ss	woh-2 2-3 N=4	23		
14A	18/24 75%	ss	woh-2 3-4 N=5	23		
15A	19/24 79%	ss	woh-1 2-3 N=3	20		
16A	18/24 75%	ss	woh-1 2-2 N=3	15		
17A	16/24 67%	ss	4-4 6-8 N=10	15		
18A	13/24 54%	ss	0-3 5-6 N=8	17		
19A	20/24 83%	ss	2-4 7-5 N=11	24		
20A	19/24 79%	ss	woh-4 7-7 N=11	11		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT. *[Continued from previous page]*	
22		598
	Dark grayish brown (10YR4/2), moist, soft, clayey SILT.	
24		596
	Grayish brown (10YR5/2) with 5% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand.	
26		594
28		592
	Dark greenish gray (5GY4/1), moist, soft, sandy CLAY with slight trace gravel.	
30		590
	Greenish gray (5GY5/1), moist, soft, sandy CLAY with slight trace gravel.	
32		588
▼	Gray (10YR5/1), wet, medium dense, silty fine- to coarse-grained SAND with slight trace gravel.	
34		586
	Greenish gray (10Y6/1), slightly moist, firm, clayey SILT with trace sand and slight trace gravel.	
36		584
	Greenish gray (10Y6/1), wet, medium dense, SILT with trace clay.	
38	Greenish gray (10Y6/1), slightly moist, firm, clayey SILT with trace sand and slight trace gravel.	582
	Gray (10YR5/1), slightly moist, firm, clayey SILT with trace sand and slight trace gravel.	
40		580

End of Boring = 40.0 ft bgs

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/30/2009
Finish: 1/30/2009
WEATHER: cold, sunny, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G57a~~
Well ID: G57L
Surface Elev: 619.98 ft. MSL
Completion: 26.00 ft. BGS
Station: 15,064.65N
987.47E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
							2	FILL - Yellowish brown (10YR5/4) with 20% dark yellowish brown (10YR4/6) and 5% very dark brown (10YR2/2) mottles, slightly moist, firm, clayey SILT.	618
							4		616
							6	FILL - Yellowish brown (10YR5/4) with 20% dark yellowish brown (10YR4/6) and 5% very dark brown (10YR2/2) mottles, moist, firm, clayey SILT with slight trace gravel, slight trace iron staining (10YR5/6) visible.	614
							8		612
							10	FILL - Dark yellowish brown (10YR4/6), moist, firm, silty CLAY.	610
							12	Dark gray (10YR4/1), moist, firm, silty CLAY with trace gravel.	608
							14	Dark grayish brown (10YR4/2) with gray (10YR5/1) mottles, moist, firm, clayey SILT with trace gravel.	606
							16	Dark yellowish brown (10YR3/6), moist, firm, silty CLAY.	604
							18	Light yellowish brown (10YR6/4), slightly moist, firm, clayey SILT, with trace iron staining (10YR4/6) visible.	602
							20	Dark grayish brown (10YR4/2), moist, firm, clayey SILT.	600

Borehole Detail

Remarks

NOTE(S): See G57S Boring log for sample and testing data.

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/30/2009
Finish: 1/30/2009
WEATHER: cold, sunny, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G57a
Well ID: G57L
Surface Elev: 619.98 ft. MSL
Completion: 26.00 ft. BGS
Station: 15,064.65N
987.47E

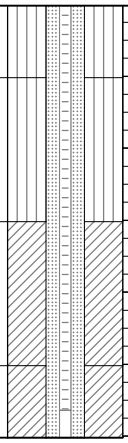
TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
								Dark grayish brown (10YR4/2), moist, firm, clayey SILT. *[Continued from previous page]*	
							22	Grayish brown (10YR5/2), moist, firm, clayey SILT, with trace iron staining (10YR5/6) visible.	598
							24	Dark brown (10YR3/3), moist, firm, silty CLAY.	596
							26	Dark yellowish brown (10YR3/6) with 40% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY.	594

End of Boring = 26.00 ft bgs

Borehole Detail



Remarks

NOTE(S): See G57S Boring log for sample and testing data.

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/30/2009
Finish: 1/30/2009
WEATHER: cold, sunny, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G57~~
Well ID: G57S
Surface Elev: 619.98 ft. MSL
Completion: 38.00 ft. BGS
Station: 15,060.26N
987.45E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	ss	13-8 5-3 N=13	25		
2A	20/24 83%	ss	3-3 5-4 N=8	19		
3A	24/24 100%	ss	3-3 4-5 N=7	17		
4A	24/24 100%	ss	8-5 5-8 N=10	20		
5A	22/24 92%	ss	1-3 3-3 N=6	22		
6A	16/24 67%	ss	3-3 7-6 N=10	17		
7A	24/24 100%	ss	5-6 7-6 N=13	22		
7B				20		
8A	22/24 92%	ss	5-5 7-5 N=12	22		
9A	24/24 100%	ss	9-10 8-6 N=18	24		
10A	24/24 100%	ss	1-2 4-4 N=6	27		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
2	FILL - Yellowish brown (10YR5/4) with 20% dark yellowish brown (10YR4/6) and 5% very dark brown (10YR2/2) mottles, slightly moist, firm, clayey SILT.	618
4		616
6	FILL - Yellowish brown (10YR5/4) with 20% dark yellowish brown (10YR4/6) and 5% very dark brown (10YR2/2) mottles, moist, firm, clayey SILT with slight trace gravel, slight trace iron staining (10YR5/6) visible.	614
8		612
10	FILL - Dark yellowish brown (10YR4/6), moist, firm, silty CLAY.	610
12	Dark gray (10YR4/1), moist, firm, silty CLAY with trace gravel.	608
14	Dark grayish brown (10YR4/2) with gray (10YR5/1) mottles, moist, firm, clayey SILT with trace gravel.	606
16	Dark yellowish brown (10YR3/6), moist, firm, silty CLAY.	604
18	Light yellowish brown (10YR6/4), slightly moist, firm, clayey SILT, with trace iron staining (10YR4/6) visible.	602
20	Dark grayish brown (10YR4/2), moist, firm, clayey SILT.	600

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/30/2009
Finish: 1/30/2009
WEATHER: cold, sunny, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G57
Well ID: G57S
Surface Elev: 619.98 ft. MSL
Completion: 38.00 ft. BGS
Station: 15,060.26N
987.45E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	24/24 100%	ss	1-3 5-3 N=8	25		
12A	24/24 100%	ss	1-3 5-4 N=8	25		
13A	23/24 96%	ss	0-2 2-3 N=4	26		
14A	24/24 100%	ss	2-3 3-6 N=6	26		
15A	24/24 100%	ss	1-2 3-5 N=5	23		
16A	24/24 100%	ss	1-2 5-3 N=7	14		
16B				18		
17A	23/24 96%	ss	6-8 10-4 N=18	16		
17B				14		
18A	22/24 92%	ss	1-3 5-8 N=8	11		
19A	18/24 75%	ss	5-13 17-15 N=30	11		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark grayish brown (10YR4/2), moist, firm, clayey SILT. *[Continued from previous page]*	
22	Grayish brown (10YR5/2), moist, firm, clayey SILT, with trace iron staining (10YR5/6) visible.	598
24	Dark brown (10YR3/3), moist, firm, silty CLAY.	596
26	Dark yellowish brown (10YR3/6) with 40% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY.	594
28	Dark yellowish brown (10YR4/4) with 20% dark yellowish brown (10YR4/2) mottles, moist, firm, silty CLAY with slight trace sand and gravel.	592
30	Greenish gray (5G6/1), moist, soft, clayey SILT with trace sand and slight trace gravel.	590
	Greenish brown (10YR5/2), wet, soft, sandy CLAY.	
32	Yellowish brown (10YR5/4), wet, medium dense, silty, fine- to coarse-grained SAND with trace gravel.	588
	Gray (10YR5/1), wet, medium dense, silty, fine- to coarse-grained SAND with trace gravel.	
34	Gray (N5/1), wet, firm, clayey SILT with slight trace sand and gravel.	586
36		584
38		582

End of Boring = 38.00 ft bgs

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/30/2009
Finish: 1/30/2009
WEATHER: cold, sunny, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G57~~
Well ID: G57S
Surface Elev: 619.98 ft. MSL
Completion: 38.00 ft. BGS
Station: 15,060.26N
987.45E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	ss	13-8 5-3 N=13	25		
2A	20/24 83%	ss	3-3 5-4 N=8	19		
3A	24/24 100%	ss	3-3 4-5 N=7	17		
4A	24/24 100%	ss	8-5 5-8 N=10	20		
5A	22/24 92%	ss	1-3 3-3 N=6	22		
6A	16/24 67%	ss	3-3 7-6 N=10	17		
7A	24/24 100%	ss	5-6 7-6 N=13	22		
7B				20		
8A	22/24 92%	ss	5-5 7-5 N=12	22		
9A	24/24 100%	ss	9-10 8-6 N=18	24		
10A	24/24 100%	ss	1-2 4-4 N=6	27		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
2	FILL - Yellowish brown (10YR5/4) with 20% dark yellowish brown (10YR4/6) and 5% very dark brown (10YR2/2) mottles, slightly moist, firm, clayey SILT.	618
4		616
6	FILL - Yellowish brown (10YR5/4) with 20% dark yellowish brown (10YR4/6) and 5% very dark brown (10YR2/2) mottles, moist, firm, clayey SILT with slight trace gravel, slight trace iron staining (10YR5/6) visible.	614
8		612
10	FILL - Dark yellowish brown (10YR4/6), moist, firm, silty CLAY.	610
12	Dark gray (10YR4/1), moist, firm, silty CLAY with trace gravel.	608
14	Dark grayish brown (10YR4/2) with gray (10YR5/1) mottles, moist, firm, clayey SILT with trace gravel.	606
16	Dark yellowish brown (10YR3/6), moist, firm, silty CLAY.	604
18	Light yellowish brown (10YR6/4), slightly moist, firm, clayey SILT, with trace iron staining (10YR4/6) visible.	602
20	Dark grayish brown (10YR4/2), moist, firm, clayey SILT.	600

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/30/2009
Finish: 1/30/2009
WEATHER: cold, sunny, lo-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G57
Well ID: G57S
Surface Elev: 619.98 ft. MSL
Completion: 38.00 ft. BGS
Station: 15,060.26N
987.45E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	24/24 100%	ss	1-3 5-3 N=8	25		
12A	24/24 100%	ss	1-3 5-4 N=8	25		
13A	23/24 96%	ss	0-2 2-3 N=4	26		
14A	24/24 100%	ss	2-3 3-6 N=6	26		
15A	24/24 100%	ss	1-2 3-5 N=5	23		
16A	24/24 100%	ss	1-2 5-3 N=7	14		
16B				18		
17A	23/24 96%	ss	6-8 10-4 N=18	16		
17B				14		
18A	22/24 92%	ss	1-3 5-8 N=8	11		
19A	18/24 75%	ss	5-13 17-15 N=30	11		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark grayish brown (10YR4/2), moist, firm, clayey SILT. *[Continued from previous page]*	
22	Grayish brown (10YR5/2), moist, firm, clayey SILT, with trace iron staining (10YR5/6) visible.	598
24	Dark brown (10YR3/3), moist, firm, silty CLAY.	596
26	Dark yellowish brown (10YR3/6) with 40% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY.	594
28	Dark yellowish brown (10YR4/4) with 20% dark yellowish brown (10YR4/2) mottles, moist, firm, silty CLAY with slight trace sand and gravel.	592
30	Greenish gray (5G6/1), moist, soft, clayey SILT with trace sand and slight trace gravel.	590
	Greenish brown (10YR5/2), wet, soft, sandy CLAY.	
32	Yellowish brown (10YR5/4), wet, medium dense, silty, fine- to coarse-grained SAND with trace gravel.	588
	Gray (10YR5/1), wet, medium dense, silty, fine- to coarse-grained SAND with trace gravel.	
34	Gray (N5/1), wet, firm, clayey SILT with slight trace sand and gravel.	586
36		584
38		582

End of Boring = 38.00 ft bgs

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/26/2009
Finish: 1/26/2009
WEATHER: cold, overcast, mid-teen's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: ~~G58a~~
Well ID: G58L
Surface Elev: 620.04 ft. MSL
Completion: 30.56 ft. BGS
Station: 15,204.30N
989.01E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
							2	FILL - Yellowish brown (10YR5/4) with 10% dark yellowish brown (10YR4/6) and 5% gray (10YR6/1) mottles, slightly moist, firm, clayey SILT.	618
							4		616
							6	FILL - Yellowish brown (10YR5/4) with 30% gray (10YR5/1) mottles, moist, soft, clayey SILT with slight trace sand.	614
							8	FILL - Yellowish brown (10YR5/4) with 10% dark yellowish brown (10YR4/6) and 10% gray (10YR6/1) mottles, moist, firm, clayey SILT with slight trace sand.	612
							10	FILL - Gray (10YR5/1) with 40% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand.	610
							12	Yellowish brown (10YR5/4) with 20% dark yellowish brown (10YR4/6) and 10% gray (10YR6/1) mottles, moist, soft, clayey SILT.	608
							14		606
							16	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	604
							18		602
							20		

Borehole Detail

Remarks

NOTE(S): See G58S Boring log for sample and testing data.

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/26/2009
Finish: 1/26/2009
WEATHER: cold, overcast, mid-teen's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: G58a
Well ID: G58L
Surface Elev: 620.04 ft. MSL
Completion: 30.56 ft. BGS
Station: 15,204.30N
989.01E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
								Gray (10YR6/1) with 35% dark gray (10YR4/1) and 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	
							22		598
								Dark gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	
							24		596
							26	Dark gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	594
							28		592
								Gray (10YR6/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	
							30		590
								Greenish gray (5GY5/1) with 5% yellowish brown (10YR5/6) mottles, moist, soft, sandy CLAY with trace gravel.	

End of Boring = 30.56 ft bgs

Remarks

NOTE(S): See G58S Boring log for sample and testing data.

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/26/2009
Finish: 1/26/2009
WEATHER: cold, overcast, mid-teen's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G58~~
Well ID: G58S
Surface Elev: 620.04 ft. MSL
Completion: 36.43 ft. BGS
Station: 15,200.16N
989.58E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 34.20 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	ss	13-11 7-5 N=18	23		
2A	24/24 100%	ss	7-8 10-12 N=18	23		
3A	24/24 100%	ss	4-4 6-9 N=10	20		
4A	23/24 96%	ss	8-12 14-19 N=26	19		
5A	24/24 100%	ss	2-3 7-7 N=10	20		
6A	20/24 83%	ss	2-3 5-8 N=8	22		
7A	24/24 100%	ss	7-7 7-6 N=14	25		
8A	17/24 71%	ss	1-3 5-7 N=8	23		
9A	19/24 79%	ss	3-3 5-5 N=8	24		
10A	22/24 92%	ss	1-3 3-4 N=6	33		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
2	FILL - Yellowish brown (10YR5/4) with 10% dark yellowish brown (10YR4/6) and 5% gray (10YR6/1) mottles, slightly moist, firm, clayey SILT.	618
4		616
6	FILL - Yellowish brown (10YR5/4) with 30% gray (10YR5/1) mottles, moist, soft, clayey SILT with slight trace sand.	614
8	FILL - Yellowish brown (10YR5/4) with 10% dark yellowish brown (10YR4/6) and 10% gray (10YR6/1) mottles, moist, firm, clayey SILT with slight trace sand.	612
10	FILL - Gray (10YR5/1) with 40% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand.	610
12	Yellowish brown (10YR5/4) with 20% dark yellowish brown (10YR4/6) and 10% gray (10YR6/1) mottles, moist, soft, clayey SILT.	608
14		606
16	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	604
18		602
20		

Borehole Detail

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/26/2009
Finish: 1/26/2009
WEATHER: cold, overcast, mid-teen's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G58
Well ID: G58S
Surface Elev: 620.04 ft. MSL
Completion: 36.43 ft. BGS
Station: 15,200.16N
989.58E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 34.20 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	17/24 71%	ss	2-2 5-5 N=7	24		
12A	24/24 100%	ss	5-5 6-8 N=11	22		
13A	24/24 100%	ss	2-3 5-5 N=8	20		
13B				26		
14A	24/24 100%	ss	5-9 6-7 N=15	30		
15A	23/24 96%	ss	woh-2 3-4 N=5	21		
16A	24/24 100%	ss	6-8 11-7 N=19	18		
16B				16		
16C				20		
17A	20/24 83%	ss	3-6 10-3 N=16	13		
18A	23/24 96%	ss	3-6 8-12 N=14	17		
18B				14		
18C				14		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Gray (10YR6/1) with 35% dark gray (10YR4/1) and 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	
22		598
	Dark gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	
24		596
	Dark gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	
26		594
28		592
	Gray (10YR6/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	
30		590
	Greenish gray (5GY5/1) with 5% yellowish brown (10YR5/6) mottles, moist, soft, sandy CLAY with trace gravel.	
	Greenish gray (5GY5/1), very moist, dense, silty, fine-to coarse-grained SAND with trace gravel.	
32	Gray (10YR6/1), wet, firm, SILT.	588
	Greenish gray (5GY5/1), moist, firm, clayey SILT with sand and trace gravel.	
	Gray (N5/1), wet, medium dense, silty very fine- to coarse-grained SAND with trace gravel.	
	Greenish gray (5GY5/1), moist, firm, sandy CLAY with trace gravel.	
▼ 34		586
	Gray (N5/1), wet, medium dense, silty fine- to coarse-grained SAND with trace gravel.	
	Greenish gray (5GY5/1), very moist, firm, sandy CLAY with trace gravel.	
36	Dark gray (N4/1), slightly moist, hard, clayey SILT with sand and slight trace gravel.	584

End of Boring = 36.43 ft bgs

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/26/2009
Finish: 1/26/2009
WEATHER: cold, overcast, mid-teen's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G58~~
Well ID: G58S
Surface Elev: 620.04 ft. MSL
Completion: 36.43 ft. BGS
Station: 15,200.16N
989.58E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 34.20 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	ss	13-11 7-5 N=18	23		
2A	24/24 100%	ss	7-8 10-12 N=18	23		
3A	24/24 100%	ss	4-4 6-9 N=10	20		
4A	23/24 96%	ss	8-12 14-19 N=26	19		
5A	24/24 100%	ss	2-3 7-7 N=10	20		
6A	20/24 83%	ss	2-3 5-8 N=8	22		
7A	24/24 100%	ss	7-7 7-6 N=14	25		
8A	17/24 71%	ss	1-3 5-7 N=8	23		
9A	19/24 79%	ss	3-3 5-5 N=8	24		
10A	22/24 92%	ss	1-3 3-4 N=6	33		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
2	FILL - Yellowish brown (10YR5/4) with 10% dark yellowish brown (10YR4/6) and 5% gray (10YR6/1) mottles, slightly moist, firm, clayey SILT.	618
4		616
6	FILL - Yellowish brown (10YR5/4) with 30% gray (10YR5/1) mottles, moist, soft, clayey SILT with slight trace sand.	614
8	FILL - Yellowish brown (10YR5/4) with 10% dark yellowish brown (10YR4/6) and 10% gray (10YR6/1) mottles, moist, firm, clayey SILT with slight trace sand.	612
10	FILL - Gray (10YR5/1) with 40% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand.	610
12	Yellowish brown (10YR5/4) with 20% dark yellowish brown (10YR4/6) and 10% gray (10YR6/1) mottles, moist, soft, clayey SILT.	608
14		606
16	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	604
18		602
20		

Borehole Detail

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/26/2009
Finish: 1/26/2009
WEATHER: cold, overcast, mid-teen's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G58
Well ID: G58S
Surface Elev: 620.04 ft. MSL
Completion: 36.43 ft. BGS
Station: 15,200.16N
989.58E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 34.20 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	17/24 71%	ss	2-2 5-5 N=7	24		
12A	24/24 100%	ss	5-5 6-8 N=11	22		
13A	24/24 100%	ss	2-3 5-5 N=8	20		
13B				26		
14A	24/24 100%	ss	5-9 6-7 N=15	30		
15A	23/24 96%	ss	woh-2 3-4 N=5	21		
16A	24/24 100%	ss	6-8 11-7 N=19	18		
16B				16		
16C				20		
17A	20/24 83%	ss	3-6 10-3 N=16	13		
18A	23/24 96%	ss	3-6 8-12 N=14	17		
18B				14		
18C				14		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Gray (10YR6/1) with 35% dark gray (10YR4/1) and 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	
22		598
	Dark gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	
24		596
	Dark gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	
26		594
28		592
	Gray (10YR6/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	
30		590
	Greenish gray (5GY5/1) with 5% yellowish brown (10YR5/6) mottles, moist, soft, sandy CLAY with trace gravel.	
	Greenish gray (5GY5/1), very moist, dense, silty, fine-to coarse-grained SAND with trace gravel.	
32	Gray (10YR6/1), wet, firm, SILT.	588
	Greenish gray (5GY5/1), moist, firm, clayey SILT with sand and trace gravel.	
	Gray (N5/1), wet, medium dense, silty very fine- to coarse-grained SAND with trace gravel.	
	Greenish gray (5GY5/1), moist, firm, sandy CLAY with trace gravel.	
▼ 34		586
	Gray (N5/1), wet, medium dense, silty fine- to coarse-grained SAND with trace gravel.	
	Greenish gray (5GY5/1), very moist, firm, sandy CLAY with trace gravel.	
36	Dark gray (N4/1), slightly moist, hard, clayey SILT with sand and slight trace gravel.	584

End of Boring = 36.43 ft bgs

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/23/2009
Finish: 1/23/2009
WEATHER: cold, overcast, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: ~~G59a~~
Well ID: G59L
Surface Elev: 620.15 ft. MSL
Completion: 33.03 ft. BGS
Station: 15,343.87N
992.61E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
							0	FILL - Dark yellowish brown (10YR4/6) with 30% gray (10YR6/1) mottles, slightly moist, firm, clayey SILT with slight trace sand and gravel.	620
							2		618
							4	FILL - Yellowish brown (10YR5/4) with 5% gray (10YR6/1) mottles, slightly moist, hard, clayey SILT with slight trace sand and gravel	616
							6		614
							8	FILL - Yellowish brown (10YR5/4) with 10% dark yellowish brown (10YR4/6) and 5% gray (10YR6/1) mottles, moist, soft, silty CLAY, trace roots.	612
							10		610
							12	FILL - Dark grayish brown (10YR4/2), slightly moist, firm, clayey SILT with slight trace sand.	608
							14	Very dark grayish brown (10YR3/2), slightly moist, firm, clayey SILT, trace roots.	606
							16	Dark grayish brown (10YR4/2), moist, firm, silty CLAY, slight trace roots.	604
							18	Dark grayish brown (10YR4/2) with 15% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY, slight trace roots.	602
							20	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	

Borehole Detail

Remarks

NOTE(S): See G59S Boring log for sample and testing data.

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/23/2009
Finish: 1/23/2009
WEATHER: cold, overcast, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: G59a
Well ID: G59L
Surface Elev: 620.15 ft. MSL
Completion: 33.03 ft. BGS
Station: 15,343.87N
992.61E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
								Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT. *[Continued from previous page]*	600
							22	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) and 10% dark gray (10YR4/1) mottles, moist, soft, clayey SILT.	598
							24	Gray (10YR5/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with slight trace sand and gravel.	596
							26	Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	594
							28	Greenish gray (10GY6/1), moist, very soft, sandy CLAY with silt and trace gravel.	592
							30		590
							32		588

Borehole Detail

End of Boring = 33.03 ft bgs

Remarks

NOTE(S): See G59S Boring log for sample and testing data.

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/23/2009
Finish: 1/23/2009
WEATHER: cold, overcast, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G59~~
Well ID: G59S
Surface Elev: 620.15 ft. MSL
Completion: 42.49 ft. BGS
Station: 15,339.79N
992.55E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 39.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	ss	13-15 20-19 N=35	17		
2A	24/24 100%	ss	26-10 15-17 N=25	19		
3A	24/24 100%	ss	6-6 10-6 N=16	19		
4A	24/24 100%	ss	10-10 9-7 N=19	23		
5A	23/24 96%	ss	3-5 5-5 N=10	20		
6A	20/24 83%	ss	2-3 5-8 N=8	20		
7A	24/24 100%	ss	10-14 12-11 N=26	17		
7B				30		
8A	20/24 83%	ss	3-4 8-9 N=12	22		
9A	24/24 100%	ss	8-11 11-11 N=22	25		
10A	20/24 83%	ss	1-2 4-5 N=6	25		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
2	FILL - Dark yellowish brown (10YR4/6) with 30% gray (10YR6/1) mottles, slightly moist, firm, clayey SILT with slight trace sand and gravel.	618
4		616
6	FILL - Yellowish brown (10YR5/4) with 5% gray (10YR6/1) mottles, slightly moist, hard, clayey SILT with slight trace sand and gravel	614
8		612
10	FILL - Yellowish brown (10YR5/4) with 10% dark yellowish brown (10YR4/6) and 5% gray (10YR6/1) mottles, moist, soft, silty CLAY, trace roots.	610
12	FILL - Dark grayish brown (10YR4/2), slightly moist, firm, clayey SILT with slight trace sand.	608
14	Very dark grayish brown (10YR3/2), slightly moist, firm, clayey SILT, trace roots.	606
	Dark grayish brown (10YR4/2), moist, firm, silty CLAY, slight trace roots.	
16		604
18	Dark grayish brown (10YR4/2) with 15% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY, slight trace roots.	602
20	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/23/2009
Finish: 1/23/2009
WEATHER: cold, overcast, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G59
Well ID: G59S
Surface Elev: 620.15 ft. MSL
Completion: 42.49 ft. BGS
Station: 15,339.79N
992.55E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 39.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	18/24 75%	ss	woh-2 2-4 N=4	29		
12A	16/24 67%	ss	4-7 5-6 N=12	31		
13A	22/24 92%	ss	1-2 3-4 N=5	24		
14A	17/24 71%	ss	4-7 7-6 N=14	23		
15A	16/24 67%	ss	1-2 4-6 N=6	21		
16A	16/24 67%	ss	woh-2 2-2 N=4	17		
17A	16/24 67%	ss	2-3 2-3 N=5	20		
18A	21/24 88%	ss	1-3 4-6 N=7	15		
19A	24/24 100%	ss	6-9 11-9 N=20	15		
20A	24/24 100%	ss	15-22 24-17 N=46	12		
20B				16		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT. *[Continued from previous page]*	600	
22	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) and 10% dark gray (10YR4/1) mottles, moist, soft, clayey SILT.	598	
24	Gray (10YR5/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with slight trace sand and gravel.	596	
26	Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	594	
28		592	
30	Greenish gray (10GY6/1), moist, very soft, sandy CLAY with silt and trace gravel.	590	
32		588	
34	Gray (N5/1), slightly moist, hard, clayey SILT with trace sand and slight trace gravel.	586	
36		584	
38		582	
▼	Gray (N5/1), wet, dense, silty, very fine- to coarse-grained SAND.		
40			

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/23/2009
Finish: 1/23/2009
WEATHER: cold, overcast, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G59
Well ID: G59S
Surface Elev: 620.15 ft. MSL
Completion: 42.49 ft. BGS
Station: 15,339.79N
992.55E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 39.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
21A	24/24 100%	ss	2-2 4-5 N=6	16				Gray (10YR5/1) with 5% dark gray (10YR4/1), moist, soft, clayey SILT.		580	
21B				30			42			578	

End of Boring = 42.49 ft bgs

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/23/2009
Finish: 1/23/2009
WEATHER: cold, overcast, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G59~~
Well ID: G59S
Surface Elev: 620.15 ft. MSL
Completion: 42.49 ft. BGS
Station: 15,339.79N
992.55E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 39.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	ss	13-15 20-19 N=35	17		
2A	24/24 100%	ss	26-10 15-17 N=25	19		
3A	24/24 100%	ss	6-6 10-6 N=16	19		
4A	24/24 100%	ss	10-10 9-7 N=19	23		
5A	23/24 96%	ss	3-5 5-5 N=10	20		
6A	20/24 83%	ss	2-3 5-8 N=8	20		
7A	24/24 100%	ss	10-14 12-11 N=26	17		
7B				30		
8A	20/24 83%	ss	3-4 8-9 N=12	22		
9A	24/24 100%	ss	8-11 11-11 N=22	25		
10A	20/24 83%	ss	1-2 4-5 N=6	25		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
2	FILL - Dark yellowish brown (10YR4/6) with 30% gray (10YR6/1) mottles, slightly moist, firm, clayey SILT with slight trace sand and gravel.	618
4		616
6	FILL - Yellowish brown (10YR5/4) with 5% gray (10YR6/1) mottles, slightly moist, hard, clayey SILT with slight trace sand and gravel	614
8		612
10	FILL - Yellowish brown (10YR5/4) with 10% dark yellowish brown (10YR4/6) and 5% gray (10YR6/1) mottles, moist, soft, silty CLAY, trace roots.	610
12	FILL - Dark grayish brown (10YR4/2), slightly moist, firm, clayey SILT with slight trace sand.	608
14	Very dark grayish brown (10YR3/2), slightly moist, firm, clayey SILT, trace roots.	606
	Dark grayish brown (10YR4/2), moist, firm, silty CLAY, slight trace roots.	
16		604
18	Dark grayish brown (10YR4/2) with 15% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY, slight trace roots.	602
20	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/23/2009
Finish: 1/23/2009
WEATHER: cold, overcast, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G59
Well ID: G59S
Surface Elev: 620.15 ft. MSL
Completion: 42.49 ft. BGS
Station: 15,339.79N
992.55E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 39.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	18/24 75%	ss	woh-2 2-4 N=4	29		
12A	16/24 67%	ss	4-7 5-6 N=12	31		
13A	22/24 92%	ss	1-2 3-4 N=5	24		
14A	17/24 71%	ss	4-7 7-6 N=14	23		
15A	16/24 67%	ss	1-2 4-6 N=6	21		
16A	16/24 67%	ss	woh-2 2-2 N=4	17		
17A	16/24 67%	ss	2-3 2-3 N=5	20		
18A	21/24 88%	ss	1-3 4-6 N=7	15		
19A	24/24 100%	ss	6-9 11-9 N=20	15		
20A	24/24 100%	ss	15-22 24-17 N=46	12		
20B				16		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT. *[Continued from previous page]*	600	
22	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) and 10% dark gray (10YR4/1) mottles, moist, soft, clayey SILT.	598	
24	Gray (10YR5/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with slight trace sand and gravel.	596	
26	Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	594	
28		592	
30	Greenish gray (10GY6/1), moist, very soft, sandy CLAY with silt and trace gravel.	590	
32		588	
34	Gray (N5/1), slightly moist, hard, clayey SILT with trace sand and slight trace gravel.	586	
36		584	
38		582	
▼	Gray (N5/1), wet, dense, silty, very fine- to coarse-grained SAND.		
40			

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/23/2009
Finish: 1/23/2009
WEATHER: cold, overcast, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G59
Well ID: G59S
Surface Elev: 620.15 ft. MSL
Completion: 42.49 ft. BGS
Station: 15,339.79N
992.55E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 39.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
21A	24/24 100%	ss	2-2 4-5 N=6	16				Gray (10YR5/1) with 5% dark gray (10YR4/1), moist, soft, clayey SILT.		580	
21B				30			42			578	

End of Boring = 42.49 ft bgs

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/17/2008
Finish: 1/17/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 4¼" hollow stem auger - blind drilled within 5 ft of BG60
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: ~~BG60b~~
Well ID: G60L
Surface Elev: 612.5 ft. MSL
Completion: 25.3 ft. BGS
Station: 15,474.74N
1,049.75E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 30.60 - during drilling
▼ = 21.02 - 1/30/2008
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) % Recovery	Type	Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
								Dark yellow brown (10YR3/4), slightly moist, silty CLAY, trace sand	612
								Light gray (10YR7/2) with 40% brown yellow (10YR6/8) mottles, moist, silty CLAY, trace sand	
							2	Brown yellow (10YR6/8) with 40% light gray (10YR7/2) mottles, moist, clayey SILT, trace sand	610
							4	Yellow brown (10YR5/8), moist, clayey SILT, trace sand	608
							6	Light yellow brown (10YR6/4) with 30% brown yellow (10YR6/8) mottles, moist, clayey SILT, trace sand	606
							8	Yellow brown (10YR5/8) with 20% light yellow brown (10YR6/4) mottles, moist, clayey SILT, trace sand	604
							10	Light brown gray (10YR6/2) with 10% brown yellow (10YR6/8) mottles, very moist, clayey SILT, trace sand	602
							12	Gray brown (10YR5/2) with 30% very dark gray brown (10YR3/2) mottles, moist, clayey SILT, trace sand	600
							14	Dark gray (10YR4/1), moist, clayey SILT, trace sand	598
								Dark gray (10YR4/1) with 10% very dark gray (10YR3/1) mottles, moist, clayey SILT, trace sand	
							16	Black (10YR2/1), moist, very silty CLAY, trace sand	596
							18	Dark gray (10YR4/1), moist, silty CLAY, trace sand	
								Dark green gray (10Y4/1) with 5% very dark gray (10YR3/1) mottles, moist, silty CLAY, trace sand, trace organics	594
							20	Dark green gray (10Y4/1) moist, silty CLAY, trace sand and gravel	

Borehole Detail

NOTE(S):

FIELD BORING LOG

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/17/2008
Finish: 1/17/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 4¼" hollow stem auger - blind drilled within 5 ft of BG60
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG60b
Well ID: G60L
Surface Elev: 612.5 ft. MSL
Completion: 25.3 ft. BGS
Station: 15,474.74N
1,049.75E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 30.60 - during drilling
▼ = 21.02 - 1/30/2008
▽ =

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
								Dark green gray (10Y4/1) moist, silty CLAY, trace sand and gravel *[Continued from previous page]*		592	
							22	Green gray (5GY5/1), very moist, silty CLAY, trace sand and gravel		590	
							24	Green gray (5GY5/1) with 5% yellow brown (10YR5/4) mottles, wet, very silty CLAY, trace sand and gravel		588	

End of Boring = 25.28 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/16/2008
Finish: 1/16/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: ~~BG60~~
Well ID: G60S
Surface Elev: 612.2 ft. MSL
Completion: 38.0 ft. BGS
Station: 15,469.50N
1,050.18E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 30.60 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	19/24 79%	ss	4-6 6-7 N=12	24		
1B				19		4.27 Sh
	21/24 88%	ss	4-4 5-6 N=9			
2A				23		0.92 Sh
3A				23		
	24/24 100%	ss	2-3 4-4 N=7			
3B				25		1.40 Sh
	21/24 88%	ss	3-4 6-5 N=10			
4A				24		
	22/24 92%	ss	2-2 3-4 N=5			
5A				27		0.78 Sh
	19/24 79%	ss	2-2 3-3 N=5			
6A				23		2.13 Sh
	21/24 88%	ss	2-2 2-3 N=4			
7A				27		2.33 Sh
8A	23/24 96%	ss	2-2 3-4 N=5	29		1.71 B
8B				33		1.82
9A				25		1.63 B
	24/24 100%	ss	2-3 3-5 N=6			
9B				23		1.67
9C				22		1.67
10A				27		0.97 B
	23/24 96%	ss	1-3 3-4 N=6			
10B				23		0.74

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark yellow brown (10YR3/4), slightly moist, silty CLAY, trace sand	612
	Light gray (10YR7/2) with 40% brown yellow (10YR6/8) mottles, moist, silty CLAY, trace sand	
2	Brown yellow (10YR6/8) with 40% light gray (10YR7/2) mottles, moist, clayey SILT, trace sand	610
4	Yellow brown (10YR5/8), moist, clayey SILT, trace sand	608
6	Light yellow brown (10YR6/4) with 30% brown yellow (10YR6/8) mottles, moist, clayey SILT, trace sand	606
8	Yellow brown (10YR5/8) with 20% light yellow brown (10YR6/4) mottles, moist, clayey SILT, trace sand	604
10	Light brown gray (10YR6/2) with 10% brown yellow (10YR6/8) mottles, very moist, clayey SILT, trace sand	602
12	Gray brown (10YR5/2) with 30% very dark gray brown (10YR3/2) mottles, moist, clayey SILT, trace sand	600
14	Dark gray (10YR4/1), moist, clayey SILT, trace sand	598
16	Dark gray (10YR4/1) with 10% very dark gray (10YR3/1) mottles, moist, clayey SILT, trace sand	596
	Black (10YR2/1), moist, very silty CLAY, trace sand	
18	Dark gray (10YR4/1), moist, silty CLAY, trace sand	594
	Dark green gray (10Y4/1) with 5% very dark gray (10YR3/1) mottles, moist, silty CLAY, trace sand, trace organics	
20	Dark green gray (10Y4/1) moist, silty CLAY, trace sand and gravel	

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/16/2008
Finish: 1/16/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG60
Well ID: G60S
Surface Elev: 612.2 ft. MSL
Completion: 38.0 ft. BGS
Station: 15,469.50N
1,050.18E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 30.60 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	24/24 100%	ss	1-2 4-5 N=6					Dark green gray (10Y4/1) moist, silty CLAY, trace sand and gravel *[Continued from previous page]*	592	
11A				18		1.32	22			
12A				18		0.47 B		Green gray (5GY5/1), very moist, silty CLAY, trace sand and gravel	590	
	24/24 100%	ss	4-4 4-4 N=8							
12B				20		0.04 B	24	Green gray (5GY5/1) with 5% yellow brown (10YR5/4) mottles, wet, very silty CLAY, trace sand and gravel	588	
13A				19		0.93 B				
	23/24 96%	ss	2-2 2-4 N=4							
13B				18		1.44 BSh	26	Green gray (5GY6/1), very moist, clayey SILT, trace sand	586	
14A			3-1 7-8 N=8	17		0.50 B		Green gray (5GY6/1), moist, very silty CLAY, trace sand and gravel		
14B	24/24 100%	ss		16		5.43 Sh	28	Dark gray (10YR4/1), moist, silty CLAY, trace sand and gravel	584	
	24/24 100%	ss	3-6 8-12 N=14							
15A				12		4.46 Sh	30		582	
16A				17			▼	Dark gray (N4/1), very moist, sandy SILT		
	24/24 100%	ss	5-6 6-7 N=12					Dark gray (N4/1), wet, fine to coarse SAND, trace gravel		
16B				16						
16C				20			32	Dark gray (N4/1), wet, fine to medium SAND	580	
	24/24 100%	ss	3-3 6-9 N=9					Gray (10YR5/1), very moist, clayey SILT, trace sand		
17A				35		1.44 Sh	34		578	
	22/24 92%	ss	3-6 14-17 N=20					Dark gray (N4/1), moist, clayey SILT, trace sand and gravel		
18A				16		3.93 Sh	36		576	
19A	24/24 100%	ss	11-13 14-13 N=27	12		4.46 Sh		Very dark green gray (10Y3/1), moist, silty CLAY, trace sand and gravel		
19B				18		6.21 Sh	38			

End of Boring = 38.0 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/16/2008
Finish: 1/16/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: ~~BG60~~
Well ID: G60S
Surface Elev: 612.2 ft. MSL
Completion: 38.0 ft. BGS
Station: 15,469.50N
1,050.18E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 30.60 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	19/24 79%	ss	4-6 6-7 N=12	24		
1B				19		4.27 Sh
	21/24 88%	ss	4-4 5-6 N=9			
2A				23		0.92 Sh
3A				23		
	24/24 100%	ss	2-3 4-4 N=7			
3B				25		1.40 Sh
	21/24 88%	ss	3-4 6-5 N=10			
4A				24		
	22/24 92%	ss	2-2 3-4 N=5			
5A				27		0.78 Sh
	19/24 79%	ss	2-2 3-3 N=5			
6A				23		2.13 Sh
	21/24 88%	ss	2-2 2-3 N=4			
7A				27		2.33 Sh
8A	23/24 96%	ss	2-2 3-4 N=5	29		1.71 B
8B				33		1.82
9A				25		1.63 B
	24/24 100%	ss	2-3 3-5 N=6			
9B				23		1.67
9C				22		1.67
10A				27		0.97 B
	23/24 96%	ss	1-3 3-4 N=6			
10B				23		0.74

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark yellow brown (10YR3/4), slightly moist, silty CLAY, trace sand	612
	Light gray (10YR7/2) with 40% brown yellow (10YR6/8) mottles, moist, silty CLAY, trace sand	
2	Brown yellow (10YR6/8) with 40% light gray (10YR7/2) mottles, moist, clayey SILT, trace sand	610
4	Yellow brown (10YR5/8), moist, clayey SILT, trace sand	608
6	Light yellow brown (10YR6/4) with 30% brown yellow (10YR6/8) mottles, moist, clayey SILT, trace sand	606
8	Yellow brown (10YR5/8) with 20% light yellow brown (10YR6/4) mottles, moist, clayey SILT, trace sand	604
10	Light brown gray (10YR6/2) with 10% brown yellow (10YR6/8) mottles, very moist, clayey SILT, trace sand	602
12	Gray brown (10YR5/2) with 30% very dark gray brown (10YR3/2) mottles, moist, clayey SILT, trace sand	600
14	Dark gray (10YR4/1), moist, clayey SILT, trace sand	598
16	Dark gray (10YR4/1) with 10% very dark gray (10YR3/1) mottles, moist, clayey SILT, trace sand	596
	Black (10YR2/1), moist, very silty CLAY, trace sand	
18	Dark gray (10YR4/1), moist, silty CLAY, trace sand	594
	Dark green gray (10Y4/1) with 5% very dark gray (10YR3/1) mottles, moist, silty CLAY, trace sand, trace organics	
20	Dark green gray (10Y4/1) moist, silty CLAY, trace sand and gravel	

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/16/2008
Finish: 1/16/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG60
Well ID: G60S
Surface Elev: 612.2 ft. MSL
Completion: 38.0 ft. BGS
Station: 15,469.50N
1,050.18E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 30.60 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	24/24 100%	ss	1-2 4-5 N=6					Dark green gray (10Y4/1) moist, silty CLAY, trace sand and gravel *[Continued from previous page]*	592	
11A				18		1.32	22			
12A				18		0.47 B		Green gray (5GY5/1), very moist, silty CLAY, trace sand and gravel	590	
	24/24 100%	ss	4-4 4-4 N=8							
12B				20		0.04 B	24	Green gray (5GY5/1) with 5% yellow brown (10YR5/4) mottles, wet, very silty CLAY, trace sand and gravel	588	
13A				19		0.93 B				
	23/24 96%	ss	2-2 2-4 N=4							
13B				18		1.44 BSh	26	Green gray (5GY6/1), very moist, clayey SILT, trace sand	586	
14A			3-1 7-8 N=8	17		0.50 B		Green gray (5GY6/1), moist, very silty CLAY, trace sand and gravel		
14B	24/24 100%	ss		16		5.43 Sh	28	Dark gray (10YR4/1), moist, silty CLAY, trace sand and gravel	584	
	24/24 100%	ss	3-6 8-12 N=14							
15A				12		4.46 Sh	30		582	
16A				17			▼	Dark gray (N4/1), very moist, sandy SILT		
	24/24 100%	ss	5-6 6-7 N=12					Dark gray (N4/1), wet, fine to coarse SAND, trace gravel		
16B				16						
16C				20			32	Dark gray (N4/1), wet, fine to medium SAND	580	
	24/24 100%	ss	3-3 6-9 N=9					Gray (10YR5/1), very moist, clayey SILT, trace sand		
17A				35		1.44 Sh	34		578	
	22/24 92%	ss	3-6 14-17 N=20					Dark gray (N4/1), moist, clayey SILT, trace sand and gravel		
18A				16		3.93 Sh	36		576	
19A	24/24 100%	ss	11-13 14-13 N=27	12		4.46 Sh		Very dark green gray (10Y3/1), moist, silty CLAY, trace sand and gravel		
19B				18		6.21 Sh	38			

End of Boring = 38.0 ft. BGS

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/21/2009
Finish: 1/21/2009
WEATHER: cold, sunny, windy, mid-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: ~~G61a~~
Well ID: G61L
Surface Elev: 620.00 ft. MSL
Completion: 19.90 ft. BGS
Station: 15,640.94N
994.40E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ = 19.50 - 01/21/09
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) % Recovery	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
							2	FILL - Yellowish brown (10YR5/4) with 15% yellowish brown (10YR5/6) mottles, slightly moist, firm, clayey SILT.	618
							4		616
							6	FILL - Yellowish brown (10YR5/4) with 15% yellowish brown (10YR5/6) and 15% gray (10YR6/1) mottles, slightly moist, firm, clayey SILT.	614
							8	Grayish brown (10YR5/2), slightly moist, hard, clayey SILT.	612
								Light brownish gray (10YR6/2) with 35% dark yellowish brown (10YR4/6) mottles, slightly moist, hard, clayey SILT.	
							10		610
							12	Gray (10YR6/1) with 40% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	608
							14		606
							16	Gray (10YR6/1) with 40% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	604
								Gray (10YR6/1) with 15% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	
							18		602
								Gray (10YR6/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	
							▼	Very dark gray (10YR3/1), slightly moist, friable, micaceous, clayey SILT.	

End of Boring = 19.9 ft bgs

NOTE(S): See G61S Boring log for sample and testing data.

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/20/2009
Finish: 1/21/2009
WEATHER: cold, sunny, windy, mid-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G61~~
Well ID: G61S
Surface Elev: 620.00 ft. MSL
Completion: 38.00 ft. BGS
Station: 15,644.94N
994.79E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ = 19.50 - 01/21/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	24/24 100%	ss	18-12 9-8 N=21					FILL - Yellowish brown (10YR5/4) with 15% yellowish brown (10YR5/6) mottles, slightly moist, firm, clayey SILT.		
2A	24/24 100%	ss	8-5 7-8 N=12	18			2		618	
							4		616	
3A	20/24 83%	ss	2-4 4-6 N=8	21				FILL - Yellowish brown (10YR5/4) with 15% yellowish brown (10YR5/6) and 15% gray (10YR6/1) mottles, slightly moist, firm, clayey SILT.		
4A	24/24 100%	ss	7-9 10-11 N=19	20			6		614	
4B				21				Grayish brown (10YR5/2), slightly moist, hard, clayey SILT.		
							8		612	
5A	19/24 79%	ss	2-3 6-7 N=9	26				Light brownish gray (10YR6/2) with 35% dark yellowish brown (10YR4/6) mottles, slightly moist, hard, clayey SILT.		
							10		610	
6A	20/24 83%	ss	2-3 4-4 N=7	24						
							12		608	
7A	24/24 100%	ss	4-4 5-6 N=9	24				Gray (10YR6/1) with 40% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.		
							14		606	
8A	22/24 92%	ss	3-4 5-5 N=9	25						
							16	Gray (10YR6/1) with 40% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	604	
9A	24/24 100%	ss	3-3 4-6 N=7	24				Gray (10YR6/1) with 15% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.		
							18		602	
10A	22/24 92%	ss	2-3 3-4 N=6	25				Gray (10YR6/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.		
10B				28			▼ 20	Very dark gray (10YR3/1), slightly moist, friable,	600	

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/20/2009
Finish: 1/21/2009
WEATHER: cold, sunny, windy, mid-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G61
Well ID: G61S
Surface Elev: 620.00 ft. MSL
Completion: 38.00 ft. BGS
Station: 15,644.94N
994.79E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ = 19.50 - 01/21/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	19/24 79%	ss	3-4 5-6 N=9	36		
11B				26		
12A	24/24 100%	ss	4-3 6-9 N=9	25		
13A	20/24 83%	ss	woh-3 4-6 N=7	24		
14A	24/24 100%	ss	3-3 5-6 N=8	22		
15A	22/24 92%	ss	woh-3 3-4 N=6	22		
16A	19/24 79%	ss	woh-1 3-3 N=4	17		
17A	24/24 100%	ss	3-4 5-5 N=9	19		
17B				14		
18A	19/24 79%	ss	1-7 7-7 N=14	21		
19A	24/24 100%	ss	7-11 19-32 N=30	12		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	micaceous, clayey SILT.	
22	Dark gray (10YR4/1), moist, soft, clayey SILT.	598
24		596
26	Greenish gray (5GY5/1), moist, soft, silty CLAY with slight trace sand.	594
28		592
30	Greenish gray (5GY5/1), very moist, very soft, sandy CLAY with slight trace gravel.	590
32		588
	Greenish gray (10Y5/1), slightly moist, soft, clayey SILT with trace sand and slight trace gravel.	
34		586
	Medium light gray (N6/1), wet, firm, SILT with slight trace sand and gravel.	
36		584
	Greenish gray (10Y5/1), slightly moist, firm, clayey SILT with trace sand and slight trace gravel.	
38		582

End of Boring = 38.0 ft bgs

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/20/2009
Finish: 1/21/2009
WEATHER: cold, sunny, windy, mid-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G61~~
Well ID: G61S
Surface Elev: 620.00 ft. MSL
Completion: 38.00 ft. BGS
Station: 15,644.94N
994.79E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ = 19.50 - 01/21/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	24/24 100%	ss	18-12 9-8 N=21					FILL - Yellowish brown (10YR5/4) with 15% yellowish brown (10YR5/6) mottles, slightly moist, firm, clayey SILT.		
2A	24/24 100%	ss	8-5 7-8 N=12	18			2		618	
							4		616	
3A	20/24 83%	ss	2-4 4-6 N=8	21				FILL - Yellowish brown (10YR5/4) with 15% yellowish brown (10YR5/6) and 15% gray (10YR6/1) mottles, slightly moist, firm, clayey SILT.		
4A	24/24 100%	ss	7-9 10-11 N=19	20			6		614	
4B				21				Grayish brown (10YR5/2), slightly moist, hard, clayey SILT.		
							8		612	
5A	19/24 79%	ss	2-3 6-7 N=9	26				Light brownish gray (10YR6/2) with 35% dark yellowish brown (10YR4/6) mottles, slightly moist, hard, clayey SILT.		
							10		610	
6A	20/24 83%	ss	2-3 4-4 N=7	24						
							12		608	
7A	24/24 100%	ss	4-4 5-6 N=9	24				Gray (10YR6/1) with 40% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.		
							14		606	
8A	22/24 92%	ss	3-4 5-5 N=9	25						
							16	Gray (10YR6/1) with 40% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	604	
9A	24/24 100%	ss	3-3 4-6 N=7	24				Gray (10YR6/1) with 15% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.		
							18		602	
10A	22/24 92%	ss	2-3 3-4 N=6	25				Gray (10YR6/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.		
10B				28			▼ 20	Very dark gray (10YR3/1), slightly moist, friable,	600	

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/20/2009
Finish: 1/21/2009
WEATHER: cold, sunny, windy, mid-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G61
Well ID: G61S
Surface Elev: 620.00 ft. MSL
Completion: 38.00 ft. BGS
Station: 15,644.94N
994.79E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ = 19.50 - 01/21/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	19/24 79%	ss	3-4 5-6 N=9	36		
11B				26		
12A	24/24 100%	ss	4-3 6-9 N=9	25		
13A	20/24 83%	ss	woh-3 4-6 N=7	24		
14A	24/24 100%	ss	3-3 5-6 N=8	22		
15A	22/24 92%	ss	woh-3 3-4 N=6	22		
16A	19/24 79%	ss	woh-1 3-3 N=4	17		
17A	24/24 100%	ss	3-4 5-5 N=9	19		
17B				14		
18A	19/24 79%	ss	1-7 7-7 N=14	21		
19A	24/24 100%	ss	7-11 19-32 N=30	12		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	micaceous, clayey SILT.	
22	Dark gray (10YR4/1), moist, soft, clayey SILT.	598
24		596
26	Greenish gray (5GY5/1), moist, soft, silty CLAY with slight trace sand.	594
28		592
30	Greenish gray (5GY5/1), very moist, very soft, sandy CLAY with slight trace gravel.	590
32		588
	Greenish gray (10Y5/1), slightly moist, soft, clayey SILT with trace sand and slight trace gravel.	
34		586
	Medium light gray (N6/1), wet, firm, SILT with slight trace sand and gravel.	
36		584
	Greenish gray (10Y5/1), slightly moist, firm, clayey SILT with trace sand and slight trace gravel.	
38		582

End of Boring = 38.0 ft bgs

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/21/2009
Finish: 1/22/2009
WEATHER: cold, sunny, windy, mid-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: ~~G62~~
Well ID: G62L
Surface Elev: 620.02 ft. MSL
Completion: 38.00 ft. BGS
Station: 15,785.21N
994.71E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	SS	13-9 5-5 N=14	25.8		
2A	24/24 100%	SS	6-8 8-10 N=16	17.4		
3A	22/24 92%	SS	3-7 7-7 N=14	17.8		
4A	24/24 100%	SS	11-14 13-11 N=27	17.1		
5A	24/24 100%	SS	3-4 6-9 N=10	15.8		
6A	24/24 100%	SS	3-6 8-11 N=14	15.9		
7A	24/24 100%	SS	11-18 22-20 N=40	16.2		
8A	24/24 100%	SS	2-8 19-12 N=27	14.8		
9A	24/24 100%	SS	12-13 18-15 N=31	23.1		
10A	22/24 92%	SS	2-2 4-4 N=6	23.5		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Yellowish brown (10YR5/4) with 10% dark yellowish brown (10YR4/6) and 5% gray (10YR6/1) mottles, slightly moist, firm, clayey SILT.	
2		618
	FILL - Yellowish brown (10YR5/4), slightly moist, firm, clayey SILT with slight trace sand and gravel.	
4		616
6		614
	FILL - Yellowish brown (10YR5/4) with 5% medium dark gray (N4/1) mottles, slightly moist, firm, clayey SILT with slight trace sand and gravel.	
8		612
10		610
	FILL - Yellowish brown (10YR5/4) with 5% medium dark gray (N4/1) mottles, slightly moist, firm, clayey SILT with slight trace sand and gravel and slight trace roots.	
12		608
	FILL - Yellowish brown (10YR5/4) with 5% medium dark gray (N4/1) mottles, slightly moist, firm, clayey SILT with slight trace sand and gravel.	
14		606
	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, slightly moist, hard, clayey SILT.	
16		604
18		602
	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	
20		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/21/2009
Finish: 1/22/2009
WEATHER: cold, sunny, windy, mid-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: G62
Well ID: G62L
Surface Elev: 620.02 ft. MSL
Completion: 38.00 ft. BGS
Station: 15,785.21N
994.71E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	22/24 92%	SS	1-2 4-4 N=6	20.6		
12A	24/24 100%	SS	2-3 3-4 N=6	23.5		
12B				21.8		
13A	22/24 92%	SS	woh-2 3-3 N=5	20.9		
14A	24/24 100%	SS	4-5 5-8 N=10	20.3		
14B				22.0		
15A	24/24 100%	SS	1-2 3-3 N=5	18.7		
16A	24/24 100%	SS	woh-1 2-4 N=3	18.2		
17A	17/24 71%	SS	4-3 5-7 N=8	19.4		
18A	22/24 92%	SS	1-4 4-6 N=8	14.7		
19A	24/24 100%	SS	6-13 13-13 N=26	13.2		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
22	Gray (10YR5/1) with 10% dark gray (10YR4/1) mottles, moist, soft, clayey SILT.	598
24	Dark reddish gray (5YR4/2) with 5% dark reddish brown (5YR3/4) mottles, moist, soft, silty CLAY.	596
26	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	594
28	Strong brown (7.5YR5/6), moist, hard, silty CLAY with trace sand and slight trace gravel.	592
30	Greenish gray (5GY5/1) with 10% dark yellowish brown (10YR4/6) and 5% olive gray (5Y4/2) mottles, moist, soft, silty CLAY with sand and trace gravel.	590
32	Greenish gray (5GY5/1) with 5% olive gray (5Y4/2) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	588
34		586
36	Dark gray (N4/1), slightly moist, hard, clayey SILT with trace sand and slight trace gravel.	584
38		

Borehole Detail

Remarks

End of Boring = 38.0 ft bgs

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/2/2009
Finish: 2/2/2009
WEATHER: cold, sunny, windy, hi-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: ~~G63a~~
Well ID: G63L
Surface Elev: 620.12 ft. MSL
Completion: 28.36 ft. BGS
Station: 15,928.37N
998.01E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
							0	FILL - Yellowish brown (10YR5/4) with 15% yellowish brown (10YR4/6) and 10% gray (10YR6/1) mottles, slightly moist, soft, clayey SILT with slight trace sand and gravel.	620
							2		618
							4		616
							6		614
							7	FILL - Brown (10YR4/3) with 15% gray (10YR5/1) mottles, moist, firm, clayey SILT with trace sand and slight trace gravel.	
							8		612
							9	FILL - Brown (10YR4/3) with 15% gray (10YR5/1) mottles, moist, soft, friable, clayey SILT with trace sand and slight trace gravel.	
							10		610
							11	Yellowish brown (10YR5/4), slightly moist, firm, clayey SILT with slight trace sand and gravel, trace roots.	
							12		608
							14	Gray (10YR5/1) with 10% yellowish brown (10YR5/4) mottles, moist, soft, clayey SILT with trace sand and slight trace gravel.	606
							15	Yellowish brown (10YR5/4) with 5% gray (10YR6/1) mottles, moist, soft, clayey SILT with trace sand and slight trace gravel.	
							16		604
							17	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT.	
							18		602
							19	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	
							20		

Borehole Detail

NOTE(S): See G63S Boring log for sample and testing data.

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/2/2009
Finish: 2/2/2009
WEATHER: cold, sunny, windy, hi-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: G63a
Well ID: G63L
Surface Elev: 620.12 ft. MSL
Completion: 28.36 ft. BGS
Station: 15,928.37N
998.01E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
								Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand.	600
							22		598
							24	Gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.	596
							26		594
							28		592

End of Boring = 28.36 ft bgs

NOTE(S): See G63S Boring log for sample and testing data.

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/2/2009
Finish: 2/2/2009
WEATHER: cold, sunny, windy, hi-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G63~~
Well ID: G63S
Surface Elev: 620.12 ft. MSL
Completion: 40.00 ft. BGS
Station: 15,924.41N
998.26E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 36.60 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	ss	3-3 3-6 N=6	21		
2A	24/24 100%	ss	2-3 4-5 N=7	22		
3A	22/24 92%	ss	3-3 4-6 N=7	18		
4A	24/24 100%	ss	9-9 10-11 N=19	17		
5A	24/24 100%	ss	1-3 4-5 N=7	13		
6A	23/24 96%	ss	1-3 3-6 N=6	15		
7A	24/24 100%	ss	8-9 12-12 N=21	15		
8A	23/24 96%	ss	1-2 5-6 N=7	13		
8B				18		
9A	24/24 100%	ss	7-10 14-13 N=24	19		
9B				19		
10A	20/24 83%	ss	1-3 3-3 N=6	26		
11A	22/24		1-4	21		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
0–8	FILL - Yellowish brown (10YR5/4) with 15% yellowish brown (10YR4/6) and 10% gray (10YR6/1) mottles, slightly moist, soft, clayey SILT with slight trace sand and gravel.	620 – 612
8	FILL - Brown (10YR4/3) with 15% gray (10YR5/1) mottles, moist, firm, clayey SILT with trace sand and slight trace gravel.	612
8–12	FILL - Brown (10YR4/3) with 15% gray (10YR5/1) mottles, moist, soft, friable, clayey SILT with trace sand and slight trace gravel.	612 – 608
12–14	Yellowish brown (10YR5/4), slightly moist, firm, clayey SILT with slight trace sand and gravel, trace roots.	608 – 606
14	Gray (10YR5/1) with 10% yellowish brown (10YR5/4) mottles, moist, soft, clayey SILT with trace sand and slight trace gravel.	606
14–18	Yellowish brown (10YR5/4) with 5% gray (10YR6/1) mottles, moist, soft, clayey SILT with trace sand and slight trace gravel.	606 – 602
18	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT.	602
18–20	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	602 – 600
20	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand.	600

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/2/2009
Finish: 2/2/2009
WEATHER: cold, sunny, windy, hi-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G63
Well ID: G63S
Surface Elev: 620.12 ft. MSL
Completion: 40.00 ft. BGS
Station: 15,924.41N
998.26E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 36.60 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
	92%	ss	4-3 N=8			
12A	24/24 100%	ss	4-5 5-6 N=10	22		
13A	19/24 79%	ss	1-2 4-5 N=6	21		
14A	24/24 100%	ss	5-7 7-7 N=14	20		
15A	24/24 100%	ss	1-2 3-4 N=5	20		
16A	20/24 83%	ss	woh-1 2-3 N=3	22		
17A 17B	20/24 83%	ss	3-4 6-6 N=10	17 16		
18A	23/24 96%	ss	3-8 17-15 N=25	11		
19A 19B	23/24 96%	ss	10-18 25-9 N=43	11 26		
20A	16/24 67%	ss	9-10 13-15 N=23	19		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand. *[Continued from previous page]*	
22		598
24		596
26	Gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.	594
28		592
30		590
32	Yellowish brown (10YR5/4) with 15% gray (10YR5/1) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	588
	Greenish gray (5GY5/1), moist, firm, silty CLAY with trace sand and slight trace gravel.	
34	Dark gray (N4/1), slightly moist, hard, clayey SILT with trace sand and gravel.	586
36		584
	Dark gray (N4/1), wet, medium dense, silty, fine- to coarse-grained SAND with slight trace gravel.	
38	Dark gray (N4/1), very moist, firm, SILT, trace organic material.	582
	Dark gray (N4/1), slightly moist, hard, clayey SILT with slight trace sand and gravel.	
40		

End of Boring = 40.0 ft bgs

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/2/2009
Finish: 2/2/2009
WEATHER: cold, sunny, windy, hi-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G63~~
Well ID: G63S
Surface Elev: 620.12 ft. MSL
Completion: 40.00 ft. BGS
Station: 15,924.41N
998.26E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 36.60 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	ss	3-3 3-6 N=6	21		
2A	24/24 100%	ss	2-3 4-5 N=7	22		
3A	22/24 92%	ss	3-3 4-6 N=7	18		
4A	24/24 100%	ss	9-9 10-11 N=19	17		
5A	24/24 100%	ss	1-3 4-5 N=7	13		
6A	23/24 96%	ss	1-3 3-6 N=6	15		
7A	24/24 100%	ss	8-9 12-12 N=21	15		
8A	23/24 96%	ss	1-2 5-6 N=7	13		
8B				18		
9A	24/24 100%	ss	7-10 14-13 N=24	19		
9B				19		
10A	20/24 83%	ss	1-3 3-3 N=6	26		
11A	22/24		1-4	21		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
0–8	FILL - Yellowish brown (10YR5/4) with 15% yellowish brown (10YR4/6) and 10% gray (10YR6/1) mottles, slightly moist, soft, clayey SILT with slight trace sand and gravel.	620 – 612
8	FILL - Brown (10YR4/3) with 15% gray (10YR5/1) mottles, moist, firm, clayey SILT with trace sand and slight trace gravel.	612
8–12	FILL - Brown (10YR4/3) with 15% gray (10YR5/1) mottles, moist, soft, friable, clayey SILT with trace sand and slight trace gravel.	612 – 608
12–14	Yellowish brown (10YR5/4), slightly moist, firm, clayey SILT with slight trace sand and gravel, trace roots.	608 – 606
14	Gray (10YR5/1) with 10% yellowish brown (10YR5/4) mottles, moist, soft, clayey SILT with trace sand and slight trace gravel.	606
14–18	Yellowish brown (10YR5/4) with 5% gray (10YR6/1) mottles, moist, soft, clayey SILT with trace sand and slight trace gravel.	606 – 602
18	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT.	602
18–20	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	602 – 600
20	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand.	600

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/2/2009
Finish: 2/2/2009
WEATHER: cold, sunny, windy, hi-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G63
Well ID: G63S
Surface Elev: 620.12 ft. MSL
Completion: 40.00 ft. BGS
Station: 15,924.41N
998.26E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 36.60 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
	92%	ss	4-3 N=8			
12A	24/24 100%	ss	4-5 5-6 N=10	22		
13A	19/24 79%	ss	1-2 4-5 N=6	21		
14A	24/24 100%	ss	5-7 7-7 N=14	20		
15A	24/24 100%	ss	1-2 3-4 N=5	20		
16A	20/24 83%	ss	woh-1 2-3 N=3	22		
17A 17B	20/24 83%	ss	3-4 6-6 N=10	17 16		
18A	23/24 96%	ss	3-8 17-15 N=25	11		
19A 19B	23/24 96%	ss	10-18 25-9 N=43	11 26		
20A	16/24 67%	ss	9-10 13-15 N=23	19		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand. *[Continued from previous page]*	
22		598
24		596
26	Gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.	594
28		592
30		590
32	Yellowish brown (10YR5/4) with 15% gray (10YR5/1) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	588
	Greenish gray (5GY5/1), moist, firm, silty CLAY with trace sand and slight trace gravel.	
34	Dark gray (N4/1), slightly moist, hard, clayey SILT with trace sand and gravel.	586
36		584
	Dark gray (N4/1), wet, medium dense, silty, fine- to coarse-grained SAND with slight trace gravel.	
38	Dark gray (N4/1), very moist, firm, SILT, trace organic material.	582
	Dark gray (N4/1), slightly moist, hard, clayey SILT with slight trace sand and gravel.	
40		

End of Boring = 40.0 ft bgs

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/22/2009
Finish: 1/22/2009
WEATHER: cold, sunny, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: ~~G64a~~
Well ID: G64L
Surface Elev: 620.02 ft. MSL
Completion: 27.95 ft. BGS
Station: 16,069.29N
995.70E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
							2	FILL - Yellowish brown (10YR5/4), slightly moist, firm, clayey SILT with slight trace sand and gravel.	618
							4		616
							6		614
							8	Gray (10YR5/1) mottles, moist, firm, clayey SILT with trace sand and slight trace gravel.	612
							10	Yellowish brown (10YR5/4) with 10% gray (10YR6/1), moist, firm, clayey SILT with trace sand and slight trace gravel.	610
							12	Yellowish brown (10YR5/4) with 10% gray (10YR6/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with trace sand and slight trace gravel.	608
							14	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	606
							16		604
							18	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	602
							20	Dark gray (10YR4/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	

Borehole Detail

NOTE(S): See G64S Boring log for sample and testing data.

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/22/2009
Finish: 1/22/2009
WEATHER: cold, sunny, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: G64a
Well ID: G64L
Surface Elev: 620.02 ft. MSL
Completion: 27.95 ft. BGS
Station: 16,069.29N
995.70E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
								Dark gray (10YR4/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT. *[Continued from previous page]*	
							22	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY.	598
							24	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.	596
							26	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, silty CLAY with sand and slight trace gravel.	594

End of Boring = 27.95 ft bgs

Borehole Detail

Remarks

NOTE(S): See G64S Boring log for sample and testing data.

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/22/2009
Finish: 1/22/2009
WEATHER: cold, sunny, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G64~~
Well ID: G64S
Surface Elev: 620.02 ft. MSL
Completion: 40.00 ft. BGS
Station: 16,064.64N
994.93E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 36.60 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	ss	24-14 10-6 N=24	24		
2A	24/24 100%	ss	4-6 8-9 N=14	17		
3A	23/24 96%	ss	5-7 5-7 N=12	15		
4A	22/24 92%	ss	7-8 10-13 N=18	13		
5A	24/24 100%	ss	3-5 7-7 N=12	19		
6A	22/24 92%	ss	3-3 5-8 N=8	24		
7A 7B	22/24 92%	ss	8-8 6-7 N=14	25 25		
8A	22/24 92%	ss	1-5 4-5 N=9	22		
9A	24/24 100%	ss	8-5 4-5 N=9	25		
10A	20/24 83%	ss	1-1 3-4 N=4	24		
11A	22/24		0-2	24		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
2	FILL - Yellowish brown (10YR5/4), slightly moist, firm, clayey SILT with slight trace sand and gravel.	618
4		616
6		614
8	Gray (10YR5/1) mottles, moist, firm, clayey SILT with trace sand and slight trace gravel.	612
10	Yellowish brown (10YR5/4) with 10% gray (10YR6/1), moist, firm, clayey SILT with trace sand and slight trace gravel.	610
12	Yellowish brown (10YR5/4) with 10% gray (10YR6/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with trace sand and slight trace gravel.	608
14	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	606
16		604
18	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	602
20	Dark gray (10YR4/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	600

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/22/2009
Finish: 1/22/2009
WEATHER: cold, sunny, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G64
Well ID: G64S
Surface Elev: 620.02 ft. MSL
Completion: 40.00 ft. BGS
Station: 16,064.64N
994.93E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 36.60 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11B	92%	ss	4-4 N=6	25		
12A	24/24 100%	ss	5-6 6-6 N=12	21		
13A	22/24 92%	ss	1-1 4-7 N=5	23		
14A	24/24 100%	ss	5-7 8-6 N=15	20		
15A	24/24 100%	ss	1-2 2-3 N=4	18		
16A	17/24 71%	ss	woh-2 4-6 N=6	17		
17A	24/24 100%	ss	6-8 12-13 N=20	17		
17B				13		
18A	19/24 79%	ss	7-8 9-13 N=17	14		
19A	24/24 100%	ss	7-10 12-13 N=22	13		
19B				22		
19C				33		
20A	20/24 83%	ss	3-6 10-14 N=16	14		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
22	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY.	598
24	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.	596
26	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, silty CLAY with sand and slight trace gravel.	594
28	Greenish gray (10GY6/1) with 10% olive (5Y5/3) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	592
30	Greenish gray (10Y5/1), slightly moist, hard, clayey SILT with trace sand and slight trace gravel.	590
32	Gray (N5/1), wet, medium dense, silty, very fine- to fine-grained SAND.	588
34	Gray (N5/1), very moist, firm, clayey SILT.	586
36	Gray (N5/1), wet, dense, silty, fine- to coarse-grained SAND with slight trace gravel.	584
38	Greenish gray (10Y5/1), slightly moist, hard, clayey SILT with trace sand and slight trace gravel.	582
40		

End of Boring = 40.0 ft bgs

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/22/2009
Finish: 1/22/2009
WEATHER: cold, sunny, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G64~~
Well ID: G64S
Surface Elev: 620.02 ft. MSL
Completion: 40.00 ft. BGS
Station: 16,064.64N
994.93E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 36.60 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	ss	24-14 10-6 N=24	24		
2A	24/24 100%	ss	4-6 8-9 N=14	17		
3A	23/24 96%	ss	5-7 5-7 N=12	15		
4A	22/24 92%	ss	7-8 10-13 N=18	13		
5A	24/24 100%	ss	3-5 7-7 N=12	19		
6A	22/24 92%	ss	3-3 5-8 N=8	24		
7A 7B	22/24 92%	ss	8-8 6-7 N=14	25 25		
8A	22/24 92%	ss	1-5 4-5 N=9	22		
9A	24/24 100%	ss	8-5 4-5 N=9	25		
10A	20/24 83%	ss	1-1 3-4 N=4	24		
11A	22/24		0-2	24		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
2	FILL - Yellowish brown (10YR5/4), slightly moist, firm, clayey SILT with slight trace sand and gravel.	618
4		616
6		614
8	Gray (10YR5/1) mottles, moist, firm, clayey SILT with trace sand and slight trace gravel.	612
10	Yellowish brown (10YR5/4) with 10% gray (10YR6/1), moist, firm, clayey SILT with trace sand and slight trace gravel.	610
12	Yellowish brown (10YR5/4) with 10% gray (10YR6/1) and 5% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with trace sand and slight trace gravel.	608
14	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	606
16		604
18	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	602
20	Dark gray (10YR4/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	600

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/22/2009
Finish: 1/22/2009
WEATHER: cold, sunny, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G64
Well ID: G64S
Surface Elev: 620.02 ft. MSL
Completion: 40.00 ft. BGS
Station: 16,064.64N
994.93E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 36.60 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11B	92%	ss	4-4 N=6	25		
12A	24/24 100%	ss	5-6 6-6 N=12	21		
13A	22/24 92%	ss	1-1 4-7 N=5	23		
14A	24/24 100%	ss	5-7 8-6 N=15	20		
15A	24/24 100%	ss	1-2 2-3 N=4	18		
16A	17/24 71%	ss	woh-2 4-6 N=6	17		
17A	24/24 100%	ss	6-8 12-13 N=20	17		
17B				13		
18A	19/24 79%	ss	7-8 9-13 N=17	14		
19A	24/24 100%	ss	7-10 12-13 N=22	13		
19B				22		
19C				33		
20A	20/24 83%	ss	3-6 10-14 N=16	14		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
22	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY.	598
24	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.	596
26	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, silty CLAY with sand and slight trace gravel.	594
28	Greenish gray (10GY6/1) with 10% olive (5Y5/3) mottles, moist, soft, silty CLAY with trace sand and slight trace gravel.	592
30	Greenish gray (10Y5/1), slightly moist, hard, clayey SILT with trace sand and slight trace gravel.	590
32	Gray (N5/1), wet, medium dense, silty, very fine- to fine-grained SAND.	588
34	Gray (N5/1), very moist, firm, clayey SILT.	586
36	Gray (N5/1), wet, dense, silty, fine- to coarse-grained SAND with slight trace gravel.	584
38	Greenish gray (10Y5/1), slightly moist, hard, clayey SILT with trace sand and slight trace gravel.	582
40		

End of Boring = 40.0 ft bgs

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/15/2008
Finish: 1/15/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger - blind drilled within 10 ft of BG65
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: ~~BG65b~~
Well ID: G65L
Surface Elev: 610.1 ft. MSL
Completion: 22.5 ft. BGS
Station: 13,986.12N
919.86E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 26.80 - during drilling
▼ = 22.31 - 1/30/2008
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
								Dark yellow brown (10YR4/4), slightly moist, silty CLAY, trace sand	
								Dark yellow brown (10YR4/6), moist, silty CLAY, trace sand	
							2		608
								Yellow brown (10YR5/6) with 30% yellow brown (10YR5/4) mottles, moist, silty CLAY, trace sand	
							4		606
								Brown yellow (10YR6/6), moist, clayey SILT, trace sand	
							6		604
							8		602
								Light gray (10YR7/2) with 5% brown yellow (10YR6/8) mottles, moist, sandy SILT	
							10		600
							12		598
							14		596
								Brown (10YR5/3) with 40% brown yellow (10YR5/4) mottles, moist, clayey SILT, trace sand	
							16		594
								Yellow brown (10YR5/8) with 35% brown (10YR5/3) and 10% very dark brown (10YR2/1) mottles, moist, very silty CLAY, trace sand	
							18		592
								Black (10YR2/1) with 40% brown yellow (10YR6/6) and 5% gray brown (10YR5/2) mottles, moist, silty CLAY, trace sand and gravel	
								Dark yellow brown (10YR4/6) with 30% brown yellow (10YR6/6) and 5% black (10YR2/1) mottles, moist, sandy CLAY, trace gravel	
							20		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/15/2008
Finish: 1/15/2008
WEATHER: Overcast, windy, cold

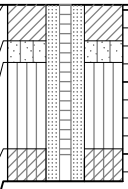
CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger - blind drilled within 10 ft of BG65
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG65b
Well ID: G65L
Surface Elev: 610.1 ft. MSL
Completion: 22.5 ft. BGS
Station: 13,986.12N
919.86E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 26.80 - during drilling
▼ = 22.31 - 1/30/2008
▽ =

SAMPLE			TESTING							
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
								Brown (10YR5/3) with 45% dark yellow brown (10YR4/6) mottles, moist, sandy CLAY, trace gravel			
								Gray brown (10YR5/2) with 30% yellow brown (10YR5/6) mottles, moist, silty CLAY, trace sand and gravel			
								Dark yellow (10YR4/6) with 10% brown (10YR3/4) mottles, moist, silty fine to medium SAND			
							▼ 22	Yellow brown (10YR5/6) with30% light gray (10YR7/2) mottles, moist, clayey SILT, trace sand and gravel		588	
								Yellow brown (10YR5/8) with 20% gray (10YR6/1) and 15% dark brown (10YR3/3) mottles, very moist, very silty CLAY, trace sand and gravel			



End of Boring = 22.45 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/14/2008
Finish: 1/14/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG65
Well ID: hole abandoned
Surface Elev: 609.7 ft. MSL
Completion: 44.0 ft. BGS
Station: 13,982.80N 909.90E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 26.80 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	24/24 100%	ss	4-4 6-6 N=10	23		
1B				22		2.72 BSh
	24/24 100%	ss	6-6 8-10 N=14			
2A				19		4.15 Sh
	20/24 83%	ss	4-4 7-7 N=11			
3A				17		2.62 Sh
	22/24 92%	ss	4-8 6-8 N=14			
4A						
4B				11		
	17/24 71%	ss	3-5 6-8 N=11			
5A				9		
	24/24 100%	ss	3-5 7-6 N=12			
6A				11		
7A				13		
	24/24 100%	ss	6-9 9-10 N=18			
7B				17		
	17/24 71%	ss	2-3 5-6 N=8			
8A				18		
9A	21/24 88%	ss	5-8 10-10 N=18	17		
9B				17		
10A				20		
10B	19/24 79%	ss	1-3 4-7 N=7	18		
10C				22		1.44

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark yellow brown (10YR4/4), slightly moist, silty CLAY, trace sand	
	Dark yellow brown (10YR4/6), moist, silty CLAY, trace sand	608
2	Yellow brown (10YR5/6) with 30% yellow brown (10YR5/4) mottles, moist, silty CLAY, trace sand	606
4	Brown yellow (10YR6/6), moist, clayey SILT, trace sand	604
6	Light gray (10YR7/2) with 5% brown yellow (10YR6/8) mottles, moist, sandy SILT	602
8		600
10		598
12	Brown (10YR5/3) with 40% brown yellow (10YR5/4) mottles, moist, clayey SILT, trace sand	596
14		594
16	Yellow brown (10YR5/8) with 35% brown (10YR5/3) and 10% very dark brown (10YR2/1) mottles, moist, very silty CLAY, trace sand	592
18	Black (10YR2/1) with 40% brown yellow (10YR6/6) and 5% gray brown (10YR5/2) mottles, moist, silty CLAY, trace sand and gravel	
	Dark yellow brown (10YR4/6) with 30% brown yellow (10YR6/6) and 5% black (10YR2/1) mottles, moist, sandy CLAY, trace gravel	590
20		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/14/2008
Finish: 1/14/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG65
Well ID: hole abandoned
Surface Elev: 609.7 ft. MSL
Completion: 44.0 ft. BGS
Station: 13,982.80N 909.90E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 26.80 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
11A				21		Sh
						1.16
	20/24 83%	ss	4-4 3-3 N=7			BSh
11B						
11C				16		
12A	19/24 79%	ss	3-5 4-43 N=9	26		
12B				26		
	24/24 100%	ss	1-3 5-10 N=8			
13A				19		
14A	20/24 83%	ss	10-8 7-6 N=15	19		
14B				14		
14C				22		1.09
15A				25		B
15B	24/24 100%	ss	7-12 11-17 N=23	21		
15C				13		
15D				11		
16A				13		
	20/24 83%	ss	2-10 9-14 N=19			
16B				12		5.82
						BSh
	24/24 100%	ss	11-15 16-20 N=31			
17A				12		6.40
						Bh
	24/24 100%	ss	7-16 24-35 N=40			
18A				11		7.62
						Sh
	24/24 100%	ss	43-72 75-97 N=147			
19A				10		
19B				11		
	22/24 92%	ss	11-27 25-25 N=52			
20A				13		5.24

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Brown (10YR5/3) with 45% dark yellow brown (10YR4/6) mottles, moist, sandy CLAY, trace gravel	
	Gray brown (10YR5/2) with 30% yellow brown (10YR5/6) mottles, moist, silty CLAY, trace sand and gravel	
	Dark yellow (10YR4/6) with 10% brown (10YR3/4) mottles, moist, silty fine to medium SAND	588
22	Yellow brown (10YR5/6) with30% light gray (10YR7/2) mottles, moist, clayey SILT, trace sand and gravel	
	Yellow brown (10YR5/8) with 20% gray (10YR6/1) and 15% dark brown (10YR3/3) mottles, very moist, very silty CLAY, trace sand and gravel	586
24	Yellow brown (10YR5/6) with 50% light brown gray (10YR6/2) mottles, moist, very silty CLAY, trace sand and gravel	
		584
26	Gray (10YR6/1) with 5% yellow brown (10YR5/4) mottles, moist, clayey SILT, trace sand and gravel	
▼	Gray (10YR6/1) with 25% yellow brown (10YR5/4) mottles, wet, sandy SILT, trace gravel	
	Gray brown (10YR5/2), very moist, clayey SILT, trace sand	582
28	Yellow brown (10YR5/8), very moist to wet, fine to coarse SAND, trace gravel	
	Dark yellow brown (10YR4/6) with 40% yellow brown (10YR5/6) mottles, wet, sandy SILT, trace gravel	
	Gray brown (10YR5/2) with 40% yellow brown (10YR5/6) mottles, moist, very silty CLAY, trace sand and gravel	580
30	Dark yellow brown (10YR4/6) with 15% pale brown (10YR6/3) mottles, moist, very silty CLAY, little sand, trace gravel	
	Green gray (10Y5/1), moist, silty CLAY, trace sand and gravel	578
32		
		576
34	Gray (N5/1) with 30% gray brown (10YR5/2) mottles, moist, silty CLAY, little sand and gravel	
		574
36		
		572
38	Gray (N5), wet, fine to medium SAND	
	Gray (N5) with 10% gray brown (10YR5/2) mottles, moist, silty CLAY, trace sand and gravel	
		570
40		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/14/2008
Finish: 1/14/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG65
Well ID: hole abandoned
Surface Elev: 609.7 ft. MSL
Completion: 44.0 ft. BGS
Station: 13,982.80N
909.90E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 26.80 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
						Sh
	24/24 *100%*	ss	*4-14 17-24* N=31			
21A				10		10.86 *BSh*
21B				11		6.98 *Sh*
22A				24		2.33 *Sh*
22B	24/24 *100%*	ss	*27-41 77-109* N=118	18		
22C				14		
22D				11		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	Gray (N5) with 10% gray brown (10YR5/2) mottles, moist, silty CLAY, trace sand and gravel *[Continued from previous page]*		
42	Very dark green (10Y3/1) with 25% gray brown yellow (10YR6/8) mottles, moist, silty CLAY, trace sand and gravel	568	
	Green (5GY) with 10% gray brown (10YR4/3) mottles, moist, silty CLAY, trace sand and gravel		
	Dark green gray (10GY4/1), moist, silty CLAY, trace sand		
	Green (10Y5/1), wet, fine to medium SAND	566	
44	CHERT		

End of Boring = 44.0 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/15/2008
Finish: 1/15/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger - blind drilled within 5 ft of BG65
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: ~~BG65a~~
Well ID: G65S
Surface Elev: 609.9 ft. MSL
Completion: 32.7 ft. BGS
Station: 13,985.08N
914.07E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 26.80 - during drilling
▼ = 25.28 - 1/30/2008
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
								Dark yellow brown (10YR4/4), slightly moist, silty CLAY, trace sand	
								Dark yellow brown (10YR4/6), moist, silty CLAY, trace sand	
							2		608
								Yellow brown (10YR5/6) with 30% yellow brown (10YR5/4) mottles, moist, silty CLAY, trace sand	
							4		606
								Brown yellow (10YR6/6), moist, clayey SILT, trace sand	
							6		604
							8		602
								Light gray (10YR7/2) with 5% brown yellow (10YR6/8) mottles, moist, sandy SILT	
							10		600
							12		598
							14		596
								Brown (10YR5/3) with 40% brown yellow (10YR5/4) mottles, moist, clayey SILT, trace sand	
							16		594
								Yellow brown (10YR5/8) with 35% brown (10YR5/3) and 10% very dark brown (10YR2/1) mottles, moist, very silty CLAY, trace sand	
							18		592
								Black (10YR2/1) with 40% brown yellow (10YR6/6) and 5% gray brown (10YR5/2) mottles, moist, silty CLAY, trace sand and gravel	
								Dark yellow brown (10YR4/6) with 30% brown yellow (10YR6/6) and 5% black (10YR2/1) mottles, moist, sandy CLAY, trace gravel	
							20		590

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/15/2008
Finish: 1/15/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger - blind drilled within 5 ft of BG65
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG65a
Well ID: G65S
Surface Elev: 609.9 ft. MSL
Completion: 32.7 ft. BGS
Station: 13,985.08N
914.07E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 26.80 - during drilling
▼ = 25.28 - 1/30/2008
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft^3)	Qu (tsf) *Failure Type*	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
								Brown (10YR5/3) with 45% dark yellow brown (10YR4/6) mottles, moist, sandy CLAY, trace gravel	
								Gray brown (10YR5/2) with 30% yellow brown (10YR5/6) mottles, moist, silty CLAY, trace sand and gravel	
								Dark yellow (10YR4/6) with 10% brown (10YR3/4) mottles, moist, silty fine to medium SAND	
							22	Yellow brown (10YR5/6) with30% light gray (10YR7/2) mottles, moist, clayey SILT, trace sand and gravel	588
								Yellow brown (10YR5/8) with 20% gray (10YR6/1) and 15% dark brown (10YR3/3) mottles, very moist, very silty CLAY, trace sand and gravel	
							24	Yellow brown (10YR5/6) with 50% light brown gray (10YR6/2) mottles, moist, very silty CLAY, trace sand and gravel	586
							26	Gray (10YR6/1) with 5% yellow brown (10YR5/4) mottles, moist, clayey SILT, trace sand and gravel	584
								Gray (10YR6/1) with 25% yellow brown (10YR5/4) mottles, wet, sandy SILT, trace gravel	
							28	Gray brown (10YR5/2), very moist, clayey SILT, trace sand	582
								Yellow brown (10YR5/8), very moist to wet, fine to coarse SAND, trace gravel	
								Dark yellow brown (10YR4/6) with 40% yellow brown (10YR5/6) mottles, wet, sandy SILT, trace gravel	
							30	Gray brown (10YR5/2) with 40% yellow brown (10YR5/6) mottles, moist, very silty CLAY, trace sand and gravel	580
								Dark yellow brown (10YR4/6) with 15% pale brown (10YR6/3) mottles, moist, very silty CLAY, little sand, trace gravel	
							32	Green gray (10Y5/1), moist, silty CLAY, trace sand and gravel	578
								Gray (N5/1) with 30% gray brown (10YR5/2) mottles, moist, silty CLAY, little sand and gravel	

End of Boring = 32.70 ft. BGS

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/14/2008
Finish: 1/14/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG65
Well ID: hole abandoned
Surface Elev: 609.7 ft. MSL
Completion: 44.0 ft. BGS
Station: 13,982.80N 909.90E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 26.80 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	24/24 100%	ss	4-4 6-6 N=10	23		
1B				22		2.72 BSh
	24/24 100%	ss	6-6 8-10 N=14			
2A				19		4.15 Sh
	20/24 83%	ss	4-4 7-7 N=11			
3A				17		2.62 Sh
	22/24 92%	ss	4-8 6-8 N=14			
4A						
4B				11		
	17/24 71%	ss	3-5 6-8 N=11			
5A				9		
	24/24 100%	ss	3-5 7-6 N=12			
6A				11		
7A				13		
	24/24 100%	ss	6-9 9-10 N=18			
7B				17		
	17/24 71%	ss	2-3 5-6 N=8			
8A				18		
9A	21/24 88%	ss	5-8 10-10 N=18	17		
9B				17		
10A				20		
10B	19/24 79%	ss	1-3 4-7 N=7	18		
10C				22		1.44

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark yellow brown (10YR4/4), slightly moist, silty CLAY, trace sand	
	Dark yellow brown (10YR4/6), moist, silty CLAY, trace sand	608
2	Yellow brown (10YR5/6) with 30% yellow brown (10YR5/4) mottles, moist, silty CLAY, trace sand	606
4	Brown yellow (10YR6/6), moist, clayey SILT, trace sand	604
6	Light gray (10YR7/2) with 5% brown yellow (10YR6/8) mottles, moist, sandy SILT	602
8		600
10		598
12	Brown (10YR5/3) with 40% brown yellow (10YR5/4) mottles, moist, clayey SILT, trace sand	596
14		594
16	Yellow brown (10YR5/8) with 35% brown (10YR5/3) and 10% very dark brown (10YR2/1) mottles, moist, very silty CLAY, trace sand	592
18	Black (10YR2/1) with 40% brown yellow (10YR6/6) and 5% gray brown (10YR5/2) mottles, moist, silty CLAY, trace sand and gravel	
	Dark yellow brown (10YR4/6) with 30% brown yellow (10YR6/6) and 5% black (10YR2/1) mottles, moist, sandy CLAY, trace gravel	590
20		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/14/2008
Finish: 1/14/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG65
Well ID: hole abandoned
Surface Elev: 609.7 ft. MSL
Completion: 44.0 ft. BGS
Station: 13,982.80N 909.90E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 26.80 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
11A				21		Sh
						1.16
	20/24 83%	ss	4-4 3-3 N=7			BSh
11B						
11C				16		
12A	19/24 79%	ss	3-5 4-43 N=9	26		
12B				26		
	24/24 100%	ss	1-3 5-10 N=8			
13A				19		
14A	20/24 83%	ss	10-8 7-6 N=15	19		
14B				14		
14C				22		1.09
15A				25		B
15B	24/24 100%	ss	7-12 11-17 N=23	21		
15C				13		
15D				11		
16A				13		
	20/24 83%	ss	2-10 9-14 N=19			
16B				12		5.82
						BSh
	24/24 100%	ss	11-15 16-20 N=31			
17A				12		6.40
						Bh
	24/24 100%	ss	7-16 24-35 N=40			
18A				11		7.62
						Sh
	24/24 100%	ss	43-72 75-97 N=147			
19A				10		
19B				11		
	22/24 92%	ss	11-27 25-25 N=52			
20A				13		5.24

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Brown (10YR5/3) with 45% dark yellow brown (10YR4/6) mottles, moist, sandy CLAY, trace gravel	
	Gray brown (10YR5/2) with 30% yellow brown (10YR5/6) mottles, moist, silty CLAY, trace sand and gravel	
	Dark yellow (10YR4/6) with 10% brown (10YR3/4) mottles, moist, silty fine to medium SAND	588
22	Yellow brown (10YR5/6) with30% light gray (10YR7/2) mottles, moist, clayey SILT, trace sand and gravel	
	Yellow brown (10YR5/8) with 20% gray (10YR6/1) and 15% dark brown (10YR3/3) mottles, very moist, very silty CLAY, trace sand and gravel	586
24	Yellow brown (10YR5/6) with 50% light brown gray (10YR6/2) mottles, moist, very silty CLAY, trace sand and gravel	
		584
26	Gray (10YR6/1) with 5% yellow brown (10YR5/4) mottles, moist, clayey SILT, trace sand and gravel	
▼	Gray (10YR6/1) with 25% yellow brown (10YR5/4) mottles, wet, sandy SILT, trace gravel	
	Gray brown (10YR5/2), very moist, clayey SILT, trace sand	582
28	Yellow brown (10YR5/8), very moist to wet, fine to coarse SAND, trace gravel	
	Dark yellow brown (10YR4/6) with 40% yellow brown (10YR5/6) mottles, wet, sandy SILT, trace gravel	
	Gray brown (10YR5/2) with 40% yellow brown (10YR5/6) mottles, moist, very silty CLAY, trace sand and gravel	580
30	Dark yellow brown (10YR4/6) with 15% pale brown (10YR6/3) mottles, moist, very silty CLAY, little sand, trace gravel	
	Green gray (10Y5/1), moist, silty CLAY, trace sand and gravel	578
32		
		576
34	Gray (N5/1) with 30% gray brown (10YR5/2) mottles, moist, silty CLAY, little sand and gravel	
		574
36		
		572
38	Gray (N5), wet, fine to medium SAND	
	Gray (N5) with 10% gray brown (10YR5/2) mottles, moist, silty CLAY, trace sand and gravel	
		570
40		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Ameren Energy Resources Generating Co.
Site: Duck Creek Gypsum Managment Facility
Location: Canton, Fulton Co., Illinois
Project: 03S5010
DATES: Start: 1/14/2008
Finish: 1/14/2008
WEATHER: Overcast, windy, cold

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: BG65
Well ID: hole abandoned
Surface Elev: 609.7 ft. MSL
Completion: 44.0 ft. BGS
Station: 13,982.80N
909.90E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 26.80 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Failure Type*
						Sh
	24/24 *100%*	ss	*4-14 17-24* N=31			
21A				10		10.86 *BSh*
21B				11		6.98 *Sh*
22A				24		2.33 *Sh*
22B	24/24 *100%*	ss	*27-41 77-109* N=118	18		
22C				14		
22D				11		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	Gray (N5) with 10% gray brown (10YR5/2) mottles, moist, silty CLAY, trace sand and gravel *[Continued from previous page]*		
42	Very dark green (10Y3/1) with 25% gray brown yellow (10YR6/8) mottles, moist, silty CLAY, trace sand and gravel	568	
	Green (5GY) with 10% gray brown (10YR4/3) mottles, moist, silty CLAY, trace sand and gravel		
	Dark green gray (10GY4/1), moist, silty CLAY, trace sand		
	Green (10Y5/1), wet, fine to medium SAND	566	
44	CHERT		

End of Boring = 44.0 ft. BGS

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/4/2009
Finish: 2/4/2009
WEATHER: very cold, sunny, windy, lo-teen's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: ~~G66a~~
Well ID: G66L
Surface Elev: 614.86 ft. MSL
Completion: 19.74 ft. BGS
Station: 14,240.49N
965.72E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) % Recovery	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
								FILL - Yellowish brown (10YR5/4) with 10% dark yellowish brown (10YR4/6) mottles, slightly moist, hard, clayey SILT.	614	
							2	FILL - Grayish brown (10YR5/2) with 10% dark yellowish brown (10YR4/6) and 10% yellowish brown (10YR5/4) mottles, slightly moist, hard, clayey SILT with slight trace sand.		
								FILL - Gray (10YR6/1) with 40% dark yellowish brown (10YR4/6) mottles, slightly moist, firm, clayey SILT, slight trace roots.	612	
							4			
								FILL - Yellowish brown (10YR5/4) with 20% gray (10YR6/1) mottles, slightly moist, firm, clayey SILT.	610	
							6			
									608	
							8			
								Yellowish brown (10YR5/4) with 20% dark yellowish brown (10YR4/6) and 5% gray (10YR6/1) mottles, moist, firm, clayey SILT.	606	
							10			
								Yellowish brown (10YR5/4) with 20% dark yellowish brown (10YR4/6) and 5% gray (10YR6/1) mottles, moist, soft, clayey SILT.	604	
							12			
								Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY.	602	
							14			
									600	
							16	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.		
									598	
							18			
								Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY.	596	

End of Boring = 19.74 ft bgs

NOTE(S): See G66S Boring log for sample and testing data.

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/4/2009
Finish: 2/4/2009
WEATHER: very cold, sunny, windy, lo-teen's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: ~~G66~~
Well ID: G66S
Surface Elev: 614.86 ft. MSL
Completion: 40.09 ft. BGS
Station: 14,236.19N
964.90E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 34.20 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	ss	30-30 20-10 N=50	18.4		
2A	24/24 100%	ss	10-13 15-22 N=28	20.5		
2B				16.3		
3A	20/24 83%	ss	4-8 8-7 N=16	17.7		
4A	24/24 100%	ss	10-12 12-9 N=24	19.5		
5A	19/24 79%	ss	3-6 8-10 N=14	22.8		
6A	19/24 79%	ss	1-3 3-5 N=6	26.1		
7A	22/24 92%	ss	3-4 3-4 N=7	28.4		
8A	16/24 67%	ss	1-2 4-4 N=6	23.4		
9A	20/24 83%	ss	3-4 5-6 N=9	23.5		
10A	19/24 79%	ss	1-3 4-3 N=7	24.6		
11A	19/24		2-2	25.9		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Yellowish brown (10YR5/4) with 10% dark yellowish brown (10YR4/6) mottles, slightly moist, hard, clayey SILT.	614
2	FILL - Grayish brown (10YR5/2) with 10% dark yellowish brown (10YR4/6) and 10% yellowish brown (10YR5/4) mottles, slightly moist, hard, clayey SILT with slight trace sand.	
	FILL - Gray (10YR6/1) with 40% dark yellowish brown (10YR4/6) mottles, slightly moist, firm, clayey SILT, slight trace roots.	612
4		
	FILL - Yellowish brown (10YR5/4) with 20% gray (10YR6/1) mottles, slightly moist, firm, clayey SILT.	610
6		608
8		
	Yellowish brown (10YR5/4) with 20% dark yellowish brown (10YR4/6) and 5% gray (10YR6/1) mottles, moist, firm, clayey SILT.	606
10		
	Yellowish brown (10YR5/4) with 20% dark yellowish brown (10YR4/6) and 5% gray (10YR6/1) mottles, moist, soft, clayey SILT.	604
12		
	Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY.	602
14		
	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	600
16		598
18		
	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY.	596
20		594

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/4/2009
Finish: 2/4/2009
WEATHER: very cold, sunny, windy, lo-teen's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: G66
Well ID: G66S
Surface Elev: 614.86 ft. MSL
Completion: 40.09 ft. BGS
Station: 14,236.19N
964.90E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 34.20 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11B	79%	SS	3-4 N=5	23.9		
12A	23/24 96%	SS	3-3 4-5 N=7	25.2		
13A	22/24 92%	SS	woh-2 2-3 N=4	22.7		
14A	23/24 96%	SS	4-7 7-8 N=14	18.8		
15A	18/24 75%	SS	1-1 3-4 N=4	21.3		
16A	19/24 79%	SS	1-3 4-5 N=7	17.2		
17A	24/24 100%	SS	6-8 9-9 N=17	13.9		
17B				32.2		
18A	22/24 92%	SS	4-10 16-13 N=26	15.6		
19A	24/24 100%	SS	12-12 13-22 N=25	11.8		
20A	19/24 79%	SS	18-28 36-48 N=64	11.2		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
22	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand.	592	
24	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with trace sand and slight trace gravel.	590	
26	Greenish gray (5GY5/1), moist, firm, silty CLAY with trace sand and slight trace gravel.	588	
28	Greenish gray (5GY5/1), moist, soft, silty CLAY with trace sand.	586	
30	Greenish gray (5GY6/1), moist, soft, clayey SILT with slight trace sand and gravel.	584	
32	Dark gray (N4/1), slightly moist, firm, clayey SILT with trace sand and slight trace gravel.	582	
▼ 34	Dark gray (N4/1), very moist, firm, clayey SILT with slight trace sand.		
	Dark gray (N4/1), moist, firm, clayey SILT with slight trace sand.	580	
36	Dark gray (N4/1), moist, firm, clayey SILT with sand and slight trace gravel.	578	
38	Dark gray (N4/1), slightly moist, hard, clayey SILT with slight trace sand and gravel.	576	Thin(<0.1'), wet, fine- to medium-grained sand seams near 36.0', 38.0', and 39.5'.
40			

End of Boring = 40.09 ft bgs

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/4/2009
Finish: 2/4/2009
WEATHER: very cold, sunny, windy, lo-teen's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: ~~G66~~
Well ID: G66S
Surface Elev: 614.86 ft. MSL
Completion: 40.09 ft. BGS
Station: 14,236.19N
964.90E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 34.20 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	ss	30-30 20-10 N=50	18.4		
2A	24/24 100%	ss	10-13 15-22 N=28	20.5		
2B				16.3		
3A	20/24 83%	ss	4-8 8-7 N=16	17.7		
4A	24/24 100%	ss	10-12 12-9 N=24	19.5		
5A	19/24 79%	ss	3-6 8-10 N=14	22.8		
6A	19/24 79%	ss	1-3 3-5 N=6	26.1		
7A	22/24 92%	ss	3-4 3-4 N=7	28.4		
8A	16/24 67%	ss	1-2 4-4 N=6	23.4		
9A	20/24 83%	ss	3-4 5-6 N=9	23.5		
10A	19/24 79%	ss	1-3 4-3 N=7	24.6		
11A	19/24		2-2	25.9		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Yellowish brown (10YR5/4) with 10% dark yellowish brown (10YR4/6) mottles, slightly moist, hard, clayey SILT.	614
2	FILL - Grayish brown (10YR5/2) with 10% dark yellowish brown (10YR4/6) and 10% yellowish brown (10YR5/4) mottles, slightly moist, hard, clayey SILT with slight trace sand.	
	FILL - Gray (10YR6/1) with 40% dark yellowish brown (10YR4/6) mottles, slightly moist, firm, clayey SILT, slight trace roots.	612
4		
	FILL - Yellowish brown (10YR5/4) with 20% gray (10YR6/1) mottles, slightly moist, firm, clayey SILT.	610
6		608
8		
	Yellowish brown (10YR5/4) with 20% dark yellowish brown (10YR4/6) and 5% gray (10YR6/1) mottles, moist, firm, clayey SILT.	606
10		
	Yellowish brown (10YR5/4) with 20% dark yellowish brown (10YR4/6) and 5% gray (10YR6/1) mottles, moist, soft, clayey SILT.	604
12		
	Gray (10YR5/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY.	602
14		
	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	600
16		598
18		
	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY.	596
20		594

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/4/2009
Finish: 2/4/2009
WEATHER: very cold, sunny, windy, lo-teen's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: G66
Well ID: G66S
Surface Elev: 614.86 ft. MSL
Completion: 40.09 ft. BGS
Station: 14,236.19N
964.90E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 34.20 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11B	79%	SS	3-4 N=5	23.9		
12A	23/24 96%	SS	3-3 4-5 N=7	25.2		
13A	22/24 92%	SS	woh-2 2-3 N=4	22.7		
14A	23/24 96%	SS	4-7 7-8 N=14	18.8		
15A	18/24 75%	SS	1-1 3-4 N=4	21.3		
16A	19/24 79%	SS	1-3 4-5 N=7	17.2		
17A	24/24 100%	SS	6-8 9-9 N=17	13.9		
17B				32.2		
18A	22/24 92%	SS	4-10 16-13 N=26	15.6		
19A	24/24 100%	SS	12-12 13-22 N=25	11.8		
20A	19/24 79%	SS	18-28 36-48 N=64	11.2		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
22	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with slight trace sand.	592	
24	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT with trace sand and slight trace gravel.	590	
26	Greenish gray (5GY5/1), moist, firm, silty CLAY with trace sand and slight trace gravel.	588	
28	Greenish gray (5GY5/1), moist, soft, silty CLAY with trace sand.	586	
30	Greenish gray (5GY6/1), moist, soft, clayey SILT with slight trace sand and gravel.	584	
32	Dark gray (N4/1), slightly moist, firm, clayey SILT with trace sand and slight trace gravel.	582	
▼ 34	Dark gray (N4/1), very moist, firm, clayey SILT with slight trace sand.		
	Dark gray (N4/1), moist, firm, clayey SILT with slight trace sand.	580	
36	Dark gray (N4/1), moist, firm, clayey SILT with sand and slight trace gravel.	578	
38	Dark gray (N4/1), slightly moist, hard, clayey SILT with slight trace sand and gravel.	576	Thin(<0.1'), wet, fine- to medium-grained sand seams near 36.0', 38.0', and 39.5'.
40			

End of Boring = 40.09 ft bgs

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/3/2009
Finish: 2/3/2009
WEATHER: very cold, partly cloudy, windy, lo-teen's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: ~~G67a~~
Well ID: G67L
Surface Elev: 614.64 ft. MSL
Completion: 17.18 ft. BGS
Station: 14,527.50N
928.85E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
								FILL - Yellowish brown (10YR5/4) with 10% gray (10YR5/1) mottles, slightly moist, hard, clayey SILT with slight trace sand and gravel.	614
							2	FILL - Yellowish brown (10YR5/4) with 15% gray (10YR6/1) and 10% dark yellowish brown (10YR4/6) mottles, slightly moist, firm, clayey SILT with slight trace sand and gravel.	612
							4	FILL - Yellowish brown (10YR5/4) with 10% gray (10YR6/1) mottles, moist, firm, clayey SILT with slight trace sand and gravel, trace roots.	610
							6	Gray (10YR5/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, hard, clayey SILT.	608
							8	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	606
							10		604
							12	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	602
							14	Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, wet, soft, clayey SILT.	600
							16	Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	598

Borehole Detail

End of Boring = 17.18 ft bgs

NOTE(S): See G67S Boring log for sample and testing data.

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/3/2009
Finish: 2/3/2009
WEATHER: very cold, partly cloudy, windy, lo-teen's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: ~~G67~~
Well ID: G67S
Surface Elev: 614.64 ft. MSL
Completion: 38.00 ft. BGS
Station: 14,530.27N
925.18E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 33.50 - during drilling
▼ = 31.71 - 02/03/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	SS	24-18 14-18 N=32	18.7		
2A	24/24 100%	SS	8-13 11-14 N=24	16.6		
3A	24/24 100%	SS	4-4 7-8 N=11	18.0		
4A	24/24 100%	SS	8-8 14-15 N=22	25.8		
5A	19/24 79%	SS	1-3 3-3 N=6	25.5		
6A	22/24 92%	SS	1-2 4-4 N=6	21.9		
7A	22/24 92%	SS	6-6 6-5 N=12	21.2		
8A	16/24 67%	SS	1-2 2-2 N=4	22.2		
9A	24/24 100%	SS	3-3 4-3 N=7	22.9		
9B				25.5		
10A	19/24 79%	SS	1-2 1-2 N=3	25.4		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Yellowish brown (10YR5/4) with 10% gray (10YR5/1) mottles, slightly moist, hard, clayey SILT with slight trace sand and gravel.	614
2	FILL - Yellowish brown (10YR5/4) with 15% gray (10YR6/1) and 10% dark yellowish brown (10YR4/6) mottles, slightly moist, firm, clayey SILT with slight trace sand and gravel.	612
4	FILL - Yellowish brown (10YR5/4) with 10% gray (10YR6/1) mottles, moist, firm, clayey SILT with slight trace sand and gravel, trace roots.	610
6	Gray (10YR5/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, hard, clayey SILT.	608
8	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	606
10		604
12	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	602
14	Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, wet, soft, clayey SILT.	600
16	Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	598
18	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY.	596
20		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/3/2009
Finish: 2/3/2009
WEATHER: very cold, partly cloudy, windy, lo-teen's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: G67
Well ID: G67S
Surface Elev: 614.64 ft. MSL
Completion: 38.00 ft. BGS
Station: 14,530.27N
925.18E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 33.50 - during drilling
▼ = 31.71 - 02/03/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	18/24 75%	SS	1-2 2-2 N=4	25.5		
12A	22/24 92%	SS	2-3 3-4 N=6	27.8		
13A	24/24 100%	SS	woh-1 2-2 N=3	23.5		
14A	16/24 67%	SS	2-2 3-3 N=5	19.2		
15A	17/24 71%	SS	woh-1 1-3 N=2	15.8		
16A	18/24 75%	SS	3-4 7-15 N=11	17.6		
16B				12.3		
17A	24/24 100%	SS	14-21 25-22 N=46	11.6		
17B				13.6		
18A	18/24 75%	SS	1-8 12-11 N=20	11.9		
19A	22/24 92%	SS	14-22 23-25 N=45	12.5		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY. *[Continued from previous page]*	594
22		592
	Gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with slight trace sand.	
24		590
	Grayish brown (10YR5/2) with 15% dark yellowish brown (10YR4/6) mottles, moist, very soft, silty CLAY with trace sand.	
26		588
28	Greenish gray (5GY5/1), moist, very soft, silty CLAY with trace sand and slight trace gravel.	586
30		584
32	Gray (N5/1), slightly moist, hard, clayey SILT with trace sand and slight trace gravel.	582
	Yellowish brown (10YR5/4), wet, medium dense, silty, fine- to coarse-grained SAND with slight trace gravel.	
34	Gray (N5/1), slightly moist, hard, clayey SILT with trace sand and slight trace gravel.	580
	Yellowish brown (10YR5/4), wet, medium dense, silty, fine- to coarse-grained SAND with slight trace gravel.	
36	Gray (N5/1), slightly moist, hard, clayey SILT with trace sand and slight trace gravel.	578
38		

End of Boring = 38.0 ft bgs

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/3/2009
Finish: 2/3/2009
WEATHER: very cold, partly cloudy, windy, lo-teen's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: ~~G67~~
Well ID: G67S
Surface Elev: 614.64 ft. MSL
Completion: 38.00 ft. BGS
Station: 14,530.27N
925.18E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 33.50 - during drilling
▼ = 31.71 - 02/03/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	SS	24-18 14-18 N=32	18.7		
2A	24/24 100%	SS	8-13 11-14 N=24	16.6		
3A	24/24 100%	SS	4-4 7-8 N=11	18.0		
4A	24/24 100%	SS	8-8 14-15 N=22	25.8		
5A	19/24 79%	SS	1-3 3-3 N=6	25.5		
6A	22/24 92%	SS	1-2 4-4 N=6	21.9		
7A	22/24 92%	SS	6-6 6-5 N=12	21.2		
8A	16/24 67%	SS	1-2 2-2 N=4	22.2		
9A	24/24 100%	SS	3-3 4-3 N=7	22.9		
9B				25.5		
10A	19/24 79%	SS	1-2 1-2 N=3	25.4		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	FILL - Yellowish brown (10YR5/4) with 10% gray (10YR5/1) mottles, slightly moist, hard, clayey SILT with slight trace sand and gravel.	614
2	FILL - Yellowish brown (10YR5/4) with 15% gray (10YR6/1) and 10% dark yellowish brown (10YR4/6) mottles, slightly moist, firm, clayey SILT with slight trace sand and gravel.	612
4	FILL - Yellowish brown (10YR5/4) with 10% gray (10YR6/1) mottles, moist, firm, clayey SILT with slight trace sand and gravel, trace roots.	610
6	Gray (10YR5/1) with 20% dark yellowish brown (10YR4/6) mottles, moist, hard, clayey SILT.	608
8	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	606
10		604
12	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	602
14	Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, wet, soft, clayey SILT.	600
16	Gray (10YR6/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	598
18	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY.	596
20		

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/3/2009
Finish: 2/3/2009
WEATHER: very cold, partly cloudy, windy, lo-teen's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: G67
Well ID: G67S
Surface Elev: 614.64 ft. MSL
Completion: 38.00 ft. BGS
Station: 14,530.27N
925.18E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 33.50 - during drilling
▼ = 31.71 - 02/03/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	18/24 75%	SS	1-2 2-2 N=4	25.5		
12A	22/24 92%	SS	2-3 3-4 N=6	27.8		
13A	24/24 100%	SS	woh-1 2-2 N=3	23.5		
14A	16/24 67%	SS	2-2 3-3 N=5	19.2		
15A	17/24 71%	SS	woh-1 1-3 N=2	15.8		
16A	18/24 75%	SS	3-4 7-15 N=11	17.6		
16B				12.3		
17A	24/24 100%	SS	14-21 25-22 N=46	11.6		
17B				13.6		
18A	18/24 75%	SS	1-8 12-11 N=20	11.9		
19A	22/24 92%	SS	14-22 23-25 N=45	12.5		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Gray (10YR5/1) with 10% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY. *[Continued from previous page]*	594
22		592
	Gray (10YR5/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, silty CLAY with slight trace sand.	
24		590
	Grayish brown (10YR5/2) with 15% dark yellowish brown (10YR4/6) mottles, moist, very soft, silty CLAY with trace sand.	
26		588
28	Greenish gray (5GY5/1), moist, very soft, silty CLAY with trace sand and slight trace gravel.	586
30		584
32	Gray (N5/1), slightly moist, hard, clayey SILT with trace sand and slight trace gravel.	582
	Yellowish brown (10YR5/4), wet, medium dense, silty, fine- to coarse-grained SAND with slight trace gravel.	
34	Gray (N5/1), slightly moist, hard, clayey SILT with trace sand and slight trace gravel.	580
	Yellowish brown (10YR5/4), wet, medium dense, silty, fine- to coarse-grained SAND with slight trace gravel.	
36	Gray (N5/1), slightly moist, hard, clayey SILT with trace sand and slight trace gravel.	578
38		

End of Boring = 38.0 ft bgs

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/18/2008
Finish: 11/18/2008
WEATHER: cold, sunny, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: ~~G70a~~
Well ID: G70L
Surface Elev: 614.97 ft. MSL
Completion: 30.00 ft. BGS
Station: 14,371.22N
156.88E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 27.00 - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
							2	FILL - Yellowish brown (10YR5/4), dry, firm, clayey SILT.	614, 612
							4	FILL - Brown (10YR5/3), dry, firm, silty CLAY.	610
							6	FILL - Dark grayish brown (10YR4/2), slightly moist, firm, silty CLAY.	608
							8	FILL - Brown (10YR5/3), slightly moist, firm, silty CLAY.	606
							10	FILL - Yellowish brown (10YR5/6), moist, hard, silty CLAY, trace roots.	604
							12	FILL - Yellowish brown (10YR5/6), very moist, hard, silty CLAY.	602
							14	FILL - Dark yellowish brown (10YR3/6), very moist, hard, silty CLAY.	600
							16	FILL - Yellowish brown (10YR5/6), very moist, hard, silty CLAY.	598
							18	Brown (7.5YR4/4) with 50% strong brown (7.5YR4/6) mottles, moist, hard, silty CLAY.	596
							20		

Borehole Detail

Remarks

NOTE(S): See G70S Boring log for sample and testing data.

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/18/2008
Finish: 11/18/2008
WEATHER: cold, sunny, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: .

BOREHOLE ID: G70a
Well ID: G70L
Surface Elev: 614.97 ft. MSL
Completion: 30.00 ft. BGS
Station: 14,371.22N
156.88E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 27.00 - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
								Brown (7.5YR4/4) with 50% strong brown (7.5YR4/6) mottles, moist, hard, silty CLAY. *[Continued from previous page]*	594
							22	Brown (7.5YR4/3), moist, hard, silty CLAY with trace sand.	592
							24	Brown (10YR5/3) with 50% dark yellowish brown (10YR4/6) mottles, moist, hard, silty CLAY with trace sand and slight trace gravel.	590
							26	Dark yellowish brown (10YR4/4) with 30% grayish brown (10YR5/2) very moist to wet, soft, clayey SILT with trace sand and slight trace gravel.	588
							28	Yellowish brown (10YR5/4) with 50% pale brown (10YR6/3) mottles, very moist to wet, soft, clayey SILT with slight trace sand and gravel. *Silt content increases with depth.*	586
							30	Yellowish brown (10YR5/4) with 20% light yellowish brown (10YR6/4) mottles, very moist, hard, clayey SILT with slight trace gravel.	

End of Boring = 30.00 ft bgs

Borehole Detail

Remarks

NOTE(S): See G70S Boring log for sample and testing data.

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/20/2008
Finish: 11/20/2008
WEATHER: cold, overcast, (30's)

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: ~~G71a~~
Well ID: G71L
Surface Elev: 614.94 ft. MSL
Completion: 30.20 ft. BGS
Station: 14,106.39N
278.83E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
							2	FILL - Yellowish brown (10YR5/8), slightly moist, firm, clayey SILT with slight trace sand and gravel.	614
							4		612
							6	FILL - Yellowish brown (10YR5/8) with 20% gray (10YR6/1) mottles, moist, firm, silty CLAY with slight trace sand and gravel, trace roots.	610
							8		608
							10	Light yellowish brown (10YR6/4) with 30% brownish yellow (10YR6/8) mottles, moist, soft to friable, clayey SILT with slight trace sand.	606
							12		604
							14	Light gray (10YR7/1) with 20% yellowish brown (10YR5/8) mottles, slightly moist, friable, clayey SILT with slight trace sand.	602
							16	Dark yellowish brown (10YR4/6), moist, friable, clayey SILT with slight trace sand.	600
							18	Dark yellowish brown (10YR4/4) with 30% very dark grayish brown (10YR3/2) and 10% yellowish brown (10YR5/8) mottles, moist, friable, clayey SILT with slight trace sand.	598
							20		596

Borehole Detail

Remarks

NOTE(S): See G71S Boring log for sample and testing data.

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/20/2008
Finish: 11/20/2008
WEATHER: cold, overcast, (30's)

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: G71a
Well ID: G71L
Surface Elev: 614.94 ft. MSL
Completion: 30.20 ft. BGS
Station: 14,106.39N
278.83E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
								Dark yellowish brown (10YR4/4) with 30% very dark grayish brown (10YR3/2) and 10% yellowish brown (10YR5/8) mottles, moist, firm, clayey SILT with slight trace sand.	594
							22	Yellowish brown (10YR5/8) with 25% very dark grayish brown (10YR3/2) and 10% gray (10YR5/1) mottles, moist, firm, silty CLAY with sand and slight trace gravel.	592
							24	Brownish yellow (10YR6/6) with 20% gray (10YR6/1) mottles, moist, soft to friable, clayey SILT with trace sand and slight trace gravel.	590
							26	Gray (10YR5/1) with 50% brownish yellow (10YR6/6) mottles, moist, soft, silty CLAY with sand and trace gravel.	588
							28	Brownish yellow (10YR6/6) with 25% gray (10YR6/1) mottles, moist, soft to friable, clayey SILT with slight trace sand.	
								Brownish yellow (10YR6/6), slightly moist, loose, silty, very fine- to medium-grained SAND with slight trace gravel.	586
							30	Brownish yellow (10YR6/6) with 30% gray (10YR6/1) mottles, moist, friable, clayey SILT.	

End of Boring = 30.20 ft bgs

Borehole Detail

NOTE(S): See G71S Boring log for sample and testing data.

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/20/2008
Finish: 11/20/2008
WEATHER: cold, overcast, (30's)

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: ~~G71~~
Well ID: G71S
Surface Elev: 614.94 ft. MSL
Completion: 40.00 ft. BGS
Station: 14,110.54N
277.06E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 35.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	SS	6-9 9-5 N=18	15.5		
2A	24/24 100%	SS	4-6 9-11 N=15	18.2		
3A	24/24 100%	SS	3-6 9-12 N=15	18.9		
4A	24/24 100%	SS	10-15 17-13 N=32	18.4		
5A	24/24 100%	SS	2-4 6-7 N=10	17.0		
6A	20/24 83%	SS	1-4 5-6 N=9	9.0		
7A	24/24 100%	SS	7-10 12-12 N=22	8.0		
8A	24/24 100%	SS	3-5 6-7 N=11	10.3		
9A	24/24 100%	SS	6-8 10-9 N=18	15.4		
10A	24/24 100%	SS	2-4 6-6 N=10	15.8		
	24/24		3-4			

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
2	FILL - Yellowish brown (10YR5/8), slightly moist, firm, clayey SILT with slight trace sand and gravel.	614	
4		612	
6	FILL - Yellowish brown (10YR5/8) with 20% gray (10YR6/1) mottles, moist, firm, silty CLAY with slight trace sand and gravel, trace roots.	610	
8		608	
10	Light yellowish brown (10YR6/4) with 30% brownish yellow (10YR6/8) mottles, moist, soft to friable, clayey SILT with slight trace sand.	606	
12		604	
14	Light gray (10YR7/1) with 20% yellowish brown (10YR5/8) mottles, slightly moist, friable, clayey SILT with slight trace sand.	602	
16		600	
18	Dark yellowish brown (10YR4/6), moist, friable, clayey SILT with slight trace sand.	598	
20	Dark yellowish brown (10YR4/4) with 30% very dark grayish brown (10YR3/2) and 10% yellowish brown (10YR5/8) mottles, moist, friable, clayey SILT with slight trace sand.	596	
	Dark yellowish brown (10YR4/4) with 30% very dark grayish brown (10YR3/2) and 10% yellowish brown (10YR5/8) mottles, moist, firm, clayey SILT with slight	594	

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/20/2008
Finish: 11/20/2008
WEATHER: cold, overcast, (30's)

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: G71
Well ID: G71S
Surface Elev: 614.94 ft. MSL
Completion: 40.00 ft. BGS
Station: 14,110.54N
277.06E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 35.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	100%	SS	6-9 N=10	18.0		
12A	24/24 100%	SS	6-13 15-14 N=28	20.6		
13A	24/24 100%	SS	woh-2 4-6 N=6	18.0		
14A	24/24 100%	SS	6-16 14-16 N=30	17.8		
14B				11.5		
15A	24/24 100%	SS	2-12 14-50/5" N=26	12.6		
16A	24/24 100%	SS	3-14 10-11 N=24	13.5		
16B				13.3		
17A	24/24 100%	SS	8-13 15-11 N=28	14.0		
18A	23/24 96%	SS	2-11 9-7 N=20	13.0		
18B				28.0		
19A	22/24 92%	SS	4-6 7-10 N=13	28.5		
20A	24/24 100%	SS	10-13 15-26 N=28	12.0		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	trace sand.	
22	Yellowish brown (10YR5/8) with 25% very dark grayish brown (10YR3/2) and 10% gray (10YR5/1) mottles, moist, firm, silty CLAY with sand and slight trace gravel.	592
24	Brownish yellow (10YR6/6) with 20% gray (10YR6/1) mottles, moist, soft to friable, clayey SILT with trace sand and slight trace gravel.	590
26	Gray (10YR5/1) with 50% brownish yellow (10YR6/6) mottles, moist, soft, silty CLAY with sand and trace gravel.	588
28	Brownish yellow (10YR6/6) with 25% gray (10YR6/1) mottles, moist, soft to friable, clayey SILT with slight trace sand.	
	Brownish yellow (10YR6/6), slightly moist, loose, silty, very fine- to medium-grained SAND with slight trace gravel.	586
30	Brownish yellow (10YR6/6) with 30% gray (10YR6/1) mottles, moist, friable, clayey SILT.	584
32	Dark gray (10YR4/1), moist, firm, silty CLAY with sand and trace gravel.	582
34		580
36	Dark gray (10YR4/1), wet, soft, clayey SILT, trace wood fragments.	578
38	Dark gray (10YR4/1), moist, firm, silty CLAY with sand and trace gravel.	576
40	**End of Boring = 40.00 ft bgs**	

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/20/2008
Finish: 11/20/2008
WEATHER: cold, overcast, (30's)

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: ~~G71~~
Well ID: G71S
Surface Elev: 614.94 ft. MSL
Completion: 40.00 ft. BGS
Station: 14,110.54N
277.06E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 35.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	SS	6-9 9-5 N=18	15.5		
2A	24/24 100%	SS	4-6 9-11 N=15	18.2		
3A	24/24 100%	SS	3-6 9-12 N=15	18.9		
4A	24/24 100%	SS	10-15 17-13 N=32	18.4		
5A	24/24 100%	SS	2-4 6-7 N=10	17.0		
6A	20/24 83%	SS	1-4 5-6 N=9	9.0		
7A	24/24 100%	SS	7-10 12-12 N=22	8.0		
8A	24/24 100%	SS	3-5 6-7 N=11	10.3		
9A	24/24 100%	SS	6-8 10-9 N=18	15.4		
10A	24/24 100%	SS	2-4 6-6 N=10	15.8		
	24/24		3-4			

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
2	FILL - Yellowish brown (10YR5/8), slightly moist, firm, clayey SILT with slight trace sand and gravel.	614	
4		612	
6	FILL - Yellowish brown (10YR5/8) with 20% gray (10YR6/1) mottles, moist, firm, silty CLAY with slight trace sand and gravel, trace roots.	610	
8		608	
10	Light yellowish brown (10YR6/4) with 30% brownish yellow (10YR6/8) mottles, moist, soft to friable, clayey SILT with slight trace sand.	606	
12		604	
14	Light gray (10YR7/1) with 20% yellowish brown (10YR5/8) mottles, slightly moist, friable, clayey SILT with slight trace sand.	602	
16		600	
18	Dark yellowish brown (10YR4/6), moist, friable, clayey SILT with slight trace sand.	598	
20	Dark yellowish brown (10YR4/4) with 30% very dark grayish brown (10YR3/2) and 10% yellowish brown (10YR5/8) mottles, moist, friable, clayey SILT with slight trace sand.	596	
	Dark yellowish brown (10YR4/4) with 30% very dark grayish brown (10YR3/2) and 10% yellowish brown (10YR5/8) mottles, moist, firm, clayey SILT with slight	594	

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/20/2008
Finish: 11/20/2008
WEATHER: cold, overcast, (30's)

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: G71
Well ID: G71S
Surface Elev: 614.94 ft. MSL
Completion: 40.00 ft. BGS
Station: 14,110.54N
277.06E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 35.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	100%	SS	6-9 N=10	18.0		
12A	24/24 100%	SS	6-13 15-14 N=28	20.6		
13A	24/24 100%	SS	woh-2 4-6 N=6	18.0		
14A	24/24 100%	SS	6-16 14-16 N=30	17.8		
14B				11.5		
15A	24/24 100%	SS	2-12 14-50/5" N=26	12.6		
16A	24/24 100%	SS	3-14 10-11 N=24	13.5		
16B				13.3		
17A	24/24 100%	SS	8-13 15-11 N=28	14.0		
18A	23/24 96%	SS	2-11 9-7 N=20	13.0		
18B				28.0		
19A	22/24 92%	SS	4-6 7-10 N=13	28.5		
20A	24/24 100%	SS	10-13 15-26 N=28	12.0		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	trace sand.	
22	Yellowish brown (10YR5/8) with 25% very dark grayish brown (10YR3/2) and 10% gray (10YR5/1) mottles, moist, firm, silty CLAY with sand and slight trace gravel.	592
24	Brownish yellow (10YR6/6) with 20% gray (10YR6/1) mottles, moist, soft to friable, clayey SILT with trace sand and slight trace gravel.	590
26	Gray (10YR5/1) with 50% brownish yellow (10YR6/6) mottles, moist, soft, silty CLAY with sand and trace gravel.	588
28	Brownish yellow (10YR6/6) with 25% gray (10YR6/1) mottles, moist, soft to friable, clayey SILT with slight trace sand.	
	Brownish yellow (10YR6/6), slightly moist, loose, silty, very fine- to medium-grained SAND with slight trace gravel.	586
30	Brownish yellow (10YR6/6) with 30% gray (10YR6/1) mottles, moist, friable, clayey SILT.	584
32	Dark gray (10YR4/1), moist, firm, silty CLAY with sand and trace gravel.	582
34		580
36	Dark gray (10YR4/1), wet, soft, clayey SILT, trace wood fragments.	578
38	Dark gray (10YR4/1), moist, firm, silty CLAY with sand and trace gravel.	576
40	**End of Boring = 40.00 ft bgs**	

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/19/2008
Finish: 11/19/2008
WEATHER: sunny, cold, (40's)

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: ~~G72a~~
Well ID: G72L
Surface Elev: 615.01 ft. MSL
Completion: 24.79 ft. BGS
Station: 13,904.84N
509.93E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
							2	FILL - Yellowish brown (10YR5/8), moist, firm, clayey SILT with slight trace sand and gravel.	614, 612, 610
							6	Yellowish brown (10YR5/8), moist, firm, silty CLAY with slight trace sand and gravel.	608
							8		606
							10	Yellowish brown (10YR5/8), moist, soft, silty CLAY with slight trace sand.	604
							12		602
							14	Light gray (10YR7/1) with 30% yellowish brown (10YR5/8) mottles, moist, friable, clayey SILT with slight trace sand.	600
							16	Light gray (10YR7/1) with 10% yellowish brown (10YR5/8) mottles, moist, friable, SILT with some clay and slight trace sand.	598
							18	Dark gray (10YR4/1) with 80% dark yellowish brown (10YR4/4) mottles, moist, friable, clayey SILT with slight trace sand.	596
							20		

Borehole Detail

NOTE(S): See G72S Boring log for sample and testing data.

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/19/2008
Finish: 11/19/2008
WEATHER: sunny, cold, (40's)

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: G72a
Well ID: G72L
Surface Elev: 615.01 ft. MSL
Completion: 24.79 ft. BGS
Station: 13,904.84N
509.93E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
								Dark yellowish brown (10YR4/8), moist, friable, very clayey SILT with trace sand.		594	
							22	Dark yellowish brown (10YR4/6) with 40% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.		592	
							24	Grayish brown (10YR5/2) with 30% yellowish brown (10YR5/8) mottles, moist, soft, clayey SILT with trace sand.			

End of Boring = 24.79 ft bgs

NOTE(S): See G72S Boring log for sample and testing data.

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/19/2008
Finish: 11/19/2008
WEATHER: sunny, cold, (40's)

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: ~~G72~~
Well ID: G72S
Surface Elev: 615.01 ft. MSL
Completion: 39.40 ft. BGS
Station: 13,905.05N
504.94E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 28.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	SS	3-3 6-6 N=9	20.4		
2A	24/24 100%	SS	3-5 6-6 N=11	18.3		
3A	24/24 100%	SS	3-5 6-9 N=11	15.7		
4A	24/24 100%	SS	10-14 16-16 N=30	21.3		
5A	24/24 100%	SS	3-4 6-7 N=10	19.3		
6A	24/24 100%	SS	2-3 6-8 N=9	18.2		
7A	20/24 83%	SS	5-7 12-13 N=19	9.2		
8A	24/24 100%	SS	1-3 4-6 N=7	11.1		
9A	24/24 100%	SS	5-7 10-9 N=17	12.3		
10A	24/24 100%	SS	1-3 4-7 N=7	17.5		
	24/24		1-3			

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
2	FILL - Yellowish brown (10YR5/8), moist, firm, clayey SILT with slight trace sand and gravel.	614	
4		612	
6		610	
8	Yellowish brown (10YR5/8), moist, firm, silty CLAY with slight trace sand and gravel.	608	
10		606	
12	Yellowish brown (10YR5/8), moist, soft, silty CLAY with slight trace sand.	604	
14		602	
16	Light gray (10YR7/1) with 30% yellowish brown (10YR5/8) mottles, moist, friable, clayey SILT with slight trace sand.	600	
18		598	
20	Light gray (10YR7/1) with 10% yellowish brown (10YR5/8) mottles, moist, friable, SILT with some clay and slight trace sand.	596	
	Dark gray (10YR4/1) with 80% dark yellowish brown (10YR4/4) mottles, moist, friable, clayey SILT with slight trace sand. Dark yellowish brown (10YR4/8), moist, friable, very clayey SILT with trace sand.		

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/19/2008
Finish: 11/19/2008
WEATHER: sunny, cold, (40's)

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: G72
Well ID: G72S
Surface Elev: 615.01 ft. MSL
Completion: 39.40 ft. BGS
Station: 13,905.05N
504.94E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 28.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	100%	SS	4-8 N=7	16.6		
12A	24/24 100%	SS	4-8 12-13 N=20	19.1		
13A	24/24 100%	SS	1-3 5-8 N=8	17.4		
14A	24/24 100%	SS	5-6 8-8 N=14	21.2		
15A	24/24 100%	SS	woh-1 2-3 N=3	26.5		
16A	24/24 100%	SS	1-3 6-10 N=9	19.3		
16B				15.9		
17A	20/24 83%	SS	5-10 13-11 N=23	24.9		
18A	24/24 100%	SS	2-6 7-9 N=13	27.8		
18B				11.1		
19A	24/24 100%	SS	7-9 12-14 N=21	11.1		
20A	17/17 100%	SS	26-45 50/5"	9.4		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark yellowish brown (10YR4/8), moist, friable, very clayey SILT with trace sand. *[Continued from previous page]*	
22		
	Dark yellowish brown (10YR4/6) with 40% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.	592
24		
	Grayish brown (10YR5/2) with 30% yellowish brown (10YR5/8) mottles, moist, soft, clayey SILT with trace sand.	590
26		
	Yellowish brown (10YR5/8) with 10% gray (10YR6/1) mottles, very moist, soft, silty CLAY with trace sand.	588
▼ 28		
	Gray (10YR6/1) with 20% yellowish brown (10YR5/8) mottles, very moist to wet, very soft, silty CLAY with trace sand and slight trace gravel.	586
30		
	Light gray (10YR7/1) with 30% yellowish brown (10YR5/8) mottles, wet, very soft, clayey SILT with some very fine-grained sand and slight trace gravel.	584
	Dark gray (10YR4/1), moist, firm, silty CLAY with trace sand and slight trace gravel.	
32		
	Brownish yellow (10YR6/6), wet, soft, clayey SILT with trace very fine-grained sand.	582
34	Dark gray (10YR4/1), moist, firm, very silty CLAY with slight trace sand.	
	Dark gray (10YR4/1), moist, loose, SILT and very fine-grained SAND.	580
36		
	Dark gray (10YR4/1), moist, firm, silty CLAY with trace sand and slight trace gravel.	578
38		
		576

End of Boring = 39.40 ft bgs

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/19/2008
Finish: 11/19/2008
WEATHER: sunny, cold, (40's)

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: ~~G72~~
Well ID: G72S
Surface Elev: 615.01 ft. MSL
Completion: 39.40 ft. BGS
Station: 13,905.05N
504.94E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 28.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	SS	3-3 6-6 N=9	20.4		
2A	24/24 100%	SS	3-5 6-6 N=11	18.3		
3A	24/24 100%	SS	3-5 6-9 N=11	15.7		
4A	24/24 100%	SS	10-14 16-16 N=30	21.3		
5A	24/24 100%	SS	3-4 6-7 N=10	19.3		
6A	24/24 100%	SS	2-3 6-8 N=9	18.2		
7A	20/24 83%	SS	5-7 12-13 N=19	9.2		
8A	24/24 100%	SS	1-3 4-6 N=7	11.1		
9A	24/24 100%	SS	5-7 10-9 N=17	12.3		
10A	24/24 100%	SS	1-3 4-7 N=7	17.5		
	24/24		1-3			

Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
2	FILL - Yellowish brown (10YR5/8), moist, firm, clayey SILT with slight trace sand and gravel.	614	
4		612	
6		610	
8	Yellowish brown (10YR5/8), moist, firm, silty CLAY with slight trace sand and gravel.	608	
10		606	
12	Yellowish brown (10YR5/8), moist, soft, silty CLAY with slight trace sand.	604	
14		602	
16	Light gray (10YR7/1) with 30% yellowish brown (10YR5/8) mottles, moist, friable, clayey SILT with slight trace sand.	600	
18		598	
20	Light gray (10YR7/1) with 10% yellowish brown (10YR5/8) mottles, moist, friable, SILT with some clay and slight trace sand.	596	
	Dark gray (10YR4/1) with 80% dark yellowish brown (10YR4/4) mottles, moist, friable, clayey SILT with slight trace sand. Dark yellowish brown (10YR4/8), moist, friable, very clayey SILT with trace sand.		

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/19/2008
Finish: 11/19/2008
WEATHER: sunny, cold, (40's)

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: G72
Well ID: G72S
Surface Elev: 615.01 ft. MSL
Completion: 39.40 ft. BGS
Station: 13,905.05N
504.94E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 28.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	100%	SS	4-8 N=7	16.6		
12A	24/24 100%	SS	4-8 12-13 N=20	19.1		
13A	24/24 100%	SS	1-3 5-8 N=8	17.4		
14A	24/24 100%	SS	5-6 8-8 N=14	21.2		
15A	24/24 100%	SS	woh-1 2-3 N=3	26.5		
16A	24/24 100%	SS	1-3 6-10 N=9	19.3		
16B				15.9		
17A	20/24 83%	SS	5-10 13-11 N=23	24.9		
18A	24/24 100%	SS	2-6 7-9 N=13	27.8		
18B				11.1		
19A	24/24 100%	SS	7-9 12-14 N=21	11.1		
20A	17/17 100%	SS	26-45 50/5"	9.4		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark yellowish brown (10YR4/8), moist, friable, very clayey SILT with trace sand. *[Continued from previous page]*	
22		
	Dark yellowish brown (10YR4/6) with 40% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.	592
24		
	Grayish brown (10YR5/2) with 30% yellowish brown (10YR5/8) mottles, moist, soft, clayey SILT with trace sand.	590
26		
	Yellowish brown (10YR5/8) with 10% gray (10YR6/1) mottles, very moist, soft, silty CLAY with trace sand.	588
▼ 28		
	Gray (10YR6/1) with 20% yellowish brown (10YR5/8) mottles, very moist to wet, very soft, silty CLAY with trace sand and slight trace gravel.	586
30		
	Light gray (10YR7/1) with 30% yellowish brown (10YR5/8) mottles, wet, very soft, clayey SILT with some very fine-grained sand and slight trace gravel.	584
	Dark gray (10YR4/1), moist, firm, silty CLAY with trace sand and slight trace gravel.	
32		
	Brownish yellow (10YR6/6), wet, soft, clayey SILT with trace very fine-grained sand.	582
34	Dark gray (10YR4/1), moist, firm, very silty CLAY with slight trace sand.	
	Dark gray (10YR4/1), moist, loose, SILT and very fine-grained SAND.	580
36		
	Dark gray (10YR4/1), moist, firm, silty CLAY with trace sand and slight trace gravel.	578
38		
		576

End of Boring = 39.40 ft bgs

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/6/2009
Finish: 2/6/2009
WEATHER: cool, sunny, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: ~~G73a~~
Well ID: G73L
Surface Elev: 614.64 ft. MSL
Completion: 34.76 ft. BGS
Station: 13,924.52N
799.45E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
								FILL - Yellowish brown (10YR5/4) with 30% gray (10YR5/1) mottles, slightly moist, hard, clayey SILT with slight trace sand and gravel.	614
							2	FILL - Dark yellowish brown (10YR4/4), slightly moist, firm, clayey SILT with slight trace sand and gravel.	612
							4	FILL - Gray (10YR5/1) with 40% dark yellowish brown (10YR4/6) mottles, moist, firm, clayey SILT with slight trace sand and gravel.	610
							6	FILL - Dark yellowish brown (10YR4/4) with 10% gray (10YR6/1) mottles, slightly moist, firm, clayey SILT with slight trace sand and gravel.	608
							8	FILL - Dark yellowish brown (10YR4/4) with 10% gray (10YR6/1) mottles, slightly moist, soft, clayey SILT with slight trace sand and gravel.	606
							10	FILL - Dark yellowish brown (10YR4/4) with 5% gray (10YR6/1) mottles, moist, firm, clayey SILT with slight trace sand and gravel.	604
							12	FILL - Strong brown (7.5YR4/6), moist, firm, silty CLAY with slight trace sand, trace roots.	602
							14	Dark yellowish brown (10YR4/4) with 10% gray (10YR6/1) mottles, moist, soft to friable, clayey SILT with slight trace sand.	600
							16	Yellowish brown (10YR5/4) with 5% dark yellowish brown (10YR4/6) and 5% (10YR5/1) mottles, moist, firm, clayey SILT with slight trace sand, trace roots.	598
							18	Brown (10YR4/3) with 5% dark yellowish brown (10YR4/6) and 5% gray (10YR6/1) mottles, slightly moist, hard, clayey SILT with slight trace sand and gravel.	596
							20		

Borehole Detail

Remarks

NOTE(S): See G73S Boring log for sample and testing data.

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 2/6/2009
Finish: 2/6/2009
WEATHER: cool, sunny, lo-30's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: G73a
Well ID: G73L
Surface Elev: 614.64 ft. MSL
Completion: 34.76 ft. BGS
Station: 13,924.52N
799.45E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
							22	Brown (10YR4/3) with 5% dark yellowish brown (10YR4/6) and 5% gray (10YR6/1) mottles, slightly moist, hard, clayey SILT with slight trace sand and gravel. *[Continued from previous page]*	594, 592
							24		590
							26	Dark yellowish brown (10YR4/4) with 5% gray (10YR6/1) mottles, slightly moist, firm, clayey SILT with trace sand and slight trace gravel.	
								Dark gray (10YR4/1), slightly moist, hard, clayey SILT with trace sand and slight trace gravel.	588
							28	Dark yellowish brown (10YR4/4) with 20% gray (10YR6/1) mottles, slightly moist, firm, clayey SILT with slight trace sand and gravel.	586
							30	Brown (10YR4/3) with 15% gray (10YR5/1) mottles, moist, firm, clayey SILT with slight trace sand and gravel.	584
							32	Dark yellowish brown (10YR4/4) with 10% gray (10YR6/1) mottles, slightly moist, firm, clayey SILT with slight trace sand and gravel.	582
								Dark yellowish brown (10YR4/4) with 30% gray (10YR6/1) mottles, very moist, soft, clayey SILT.	
							34	Gray (10YR6/1) with 30% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	580
								Dark yellowish brown (10YR4/6) with 30% gray (10YR5/1) mottles, moist, soft, clayey SILT with slight trace sand and gravel.	

End of Boring = 34.76 ft bgs

NOTE(S): See G73S Boring log for sample and testing data.

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/10/2008
Finish: 11/10/2008
WEATHER: cool, sunny, lo-40's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

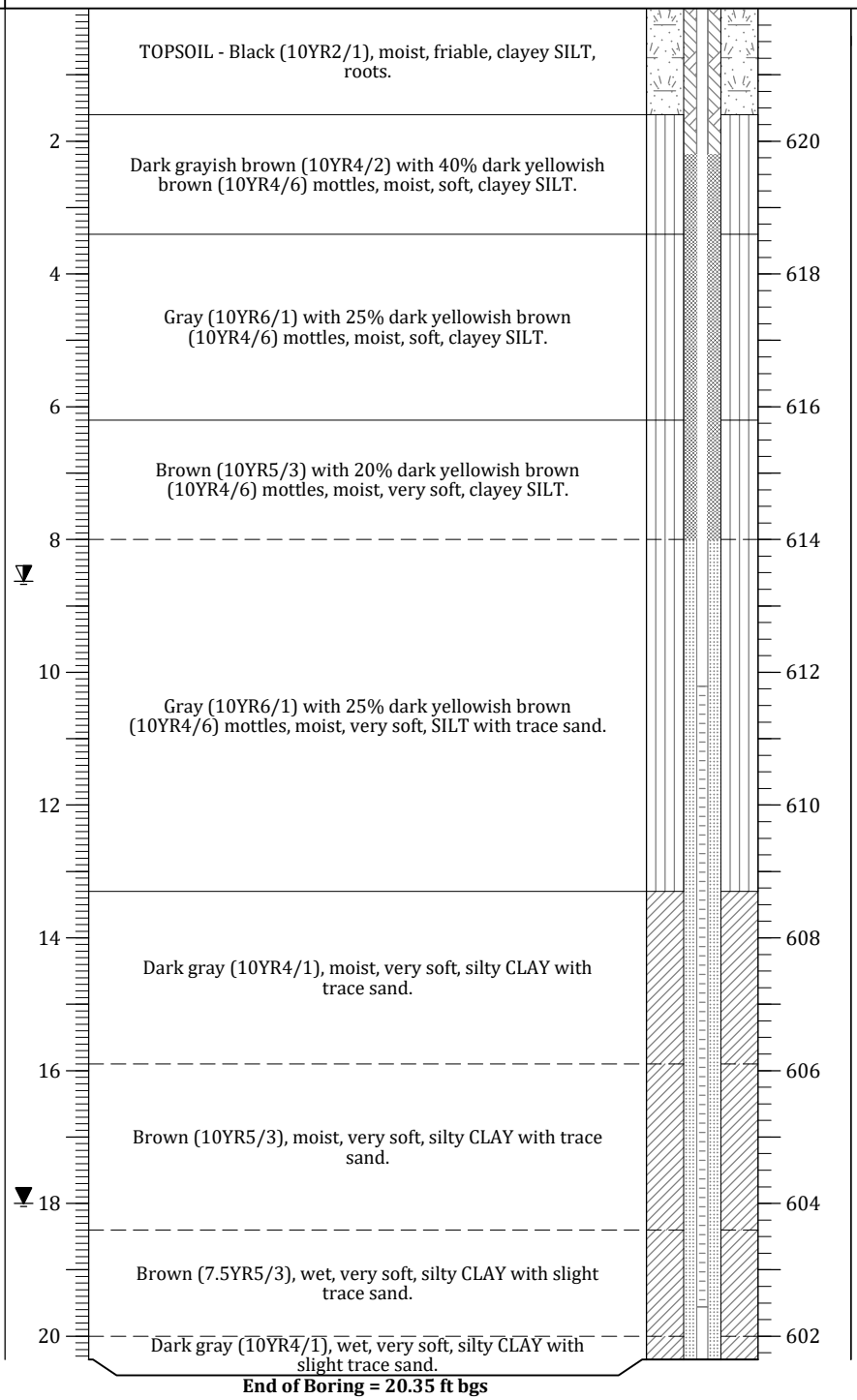
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: ~~P01b~~
Well ID: P01L
Surface Elev: 622.00 ft. MSL
Completion: 20.35 ft. BGS
Station: 16,744.77N
-194.61E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 7, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 18.00 - during drilling
▼ = 8.63 - 01/08/09
▽ =

SAMPLE			TESTING							
Number	Recov / Total (in) % Recovery	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks



End of Boring = 20.35 ft bgs

NOTE(S): See P01I Boring log for sample and testing data.

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/10/2008
Finish: 11/10/2008
WEATHER: cool, sunny, lo-40's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: ~~P01~~
Well ID: P01I
Surface Elev: 622.00 ft. MSL
Completion: 46.00 ft. BGS
Station: 16,749.97N
-194.61E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 7, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 18.00 - during drilling
▼ = 9.58 - 01/08/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	SS	4-4 5-10 N=9	17.2		
1B				30.5		
2A	24/24 100%	SS	2-2 3-4 N=5	30.3		
2B				24.9		
3A	23/24 96%	SS	2-2 3-4 N=5	24.9		
4A	24/24 100%	SS	2-3 4-4 N=7	22.9		
5A	20/24 83%	SS	2-2 3-3 N=5	22.1		
6A	12/24 50%	SS	1-1 2-3 N=3	26.9		
7A	18/24 75%	SS	2-4 5-6 N=9	24.5		
7B				27.7		
8A	24/24 100%	SS	2-2 3-4 N=5	25.2		
8B				25.1		
9A	7/24 29%	SS	woh-woh woh-woh	24.9		
10A	24/24 100%	SS	2-3 4-5 N=7	22.5		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	TOPSOIL - Black (10YR2/1), moist, friable, clayey SILT, roots.	
2	Dark grayish brown (10YR4/2) with 40% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	620
4	Gray (10YR6/1) with 25% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	618
6	Brown (10YR5/3) with 20% dark yellowish brown (10YR4/6) mottles, moist, very soft, clayey SILT.	616
8	Gray (10YR6/1) with 25% dark yellowish brown (10YR4/6) mottles, moist, very soft, SILT with trace sand.	614
10 ▼		612
12		610
14	Dark gray (10YR4/1), moist, very soft, silty CLAY with trace sand.	608
16	Brown (10YR5/3), moist, very soft, silty CLAY with trace sand.	606
18 ▼	Brown (7.5YR5/3), wet, very soft, silty CLAY with slight trace sand.	604
20		602

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/10/2008
Finish: 11/10/2008
WEATHER: cool, sunny, lo-40's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: P01
Well ID: P01I
Surface Elev: 622.00 ft. MSL
Completion: 46.00 ft. BGS
Station: 16,749.97N
-194.61E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 7, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 18.00 - during drilling
▼ = 9.58 - 01/08/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	23/24 96%	SS	2-2 3-6 N=5	28.0		
11B				21.9		
12A	24/24 100%	SS	0-0 3-5 N=3	24.5		
12B				21.8		
13A	24/24 100%	SS	1-2 2-4 N=4	20.3		
14A	24/24 100%	SS	0-3 3-3 N=6	19.9		
14B				16.4		
15A	24/24 100%	SS	4-5 7-10 N=12	16.5		
16A	24/24 100%	SS	2-3 4-5 N=7	16.4		
17A	18/24 75%	SS	3-3 4-5 N=7	30.6		
18A	24/24 100%	SS	7-9 14-21 N=23	23.5		
18B				12.5		
19A	24/24 100%	SS	8-10 15-20 N=25	12.4		
19B				11.4		
20A	12/16 75%	SS	16-26 50/4"	12.5		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark gray (10YR4/1), wet, very soft, silty CLAY with slight trace sand.	
	Dark greenish gray (5GY4/1), moist, hard, silty CLAY with some sand and trace gravel.	
22	Dark gray (10YR4/1), wet, soft, silty CLAY with little sand.	600
	Dark greenish gray (5GY4/1), moist, hard, silty CLAY with some sand and trace gravel.	
24		598
	Greenish gray (5GY6/1), wet, loose, clayey fine- to coarse-grained SAND with trace gravel.	
26		596
	Olive (5Y5/3), moist, soft, clayey SILT with slight trace sand.	
28		594
30	Gray (N5/1), moist, firm, clayey SILT with slight trace sand and gravel.	592
32		590
34		588
	Dark gray (10YR4/1), moist, firm, clayey SILT.	
36	Greenish gray (5G5/1) with 30% reddish brown (5YR5/3) mottles, slightly moist, hard, clayey SILT with little sand and gravel.	586
	Gray (N5/1), wet, silty fine- to coarse-grained SAND with trace gravel.	
38	Gray (10YR5/1) slightly moist, hard, clayey SILT with trace sand and slight trace gravel.	584
40		582

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/10/2008
Finish: 11/10/2008
WEATHER: cool, sunny, lo-40's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

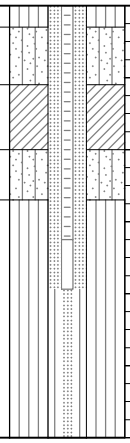
BOREHOLE ID: P01
Well ID: P01I
Surface Elev: 622.00 ft. MSL
Completion: 46.00 ft. BGS
Station: 16,749.97N
-194.61E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 7, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 18.00 - during drilling
▼ = 9.58 - 01/08/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
21A	24/24 100%	SS	7-15 18-21 N=33	11.5				Dark greenish gray (10Y4/1), wet, silty fine- to coarse-grained SAND with trace gravel.	
21B				15.2				Dark gray (N4/1), moist, very hard, silty CLAY with some sand and gravel.	
22A	24/24 100%	SS	8-6 17-21 N=23	14.3			42	Dark greenish gray (10Y4/1), wet, silty fine- to coarse-grained SAND with trace gravel.	580
22B				13.0			44	Dark gray (N4/1), slightly moist, very hard, clayey SILT with little sand and trace gravel.	578
23A	13/24 54%	SS	24-22 20-22 N=42	13.7			46		576

Borehole Detail



Remarks

End of Boring = 46.00 ft bgs

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/10/2008
Finish: 11/10/2008
WEATHER: cool, sunny, lo-40's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA

FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

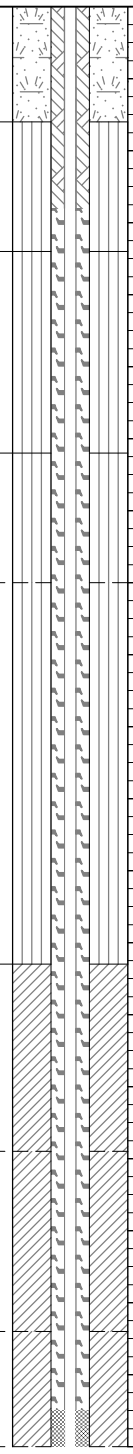
BOREHOLE ID: ~~P01a~~
Well ID: P01S
Surface Elev: 622.00 ft. MSL
Completion: 27.74 ft. BGS
Station: 16,754.60N
-194.67E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 7, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 18.00 - during drilling
▼ = 8.46 - 01/08/09
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
								TOPSOIL - Black (10YR2/1), moist, friable, clayey SILT, roots.	
							2	Dark grayish brown (10YR4/2) with 40% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	620
							4	Gray (10YR6/1) with 25% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	618
							6	Brown (10YR5/3) with 20% dark yellowish brown (10YR4/6) mottles, moist, very soft, clayey SILT.	616
							8 ▼	Gray (10YR6/1) with 25% dark yellowish brown (10YR4/6) mottles, moist, very soft, SILT with trace sand.	614
							10		612
							12		610
							14	Dark gray (10YR4/1), moist, very soft, silty CLAY with trace sand.	608
							16	Brown (10YR5/3), moist, very soft, silty CLAY with trace sand.	606
							18 ▼	Brown (7.5YR5/3), wet, very soft, silty CLAY with slight trace sand.	604
							20		602

Borehole Detail



NOTE(S): See P01I Boring log for sample and testing data.

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/10/2008
Finish: 11/10/2008
WEATHER: cool, sunny, lo-40's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

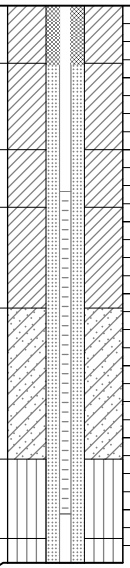
BOREHOLE ID: P01a
Well ID: P01S
Surface Elev: 622.00 ft. MSL
Completion: 27.74 ft. BGS
Station: 16,754.60N
-194.67E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 7, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 18.00 - during drilling
▼ = 8.46 - 01/08/09
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
								Dark gray (10YR4/1), wet, very soft, silty CLAY with slight trace sand.	
								Dark greenish gray (5GY4/1), moist, hard, silty CLAY with some sand and trace gravel.	
							22	Dark gray (10YR4/1), wet, soft, silty CLAY with little sand.	600
								Dark greenish gray (5GY4/1), moist, hard, silty CLAY with some sand and trace gravel.	
							24	Greenish gray (5GY6/1), wet, loose, clayey fine- to coarse-grained SAND with trace gravel.	598
							26	Olive (5Y5/3), moist, soft, clayey SILT with slight trace sand.	596
								Gray (N5/1), moist, firm, clayey SILT with slight trace sand and gravel.	

Borehole Detail



Remarks

End of Boring = 27.74 ft bgs

NOTE(S): See P01I Boring log for sample and testing data.

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/10/2008
Finish: 11/10/2008
WEATHER: cool, sunny, lo-40's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: ~~P01~~
Well ID: P01I
Surface Elev: 622.00 ft. MSL
Completion: 46.00 ft. BGS
Station: 16,749.97N
-194.61E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 7, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 18.00 - during drilling
▼ = 9.58 - 01/08/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	SS	4-4 5-10 N=9	17.2		
1B				30.5		
2A	24/24 100%	SS	2-2 3-4 N=5	30.3		
2B				24.9		
3A	23/24 96%	SS	2-2 3-4 N=5	24.9		
4A	24/24 100%	SS	2-3 4-4 N=7	22.9		
5A	20/24 83%	SS	2-2 3-3 N=5	22.1		
6A	12/24 50%	SS	1-1 2-3 N=3	26.9		
7A	18/24 75%	SS	2-4 5-6 N=9	24.5		
7B				27.7		
8A	24/24 100%	SS	2-2 3-4 N=5	25.2		
8B				25.1		
9A	7/24 29%	SS	woh-woh woh-woh	24.9		
10A	24/24 100%	SS	2-3 4-5 N=7	22.5		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	TOPSOIL - Black (10YR2/1), moist, friable, clayey SILT, roots.	
2	Dark grayish brown (10YR4/2) with 40% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	620
4	Gray (10YR6/1) with 25% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	618
6	Brown (10YR5/3) with 20% dark yellowish brown (10YR4/6) mottles, moist, very soft, clayey SILT.	616
8	Gray (10YR6/1) with 25% dark yellowish brown (10YR4/6) mottles, moist, very soft, SILT with trace sand.	614
10 ▼		612
12		610
14	Dark gray (10YR4/1), moist, very soft, silty CLAY with trace sand.	608
16	Brown (10YR5/3), moist, very soft, silty CLAY with trace sand.	606
18 ▼	Brown (7.5YR5/3), wet, very soft, silty CLAY with slight trace sand.	604
20		602

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/10/2008
Finish: 11/10/2008
WEATHER: cool, sunny, lo-40's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: P01
Well ID: P01I
Surface Elev: 622.00 ft. MSL
Completion: 46.00 ft. BGS
Station: 16,749.97N
-194.61E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 7, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 18.00 - during drilling
▼ = 9.58 - 01/08/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	23/24 96%	SS	2-2 3-6 N=5	28.0		
11B				21.9		
12A	24/24 100%	SS	0-0 3-5 N=3	24.5		
12B				21.8		
13A	24/24 100%	SS	1-2 2-4 N=4	20.3		
14A	24/24 100%	SS	0-3 3-3 N=6	19.9		
14B				16.4		
15A	24/24 100%	SS	4-5 7-10 N=12	16.5		
16A	24/24 100%	SS	2-3 4-5 N=7	16.4		
17A	18/24 75%	SS	3-3 4-5 N=7	30.6		
18A	24/24 100%	SS	7-9 14-21 N=23	23.5		
18B				12.5		
19A	24/24 100%	SS	8-10 15-20 N=25	12.4		
19B				11.4		
20A	12/16 75%	SS	16-26 50/4"	12.5		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark gray (10YR4/1), wet, very soft, silty CLAY with slight trace sand.	
	Dark greenish gray (5GY4/1), moist, hard, silty CLAY with some sand and trace gravel.	
22	Dark gray (10YR4/1), wet, soft, silty CLAY with little sand.	600
	Dark greenish gray (5GY4/1), moist, hard, silty CLAY with some sand and trace gravel.	
24		598
	Greenish gray (5GY6/1), wet, loose, clayey fine- to coarse-grained SAND with trace gravel.	
26		596
	Olive (5Y5/3), moist, soft, clayey SILT with slight trace sand.	
28		594
30	Gray (N5/1), moist, firm, clayey SILT with slight trace sand and gravel.	592
32		590
34		588
	Dark gray (10YR4/1), moist, firm, clayey SILT.	
36	Greenish gray (5G5/1) with 30% reddish brown (5YR5/3) mottles, slightly moist, hard, clayey SILT with little sand and gravel.	586
	Gray (N5/1), wet, silty fine- to coarse-grained SAND with trace gravel.	
38	Gray (10YR5/1) slightly moist, hard, clayey SILT with trace sand and slight trace gravel.	584
40		582

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/10/2008
Finish: 11/10/2008
WEATHER: cool, sunny, lo-40's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

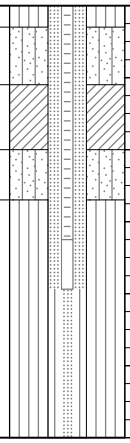
BOREHOLE ID: P01
Well ID: P01I
Surface Elev: 622.00 ft. MSL
Completion: 46.00 ft. BGS
Station: 16,749.97N
-194.61E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 7, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 18.00 - during drilling
▼ = 9.58 - 01/08/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
21A	24/24 100%	SS	7-15 18-21 N=33	11.5				Dark greenish gray (10Y4/1), wet, silty fine- to coarse-grained SAND with trace gravel.	
21B				15.2				Dark gray (N4/1), moist, very hard, silty CLAY with some sand and gravel.	
22A	24/24 100%	SS	8-6 17-21 N=23	14.3			42	Dark greenish gray (10Y4/1), wet, silty fine- to coarse-grained SAND with trace gravel.	580
22B				13.0			44	Dark gray (N4/1), slightly moist, very hard, clayey SILT with little sand and trace gravel.	578
23A	13/24 54%	SS	24-22 20-22 N=42	13.7			46		576

Borehole Detail



Remarks

End of Boring = 46.00 ft bgs

NOTE(S):

HANSON

P41D (MW-5D)

RECORD OF SOIL EXPLORATION

Project Name	Ameren Duck Creek	Sheet	1 of 3
Job #	03S5010	Boring #	~~B-14/MW-5~~
Location	CCB Landfill - Phase II Site Invest.	Station	-
Driller	Western Environmental Drilling Inc.	Surface Elevation	610.3
Foreman	Randy Howard CME 850	Drilling Method	HSA/ 2-3/4" Mud Rotary
Engineer/Geologist	ASY	Sampling Method	SS/Core
Weather & Temp.	82°, Sunny, Breezy	Hammer Type	Auto
Date: Start	9/17/2003 1250	Water Depth: DD	18'
Finish	9/19/2003 1255	AAR	-
		Delayed	-

STRATUM DEPTH From	STRATUM DEPTH To	SOIL CLASSIFICATION	SAMPLE NUMBER	SAMPLE DEPTH From	SAMPLE DEPTH To	STD. PENETRATION TEST BLOWS / 6 INCHES P=Penetrometer
0.0	0.5	Brn. silt loam, moist, topsoil.	SS-1	1.5	3.5	3-5-5-5 Rec = 18" Qp = 2.5
0.5	4.5	Lt. brn.-gray to yellow-brn. silt, tr.-so. clay, moist, mottled, iron staining, roots (loess).	SS-2	4.0	6.0	3-4-4-4 Rec = 20" Qp = 1.7
4.5	7.8	Gray silt, so. iron staining, v. moist @ 6' 7", occ. roots, moist (loess).	SS-3	6.5	8.5	2-2-3-3 Rec = 24" Qp = 1.6
7.8	9.0	Brn. and gray mottled silt, tr. clay, moist (loess).	SS-4	9.0	11.0	1-2-3-4 Rec = 20" Qp = 1.3
9.0	11.0	Yel.-brn. silt, tr. clay, moist (loess).	SS-5	11.5	13.5	1-2-3-3 Rec = 24" Qp = 1.3
11.0	14.5	Red-brn. and gray clayey silt, tr. f. sand, moist (till).	SS-6	14.0	16.0	2-3-3-3 Rec = 22" Qp = 1.4 to 2.4
14.5	18.0	As above, so. f.-m. sand, tr. coal frags and gravel (till).	SS-7	16.5	18.5	2-2-2-2 Rec = 24" Qp = -
18.0	20.8	Yellow-brn. sa. silt, so. clay, tr. gravel, v. moist to wet.	SS-8	19.0	21.0	1-1-2-2 Rec = 24" Qp = -
20.8	23.3	Red-brn and gray clayey silt, tr.-so. f. sand, tr. gravel and coal frags., moist (till).	SS-9	21.5	23.5	2-4-3-5 Rec = 19" Qp = 2.2
23.3	24.0	Brn-gray silty v.f. sand, wet.	SS-10	24.0	26.0	1-2-2-3 Rec = 19" Qp = -
24.0	26.0	Lt. gray to yellow-gray silt, v. moist-wet, laminated, so. dark gray laminae, occ. wood frags.	SS-11	26.5	28.5	4-9-17-25 Rec = 23" Qp = 3.2 (till)

General Remarks:

Project Name Ameren Duck Creek - Phase II Site Invest. **Boring #** B-14/MW-5

Sheet 2 of 3

STRATUM DEPTH From	STRATUM DEPTH To	SOIL CLASSIFICATION	SAMPLE NUMBER	SAMPLE DEPTH From	SAMPLE DEPTH To	STD. PENETRATION TEST BLOWS / 6 INCHES P=Penetrometer
26.0	27.5	Gray cl. silt, so. sand (f.-m.), stiff, moist, occ. f. gravel (till).	SS-12	29.0	31.0	6-11-18-24 Rec = 24" Qp = 4.5+
27.5	28.4	Red brown to brn. f.-m. sand, wet.	SS-13	31.5	33.5	5-13-25-40 Rec = 21" Qp = 4.5+ to -
28.4	33.0	Gray sa. silt, so. clay, tr. gravel, moist, v. stiff (till).	SS-14	34.0	36.0	13-29-33-44 Rec = 19" Qp = -
33.0	38.4	Gray f.-m. sand, wet, tr. crs. sand (gravel @ base), dense.	SS-15	36.5	38.5	3-17-28-22 Rec = 18" Qp = -
38.4	46.0	Gray silty clay, tr.-so. gravel (f.-m.), tr. v.f.-f. sand, occ. coal fragments, dry to mst. v. stiff (till).	SS-16	39.0	41.0	5-11-16-23 Rec = 22" Qp = 4.5+
46.0	48.6	Brown to brn.-gray f.-m. sandy silt, so. clay, tr. gravel, stiff, moist (till).	SS-17	41.5	43.5	5-12-17-24 Rec = 24" Qp = 4.5+
48.6	50.0	Gray f.-crs. sand, dry, v. dense, tr.-so. gravel, v. moist @ base, methane production.	SS-18	44.0	46.0	6-10-17-21 Rec = 23" Qp = 4.5+
50.0	51.5	Lt. gray to yel-gray silt, v. moist-wet, iron staining, methane production.	SS-19	46.5	48.0	5-20-50/5" Rec = 15" Qp = 4.3 to 4.5+
51.5	55.8	Gray-brn. v.f. sa. silt, so. clay, tr. f. gravel, moist, v. stiff (till).	SS-20	49.0	51.0	35-40-47-50/5" Rec = 24" Qp = 1.0 (silt)
55.8	65.5	Gray f.-crs. sand, tr. f. gravel and silt, wet, partially cemented (calcareous), v. dense, more gravel 61.5' - 65.5'.	SS-21	51.5	53.0	14-34-50/4" (overpacked w/sand) Rec = 12" silt Qp = 1.0 (silt)
65.5	66.5	Gray silty v.f.-m. sand, tr. gravel, partially cemented, v. dense.	SS-22	54.0	55.0	14-50 Rec = 12" Qp = 4.5+
66.5	71.7	Gray clayey silt, so. v.f.-f. sand, tr. gravel (f.-m.), calcareous, sl. moist, v. stiff (till), so. shale frags.	SS-23	56.5	58.5	18-31-31-37 Rec = 21" Qp = -
71.7	80.8	Gray v.f.-f. sa. silt, tr.-so. clay, tr. f.-m. gravel, occ. coal frags., v. stiff, sl. moist, calcareous (till).	SS-24	59.0	61.0	16-27-32-41 Rec = 18" Qp = -
80.8	84.0	Gray to dk. gray silt, tr.-so. clay, tr. v.f.-f. sand and f.-m. gravel, occ. varves, wood frags., stiff, sl. calcareous (till).	SS-25	61.5	63.5	16-26-29-30 Rec = 19" Qp = -
84.0	89.6	Dk. gray silt, tr. clay, tr. v.f. sand, occ. zones of diss. carbonaceous material (m. sand sized), occ. coal frags., occ. varved zones, v. stiff.	SS-26	64.0	65.5	12-30-50/4" Rec = 14" Qp = -

General Remarks:

1640 Switch to mud rotary @ 55'.
1748 Begin mud rotary w/polymer.
1905 end drilling for today at 64.0'.
Methane produced from 49' - 53' inside borehole.

Project Name Ameren Duck Creek - Phase II Site Invest.

Boring # B-14/MW-5

Sheet 3 of 3

STRATUM DEPTH From	STRATUM DEPTH To	SOIL CLASSIFICATION	SAMPLE NUMBER	SAMPLE DEPTH From	SAMPLE DEPTH To	STD. PENETRATION TEST BLOWS / 6 INCHES P=Penetrometer
89.6	93.0	Gray wthrd. siltstone, thinly bedded, tr. clay.	SS-27	66.5	68.5	18-34-45-50/5" Rec = 24" Qp = 4.5++
			SS-28	69.0	71.0	15-29-32-45 Rec = 24" Qp = 4.5++
			SS-29	71.5	73.0	23-45-50/4" Rec = 15" Qp = 4.5+
			SS-30	74.0	75.5	24-36-37 Rec = 17" Qp = 4.5++
			SS-31	76.5	78.0	26-37-44 Rec = 18" Qp = 4.5+
			SS-32	79.0	81.0	Drop Rod-27-39-50 Rec = 22" Qp = 4.5+
			SS-33	81.5	83.5	13-23-33-44 Rec = 24" Qp = 4.5+
			SS-34	84.0	86.0	7-13-21-27 Rec = 24" Qp = 4.5+
			SS-35	87.5	89.5	8-16-32-50/3" Rec = 17" Qp = 4.5+
			SS-36	90.0	90.5	50/5-1/2" Rec = 6" Qp = 4.5+
		End SS @ 93.0'. Begin coring @ 93.7'.	SS-37	92.5	93.0	50/4"

General Remarks:

* 9-18-03 Resume B-14 @ 0800 @ 64.0'.
* Drilled much harder @ 89.6'.
* 9-18-03 1240 Stopped drilling @ 92.5'.

HANSON

BORING NO.	B-14/MW-5
PROJECT No. 03S5010	SHEET 1 OF 3

PROJECT NAME:	DATE	Engineer/Geologist:
Ameren Duck Creek	9/19/2003	Scott Yankey

Depth In Feet	ROCK, COLOR, HARDNESS, WEATHERING, GRAIN OR CRYSTALLINITY, BEDDING, VOIDS (OTHER: THICKNESS & LOCATION OF CLAY/SHALE SEAMS)	Sample or Run Number	% REC --------- % RQD	Box Number	Time 8:35	DWR %	DWRC	Down Pressure	Depth In Feet
93.0	Start core 93.7'	1	Run 9.3'	1		100%	Gray	250#	
94.0	Loss 94.8'		Rec 8.15' 88%		1:53				
95.0	Gray silty shale, thinly bedded. 95.6' High angle fracture 96.0'		RQD 7.95'/ 9.3' 85%		1:35				
96.0					2:07		Lt. gray		
97.0					1:47				
98.0	98.3'				1:54	4'4" added 5.0'			
99.0	Gray shale, so. silt, thinly bedded.				1:35				
100.0					1:12		Dk. gray		
101.0					1:03				
102.0					0:53				
103.0									

Core barrel 13.0' - End Run 1 - 103.0

HANSON	BORING NO. B-14/MW-5	
	PROJECT No. 03S5010	SHEET 2 OF 3

PROJECT NAME: Ameren Duck Creek	DATE 9/19/2003	Engineer/Geologist: Scott Yankey

Depth In Feet	ROCK, COLOR, HARDNESS, WEATHERING, GRAIN OR CRYSTALLINITY, BEDDING, VOIDS (OTHER: THICKNESS & LOCATION OF CLAY/SHALE SEAMS)	Sample or Run Number	% REC / % RQD	Box Number	Time	DWR %	DWRC	Down Pressure	Depth In Feet
103.0	Dark gray shale, fissil.	2		1		100	Gray	450#	
			Run 10.0'						
104.0					1:45				
			Rec 8.6'						
				104.8'					
105.0					1:52				
				2					
			RQD 7.5'/ 10.0'						
106.0					1:58				
107.0					2:30				
108.0	108.0'				1:53				
	108.3' Gray shaley limestone.								
	Loss					sl. drop			
109.0	109.1'				1:50				
	Dark gray limey shale, fractured, near vert., open, clean. 109.7'					sl. drop			
110.0	Loss 110.1'				2:23				
	Gray shaley limestone, tr. fossils.								
	Dark gray shale, fissil.								
111.0					-			250#	
112.0					3:30				
	112.65'								
	112.75' Gray shaley limestone.								
113.0					3:02				

HANSON

BORING NO.	B-14/MW-5
PROJECT No. 03S5010	SHEET 3 OF 3

PROJECT NAME:	DATE	Engineer/Geologist: Scott Yankey
Ameren Duck Creek	9/19/2003	

Depth In Feet	ROCK, COLOR, HARDNESS, WEATHERING, GRAIN OR CRYSTALLINITY, BEDDING, VOIDS (OTHER: THICKNESS & LOCATION OF CLAY/SHALE SEAMS)	Sample or Run Number	% REC / % RQD	Box Number	Time	DWR %	DWRC	Down Pressure	Depth In Feet
113.0	Dark gray limey shale.	2		2		100	Gray	250#	
	113.85'								
114.0	104.05' Dark gray shaley, limestone, fossiliferous.								
	Dk. gray to black shale, so. lime, scattered fossils.								
115.0									
	115.9'			115.9'					
116.0				3					
	Black shale, so. lime. 116.5'								
117.0	Dk. gray shaley limestone to limey shale, fossiliferous.								
	117.3'								
	Loss (in hole)								
118.0	118.0'								
	EOB @ 118.0'								

9-19-03 Coring completed 1255

HANSON

RECORD OF SOIL EXPLORATION

P41I1 (MW-5I1)

Project Name	Ameren Duck Creek	Sheet	1 of 1
Job #	03S5010	Boring #	~~B-14A/P-5I1~~
Location	CCB Landfill - Phase III Site Invest.	Station	-
Driller	Western Environmental Drilling Inc.	Surface Elevation	609.9
Foreman	Randy Howard	Drilling Method	HSA CME 850 ATV
Engineer/Geologist	ASY	Sampling Method	SS
Weather & Temp.	35°, Sunny, Windy	Hammer Type	Auto

Date:	Start	12/15/2003 1330	Water Depth: DD	-
	Finish	12/15/2003 1600	AAR	-
			Delayed	-

STRATUM DEPTH From	STRATUM DEPTH To	SOIL CLASSIFICATION	SAMPLE NUMBER	SAMPLE DEPTH From	SAMPLE DEPTH To	STD. PENETRATION TEST BLOWS / 6 INCHES P=Penetrometer
		No sampling to 29' (see B-14)				
29.0	30.5	Brown-red f.-m. sand, wet.	SS-1	29.0	31.0	16-26-25-23 sand: - Rec = 24" Qp = till: 4.5+
30.5	32.5	Gray sandy clay, so. silt, tr. gravel, v. stiff, moist (till).	SS-2	31.5	33.5	8-18-26-46 sand: - Rec = 24" Qp = till: 4.5+
32.5	37.0	Gray f.-m. sand, wet.	SS-3	34.0	36.0	No sample. Sand blown-in inside auger. Rec = Qp =
37.0	38.5	Gray silty clay, tr. sand and gravel, tr.-so. coal frags., v. stiff, moist (till).	SS-4	36.5	38.5	14-10-11-14 Rec = 20" Qp = 4.5+
		EOB @ 38.5'				

General Remarks:

HANSON

RECORD OF SOIL EXPLORATION

Project Name	Ameren Duck Creek	Sheet	1 of 3
Job #	03S5010	Boring #	B-14/MW-5
Location	CCB Landfill - Phase II Site Invest.	Station	-
Driller	Western Environmental Drilling Inc.	Surface Elevation	610.3
Foreman	Randy Howard CME 850	Drilling Method	HSA/ 2-3/4" Mud Rotary
Engineer/Geologist	ASY	Sampling Method	SS/Core
Weather & Temp.	82°, Sunny, Breezy	Hammer Type	Auto
Date: Start	9/17/2003 1250	Water Depth: DD	18'
Finish	9/19/2003 1255	AAR	-
		Delayed	-

STRATUM DEPTH From	STRATUM DEPTH To	SOIL CLASSIFICATION	SAMPLE NUMBER	SAMPLE DEPTH From	SAMPLE DEPTH To	STD. PENETRATION TEST BLOWS / 6 INCHES P=Penetrometer
0.0	0.5	Brn. silt loam, moist, topsoil.	SS-1	1.5	3.5	3-5-5-5 Rec = 18" Qp = 2.5
0.5	4.5	Lt. brn.-gray to yellow-brn. silt, tr.-so. clay, moist, mottled, iron staining, roots (loess).	SS-2	4.0	6.0	3-4-4-4 Rec = 20" Qp = 1.7
4.5	7.8	Gray silt, so. iron staining, v. moist @ 6' 7", occ. roots, moist (loess).	SS-3	6.5	8.5	2-2-3-3 Rec = 24" Qp = 1.6
7.8	9.0	Brn. and gray mottled silt, tr. clay, moist (loess).	SS-4	9.0	11.0	1-2-3-4 Rec = 20" Qp = 1.3
9.0	11.0	Yel.-brn. silt, tr. clay, moist (loess).	SS-5	11.5	13.5	1-2-3-3 Rec = 24" Qp = 1.3
11.0	14.5	Red-brn. and gray clayey silt, tr. f. sand, moist (till).	SS-6	14.0	16.0	2-3-3-3 Rec = 22" Qp = 1.4 to 2.4
14.5	18.0	As above, so. f.-m. sand, tr. coal frags and gravel (till).	SS-7	16.5	18.5	2-2-2-2 Rec = 24" Qp = -
18.0	20.8	Yellow-brn. sa. silt, so. clay, tr. gravel, v. moist to wet.	SS-8	19.0	21.0	1-1-2-2 Rec = 24" Qp = -
20.8	23.3	Red-brn and gray clayey silt, tr.-so. f. sand, tr. gravel and coal frags., moist (till).	SS-9	21.5	23.5	2-4-3-5 Rec = 19" Qp = 2.2
23.3	24.0	Brn-gray silty v.f. sand, wet.	SS-10	24.0	26.0	1-2-2-3 Rec = 19" Qp = -
24.0	26.0	Lt. gray to yellow-gray silt, v. moist-wet, laminated, so. dark gray laminae, occ. wood frags.	SS-11	26.5	28.5	4-9-17-25 Rec = 23" Qp = 3.2 (till)

General Remarks:

Project Name Ameren Duck Creek - Phase II Site Invest. **Boring #** B-14/MW-5

Sheet 2 of 3

STRATUM DEPTH From	STRATUM DEPTH To	SOIL CLASSIFICATION	SAMPLE NUMBER	SAMPLE DEPTH From	SAMPLE DEPTH To	STD. PENETRATION TEST BLOWS / 6 INCHES P=Penetrometer
26.0	27.5	Gray cl. silt, so. sand (f.-m.), stiff, moist, occ. f. gravel (till).	SS-12	29.0	31.0	6-11-18-24 Rec = 24" Qp = 4.5+
27.5	28.4	Red brown to brn. f.-m. sand, wet.	SS-13	31.5	33.5	5-13-25-40 Rec = 21" Qp = 4.5+ to -
28.4	33.0	Gray sa. silt, so. clay, tr. gravel, moist, v. stiff (till).	SS-14	34.0	36.0	13-29-33-44 Rec = 19" Qp = -
33.0	38.4	Gray f.-m. sand, wet, tr. crs. sand (gravel @ base), dense.	SS-15	36.5	38.5	3-17-28-22 Rec = 18" Qp = -
38.4	46.0	Gray silty clay, tr.-so. gravel (f.-m.), tr. v.f.-f. sand, occ. coal fragments, dry to mst. v. stiff (till).	SS-16	39.0	41.0	5-11-16-23 Rec = 22" Qp = 4.5+
46.0	48.6	Brown to brn.-gray f.-m. sandy silt, so. clay, tr. gravel, stiff, moist (till).	SS-17	41.5	43.5	5-12-17-24 Rec = 24" Qp = 4.5+
48.6	50.0	Gray f.-crs. sand, dry, v. dense, tr.-so. gravel, v. moist @ base, methane production.	SS-18	44.0	46.0	6-10-17-21 Rec = 23" Qp = 4.5+
50.0	51.5	Lt. gray to yel-gray silt, v. moist-wet, iron staining, methane production.	SS-19	46.5	48.0	5-20-50/5" Rec = 15" Qp = 4.3 to 4.5+
51.5	55.8	Gray-brn. v.f. sa. silt, so. clay, tr. f. gravel, moist, v. stiff (till).	SS-20	49.0	51.0	35-40-47-50/5" Rec = 24" Qp = 1.0 (silt)
55.8	65.5	Gray f.-crs. sand, tr. f. gravel and silt, wet, partially cemented (calcareous), v. dense, more gravel 61.5' - 65.5'.	SS-21	51.5	53.0	14-34-50/4" (overpacked w/sand) Rec = 12" silt Qp = 1.0 (silt)
65.5	66.5	Gray silty v.f.-m. sand, tr. gravel, partially cemented, v. dense.	SS-22	54.0	55.0	14-50 Rec = 12" Qp = 4.5+
66.5	71.7	Gray clayey silt, so. v.f.-f. sand, tr. gravel (f.-m.), calcareous, sl. moist, v. stiff (till), so. shale frags.	SS-23	56.5	58.5	18-31-31-37 Rec = 21" Qp = -
71.7	80.8	Gray v.f.-f. sa. silt, tr.-so. clay, tr. f.-m. gravel, occ. coal frags., v. stiff, sl. moist, calcareous (till).	SS-24	59.0	61.0	16-27-32-41 Rec = 18" Qp = -
80.8	84.0	Gray to dk. gray silt, tr.-so. clay, tr. v.f.-f. sand and f.-m. gravel, occ. varves, wood frags., stiff, sl. calcareous (till).	SS-25	61.5	63.5	16-26-29-30 Rec = 19" Qp = -
84.0	89.6	Dk. gray silt, tr. clay, tr. v.f. sand, occ. zones of diss. carbonaceous material (m. sand sized), occ. coal frags., occ. varved zones, v. stiff.	SS-26	64.0	65.5	12-30-50/4" Rec = 14" Qp = -

General Remarks:

1640 Switch to mud rotary @ 55'.
1748 Begin mud rotary w/polymer.
1905 end drilling for today at 64.0'.
Methane produced from 49' - 53' inside borehole.

Project Name Ameren Duck Creek - Phase II Site Invest.

Boring # B-14/MW-5

Sheet 3 of 3

STRATUM DEPTH From	STRATUM DEPTH To	SOIL CLASSIFICATION	SAMPLE NUMBER	SAMPLE DEPTH From	SAMPLE DEPTH To	STD. PENETRATION TEST BLOWS / 6 INCHES P=Penetrometer
89.6	93.0	Gray wthrd. siltstone, thinly bedded, tr. clay.	SS-27	66.5	68.5	18-34-45-50/5" Rec = 24" Qp = 4.5++
			SS-28	69.0	71.0	15-29-32-45 Rec = 24" Qp = 4.5++
			SS-29	71.5	73.0	23-45-50/4" Rec = 15" Qp = 4.5+
			SS-30	74.0	75.5	24-36-37 Rec = 17" Qp = 4.5++
			SS-31	76.5	78.0	26-37-44 Rec = 18" Qp = 4.5+
			SS-32	79.0	81.0	Drop Rod-27-39-50 Rec = 22" Qp = 4.5+
			SS-33	81.5	83.5	13-23-33-44 Rec = 24" Qp = 4.5+
			SS-34	84.0	86.0	7-13-21-27 Rec = 24" Qp = 4.5+
			SS-35	87.5	89.5	8-16-32-50/3" Rec = 17" Qp = 4.5+
			SS-36	90.0	90.5	50/5-1/2" Rec = 6" Qp = 4.5+
		End SS @ 93.0'. Begin coring @ 93.7'.	SS-37	92.5	93.0	50/4"

General Remarks:

* 9-18-03 Resume B-14 @ 0800 @ 64.0'.
* Drilled much harder @ 89.6'.
* 9-18-03 1240 Stopped drilling @ 92.5'.

HANSON

BORING NO.	B-14/MW-5
PROJECT No. 03S5010	SHEET 1 OF 3

PROJECT NAME:	DATE	Engineer/Geologist:
Ameren Duck Creek	9/19/2003	Scott Yankey

Depth In Feet	ROCK, COLOR, HARDNESS, WEATHERING, GRAIN OR CRYSTALLINITY, BEDDING, VOIDS (OTHER: THICKNESS & LOCATION OF CLAY/SHALE SEAMS)	Sample or Run Number	% REC --------- % RQD	Box Number	Time 8:35	DWR %	DWRC	Down Pressure	Depth In Feet
93.0	Start core 93.7'	1	Run 9.3'	1		100%	Gray	250#	
94.0	Loss 94.8'		Rec 8.15' 88%		1:53				
95.0	Gray silty shale, thinly bedded. 95.6' High angle fracture 96.0'		RQD 7.95'/ 9.3' 85%		1:35				
96.0					2:07		Lt. gray		
97.0					1:47				
98.0	98.3'				1:54	4'4" added 5.0'			
99.0	Gray shale, so. silt, thinly bedded.				1:35				
100.0					1:12		Dk. gray		
101.0					1:03				
102.0					0:53				
103.0									

Core barrel 13.0' - End Run 1 - 103.0

HANSON	BORING NO. B-14/MW-5	
	PROJECT No. 03S5010	SHEET 2 OF 3

PROJECT NAME: Ameren Duck Creek	DATE 9/19/2003	Engineer/Geologist: Scott Yankey

Depth In Feet	ROCK, COLOR, HARDNESS, WEATHERING, GRAIN OR CRYSTALLINITY, BEDDING, VOIDS (OTHER: THICKNESS & LOCATION OF CLAY/SHALE SEAMS)	Sample or Run Number	% REC / % RQD	Box Number	Time	DWR %	DWRC	Down Pressure	Depth In Feet
103.0	Dark gray shale, fissil.	2		1		100	Gray	450#	
			Run 10.0'						
104.0					1:45				
			Rec 8.6'						
				104.8'					
105.0					1:52				
				2					
			RQD 7.5'/ 10.0'						
106.0					1:58				
107.0					2:30				
108.0	108.0'				1:53				
	108.3' Gray shaley limestone.								
	Loss					sl. drop			
109.0	109.1'				1:50				
	Dark gray limey shale, fractured, near vert., open, clean. 109.7'					sl. drop			
110.0	Loss 110.1'				2:23				
	Gray shaley limestone, tr. fossils.								
	Dark gray shale, fissil.								
111.0					-			250#	
112.0					3:30				
	112.65'								
	112.75' Gray shaley limestone.								
113.0					3:02				

HANSON

BORING NO.	B-14/MW-5
PROJECT No. 03S5010	SHEET 3 OF 3

PROJECT NAME:	DATE	Engineer/Geologist: Scott Yankey
Ameren Duck Creek	9/19/2003	

Depth In Feet	ROCK, COLOR, HARDNESS, WEATHERING, GRAIN OR CRYSTALLINITY, BEDDING, VOIDS (OTHER: THICKNESS & LOCATION OF CLAY/SHALE SEAMS)	Sample or Run Number	% REC / % RQD	Box Number	Time	DWR %	DWRC	Down Pressure	Depth In Feet
113.0	Dark gray limey shale.	2		2		100	Gray	250#	
	113.85'								
114.0	104.05' Dark gray shaley, limestone, fossiliferous.								
	Dk. gray to black shale, so. lime, scattered fossils.								
115.0									
	115.9'			115.9'					
116.0				3					
	Black shale, so. lime. 116.5'								
117.0	Dk. gray shaley limestone to limey shale, fossiliferous.								
	117.3'								
	Loss (in hole)								
118.0	118.0'								
	EOB @ 118.0'								

9-19-03 Coring completed 1255

P41I2 (MW-5I2)

HANSON

RECORD OF SOIL EXPLORATION

Project Name	Ameren Duck Creek	Sheet	1 of 1
Job #	03S5010	Boring #	~~B-14B/P-5I2~~
Location	CCB Landfill - Phase III Site Invest.	Station	-
Driller	Western Environmental Drilling Inc.	Surface Elevation	609.8
Foreman	Randy Howard	Drilling Method	HSA CME 850 ATV
Engineer/Geologist	ASY	Sampling Method	SS
Weather & Temp.		Hammer Type	Auto

Date:	Start	12/16/2003 0805	Water Depth: DD	-
	Finish	12/16/2003 1230	AAR	-
			Delayed	-

STRATUM DEPTH From	STRATUM DEPTH To	SOIL CLASSIFICATION	SAMPLE NUMBER	SAMPLE DEPTH From	SAMPLE DEPTH To	STD. PENETRATION TEST BLOWS / 6 INCHES P=Penetrometer
		No sampling to 44' (see B-14)				
44.0	47.0	Gray to brown-gray silty clay, tr. sand and gravel, occ. coal frags., v. stiff, sl. moist (till).	SS-1	44.0	46.0	5-10-15-24 Rec = 24" Qp = 4.5+
47.0	49.0	Gray f.-crs. sand, so. gravel, partially cemented, wet, methane production.	SS-2	46.5	47.3	12-50/4" till: 4.5+ Rec = 10" Qp = sand: -
49.0	50.3	Gray-brown silt, partially cemented, wet, methane production.	SS-3	49.0	51.0	8-18-28-32 silt: - to 0.5 Rec = 10" Qp = till: 4.5+
50.3	51.0	Gray-brown clayey silt, so. v.f. sand, tr. gravel, v. stiff, moist (till).				
		EOB @ 51.0'				

General Remarks:

HANSON

RECORD OF SOIL EXPLORATION

Project Name	Ameren Duck Creek	Sheet	1 of 3
Job #	03S5010	Boring #	B-14/MW-5
Location	CCB Landfill - Phase II Site Invest.	Station	-
Driller	Western Environmental Drilling Inc.	Surface Elevation	610.3
Foreman	Randy Howard CME 850	Drilling Method	HSA/ 2-3/4" Mud Rotary
Engineer/Geologist	ASY	Sampling Method	SS/Core
Weather & Temp.	82°, Sunny, Breezy	Hammer Type	Auto
Date: Start	9/17/2003 1250	Water Depth: DD	18'
Finish	9/19/2003 1255	AAR	-
		Delayed	-

STRATUM DEPTH From	STRATUM DEPTH To	SOIL CLASSIFICATION	SAMPLE NUMBER	SAMPLE DEPTH From	SAMPLE DEPTH To	STD. PENETRATION TEST BLOWS / 6 INCHES P=Penetrometer
0.0	0.5	Brn. silt loam, moist, topsoil.	SS-1	1.5	3.5	3-5-5-5 Rec = 18" Qp = 2.5
0.5	4.5	Lt. brn.-gray to yellow-brn. silt, tr.-so. clay, moist, mottled, iron staining, roots (loess).	SS-2	4.0	6.0	3-4-4-4 Rec = 20" Qp = 1.7
4.5	7.8	Gray silt, so. iron staining, v. moist @ 6' 7", occ. roots, moist (loess).	SS-3	6.5	8.5	2-2-3-3 Rec = 24" Qp = 1.6
7.8	9.0	Brn. and gray mottled silt, tr. clay, moist (loess).	SS-4	9.0	11.0	1-2-3-4 Rec = 20" Qp = 1.3
9.0	11.0	Yel.-brn. silt, tr. clay, moist (loess).	SS-5	11.5	13.5	1-2-3-3 Rec = 24" Qp = 1.3
11.0	14.5	Red-brn. and gray clayey silt, tr. f. sand, moist (till).	SS-6	14.0	16.0	2-3-3-3 Rec = 22" Qp = 1.4 to 2.4
14.5	18.0	As above, so. f.-m. sand, tr. coal frags and gravel (till).	SS-7	16.5	18.5	2-2-2-2 Rec = 24" Qp = -
18.0	20.8	Yellow-brn. sa. silt, so. clay, tr. gravel, v. moist to wet.	SS-8	19.0	21.0	1-1-2-2 Rec = 24" Qp = -
20.8	23.3	Red-brn and gray clayey silt, tr.-so. f. sand, tr. gravel and coal frags., moist (till).	SS-9	21.5	23.5	2-4-3-5 Rec = 19" Qp = 2.2
23.3	24.0	Brn-gray silty v.f. sand, wet.	SS-10	24.0	26.0	1-2-2-3 Rec = 19" Qp = -
24.0	26.0	Lt. gray to yellow-gray silt, v. moist-wet, laminated, so. dark gray laminae, occ. wood frags.	SS-11	26.5	28.5	4-9-17-25 Rec = 23" Qp = 3.2 (till)

General Remarks:

Project Name Ameren Duck Creek - Phase II Site Invest. **Boring #** B-14/MW-5

Sheet 2 of 3

STRATUM DEPTH From	STRATUM DEPTH To	SOIL CLASSIFICATION	SAMPLE NUMBER	SAMPLE DEPTH From	SAMPLE DEPTH To	STD. PENETRATION TEST BLOWS / 6 INCHES P=Penetrometer
26.0	27.5	Gray cl. silt, so. sand (f.-m.), stiff, moist, occ. f. gravel (till).	SS-12	29.0	31.0	6-11-18-24 Rec = 24" Qp = 4.5+
27.5	28.4	Red brown to brn. f.-m. sand, wet.	SS-13	31.5	33.5	5-13-25-40 Rec = 21" Qp = 4.5+ to -
28.4	33.0	Gray sa. silt, so. clay, tr. gravel, moist, v. stiff (till).	SS-14	34.0	36.0	13-29-33-44 Rec = 19" Qp = -
33.0	38.4	Gray f.-m. sand, wet, tr. crs. sand (gravel @ base), dense.	SS-15	36.5	38.5	3-17-28-22 Rec = 18" Qp = -
38.4	46.0	Gray silty clay, tr.-so. gravel (f.-m.), tr. v.f.-f. sand, occ. coal fragments, dry to mst. v. stiff (till).	SS-16	39.0	41.0	5-11-16-23 Rec = 22" Qp = 4.5+
46.0	48.6	Brown to brn.-gray f.-m. sandy silt, so. clay, tr. gravel, stiff, moist (till).	SS-17	41.5	43.5	5-12-17-24 Rec = 24" Qp = 4.5+
48.6	50.0	Gray f.-crs. sand, dry, v. dense, tr.-so. gravel, v. moist @ base, methane production.	SS-18	44.0	46.0	6-10-17-21 Rec = 23" Qp = 4.5+
50.0	51.5	Lt. gray to yel-gray silt, v. moist-wet, iron staining, methane production.	SS-19	46.5	48.0	5-20-50/5" Rec = 15" Qp = 4.3 to 4.5+
51.5	55.8	Gray-brn. v.f. sa. silt, so. clay, tr. f. gravel, moist, v. stiff (till).	SS-20	49.0	51.0	35-40-47-50/5" Rec = 24" Qp = 1.0 (silt)
55.8	65.5	Gray f.-crs. sand, tr. f. gravel and silt, wet, partially cemented (calcareous), v. dense, more gravel 61.5' - 65.5'.	SS-21	51.5	53.0	14-34-50/4" (overpacked w/sand) Rec = 12" silt Qp = 1.0 (silt)
65.5	66.5	Gray silty v.f.-m. sand, tr. gravel, partially cemented, v. dense.	SS-22	54.0	55.0	14-50 Rec = 12" Qp = 4.5+
66.5	71.7	Gray clayey silt, so. v.f.-f. sand, tr. gravel (f.-m.), calcareous, sl. moist, v. stiff (till), so. shale frags.	SS-23	56.5	58.5	18-31-31-37 Rec = 21" Qp = -
71.7	80.8	Gray v.f.-f. sa. silt, tr.-so. clay, tr. f.-m. gravel, occ. coal frags., v. stiff, sl. moist, calcareous (till).	SS-24	59.0	61.0	16-27-32-41 Rec = 18" Qp = -
80.8	84.0	Gray to dk. gray silt, tr.-so. clay, tr. v.f.-f. sand and f.-m. gravel, occ. varves, wood frags., stiff, sl. calcareous (till).	SS-25	61.5	63.5	16-26-29-30 Rec = 19" Qp = -
84.0	89.6	Dk. gray silt, tr. clay, tr. v.f. sand, occ. zones of diss. carbonaceous material (m. sand sized), occ. coal frags., occ. varved zones, v. stiff.	SS-26	64.0	65.5	12-30-50/4" Rec = 14" Qp = -

General Remarks:

1640 Switch to mud rotary @ 55'.
1748 Begin mud rotary w/polymer.
1905 end drilling for today at 64.0'.
Methane produced from 49' - 53' inside borehole.

Project Name Ameren Duck Creek - Phase II Site Invest.

Boring # B-14/MW-5

Sheet 3 of 3

STRATUM DEPTH From	STRATUM DEPTH To	SOIL CLASSIFICATION	SAMPLE NUMBER	SAMPLE DEPTH From	SAMPLE DEPTH To	STD. PENETRATION TEST BLOWS / 6 INCHES P=Penetrometer
89.6	93.0	Gray wthrd. siltstone, thinly bedded, tr. clay.	SS-27	66.5	68.5	18-34-45-50/5" Rec = 24" Qp = 4.5++
			SS-28	69.0	71.0	15-29-32-45 Rec = 24" Qp = 4.5++
			SS-29	71.5	73.0	23-45-50/4" Rec = 15" Qp = 4.5+
			SS-30	74.0	75.5	24-36-37 Rec = 17" Qp = 4.5++
			SS-31	76.5	78.0	26-37-44 Rec = 18" Qp = 4.5+
			SS-32	79.0	81.0	Drop Rod-27-39-50 Rec = 22" Qp = 4.5+
			SS-33	81.5	83.5	13-23-33-44 Rec = 24" Qp = 4.5+
			SS-34	84.0	86.0	7-13-21-27 Rec = 24" Qp = 4.5+
			SS-35	87.5	89.5	8-16-32-50/3" Rec = 17" Qp = 4.5+
			SS-36	90.0	90.5	50/5-1/2" Rec = 6" Qp = 4.5+
		End SS @ 93.0'. Begin coring @ 93.7'.	SS-37	92.5	93.0	50/4"

General Remarks:

* 9-18-03 Resume B-14 @ 0800 @ 64.0'.
* Drilled much harder @ 89.6'.
* 9-18-03 1240 Stopped drilling @ 92.5'.

HANSON

BORING NO.	B-14/MW-5
PROJECT No. 03S5010	SHEET 1 OF 3

PROJECT NAME:	DATE	Engineer/Geologist:
Ameren Duck Creek	9/19/2003	Scott Yankey

Depth In Feet	ROCK, COLOR, HARDNESS, WEATHERING, GRAIN OR CRYSTALLINITY, BEDDING, VOIDS (OTHER: THICKNESS & LOCATION OF CLAY/SHALE SEAMS)	Sample or Run Number	% REC --------- % RQD	Box Number	Time 8:35	DWR %	DWRC	Down Pressure	Depth In Feet
93.0	Start core 93.7'	1	Run 9.3'	1		100%	Gray	250#	
94.0	Loss 94.8'		Rec 8.15' 88%		1:53				
95.0	Gray silty shale, thinly bedded. 95.6' High angle fracture 96.0'		RQD 7.95'/ 9.3' 85%		1:35				
96.0					2:07		Lt. gray		
97.0					1:47				
98.0	98.3'				1:54	4'4" added 5.0'			
99.0	Gray shale, so. silt, thinly bedded.				1:35				
100.0					1:12		Dk. gray		
101.0					1:03				
102.0					0:53				
103.0									

Core barrel 13.0' - End Run 1 - 103.0

HANSON	BORING NO. B-14/MW-5	
	PROJECT No. 03S5010	SHEET 2 OF 3

PROJECT NAME: Ameren Duck Creek	DATE 9/19/2003	Engineer/Geologist: Scott Yankey

Depth In Feet	ROCK, COLOR, HARDNESS, WEATHERING, GRAIN OR CRYSTALLINITY, BEDDING, VOIDS (OTHER: THICKNESS & LOCATION OF CLAY/SHALE SEAMS)	Sample or Run Number	% REC / % RQD	Box Number	Time	DWR %	DWRC	Down Pressure	Depth In Feet
103.0	Dark gray shale, fissil.	2		1		100	Gray	450#	
			Run 10.0'						
104.0					1:45				
			Rec 8.6'						
				104.8'					
105.0					1:52				
				2					
			RQD 7.5'/ 10.0'						
106.0					1:58				
107.0					2:30				
108.0	108.0'				1:53				
	108.3' Gray shaley limestone.								
	Loss					sl. drop			
109.0	109.1'				1:50				
	Dark gray limey shale, fractured, near vert., open, clean. 109.7'					sl. drop			
110.0	Loss 110.1'				2:23				
	Gray shaley limestone, tr. fossils.								
	Dark gray shale, fissil.								
111.0					-			250#	
112.0					3:30				
	112.65'								
	112.75' Gray shaley limestone.								
113.0					3:02				

HANSON

BORING NO.	B-14/MW-5
PROJECT No. 03S5010	SHEET 3 OF 3

PROJECT NAME:	DATE	Engineer/Geologist: Scott Yankey
Ameren Duck Creek	9/19/2003	

Depth In Feet	ROCK, COLOR, HARDNESS, WEATHERING, GRAIN OR CRYSTALLINITY, BEDDING, VOIDS (OTHER: THICKNESS & LOCATION OF CLAY/SHALE SEAMS)	Sample or Run Number	% REC / % RQD	Box Number	Time	DWR %	DWRC	Down Pressure	Depth In Feet
113.0	Dark gray limey shale.	2		2		100	Gray	250#	
	113.85'								
114.0	104.05' Dark gray shaley, limestone, fossiliferous.								
	Dk. gray to black shale, so. lime, scattered fossils.								
115.0									
	115.9'			115.9'					
116.0				3					
	Black shale, so. lime. 116.5'								
117.0	Dk. gray shaley limestone to limey shale, fossiliferous.								
	117.3'								
	Loss (in hole)								
118.0	118.0'								
	EOB @ 118.0'								

9-19-03 Coring completed 1255

P42D (MW-9D)

HANSON

RECORD OF SOIL EXPLORATION

Project Name	Ameren Duck Creek	Sheet	1 of 2
Job #	03S5010	Boring #	~~B-22 / MW-9~~
Location	CCB Landfill - Phase IV Site Invest.	Station	-
Driller	Testing Service Corporation	Surface Elevation	615.7
Foreman	Bruno Williamson	Drilling Method	HSA 3 1/4" I.D.
Engineer/Geologist	Scott Yankey	Sampling Method	SB/SS
Weather & Temp.	32°, Sunny, Calm	Hammer Type	Auto
Date: Start	12/8/2004	Water Depth: DD	8.5'
Finish	12/8/2004	AAR	-
		Delayed	-

STRATUM DEPTH From	STRATUM DEPTH To	SOIL CLASSIFICATION	SAMPLE NUMBER	SAMPLE DEPTH From	SAMPLE DEPTH To	STD. PENETRATION TEST BLOWS / 6 INCHES P=Penetrometer
0.0	0.5	Brown silt loam (topsoil).	SB-1	0.0	4.5	Rec = 4' Qp = 0.6
0.5	8.0	Yellow-brown silt, so. gray mottling, so. clay, iron staining, concretions, soft, moist (loess).	SB-2	4.5	9.5	Rec = 4' Qp = 0.8
8.0	11.2	Gray silt, tr. clay and v.f. sand, so. brown mottling, iron staining, concretions, moist, wet at 8.5' (loess).	SB-3	9.5	14.5	Rec = 5' Qp = 2.4
11.2	17.0	Dark gray and brown mottled clayey silt, so. v.f. sand, iron staining, stiff, moist (paleosol?).	SB-4	14.5	19.5	Rec = 5' Qp = 2.0
17.0	23.0	Brown and gray mottled silty clay, tr. v.f. sand and f. gravel, stiff, moist (till).	SB-5	19.5	24.5	Rec = 5' Qp = 2.0
23.0	24.5	Gray silt, so. v.f.-f. sand, soft v. moist.	SB-6	24.5	29.5	Rec = 2.0' Qp = -
24.5	29.5	Brown-gray f.-med. sand, wet.	SB-7	29.5	34.5	Rec = 5' Qp = 1.5-4.0
29.5	30.5	Gray clayey silt, so. sand and gravel, stiff, moist (till).	SB-8	34.5	39.5	Rec = 3' Qp = 1.7-4.5+
30.5	31.7	Gray silt, so. v.f.-f. sand, tr. gravel, wet.	SB-9	39.5	44.5	Rec = 5' Qp = 4.5+
31.7	32.2	Brown med. sand, wet.	SB-10	44.5	49.5	Rec = 5' Qp = 4.5+
32.2	35.0	Brown clayey silt, so. sand, tr.-so. gravel, v. stiff, moist (till).	SB-11	49.5	54.5	Rec = 1.0' Qp = -

General Remarks:

Project Name Ameren Duck Creek - Phase IV Site Invest. **Boring #** B-22 / MW-9

Sheet 2 of 2

STRATUM DEPTH From	STRATUM DEPTH To	SOIL CLASSIFICATION	SAMPLE NUMBER	SAMPLE DEPTH From	SAMPLE DEPTH To	STD. PENETRATION TEST BLOWS / 6 INCHES P=Penetrometer
35.0	39.0	Gray silt, with some sand seams, wet.	SB-12	54.5	59.5	Rec = 5' Qp = 4.5+
39.0	47.0	Gray silty clay, so. v.f.-f. sand, tr.-so. gravel, occ. coal and wood fragments, v. stiff (till).	SB-13	59.5	64.5	Rec = 5' Qp = 4.5+
47.0	48.0	Gray clayey sand. so. silt and gravel, so. thin sand partings.	SB-14	64.5	69.5	Rec = 5' Qp = 4.5+
48.0	49.5	Gray silty clay, so. v.f.-f. sand, tr.-so. gravel, occ. coal and wood fragments, v. stiff, organic zone 49.1-49.2' (till).	SB-15	69.5	74.5	Rec = 2.5' Qp = -
49.5	54.5	Gray f.-v.crs. sand, partially cemented, calcareous, wet.	SB-16	74.5	79.5	Rec = 5' Qp = 4.5+
54.5	67.0	Gray clayey silt, so. v.f.-f. sand, tr.-so. gravel, calcareous (till).	SB-17	79.5	84.5	Rec = 5' Qp = 4.5+
67.0	67.5	Gray silt, wet.	SB-18	84.5	85.5	Refusal Rec = 1' Qp = 4.5+
67.5	69.5	Gray sandy silt, partially cemented, wet.	SS-1	85.5	87.0	28-50-100/3" Rec = 16" Qp = 4.5+
69.5	73.8	Gray f.-v.crs. sand, partially cemented, calcareous, wet.	SS-2	89.5	89.7	100/3" Rec = 2.5" Qp = 4.5+
73.8	74.5	Gray silt, so. v.f. sand, partially cemented, calcareous.				
74.5	79.5	Gray clayey silt, so. v.f. sand, tr.-so. gravel, occ. coal and wood fragments, v. stiff, abund. wood frags. and organics 79-79.5' (till).				
79.5	83.0	Darh gray clayey silt, so. v.f. sand, tr. gravel, v. stiff (till).				
83.0	85.5	Gray silty sand, so. silt and clay, cemented, calcareous, so. v. thin sand partings.				
85.5	89.5	Dark gray-brown sandy silt, tr. clay and gravel, cemented, calcareous.				
89.5	89.7	Dark gray weathered shale.				

General Remarks:

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Company, LLC
Site: Duck Creek Power Station - Ash Landfill
Location: 17751 N. CILCO Rd., Canton, IL 61520
Project: 17E0057
DATES: Start: 3/15/2017
Finish: 3/15/2017
WEATHER: Sunny, cold (lo-30s)

CONTRACTOR: Ramsey Geotechnical Engineering, LLC
Rig mfg/model: Diedrich D-50
Drilling Method: 4¼" Hollow Stem Auger, split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: P60
Well ID: P60
Surface Elev: 620.12 ft. MSL
Completion: 34.62 ft. BGS
Station: 15,477.09N
992.24E

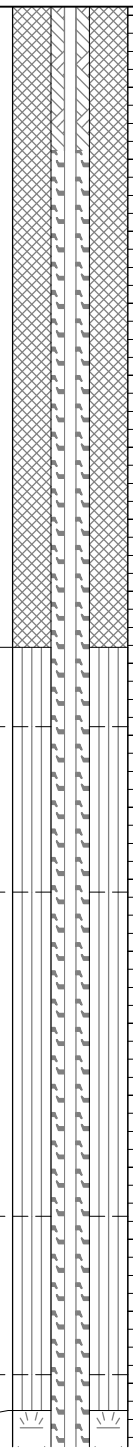
TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 16.80 - During drilling
▼ = Dry - At completion
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	14/24 58%	SS	2-3 3-4 N=6			
2A	18/24 75%	SS	3-6 8-11 N=14	17.5		
3A	15/24 63%	SS	3-4 6-7 N=10	19.6		
4A	20/24 83%	SS	6-8 11-14 N=19	18.5		
5A	22/24 92%	SS	3-5 6-7 N=11	26.8		
6A	21/24 88%	SS	2-4 5-5 N=9	23.8		
7A	20/24 83%	SS	4-4 6-7 N=10	22.8		
8A	21/24 88%	SS	5-6 7-7 N=13	22.1		
9A	21/24 88%	SS	5-5 6-6 N=11	21.0		
10A	24/24 100%	SS	2-3 4-7 N=7	28.1		
10B				61.7		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
0	FILL - Yellowish brown (10YR5/6), moist, medium, CLAY with some silt and trace sand.	620
2		618
4		616
6		614
8		612
9	Yellowish brown (10YR5/6), moist, medium, SILT with few clay and trace sand.	
10	Yellowish brown (10YR5/8) with 30% gray (10YR5/1) mottles, moist, medium, SILT with few clay and trace sand.	610
12		608
14	Gray (10YR5/1) with 20% yellowish brown (10YR5/8) mottles, moist, medium, SILT with few clay and trace sand.	606
16		604
17 ▼		
18	Gray (10YR5/1) with 25% yellowish brown (10YR5/8) mottles, wet, medium, SILT with few clay and trace sand.	602
19	Dark yellowish brown (10YR3/4), moist, medium, SILT with few clay and trace sand, trace organics.	
20	Dark brown (10YR3/3), moist, medium, PEAT.	

Borehole Detail



Remarks

NOTE(S): P60 installed in boring.
Coordinates are on Plant (Local) grid.

FIELD BORING LOG

CLIENT: Illinois Power Generating Company, LLC
Site: Duck Creek Power Station - Ash Landfill
Location: 17751 N. CILCO Rd., Canton, IL 61520
Project: 17E0057
DATES: Start: 3/15/2017
Finish: 3/15/2017
WEATHER: Sunny, cold (lo-30s)

CONTRACTOR: Ramsey Geotechnical Engineering, LLC
Rig mfg/model: Diedrich D-50
Drilling Method: 4¼" Hollow Stem Auger, split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: P60
Well ID: P60
Surface Elev: 620.12 ft. MSL
Completion: 34.62 ft. BGS
Station: 15,477.09N
992.24E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 16.80 - During drilling
▼ = Dry - At completion
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	20/24 83%	SS	2-5 6-7 N=11	31.4		
12A	24/24 100%	SS	9-8 7-6 N=15	33.7		
13A	20/24 83%	SS	4-3 4-4 N=7	23.0		
14A	22/24 92%	SS	4-5 6-6 N=11	20.6		
15A	24/24 100%	SS	3-3 4-5 N=7	17.5		
16A	24/24 100%	SS	1-3 3-3 N=6	20.2		
17A	24/24 100%	SS	5-6 6-7 N=12	15.9		
	0/7 0%	BD				

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark brown (10YR3/3), moist, medium, PEAT. *[Continued from previous page]*	600
22	Very dark gray (10YR3/1), moist, medium, SILT with some clay and trace sand, trace organics.	598
24	Very dark gray (10YR3/1), wet, medium, SILT with some clay and trace sand, trace organics.	596
	Dark brown (10YR3/3), moist, medium, PEAT.	
26	Gray (10YR5/1), moist, medium, CLAY with some silt and trace sand and gravel.	594
28		592
30	Greenish gray (5G6/1), moist, medium, CLAY with some silt and trace sand and gravel.	590
32		588
34	Greenish gray (5G6/1), wet, soft, SILT with few clay, little sand, and trace gravel.	586

Borehole Detail

End of Boring = 34.62 ft bgs

NOTE(S): P60 installed in boring.
Coordinates are on Plant (Local) grid.

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/24/2021
Finish: 2/24/2021
WEATHER: Sunny, cool (lo-40's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Doug
Eng/Geo: R. Hasenyager

BOREHOLE ID: P61
Well ID: P61
Surface Elev: 611.09 ft. MSL
Completion: 20.00 ft. BGS
Station: 1,398,670.81N
2,346,779.33E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▽ = 8.00 - durring drilling
▼ =
▼ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	0/24 *0%*	SS	--- ---					Yellowish brown (10YR5/6), moist, medium, CLAY with some silt and trace sand.	610	
2A	19/24 *79%*	SS	*1-3* *3-3* N=6				2	Yellowish brown (10YR5/6) with 5% gray (10YR5/1) mottles, moist, medium CLAY with some silt and trace sand.	608	
3A	21/24 *88%*	SS	*2-4* *4-5* N=8				4	Yellowish brown (10YR5/6) with 25% gray (10YR5/1) mottles, moist, medium, SILT with few clay and trace sand.	606	
4A	19/24 *79%*	SS	*woh-2* *4-4* N=6				6	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, soft, SILT with few clay and trace sand.	604	
5A	10/24 *42%*	SS	*1-2* *2-3* N=4				▽ 8	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, wet, soft, SILT with few clay and trace sand.	602	
6A	17/24 *71%*	SS	*2-2* *3-3* N=5				10	Yellowish brown (10YR5/8), moist, soft, SILT with few clay and trace sand. Gray (10YR5/1) with 25% yellowish brown (10YR5/8) mottles, wet, soft, SILT with few clay and trace sand.	600	
7A	24/24 *100%*	SS	*woh-1* *2-2* N=3				12	Brown (10YR4/3), wet, soft, SILT with few clay and trace sand.	598	
8A	24/24 *100%*	SS	*1-2* *3-3* N=5				14	Black (10YR2/1), moist, medium, CLAY with few silt and trace sand.	596	
9A	24/24 *100%*	SS	*1-3* *3-4* N=6				16		594	
10A	24/24 *100%*	SS	*1-1* *3-3* N=4				18	Gray (10YR5/1), moist, medium CLAY with some silt and trace sand.	592	
							20	**End of boring = 20 ft.**		

NOTE(S):

FIELD BORING LOG

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/24/2021
Finish: 2/24/2021
WEATHER: Sunny, cool (lo-40's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Doug
Eng/Geo: R. Hasenyager

BOREHOLE ID: P62
Well ID: P62
Surface Elev: 610.81 ft. MSL
Completion: 16.30 ft. BGS
Station: 1,398,887.32N
2,346,602.30E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
= Dry - durring drilling
=
=

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	0/24 0%	SS	--- ---					Yellowish brown (10YR5/6), moist, medium, SILT with some clay and trace sand.	610	
							2	Yellowish brown (10YR5/6), moist, hard, CLAY with some silt, trace sand, and trace gravel.		
2A	23/24 96%	SS	1-7 9-9 N=16					Yellowish brown (10YR5/6), moist, hard, SILT with few clay, trace sand, and trace gravel.	608	
							4			
3A	24/24 100%	SS	2-5 5-6 N=10					Gray (10YR5/1), moist, medium, SILT with few clay, trace sand, and trace gravel.	606	
							6			
4A	24/24 100%	SS	4-4 7-8 N=11						604	
							8	Yellowish brown (10YR5/6), moist, medium, SILT with few clay and trace sand.		
5A	24/24 100%	SS	2-5 5-6 N=10						602	
							10			
6A	24/24 100%	SS	3-4 6-10 N=10					Yellowish brown (10YR5/6) with 15% gray (10YR5/1) mottles, moist, medium, SILT with few clay and trace sand.	600	
							12			
7A	23/24 96%	SS	2-3 5-6 N=8					Dark yellowish brown (10YR4/6), moist, medium, SILT with few clay and trace sand.	598	
							14			
8A	24/24 100%	SS	1-2 3-4 N=5					Gray (10YR5/1) with 5% yellowish brown (10YR5/8) mottles, moist, soft, CLAY with some silt, trace sand, and trace gravel	596	
	0/4 0%	BD					16			

Borehole Detail

End of boring = 16.3 ft.

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/24/2021
Finish: 2/24/2021
WEATHER: Sunny, cool (lo-40's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Doug
Eng/Geo: R. Hasenyager

BOREHOLE ID: P63
Well ID: P63
Surface Elev: 612.33 ft. MSL
Completion: 18.25 ft. BGS
Station: 1,399,026.62N
2,346,605.85E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▽ = 8.00 - durring drilling
▼ =
▼ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	0/24 *0%*	SS	--- ---					Grayish brown (10R5/2), moist, medium, CLAY with some silt, trace sand, and trace gravel.	612	
2A	24/24 *100%*	SS	*3-7* *7-10* N=14				2	Yellowish brown (10YR5/6), moist, hard, CLAY with some silt, trace sand, and trace gravel.	610	
3A	24/24 *100%*	SS	*2-4* *4-4* N=8				4	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, moist, medium, CLAY with some silt and trace sand.	608	
4A	22/24 *92%*	SS	*1-1* *4-5* N=5				6	Yellowish brown (10YR5/8) with 25% gray (10YR5/1) mottles, moist, soft, SILT with few clay and trace sand.	606	
5A	21/24 *88%*	SS	*2-2* *3-4* N=5				▽ 8		604	
6A	23/24 *96%*	SS	*2-3* *3-5* N=6				10	Yellowish brown (10YR5/8) with 25% gray (10YR5/1) mottles, wet, soft, SILT with few clay and trace sand.	602	
7A	20/24 *83%*	SS	*2-2* *3-4* N=5				12	Dark yellowish brown (10YR3/4), moist, medium SILT with few clay and trace sand.	600	
8A	24/24 *100%*	SS	*2-2* *3-3* N=5				14	Gray (10YR5/1) with 35% yellowish brown (10YR5/6) mottles, wet, soft, SILT with few clay and trace sand.	598	
9A	24/24 *100%*	SS	*1-2* *3-3* N=5				16	Yellowish brown(10YR5/6), moist, soft, CLAY with some silt, trace sand, and trace gravel.	596	
	0/4 *0%*	BD					18			

End of boring = 18.25 ft.

NOTE(S):

FIELD BORING LOG

CLIENT: Illinois Power Resource Generating, LLC
Site: Duck Creek Part 845 Groundwater
Location: Canton, Illinois
Project: 20E0111A
DATES: Start: 2/25/2021
Finish: 2/25/2021
WEATHER: Sunny, cool (lo-40's)

CONTRACTOR: Geotechnics
Rig mfg/model: CME-750X ATV Drill
Drilling Method: Hollow Stem Auger
FIELD STAFF: Driller: Matt
Helper: Doug
Eng/Geo: R. Hasenyager

BOREHOLE ID: P64
Well ID: P64
Surface Elev: 614.04 ft. MSL
Completion: 16.47 ft. BGS
Station: 1,399,305.91N
2,346,597.96E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Duck Island
Township: Banner
Section 30, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▽ = 6.70 - durring drilling
▽ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Water Content (%)	Dry Density (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	0/24 0%	SS	--- ---					Yellowish brown (10YR5/6), medium CLAY with some silt and trace sand.		
2A	23/24 96%	SS	2-4 4-5 N=8				2	Yellowish brown (10YR5/6) with 10% gray (10YR5/1) mottles, moist, medium, CLAY with some silt and trace sand.	612	
3A	23/24 96%	SS	2-2 2-3 N=4				4	Yellowish brown (10YR5/6) with 15% gray (10YR5/1) mottles, moist, soft, SILT with few clay, trace sand, and trace wood fragments.	610	
4A	20/24 83%	SS	1-2 4-4 N=6				6 ▽	Gray (10YR5/1) with 20% yellowish brown (10YR5/6) mottles, wet, soft, SILT with few clay and trace sand.	608	
5A	15/24 63%	SS	1-2 2-3 N=4				8		606	
6A	19/24 79%	SS	1-2 2-3 N=4				10		604	
7A	24/24 100%	SS	1-1 2-3 N=3				12	Yellowish brown (10YR5/6), moist, soft, SILT with some clay and trace sand.	602	
8A	24/24 100%	SS	1-2 2-3 N=4				14	Yellowish brown (10YR5/6) with 25% gray (10YR5/1) mottles, moist, soft, CLAY with some silt and trace sand.	600	
	0/6 0%	BD					16		598	

End of boring = 16.5 ft.

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Company, LLC
Site: Duck Creek Power Station - Ash Landfill
Location: 17751 N. CILCO Rd., Canton, IL 61520
Project: 17E0057
DATES: Start: 3/14/2017
Finish: 3/14/2017
WEATHER: Sunny, cold (lo-30s)

CONTRACTOR: Ramsey Geotechnical Engineering, LLC
Rig mfg/model: Diedrich D-50
Drilling Method: 4¼" Hollow Stem Auger, split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

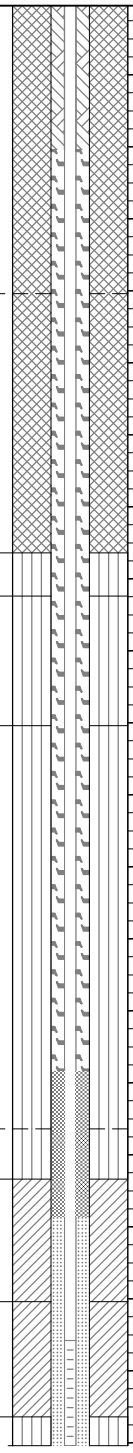
BOREHOLE ID: R61L
Well ID: R61L
Surface Elev: 619.96 ft. MSL
Completion: 28.67 ft. BGS
Station: 15,649.93N
994.33E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - At completion
▼ =
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL
							2	FILL - Yellowish brown (10YR5/4) with 15% yellowish brown (10YR5/6) mottles, moist, firm, clayey SILT.	618
							4		616
							6	FILL - Yellowish brown (10YR5/4) with 15% yellowish brown (10YR5/6) and 15% gray (10YR6/1) mottles, moist, firm, clayey SILT.	614
							8	Grayish brown (10YR5/2), moist, hard, clayey SILT.	612
								Light brownish gray (10YR6/2) with 35% dark yellowish brown (10YR4/6) mottles, moist, hard, clayey SILT.	
							10		610
							12	Gray (10YR6/1) with 40% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	608
							14		606
							16	Gray (10YR6/1) with 40% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	604
								Gray (10YR6/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	
							18		602
								Gray (10YR6/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	
							20	Very dark gray (10YR3/1), moist, friable, micaceous,	600

Borehole Detail



Remarks

NOTE(S): R61L installed in blind drilled boring approximately 10 ft. west of G61L. Lithologies from boring G61L, except as indicated.

FIELD BORING LOG

CLIENT: Illinois Power Generating Company, LLC
Site: Duck Creek Power Station - Ash Landfill
Location: 17751 N. CILCO Rd., Canton, IL 61520
Project: 17E0057
DATES: Start: 3/14/2017
Finish: 3/14/2017
WEATHER: Sunny, cold (lo-30s)

CONTRACTOR: Ramsey Geotechnical Engineering, LLC
Rig mfg/model: Diedrich D-50
Drilling Method: 4¼" Hollow Stem Auger, split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: R61L
Well ID: R61L
Surface Elev: 619.96 ft. MSL
Completion: 28.67 ft. BGS
Station: 15,649.93N
994.33E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - At completion
▼ =
▽ =

SAMPLE Number	Recov / Total (in) *% Recovery*	Type	TESTING *Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type
1A	13/24 *54%*	SS	*2-2 2-3* N=4	23.1		
2A	24/24 *100%*	SS	*5-5 6-6* N=11	23.9		
3A	20/24 *83%*	SS	*2-3 4-5* N=7	22.5		
4A	24/24 *100%*	SS	*5-5 6-6* N=11	22.1		
	0/8 *0%*	BD				

Depth ft. BGS	Lithologic Description	Borehole Detail	Elevation ft. MSL	Remarks
	clayey SILT.			
	Very dark grayish brown (10YR3/2), moist, soft, CLAY with some silt and trace sand and gravel.			
22			598	
	Very dark grayish brown (10YR3/2), moist, medium, CLAY with some silt and trace sand.			
24			596	
	Dark gray (10YR4/1), moist, medium, CLAY with some silt and trace sand.			
26			594	
28			592	

End of Boring = 28.67 ft bgs

NOTE(S): R61L installed in blind drilled boring approximately 10 ft. west of G61L. Lithologies from boring G61L, except as indicated.

FIELD BORING LOG

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/20/2009
Finish: 1/21/2009
WEATHER: cold, sunny, windy, mid-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: G61
Well ID: G61S
Surface Elev: 620.00 ft. MSL
Completion: 38.00 ft. BGS
Station: 15,644.94N
994.79E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ = 19.50 - 01/21/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
	24/24 100%	ss	18-12 9-8 N=21					FILL - Yellowish brown (10YR5/4) with 15% yellowish brown (10YR5/6) mottles, slightly moist, firm, clayey SILT.		
2A	24/24 100%	ss	8-5 7-8 N=12	18.4			2		618	
							4		616	
3A	20/24 83%	ss	2-4 4-6 N=8	20.9				FILL - Yellowish brown (10YR5/4) with 15% yellowish brown (10YR5/6) and 15% gray (10YR6/1) mottles, slightly moist, firm, clayey SILT.		
4A	24/24 100%	ss	7-9 10-11 N=19	20.1			6		614	
4B				20.5				Grayish brown (10YR5/2), slightly moist, hard, clayey SILT.		
5A	19/24 79%	ss	2-3 6-7 N=9	26.5			8		612	
								Light brownish gray (10YR6/2) with 35% dark yellowish brown (10YR4/6) mottles, slightly moist, hard, clayey SILT.		
6A	20/24 83%	ss	2-3 4-4 N=7	24.4			10		610	
							12		608	
7A	24/24 100%	ss	4-4 5-6 N=9	24.0				Gray (10YR6/1) with 40% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.		
							14		606	
8A	22/24 92%	ss	3-4 5-5 N=9	25.0						
							16	Gray (10YR6/1) with 40% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	604	
9A	24/24 100%	ss	3-3 4-6 N=7	23.9				Gray (10YR6/1) with 15% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.		
							18		602	
10A	22/24 92%	ss	2-3 3-4 N=6	25.0				Gray (10YR6/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.		
10B				28.2			▼ 20	Very dark gray (10YR3/1), slightly moist, friable,	600	

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/20/2009
Finish: 1/21/2009
WEATHER: cold, sunny, windy, mid-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: G61
Well ID: G61S
Surface Elev: 620.00 ft. MSL
Completion: 38.00 ft. BGS
Station: 15,644.94N
994.79E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ = 19.50 - 01/21/09
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	19/24 79%	SS	3-4 5-6 N=9	35.8		
11B				26.0		
12A	24/24 100%	SS	4-3 6-9 N=9	25.3		
13A	20/24 83%	SS	woh-3 4-6 N=7	24.4		
14A	24/24 100%	SS	3-3 5-6 N=8	22.4		
15A	22/24 92%	SS	woh-3 3-4 N=6	21.5		
16A	19/24 79%	SS	woh-1 3-3 N=4	16.7		
17A	24/24 100%	SS	3-4 5-5 N=9	18.8		
17B				13.6		
18A	19/24 79%	SS	1-7 7-7 N=14	20.7		
19A	24/24 100%	SS	7-11 19-32 N=30	12.4		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	micaceous, clayey SILT.	
22	Dark gray (10YR4/1), moist, soft, clayey SILT.	598
24		596
26	Greenish gray (5GY5/1), moist, soft, silty CLAY with slight trace sand.	594
28		592
30	Greenish gray (5GY5/1), very moist, very soft, sandy CLAY with slight trace gravel.	590
32		588
	Greenish gray (10Y5/1), slightly moist, soft, clayey SILT with trace sand and slight trace gravel.	
34		586
	Medium light gray (N6/1), wet, firm, SILT with slight trace sand and gravel.	
36		584
	Greenish gray (10Y5/1), slightly moist, firm, clayey SILT with trace sand and slight trace gravel.	
38		582

End of Boring = 38.0 ft bgs

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 1/21/2009
Finish: 1/21/2009
WEATHER: cold, sunny, windy, mid-20's

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: S. Suzanna Simpson

BOREHOLE ID: G61a
Well ID: G61L
Surface Elev: 620.00 ft. MSL
Completion: 19.90 ft. BGS
Station: 15,640.94N
994.40E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = Dry - during drilling
▼ = 19.50 - 01/21/09
▽ =

SAMPLE			TESTING						
Number	Recov / Total (in) *% Recovery*	Type	*Blows / 6 in* N - Value **RQD**	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) *Qp* (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
							2	FILL - Yellowish brown (10YR5/4) with 15% yellowish brown (10YR5/6) mottles, slightly moist, firm, clayey SILT.	618	
							4		616	
							6	FILL - Yellowish brown (10YR5/4) with 15% yellowish brown (10YR5/6) and 15% gray (10YR6/1) mottles, slightly moist, firm, clayey SILT.	614	
							8	Grayish brown (10YR5/2), slightly moist, hard, clayey SILT.	612	
								Light brownish gray (10YR6/2) with 35% dark yellowish brown (10YR4/6) mottles, slightly moist, hard, clayey SILT.		
							10		610	
							12	Gray (10YR6/1) with 40% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.	608	
							14		606	
							16	Gray (10YR6/1) with 40% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.	604	
								Gray (10YR6/1) with 15% dark yellowish brown (10YR4/6) mottles, very moist, soft, clayey SILT.		
							18		602	
								Gray (10YR6/1) with 15% dark yellowish brown (10YR4/6) mottles, moist, soft, clayey SILT.		
							▼	Very dark gray (10YR3/1), slightly moist, friable, micaceous, clayey SILT.		

End of Boring = 19.9 ft bgs

NOTE(S): See G61S Boring log for sample and testing data.

FIELD BORING LOG

R72S

HANSON

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/19/2008
Finish: 11/19/2008
WEATHER: sunny, cold, (40's)

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: ~~G72~~
Well ID: ~~G72S~~
Surface Elev: 615.01 ft. MSL
Completion: 39.40 ft. BGS
Station: 13,905.05N
504.94E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 28.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
1A	24/24 100%	SS	3-3 6-6 N=9	20.4		
2A	24/24 100%	SS	3-5 6-6 N=11	18.3		
3A	24/24 100%	SS	3-5 6-9 N=11	15.7		
4A	24/24 100%	SS	10-14 16-16 N=30	21.3		
5A	24/24 100%	SS	3-4 6-7 N=10	19.3		
6A	24/24 100%	SS	2-3 6-8 N=9	18.2		
7A	20/24 83%	SS	5-7 12-13 N=19	9.2		
8A	24/24 100%	SS	1-3 4-6 N=7	11.1		
9A	24/24 100%	SS	5-7 10-9 N=17	12.3		
10A	24/24 100%	SS	1-3 4-7 N=7	17.5		
	24/24		1-3			

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
2	FILL - Yellowish brown (10YR5/8), moist, firm, clayey SILT with slight trace sand and gravel.	614
4		612
6		610
8	Yellowish brown (10YR5/8), moist, firm, silty CLAY with slight trace sand and gravel.	608
10		606
12	Yellowish brown (10YR5/8), moist, soft, silty CLAY with slight trace sand.	604
14	Light gray (10YR7/1) with 30% yellowish brown (10YR5/8) mottles, moist, friable, clayey SILT with slight trace sand.	602
16		600
18	Light gray (10YR7/1) with 10% yellowish brown (10YR5/8) mottles, moist, friable, SILT with some clay and slight trace sand.	598
20	Dark gray (10YR4/1) with 80% dark yellowish brown (10YR4/4) mottles, moist, friable, clayey SILT with slight trace sand.	596
	Dark yellowish brown (10YR4/8), moist, friable, very clayey SILT with trace sand.	

Borehole Detail

Remarks

NOTE(S):

FIELD BORING LOG

CLIENT: AERG Duck Creek Power Generating Station
Site: Gypsum Management Facility
Location: Canton, Illinois
Project: 03S5010D 1000
DATES: Start: 11/19/2008
Finish: 11/19/2008
WEATHER: sunny, cold, (40's)

CONTRACTOR: Testing Service Corp.
Rig mfg/model: CME-550 ATV Drill
Drilling Method: 3¼" HSA w/SS & CME samplers
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: G72
Well ID: G72S
Surface Elev: 615.01 ft. MSL
Completion: 39.40 ft. BGS
Station: 13,905.05N
504.94E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 28.30 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	100%	SS	4-8 N=7	16.6		
12A	24/24 100%	SS	4-8 12-13 N=20	19.1		
13A	24/24 100%	SS	1-3 5-8 N=8	17.4		
14A	24/24 100%	SS	5-6 8-8 N=14	21.2		
15A	24/24 100%	SS	woh-1 2-3 N=3	26.5		
16A	24/24 100%	SS	1-3 6-10 N=9	19.3		
16B				15.9		
17A	20/24 83%	SS	5-10 13-11 N=23	24.9		
18A	24/24 100%	SS	2-6 7-9 N=13	27.8		
18B				11.1		
19A	24/24 100%	SS	7-9 12-14 N=21	11.1		
20A	17/17 100%	SS	26-45 50/5"	9.4		

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark yellowish brown (10YR4/8), moist, friable, very clayey SILT with trace sand. *[Continued from previous page]*	
22		
	Dark yellowish brown (10YR4/6) with 40% yellowish brown (10YR5/8) mottles, moist, firm, silty CLAY with trace sand and slight trace gravel.	592
24		
	Grayish brown (10YR5/2) with 30% yellowish brown (10YR5/8) mottles, moist, soft, clayey SILT with trace sand.	590
26		
	Yellowish brown (10YR5/8) with 10% gray (10YR6/1) mottles, very moist, soft, silty CLAY with trace sand.	588
▼ 28		
	Gray (10YR6/1) with 20% yellowish brown (10YR5/8) mottles, very moist to wet, very soft, silty CLAY with trace sand and slight trace gravel.	586
30		
	Light gray (10YR7/1) with 30% yellowish brown (10YR5/8) mottles, wet, very soft, clayey SILT with some very fine-grained sand and slight trace gravel.	584
	Dark gray (10YR4/1), moist, firm, silty CLAY with trace sand and slight trace gravel.	
32		
	Brownish yellow (10YR6/6), wet, soft, clayey SILT with trace very fine-grained sand.	582
34	Dark gray (10YR4/1), moist, firm, very silty CLAY with slight trace sand.	
	Dark gray (10YR4/1), moist, loose, SILT and very fine-grained SAND.	580
36		
	Dark gray (10YR4/1), moist, firm, silty CLAY with trace sand and slight trace gravel.	578
38		
		576

End of Boring = 39.40 ft bgs

NOTE(S):

WELL CONSTRUCTION LOGS

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Fulton Well #: G54C

Site Name: Duck Creek Part 845 Groundwater Borehole #: G54C

State Plane Coordinate: X 2,348,250.1 Y 1,384,885.2 (or) Latitude: _____ Longitude: _____

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Geotechnics Driller: Matt

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow Stem Auger Drilling Fluid (Type): none

Logged By: Tad A. Gass Date Started: 2/3/2021 Date Finished: 2/5/2021

Report Form Completed By: Tad A. Gass Date: 2/23/2021

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High solids bentonite

Installation Method: tremie

Setting Time: 45 min.

Type of Bentonite Seal -- Granular [Pellet] Slurry (choose one)

Installation Method: gravity

Setting Time: 25 min.

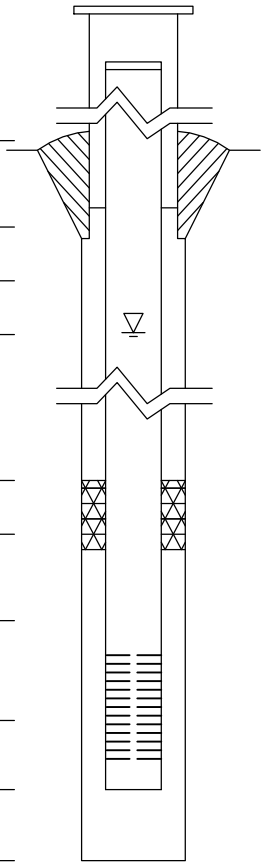
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: gravity

Type of Backfill Material: _____ (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.03	-3.43	Top of Protective Casing
622.72	-3.13	Top of Riser Pipe
619.59	0.00	Ground Surface
615.59	4.00	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
530.00	89.59	Top of Sand Pack
528.00	91.59	Top of Screen
518.09	101.50	Bottom of Screen
517.59	102.00	Bottom of Well
517.59	102.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	95.56
Bottom of Screen to End Cap	(feet)	0.50
Screen Length (1st slot to last slot)	(feet)	9.07
Total Length of Casing	(feet)	105.13
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Fulton Well #: P61

Site Name: Duck Creek Part 845 Groundwater Borehole #: P61

State Plane Coordinate: X 2,346,779.3 Y 1,398,670.8 (or) Latitude: _____ Longitude: _____

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Geotechnics Driller: Matt

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow Stem Auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 2/24/2021 Date Finished: 2/24/2021

Report Form Completed By: Tad A. Gass Date: 2/24/2021

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Granular bentonite

Installation Method: gravity

Setting Time: +24 hrs.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: _____

Setting Time: _____

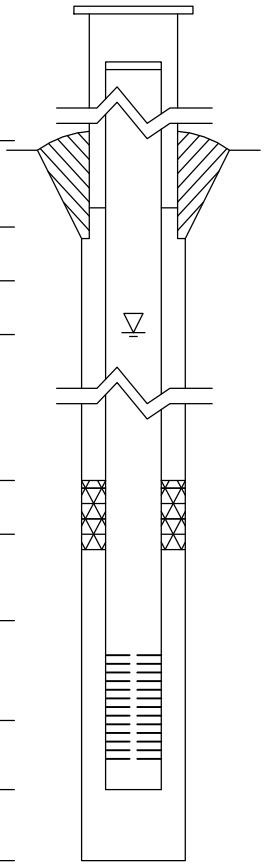
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: gravity

Type of Backfill Material: _____ (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
614.31	-3.21	Top of Protective Casing
613.96	-2.87	Top of Riser Pipe
611.09	0.00	Ground Surface
607.58	3.51	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
603.54	7.55	Top of Sand Pack
602.38	8.71	Top of Screen
592.72	18.37	Bottom of Screen
592.33	18.76	Bottom of Well
591.09	20.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	10.0
Riser Pipe Length	(feet)	11.58
Bottom of Screen to End Cap	(feet)	0.39
Screen Length (1st slot to last slot)	(feet)	9.66
Total Length of Casing	(feet)	21.63
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Fulton Well #: P62

Site Name: Duck Creek Part 845 Groundwater Borehole #: P62

State Plane Coordinate: X 2,346,602.3 Y 1,398,887.3 (or) Latitude: _____ Longitude: _____

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Geotechnics Driller: Matt

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow Stem Auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 2/24/2021 Date Finished: 2/24/2021

Report Form Completed By: Tad A. Gass Date: 2/24/2021

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Granular bentonite

Installation Method: gravity

Setting Time: +24 hrs.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: _____

Setting Time: _____

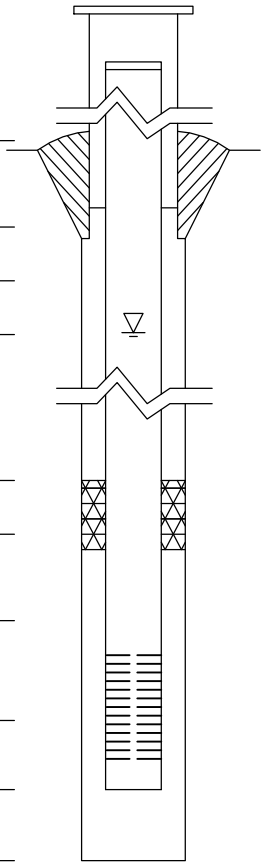
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: gravity

Type of Backfill Material: _____ (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
613.96	-3.15	Top of Protective Casing
613.54	-2.73	Top of Riser Pipe
610.81	0.00	Ground Surface
607.89	2.92	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
601.33	9.48	Top of Sand Pack
599.63	11.18	Top of Screen
595.03	15.78	Bottom of Screen
594.51	16.30	Bottom of Well
594.51	16.30	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	16.30
Bottom of Screen to End Cap	(feet)	0.52
Screen Length (1st slot to last slot)	(feet)	4.60
Total Length of Casing	(feet)	21.42
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Fulton Well #: P63

Site Name: Duck Creek Part 845 Groundwater Borehole #: P63

State Plane Coordinate: X 2,346,605.9 Y 1,399,026.6 (or) Latitude: _____ Longitude: _____

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Geotechnics Driller: Matt

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow Stem Auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 2/24/2021 Date Finished: 2/24/2021

Report Form Completed By: Tad A. Gass Date: 2/24/2021

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Granular bentonite

Installation Method: gravity

Setting Time: +24 hrs.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: _____

Setting Time: _____

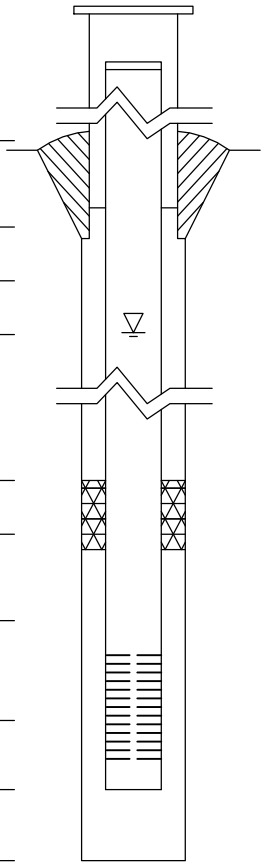
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: gravity

Type of Backfill Material: _____ (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
614.85	-2.52	Top of Protective Casing
614.47	-2.15	Top of Riser Pipe
612.33	0.00	Ground Surface
609.23	3.10	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
600.98	11.35	Top of Sand Pack
599.29	13.04	Top of Screen
594.70	17.63	Bottom of Screen
594.08	18.25	Bottom of Well
594.08	18.25	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	15.19
Bottom of Screen to End Cap	(feet)	0.62
Screen Length (1st slot to last slot)	(feet)	4.59
Total Length of Casing	(feet)	20.40
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Fulton Well #: P64

Site Name: Duck Creek Part 845 Groundwater Borehole #: P64

State Plane Coordinate: X 2,346,598.0 Y 1,399,305.9 (or) Latitude: _____ Longitude: _____

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Geotechnics Driller: Matt

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow Stem Auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 2/25/2021 Date Finished: 2/25/2021

Report Form Completed By: Tad A. Gass Date: 2/25/2021

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Granular bentonite

Installation Method: gravity

Setting Time: +24 hrs.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: _____

Setting Time: _____

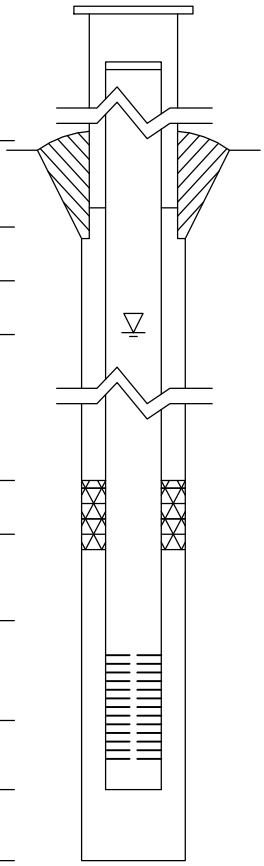
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: gravity

Type of Backfill Material: _____ (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
616.83	-2.78	Top of Protective Casing
616.47	-2.43	Top of Riser Pipe
614.04	0.00	Ground Surface
611.04	3.00	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
608.96	5.08	Top of Sand Pack
607.87	6.17	Top of Screen
598.08	15.96	Bottom of Screen
597.57	16.47	Bottom of Well
597.57	16.47	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

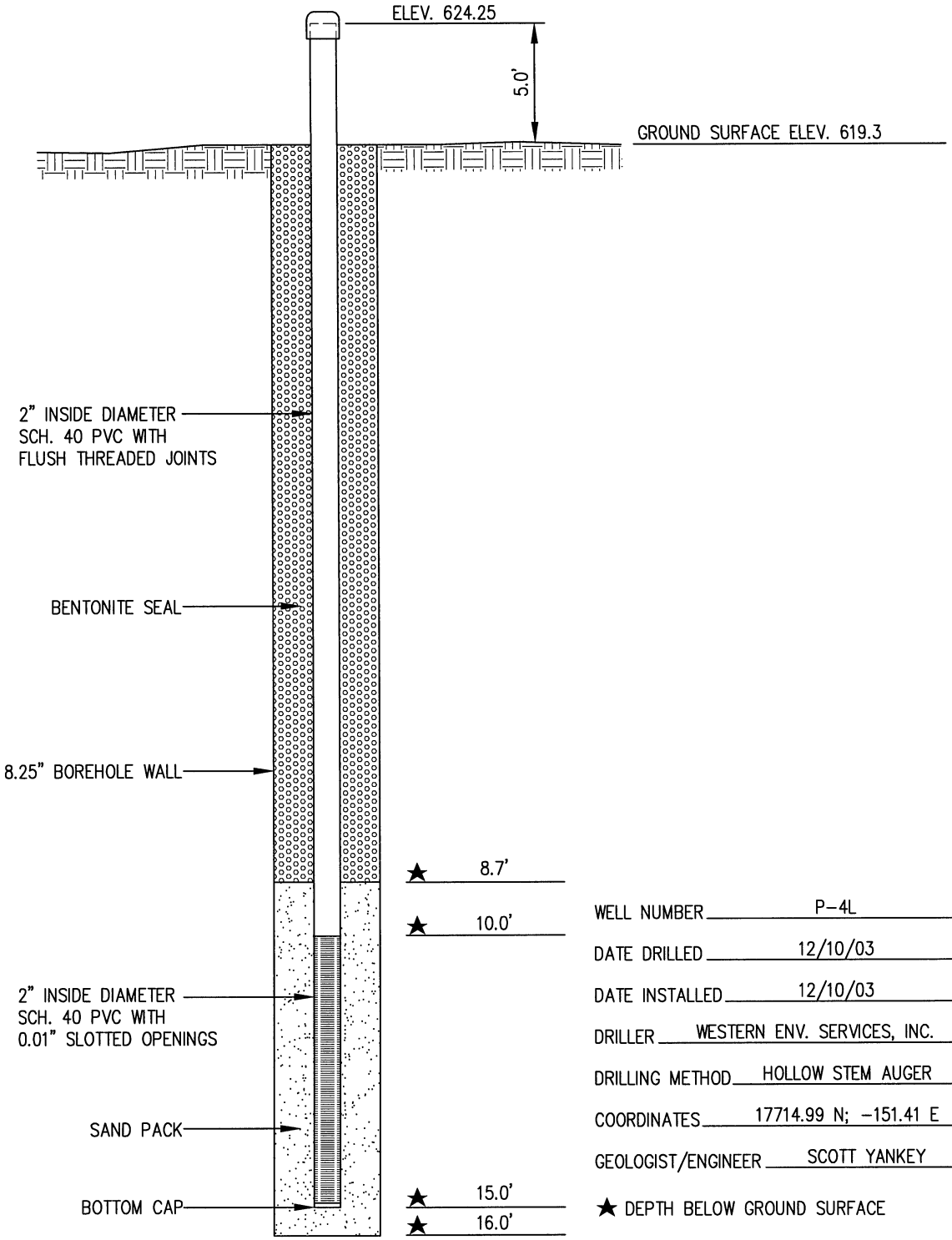
Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	10.0
Riser Pipe Length	(feet)	9.19
Bottom of Screen to End Cap	(feet)	0.52
Screen Length (1st slot to last slot)	(feet)	9.19
Total Length of Casing	(feet)	18.90
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

G02L (MW-4L)



WELL NUMBER P-4L

DATE DRILLED 12/10/03

DATE INSTALLED 12/10/03

DRILLER WESTERN ENV. SERVICES, INC.

DRILLING METHOD HOLLOW STEM AUGER

COORDINATES 17714.99 N; -151.41 E

GEOLOGIST/ENGINEER SCOTT YANKEY

★ DEPTH BELOW GROUND SURFACE

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HANSON

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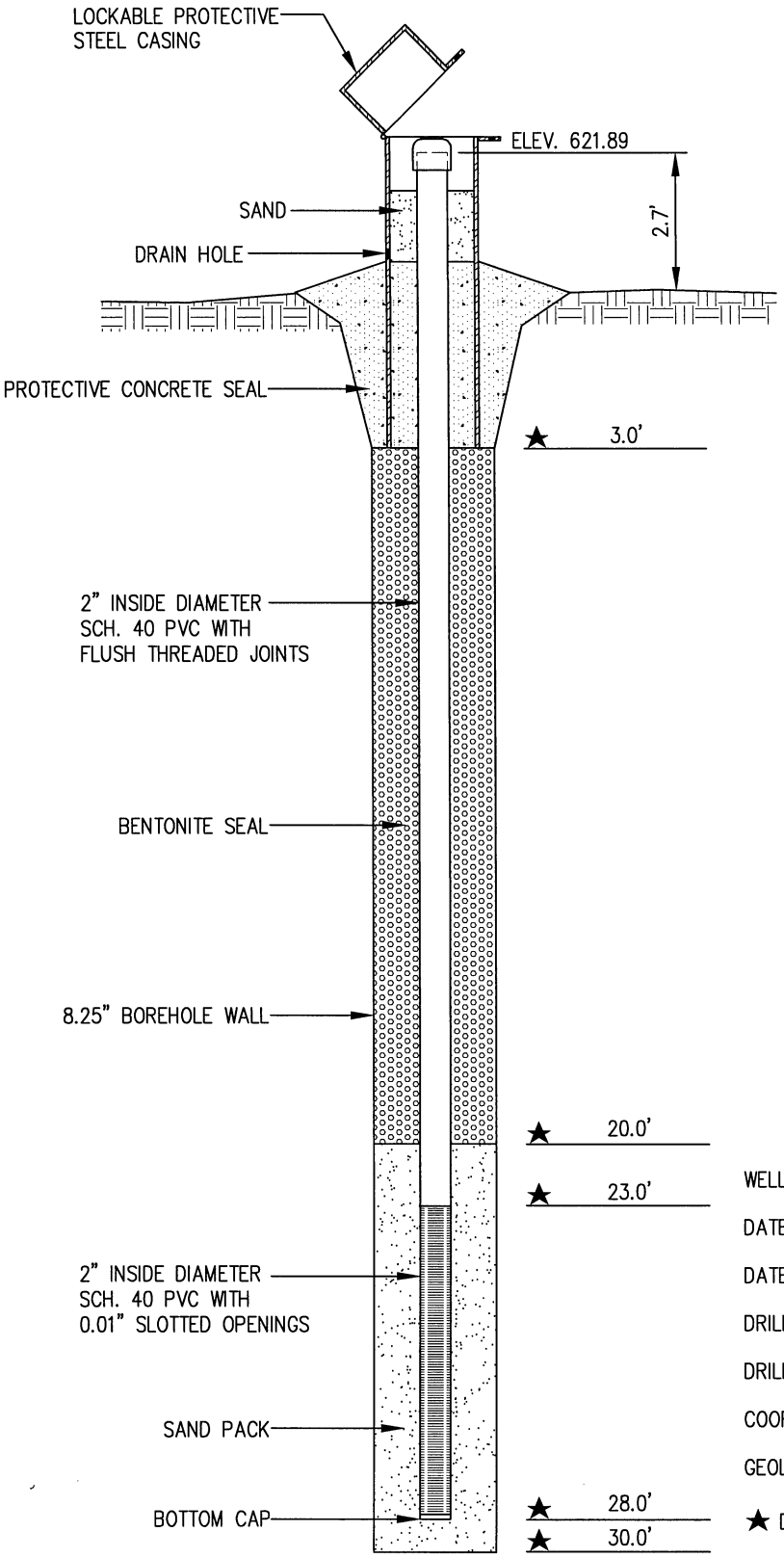
PIEZOMETER P-4L CONSTRUCTION DETAIL

PHASE III HYDROGEOLOGIC SITE INVESTIGATION
AERG - DUCK CREEK STATION CCB LANDFILL
CANTON, ILLINOIS

JOB NO. 03S5010 ATTACHMENT B

AUG 24, 2004 3:13 PM KDE
I:\03JOBS\03S5010\ENVIRONMENTAL\PHASE III\H-P-4L.DWG

G02S (P02S, MW-4S)



WELL NUMBER MW-4S G02S

DATE DRILLED 9/29/03

DATE INSTALLED 9/29/03

DRILLER WESTERN ENV. SERVICES, INC.

DRILLING METHOD HOLLOW STEM AUGER

COORDINATES 17706.74 N; -148.45 E

GEOLOGIST/ENGINEER SCOTT YANKEY

★ DEPTH BELOW GROUND SURFACE

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HANSON
Hanson Professional Services Inc.

MONITORING WELL MW-4S CONSTRUCTION DETAIL

PHASE II HYDROGEOLOGIC SITE INVESTIGATION
AERG - DUCK CREEK STATION
CANTON, ILLINOIS

JOB NO. 03S5010 ATTACHMENT B

AUG 23, 2004 1:50 PM KDE
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Illinois Environmental Protection Agency — Well Completion Report

G50L (MW51L)

Site #: _____ County: Fulton Well #: ~~MW51L~~

Site Name: Ameren Gypsum Stack Borehole #: ~~B 51a~~

State Plane Coordinate: X 16,174.9 Y -5.3 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Andrew D. Canopy IL Registration #: 035-003391

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, 196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Ryan Keedy Date Started: 3/13/2007 Date Finished: 3/13/2007

Report Form Completed By: Rhonald W Hasenyager Date: 4/17/2007

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: gravity

Setting Time: >24 hr

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: >24 hr

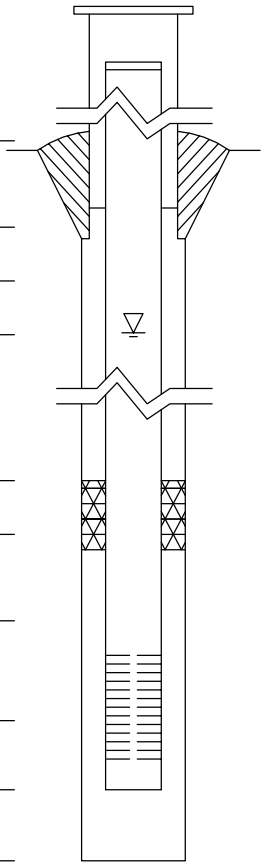
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: _____ (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
624.31	-3.47	Top of Protective Casing
623.83	-2.99	Top of Riser Pipe
620.84	0.00	Ground Surface
620.54	0.30	Top of Annular Sealant
615.27	5.57	Static Water Level (After Completion) 3/29/2007
620.54	0.30	Top of Seal
610.81	10.03	Top of Sand Pack
609.23	11.61	Top of Screen
604.52	16.32	Bottom of Screen
604.13	16.71	Bottom of Well
604.13	16.71	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	14.60
Bottom of Screen to End Cap	(feet)	0.39
Screen Length (1st slot to last slot)	(feet)	4.71
Total Length of Casing	(feet)	19.70
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

G50S (MW51S)

Site #: _____ County: Fulton Well #: ~~MW51S~~

Site Name: Ameren Gypsum Stack Borehole #: ~~B-51b~~

State Plane Coordinate: X 16,180.8 Y -5.1 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Andrew D. Canopy IL Registration #: 035-003391

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, 196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Ryan Keedy Date Started: 3/13/2007 Date Finished: 3/13/2007

Report Form Completed By: Rhonald W Hasenyager Date: 4/17/2007

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite grout

Installation Method: Tremie

Setting Time: >24 hr

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 20 min

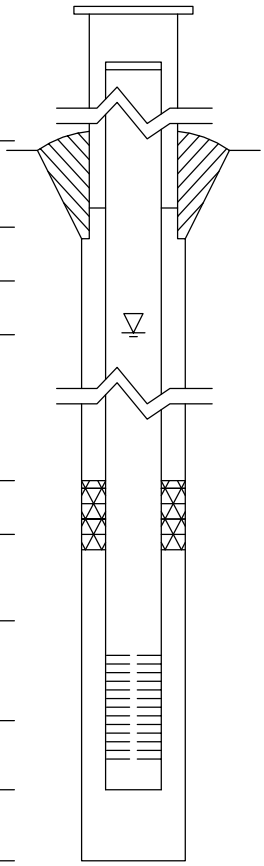
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: _____ (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
624.22	-3.38	Top of Protective Casing
623.82	-2.98	Top of Riser Pipe
620.84	0.00	Ground Surface
620.54	0.30	Top of Annular Sealant
614.98	5.86	Static Water Level (After Completion) 3/29/2007
597.42	23.42	Top of Seal
593.80	27.04	Top of Sand Pack
591.67	29.17	Top of Screen
586.86	33.98	Bottom of Screen
586.52	34.32	Bottom of Well
586.52	34.32	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	32.25
Bottom of Screen to End Cap	(feet)	0.34
Screen Length (1st slot to last slot)	(feet)	4.71
Total Length of Casing	(feet)	37.30
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G51L

Site Name: Duck Creek Gypsum Managment Facility Borehole #: ~~BG51b~~

~~State~~ Plant ~~Plane~~ Coordinate: X -75.7 Y 15,409.7 (or) Latitude: Longitude:

Surveyed By: Kimberley R. Lyons IL Registration #: 035-003669

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Testing Services Corp. Date Started: 1/28/2008 Date Finished: 1/28/2008

Report Form Completed By: Rhonald W. Hasenyager Date: 2/20/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: >24 hr

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method:

Setting Time:

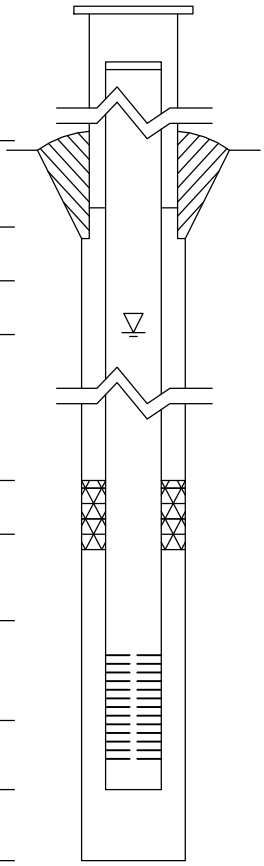
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
620.35	-3.44	Top of Protective Casing
619.91	-3.00	Top of Riser Pipe
616.91	0.00	Ground Surface
614.81	2.10	Top of Annular Sealant
606.34	10.57	Static Water Level (After Completion) 1/30/2008
614.81	2.10	Top of Seal
606.77	10.14	Top of Sand Pack
604.87	12.04	Top of Screen
600.08	16.83	Bottom of Screen
599.70	17.21	Bottom of Well
599.19	17.72	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	15.15
Bottom of Screen to End Cap	(feet)	0.38
Screen Length (1st slot to last slot)	(feet)	4.79
Total Length of Casing	(feet)	20.32
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G51S

Site Name: Duck Creek Gypsum Managment Facility Borehole #: ~~BG51a~~

~~State~~ Plant ~~Plane~~ Coordinate: X -75.3 Y 15,405.4 (or) Latitude: Longitude:

Surveyed By: Kimberley R. Lyons IL Registration #: 035-003669

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Testing Services Corp. Date Started: 1/28/2008 Date Finished: 1/28/2008

Report Form Completed By: Rhonald W. Hasenyager Date: 2/20/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite grout

Installation Method: Tremie

Setting Time: >24 hr

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 20 min

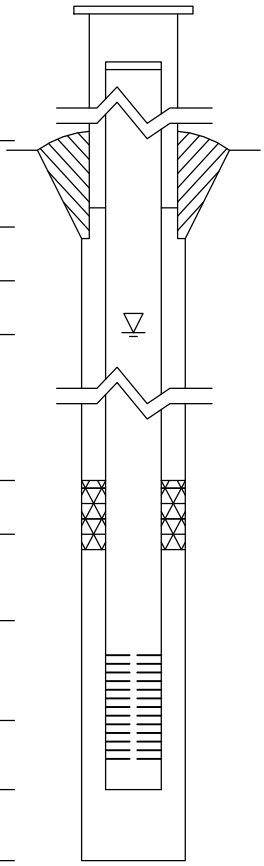
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
620.32	-3.52	Top of Protective Casing
619.81	-3.01	Top of Riser Pipe
616.80	0.00	Ground Surface
614.50	2.30	Top of Annular Sealant
606.39	10.41	Static Water Level (After Completion) 1/30/2008
597.05	19.75	Top of Seal
594.58	22.22	Top of Sand Pack
592.79	24.01	Top of Screen
588.01	28.79	Bottom of Screen
587.64	29.16	Bottom of Well
587.64	29.16	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	27.02
Bottom of Screen to End Cap	(feet)	0.37
Screen Length (1st slot to last slot)	(feet)	4.78
Total Length of Casing	(feet)	32.17
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G52L

Site Name: Duck Creek Gypsum Managment Facility Borehole #: ~~BG52b~~

~~State Plane~~ Plant Coordinate: X -76.5 Y 14,660.1 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Kimberley R. Lyons IL Registration #: 035-003669

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Testing Services Corp. Date Started: 1/22/2008 Date Finished: 1/22/2008

Report Form Completed By: Rhonald W. Hasenyager Date: 2/20/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite grout

Installation Method: Tremie

Setting Time: >24 hr

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: ____

Setting Time: 12 hrs

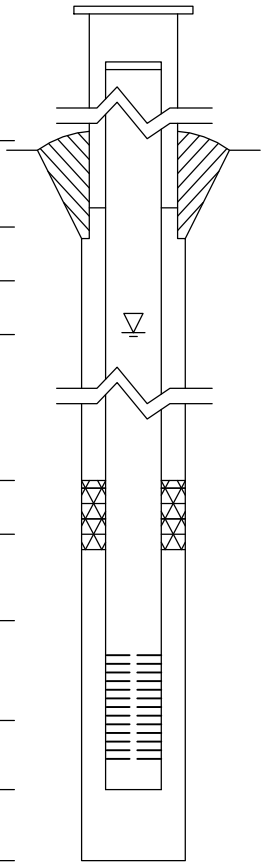
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: ____ (if applicable)

Installation Method: ____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
620.10	-3.40	Top of Protective Casing
619.64	-2.94	Top of Riser Pipe
616.70	0.00	Ground Surface
614.50	2.20	Top of Annular Sealant
587.92	28.78	Static Water Level (After Completion) 1/30/2008
591.25	25.45	Top of Seal
588.79	27.91	Top of Sand Pack
587.49	29.21	Top of Screen
582.90	33.80	Bottom of Screen
582.53	34.17	Bottom of Well
582.53	34.17	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	32.15
Bottom of Screen to End Cap	(feet)	0.37
Screen Length (1st slot to last slot)	(feet)	4.79
Total Length of Casing	(feet)	37.31
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G52S

Site Name: Duck Creek Gypsum Managment Facility Borehole #: ~~BG52~~

~~State Plane~~ Plant Coordinate: X -76.1 Y 14,655.3 (or) Latitude: Longitude:

Surveyed By: Kimberley R. Lyons IL Registration #: 035-003669

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Testing Services Corp. Date Started: 1/21/2008 Date Finished: 1/22/2008

Report Form Completed By: Rhonald W. Hasenyager Date: 2/20/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite grout

Installation Method: Tremie

Setting Time: >24 hr

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 25 min

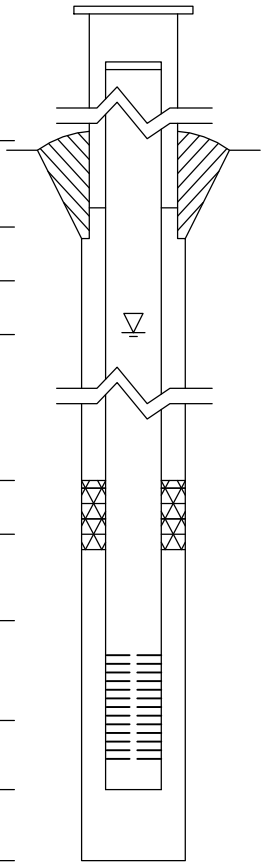
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
620.19	-3.66	Top of Protective Casing
619.64	-3.11	Top of Riser Pipe
616.53	0.00	Ground Surface
613.33	3.20	Top of Annular Sealant
584.08	32.45	Static Water Level (After Completion) 1/30/2008
582.26	34.27	Top of Seal
579.31	37.22	Top of Sand Pack
577.38	39.15	Top of Screen
572.60	43.93	Bottom of Screen
572.33	44.20	Bottom of Well
570.53	46.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	42.29
Bottom of Screen to End Cap	(feet)	0.37
Screen Length (1st slot to last slot)	(feet)	4.78
Total Length of Casing	(feet)	47.44
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G53L

Site Name: Gypsum Management Facility Borehole #: ~~G53a~~

~~State~~ Plant ~~Plane~~ Coordinate: X 506.3 Y 16,200.0 (or) Latitude: ___ ___ ___ Longitude: ___ ___ ___

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/5/2009 Date Finished: 2/5/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 25 minutes

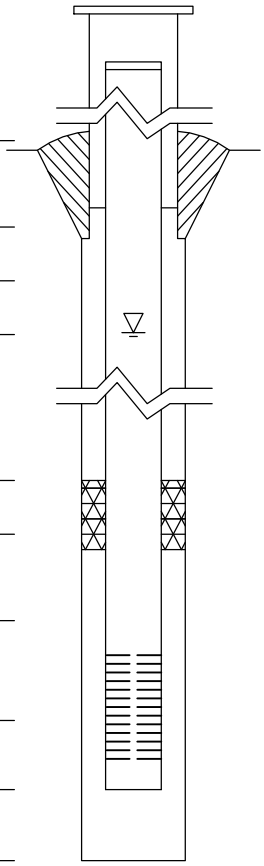
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.61	-3.32	Top of Protective Casing
623.28	-2.99	Top of Riser Pipe
620.29	0.00	Ground Surface
618.29	2.00	Top of Annular Sealant
600.45	19.84	Static Water Level (After Completion) 3/4/2009
607.79	12.50	Top of Seal
605.67	14.62	Top of Sand Pack
603.32	16.97	Top of Screen
593.97	26.32	Bottom of Screen
593.50	26.79	Bottom of Well
593.50	26.79	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	19.96
Bottom of Screen to End Cap	(feet)	0.47
Screen Length (1st slot to last slot)	(feet)	9.35
Total Length of Casing	(feet)	29.78
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G53S

Site Name: Gypsum Management Facility Borehole #: ~~G53~~

~~State~~ Plant ~~Plane~~ Coordinate: X 510.5 Y 16,199.6 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/5/2009 Date Finished: 2/5/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- (Granular) Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 60 minutes

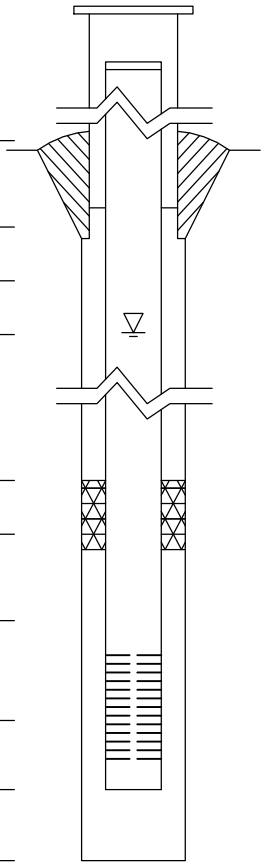
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.33	-3.04	Top of Protective Casing
623.17	-2.88	Top of Riser Pipe
620.29	0.00	Ground Surface
618.29	2.00	Top of Annular Sealant
599.63	20.66	Static Water Level (After Completion) 3/4/2009
595.29	25.00	Top of Seal
592.29	28.00	Top of Sand Pack
589.65	30.64	Top of Screen
585.16	35.13	Bottom of Screen
584.73	35.56	Bottom of Well
584.25	36.04	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS
(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	33.52
Bottom of Screen to End Cap	(feet)	0.43
Screen Length (1st slot to last slot)	(feet)	4.49
Total Length of Casing	(feet)	38.44
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Fulton Well #: G54C

Site Name: Duck Creek Part 845 Groundwater Borehole #: G54C

State Plane Coordinate: X 2,348,250.1 Y 1,384,885.2 (or) Latitude: _____ Longitude: _____

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Geotechnics Driller: Matt

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow Stem Auger Drilling Fluid (Type): none

Logged By: Tad A. Gass Date Started: 2/3/2021 Date Finished: 2/5/2021

Report Form Completed By: Tad A. Gass Date: 2/23/2021

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High solids bentonite

Installation Method: tremie

Setting Time: 45 min.

Type of Bentonite Seal -- Granular [Pellet] Slurry (choose one)

Installation Method: gravity

Setting Time: 25 min.

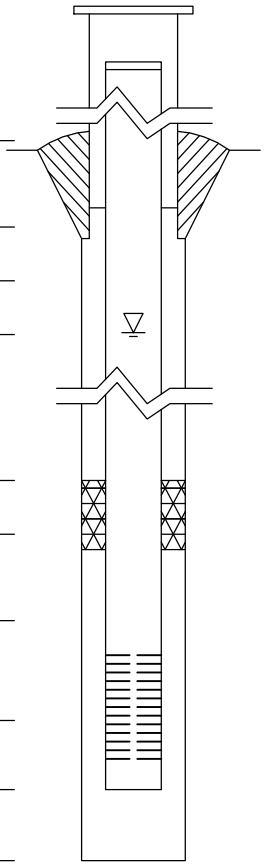
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: gravity

Type of Backfill Material: _____ (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.03	-3.43	Top of Protective Casing
622.72	-3.13	Top of Riser Pipe
619.59	0.00	Ground Surface
615.59	4.00	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
530.00	89.59	Top of Sand Pack
528.00	91.59	Top of Screen
518.09	101.50	Bottom of Screen
517.59	102.00	Bottom of Well
517.59	102.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	95.56
Bottom of Screen to End Cap	(feet)	0.50
Screen Length (1st slot to last slot)	(feet)	9.07
Total Length of Casing	(feet)	105.13
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G54L

Site Name: Gypsum Management Facility Borehole #: ~~G54a~~

~~State Plane~~ Plant Coordinate: X 463.8 Y 14,664.4 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/12/2009 Date Finished: 2/12/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 20 minutes

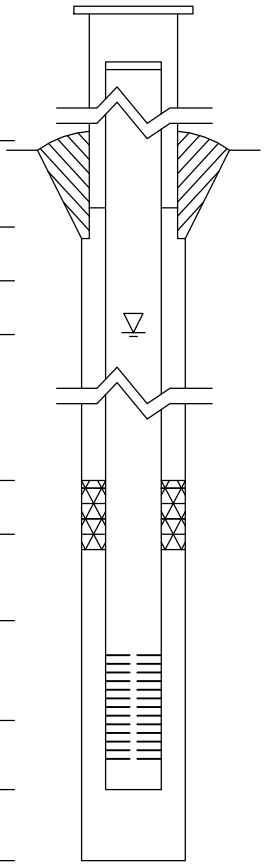
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.37	-3.09	Top of Protective Casing
623.00	-2.72	Top of Riser Pipe
620.28	0.00	Ground Surface
618.48	1.80	Top of Annular Sealant
	DRY	Static Water Level (After Completion) 3/4/2009
597.78	22.50	Top of Seal
595.28	25.00	Top of Sand Pack
592.96	27.32	Top of Screen
583.53	36.75	Bottom of Screen
583.06	37.22	Bottom of Well
583.06	37.22	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	30.04
Bottom of Screen to End Cap	(feet)	0.47
Screen Length (1st slot to last slot)	(feet)	9.43
Total Length of Casing	(feet)	39.94
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G54S

Site Name: Gypsum Management Facility Borehole #: ~~G54~~

~~State~~ Plant ~~Plane~~ Coordinate: X 460.5 Y 14,664.8 (or) Latitude: ___ ___ ___ Longitude: ___ ___ ___

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/12/2009 Date Finished: 2/12/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 60 minutes

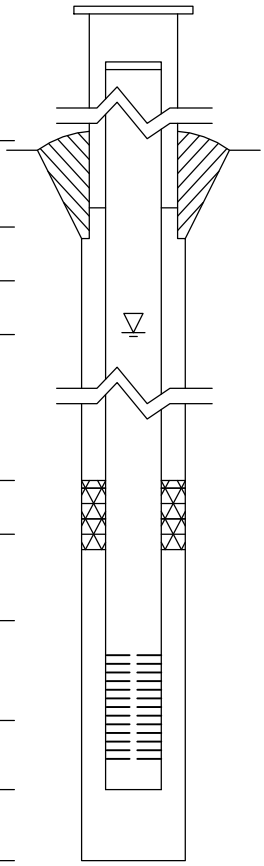
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.54	-3.26	Top of Protective Casing
623.13	-2.85	Top of Riser Pipe
620.28	0.00	Ground Surface
618.38	1.90	Top of Annular Sealant
580.98	39.30	Static Water Level (After Completion) 3/4/2009
580.78	39.50	Top of Seal
578.61	41.67	Top of Sand Pack
576.78	43.50	Top of Screen
572.31	47.97	Bottom of Screen
571.87	48.41	Bottom of Well
571.87	48.41	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	46.50
Bottom of Screen to End Cap	(feet)	0.44
Screen Length (1st slot to last slot)	(feet)	4.47
Total Length of Casing	(feet)	51.41
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G55L

Site Name: Gypsum Management Facility Borehole #: ~~G55a~~

~~State~~ Plant ~~Plane~~ Coordinate: X 705.1 Y 14,667.7 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/19/2009 Date Finished: 2/19/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 22 minutes

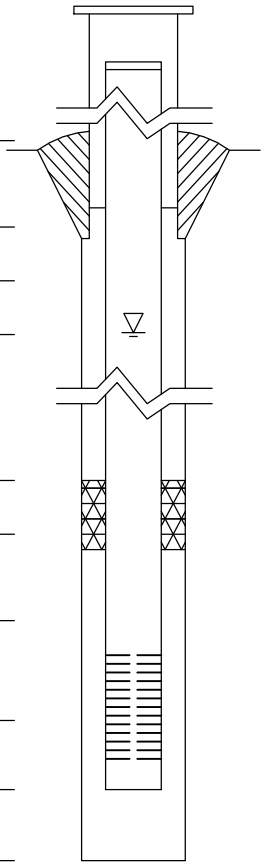
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.47	-3.69	Top of Protective Casing
623.28	-3.50	Top of Riser Pipe
619.78	0.00	Ground Surface
617.78	2.00	Top of Annular Sealant
585.79	33.99	Static Water Level (After Completion) 3/4/2009
597.95	21.83	Top of Seal
596.28	23.50	Top of Sand Pack
593.02	26.76	Top of Screen
583.66	36.12	Bottom of Screen
583.18	36.60	Bottom of Well
583.18	36.60	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	30.26
Bottom of Screen to End Cap	(feet)	0.48
Screen Length (1st slot to last slot)	(feet)	9.36
Total Length of Casing	(feet)	40.10
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G55S

Site Name: Gypsum Management Facility Borehole #: ~~G55~~

~~State Plane~~ Plant Coordinate: X 705.0 Y 14,663.9 (or) Latitude: Longitude:

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/19/2009 Date Finished: 2/19/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 55 minutes

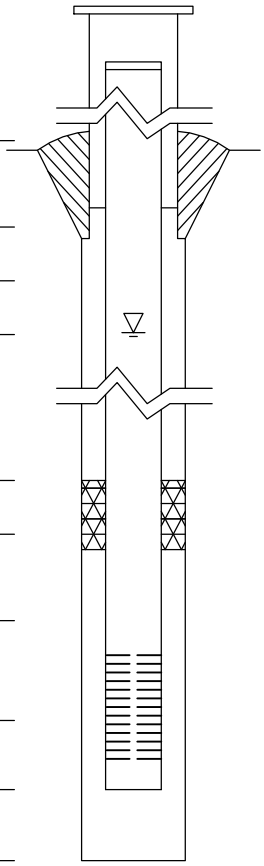
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.21	-3.43	Top of Protective Casing
622.91	-3.13	Top of Riser Pipe
619.78	0.00	Ground Surface
617.95	1.83	Top of Annular Sealant
586.49	33.29	Static Water Level (After Completion) 3/4/2009
582.78	37.00	Top of Seal
580.95	38.83	Top of Sand Pack
578.74	41.04	Top of Screen
574.29	45.49	Bottom of Screen
573.82	45.96	Bottom of Well
573.82	45.96	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

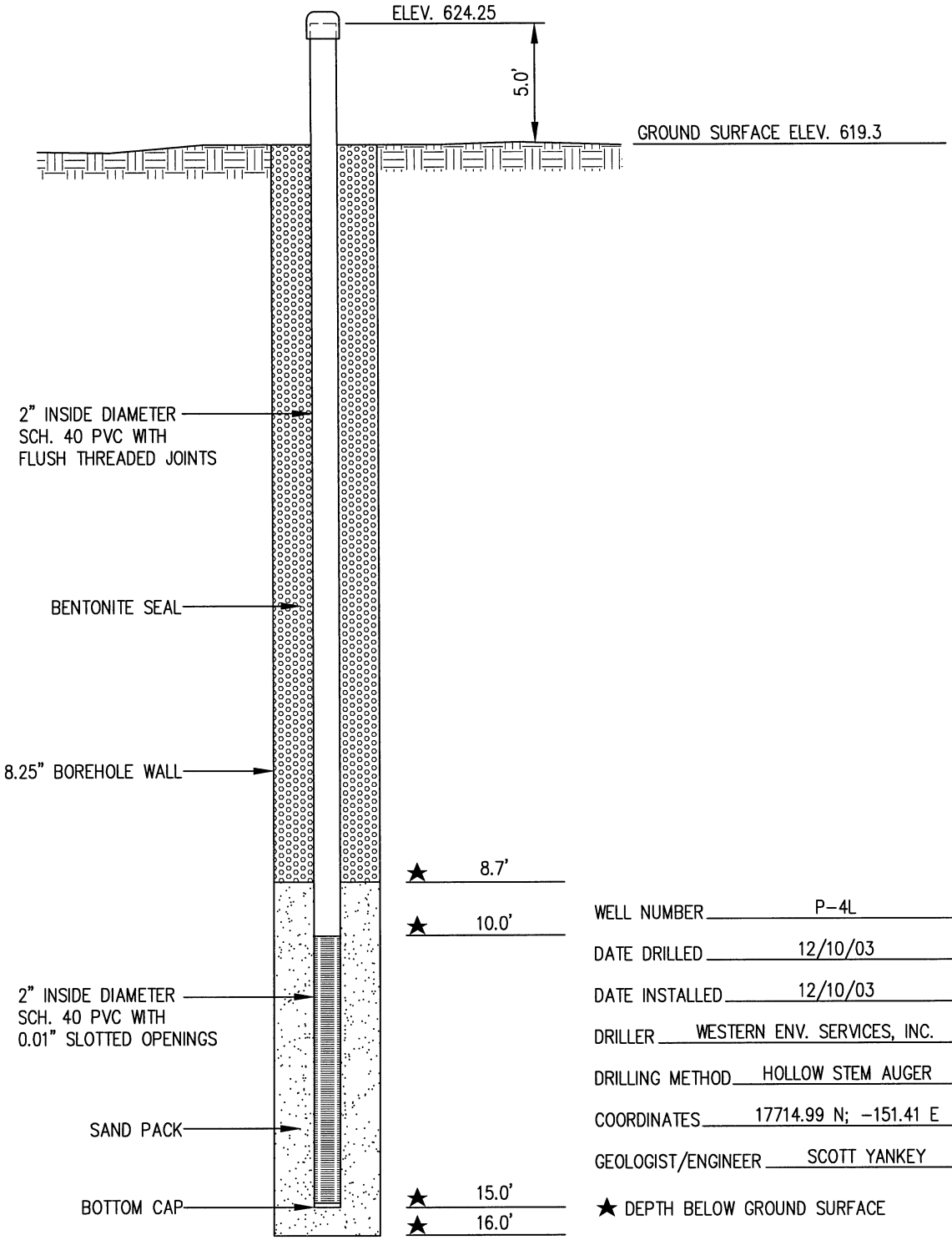
Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	44.17
Bottom of Screen to End Cap	(feet)	0.47
Screen Length (1st slot to last slot)	(feet)	4.45
Total Length of Casing	(feet)	49.09
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

G02L (MW-4L)



WELL NUMBER P-4L

DATE DRILLED 12/10/03

DATE INSTALLED 12/10/03

DRILLER WESTERN ENV. SERVICES, INC.

DRILLING METHOD HOLLOW STEM AUGER

COORDINATES 17714.99 N; -151.41 E

GEOLOGIST/ENGINEER SCOTT YANKEY

★ DEPTH BELOW GROUND SURFACE

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Hanson Professional Services Inc.

PIEZOMETER P-4L CONSTRUCTION DETAIL

PHASE III HYDROGEOLOGIC SITE INVESTIGATION
AERG - DUCK CREEK STATION CCB LANDFILL
CANTON, ILLINOIS

JOB NO. 03S5010 ATTACHMENT B

AUG 24, 2004 3:13 PM KDE
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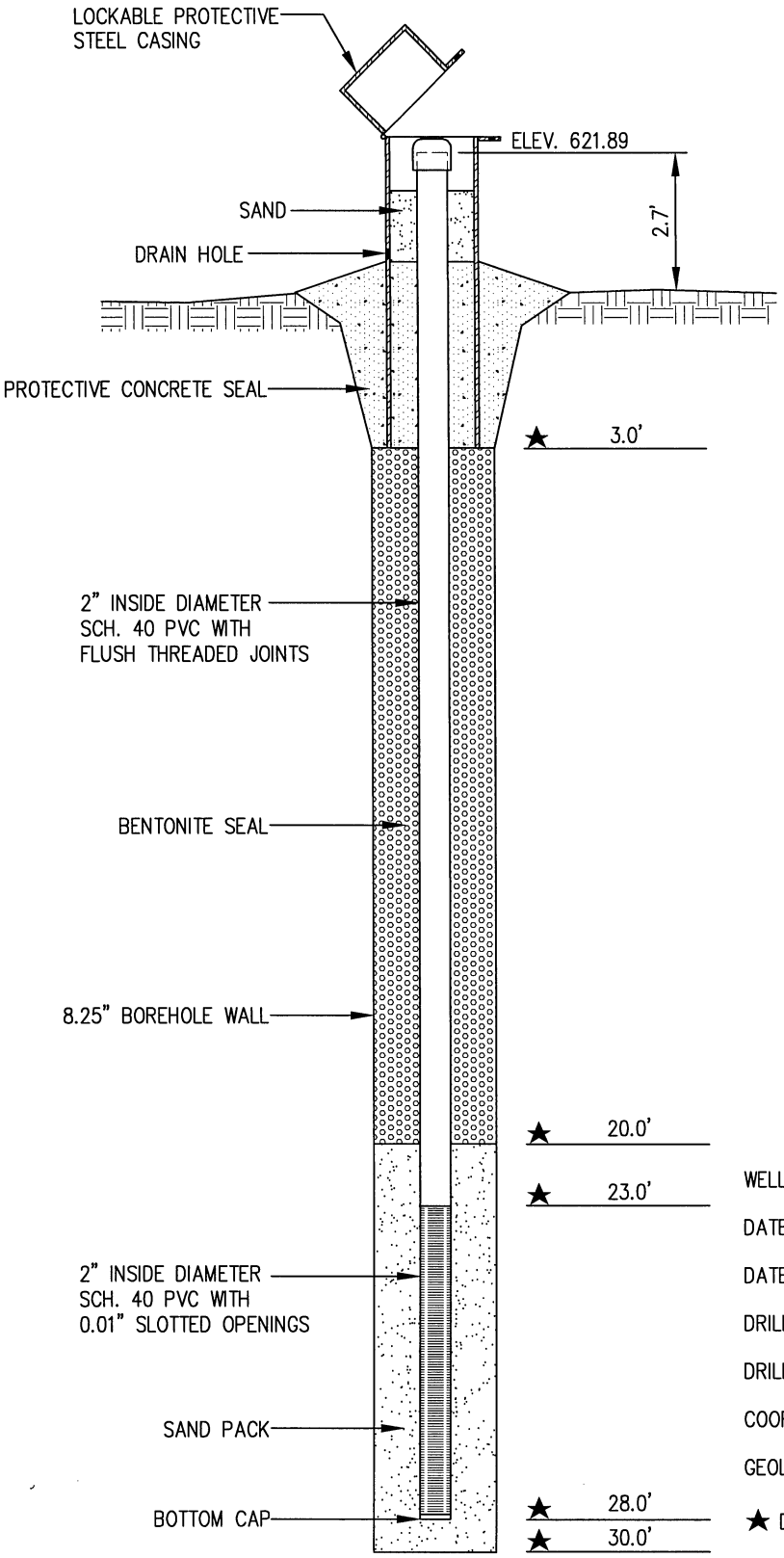
G02S (P02S, MW-4S)



WELL NUMBER MW-4S G02S

DATE DRILLED 9/29/03

DATE INSTALLED 9/29/03

DRILLER WESTERN ENV. SERVICES, INC.

DRILLING METHOD HOLLOW STEM AUGER

COORDINATES 17706.74 N; -148.45 E

GEOLOGIST/ENGINEER SCOTT YANKEY

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MONITORING WELL MW-4S CONSTRUCTION DETAIL

PHASE II HYDROGEOLOGIC SITE INVESTIGATION
AERG - DUCK CREEK STATION
CANTON, ILLINOIS

JOB NO. 03S5010 ATTACHMENT B

AUG 23, 2004 1:50 PM KDE
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Illinois Environmental Protection Agency — Well Completion Report

G50L (MW51L)

Site #: _____ County: Fulton Well #: ~~MW51L~~

Site Name: Ameren Gypsum Stack Borehole #: ~~B 51a~~

State Plane Coordinate: X 16,174.9 Y -5.3 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Andrew D. Canopy IL Registration #: 035-003391

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, 196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Ryan Keedy Date Started: 3/13/2007 Date Finished: 3/13/2007

Report Form Completed By: Rhonald W Hasenyager Date: 4/17/2007

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: gravity

Setting Time: >24 hr

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: >24 hr

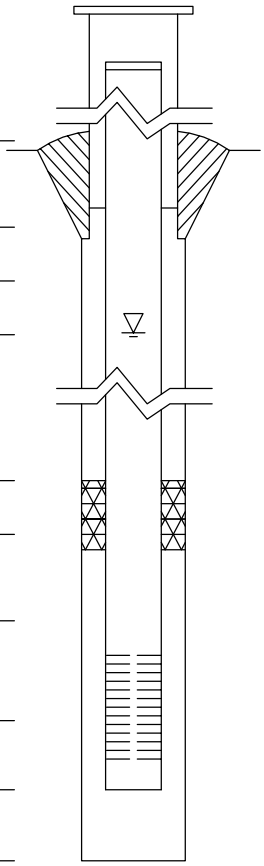
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: _____ (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
624.31	-3.47	Top of Protective Casing
623.83	-2.99	Top of Riser Pipe
620.84	0.00	Ground Surface
620.54	0.30	Top of Annular Sealant
615.27	5.57	Static Water Level (After Completion) 3/29/2007
620.54	0.30	Top of Seal
610.81	10.03	Top of Sand Pack
609.23	11.61	Top of Screen
604.52	16.32	Bottom of Screen
604.13	16.71	Bottom of Well
604.13	16.71	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	14.60
Bottom of Screen to End Cap	(feet)	0.39
Screen Length (1st slot to last slot)	(feet)	4.71
Total Length of Casing	(feet)	19.70
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

G50S (MW51S)

Site #: _____ County: Fulton Well #: ~~MW51S~~

Site Name: Ameren Gypsum Stack Borehole #: ~~B-51b~~

State Plane Coordinate: X 16,180.8 Y -5.1 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed By: Andrew D. Canopy IL Registration #: 035-003391

Drilling Contractor: Testing Service Corporation Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W Hasenyager, 196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Ryan Keedy Date Started: 3/13/2007 Date Finished: 3/13/2007

Report Form Completed By: Rhonald W Hasenyager Date: 4/17/2007

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite grout

Installation Method: Tremie

Setting Time: >24 hr

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 20 min

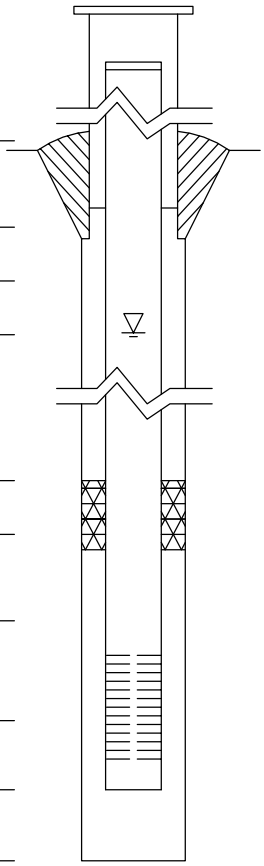
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: _____ (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
624.22	-3.38	Top of Protective Casing
623.82	-2.98	Top of Riser Pipe
620.84	0.00	Ground Surface
620.54	0.30	Top of Annular Sealant
614.98	5.86	Static Water Level (After Completion) 3/29/2007
597.42	23.42	Top of Seal
593.80	27.04	Top of Sand Pack
591.67	29.17	Top of Screen
586.86	33.98	Bottom of Screen
586.52	34.32	Bottom of Well
586.52	34.32	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	32.25
Bottom of Screen to End Cap	(feet)	0.34
Screen Length (1st slot to last slot)	(feet)	4.71
Total Length of Casing	(feet)	37.30
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G51L

Site Name: Duck Creek Gypsum Managment Facility Borehole #: ~~BG51b~~

~~State~~ Plant ~~Plane~~ Coordinate: X -75.7 Y 15,409.7 (or) Latitude: Longitude:

Surveyed By: Kimberley R. Lyons IL Registration #: 035-003669

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Testing Services Corp. Date Started: 1/28/2008 Date Finished: 1/28/2008

Report Form Completed By: Rhonald W. Hasenyager Date: 2/20/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: >24 hr

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method:

Setting Time:

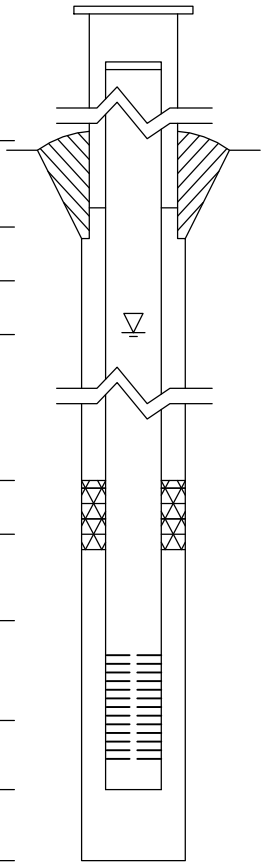
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
620.35	-3.44	Top of Protective Casing
619.91	-3.00	Top of Riser Pipe
616.91	0.00	Ground Surface
614.81	2.10	Top of Annular Sealant
606.34	10.57	Static Water Level (After Completion) 1/30/2008
614.81	2.10	Top of Seal
606.77	10.14	Top of Sand Pack
604.87	12.04	Top of Screen
600.08	16.83	Bottom of Screen
599.70	17.21	Bottom of Well
599.19	17.72	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	15.15
Bottom of Screen to End Cap	(feet)	0.38
Screen Length (1st slot to last slot)	(feet)	4.79
Total Length of Casing	(feet)	20.32
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G51S

Site Name: Duck Creek Gypsum Managment Facility Borehole #: ~~BG51a~~

~~State~~ Plant ~~Plane~~ Coordinate: X -75.3 Y 15,405.4 (or) Latitude: Longitude:

Surveyed By: Kimberley R. Lyons IL Registration #: 035-003669

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Testing Services Corp. Date Started: 1/28/2008 Date Finished: 1/28/2008

Report Form Completed By: Rhonald W. Hasenyager Date: 2/20/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite grout

Installation Method: Tremie

Setting Time: >24 hr

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 20 min

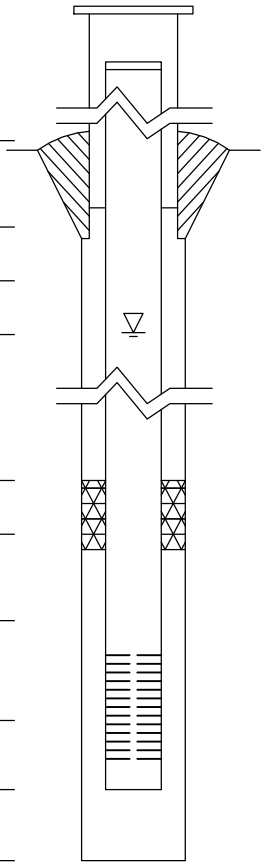
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
620.32	-3.52	Top of Protective Casing
619.81	-3.01	Top of Riser Pipe
616.80	0.00	Ground Surface
614.50	2.30	Top of Annular Sealant
606.39	10.41	Static Water Level (After Completion) 1/30/2008
597.05	19.75	Top of Seal
594.58	22.22	Top of Sand Pack
592.79	24.01	Top of Screen
588.01	28.79	Bottom of Screen
587.64	29.16	Bottom of Well
587.64	29.16	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	27.02
Bottom of Screen to End Cap	(feet)	0.37
Screen Length (1st slot to last slot)	(feet)	4.78
Total Length of Casing	(feet)	32.17
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G52L

Site Name: Duck Creek Gypsum Managment Facility Borehole #: ~~BG52b~~

~~State Plane~~ Plant Coordinate: X -76.5 Y 14,660.1 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Kimberley R. Lyons IL Registration #: 035-003669

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Testing Services Corp. Date Started: 1/22/2008 Date Finished: 1/22/2008

Report Form Completed By: Rhonald W. Hasenyager Date: 2/20/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite grout

Installation Method: Tremie

Setting Time: >24 hr

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: ____

Setting Time: 12 hrs

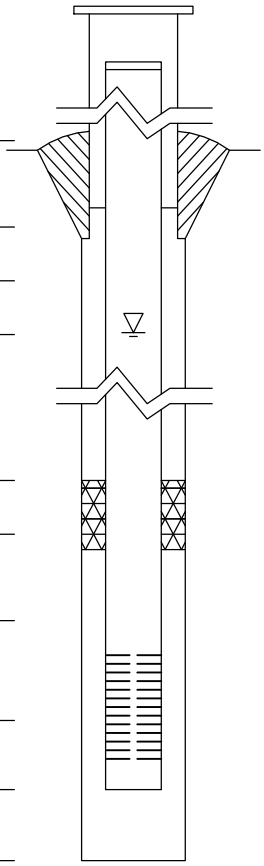
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: ____ (if applicable)

Installation Method: ____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
620.10	-3.40	Top of Protective Casing
619.64	-2.94	Top of Riser Pipe
616.70	0.00	Ground Surface
614.50	2.20	Top of Annular Sealant
587.92	28.78	Static Water Level (After Completion) 1/30/2008
591.25	25.45	Top of Seal
588.79	27.91	Top of Sand Pack
587.49	29.21	Top of Screen
582.90	33.80	Bottom of Screen
582.53	34.17	Bottom of Well
582.53	34.17	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	32.15
Bottom of Screen to End Cap	(feet)	0.37
Screen Length (1st slot to last slot)	(feet)	4.79
Total Length of Casing	(feet)	37.31
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G52S

Site Name: Duck Creek Gypsum Managment Facility Borehole #: ~~BG52~~

~~State Plane~~ Plant Coordinate: X -76.1 Y 14,655.3 (or) Latitude: Longitude:

Surveyed By: Kimberley R. Lyons IL Registration #: 035-003669

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Testing Services Corp. Date Started: 1/21/2008 Date Finished: 1/22/2008

Report Form Completed By: Rhonald W. Hasenyager Date: 2/20/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite grout

Installation Method: Tremie

Setting Time: >24 hr

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 25 min

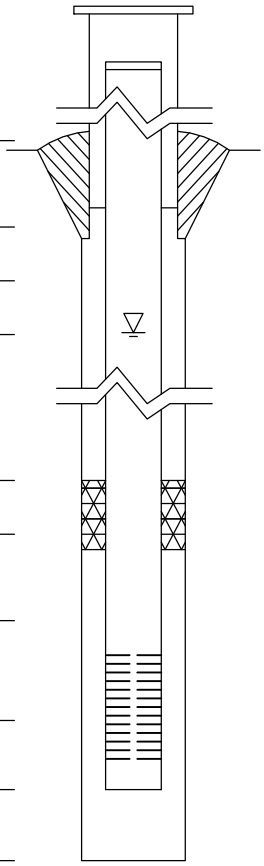
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
620.19	-3.66	Top of Protective Casing
619.64	-3.11	Top of Riser Pipe
616.53	0.00	Ground Surface
613.33	3.20	Top of Annular Sealant
584.08	32.45	Static Water Level (After Completion) 1/30/2008
582.26	34.27	Top of Seal
579.31	37.22	Top of Sand Pack
577.38	39.15	Top of Screen
572.60	43.93	Bottom of Screen
572.33	44.20	Bottom of Well
570.53	46.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	42.29
Bottom of Screen to End Cap	(feet)	0.37
Screen Length (1st slot to last slot)	(feet)	4.78
Total Length of Casing	(feet)	47.44
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G53L

Site Name: Gypsum Management Facility Borehole #: ~~G53a~~

~~State~~ Plant ~~Plane~~ Coordinate: X 506.3 Y 16,200.0 (or) Latitude: ___ ___ ___ Longitude: ___ ___ ___

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/5/2009 Date Finished: 2/5/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 25 minutes

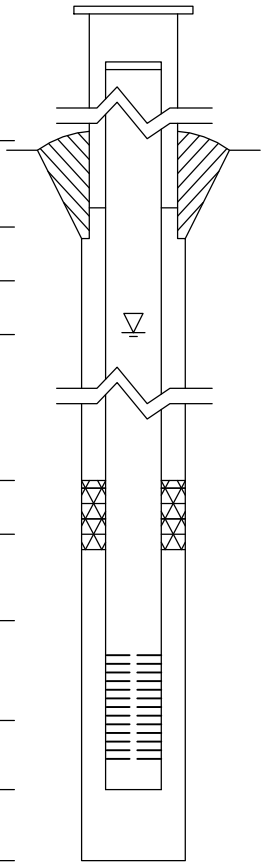
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.61	-3.32	Top of Protective Casing
623.28	-2.99	Top of Riser Pipe
620.29	0.00	Ground Surface
618.29	2.00	Top of Annular Sealant
600.45	19.84	Static Water Level (After Completion) 3/4/2009
607.79	12.50	Top of Seal
605.67	14.62	Top of Sand Pack
603.32	16.97	Top of Screen
593.97	26.32	Bottom of Screen
593.50	26.79	Bottom of Well
593.50	26.79	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	19.96
Bottom of Screen to End Cap	(feet)	0.47
Screen Length (1st slot to last slot)	(feet)	9.35
Total Length of Casing	(feet)	29.78
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G53S

Site Name: Gypsum Management Facility Borehole #: ~~G53~~

~~State~~ Plant ~~Plane~~ Coordinate: X 510.5 Y 16,199.6 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/5/2009 Date Finished: 2/5/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- (Granular) Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 60 minutes

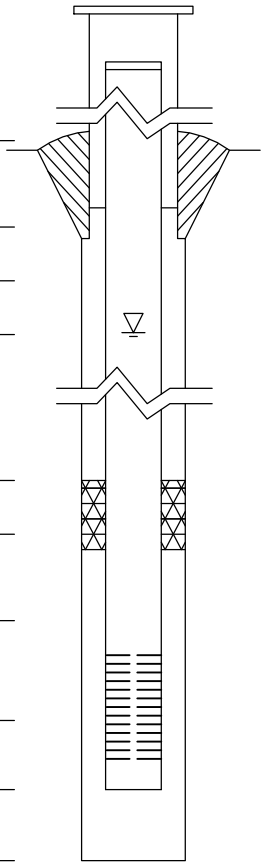
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.33	-3.04	Top of Protective Casing
623.17	-2.88	Top of Riser Pipe
620.29	0.00	Ground Surface
618.29	2.00	Top of Annular Sealant
599.63	20.66	Static Water Level (After Completion) 3/4/2009
595.29	25.00	Top of Seal
592.29	28.00	Top of Sand Pack
589.65	30.64	Top of Screen
585.16	35.13	Bottom of Screen
584.73	35.56	Bottom of Well
584.25	36.04	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS
(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	33.52
Bottom of Screen to End Cap	(feet)	0.43
Screen Length (1st slot to last slot)	(feet)	4.49
Total Length of Casing	(feet)	38.44
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Fulton Well #: G54C

Site Name: Duck Creek Part 845 Groundwater Borehole #: G54C

State Plane Coordinate: X 2,348,250.1 Y 1,384,885.2 (or) Latitude: _____ Longitude: _____

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Geotechnics Driller: Matt

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow Stem Auger Drilling Fluid (Type): none

Logged By: Tad A. Gass Date Started: 2/3/2021 Date Finished: 2/5/2021

Report Form Completed By: Tad A. Gass Date: 2/23/2021

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High solids bentonite

Installation Method: tremie

Setting Time: 45 min.

Type of Bentonite Seal -- Granular [Pellet] Slurry (choose one)

Installation Method: gravity

Setting Time: 25 min.

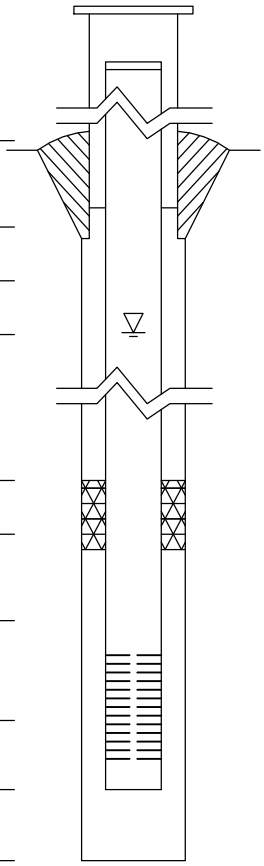
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: gravity

Type of Backfill Material: _____ (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.03	-3.43	Top of Protective Casing
622.72	-3.13	Top of Riser Pipe
619.59	0.00	Ground Surface
615.59	4.00	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
530.00	89.59	Top of Sand Pack
528.00	91.59	Top of Screen
518.09	101.50	Bottom of Screen
517.59	102.00	Bottom of Well
517.59	102.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: [Steel]
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	95.56
Bottom of Screen to End Cap	(feet)	0.50
Screen Length (1st slot to last slot)	(feet)	9.07
Total Length of Casing	(feet)	105.13
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G54L

Site Name: Gypsum Management Facility Borehole #: ~~G54a~~

~~State Plane~~ Plant Coordinate: X 463.8 Y 14,664.4 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/12/2009 Date Finished: 2/12/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 20 minutes

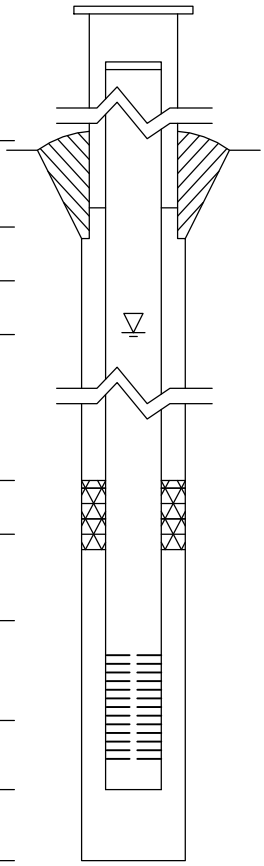
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.37	-3.09	Top of Protective Casing
623.00	-2.72	Top of Riser Pipe
620.28	0.00	Ground Surface
618.48	1.80	Top of Annular Sealant
	DRY	Static Water Level (After Completion) 3/4/2009
597.78	22.50	Top of Seal
595.28	25.00	Top of Sand Pack
592.96	27.32	Top of Screen
583.53	36.75	Bottom of Screen
583.06	37.22	Bottom of Well
583.06	37.22	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	30.04
Bottom of Screen to End Cap	(feet)	0.47
Screen Length (1st slot to last slot)	(feet)	9.43
Total Length of Casing	(feet)	39.94
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G54S

Site Name: Gypsum Management Facility Borehole #: ~~G54~~

~~State~~ Plant ~~Plane~~ Coordinate: X 460.5 Y 14,664.8 (or) Latitude: ___ ___ ___ Longitude: ___ ___ ___

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/12/2009 Date Finished: 2/12/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 60 minutes

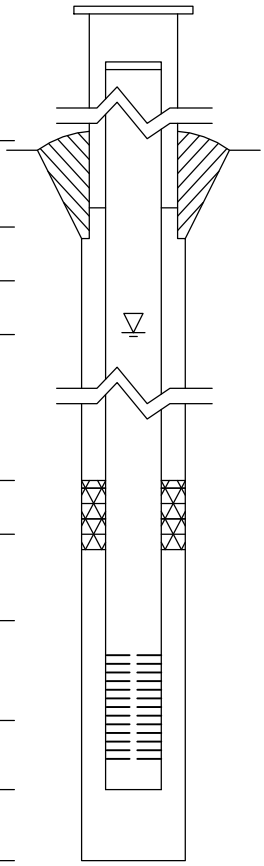
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.54	-3.26	Top of Protective Casing
623.13	-2.85	Top of Riser Pipe
620.28	0.00	Ground Surface
618.38	1.90	Top of Annular Sealant
580.98	39.30	Static Water Level (After Completion) 3/4/2009
580.78	39.50	Top of Seal
578.61	41.67	Top of Sand Pack
576.78	43.50	Top of Screen
572.31	47.97	Bottom of Screen
571.87	48.41	Bottom of Well
571.87	48.41	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	46.50
Bottom of Screen to End Cap	(feet)	0.44
Screen Length (1st slot to last slot)	(feet)	4.47
Total Length of Casing	(feet)	51.41
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G55L

Site Name: Gypsum Management Facility Borehole #: ~~G55a~~

~~State~~ Plant ~~Plane~~ Coordinate: X 705.1 Y 14,667.7 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/19/2009 Date Finished: 2/19/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 22 minutes

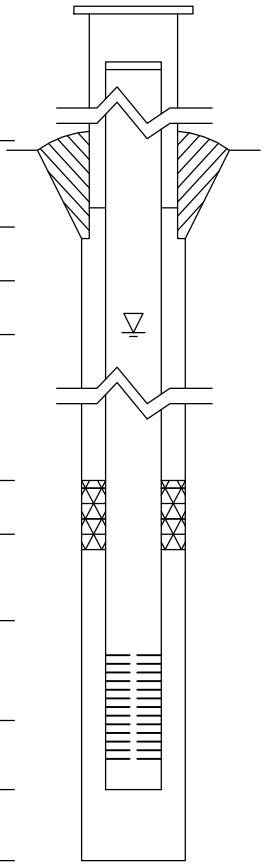
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.47	-3.69	Top of Protective Casing
623.28	-3.50	Top of Riser Pipe
619.78	0.00	Ground Surface
617.78	2.00	Top of Annular Sealant
585.79	33.99	Static Water Level (After Completion) 3/4/2009
597.95	21.83	Top of Seal
596.28	23.50	Top of Sand Pack
593.02	26.76	Top of Screen
583.66	36.12	Bottom of Screen
583.18	36.60	Bottom of Well
583.18	36.60	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	30.26
Bottom of Screen to End Cap	(feet)	0.48
Screen Length (1st slot to last slot)	(feet)	9.36
Total Length of Casing	(feet)	40.10
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G55S

Site Name: Gypsum Management Facility Borehole #: ~~G55~~

~~State Plane~~ Plant Coordinate: X 705.0 Y 14,663.9 (or) Latitude: Longitude:

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/19/2009 Date Finished: 2/19/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 55 minutes

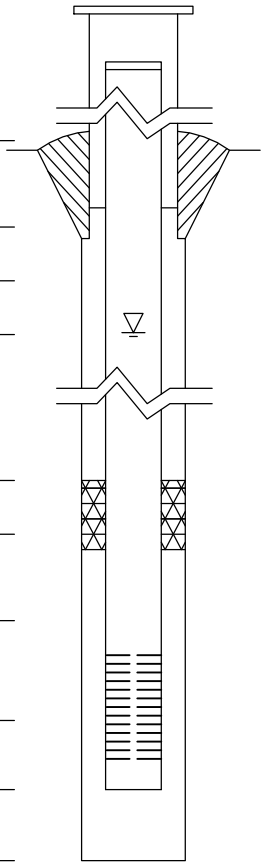
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.21	-3.43	Top of Protective Casing
622.91	-3.13	Top of Riser Pipe
619.78	0.00	Ground Surface
617.95	1.83	Top of Annular Sealant
586.49	33.29	Static Water Level (After Completion) 3/4/2009
582.78	37.00	Top of Seal
580.95	38.83	Top of Sand Pack
578.74	41.04	Top of Screen
574.29	45.49	Bottom of Screen
573.82	45.96	Bottom of Well
573.82	45.96	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	44.17
Bottom of Screen to End Cap	(feet)	0.47
Screen Length (1st slot to last slot)	(feet)	4.45
Total Length of Casing	(feet)	49.09
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G56L

Site Name: Gypsum Management Facility Borehole #: ~~G56a~~

~~State Plane~~ Plant Coordinate: X 979.2 Y 14,708.6 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/16/2009 Date Finished: 2/16/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 24+ hours

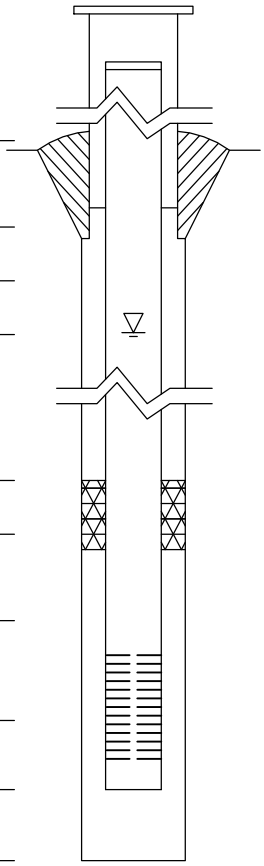
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
622.94	-3.03	Top of Protective Casing
622.37	-2.46	Top of Riser Pipe
619.91	0.00	Ground Surface
617.91	2.00	Top of Annular Sealant
	DRY	Static Water Level (After Completion) 3/4/2009
617.91	2.00	Top of Seal
608.91	11.00	Top of Sand Pack
606.14	13.77	Top of Screen
597.80	22.11	Bottom of Screen
597.02	22.89	Bottom of Well
597.02	22.89	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	16.23
Bottom of Screen to End Cap	(feet)	0.78
Screen Length (1st slot to last slot)	(feet)	9.34
Total Length of Casing	(feet)	26.35
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G56S

Site Name: Gypsum Management Facility Borehole #: ~~G56~~

~~State~~ Plant ~~Plane~~ Coordinate: X 978.8 Y 14,705.0 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/16/2009 Date Finished: 2/16/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 45 minutes

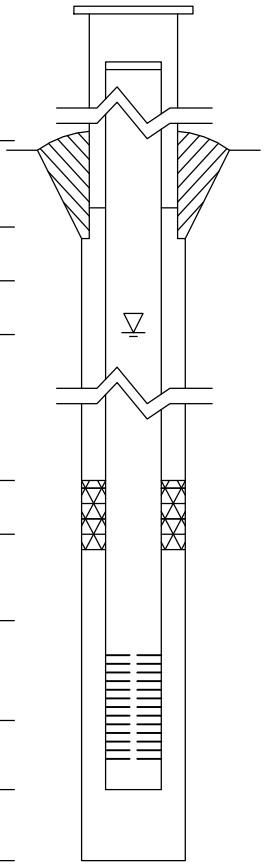
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.14	-3.23	Top of Protective Casing
622.74	-2.83	Top of Riser Pipe
619.91	0.00	Ground Surface
617.95	1.96	Top of Annular Sealant
589.36	30.55	Static Water Level (After Completion) 3/4/2009
591.83	28.08	Top of Seal
588.76	31.15	Top of Sand Pack
586.74	33.17	Top of Screen
582.25	37.66	Bottom of Screen
581.62	38.29	Bottom of Well
579.91	40.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	36.00
Bottom of Screen to End Cap	(feet)	0.63
Screen Length (1st slot to last slot)	(feet)	4.49
Total Length of Casing	(feet)	41.12
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G57L

Site Name: Gypsum Management Facility Borehole #: ~~G57a~~

~~State Plane~~ Plant Coordinate: X 987.5 Y 15,064.7 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: ____ Date Started: 1/30/2009 Date Finished: 1/30/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 20 minutes

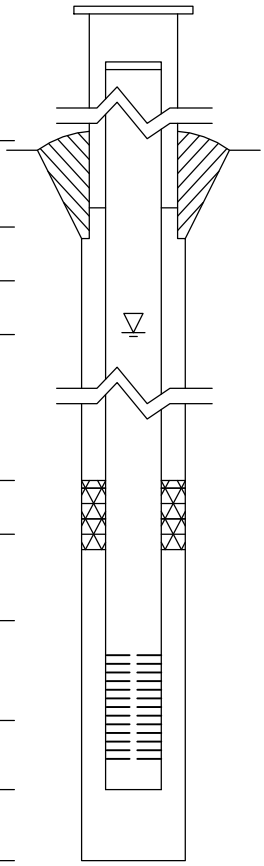
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: ____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.12	-3.14	Top of Protective Casing
622.93	-2.95	Top of Riser Pipe
619.98	0.00	Ground Surface
617.98	2.00	Top of Annular Sealant
____	DRY	Static Water Level (After Completion) 3/4/2009
608.48	11.50	Top of Seal
605.48	14.50	Top of Sand Pack
603.81	16.17	Top of Screen
594.36	25.62	Bottom of Screen
593.98	26.00	Bottom of Well
593.98	26.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	19.12
Bottom of Screen to End Cap	(feet)	0.38
Screen Length (1st slot to last slot)	(feet)	9.45
Total Length of Casing	(feet)	28.95
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G57S

Site Name: Gypsum Management Facility Borehole #: ~~G57~~

~~State~~ Plant ~~Plane~~ Coordinate: X 987.5 Y 15,060.3 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: ____ Date Started: 1/30/2009 Date Finished: 1/30/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 42 minutes

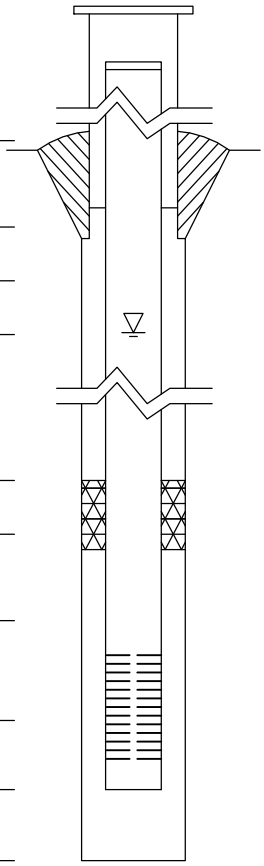
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
622.96	-2.98	Top of Protective Casing
622.76	-2.78	Top of Riser Pipe
619.98	0.00	Ground Surface
617.98	2.00	Top of Annular Sealant
588.50	31.48	Static Water Level (After Completion) 3/4/2009
596.98	23.00	Top of Seal
593.18	26.80	Top of Sand Pack
590.33	29.65	Top of Screen
585.80	34.18	Bottom of Screen
585.36	34.62	Bottom of Well
581.98	38.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	32.43
Bottom of Screen to End Cap	(feet)	0.44
Screen Length (1st slot to last slot)	(feet)	4.53
Total Length of Casing	(feet)	37.40
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G58L

Site Name: Gypsum Management Facility Borehole #: ~~G58a~~

~~State~~ Plant ~~Plane~~ Coordinate: X 989.0 Y 15,204.3 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 1/26/2009 Date Finished: 1/26/2009

Report Form Completed By: Suzanna Simpson Date: 1/30/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 20 minutes

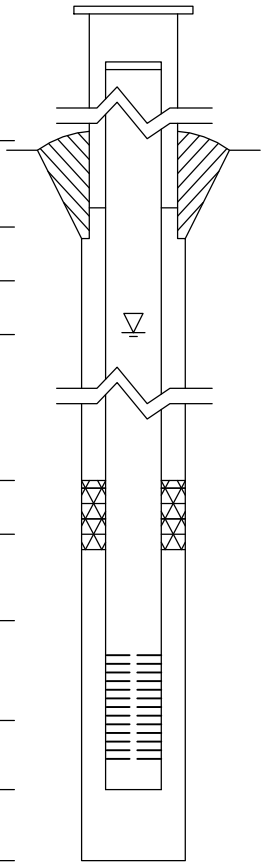
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.24	-3.20	Top of Protective Casing
623.04	-3.00	Top of Riser Pipe
620.04	0.00	Ground Surface
617.94	2.10	Top of Annular Sealant
	DRY	Static Water Level (After Completion) 3/4/2009
604.54	15.50	Top of Seal
601.49	18.55	Top of Sand Pack
599.35	20.69	Top of Screen
589.94	30.10	Bottom of Screen
589.48	30.56	Bottom of Well
589.48	30.56	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS
(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	23.69
Bottom of Screen to End Cap	(feet)	0.46
Screen Length (1st slot to last slot)	(feet)	9.41
Total Length of Casing	(feet)	33.56
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G58S

Site Name: Gypsum Management Facility Borehole #: ~~G58~~

~~State Plane~~ Plant Coordinate: X 989.6 Y 15,200.2 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 1/26/2009 Date Finished: 1/26/2009

Report Form Completed By: Suzanna Simpson Date: 1/30/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 60 minutes

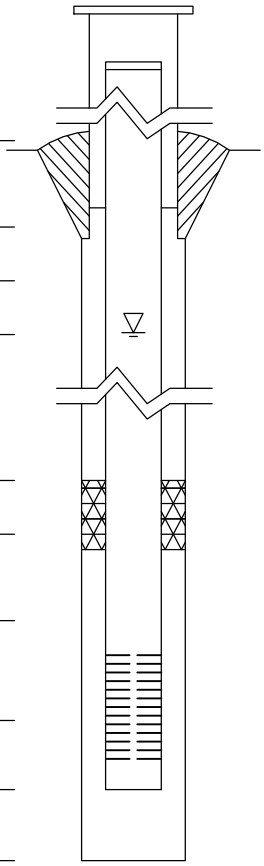
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.27	-3.23	Top of Protective Casing
623.05	-3.01	Top of Riser Pipe
620.04	0.00	Ground Surface
617.94	2.10	Top of Annular Sealant
582.62	37.42	Static Water Level (After Completion) 3/4/2009
593.04	27.00	Top of Seal
590.79	29.25	Top of Sand Pack
588.72	31.32	Top of Screen
584.24	35.80	Bottom of Screen
583.61	36.43	Bottom of Well
583.61	36.43	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	34.33
Bottom of Screen to End Cap	(feet)	0.63
Screen Length (1st slot to last slot)	(feet)	4.48
Total Length of Casing	(feet)	39.44
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G59L

Site Name: Gypsum Management Facility Borehole #: ~~G59a~~

~~State Plane~~ Plant Coordinate: X 992.6 Y 15,343.9 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 1/23/2009 Date Finished: 1/23/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 30 minutes

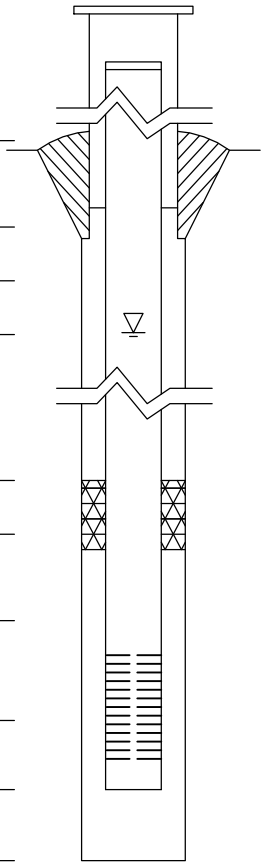
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
622.76	-2.61	Top of Protective Casing
622.45	-2.30	Top of Riser Pipe
620.15	0.00	Ground Surface
618.15	2.00	Top of Annular Sealant
	DRY	Static Water Level (After Completion) 3/4/2009
602.29	17.86	Top of Seal
599.47	20.68	Top of Sand Pack
597.24	22.91	Top of Screen
587.82	32.33	Bottom of Screen
587.12	33.03	Bottom of Well
587.12	33.03	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS
(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	25.21
Bottom of Screen to End Cap	(feet)	0.70
Screen Length (1st slot to last slot)	(feet)	9.42
Total Length of Casing	(feet)	35.33
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G59S

Site Name: Gypsum Management Facility Borehole #: ~~G59~~

~~State~~ Plant ~~Plane~~ Coordinate: X 992.6 Y 15,339.8 (or) Latitude: Longitude:

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 1/23/2009 Date Finished: 1/23/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 90 minutes

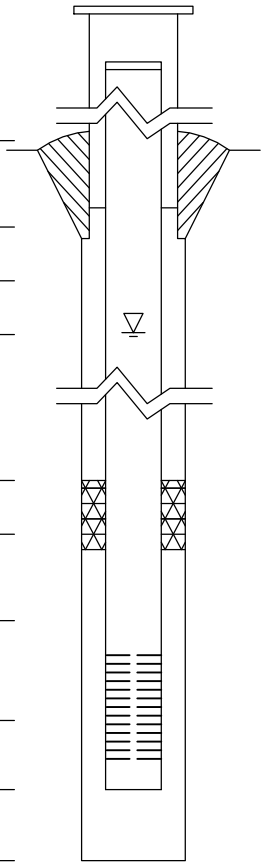
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.23	-3.08	Top of Protective Casing
622.84	-2.69	Top of Riser Pipe
620.15	0.00	Ground Surface
618.15	2.00	Top of Annular Sealant
578.24	41.91	Static Water Level (After Completion) 3/4/2009
588.15	32.00	Top of Seal
584.81	35.34	Top of Sand Pack
582.77	37.38	Top of Screen
578.27	41.88	Bottom of Screen
577.66	42.49	Bottom of Well
577.66	42.49	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	40.07
Bottom of Screen to End Cap	(feet)	0.61
Screen Length (1st slot to last slot)	(feet)	4.50
Total Length of Casing	(feet)	45.18
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G60L

Site Name: Duck Creek Gypsum Managment Facility Borehole #: ~~BG60b~~

~~State Plane~~ Plant Coordinate: X 1,049.8 Y 15,474.7 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Kimberley R. Lyons IL Registration #: 035-003669

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Testing Services Corp. Date Started: 1/17/2008 Date Finished: 1/17/2008

Report Form Completed By: Rhonald W. Hasenyager Date: 2/20/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: >24 hr

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: ____

Setting Time: ____

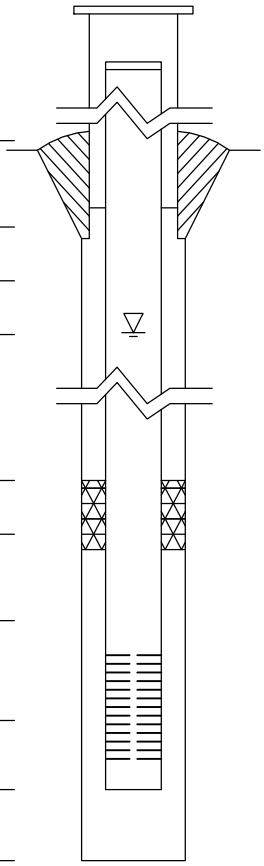
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: ____ (if applicable)

Installation Method: ____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
616.00	-3.55	Top of Protective Casing
615.49	-3.04	Top of Riser Pipe
612.45	0.00	Ground Surface
609.85	2.60	Top of Annular Sealant
591.43	21.02	Static Water Level (After Completion) 1/30/2008
596.03	16.42	Top of Seal
593.32	19.13	Top of Sand Pack
592.33	20.12	Top of Screen
587.54	24.91	Bottom of Screen
587.17	25.28	Bottom of Well
587.17	25.28	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	23.45
Bottom of Screen to End Cap	(feet)	0.37
Screen Length (1st slot to last slot)	(feet)	4.79
Total Length of Casing	(feet)	28.61
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G60S

Site Name: Duck Creek Gypsum Managment Facility Borehole #: ~~BG60~~

~~State~~ Plant ~~Plane~~ Coordinate: X 1,050.2 Y 15,469.5 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Kimberley R. Lyons IL Registration #: 035-003669

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Testing Services Corp. Date Started: 1/16/2008 Date Finished: 1/16/2008

Report Form Completed By: Rhonald W. Hasenyager Date: 2/20/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite grout

Installation Method: Tremie

Setting Time: >24 hr

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 22 min

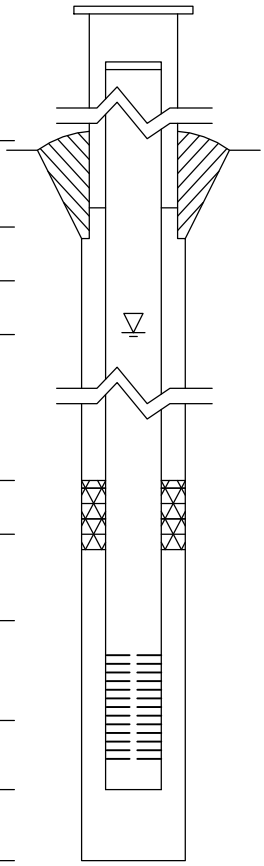
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
615.56	-3.37	Top of Protective Casing
615.11	-2.92	Top of Riser Pipe
612.19	0.00	Ground Surface
609.19	3.00	Top of Annular Sealant
582.46	29.73	Static Water Level (After Completion) 1/30/2008
584.51	27.68	Top of Seal
582.39	29.80	Top of Sand Pack
581.07	31.12	Top of Screen
576.28	35.91	Bottom of Screen
575.90	36.29	Bottom of Well
574.19	38.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	34.07
Bottom of Screen to End Cap	(feet)	0.38
Screen Length (1st slot to last slot)	(feet)	4.79
Total Length of Casing	(feet)	39.24
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G61L

Site Name: Gypsum Management Facility Borehole #: ~~G61a~~

~~State Plane~~ Plant Coordinate: X 994.4 Y 15,640.9 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 1/21/2009 Date Finished: 1/21/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 24+ hours

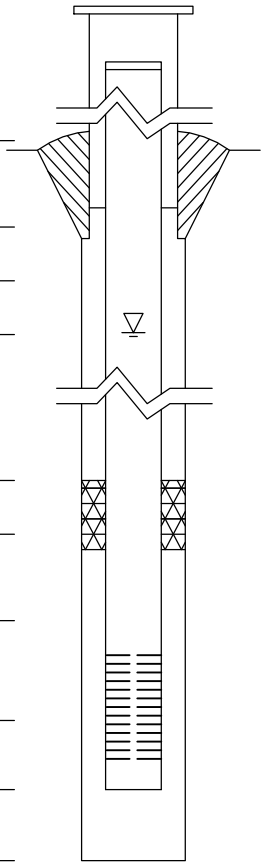
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
622.97	-2.97	Top of Protective Casing
622.77	-2.77	Top of Riser Pipe
620.00	0.00	Ground Surface
618.00	2.00	Top of Annular Sealant
	DRY	Static Water Level (After Completion) 3/4/2009
618.00	2.00	Top of Seal
612.60	7.40	Top of Sand Pack
610.36	9.64	Top of Screen
601.00	19.00	Bottom of Screen
600.10	19.90	Bottom of Well
600.10	19.90	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	12.41
Bottom of Screen to End Cap	(feet)	0.90
Screen Length (1st slot to last slot)	(feet)	9.36
Total Length of Casing	(feet)	22.67
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

4/2000

ILLINOIS DEPARTMENT OF PUBLIC HEALTH
DIVISION OF ENVIRONMENTAL HEALTH
525 W. JEFFERSON ST.
SPRINGFIELD, IL 62761

WATER WELL SEALING FORM

TYPE OR PRESS FIRMLY

RETURN ALL COPIES TO IDPH OR LOCAL HEALTH DEPARTMENT

This form shall be submitted to this Department or the local health department not more than 30 days after a water well, boring or monitoring well is sealed. Such wells are to be sealed not more than 30 days after they are abandoned in accordance with the sealing requirements in the Water Well Construction Code. THE LOCAL HEALTH DEPARTMENT OR REGIONAL PUBLIC HEALTH DEPARTMENT MUST BE NOTIFIED AT LEAST 48 HOURS PRIOR TO SEALING.

1. **Ownership (Name of Controlling Party)** Duck Creek Power Station - GMF (G61L)

2. **Well Location** 17751 N Cilco Road — Canton — Fulton
   Address - Lot Number — **City** — **County**

   General Description **Township** 6 (N)(~~S~~) **Range** 5 (E)(~~W~~) **Section** 18

   SW **Quarter of the** NE **Quarter of the** NW **Quarter**

3. **Year Drilled** 2009

4. **Drilling Permit Number (and date, if known)** n/a

5. **Type of Well** **Bored** ____ **Drilled** ✓ **Other** ____

6. **Total Depth** 19.9 **Diameter (inches)** 8

7. **Formation clear of obstruction** ✓ **Yes** ____ **No**

8. **DETAILS OF PLUGGING** *(riser pipe and screen pulled and annulus was grouted)*

   Filled with Bentonite grout **from** 0 **to** 19.9 **ft.**
   (cement or other materials)

   Kind of plug ____ **from** ____ **to** ____ **ft.**

   Filled with ____ **from** ____ **to** ____ **ft.**

   Kind of plug ____ **from** ____ **to** ____ **ft.**

   Filled with ____ **from** ____ **to** ____ **ft.**

   Kind of plug ____ **from** ____ **to** ____ **ft.**

9. **CASING RECORD** **Upper 2 feet of casing removed** ✓ **Yes** ____ **No**

10. **Date well was sealed** **Month** March **Day** 14 **Year** 2017.

11. **Licensed water well driller or other person approved by the Department performing well sealing.**

    Rhonald W. Hasenyager, L.P.G. — **Name**
    196-000246 — **Complete License Number**

    Hanson Professional Services Inc., 1525 S. 6th St. — **Address**
    Springfield — **City**
    IL 62703 — **State/ZIP**

This state agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863. Disclosure of this information is mandatory. This form has been approved by the Forms Management Center. IL 482-0631

Printed by Authority of the State of Illinois
P.O. #530379 9.6M 4/00

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G61S

Site Name: Gypsum Management Facility Borehole #: ~~G61~~

~~State~~ Plant ~~Plane~~ Coordinate: X 994.8 Y 15,644.9 (or) Latitude: ___ ___ ___ Longitude: ___ ___ ___

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 1/20/2009 Date Finished: 1/21/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- (Granular) Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 2.5 hours

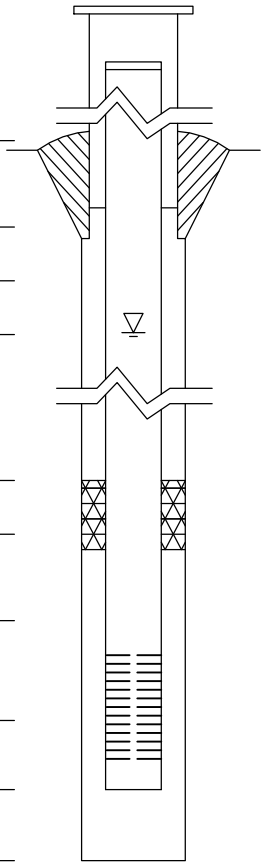
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
622.80	-2.80	Top of Protective Casing
622.58	-2.58	Top of Riser Pipe
620.00	0.00	Ground Surface
618.00	2.00	Top of Annular Sealant
587.62	32.38	Static Water Level (After Completion) 3/4/2009
595.00	25.00	Top of Seal
591.80	28.20	Top of Sand Pack
589.81	30.19	Top of Screen
585.37	34.63	Bottom of Screen
584.74	35.26	Bottom of Well
582.00	38.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	(PVC)	OTHER:
Screen	SS304	SS316	PTFE	(PVC)	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	32.77
Bottom of Screen to End Cap	(feet)	0.63
Screen Length (1st slot to last slot)	(feet)	4.44
Total Length of Casing	(feet)	37.84
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G62L

Site Name: Gypsum Management Facility Borehole #: ~~G62~~

~~State~~ Plant ~~Plane~~ Coordinate: X 994.7 Y 15,785.2 (or) Latitude: ___ ___ ___ Longitude: ___ ___ ___

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 1/21/2009 Date Finished: 1/22/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 20 minutes

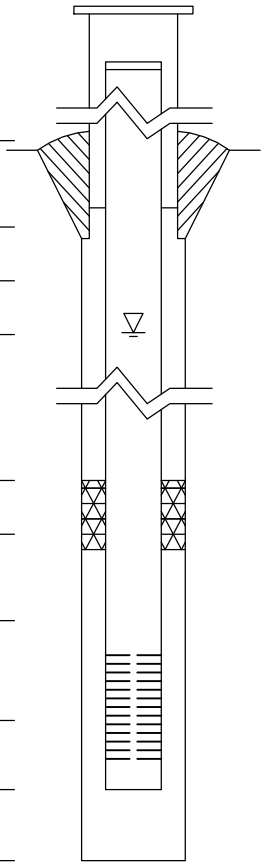
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Bentonite Chips (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.67	-3.65	Top of Protective Casing
623.48	-3.46	Top of Riser Pipe
620.02	0.00	Ground Surface
618.02	2.00	Top of Annular Sealant
	DRY	Static Water Level (After Completion) 3/4/2009
605.12	14.90	Top of Seal
602.12	17.90	Top of Sand Pack
599.71	20.31	Top of Screen
590.36	29.66	Bottom of Screen
589.90	30.12	Bottom of Well
582.02	38.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS
(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	23.77
Bottom of Screen to End Cap	(feet)	0.46
Screen Length (1st slot to last slot)	(feet)	9.35
Total Length of Casing	(feet)	33.58
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G63L

Site Name: Gypsum Management Facility Borehole #: ~~G63a~~

~~State~~ Plant ~~Plane~~ Coordinate: X 998.0 Y 15,928.4 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/2/2009 Date Finished: 2/2/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 45 minutes

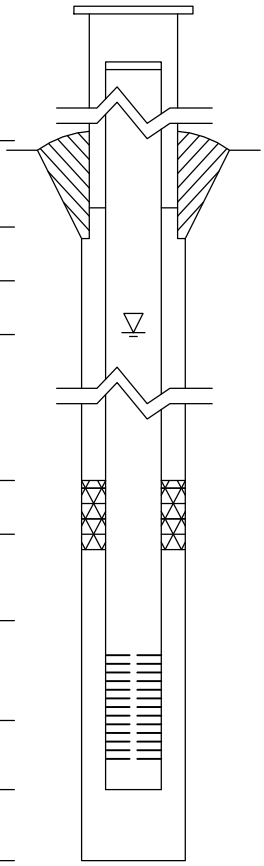
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.33	-3.21	Top of Protective Casing
622.98	-2.86	Top of Riser Pipe
620.12	0.00	Ground Surface
618.12	2.00	Top of Annular Sealant
	DRY	Static Water Level (After Completion) 3/4/2009
606.62	13.50	Top of Seal
603.62	16.50	Top of Sand Pack
601.65	18.47	Top of Screen
592.23	27.89	Bottom of Screen
591.76	28.36	Bottom of Well
591.76	28.36	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	21.33
Bottom of Screen to End Cap	(feet)	0.47
Screen Length (1st slot to last slot)	(feet)	9.42
Total Length of Casing	(feet)	31.22
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G63S

Site Name: Gypsum Management Facility Borehole #: ~~G63~~

~~State~~ Plant ~~Plane~~ Coordinate: X 998.3 Y 15,924.4 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/2/2009 Date Finished: 2/2/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 90 minutes

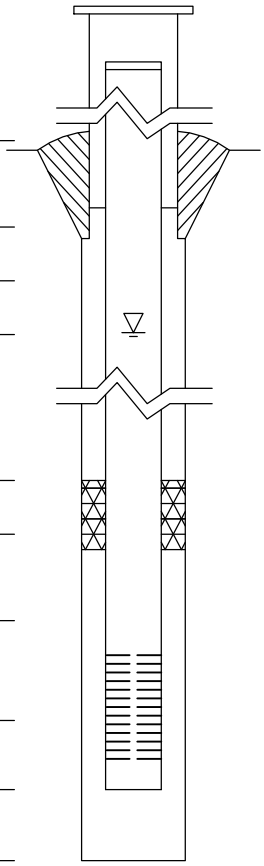
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.28	-3.16	Top of Protective Casing
623.09	-2.97	Top of Riser Pipe
620.12	0.00	Ground Surface
618.12	2.00	Top of Annular Sealant
586.64	33.48	Static Water Level (After Completion) 3/4/2009
590.62	29.50	Top of Seal
587.62	32.50	Top of Sand Pack
585.60	34.52	Top of Screen
581.11	39.01	Bottom of Screen
580.65	39.47	Bottom of Well
580.12	40.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS
(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	37.49
Bottom of Screen to End Cap	(feet)	0.46
Screen Length (1st slot to last slot)	(feet)	4.49
Total Length of Casing	(feet)	42.44
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G64L

Site Name: Gypsum Management Facility Borehole #: ~~G64a~~

~~State~~ Plant ~~Plane~~ Coordinate: X 995.7 Y 16,069.3 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 1/22/2009 Date Finished: 1/22/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 25 minutes

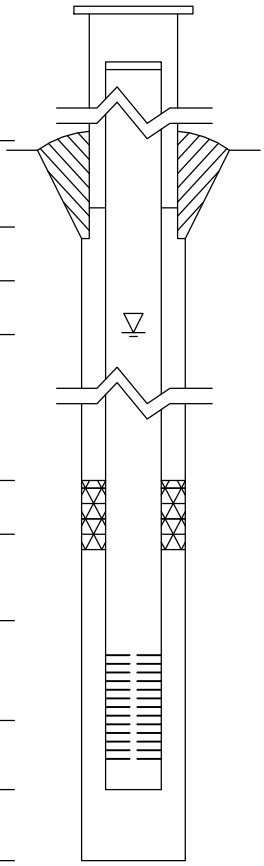
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
622.76	-2.74	Top of Protective Casing
622.54	-2.52	Top of Riser Pipe
620.02	0.00	Ground Surface
618.02	2.00	Top of Annular Sealant
	DRY	Static Water Level (After Completion) 3/4/2009
607.02	13.00	Top of Seal
604.22	15.80	Top of Sand Pack
601.90	18.12	Top of Screen
592.54	27.48	Bottom of Screen
592.07	27.95	Bottom of Well
592.07	27.95	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	20.64
Bottom of Screen to End Cap	(feet)	0.47
Screen Length (1st slot to last slot)	(feet)	9.36
Total Length of Casing	(feet)	30.47
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G64S

Site Name: Gypsum Management Facility Borehole #: ~~G64~~

~~State~~ Plant ~~Plane~~ Coordinate: X 994.9 Y 16,064.6 (or) Latitude: ___ ___ ___ Longitude: ___ ___ ___

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 1/22/2009 Date Finished: 1/22/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 90 minutes

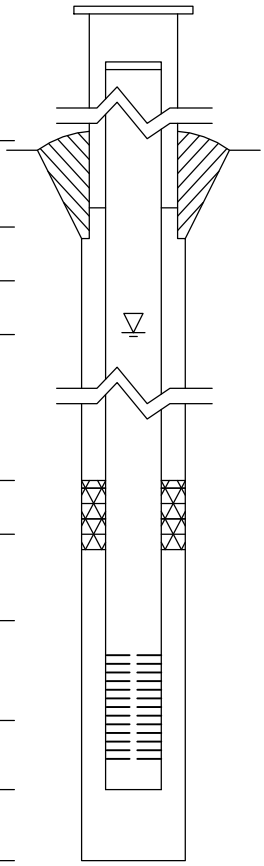
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
623.49	-3.47	Top of Protective Casing
622.98	-2.96	Top of Riser Pipe
620.02	0.00	Ground Surface
618.02	2.00	Top of Annular Sealant
587.70	32.32	Static Water Level (After Completion) 3/4/2009
590.92	29.10	Top of Seal
587.82	32.20	Top of Sand Pack
585.52	34.50	Top of Screen
581.03	38.99	Bottom of Screen
580.54	39.48	Bottom of Well
580.02	40.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS
(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	37.46
Bottom of Screen to End Cap	(feet)	0.49
Screen Length (1st slot to last slot)	(feet)	4.49
Total Length of Casing	(feet)	42.44
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G65L

Site Name: Duck Creek Gypsum Managment Facility Borehole #: ~~BG65b~~

~~State~~ Plant ~~Plane~~ Coordinate: X 919.9 Y 13,986.1 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Kimberley R. Lyons IL Registration #: 035-003669

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Testing Services Corp. Date Started: 1/15/2008 Date Finished: 1/15/2008

Report Form Completed By: Rhonald W. Hasenyager Date: 2/20/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite grout

Installation Method: Tremie

Setting Time: >24 hr

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 25 min

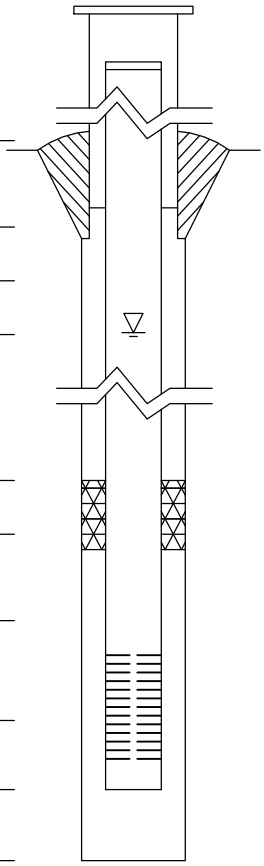
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: ____ (if applicable)

Installation Method: ____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
613.34	-3.27	Top of Protective Casing
612.84	-2.77	Top of Riser Pipe
610.07	0.00	Ground Surface
607.97	2.10	Top of Annular Sealant
587.76	22.31	Static Water Level (After Completion) 1/30/2008
596.16	13.91	Top of Seal
593.89	16.18	Top of Sand Pack
592.79	17.28	Top of Screen
587.99	22.08	Bottom of Screen
587.62	22.45	Bottom of Well
587.62	22.45	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	20.42
Bottom of Screen to End Cap	(feet)	0.37
Screen Length (1st slot to last slot)	(feet)	4.80
Total Length of Casing	(feet)	25.59
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G65S

Site Name: Duck Creek Gypsum Managment Facility Borehole #: ~~BG65a~~

~~State~~ Plant ~~Plane~~ Coordinate: X 914.1 Y 13,985.1 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Kimberley R. Lyons IL Registration #: 035-003669

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Testing Services Corp. Date Started: 1/15/2008 Date Finished: 1/15/2008

Report Form Completed By: Rhonald W. Hasenyager Date: 2/20/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite grout

Installation Method: Tremie

Setting Time: >24 hr

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 20 min

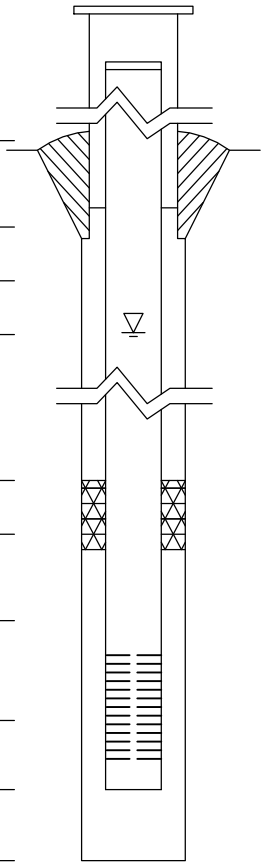
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
613.55	-3.61	Top of Protective Casing
613.04	-3.10	Top of Riser Pipe
609.94	0.00	Ground Surface
607.34	2.60	Top of Annular Sealant
584.66	25.28	Static Water Level (After Completion) 1/30/2008
586.43	23.51	Top of Seal
583.83	26.11	Top of Sand Pack
583.02	26.92	Top of Screen
578.24	31.70	Bottom of Screen
577.86	32.08	Bottom of Well
577.24	32.70	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	30.26
Bottom of Screen to End Cap	(feet)	0.38
Screen Length (1st slot to last slot)	(feet)	4.78
Total Length of Casing	(feet)	35.42
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G66L

Site Name: Gypsum Management Facility Borehole #: ~~G66a~~

~~State~~ Plant ~~Plane~~ Coordinate: X 965.7 Y 14,240.5 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/4/2009 Date Finished: 2/4/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 24+ hours

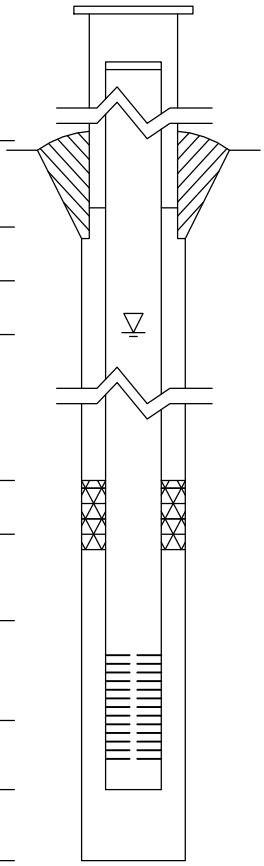
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS) (0.01 ft.)	
618.11	-3.25	Top of Protective Casing
617.82	-2.96	Top of Riser Pipe
614.86	0.00	Ground Surface
612.94	1.92	Top of Annular Sealant
	DRY	Static Water Level (After Completion) 3/4/2009
612.94	1.92	Top of Seal
607.28	7.58	Top of Sand Pack
605.02	9.84	Top of Screen
595.59	19.27	Bottom of Screen
595.12	19.74	Bottom of Well
595.12	19.74	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	12.80
Bottom of Screen to End Cap	(feet)	0.47
Screen Length (1st slot to last slot)	(feet)	9.43
Total Length of Casing	(feet)	22.70
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G66S

Site Name: Gypsum Management Facility Borehole #: ~~G66~~

~~State~~ Plant ~~Plane~~ Coordinate: X 964.9 Y 14,236.2 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/4/2009 Date Finished: 2/4/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 60 minutes

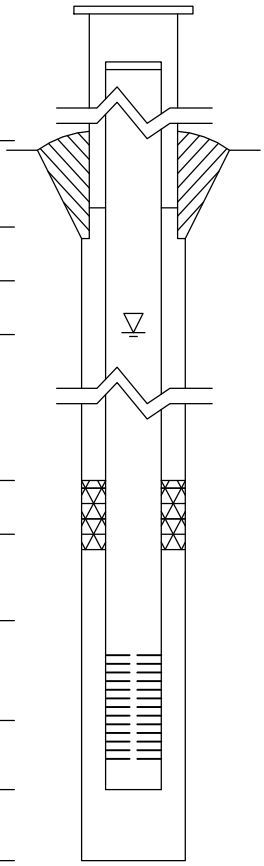
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
618.13	-3.27	Top of Protective Casing
617.84	-2.98	Top of Riser Pipe
614.86	0.00	Ground Surface
612.86	2.00	Top of Annular Sealant
590.54	24.32	Static Water Level (After Completion) 3/4/2009
584.38	30.48	Top of Seal
581.78	33.08	Top of Sand Pack
579.76	35.10	Top of Screen
575.27	39.59	Bottom of Screen
574.77	40.09	Bottom of Well
574.77	40.09	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	38.08
Bottom of Screen to End Cap	(feet)	0.50
Screen Length (1st slot to last slot)	(feet)	4.49
Total Length of Casing	(feet)	43.07
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G67L

Site Name: Gypsum Management Facility Borehole #: ~~G67a~~

~~State Plane~~ Plant Coordinate: X 928.9 Y 14,527.5 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/3/2009 Date Finished: 2/3/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 24+ hours

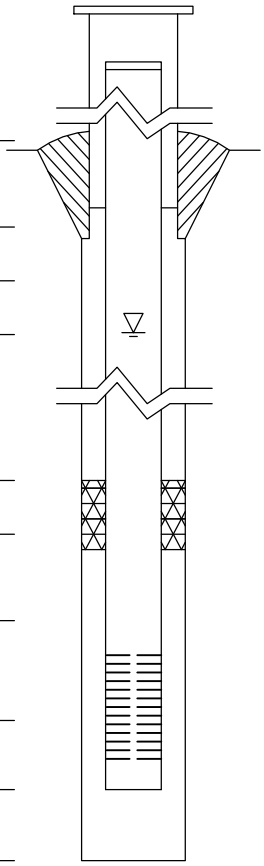
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
617.64	-3.00	Top of Protective Casing
617.22	-2.58	Top of Riser Pipe
614.64	0.00	Ground Surface
612.71	1.93	Top of Annular Sealant
	DRY	Static Water Level (After Completion) 3/4/2009
612.71	1.93	Top of Seal
609.12	5.52	Top of Sand Pack
607.28	7.36	Top of Screen
597.92	16.72	Bottom of Screen
597.46	17.18	Bottom of Well
597.46	17.18	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	9.94
Bottom of Screen to End Cap	(feet)	0.46
Screen Length (1st slot to last slot)	(feet)	9.36
Total Length of Casing	(feet)	19.76
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G67S

Site Name: Gypsum Management Facility Borehole #: ~~G67~~

~~State~~ Plant ~~Plane~~ Coordinate: X 925.2 Y 14,530.3 (or) Latitude: ___ ___ ___ Longitude: ___ ___ ___

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/3/2009 Date Finished: 2/3/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 45 minutes

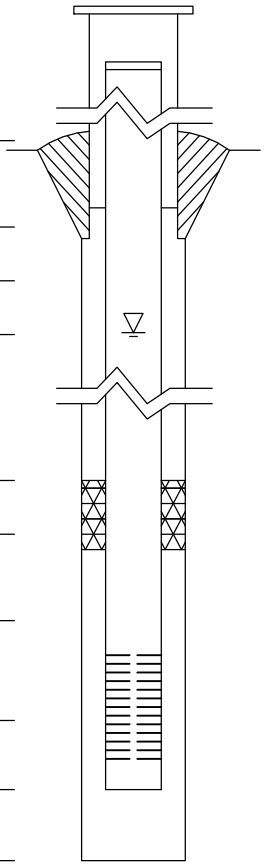
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
618.03	-3.39	Top of Protective Casing
617.86	-3.22	Top of Riser Pipe
614.64	0.00	Ground Surface
612.64	2.00	Top of Annular Sealant
590.81	23.83	Static Water Level (After Completion) 3/4/2009
589.31	25.33	Top of Seal
586.04	28.60	Top of Sand Pack
583.55	31.09	Top of Screen
579.06	35.58	Bottom of Screen
578.43	36.21	Bottom of Well
576.64	38.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	34.31
Bottom of Screen to End Cap	(feet)	0.63
Screen Length (1st slot to last slot)	(feet)	4.49
Total Length of Casing	(feet)	39.43
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G71L

Site Name: Gypsum Management Facility Borehole #: ~~G71a~~

~~State~~ Plant ~~Plane~~ Coordinate: X 278.8 Y 14,106.4 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 11/20/2008 Date Finished: 11/20/2008

Report Form Completed By: Suzanna Simpson Date: 12/23/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 26 minutes

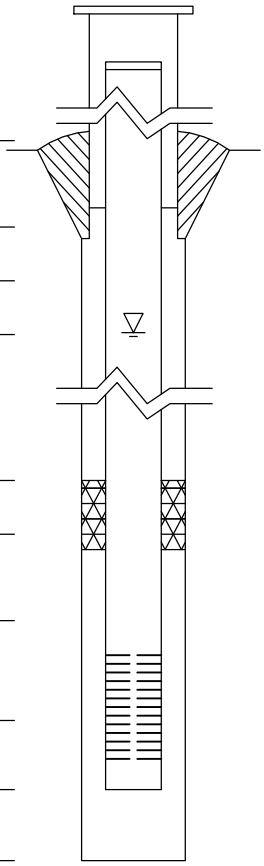
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
618.05	-3.11	Top of Protective Casing
617.62	-2.68	Top of Riser Pipe
614.94	0.00	Ground Surface
612.94	2.00	Top of Annular Sealant
	DRY	Static Water Level (After Completion) 3/4/2009
599.46	15.48	Top of Seal
597.02	17.92	Top of Sand Pack
595.14	19.80	Top of Screen
585.65	29.29	Bottom of Screen
584.74	30.20	Bottom of Well
584.74	30.20	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	22.48
Bottom of Screen to End Cap	(feet)	0.91
Screen Length (1st slot to last slot)	(feet)	9.40
Total Length of Casing	(feet)	32.79
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G71S

Site Name: Gypsum Management Facility Borehole #: ~~G71~~

~~State~~ Plant ~~Plane~~ Coordinate: X 277.1 Y 14,110.5 (or) Latitude: ___ ___ ___ Longitude: ___ ___ ___

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 11/20/2008 Date Finished: 11/20/2008

Report Form Completed By: Suzanna Simpson Date: 12/23/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 25 minutes

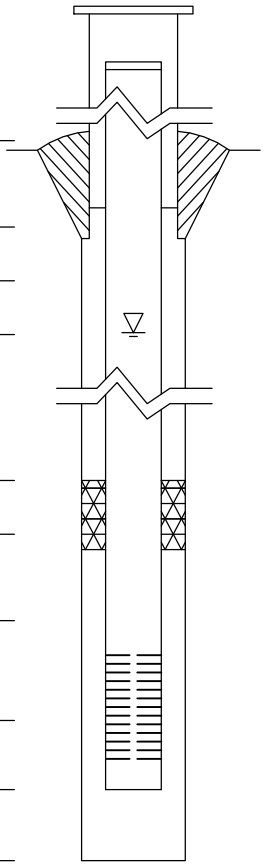
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Quartz sand (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
618.13	-3.19	Top of Protective Casing
617.93	-2.99	Top of Riser Pipe
614.94	0.00	Ground Surface
612.84	2.10	Top of Annular Sealant
577.22	37.72	Static Water Level (After Completion) 3/4/2009
586.46	28.48	Top of Seal
582.94	32.00	Top of Sand Pack
580.98	33.96	Top of Screen
576.98	37.96	Bottom of Screen
576.54	38.40	Bottom of Well
574.94	40.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	36.95
Bottom of Screen to End Cap	(feet)	0.44
Screen Length (1st slot to last slot)	(feet)	4.48
Total Length of Casing	(feet)	41.87
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G72L

Site Name: Gypsum Management Facility Borehole #: ~~G72a~~

~~State Plane~~ Plant Coordinate: X 509.9 Y 13,904.8 (or) Latitude: ___ ___ ___ Longitude: ___ ___ ___

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: ___ Date Started: 11/19/2008 Date Finished: 11/19/2008

Report Form Completed By: Suzanna Simpson Date: 12/23/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 21 minutes

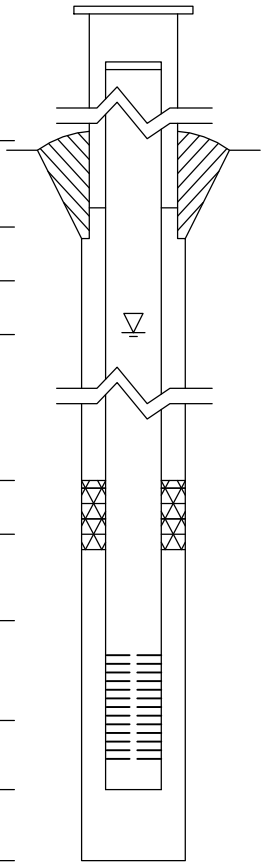
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: ___



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
617.99	-2.98	Top of Protective Casing
617.80	-2.79	Top of Riser Pipe
615.01	0.00	Ground Surface
613.21	1.80	Top of Annular Sealant
	DRY	Static Water Level (After Completion) 3/4/2009
604.10	10.91	Top of Seal
601.66	13.35	Top of Sand Pack
600.36	14.65	Top of Screen
591.00	24.01	Bottom of Screen
590.22	24.79	Bottom of Well
590.22	24.79	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	17.44
Bottom of Screen to End Cap	(feet)	0.78
Screen Length (1st slot to last slot)	(feet)	9.36
Total Length of Casing	(feet)	27.58
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G72S

Site Name: Gypsum Management Facility Borehole #: ~~G72~~

~~State~~ Plant ~~Plane~~ Coordinate: X 504.9 Y 13,905.1 (or) Latitude: ___ ___ ___ Longitude: ___ ___ ___

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: ___ Date Started: 11/19/2008 Date Finished: 11/19/2008

Report Form Completed By: Suzanna Simpson Date: 12/23/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 20 minutes

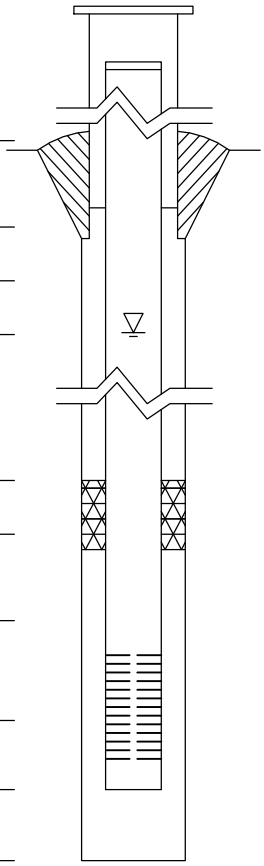
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Bentonite Chips (if applicable)

Installation Method: Gravity



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
618.12	-3.11	Top of Protective Casing
617.68	-2.67	Top of Riser Pipe
615.01	0.00	Ground Surface
612.71	2.30	Top of Annular Sealant
	DRY	Static Water Level (After Completion) 3/4/2009
589.46	25.55	Top of Seal
587.18	27.83	Top of Sand Pack
584.85	30.16	Top of Screen
580.37	34.64	Bottom of Screen
579.92	35.09	Bottom of Well
575.61	39.40	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	32.83
Bottom of Screen to End Cap	(feet)	0.45
Screen Length (1st slot to last slot)	(feet)	4.48
Total Length of Casing	(feet)	37.76
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

4/2000

ILLINOIS DEPARTMENT OF PUBLIC HEALTH
DIVISION OF ENVIRONMENTAL HEALTH
525 W. JEFFERSON ST.
SPRINGFIELD, IL 62761

WATER WELL SEALING FORM

TYPE OR PRESS FIRMLY

RETURN ALL COPIES TO IDPH OR LOCAL HEALTH DEPARTMENT

This form shall be submitted to this Department or the local health department not more than 30 days after a water well, boring or monitoring well is sealed. Such wells are to be sealed not more than 30 days after they are abandoned in accordance with the sealing requirements in the Water Well Construction Code. THE LOCAL HEALTH DEPARTMENT OR REGIONAL PUBLIC HEALTH DEPARTMENT MUST BE NOTIFIED AT LEAST 48 HOURS PRIOR TO SEALING.

1. **Ownership (Name of Controlling Party)** Duck Creek Power Station - Recycle Pond (G72S)

2. **Well Location** 17751 N Cilco Road — Canton — Fulton
   Address - Lot Number — City — County

   General Description **Township** 6 (N)(~~S~~) **Range** 5 (E)(~~W~~) **Section** 18

   NE **Quarter of the** NW **Quarter of the** SW **Quarter**

3. **Year Drilled** 2008

4. **Drilling Permit Number (and date, if known)** n/a

5. **Type of Well** **Bored** ____ **Drilled** ✓ **Other** ____

6. **Total Depth** 35.09 **Diameter (inches)** 8

7. **Formation clear of obstruction** ✓ **Yes** ____ **No**

   After G72S was sealed, replacement well R72S was installed approximately 5 feet west in a blind-drilled borehole.

8. **DETAILS OF PLUGGING**

   Filled with Bentonite grout **from** 2 **to** 35.09 **ft.**
   (cement or other materials)

   Kind of plug Random soil **from** 0 **to** 2.0 **ft.**

   Filled with ____ **from** ____ **to** ____ **ft.**

   Kind of plug ____ **from** ____ **to** ____ **ft.**

   Filled with ____ **from** ____ **to** ____ **ft.**

   Kind of plug ____ **from** ____ **to** ____ **ft.**

9. **CASING RECORD** **Upper 2 feet of casing removed** ✓ **Yes** ____ **No**

10. **Date well was sealed** **Month** November **Day** 9 **Year** 2016.

11. **Licensed water well driller or other person approved by the Department performing well sealing.**

    Rhonald W. Hasenyager, L.P.G. — **Name**
    196-000246 — **Complete License Number**

    Hanson Professional Services Inc., 1525 S. 6th St. — **Address**
    Springfield — **City**
    IL 62703 — **State/ZIP**

This state agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863. Disclosure of this information is mandatory. This form has been approved by the Forms Management Center. IL 482-0631

Printed by Authority of the State of Illinois
P.O. #530379 9.6M 4/00

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: G73L

Site Name: Gypsum Management Facility Borehole #: ~~G73a~~

~~State~~ Plant ~~Plane~~ Coordinate: X 799.5 Y 13,924.5 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 2/6/2009 Date Finished: 2/6/2009

Report Form Completed By: Suzanna Simpson Date: 2/26/2009

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 12+ hours

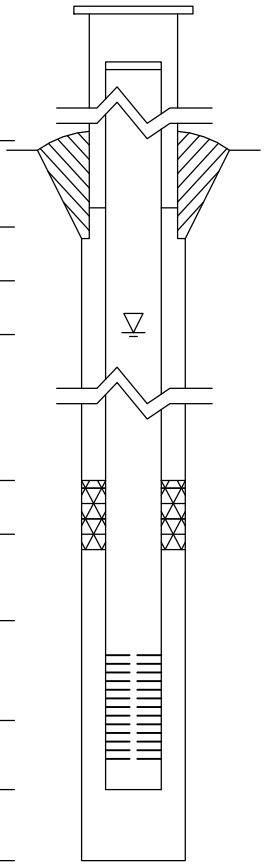
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
618.23	-3.59	Top of Protective Casing
617.58	-2.94	Top of Riser Pipe
614.64	0.00	Ground Surface
612.64	2.00	Top of Annular Sealant
	DRY	Static Water Level (After Completion) 3/4/2009
594.64	20.00	Top of Seal
592.22	22.42	Top of Sand Pack
590.01	24.63	Top of Screen
580.66	33.98	Bottom of Screen
579.88	34.76	Bottom of Well
579.88	34.76	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	27.57
Bottom of Screen to End Cap	(feet)	0.78
Screen Length (1st slot to last slot)	(feet)	9.35
Total Length of Casing	(feet)	37.70
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: P01L

Site Name: Gypsum Management Facility Borehole #: ~~P01b~~

~~State~~ Plant ~~Plane~~ Coordinate: X -194.6 Y 16,744.8 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 11/10/2008 Date Finished: 11/10/2008

Report Form Completed By: Suzanna Simpson Date: 11/21/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite chips

Installation Method: Gravity

Setting Time: 24+ hours

Type of Bentonite Seal -- [Granular] Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 24+ hours

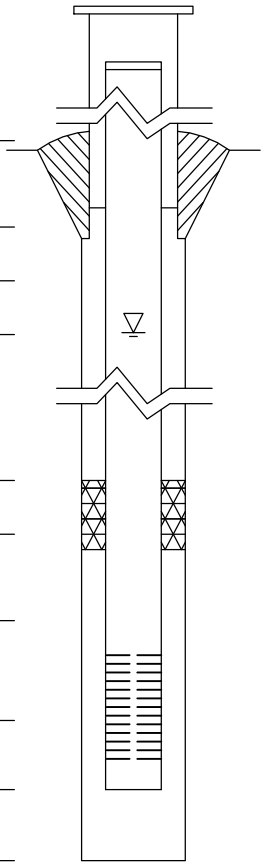
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
625.26	-3.26	Top of Protective Casing
624.99	-2.99	Top of Riser Pipe
622.00	0.00	Ground Surface
619.80	2.20	Top of Annular Sealant
604.00	18.00	Static Water Level (After Completion) 1/8/2009
619.80	2.20	Top of Seal
614.00	8.00	Top of Sand Pack
611.79	10.21	Top of Screen
602.44	19.56	Bottom of Screen
601.65	20.35	Bottom of Well
601.65	20.35	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	[PVC]	OTHER:
Screen	SS304	SS316	PTFE	[PVC]	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	13.20
Bottom of Screen to End Cap	(feet)	0.79
Screen Length (1st slot to last slot)	(feet)	9.35
Total Length of Casing	(feet)	23.34
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: WPC Permit No. 2007-EA-4026 County: Fulton Well #: P01S

Site Name: Gypsum Management Facility Borehole #: ~~P01a~~

~~State Plane~~ Plant Coordinate: X -194.7 Y 16,754.6 (or) Latitude: ____ ____ ____ Longitude: ____ ____ ____

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Testing Service Corp. Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna Simpson Date Started: 11/10/2008 Date Finished: 11/10/2008

Report Form Completed By: Suzanna Simpson Date: 11/21/2008

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 25 minutes

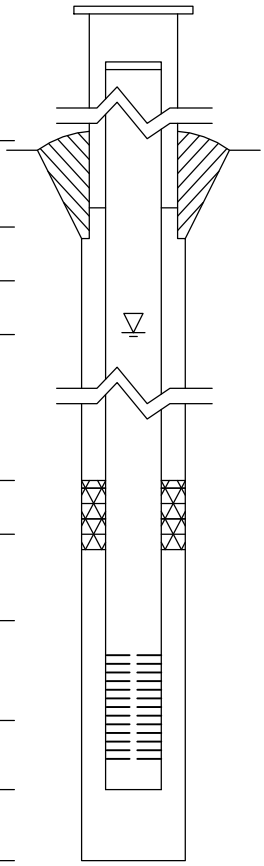
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
624.76	-2.76	Top of Protective Casing
624.52	-2.52	Top of Riser Pipe
622.00	0.00	Ground Surface
619.40	2.60	Top of Annular Sealant
604.00	18.00	Static Water Level (After Completion) 1/8/2009
602.50	19.50	Top of Seal
601.18	20.82	Top of Sand Pack
599.42	22.58	Top of Screen
594.94	27.06	Bottom of Screen
594.26	27.74	Bottom of Well
594.26	27.74	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

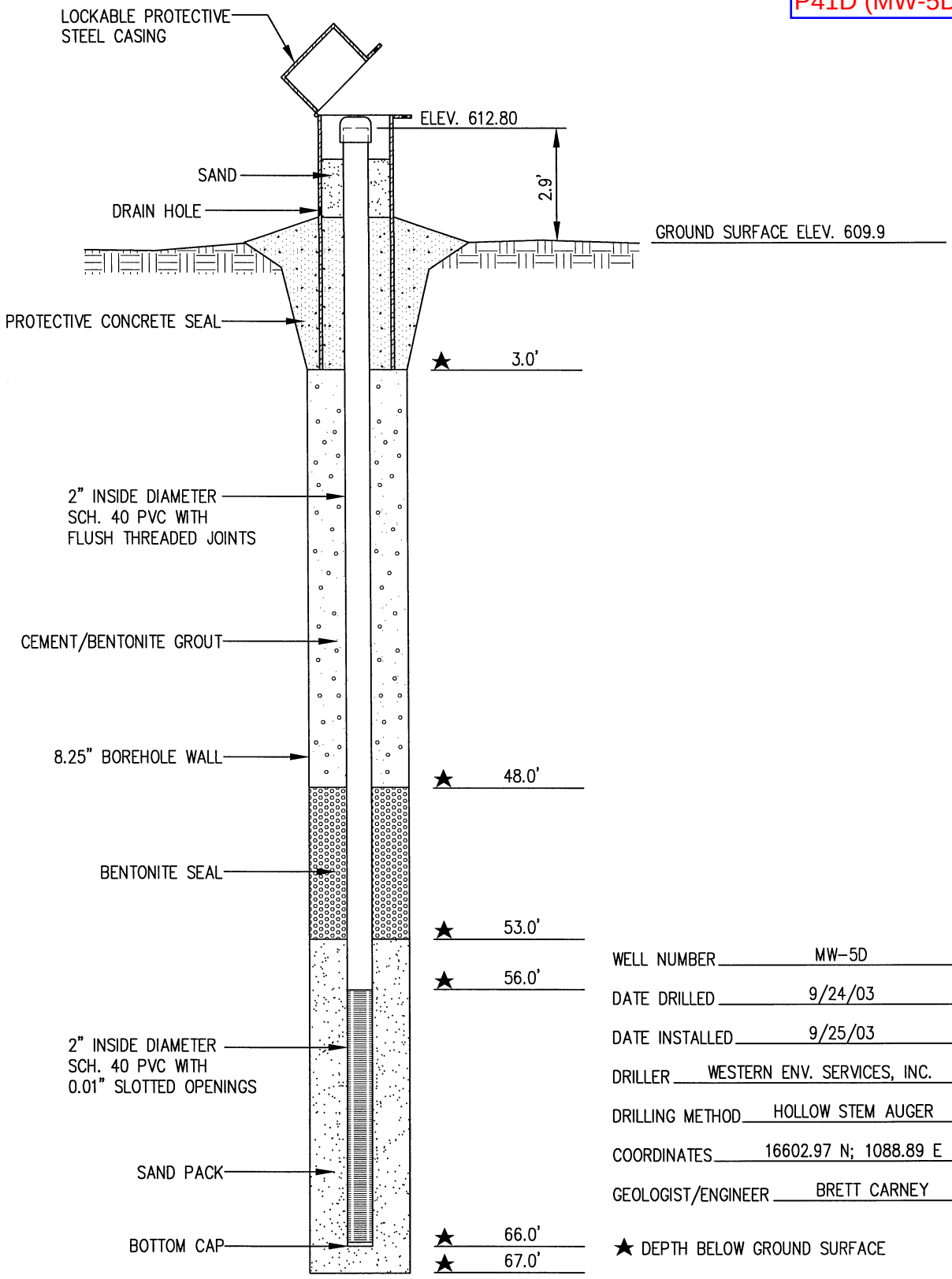
Protective Casing	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	25.10
Bottom of Screen to End Cap	(feet)	0.68
Screen Length (1st slot to last slot)	(feet)	4.48
Total Length of Casing	(feet)	30.26
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

P41D (MW-5D)



WELL NUMBER MW-5D

DATE DRILLED 9/24/03

DATE INSTALLED 9/25/03

DRILLER WESTERN ENV. SERVICES, INC.

DRILLING METHOD HOLLOW STEM AUGER

COORDINATES 16602.97 N; 1088.89 E

GEOLOGIST/ENGINEER BRETT CARNEY

★ DEPTH BELOW GROUND SURFACE

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Hanson Professional Services Inc.

MONITORING WELL MW-5D CONSTRUCTION DETAIL

PHASE II HYDROGEOLOGIC SITE INVESTIGATION
AERG - DUCK CREEK STATION
CANTON, ILLINOIS

JOB NO. 03S5010 ATTACHMENT B

AUG 19, 2004 3:33 PM KDE
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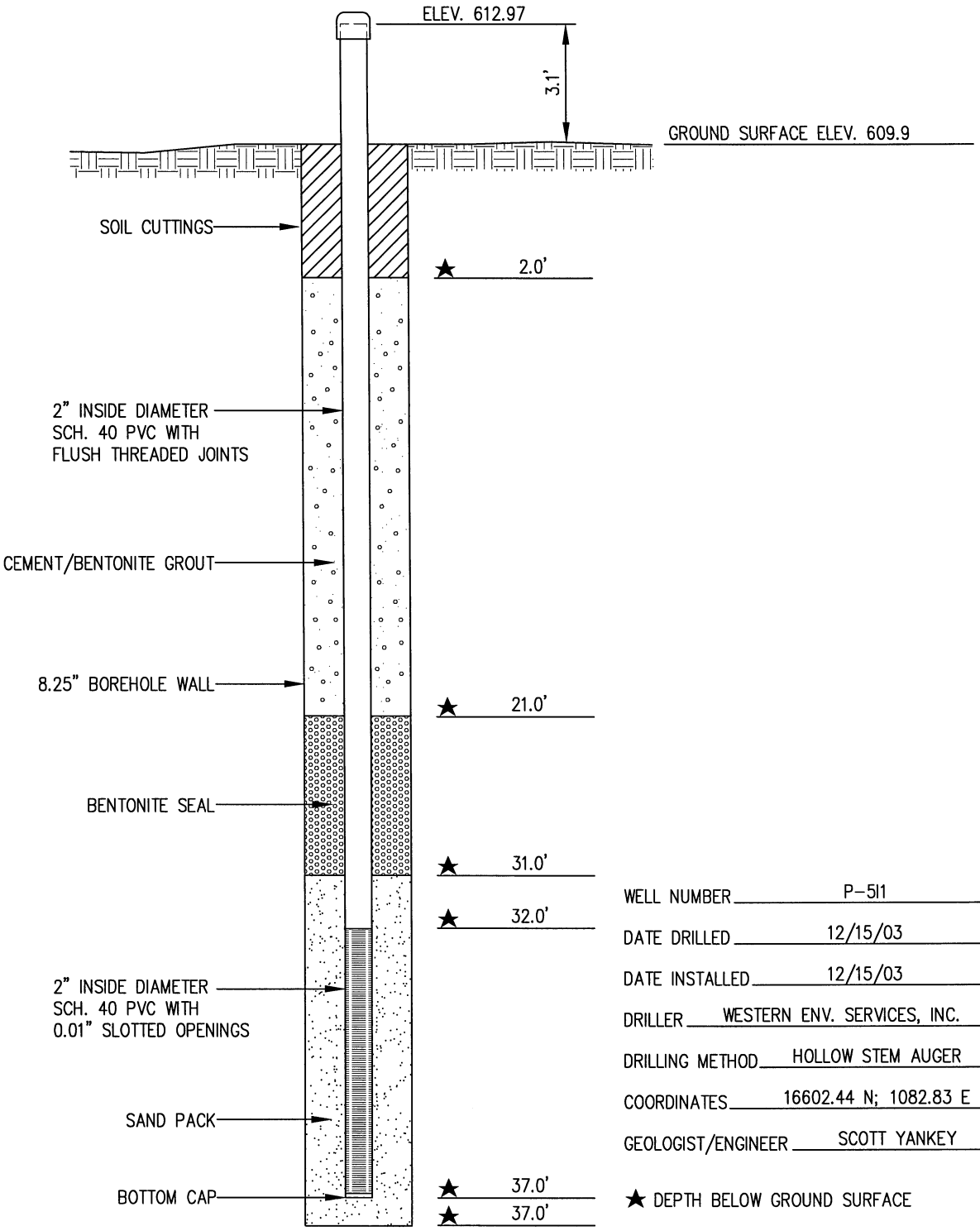
P41I1 (MW-5I1)



WELL NUMBER	P-5I1
DATE DRILLED	12/15/03
DATE INSTALLED	12/15/03
DRILLER	WESTERN ENV. SERVICES, INC.
DRILLING METHOD	HOLLOW STEM AUGER
COORDINATES	16602.44 N; 1082.83 E
GEOLOGIST/ENGINEER	SCOTT YANKEY

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PIEZOMETER P-5I1 CONSTRUCTION DETAIL

PHASE III HYDROGEOLOGIC SITE INVESTIGATION
AERG - DUCK CREEK STATION CCB LANDFILL
CANTON, ILLINOIS

JOB NO. 03S5010 ATTACHMENT B

AUG 24, 2004 3:15 PM KDE
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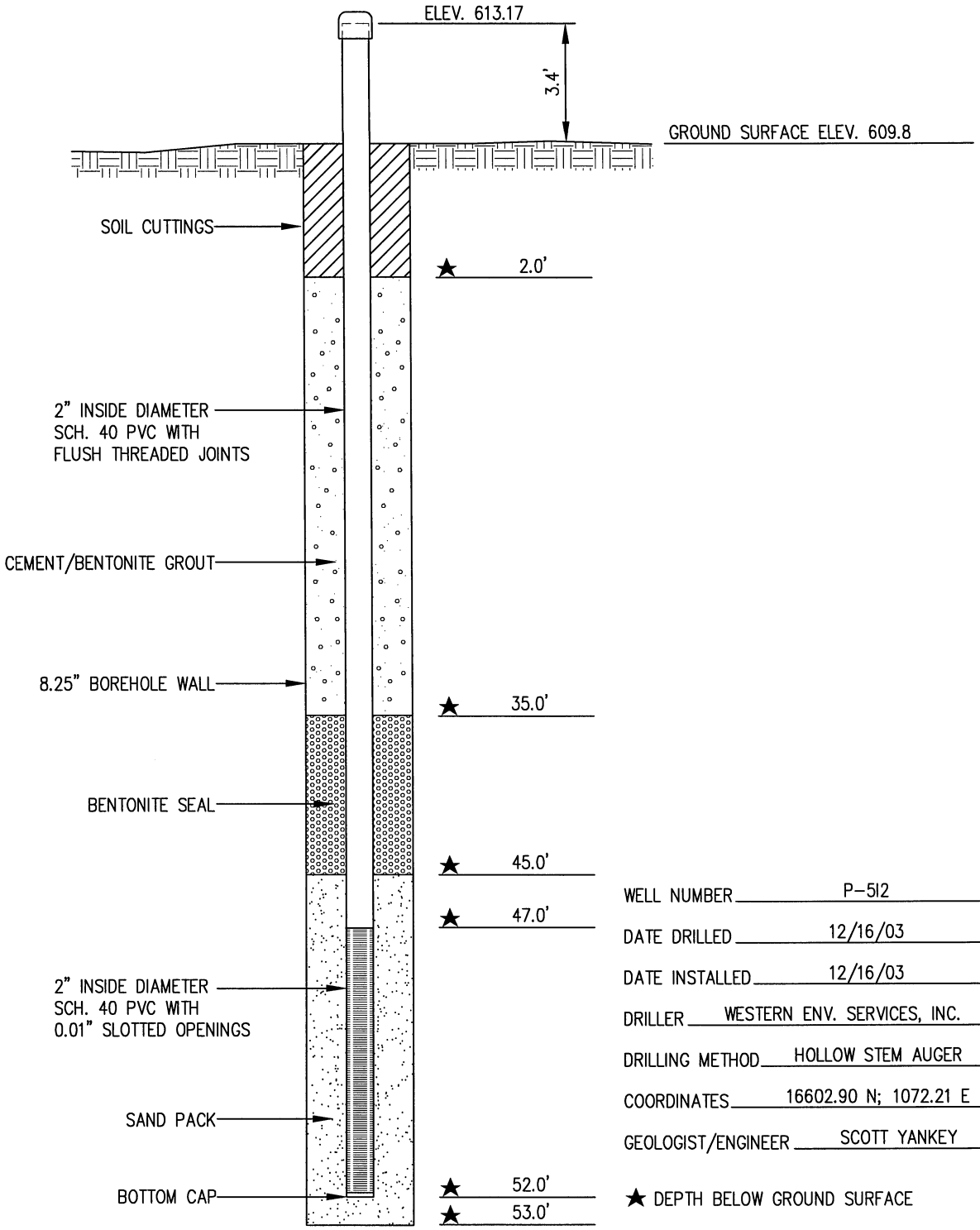
P41I2 (MW-5I2)



WELL NUMBER P-5I2

DATE DRILLED 12/16/03

DATE INSTALLED 12/16/03

DRILLER WESTERN ENV. SERVICES, INC.

DRILLING METHOD HOLLOW STEM AUGER

COORDINATES 16602.90 N; 1072.21 E

GEOLOGIST/ENGINEER SCOTT YANKEY

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PIEZOMETER P-5I2 CONSTRUCTION DETAIL

PHASE III HYDROGEOLOGIC SITE INVESTIGATION
AERG - DUCK CREEK STATION CCB LANDFILL
CANTON, ILLINOIS

JOB NO. 03S5010 ATTACHMENT B

AUG 24, 2004 3:16 PM KDE
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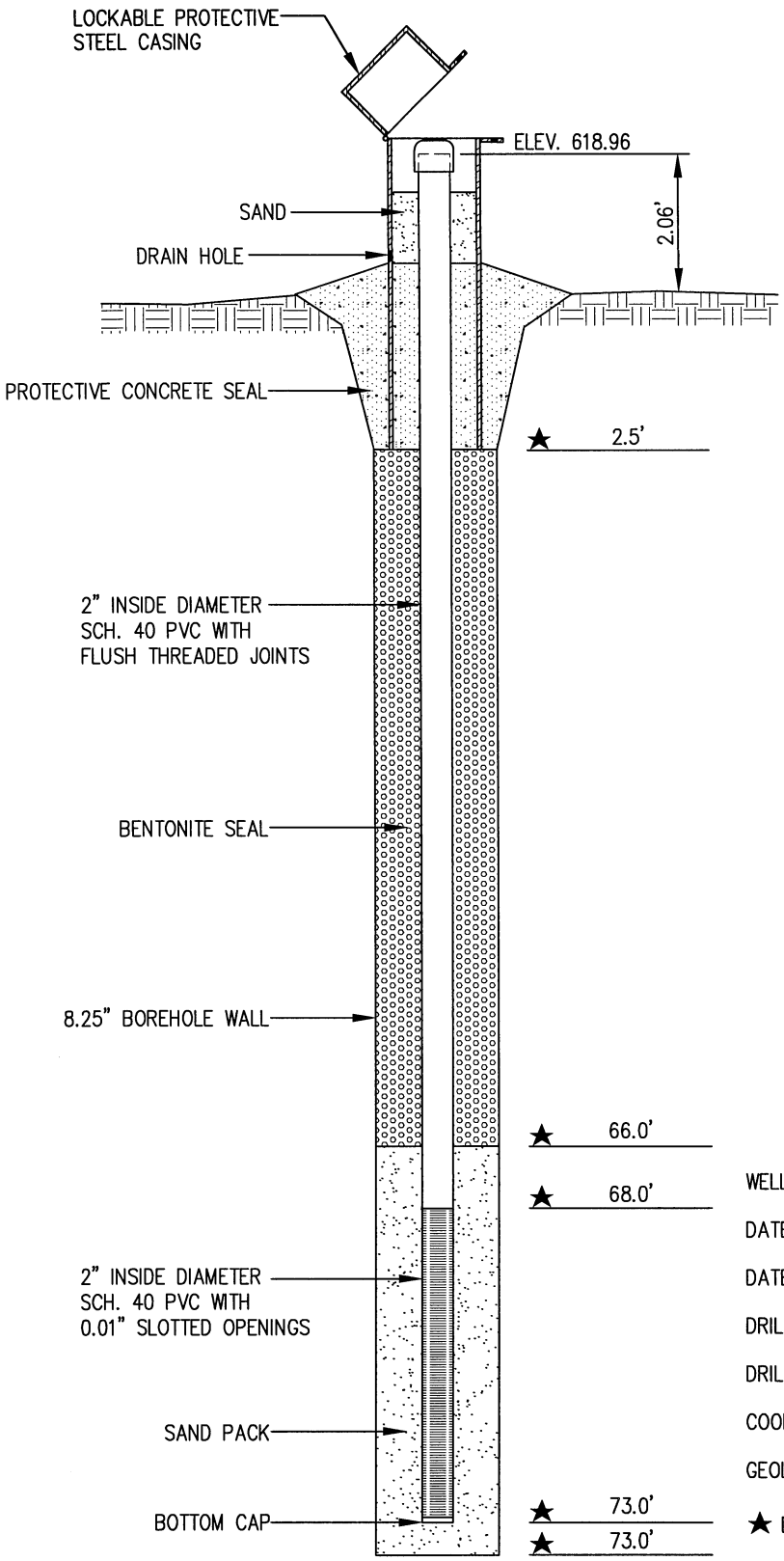
P42D (MW-9D)



WELL NUMBER	MW-9D
DATE DRILLED	12/27/04
DATE INSTALLED	12/28/04
DRILLER	TESTING SERVICE CORPORATION
DRILLING METHOD	HOLLOW STEM AUGER
COORDINATES	16595.6 N, 449.0 E
GEOLOGIST/ENGINEER	OMAR ITANI

★ DEPTH BELOW GROUND SURFACE

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MONITORING WELL MW-9D CONSTRUCTION DETAIL

PHASE IV HYDROGEOLOGIC SITE INVESTIGATION
AMEREN/CILCO - DUCK CREEK STATION
CANTON, ILLINOIS

JOB NO. 03S5010

FEB 07, 2005 1:19 PM KDE
I:\03JOBS\03S5010\ENVIRONMENTAL\PHASE IV\H-MW-9D.DWG

Illinois Environmental Protection Agency — Well Completion Report

Site #: 0570255197 County: Fulton Well #: P60

Site Name: Duck Creek Power Station - Ash Landfill Borehole #: P60

~~State Plane~~ Plant Coordinate: X 992.2 Y 15,477.1 (or) Latitude: 40° 30' 24.310" Longitude: 89° 59' 13.282"

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Ramsey Geotechnical Engineering, LLC Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 3/15/2017 Date Finished: 3/15/2017

Report Form Completed By: Suzanna L. Keim Date: 3/16/2017

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High solids bentonite

Installation Method: Tremie

Setting Time: >24 hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 20 minutes

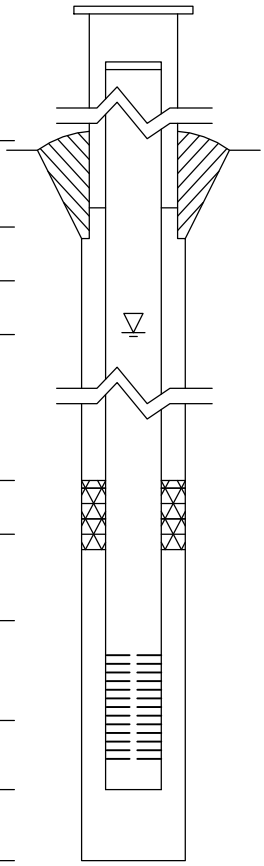
Type of Sand Pack: Quartz Sand

Grain Size: 10-40 (sieve size)

Installation Method: Gravity

Type of Backfill Material: (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
622.82	-2.70	Top of Protective Casing
622.52	-2.40	Top of Riser Pipe
620.12	0.00	Ground Surface
618.12	2.00	Top of Annular Sealant
		Static Water Level (After Completion)
594.67	25.45	Top of Seal
592.10	28.02	Top of Sand Pack
590.57	29.55	Top of Screen
585.98	34.14	Bottom of Screen
585.50	34.62	Bottom of Well
585.50	34.62	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS
(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	31.95
Bottom of Screen to End Cap	(feet)	0.48
Screen Length (1st slot to last slot)	(feet)	4.59
Total Length of Casing	(feet)	37.02
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Fulton Well #: P61

Site Name: Duck Creek Part 845 Groundwater Borehole #: P61

State Plane Coordinate: X 2,346,779.3 Y 1,398,670.8 (or) Latitude: _____ Longitude: _____

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Geotechnics Driller: Matt

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow Stem Auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 2/24/2021 Date Finished: 2/24/2021

Report Form Completed By: Tad A. Gass Date: 2/24/2021

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Granular bentonite

Installation Method: gravity

Setting Time: +24 hrs.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: _____

Setting Time: _____

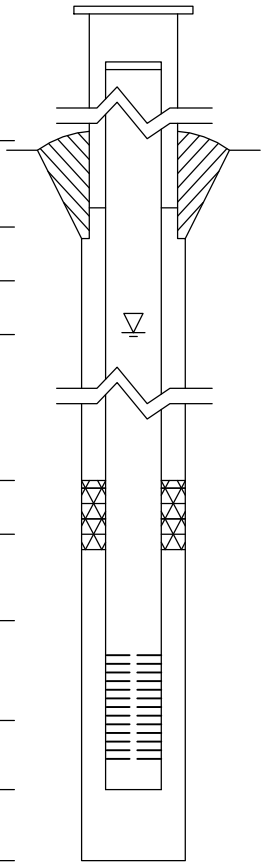
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: gravity

Type of Backfill Material: _____ (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
614.31	-3.21	Top of Protective Casing
613.96	-2.87	Top of Riser Pipe
611.09	0.00	Ground Surface
607.58	3.51	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
603.54	7.55	Top of Sand Pack
602.38	8.71	Top of Screen
592.72	18.37	Bottom of Screen
592.33	18.76	Bottom of Well
591.09	20.00	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	10.0
Riser Pipe Length	(feet)	11.58
Bottom of Screen to End Cap	(feet)	0.39
Screen Length (1st slot to last slot)	(feet)	9.66
Total Length of Casing	(feet)	21.63
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Fulton Well #: P62

Site Name: Duck Creek Part 845 Groundwater Borehole #: P62

State Plane Coordinate: X 2,346,602.3 Y 1,398,887.3 (or) Latitude: _____ Longitude: _____

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Geotechnics Driller: Matt

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow Stem Auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 2/24/2021 Date Finished: 2/24/2021

Report Form Completed By: Tad A. Gass Date: 2/24/2021

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Granular bentonite

Installation Method: gravity

Setting Time: +24 hrs.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: _____

Setting Time: _____

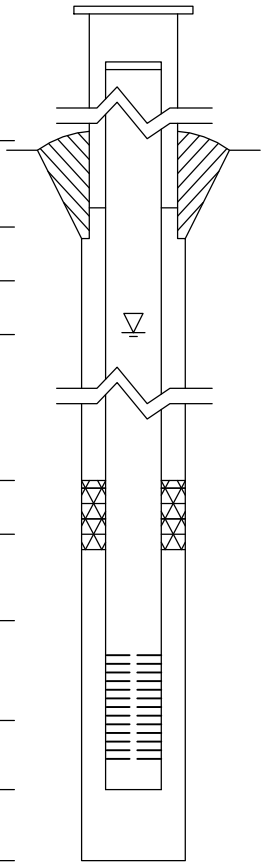
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: gravity

Type of Backfill Material: _____ (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
613.96	-3.15	Top of Protective Casing
613.54	-2.73	Top of Riser Pipe
610.81	0.00	Ground Surface
607.89	2.92	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
601.33	9.48	Top of Sand Pack
599.63	11.18	Top of Screen
595.03	15.78	Bottom of Screen
594.51	16.30	Bottom of Well
594.51	16.30	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	16.30
Bottom of Screen to End Cap	(feet)	0.52
Screen Length (1st slot to last slot)	(feet)	4.60
Total Length of Casing	(feet)	21.42
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Fulton Well #: P63

Site Name: Duck Creek Part 845 Groundwater Borehole #: P63

State Plane Coordinate: X 2,346,605.9 Y 1,399,026.6 (or) Latitude: _____ Longitude: _____

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Geotechnics Driller: Matt

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow Stem Auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 2/24/2021 Date Finished: 2/24/2021

Report Form Completed By: Tad A. Gass Date: 2/24/2021

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Granular bentonite

Installation Method: gravity

Setting Time: +24 hrs.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: _____

Setting Time: _____

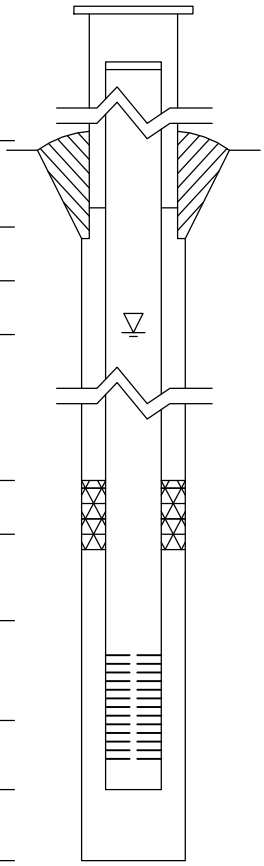
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: gravity

Type of Backfill Material: _____ (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
614.85	-2.52	Top of Protective Casing
614.47	-2.15	Top of Riser Pipe
612.33	0.00	Ground Surface
609.23	3.10	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
600.98	11.35	Top of Sand Pack
599.29	13.04	Top of Screen
594.70	17.63	Bottom of Screen
594.08	18.25	Bottom of Well
594.08	18.25	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	15.19
Bottom of Screen to End Cap	(feet)	0.62
Screen Length (1st slot to last slot)	(feet)	4.59
Total Length of Casing	(feet)	20.40
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Fulton Well #: P64

Site Name: Duck Creek Part 845 Groundwater Borehole #: P64

State Plane Coordinate: X 2,346,598.0 Y 1,399,305.9 (or) Latitude: _____ Longitude: _____

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Geotechnics Driller: Matt

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow Stem Auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 2/25/2021 Date Finished: 2/25/2021

Report Form Completed By: Tad A. Gass Date: 2/25/2021

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: Granular bentonite

Installation Method: gravity

Setting Time: +24 hrs.

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: _____

Setting Time: _____

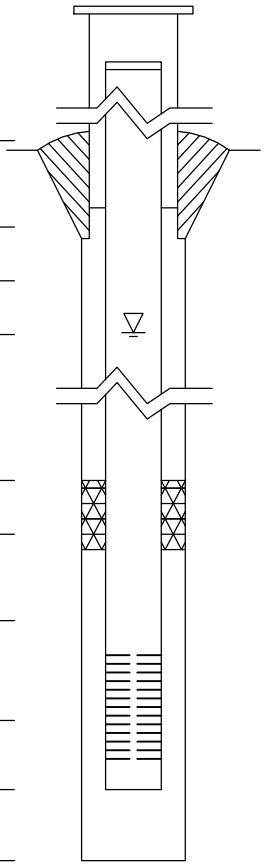
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: gravity

Type of Backfill Material: _____ (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
616.83	-2.78	Top of Protective Casing
616.47	-2.43	Top of Riser Pipe
614.04	0.00	Ground Surface
611.04	3.00	Top of Annular Sealant
		Static Water Level (After Completion)
n/a	n/a	Top of Seal
608.96	5.08	Top of Sand Pack
607.87	6.17	Top of Screen
598.08	15.96	Bottom of Screen
597.57	16.47	Bottom of Well
597.57	16.47	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	10.0
Riser Pipe Length	(feet)	9.19
Bottom of Screen to End Cap	(feet)	0.52
Screen Length (1st slot to last slot)	(feet)	9.19
Total Length of Casing	(feet)	18.90
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: 0570255197 County: Fulton Well #: R61L

Site Name: Duck Creek Power Station - Ash Landfill Borehole #: R61L

~~State Plane~~ Plant Coordinate: X 994.3 Y 15,649.9 (or) Latitude: 40° 30' 26.021" Longitude: 89° 59' 13.252"

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Ramsey Geotechnical Engineering, LLC Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 3/14/2017 Date Finished: 3/14/2017

Report Form Completed By: Suzanna L. Keim Date: 3/16/2017

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High solids bentonite

Installation Method: Tremie

Setting Time: >24 hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 75 minutes

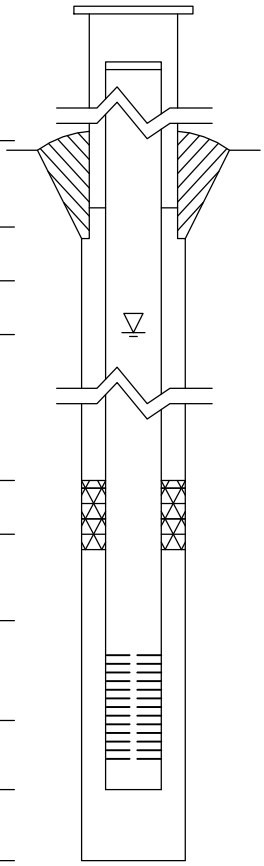
Type of Sand Pack: Quartz Sand

Grain Size: 10-40 (sieve size)

Installation Method: Gravity

Type of Backfill Material: (if applicable)

Installation Method:



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
622.99	-3.03	Top of Protective Casing
622.69	-2.73	Top of Riser Pipe
619.96	0.00	Ground Surface
617.96	2.00	Top of Annular Sealant
		Static Water Level (After Completion)
605.16	14.80	Top of Seal
603.14	16.82	Top of Sand Pack
601.42	18.54	Top of Screen
591.79	28.17	Bottom of Screen
591.29	28.67	Bottom of Well
591.29	28.67	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	8.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	21.27
Bottom of Screen to End Cap	(feet)	0.50
Screen Length (1st slot to last slot)	(feet)	9.63
Total Length of Casing	(feet)	31.40
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

Illinois Environmental Protection Agency — Well Completion Report

Site #: _____ County: Fulton Well #: R72S

Site Name: Duck Creek Power Station - Recycle Pond Borehole #: R72S

~~State Plane~~ Plant Coordinate: X 500.0 Y 13,905.4 (or) Latitude: 40° 30' 8.792" Longitude: 89° 59' 19.692"

Surveyed By: Steven P. Ford IL Registration #: 035-003653

Drilling Contractor: Ramsey Driller: B. Williamson

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow Stem Auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 11/9/2016 Date Finished: 11/9/2016

Report Form Completed By: Suzanna L. Keim Date: 11/18/2016

ANNULAR SPACE DETAILS

Type of Surface Seal: Concrete

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: 24+ hours

Type of Bentonite Seal -- Granular Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 50 minutes

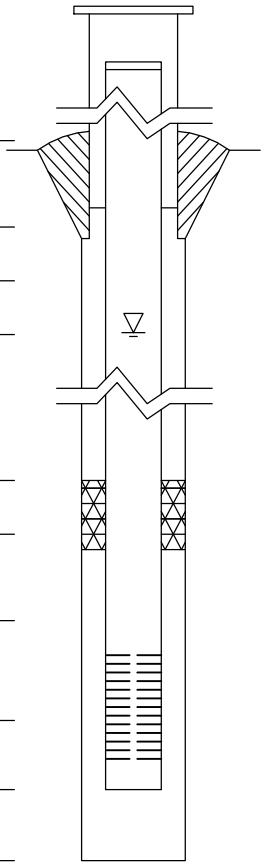
Type of Sand Pack: Quartz Sand

Grain Size: 10/20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: n/a (if applicable)

Installation Method: _____



Elevations (MSL)*	Depths (BGS)	(0.01 ft.)
618.11	-3.00	Top of Protective Casing
617.87	-2.76	Top of Riser Pipe
615.11	0.00	Ground Surface
613.01	2.10	Top of Annular Sealant
		Static Water Level (After Completion)
590.01	25.10	Top of Seal
587.06	28.05	Top of Sand Pack
585.28	29.83	Top of Screen
580.62	34.49	Bottom of Screen
580.16	34.95	Bottom of Well
580.16	34.95	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

Protective Casing	SS304	SS316	PTFE	PVC	OTHER: Steel
Riser Pipe Above W.T.	SS304	SS316	PTFE	PVC	OTHER:
Riser Pipe Below W.T.	SS304	SS316	PTFE	PVC	OTHER:
Screen	SS304	SS316	PTFE	PVC	OTHER:

CASING MEASUREMENTS

Diameter of Borehole	(inches)	6.0
ID of Riser Pipe	(inches)	2.0
Protective Casing Length	(feet)	5.0
Riser Pipe Length	(feet)	32.59
Bottom of Screen to End Cap	(feet)	0.46
Screen Length (1st slot to last slot)	(feet)	4.66
Total Length of Casing	(feet)	37.71
Screen Slot Size **	(inches)	0.010

**Hand-Slotted Well Screens Are Unacceptable

APPENDIX C
GEOTECHNICAL LABORATORY REPORTS

Via email: dramsey@ramgeoeng.com

April 5, 2021 J037264.01.6001

Mr. Douglas P. Ramsey, P.E.
Ramsey Geotechnical Engineering
1701 W. Market Street
Bloomington, Illinois 61701

Re: Duck Creek Power Station
Fulton County, Illinois

Dear Mr. Ramsey:

Included in this report are the test results from a bulk sample of gypsum received in our laboratory on March 15, 2021. The sample was tested in general accordance with the test method listed below.

Test to Determine	Method of Test
Hydraulic Conductivity of Soil Using Flexible Wall Permeameter	ASTM D5084

We trust this is the information you require. Please contact the undersigned if you have any questions regarding this report.

Respectfully submitted,

GEOTECHNOLOGY, INC.

Janet M. May
Illinois Laboratory Manager

JMM/LPH:jmm

Attachment: Test Result Summary
Hydraulic Conductivity Test Data Sheet
Proctor Curve (Provided by Ramsey)
Testing Assignment Sheets

TEST RESULT SUMMARY

Duck Creek Power Station
Fulton County, Illinois

Sample Number/ Material	Optimum Moisture Content, %	Maximum Dry Unit Weight, pcf	Percent Compact	Moisture Content, %	Dry Unit Weight, pcf	Hydraulic Conductivity, cm/sec	Range of Hydraulic Gradient
LSN-3781/ Gypsum	27.0	81.0	91.2	28.8	73.9	6.7×10^{-4}	0.2 - 2.2

Notes and abbreviations:
% - Percent
cm/sec - Centimeters per second
pcf - Pounds per cubic foot

HYDRAULIC CONDUCTIVITY TEST DATA

(ASTM D 5084)

				Initial Unit Weight		**Unit Weight as Tested**	
JOB NO.:	J037264.01.6002	ASTM D698 Results		WET UNIT WEIGHT, pcf:	95.2	WET UNIT WEIGHT, pcf:	95.2
PROJECT:	Duck Creek Bottom Ash Basins	Maximum Dry Unit Weight, pcf	81.0	DRY UNIT WEIGHT, pcf:	73.9	DRY UNIT WEIGHT, pcf:	69.4
SAMPLE NO.:	LSN-3781	Optimum Water Content, %	27.0	**Percent Compact:**	**91.2%**		
MATERIAL:	Gypsum						

	Initial	After Test**		Initial	As Tested	INITIAL MOISTURE CONTENT		FINAL MOISTURE CONTENT	
LENGTH, in.:	2.878		LENGTH, cm:	7.310		WET WT SPLE+TARE	754.45	WET WT SPLE+TARE	784.98
DIAMETER, in.:	2.878		DIAMETER, cm	7.310		DRY WT SPLE+TARE	649.86	DRY WT SPLE+TARE	649.86
WET WT., gms.:	467.82					TARE WEIGHT	286.63	TARE WEIGHT	286.63
AREA, sq.in.:	6.505		AREA, sq cm:	41.970		**% MOISTURE**	28.8	% MOISTURE	37.2

B VALUE (before Permeation): 95% Cell / Back Pressure, psi: 88 / 85 **Percent Wet of Optimum: 1.8**

HEAD (PSI)	DATE (YR,MO,DY)	TIME (HR,MN,SC)	TEMP ºC	ELAPSED MINUTES	BOTTOM BURETTE	TOP BURETTE	Q (CC)	K CM/SEC	HYDRAULIC GRADIENT	HYDRAULIC HEAD	HEAD LOSS,%	k (in/sec)
0.0	30-Mar-21	10:19 AM	20.8	0	7.32	23.70			2.24	16.38		
0.0	30-Mar-21	10:20 AM	20.8	1	10.18	20.51	2.86	7.0E-04	1.41	10.33	36.94	2.8E-04
0.0	30-Mar-21	10:22 AM	20.8	2	13.33	17.40	3.15	7.1E-04	0.56	4.07	60.60	2.8E-04
0.0	30-Mar-21	10:24 AM	20.8	2	14.46	16.18	1.13	6.6E-04	0.24	1.72	57.74	2.6E-04
0.0	30-Mar-21	11:32 AM	20.8	0	8.77	23.40			2.00	14.63		
0.0	30-Mar-21	11:33 AM	20.8	1	11.43	20.73	2.66	6.9E-04	1.27	9.30	36.43	2.7E-04
0.0	30-Mar-21	11:34 AM	20.8	1	13.10	19.03	1.67	6.9E-04	0.81	5.93	36.24	2.7E-04
0.0	30-Mar-21	11:36 AM	20.8	2	14.83	17.30	1.73	6.7E-04	0.34	2.47	58.35	2.6E-04

Average Temp. = 20.8

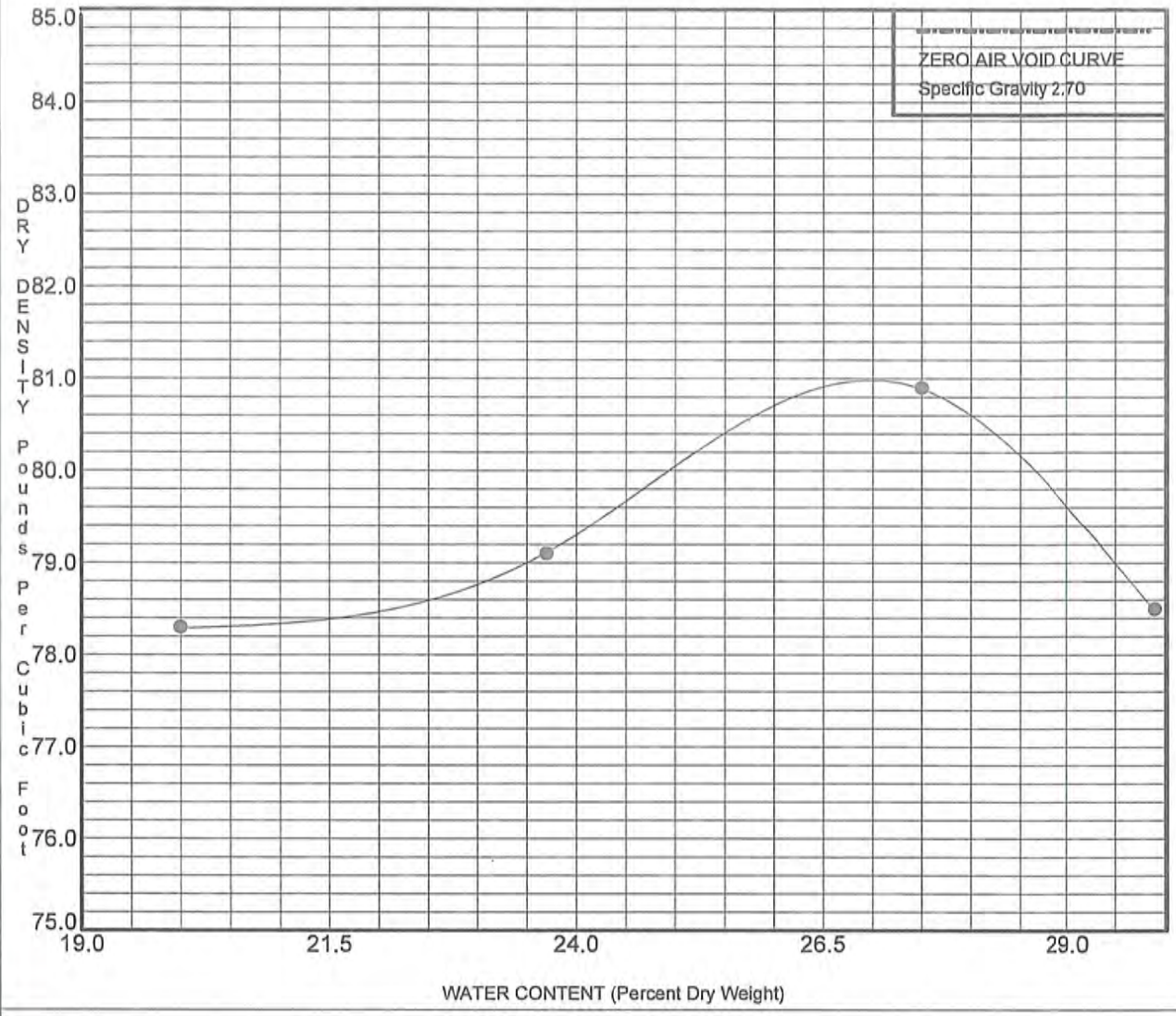
AVERAGE K = 6.9E-04

Corrected K for 20ºC = 6.7E-04

AVERAGE K = 2.7E-04

Corrected K for 20ºC = 2.6E-04

** Measurements not available at end of test.



SPECIMEN IDENTIFICATION	CLASSIFICATION
Gypsum	Gypsum
LSN-3781	

MOISTURE/DENSITY RELATIONSHIP	
Standard ASTM D698/AASHTO T99	
Modified ASTM D1557/AASHTO T180	
Maximum Dry Density (PCF)	**81.0**
Optimum Water Content (%)	**27.0**

NOTES :

PROJECT **Duck Creek Bottom Ash Basins** JOB NO. **21-026**

LOCATION **Fulton County, Illinois** DATE **March 18, 2021**

Gypsum

MOISTURE-DENSITY RELATIONSHIP

Ramsey Geotechnical Engineering

Bloomington, IL 61701

21.026

DUCK CREEK BOTTOM ASH BASIN

Hanson Professional Services Inc.

Subcontract Agreement: RGE2014

Task Order No. 20E0111A/3000A

SCHEDULE OF LABORATORY TESTING

Sample ID	Routine Testing [1]											Complex Testing [1]																Analytical Testing [1]						
	Rimac Comp Strength	Visual-Manual Classification	Unified Classification	Moisture Content	Liquid / Plastic Limits	Particle Size < #200	Particle Size - Sieves	Particle Size - Sieves + Hyd	Standard Compaction	Modified Compaction	Bulk Density	Unconfined Comp Strength	Consolidation Test	Specific Gravity	UU Triaxial Comp Strength	CU Traxail Comp Strength	CD Direct Shear Strength	Swell Test for Soil	Collapse Test for Soil	Permeability Granular Soil	Hyd Conduct Cohesive Soil	Shrinkafe Factor	Soil Resistivity	IBR and IBV of Soils	CBR Test	Elastic Moduli - Rock	Uniaxial Comp Str - Rock	Corrosivity	pH	Chloride	Sulfate	Total Organic Content	Moisture, Ash & Organ Matte	
SB01																																		
6A																																		
7A																																		
8A																																		
10A																																		
11A																																		
12A																																		
Comp1				x	x			x			x			x																				
ST9																					x	DONE.												
14A																																		
ST15																																		
Comp2				x	x			x			x			x																				
ST15																					x	DONE												
17A																																		
18A																																		
19A																																		
Comp3				x	x			x			x			x																				
20A																																		
21A																																		
22A																																		
23A																																		
Comp4				x	x			x			x			x																				

Note 1: All testing to be in accordance with *Laboratory Testing Specifications*.

See Task Order or Attachment for any special instructions regarding scheduled testing.

SCHEDULE OF LABORATORY TESTING

Sample ID	Routine Testing											Complex Testing																Analytical Testing					
	Rimac Comp Strength	Visual-Manual Classification	Unified Classification	Moisture Content	Liquid / Plastic Limits	Particle Size < #200	Particle Size - Sieves	Particle Size - Sieves + Hyd	Standard Compaction	Modified Compaction	Bulk Density	Unconfined Comp Strength	Consolidation Test	Specific Gravity	UU Triaxial Comp Strength	CU Traxail Comp Strength	CD Direct Shear Strength	Swell Test for Soil	Collapse Test for Soil	Permeability Granular Soil	Hyd Conduct Cohesive Soil	Shrinkafe Factor	Soil Resistivity	IBR and IBV of Soils	CBR Test	Elastic Moduli - Rock	Uniaxial Comp Str - Rock	Corrosivity	pH	Chloride	Sulfate	Total Organic Content	Moisture, Ash & Organ Matte
SB02																																	
3A																																	
4A																																	
6A																																	
7A																																	
8A																																	
Comp1				x	x			x			x			x																			
ST5																					x	DONE											
9A																																	
ST10																																	
11A																																	
Comp2				x	x			x			x			x																			
ST10																					x	DONE											
12A																																	
ST13																																	
Comp3				x	x			x			x			x																			
ST13																					x	DONE											
15A																																	
16A																																	
17A																																	
18A																																	
19A																																	
20A																																	
Comp4				x	x			x			x			x																			

SCHEDULE OF LABORATORY TESTING

Sample ID	Routine Testing											Complex Testing																Analytical Testing						
	Rimac Comp Strength	Visual-Manual Classification	Unified Classification	Moisture Content	Liquid / Plastic Limits	Particle Size < #200	Particle Size - Sieves	Particle Size - Sieves + Hyd	Standard Compaction	Modified Compaction	Bulk Density	Unconfined Comp Strength	Consolidation Test	Specific Gravity	UU Triaxial Comp Strength	CU Traxail Comp Strength	CD Direct Shear Strength	Swell Test for Soil	Collapse Test for Soil	Permeability Granular Soil	Hyd Conduct Cohesive Soil	Shrinkafe Factor	Soil Resistivity	IBR and IBV of Soils	CBR Test	Elastic Moduli - Rock	Uniaxial Comp Str - Rock	Corrosivity	pH	Chloride	Sulfate	Total Organic Content	Moisture, Ash & Organ Matter
SB03																																		
4A																																		
6A																																		
7A																																		
8A																																		
Comp1				x	x			x			x			x																				
ST5																					x	DONE												
ST10*				x	x			x			x			x																				
ST10^																					x	DONE												
11A																																		
12A																																		
13A																																		
Comp3				x	x			x			x			x																				
Gypsum				x	x			x	x		x			x							x*	*Remolded permeability*												

* If sand is present in Shelby tube.

^ if sufficient sample, use lower portion of Shelby tube.

GEOTECHNICS
Soil & Material Testing
A DIVISION OF KLINGNER
4510 Paris Gravel Road • Hannibal, MO 63401 • voice 573.221.7714 • fax 573.221.7762

March 26, 2021 21-1004

Hanson Professional Services, Inc.
1525 S. Sixth St.
Springfield, IL 62703-6801

Attn: Mr. Rhonald Hasenyager

RE: Duck Creek Power Station GMF: Fulton County, IL

Dear Mr. Hasenyager:

In accordance with your request, we have completed the analysis of the samples obtained from the exploration borings from the above mentioned project. The selected samples were analyzed in accordance with the applicable ASTM standards. A laboratory results summary sheet is included for your reference.

As always, if you have any questions do not hesitate to contact us.

Sincerely,

GEOTECHNICS, A DIVISION OF KLINGNER

Brian Joseph Sick

Brian Joseph Sick, P.E.
Geotechnical Services Department Manager

Enclosure: Data Results Summary, Laboratory Analysis Data Reports

Job #:
21-1004

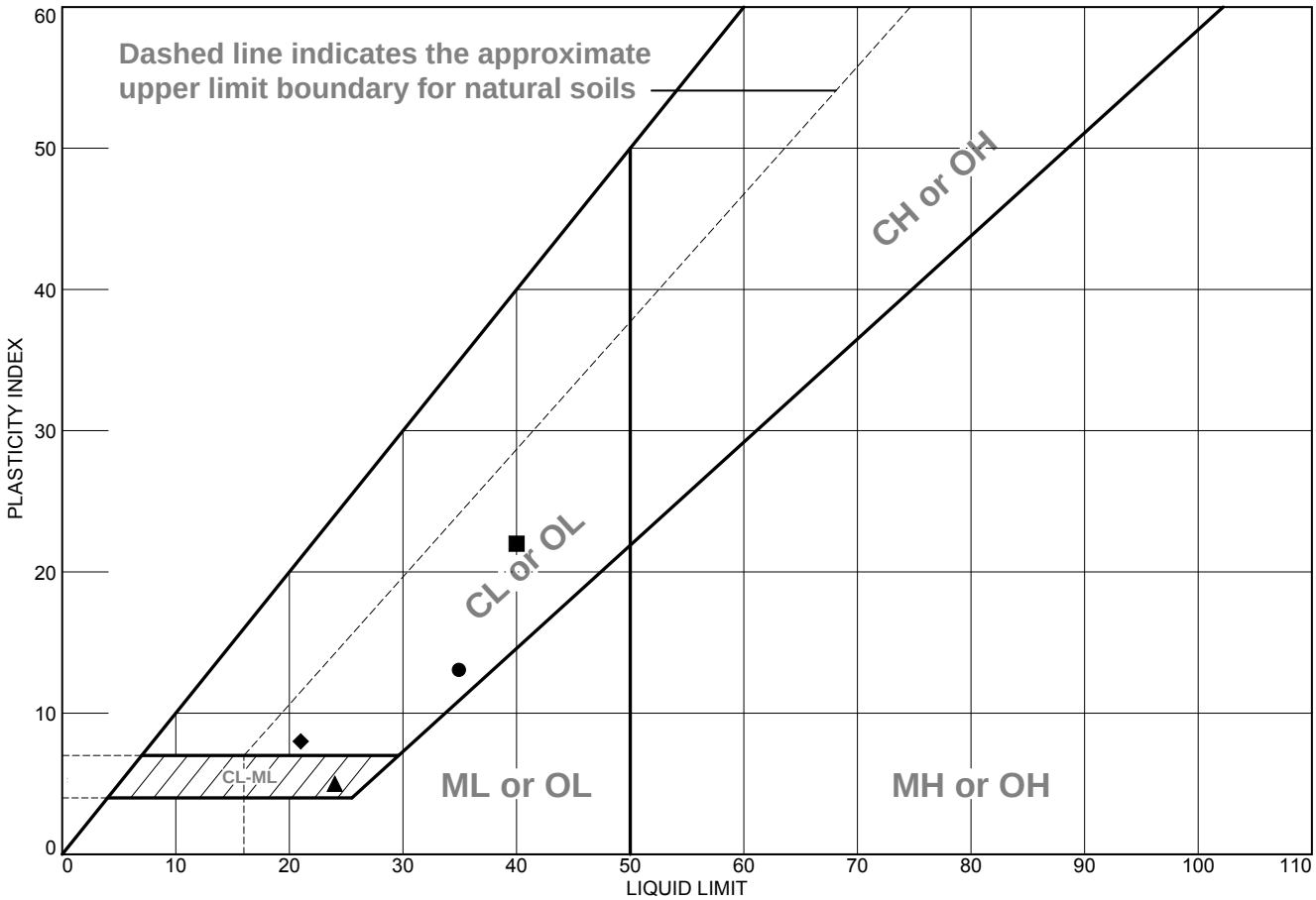
Duck Creek Power Station
Hanson Professional Services

Date:
3/26/2021

SAMPLE NO.	DEPTH	% Gravel	% Sand	% Silt	% Clay	USCS	LL	PL	PI	Sp. Gr.	Hyd. Cond.	Moist.	WET DENS.	DRY DENS.
SB50-Comp 1	5-19	0.0	2.6	81.8	15.6	CL	32	23	9	2.68		24.9	121.5	97.3
SB50-Comp 2	21-31	3.4	26.5	46.1	24.0	CL	28	18	10	2.70		21.1	141.4	116.7
SB50-Comp 3	31-39	3.6	32.0	50.5	13.9	CL	27	18	9	2.70		17.1	143.2	122.3
SB50-Comp 4	41-51	12.9	37.8	34.3	15.0	SC-SM	21	15	6	2.70		7.7	144.2	133.8
SB50/ST10-12	10-12										6.34E-07	25.9	123.5	98.0
SB50/ST22-24	22-24										2.59E-07	21.8	129.5	106.3
G54C-Comp 1	7-19	0.2	11.6	66.1	22.1	CL	35	22	13	2.68		18.6	134.2	113.1
G54C-Comp 2	25-33	1.0	18.4	49.1	31.5	CL	40	18	22	2.68		24.6	122.1	98.0
G54C-Comp 3	35-41	10.6	25.8	45.2	18.4	CL-ML	24	19	5	2.64		18.2	133.6	113.0
G54C-Comp 4	47-73	7.4	36.3	38.0	18.3	CL	21	13	8	2.67		9.8	141.0	128.4
G54C/ST14-16	14-16										7.06E-08	22.2	127.0	104.0
G54C/ST32-34	32-34										7.47E-07	21.9	128.2	105.1
G54C/ST44-46	44-46										5.39E-06	12.2	141.5	126.1
G54C/ST76-78	76-78										4.11E-08	12.6	138.7	123.2
SB62-Comp 1	7-19	0.0	11.5	62.0	26.5	CL	35	22	13	2.65		19.3	124.9	104.7
SB62-Comp 2	23-33	0.0	23.0	48.6	28.4	CL	29	17	12	2.70		21.5	126.6	104.1
SB62-Comp 3	33-39	2.9	23.4	57.5	16.2	CL-ML	26	19	7	2.65		14.5	133.0	116.1
SB62-Comp 4	41-51	2.8	40.7	38.7	17.8	CL-ML	21	15	6	2.64		10.0	138.6	126.1
SB62/ST12-14	12-14										1.94E-07	21.1	127.8	105.5
SB62/ST26-28	26-28										2.28E-06	23.2	129.8	105.3
SB62/ST38-40	38-40										1.09E-06	15.6	136.8	118.4

Lab Results

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean Clay (CL), Yellow Brown, Silty, Trace Sand, Moist	35	22	13	94.5	88.2	CL
■	Lean Clay with Sand (CL), Yellow Brown, Silty, Moist	40	18	22	95.5	80.6	CL
▲	Sandy Silty Clay (CL-ML), Gray, Moist	24	19	5	79.9	63.6	CL-ML
◆	Sandy Lean Clay (CL), Gray, Silty	21	13	8	80.1	56.3	CL

Project No. 21-1004 **Client:** Hanson Professional Services, Inc.

Project: Duck Creek Power Station GMF

●**Location:** G54C **Depth:** 7 to 19 ft. **Sample Number:** Comp 1
■**Location:** G54C **Depth:** 25 to 33 ft. **Sample Number:** Comp 2
▲**Location:** G54C **Depth:** 35 to 41 ft. **Sample Number:** Comp 3
◆**Location:** G54C **Depth:** 47 to 73 ft. **Sample Number:** Comp 4

Remarks:
●Moisture Content = 18.6%
■Moisture Content = 24.6%
▲Moisture Content = 18.2%
◆Moisture Content = 9.8%

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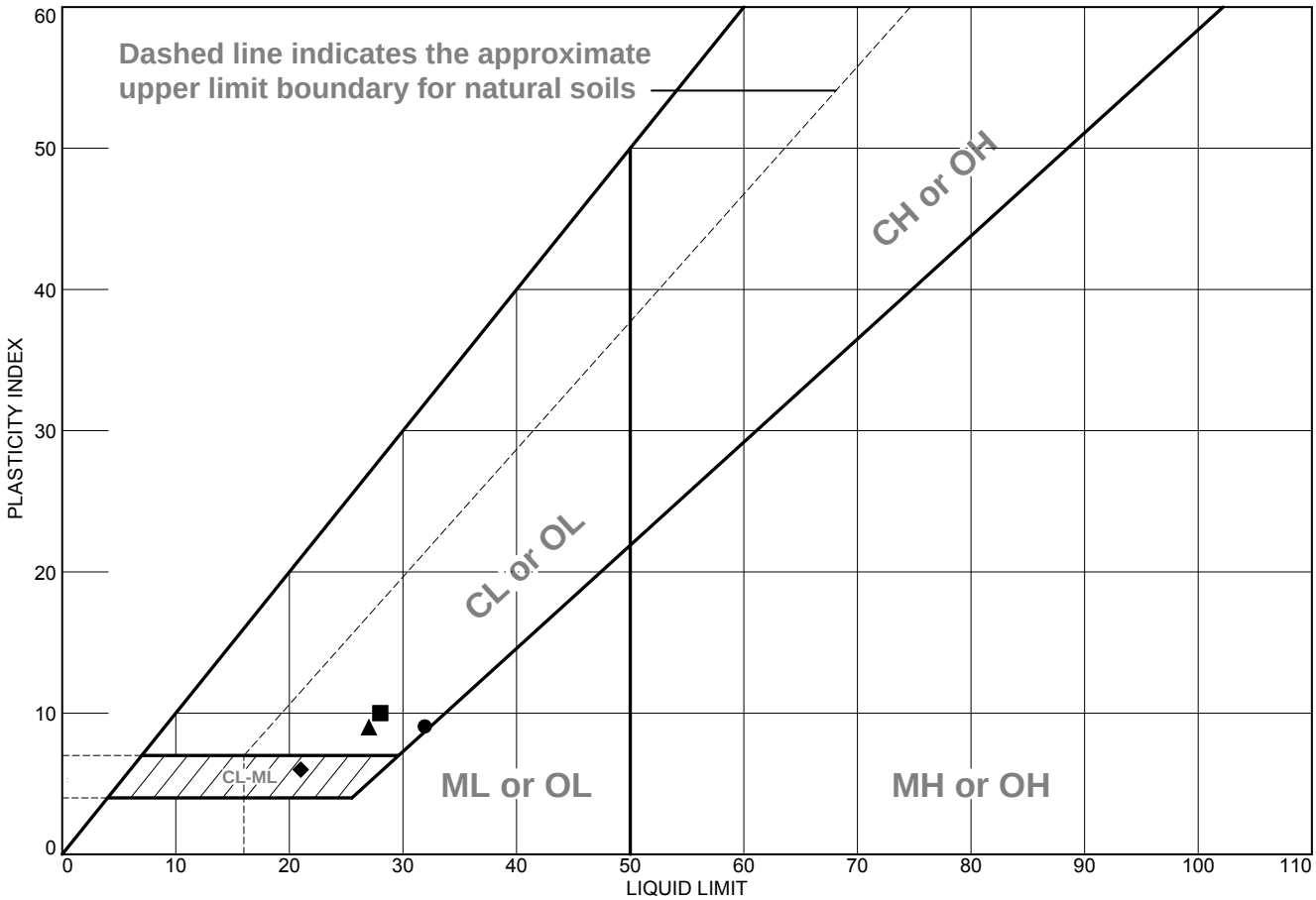
4510 Paris Gravel Road - Hannibal, MO

Figure

Tested By: AJK **Checked By:** BJS

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean Clay (CL), Light Brown, Silty, Moist	32	23	9	99.5	97.4	CL
■	Lean Clay with Sand (CL), Yellow Brown/Light Brown mottled Light Gray, Reddish Brown Oxidation, Silty, Moist	28	18	10	86.3	70.1	CL
▲	Sandy Lean Clay (CL), Gray, Silty, Moist	27	18	9	85.9	64.4	CL
◆	Silty, Clayey Sand (SC-SM), Gray, Dry	21	15	6	75.0	49.3	SC-SM

Project No. 21-1004 **Client:** Hanson Professional Services, Inc.

Project: Duck Creek Power Station GMF

●**Location:** SB50 **Depth:** 5 to 19 ft. **Sample Number:** Comp 1
■**Location:** SB50 **Depth:** 21 to 31 ft. **Sample Number:** Comp 2
▲**Location:** SB50 **Depth:** 31 to 39 ft. **Sample Number:** Comp 3
◆**Location:** SB50 **Depth:** 41 to 51 ft. **Sample Number:** Comp 4

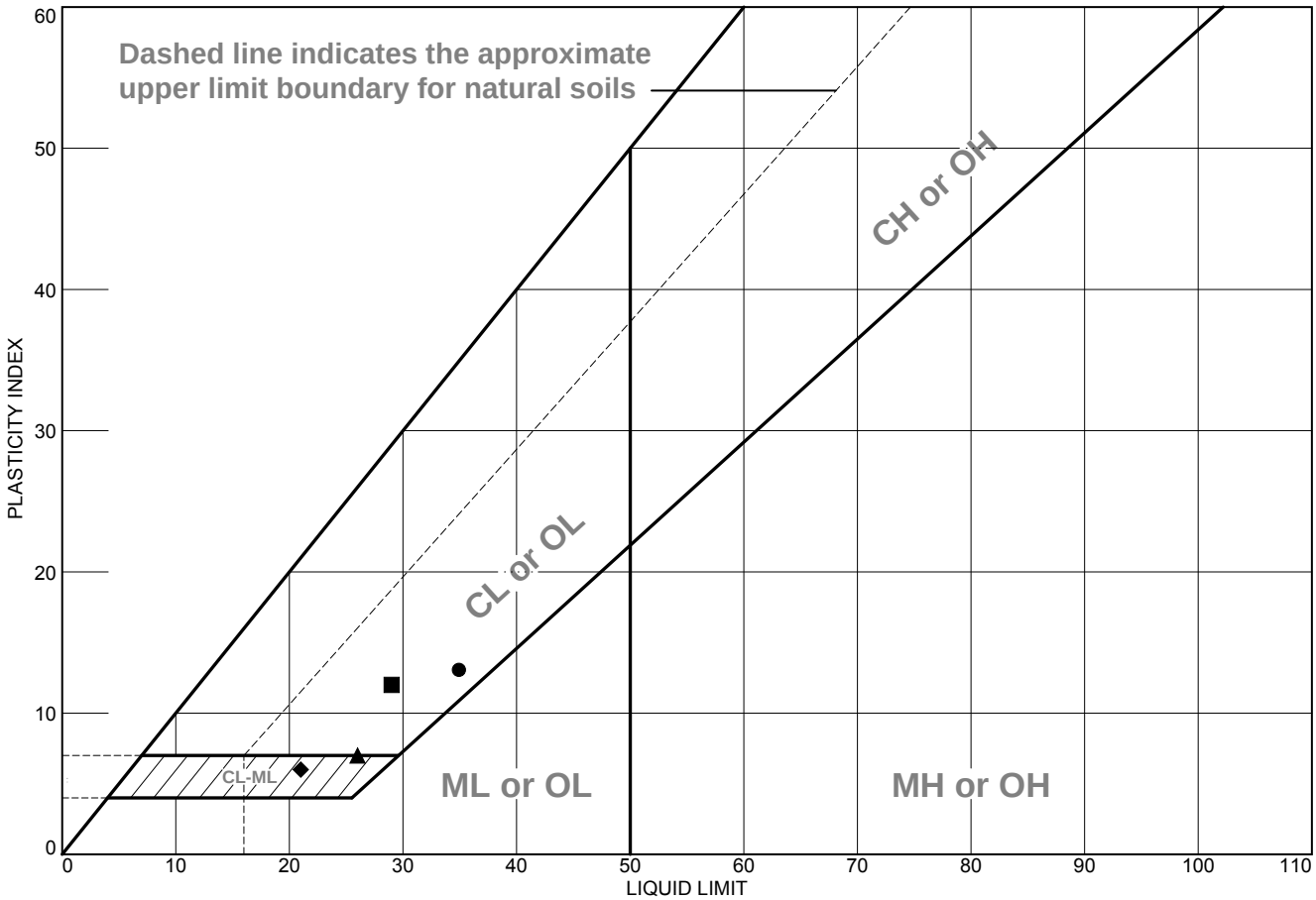
Remarks:
●Moisture Content = 24.9%
■Moisture Content = 21.1%
▲Moisture Content = 17.1%
◆Moisture Content = 7.7%

GEOTECHNICS
Soil & Material Testing
4510 Paris Gravel Road - Hannibal, MO

Figure

Tested By: ○ NAS □ NAS △ AJK ◇ AJK **Checked By:** BJS

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean Clay (CL), Yellow Brown, Silty, Trace Sand, Moist	35	22	13	93.1	88.5	CL
■	Lean Clay with Sand (CL), Gray, Silty, Moist	29	17	12	94.3	77.0	CL
▲	Silty Clay with Sand (CL-ML), Gray, Moist	26	19	7	88.5	73.7	CL-ML
◆	Sandy Silty Clay (CL-ML), Gray, Dry	21	15	6	83.5	56.5	CL-ML

Project No. 21-1004 **Client:** Hanson Professional Services, Inc.

Project: Duck Creek Power Station GMF

●**Location:** SB62 **Depth:** 7 to 19 ft. **Sample Number:** Comp 1
■**Location:** SB62 **Depth:** 23 to 33 ft. **Sample Number:** Comp 2
▲**Location:** SB62 **Depth:** 33 to 39 ft. **Sample Number:** Comp 3
◆**Location:** SB62 **Depth:** 41 to 51 ft. **Sample Number:** Comp 4

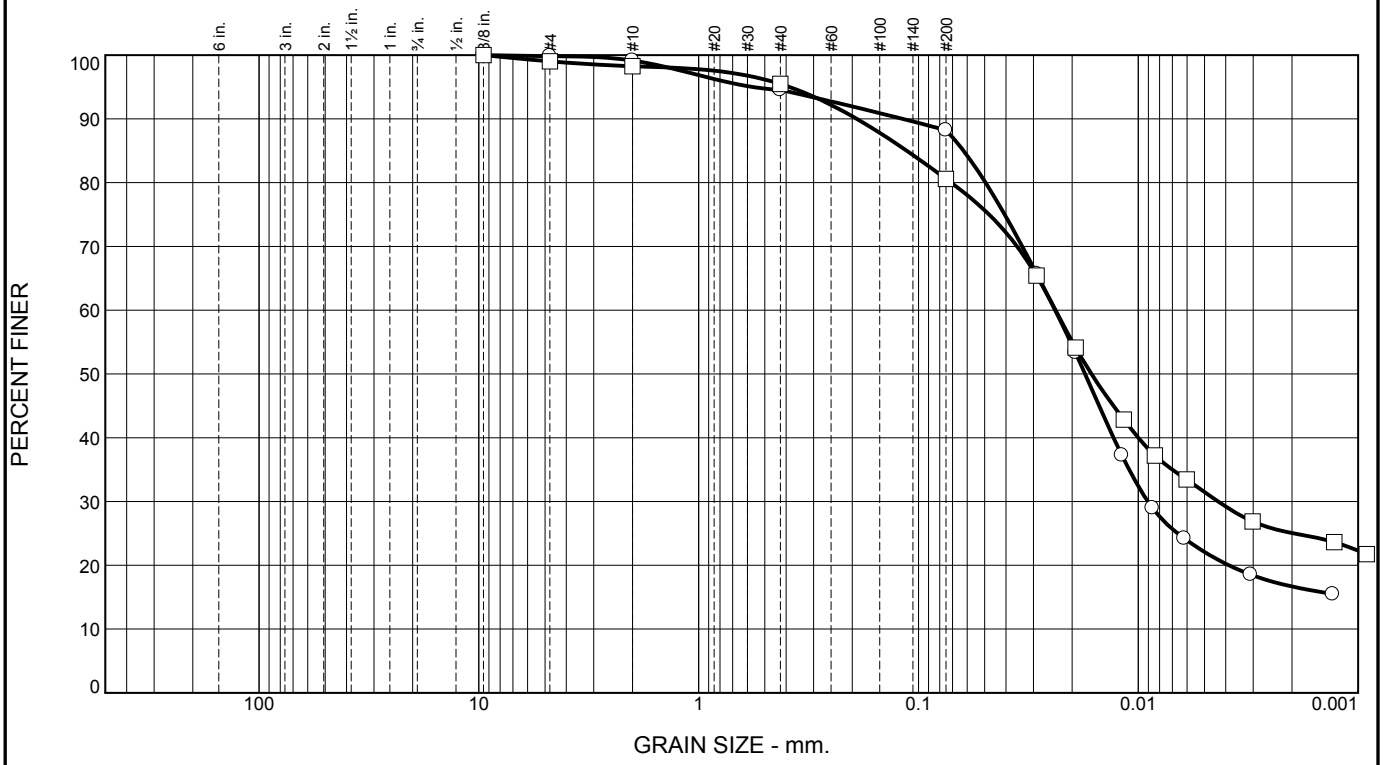
Remarks:
●Moisture Content = 19.3%
■Moisture Content = 21.5%
▲Moisture Content = 14.5%
◆Moisture Content = 10.0%

GEOTECHNICS
Soil & Material Testing
4510 Paris Gravel Road - Hannibal, MO

Figure

Tested By: AJK **Checked By:** BJS

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PL	PI
○	0.0	0.2	11.6	66.1	22.1	CL	35	22	13
□	0.0	1.0	18.4	49.1	31.5	CL	40	18	22

SIEVE inches size	PERCENT FINER ○	PERCENT FINER □
3/8	100.0	100.0
GRAIN SIZE		
D_{60}	0.0239	0.0238
D_{30}	0.0090	0.0043
D_{10}		
COEFFICIENTS		
C_c		
C_u		

SIEVE number size	PERCENT FINER ○	PERCENT FINER □
#4	99.8	99.0
#10	99.1	98.3
#40	94.5	95.5
#200	88.2	80.6

Material Description

○ Lean Clay (CL), Yellow Brown, Silty, Trace Sand, Moist

□ Lean Clay with Sand (CL), Yellow Brown, Silty, Moist

REMARKS:

○ Moisture Content = 18.6%

□ Moisture Content = 24.6%

○ Location: G54C Depth: 7 to 19 ft. Sample Number: Comp 1

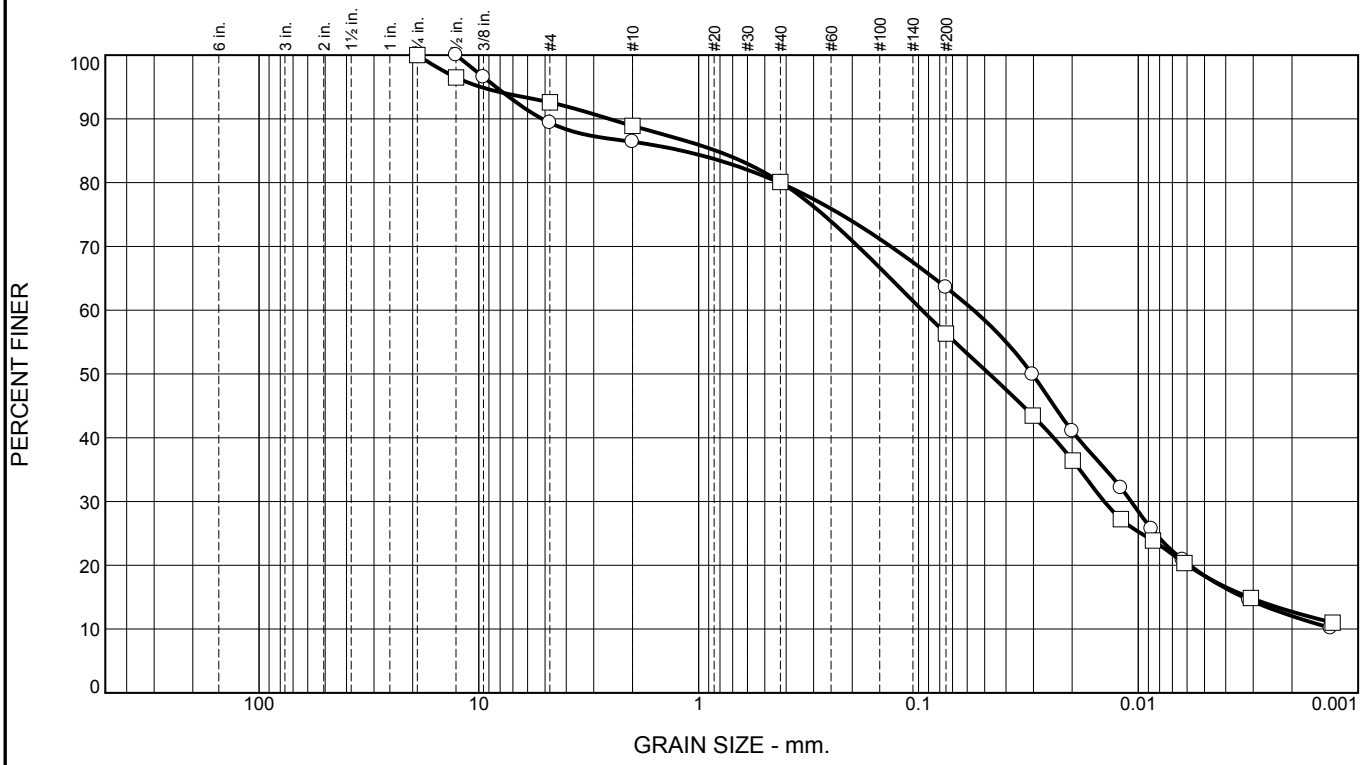
□ Location: G54C Depth: 25 to 33 ft. Sample Number: Comp 2

GEOTECHNICS
Soil & Material Testing
4510 Paris Gravel Road - Hannibal, MO

Client: Hanson Professional Services, Inc.
Project: Duck Creek Power Station GMF
Project No.: 21-1004 Figure

Tested By: MAS/NAS **Checked By:** BJS

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PL	PI
○	0.0	10.6	25.8	45.2	18.4	CL-ML	24	19	5
□	0.0	7.4	36.3	38.0	18.3	CL	21	13	8

SIEVE inches size	PERCENT FINER ○	PERCENT FINER □
3/4		100.0
.5	100.0	96.5
3/8	96.6	
GRAIN SIZE		
D_{60}	0.0562	0.0963
D_{30}	0.0108	0.0143
D_{10}		
COEFFICIENTS		
C_c		
C_u		

SIEVE number size	PERCENT FINER ○	PERCENT FINER □
#4	89.4	92.6
#10	86.4	88.9
#40	79.9	80.1
#200	63.6	56.3

Material Description

○ Sandy Silty Clay (CL-ML), Gray, Moist

□ Sandy Lean Clay (CL), Gray, Silty

REMARKS:

○ Moisture Content = 18.2%

□ Moisture Content = 9.8%

○ Location: G54C Depth: 35 to 41 ft. Sample Number: Comp 3

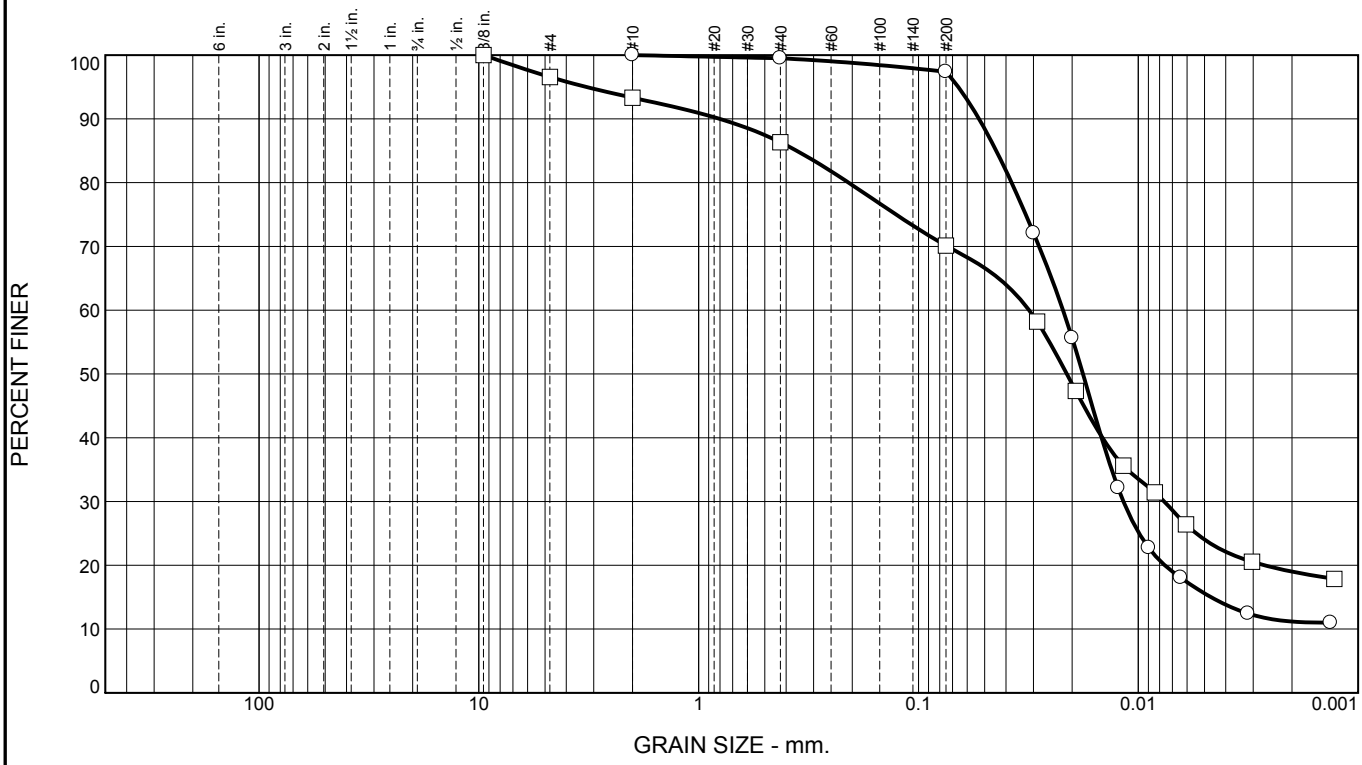
□ Location: G54C Depth: 47 to 73 ft. Sample Number: Comp 4

GEOTECHNICS
Soil & Material Testing
4510 Paris Gravel Road - Hannibal, MO

Client: Hanson Professional Services, Inc.
Project: Duck Creek Power Station GMF
Project No.: 21-1004 Figure

Tested By: ○ DAW/NAS □ MAS/NAS **Checked By:** BJS

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PL	PI
○	0.0	0.0	2.6	81.8	15.6	CL	32	23	9
□	0.0	3.4	26.5	46.1	24.0	CL	28	18	10

SIEVE inches size	PERCENT FINER ○	PERCENT FINER □	
3/8		100.0	
	GRAIN SIZE		
D_{60}	0.0220	0.0314	
D_{30}	0.0117	0.0076	
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	PERCENT FINER □	
#4		96.6	
#10	100.0	93.3	
#40	99.5	86.3	
#200	97.4	70.1	

Material Description

○ Lean Clay (CL), Light Brown, Silty, Moist

□ Lean Clay with Sand (CL), Yellow Brown/Light Brown mottled Light Gray, Reddish Brown Oxidation, Silty, Moist

REMARKS:

○ Moisture Content = 24.9%

□ Moisture Content = 21.1%

○ Location: SB50 Depth: 5 to 19 ft. Sample Number: Comp 1

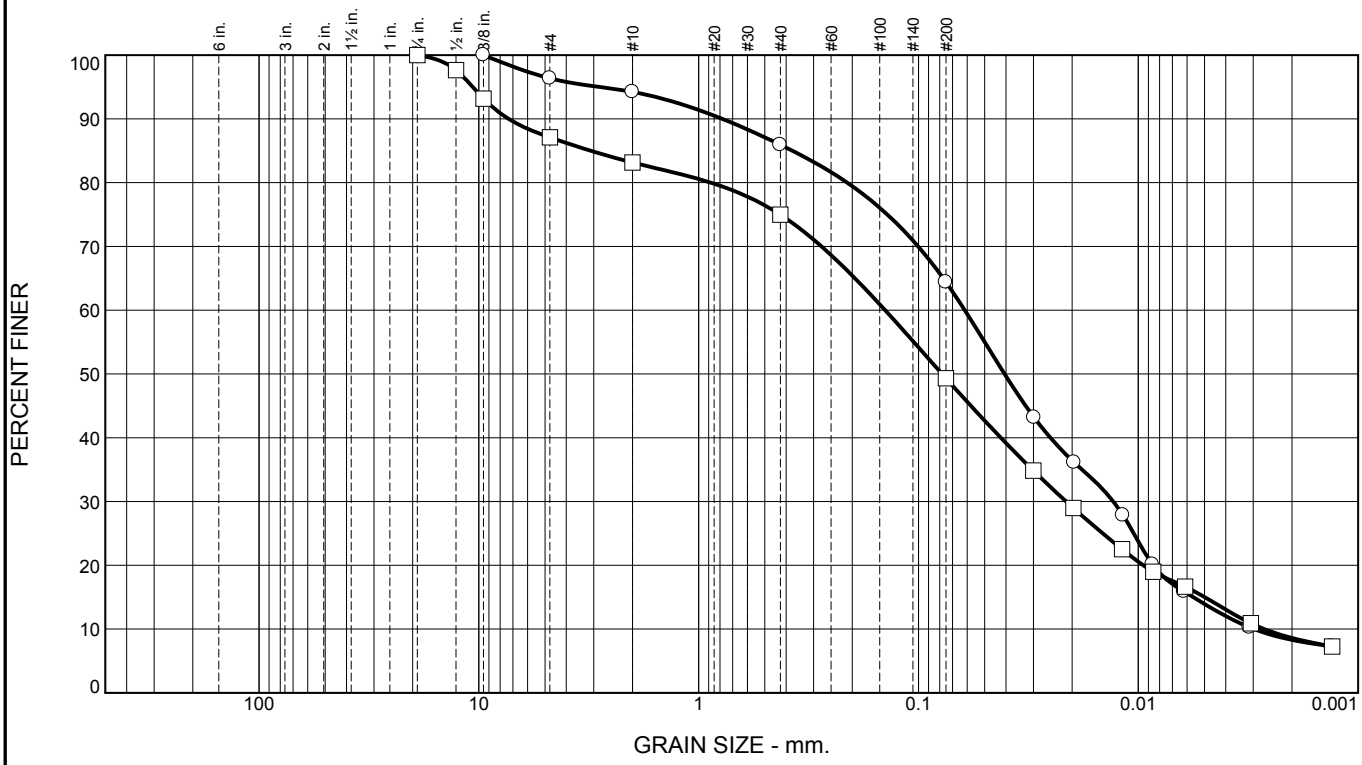
□ Location: SB50 Depth: 21 to 31 ft. Sample Number: Comp 2

GEOTECHNICS
Soil & Material Testing
4510 Paris Gravel Road - Hannibal, MO

Client: Hanson Professional Services, Inc.
Project: Duck Creek Power Station GMF
Project No.: 21-1004 Figure

Tested By: MAS/NAS **Checked By:** BJS

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PL	PI
○	0.0	3.6	32.0	50.5	13.9	CL	27	18	9
□	0.0	12.9	37.8	34.3	15.0	SC-SM	21	15	6

SIEVE inches size	PERCENT FINER ○	PERCENT FINER □
3/4		100.0
.5		97.6
3/8	100.0	93.2
	GRAIN SIZE	
D_{60}	0.0616	0.1419
D_{30}	0.0130	0.0213
D_{10}	0.0030	0.0027
	COEFFICIENTS	
C_c	0.92	1.19
C_u	20.67	53.01

SIEVE number size	PERCENT FINER ○	PERCENT FINER □
#4	96.4	87.1
#10	94.2	83.2
#40	85.9	75.0
#200	64.4	49.3

Material Description

○ Sandy Lean Clay (CL), Gray, Silty, Moist

□ Silty, Clayey Sand (SC-SM), Gray, Dry

REMARKS:

○ Moisture Content = 17.1%

□ Moisture Content = 7.7%

○ Location: SB50 Depth: 31 to 39 ft. Sample Number: Comp 3

□ Location: SB50 Depth: 41 to 51 ft. Sample Number: Comp 4

GEOTECHNICS
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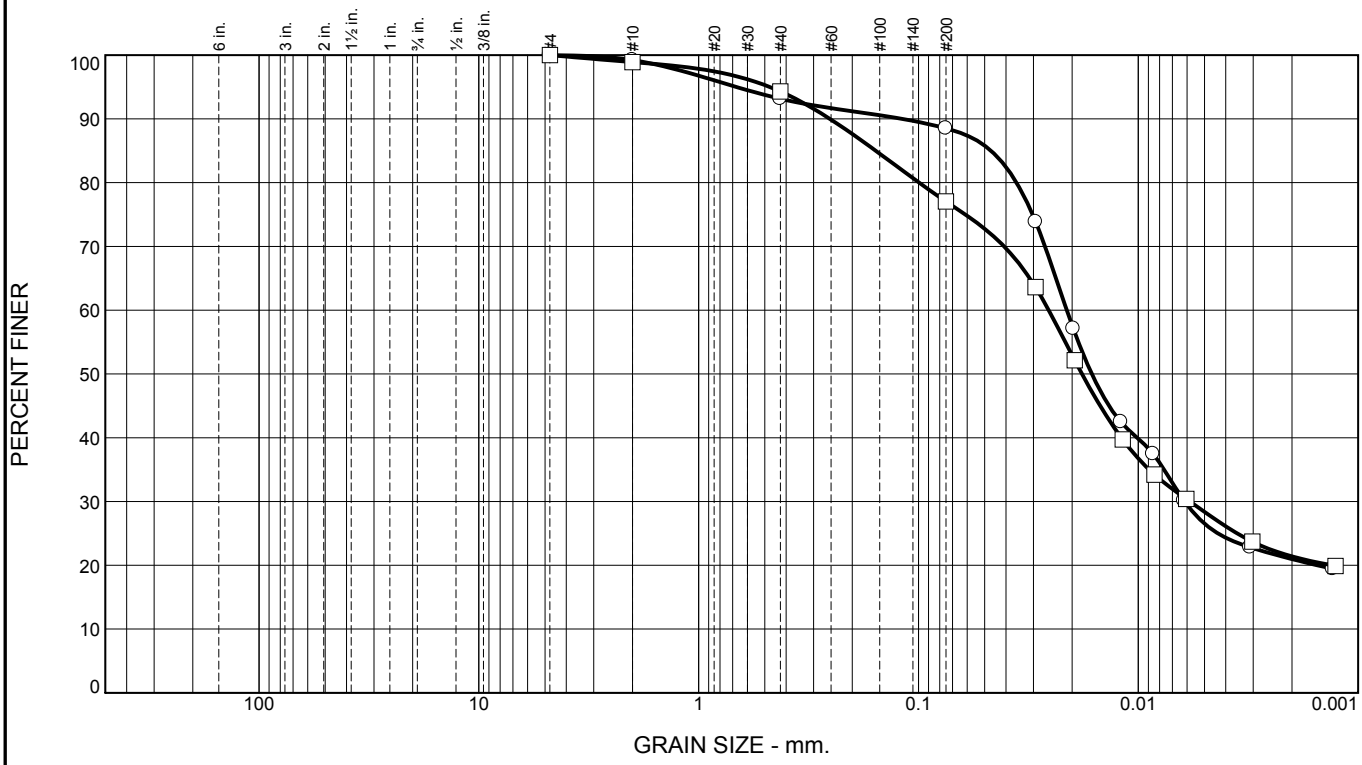
4510 Paris Gravel Road - Hannibal, MO

Client: Hanson Professional Services, Inc.
Project: Duck Creek Power Station GMF
Project No.: 21-1004 Figure

Tested By: ○ MAS □ MAS/NAS **Checked By:** NAS

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PL	PI
○	0.0	0.0	11.5	62.0	26.5	CL	35	22	13
□	0.0	0.0	23.0	48.6	28.4	CL	29	17	12

SIEVE inches size	PERCENT FINER ○	PERCENT FINER □	
	GRAIN SIZE		
D_{60}	0.0212	0.0256	
D_{30}	0.0062	0.0058	
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	PERCENT FINER □	
#4	100.0	100.0	
#10	99.2	98.9	
#40	93.1	94.3	
#200	88.5	77.0	

Material Description

○ Lean Clay (CL), Yellow Brown, Silty, Trace Sand, Moist

□ Lean Clay with Sand (CL), Gray, Silty, Moist

REMARKS:

○ Moisture Content = 19.3%

□ Moisture Content = 21.5%

○ Location: SB62 Depth: 7 to 19 ft. Sample Number: Comp 1

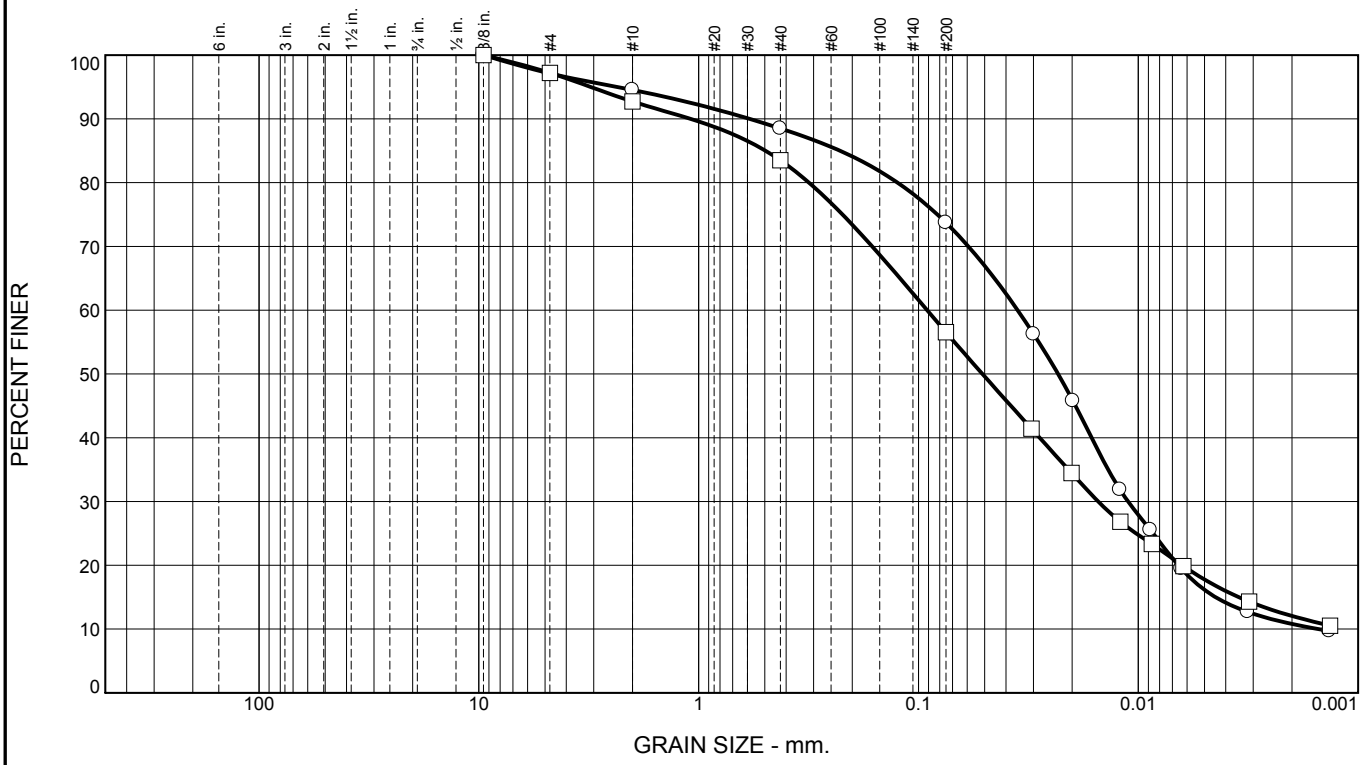
□ Location: SB62 Depth: 23 to 33 ft. Sample Number: Comp 2

GEOTECHNICS
Soil & Material Testing
4510 Paris Gravel Road - Hannibal, MO

Client: Hanson Professional Services, Inc.
Project: Duck Creek Power Station GMF
Project No.: 21-1004 Figure

Tested By: DAW/NAS **Checked By:** BJS

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PL	PI
○	0.0	2.9	23.4	57.5	16.2	CL-ML	26	19	7
□	0.0	2.8	40.7	38.7	17.8	CL-ML	21	15	6

SIEVE inches size	PERCENT FINER ○	PERCENT FINER □	
3/8	100.0	100.0	
	GRAIN SIZE		
D_{60}	0.0354	0.0913	
D_{30}	0.0111	0.0152	
D_{10}	0.0015		
	COEFFICIENTS		
C_c	2.31		
C_u	23.34		

SIEVE number size	PERCENT FINER ○	PERCENT FINER □	
#4	97.1	97.2	
#10	94.5	92.7	
#40	88.5	83.5	
#200	73.7	56.5	

Material Description

○ Silty Clay with Sand (CL-ML), Gray, Moist

□ Sandy Silty Clay (CL-ML), Gray, Dry

REMARKS:

○ Moisture Content = 14.5%

□ Moisture Content = 10.0%

○ Location: SB62 Depth: 33 to 39 ft. Sample Number: Comp 3

□ Location: SB62 Depth: 41 to 51 ft. Sample Number: Comp 4

GEOTECHNICS
Soil & Material Testing
4510 Paris Gravel Road - Hannibal, MO

Client: Hanson Professional Services, Inc.
Project: Duck Creek Power Station GMF
Project No.: 21-1004 Figure

Tested By: DAW/NAS **Checked By:** BJS

Project No: 21-1004

Specific Gravity of Soil Solids by Water Pycnometer (ASTM D854)

Project: Duck Creek Power Station GMF Location: Canton, IL

Client: Hanson Professional Services Test Method: B

Sample Description: Lean Clay (CL), Yellow Brown, Silty, Trace Sand, Moist

Sample Source: SS Composite

Boring or Test Pit No.: G54C/Comp#1 Maximum Particle Size: 3/8”

Sample Depth: 7 to 19 ft. Percent Passing No. 4 Sieve: 99.8%

Sample Type: SS Percent Passing No. 200 Sieve: 88.2%

Specific gravity of soil solids (ASTM D854)			
Sample No.	G54C-Comp1		
Pycnometer No.	1		
Temp. of Water & Soil, T, ºC	26.0		
Correction Factor, **(K)** from Table 2 ASTM D 854	0.99844		
Tare No.	239		
Wt. of Tare & Dry Soil	99.02		
Wt. of Tare	48.70		
Wt. of Dry Soil **(M_s)**	50.32		
Wt. of Calibrated Pycnometer, dry **(M_p)**	143.91		
Wt. of Pycnometer and Water at Test Temp **($M_{pw,t}$)**	641.70		
Vol. of Pycnometer, ml **(V_p)**	500		
Density of Water at Test Temp **($P_{w,t}$)**	0.99665		
Wt. of Pycnometer, Water and Soil **($M_{pws,t}$)**	673.23		
Specific Gravity, $G_t = M_s/(M_{pw,t} - (M_{pws,t} - M_s))$	2.689		
Specific Gravity @ 20ºC=K*G_t	2.68		

Sample Obtained By: Geotechnics Date: 2/4/2021

Tested By Technician: NAS Date: 2/15/2021

Checked By Project Engineer: BJS Date: 3/26/2021

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Project No: 21-1004

Specific Gravity of Soil Solids by Water Pycnometer (ASTM D854)

Project: Duck Creek Power Station GMF Location: Canton, IL

Client: Hanson Professional Services Test Method: B

Sample Description: Lean Clay with Sand (CL), Yellow Brown, Silty, Moist

Sample Source: SS Composite

Boring or Test Pit No.: G54C/Comp#2 Maximum Particle Size: 3/8”

Sample Depth: 25 to 33 ft. Percent Passing No. 4 Sieve: 99.0%

Sample Type: SS Percent Passing No. 200 Sieve: 80.6%

Specific gravity of soil solids (ASTM D854)			
Sample No.	G54C-Comp2		
Pycnometer No.	1		
Temp. of Water & Soil, T, ºC	21.0		
Correction Factor, **(K)** from Table 2 ASTM D 854	0.99979		
Tare No.	231		
Wt. of Tare & Dry Soil	93.41		
Wt. of Tare	49.02		
Wt. of Dry Soil **(M_s)**	44.39		
Wt. of Calibrated Pycnometer, dry **(M_p)**	143.91		
Wt. of Pycnometer and Water at Test Temp **($M_{pw,t}$)**	642.30		
Vol. of Pycnometer, ml **(V_p)**	500		
Density of Water at Test Temp **($P_{w,t}$)**	0.99799		
Wt. of Pycnometer, Water and Soil **($M_{pws,t}$)**	670.15		
Specific Gravity, $G_t = M_s/(M_{pw,t} - (M_{pws,t} - M_s))$	2.684		
Specific Gravity @ 20ºC=K*G_t	2.68		

Sample Obtained By: Geotechnics Date: 2/4/2021

Tested By Technician: NAS Date: 2/15/2021

Checked By Project Engineer: BJS Date: 3/26/2021

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Project No: 21-1004

Specific Gravity of Soil Solids by Water Pycnometer (ASTM D854)

Project: Duck Creek Power Station GMF Location: Canton, IL

Client: Hanson Professional Services Test Method: B

Sample Description: Sandy Silty Clay (CL-ML), Gray, Moist

Sample Source: SS Composite

Boring or Test Pit No.: G54C/Comp#3 Maximum Particle Size: 1/2"

Sample Depth: 35 to 41 ft. Percent Passing No. 4 Sieve: 89.4%

Sample Type: SS Percent Passing No. 200 Sieve: 63.6%

Specific gravity of soil solids (ASTM D854)			
Sample No.	G54C-Comp3		
Pycnometer No.	1		
Temp. of Water & Soil, T, ºC	26.5		
Correction Factor, **(K)** from Table 2 ASTM D 854	0.99844		
Tare No.	237		
Wt. of Tare & Dry Soil	105.00		
Wt. of Tare	49.34		
Wt. of Dry Soil **(M_s)**	55.66		
Wt. of Calibrated Pycnometer, dry **(M_p)**	143.91		
Wt. of Pycnometer and Water at Test Temp **($M_{pw,t}$)**	642.24		
Vol. of Pycnometer, ml **(V_p)**	500		
Density of Water at Test Temp **($P_{w,t}$)**	0.99665		
Wt. of Pycnometer, Water and Soil **($M_{pws,t}$)**	676.82		
Specific Gravity, $G_t = M_s/(M_{pw,t} - (M_{pws,t} - M_s))$	2.640		
Specific Gravity @ 20ºC=K*G_t	2.64		

Sample Obtained By: Geotechnics Date: 2/4/2021

Tested By Technician: NAS Date: 2/16/2021

Checked By Project Engineer: BJS Date: 3/26/2021

Project No: 21-1004

Specific Gravity of Soil Solids by Water Pycnometer (ASTM D854)

Project: Duck Creek Power Station GMF Location: Canton, IL

Client: Hanson Professional Services Test Method: B

Sample Description: Sandy Lean Clay (CL), Gray, Silty, Dry

Sample Source: SS Composite

Boring or Test Pit No.: G54C/Comp#4 Maximum Particle Size: 3/4"

Sample Depth: 47 to 73 ft. Percent Passing No. 4 Sieve: 92.6%

Sample Type: SS Percent Passing No. 200 Sieve: 56.3%

Specific gravity of soil solids (ASTM D854)			
Sample No.	G54C-Comp4		
Pycnometer No.	2		
Temp. of Water & Soil, T, ºC	25.0		
Correction Factor, **(K)** from Table 2 ASTM D 854	0.99884		
Tare No.	228		
Wt. of Tare & Dry Soil	105.70		
Wt. of Tare	49.94		
Wt. of Dry Soil **(M_s)**	55.76		
Wt. of Calibrated Pycnometer, dry **(M_p)**	133.50		
Wt. of Pycnometer and Water at Test Temp **($M_{pw,t}$)**	631.40		
Vol. of Pycnometer, ml **(V_p)**	500		
Density of Water at Test Temp **($P_{w,t}$)**	0.99705		
Wt. of Pycnometer, Water and Soil **($M_{pws,t}$)**	666.34		
Specific Gravity, $G_t = M_s/(M_{pw,t}-(M_{pws,t}-M_s))$	2.678		
Specific Gravity @ 20ºC=K*G_t	2.67		

Sample Obtained By: Geotechnics Date: 2/4/2021

Tested By Technician: NAS Date: 2/16/2021

Checked By Project Engineer: BJS Date: 3/26/2021

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Project No: 21-1004

Specific Gravity of Soil Solids by Water Pycnometer (ASTM D854)

Project: Duck Creek Power Station GMF Location: Canton, IL

Client: Hanson Professional Services Test Method: B

Sample Description: Lean Clay (CL), Light Brown, Silty, Moist

Sample Source: SS Composite

Boring or Test Pit No.: SB50/Comp#1 Maximum Particle Size: #10

Sample Depth: 5 to 19 ft. Percent Passing No. 4 Sieve: 100.0%

Sample Type: SS Percent Passing No. 200 Sieve: 97.4%

Specific gravity of soil solids (ASTM D854)			
Sample No.	SB50-Comp1		
Pycnometer No.	1		
Temp. of Water & Soil, T, ºC	24.5		
Correction Factor, **(K)** from Table 2 ASTM D 854	0.99897		
Tare No.	233		
Wt. of Tare & Dry Soil	96.94		
Wt. of Tare	49.38		
Wt. of Dry Soil **(M_s)**	47.56		
Wt. of Calibrated Pycnometer, dry **(M_p)**	143.91		
Wt. of Pycnometer and Water at Test Temp **($M_{pw,t}$)**	641.88		
Vol. of Pycnometer, ml **(V_p)**	500		
Density of Water at Test Temp **($P_{w,t}$)**	0.99717		
Wt. of Pycnometer, Water and Soil **($M_{pws,t}$)**	671.72		
Specific Gravity, $G_t = M_s/(M_{pw,t} - (M_{pws,t} - M_s))$	2.684		
Specific Gravity @ 20ºC=K*G_t	2.68		

Sample Obtained By: Geotechnics Date: 2/3/2021

Tested By Technician: NAS Date: 2/12/2021

Checked By Project Engineer: BJS Date: 3/26/2021

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Project No: 21-1004

Specific Gravity of Soil Solids by Water Pycnometer (ASTM D854)

Project: Duck Creek Power Station GMF Location: Canton, IL

Client: Hanson Professional Services Test Method: B

Sample Description: Lean Clay with Sand (CL), YBrn/Lt Brn mot. Lt Gray, RBrn Ox, Silty, Moist

Sample Source: SS Composite

Boring or Test Pit No.: SB50/Comp#2 Maximum Particle Size: 3/8

Sample Depth: 21 to 31 ft. Percent Passing No. 4 Sieve: 96.6%

Sample Type: SS Percent Passing No. 200 Sieve: 70.1%

Specific gravity of soil solids (ASTM D854)			
Sample No.	SB50-Comp2		
Pycnometer No.	2		
Temp. of Water & Soil, T, ºC	21.0		
Correction Factor, **(K)** from Table 2 ASTM D 854	0.99979		
Tare No.	236		
Wt. of Tare & Dry Soil	97.27		
Wt. of Tare	49.36		
Wt. of Dry Soil **(M_s)**	47.91		
Wt. of Calibrated Pycnometer, dry **(M_p)**	133.50		
Wt. of Pycnometer and Water at Test Temp **($M_{pw,t}$)**	631.87		
Vol. of Pycnometer, ml **(V_p)**	500		
Density of Water at Test Temp **($P_{w,t}$)**	0.99799		
Wt. of Pycnometer, Water and Soil **($M_{pws,t}$)**	662.03		
Specific Gravity, $G_t = M_s/(M_{pw,t}-(M_{pws,t}-M_s))$	2.699		
Specific Gravity @ 20ºC=K*G_t	2.70		

Sample Obtained By: Geotechnics Date: 2/3/2021

Tested By Technician: NAS Date: 2/12/2021

Checked By Project Engineer: BJS Date: 3/26/2021

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Project No: 21-1004

Specific Gravity of Soil Solids by Water Pycnometer (ASTM D854)

Project: Duck Creek Power Station GMF Location: Canton, IL

Client: Hanson Professional Services Test Method: B

Sample Description: Sandy Lean Clay (CL), Gray, Silty, Moist

Sample Source: SS Composite

Boring or Test Pit No.: SB50/Comp#3 Maximum Particle Size: 3/8

Sample Depth: 31 to 39 ft. Percent Passing No. 4 Sieve: 96.4%

Sample Type: SS Percent Passing No. 200 Sieve: 64.4%

Specific gravity of soil solids (ASTM D854)			
Sample No.	SB50-Comp3		
Pycnometer No.	2		
Temp. of Water & Soil, T, ºC	26.0		
Correction Factor, **(K)** from Table 2 ASTM D 854	0.99858		
Tare No.	220		
Wt. of Tare & Dry Soil	98.97		
Wt. of Tare	49.09		
Wt. of Dry Soil **(M_s)**	49.88		
Wt. of Calibrated Pycnometer, dry **(M_p)**	133.50		
Wt. of Pycnometer and Water at Test Temp **($M_{pw,t}$)**	631.27		
Vol. of Pycnometer, ml **(V_p)**	500		
Density of Water at Test Temp **($P_{w,t}$)**	0.99679		
Wt. of Pycnometer, Water and Soil **($M_{pws,t}$)**	662.68		
Specific Gravity, $G_t = M_s/(M_{pw,t}-(M_{pws,t}-M_s))$	2.701		
Specific Gravity @ 20ºC=K*G_t	2.70		

Sample Obtained By: Geotechnics Date: 2/3/2021

Tested By Technician: NAS Date: 2/15/2021

Checked By Project Engineer: BJS Date: 3/26/2021

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Project No: 21-1004

Specific Gravity of Soil Solids by Water Pycnometer (ASTM D854)

Project: Duck Creek Power Station GMF Location: Canton, IL

Client: Hanson Professional Services Test Method: B

Sample Description: Silty, Clayey Sand (SC-SM), Gray, Dry

Sample Source: SS Composite

Boring or Test Pit No.: SB50/Comp#4 Maximum Particle Size: 3/4

Sample Depth: 41 to 51 ft. Percent Passing No. 4 Sieve: 87.1%

Sample Type: SS Percent Passing No. 200 Sieve: 49.3%

Specific gravity of soil solids (ASTM D854)			
Sample No.	SB50-Comp4		
Pycnometer No.	1		
Temp. of Water & Soil, T, ºC	25.0		
Correction Factor, **(K)** from Table 2 ASTM D 854	0.99884		
Tare No.	237		
Wt. of Tare & Dry Soil	99.71		
Wt. of Tare	49.44		
Wt. of Dry Soil **(M_s)**	50.27		
Wt. of Calibrated Pycnometer, dry **(M_p)**	143.91		
Wt. of Pycnometer and Water at Test Temp **($M_{pw,t}$)**	641.83		
Vol. of Pycnometer, ml **(V_p)**	500		
Density of Water at Test Temp **($P_{w,t}$)**	0.99705		
Wt. of Pycnometer, Water and Soil **($M_{pws,t}$)**	673.49		
Specific Gravity, $G_t = M_s/(M_{pw,t}-(M_{pws,t}-M_s))$	2.701		
Specific Gravity @ 20ºC=K*G_t	2.70		

Sample Obtained By: Geotechnics Date: 2/3/2021

Tested By Technician: NAS Date: 2/12/2021

Checked By Project Engineer: BJS Date: 3/26/2021

Project No: 21-1004

Specific Gravity of Soil Solids by Water Pycnometer (ASTM D854)

Project: Duck Creek Power Station GMF Location: Canton, IL

Client: Hanson Professional Services Test Method: B

Sample Description: Lean Clay (CL), Yellow Brown, Silty, Trace Sand, Moist

Sample Source: SS Composite

Boring or Test Pit No.: SB62/Comp#1 Maximum Particle Size: #4

Sample Depth: 7 to 19 ft. Percent Passing No. 4 Sieve: 100.0%

Sample Type: SS Percent Passing No. 200 Sieve: 88.5%

Specific gravity of soil solids (ASTM D854)			
Sample No.	SB62-Comp1		
Pycnometer No.	1		
Temp. of Water & Soil, T, ºC	24.0		
Correction Factor, **(K)** from Table 2 ASTM D 854	0.99909		
Tare No.	239		
Wt. of Tare & Dry Soil	88.7		
Wt. of Tare	48.66		
Wt. of Dry Soil **(M_s)**	40.04		
Wt. of Calibrated Pycnometer, dry **(M_p)**	143.91		
Wt. of Pycnometer and Water at Test Temp **($M_{pw,t}$)**	641.95		
Vol. of Pycnometer, ml **(V_p)**	500		
Density of Water at Test Temp **($P_{w,t}$)**	0.99730		
Wt. of Pycnometer, Water and Soil **($M_{pws,t}$)**	666.87		
Specific Gravity, $G_t = M_s/(M_{pw,t}-(M_{pws,t}-M_s))$	2.648		
Specific Gravity @ 20ºC=K*G_t	2.65		

Sample Obtained By: Geotechnics Date: 2/3/2021

Tested By Technician: NAS Date: 2/16/2021

Checked By Project Engineer: BJS Date: 3/26/2021

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Project No: 21-1004

Specific Gravity of Soil Solids by Water Pycnometer (ASTM D854)

Project: Duck Creek Power Station GMF Location: Canton, IL

Client: Hanson Professional Services Test Method: B

Sample Description: Lean Clay with Sand (CL), Gray, Silty, Moist

Sample Source: SS Composite

Boring or Test Pit No.: SB62/Comp#2 Maximum Particle Size: #4

Sample Depth: 23 to 33 ft. Percent Passing No. 4 Sieve: 100.0%

Sample Type: SS Percent Passing No. 200 Sieve: 77.0%

Specific gravity of soil solids (ASTM D854)			
Sample No.	SB62-Comp2		
Pycnometer No.	2		
Temp. of Water & Soil, T, ºC	26.0		
Correction Factor, **(K)** from Table 2 ASTM D 854	0.99858		
Tare No.	234		
Wt. of Tare & Dry Soil	101.50		
Wt. of Tare	49.10		
Wt. of Dry Soil **(M_s)**	52.40		
Wt. of Calibrated Pycnometer, dry **(M_p)**	133.50		
Wt. of Pycnometer and Water at Test Temp **($M_{pw,t}$)**	631.27		
Vol. of Pycnometer, ml **(V_p)**	500		
Density of Water at Test Temp **($P_{w,t}$)**	0.99679		
Wt. of Pycnometer, Water and Soil **($M_{pws,t}$)**	664.27		
Specific Gravity, $G_t = M_s/(M_{pw,t} - (M_{pws,t} - M_s))$	2.701		
Specific Gravity @ 20ºC=K*G_t	2.70		

Sample Obtained By: Geotechnics Date: 2/3/2021

Tested By Technician: NAS Date: 2/16/2021

Checked By Project Engineer: BJS Date: 3/26/2021

Project No: 21-1004

Specific Gravity of Soil Solids by Water Pycnometer (ASTM D854)

Project: Duck Creek Power Station GMF Location: Canton, IL

Client: Hanson Professional Services Test Method: B

Sample Description: Silty Clay with Sand (CL-ML), Gray, Moist

Sample Source: SS Composite

Boring or Test Pit No.: SB62/Comp#3 Maximum Particle Size: 3/8"

Sample Depth: 33 to 39 ft. Percent Passing No. 4 Sieve: 97.1%

Sample Type: SS Percent Passing No. 200 Sieve: 73.7%

Specific gravity of soil solids (ASTM D854)			
Sample No.	SB62-Comp3		
Pycnometer No.	1		
Temp. of Water & Soil, T, ºC	26.5		
Correction Factor, **(K)** from Table 2 ASTM D 854	0.99844		
Tare No.	223		
Wt. of Tare & Dry Soil	103.96		
Wt. of Tare	49.21		
Wt. of Dry Soil **(M_s)**	54.75		
Wt. of Calibrated Pycnometer, dry **(M_p)**	143.91		
Wt. of Pycnometer and Water at Test Temp **($M_{pw,t}$)**	647.24		
Vol. of Pycnometer, ml **(V_p)**	500		
Density of Water at Test Temp **($P_{w,t}$)**	0.99665		
Wt. of Pycnometer, Water and Soil **($M_{pws,t}$)**	676.33		
Specific Gravity, $G_t = M_s/(M_{pw,t} - (M_{pws,t} - M_s))$	2.650		
Specific Gravity @ 20ºC=K*G_t	2.65		

Sample Obtained By: Geotechnics Date: 2/3/2021

Tested By Technician: NAS Date: 2/17/2021

Checked By Project Engineer: BJS Date: 3/26/2021

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Project No: 21-1004

Specific Gravity of Soil Solids by Water Pycnometer (ASTM D854)

Project: Duck Creek Power Station GMF Location: Canton, IL

Client: Hanson Professional Services Test Method: B

Sample Description: Sandy Silty Clay (CL-ML), Gray, Dry

Sample Source: SS Composite

Boring or Test Pit No.: SB62/Comp#4 Maximum Particle Size: 3/8"

Sample Depth: 41 to 51 ft. Percent Passing No. 4 Sieve: 97.2%

Sample Type: SS Percent Passing No. 200 Sieve: 56.5%

Specific gravity of soil solids (ASTM D854)			
Sample No.	SB62-Comp4		
Pycnometer No.	2		
Temp. of Water & Soil, T, ºC	23.5		
Correction Factor, **(K)** from Table 2 ASTM D 854	0.99921		
Tare No.	231		
Wt. of Tare & Dry Soil	99.47		
Wt. of Tare	49.03		
Wt. of Dry Soil **(M_s)**	50.44		
Wt. of Calibrated Pycnometer, dry **(M_p)**	133.50		
Wt. of Pycnometer and Water at Test Temp **($M_{pw,t}$)**	631.59		
Vol. of Pycnometer, ml **(V_p)**	500		
Density of Water at Test Temp **($P_{w,t}$)**	0.99742		
Wt. of Pycnometer, Water and Soil **($M_{pws,t}$)**	662.94		
Specific Gravity, $G_t = M_s/(M_{pw,t}-(M_{pws,t}-M_s))$	2.642		
Specific Gravity @ 20ºC=K*G_t	2.64		

Sample Obtained By: Geotechnics Date: 2/3/2021

Tested By Technician: NAS Date: 2/17/2021

Checked By Project Engineer: BJS Date: 3/26/2021

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PERMEABILITY TEST REPORT
ASTM D 5084-10

PROJECT No. **21-1004**

PROJECT **Duck Creek Power Station GMF** LOCATION
CLIENT **Hanson Professional Services, Inc.** SAMPLING DATE **2/3/2021**

SAMPLE DESCRIPTION **Lean Clay (CL/CH), Light Brown mottled Light Gray, Reddish Brown Oxidation, Silty, Moist**

LIQUID LIMIT PLASTIC LIMIT P.I.

BORING NO. **G-54C** SAMPLE NO. **14-16**

SAMPLE TYPE **ST** DEPTH **14-16 ft.**

SPECIFIC GRAVITY, Gs TEST METHOD **ASTM D 5084-10**

INITIAL WATER CONTENT **22.2%** INITIAL DRY DENSITY **104.0 P.C.F.**

FINAL WATER CONTENT **23.9%** FINAL DRY DENSITY **103.0 P.C.F.**

t_1	t_2	a	L	A	t	head	tail	h_w	h_a	dt/dh	h_a+h_w	k	k_{20}
14:18		0.200	7.818	42.077		1.49	8.10	33.050	210.9		243.950		
14:18	15:10	0.200	7.818	42.077	3120	1.78	7.80	30.100	210.9	1.03	241.000	7.25E-08	7.35E-08
15:10	15:44	0.200	7.818	42.077	2040	1.96	7.62	28.300	210.9	1.00	239.200	6.83E-08	6.93E-08
15:44	16:36	0.200	7.818	42.077	3120	2.23	7.35	25.600	210.9	1.00	236.500	6.76E-08	6.86E-08
													7.06E-08

COEFFICIENT OF VERTICAL PERMEABILITY
K_{20} = 7.06 E-08 CM/SEC

REMARKS: Testing Completed 2/17/2021

TESTED BY: **BJS**

COMPUTED BY: **BJS**

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PERMEABILITY TEST REPORT
ASTM D 5084-10

PROJECT No. **21-1004**

PROJECT **Duck Creek Power Station GMF** LOCATION
CLIENT **Hanson Professional Services, Inc.** SAMPLING DATE **2/4/2021**

SAMPLE DESCRIPTION **Sandy Lean Clay (CL), Light Brown mottled Light Gray, Reddish Brown Oxidation, Silty, Moist**

LIQUID LIMIT PLASTIC LIMIT P.I.

BORING NO. **G-54C** SAMPLE NO. **32-34**

SAMPLE TYPE **ST** DEPTH **32-34 ft.**

SPECIFIC GRAVITY, Gs TEST METHOD **ASTM D 5084-10**

INITIAL WATER CONTENT **21.9%** INITIAL DRY DENSITY **105.1 P.C.F.**

FINAL WATER CONTENT **21.4%** FINAL DRY DENSITY **106.7 P.C.F.**

t_1	t_2	a	L	A	t	head	tail	h_w	h_a	dt/dh	h_a+h_w	k	k_{20}
8:33		0.200	7.523	40.438		3.65	5.72	10.350	210.9		221.250		
8:33	10:02	0.200	7.523	40.438	5340	7.87	1.44	-32.150	210.9	1.01	178.750	7.43E-07	7.54E-07
10:02	10:25	0.200	7.523	40.438	1380	8.80	0.52	-41.400	210.9	0.99	169.500	7.16E-07	7.27E-07
10:25	10:36	0.200	7.523	40.438	660	9.22	0.08	-45.700	210.9	1.05	165.200	7.24E-07	7.35E-07
													7.47E-07

COEFFICIENT OF VERTICAL PERMEABILITY
K_{20} = 7.47 E-07 CM/SEC

REMARKS: Testing Completed 2/19/2021

TESTED BY: **BJS**

COMPUTED BY: **BJS**

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PERMEABILITY TEST REPORT
ASTM D 5084-10

PROJECT No. **21-1004**

PROJECT **Duck Creek Power Station GMF** LOCATION
CLIENT **Hanson Professional Services, Inc.** SAMPLING DATE **2/4/2021**

SAMPLE DESCRIPTION **Silty Sand (SM), Light Gray to Gray, Clayey, With Sandy Lean Clay Seams and Sand Pockets, Moist**

LIQUID LIMIT PLASTIC LIMIT P.I.

BORING NO. **G-54C** SAMPLE NO. **44-46**

SAMPLE TYPE **ST** DEPTH **44-46 ft.**

SPECIFIC GRAVITY, Gs TEST METHOD **ASTM D 5084-10**

INITIAL WATER CONTENT **12.2%** INITIAL DRY DENSITY **126.1 P.C.F.**

FINAL WATER CONTENT **12.3%** FINAL DRY DENSITY **127.4 P.C.F.**

t_1	t_2	a	L	A	t	head	tail	h_w	h_a	dt/dh	h_a+h_w	k	k_{20}
9:12		0.200	7.752	41.447		7.21	2.54	-23.350	210.9		187.550		
9:12	9:15	0.200	7.752	41.447	180	8.15	1.58	-32.850	210.9	1.02	178.050	5.40E-06	5.48E-06
9:15	9:18	0.200	7.752	41.447	180	9.02	0.69	-41.650	210.9	1.02	169.250	5.27E-06	5.35E-06
9:18	9:20	0.200	7.752	41.447	120	9.58	0.13	-47.250	210.9	1.00	163.650	5.24E-06	5.32E-06
													5.39E-06

COEFFICIENT OF VERTICAL PERMEABILITY
K_{20} = 5.39 E-06 CM/SEC

REMARKS: Testing Completed 2/22/2021

TESTED BY: **BJS**

COMPUTED BY: **BJS**

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PERMEABILITY TEST REPORT
ASTM D 5084-10

PROJECT No. **21-1004**

PROJECT **Duck Creek Power Station GMF** LOCATION
CLIENT **Hanson Professional Services, Inc.** SAMPLING DATE **2/4/2021**

SAMPLE DESCRIPTION **Sandy Lean Clay (CL), Light Gray, Silty, With Fat Clay Seam, Moist**

LIQUID LIMIT PLASTIC LIMIT P.I.

BORING NO. **G-54C** SAMPLE NO. **76-78**

SAMPLE TYPE **ST** DEPTH **76-78 ft.**

SPECIFIC GRAVITY, Gs TEST METHOD **ASTM D 5084-10**

INITIAL WATER CONTENT **12.6%** INITIAL DRY DENSITY **123.2 P.C.F.**

FINAL WATER CONTENT **13.9%** FINAL DRY DENSITY **122.0 P.C.F.**

t_1	t_2	a	L	A	t	head	tail	h_w	h_a	dt/dh	h_a+h_w	k	k_{20}
7:13		0.200	7.660	41.592		5.75	3.85	-9.500	210.9		201.400		
7:13	9:36	0.200	7.660	41.592	8580	6.13	3.48	-13.250	210.9	0.97	197.650	4.03E-08	4.09E-08
9:36	11:26	0.200	7.660	41.592	6600	6.41	3.20	-16.050	210.9	1.00	194.850	3.98E-08	4.04E-08
11:26	11:59	0.200	7.660	41.592	1980	6.50	3.11	-16.950	210.9	1.00	193.950	4.31E-08	4.37E-08
													4.11E-08

COEFFICIENT OF VERTICAL PERMEABILITY
K_{20} = 4.11 E-08 CM/SEC

REMARKS: Testing Completed 2/24/2021

TESTED BY: **BJS**

COMPUTED BY: **BJS**

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PERMEABILITY TEST REPORT
ASTM D 5084-10

PROJECT No. **21-1004**

PROJECT **Duck Creek Power Station GMF** LOCATION
CLIENT **Hanson Professional Services, Inc.** SAMPLING DATE **2/2/2021**

SAMPLE DESCRIPTION **Silt (ML), Yellow Brown mottled Light Brown/Light Gray, Black Oxidation, Clayey, Moist**

LIQUID LIMIT PLASTIC LIMIT P.I.

BORING NO. **SB-50** SAMPLE NO. **10-12**

SAMPLE TYPE **ST** DEPTH **10-12 ft.**

SPECIFIC GRAVITY, Gs TEST METHOD **ASTM D 5084-10**

INITIAL WATER CONTENT **25.9%** INITIAL DRY DENSITY **98.0 P.C.F.**

FINAL WATER CONTENT **23.4%** FINAL DRY DENSITY **106.1 P.C.F.**

t_1	t_2	a	L	A	t	head	tail	h_w	h_a	dt/dh	h_a+h_w	k	k_{20}
8:44		0.200	7.112	39.443		2.88	6.86	19.900	140.6		160.500		
8:44	10:49	0.200	7.112	39.443	7500	6.52	3.15	-16.850	140.6	1.02	123.750	6.25E-07	6.35E-07
10:49	11:56	0.200	7.112	39.443	4020	8.14	1.52	-33.100	140.6	1.01	107.500	6.31E-07	6.41E-07
11:56	13:09	0.200	7.112	39.443	4380	9.63	0.02	-48.050	140.6	1.01	92.550	6.16E-07	6.26E-07
													6.34E-07

COEFFICIENT OF VERTICAL PERMEABILITY
K_{20} = 6.34 E-07 CM/SEC

REMARKS: Testing Completed 2/15/2021

TESTED BY: **BJS**

COMPUTED BY: **BJS**

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PERMEABILITY TEST REPORT
ASTM D 5084-10

PROJECT No. **21-1004**

PROJECT **Duck Creek Power Station GMF** LOCATION
CLIENT **Hanson Professional Services, Inc.** SAMPLING DATE **2/2/2021**

SAMPLE DESCRIPTION **Lean Clay with Sand (CL), Light Gray/Gray mottled Yellow Brown, Silty, Moist**

LIQUID LIMIT PLASTIC LIMIT P.I.

BORING NO. **SB-50** SAMPLE NO. **22-24**

SAMPLE TYPE **ST** DEPTH **22-24 ft.**

SPECIFIC GRAVITY, Gs TEST METHOD **ASTM D 5084-10**

INITIAL WATER CONTENT **21.8%** INITIAL DRY DENSITY **106.3 P.C.F.**

FINAL WATER CONTENT **21.7%** FINAL DRY DENSITY **106.2 P.C.F.**

t_1	t_2	a	L	A	t	head	tail	h_w	h_a	dt/dh	h_a+h_w	k	k_{20}
9:25		0.200	7.391	41.931		1.68	7.91	31.150	210.9		242.050		
9:25	10:45	0.200	7.391	41.931	4800	3.30	6.23	14.650	210.9	1.04	225.550	2.59E-07	2.63E-07
10:45	12:50	0.200	7.391	41.931	7500	5.58	3.88	-8.500	210.9	1.03	202.400	2.55E-07	2.58E-07
12:50	13:54	0.200	7.391	41.931	3840	6.64	2.80	-19.200	210.9	1.02	191.700	2.49E-07	2.53E-07
													2.59E-07

COEFFICIENT OF VERTICAL PERMEABILITY
K_{20} = 2.59 E-07 CM/SEC

REMARKS: Testing Completed 2/16/2021

TESTED BY: **BJS**

COMPUTED BY: **BJS**

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PERMEABILITY TEST REPORT
ASTM D 5084-10

PROJECT No. **21-1004**

PROJECT **Duck Creek Power Station GMF** LOCATION
CLIENT **Hanson Professional Services, Inc.** SAMPLING DATE **2/3/2021**

SAMPLE DESCRIPTION **Fill: Lean Clay (CL), Light Brown mottled Gray, Silty, Trace Sand, Moist**

LIQUID LIMIT PLASTIC LIMIT P.I.

BORING NO. **SB-62** SAMPLE NO. **12-14**

SAMPLE TYPE **ST** DEPTH **12-14 ft.**

SPECIFIC GRAVITY, Gs TEST METHOD **ASTM D 5084-10**

INITIAL WATER CONTENT **21.1%** INITIAL DRY DENSITY **105.5 P.C.F.**

FINAL WATER CONTENT **24.5%** FINAL DRY DENSITY **102.7 P.C.F.**

t_1	t_2	a	L	A	t	head	tail	h_w	h_a	dt/dh	h_a+h_w	k	k_{20}
15:45		0.200	7.264	42.028		5.07	4.80	-1.350	210.9		209.550		
15:45	16:53	0.200	7.264	42.028	4080	6.01	3.83	-10.900	210.9	1.03	200.000	1.98E-07	2.01E-07
16:53	17:27	0.200	7.264	42.028	2040	6.44	3.40	-15.200	210.9	1.00	195.700	1.84E-07	1.87E-07
17:27	17:53	0.200	7.264	42.028	1560	6.76	3.08	-18.400	210.9	1.00	192.500	1.83E-07	1.85E-07
													1.94E-07

COEFFICIENT OF VERTICAL PERMEABILITY
K_{20} = 1.94 E-07 CM/SEC

REMARKS: Testing Completed 3/1/2021

TESTED BY: **BJS**

COMPUTED BY: **BJS**

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PERMEABILITY TEST REPORT
ASTM D 5084-10

PROJECT No. **21-1004**

PROJECT **Duck Creek Power Station GMF** LOCATION
CLIENT **Hanson Professional Services, Inc.** SAMPLING DATE **2/3/2021**

SAMPLE DESCRIPTION **Lean Clay with Sand (CL), Yellow Brown mottled Reddish Brown and Light Brown, Silty, Moist**

LIQUID LIMIT PLASTIC LIMIT P.I.

BORING NO. **SB-62** SAMPLE NO. **26-28**

SAMPLE TYPE **ST** DEPTH **26-28 ft.**

SPECIFIC GRAVITY, Gs TEST METHOD **ASTM D 5084-10**

INITIAL WATER CONTENT **23.2%** INITIAL DRY DENSITY **105.3 P.C.F.**

FINAL WATER CONTENT **21.5%** FINAL DRY DENSITY **108.1 P.C.F.**

t_1	t_2	a	L	A	t	head	tail	h_w	h_a	dt/dh	h_a+h_w	k	k_{20}
14:11		0.200	7.574	41.689		3.25	6.63	16.900	105.5		122.400		
14:11	14:36	0.200	7.574	41.689	1500	5.33	4.54	-3.950	105.5	1.00	101.550	2.26E-06	2.30E-06
14:36	15:11	0.200	7.574	41.689	2100	7.64	2.24	-27.000	105.5	1.00	78.500	2.23E-06	2.26E-06
15:11	15:28	0.200	7.574	41.689	1020	8.59	1.30	-36.450	105.5	0.99	69.050	2.28E-06	2.32E-06
													2.28E-06

COEFFICIENT OF VERTICAL PERMEABILITY
K_{20} = 2.28 E-06 CM/SEC

REMARKS: Testing Completed 2/25/2021

TESTED BY: **BJS**

COMPUTED BY: **BJS**

GEOTECHNICS
Soil & Material Testing
A Division of Klingner

4510 Paris Gravel Road • Hannibal, MO 63401
573.221.7714 • 573.221.7762 (Fax) • www.klingner.com

Quincy, IL • Galesburg, IL • Burlington, IA • Pella, IA • Columbia, MO • Hannibal, MO

Geotechnics Form No. 17-FW

PERMEABILITY TEST REPORT
ASTM D 5084-10

PROJECT No. **21-1004**

PROJECT **Duck Creek Power Station GMF** LOCATION
CLIENT **Hanson Professional Services, Inc.** SAMPLING DATE **2/3/2021**

SAMPLE DESCRIPTION **Sandy Lean Clay (CL), Light Gray, Silty, With Silt Seam, Moist**

LIQUID LIMIT PLASTIC LIMIT P.I.

BORING NO. **SB-62** SAMPLE NO. **38-40**

SAMPLE TYPE **ST** DEPTH **38-40 ft.**

SPECIFIC GRAVITY, Gs TEST METHOD **ASTM D 5084-10**

INITIAL WATER CONTENT **15.6%** INITIAL DRY DENSITY **118.4 P.C.F.**

FINAL WATER CONTENT **16.4%** FINAL DRY DENSITY **116.5 P.C.F.**

t_1	t_2	a	L	A	t	head	tail	h_w	h_a	dt/dh	h_a+h_w	k	k_{20}
15:45		0.200	7.620	41.834		4.33	5.50	5.850	210.9		216.750		
15:45	16:03	0.200	7.620	41.834	1080	5.68	4.14	-7.700	210.9	1.01	203.200	1.09E-06	1.11E-06
16:03	16:26	0.200	7.620	41.834	1380	7.27	2.54	-23.650	210.9	1.01	187.250	1.08E-06	1.10E-06
16:26	16:44	0.200	7.620	41.834	1080	8.41	1.40	-35.050	210.9	1.00	175.850	1.06E-06	1.08E-06
													1.09E-06

COEFFICIENT OF VERTICAL PERMEABILITY
K_{20} = 1.09 E-06 CM/SEC

REMARKS: Testing Completed 2/26/2021

TESTED BY: **BJS**

COMPUTED BY: **BJS**

GEOTECHNICS
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573.221.7714 • 573.221.7762 (Fax) • www.klingner.com

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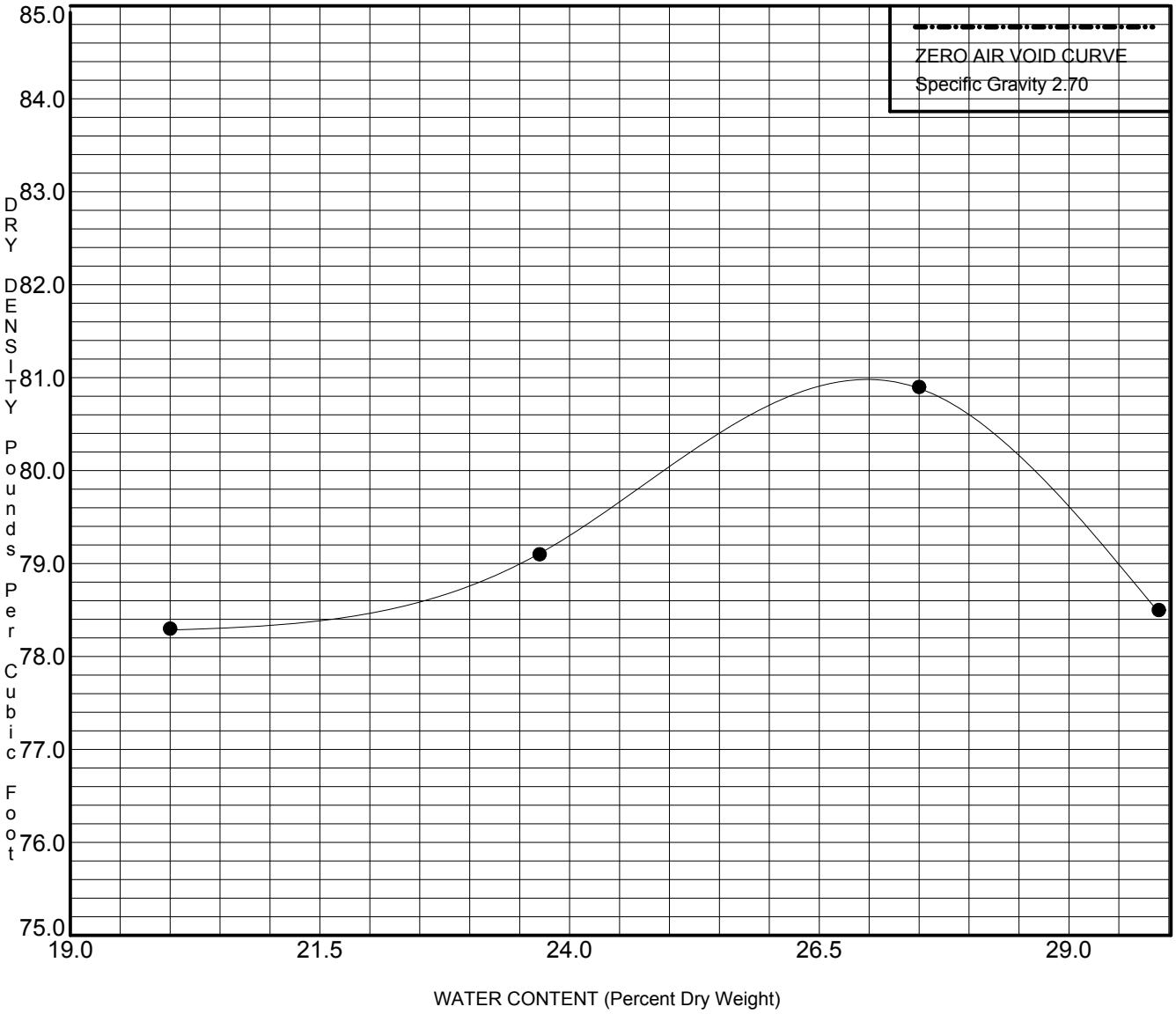


SPECIMEN IDENTIFICATION	CLASSIFICATION
Gypsum	Gypsum

MOISTURE/DENSITY RELATIONSHIP	
Standard ASTM D698/AASHTO T99	
Modified ASTM D1557/AASHTO T180	
Maximum Dry Density (PCF)	**81.0**
Optimum Water Content (%)	**27.0**

NOTES :

PROJECT **Duck Creek Bottom Ash Basins** JOB NO. **21-026**

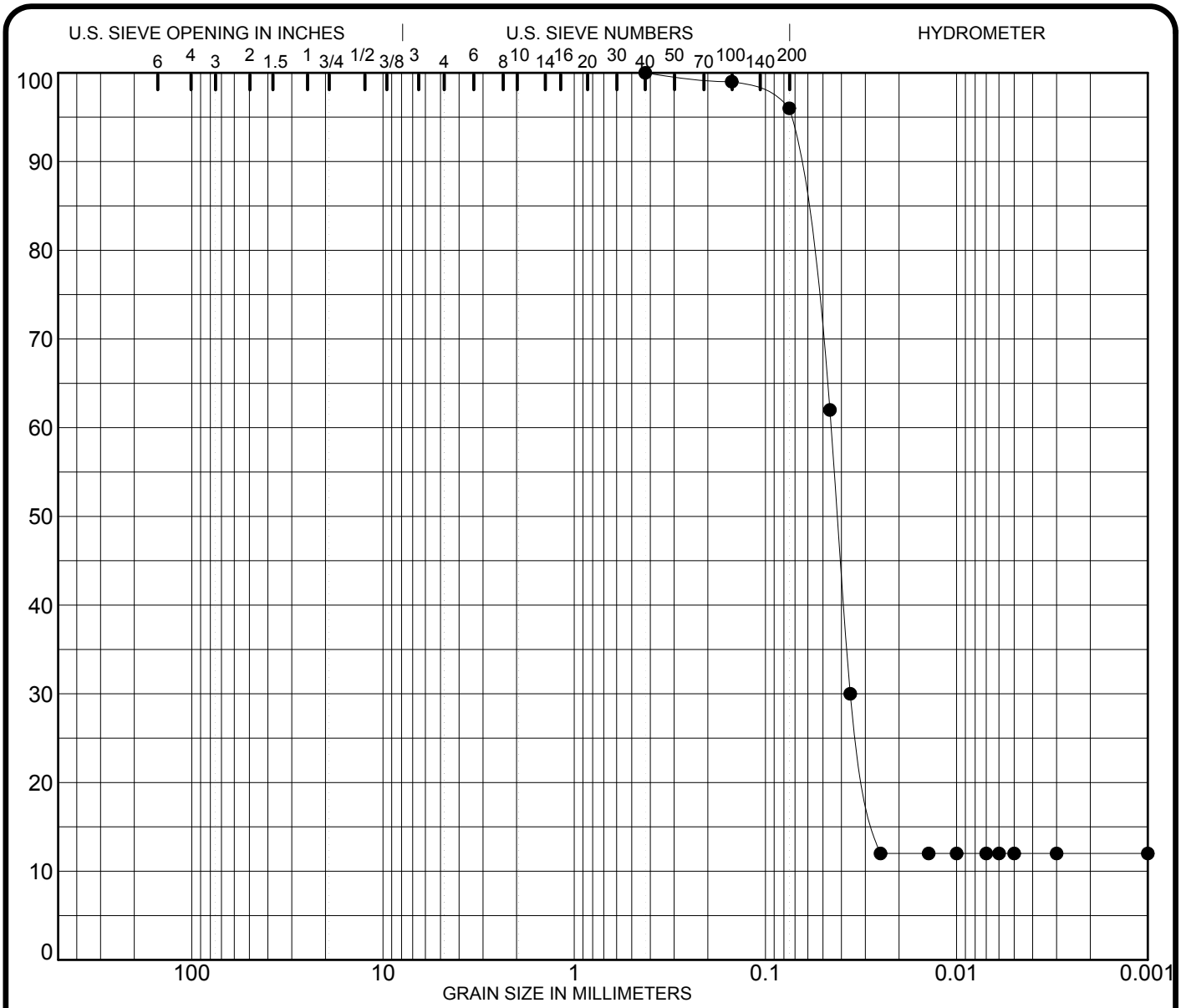
LOCATION **Fulton County, Illinois** DATE **March 18, 2021**

Gypsum

MOISTURE-DENSITY RELATIONSHIP

Ramsey Geotechnical Engineering

Bloomington, IL 61701



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SPECIMEN IDENTIFICATION	SIEVE	% PASS	CLASSIFICATION			
Gypsum	3/8	100.0	Gypsum			
	#4	100.0				
	#8	100.0				
	#10	100.0	%GRAVEL	%SAND	%SILT	%CLAY
NOTES:	# 16	100.0	0	4		
Specific Gravity - 2.31	# 30	100.0				
	# 40	100.0	MC%	γ_{dry} (pcf)	LL	PL	PI
	# 50		32.5				
	# 80					
	# 100	99.0	Density/Moisture Relationship: Standard			
	# 200	96.0	Max PCF	81.0	Opt. WC%	27.0

PROJECT **Duck Creek Bottom Ash Basins - Fulton County, Illinois**

JOB NO. **21-026**

DATE March 18, 2021

Gypsum

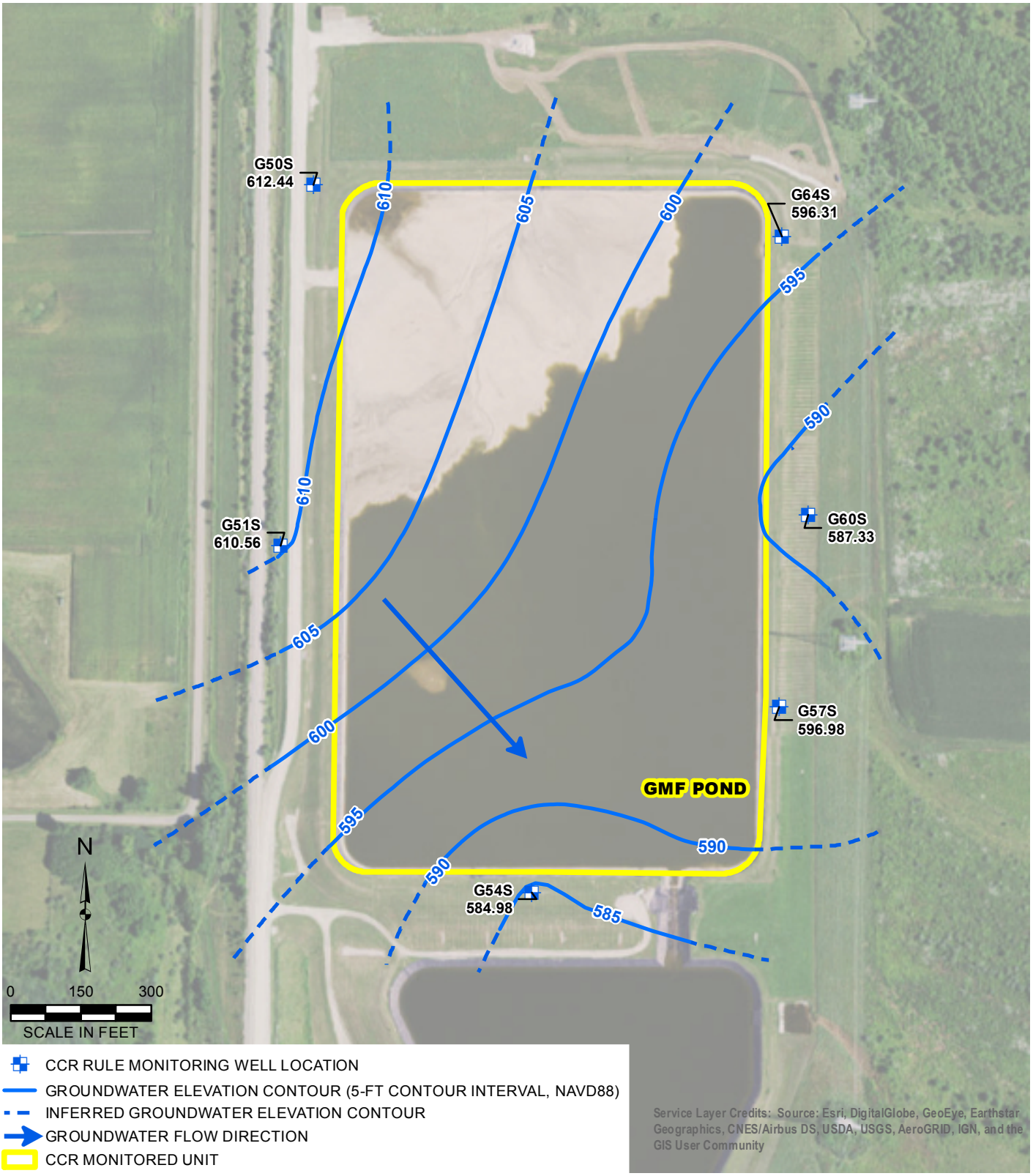
SOIL DATA SHEET

Ramsey Geotechnical Engineering

Bloomington, IL 61701

APPENDIX D
GROUNDWATER CONTOUR MAPS AND ELEVATIONS

GROUNDWATER CONTOUR MAPS



DRAWN BY/DATE:
SDS 1/23/17
REVIEWED BY/DATE:
ANS 1/25/17
APPROVED BY/DATE:
JJW 2/7/17

DUCK CREEK GMF POND (UNIT ID: 203)
UPPERMOST AQUIFER UNIT
GROUNDWATER ELEVATION CONTOUR MAP
ROUND 1: DECEMBER 2, 2015

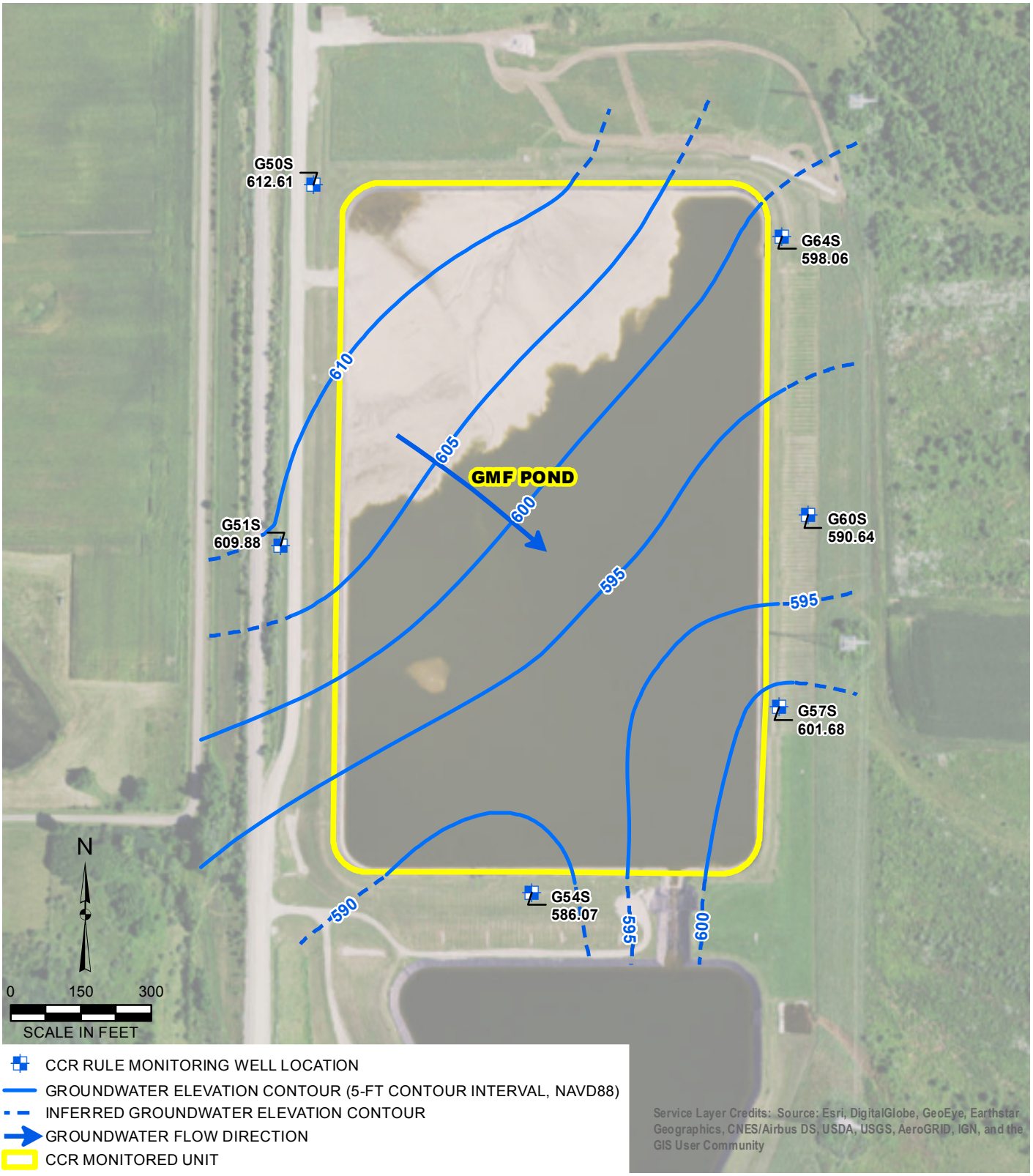
DYNEGY CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

PROJECT NO: 2285

FIGURE NO: 1

Natural Resource Technology
AN OBG COMPANY

Y:\Mapping\Projects\22\2285\MXD\GW_Contours\Round_01\R1_DuckCreekGMFP_GW_Contours.mxd Author: sstolz Date/Time: 3/2/2017, 2:44:52 PM



DRAWN BY/DATE:
SDS 1/23/17
REVIEWED BY/DATE:
ANS 1/25/17
APPROVED BY/DATE:
JJW 2/8/17

DUCK CREEK GMF POND (UNIT ID: 203)
UPPERMOST AQUIFER UNIT
GROUNDWATER ELEVATION CONTOUR MAP
ROUND 2: JANUARY 25, 2016

DYNEGY CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

PROJECT NO: 2285

FIGURE NO: 1

Natural Resource Technology
AN OBG COMPANY

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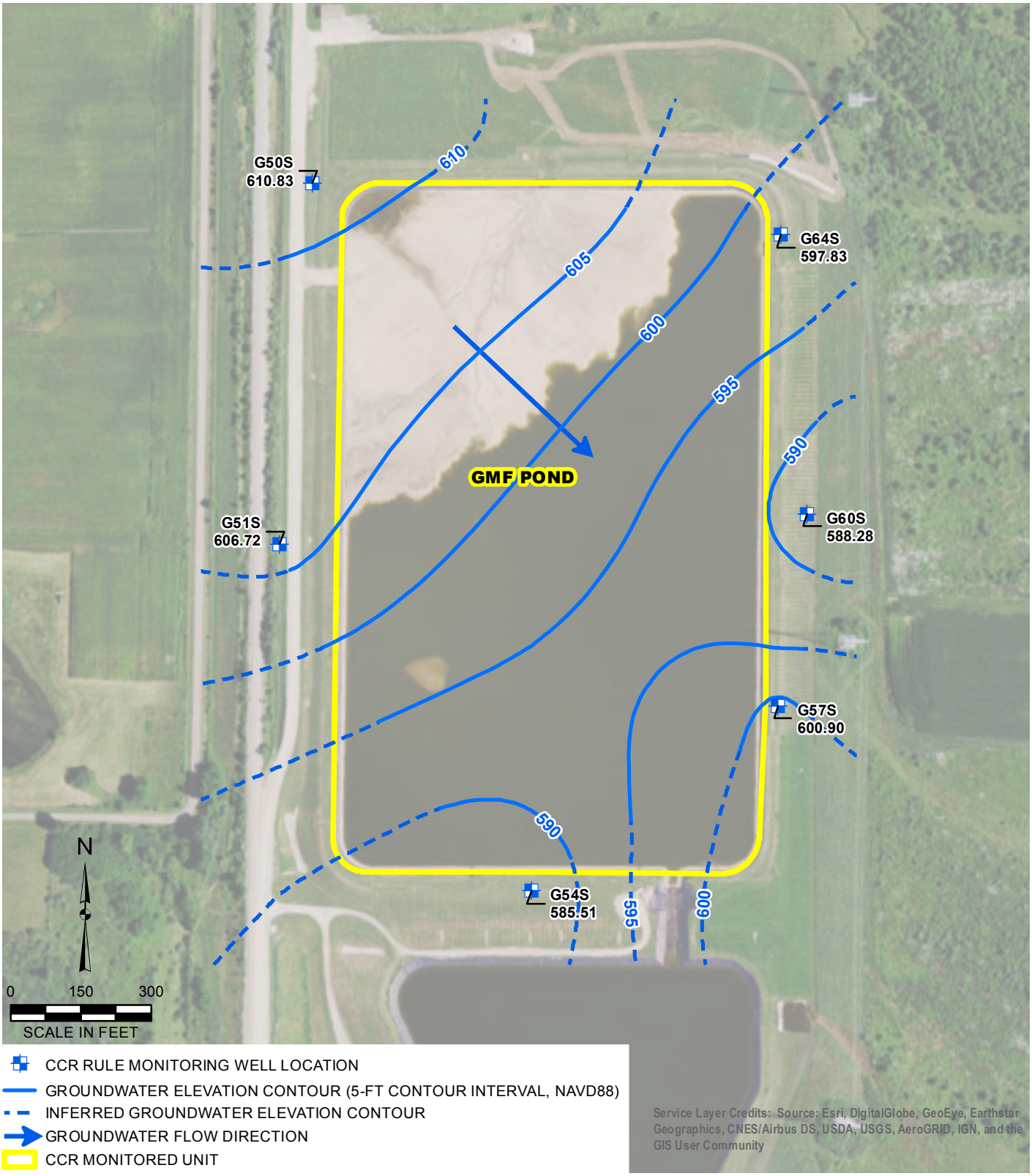

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REVIEWED BY/DATE:
ANS 1/25/17
APPROVED BY/DATE:
JJW 2/8/17

DUCK CREEK GMF POND (UNIT ID: 203)
UPPERMOST AQUIFER UNIT
GROUNDWATER ELEVATION CONTOUR MAP
ROUND 3: APRIL 18, 2016

DYNEGY CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

PROJECT NO: 2285

FIGURE NO: 1

Natural Resource Technology
AN OBG COMPANY

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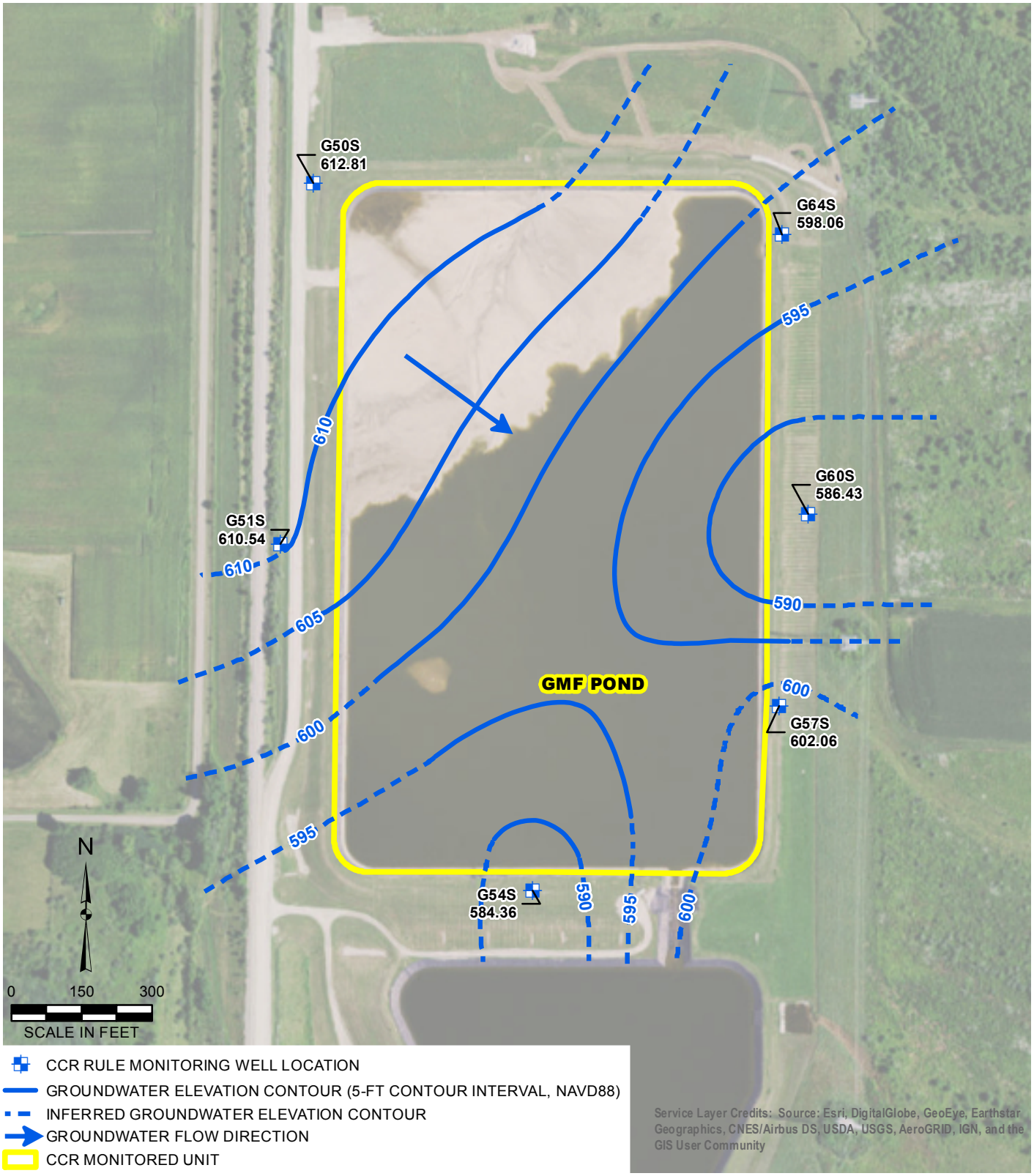

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REVIEWED BY/DATE:
ANS 1/25/17
APPROVED BY/DATE:
JJW 2/8/17

DUCK CREEK GMF POND (UNIT ID: 203)
UPPERMOST AQUIFER UNIT
GROUNDWATER ELEVATION CONTOUR MAP
ROUND 4: AUGUST 9, 2016

DYNEGY CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

PROJECT NO: 2285

FIGURE NO: 1

Natural Resource Technology
AN OBG COMPANY

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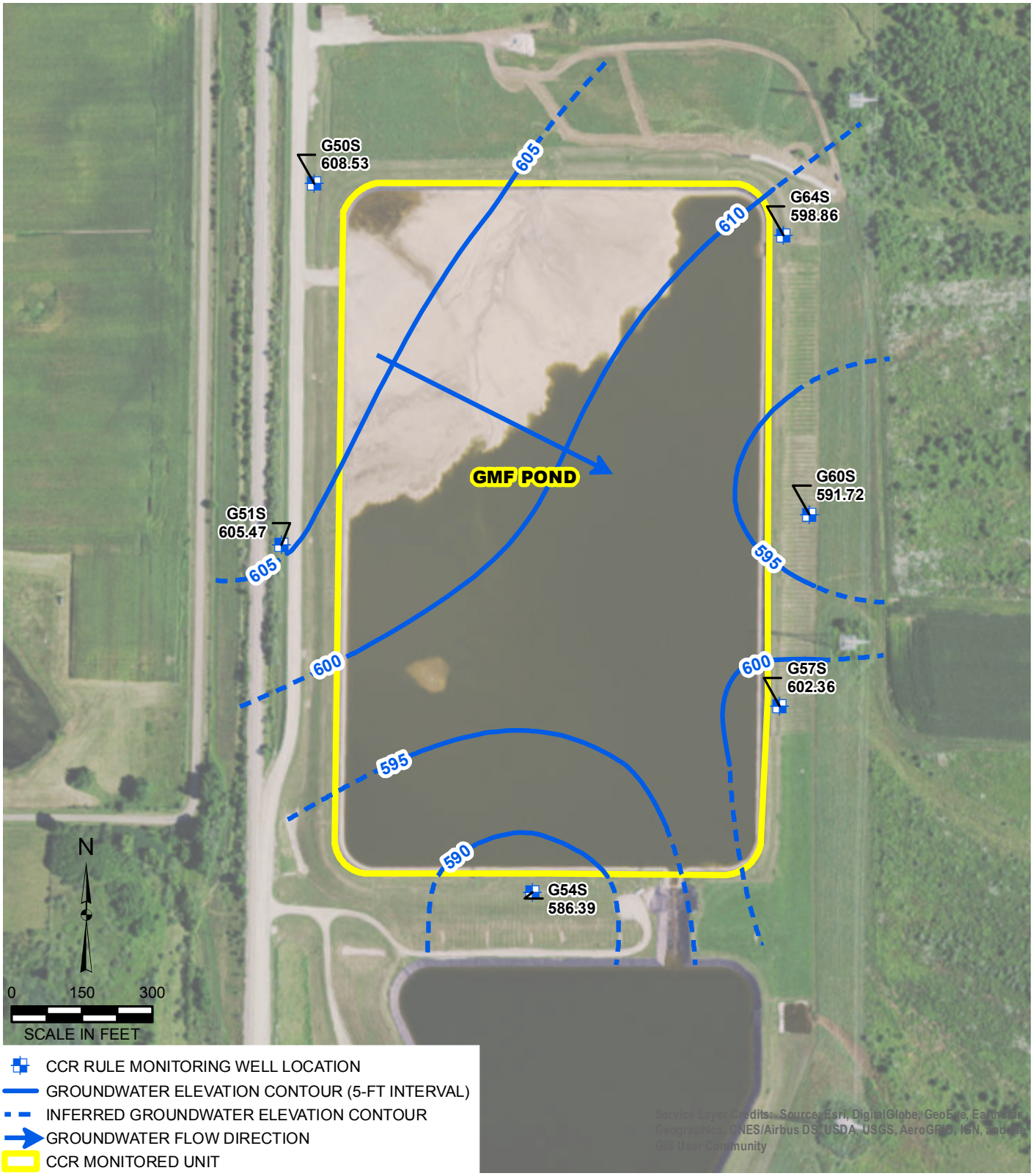

DRAWN BY/DATE:
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REVIEWED BY/DATE:
ANS 3/6/17
APPROVED BY/DATE:
JJW 9/1/17

DUCK CREEK GMF POND (UNIT ID: 203)
UPPERMOST AQUIFER UNIT
GROUNDWATER ELEVATION CONTOUR MAP
ROUND 5: OCTOBER 14, 2016

DYNEGY CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

PROJECT NO: 2285

FIGURE NO: 1

Natural Resource Technology
AN OBG COMPANY

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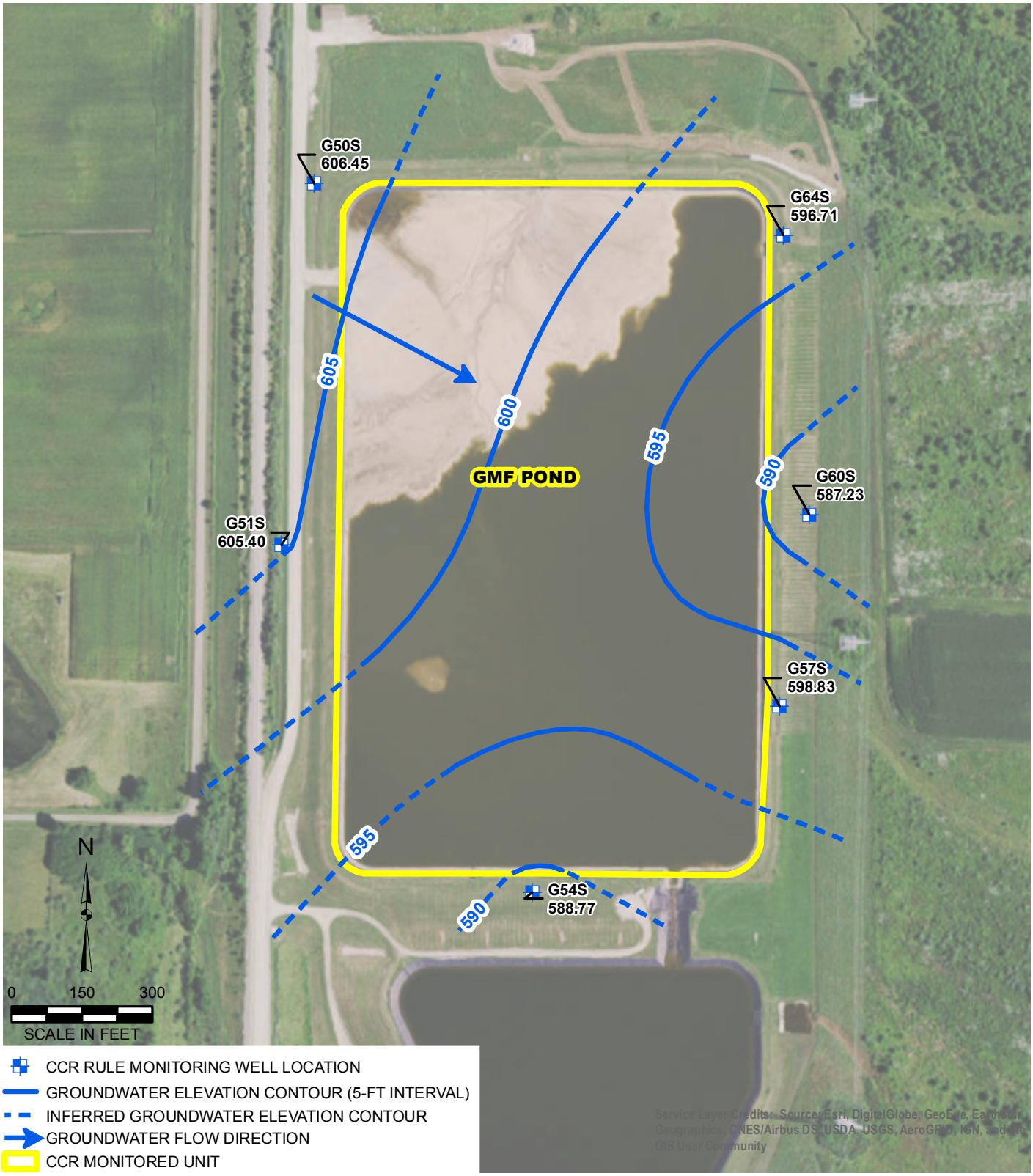

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REVIEWED BY/DATE:
ANS 3/6/17
APPROVED BY/DATE:
JJW 9/1/17

DUCK CREEK GMF POND (UNIT ID: 203)
UPPERMOST AQUIFER UNIT
GROUNDWATER ELEVATION CONTOUR MAP
ROUND 6: JANUARY 9, 2017

DYNEGY CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

PROJECT NO: 2285

FIGURE NO: 1

Natural Resource Technology
AN OBG COMPANY

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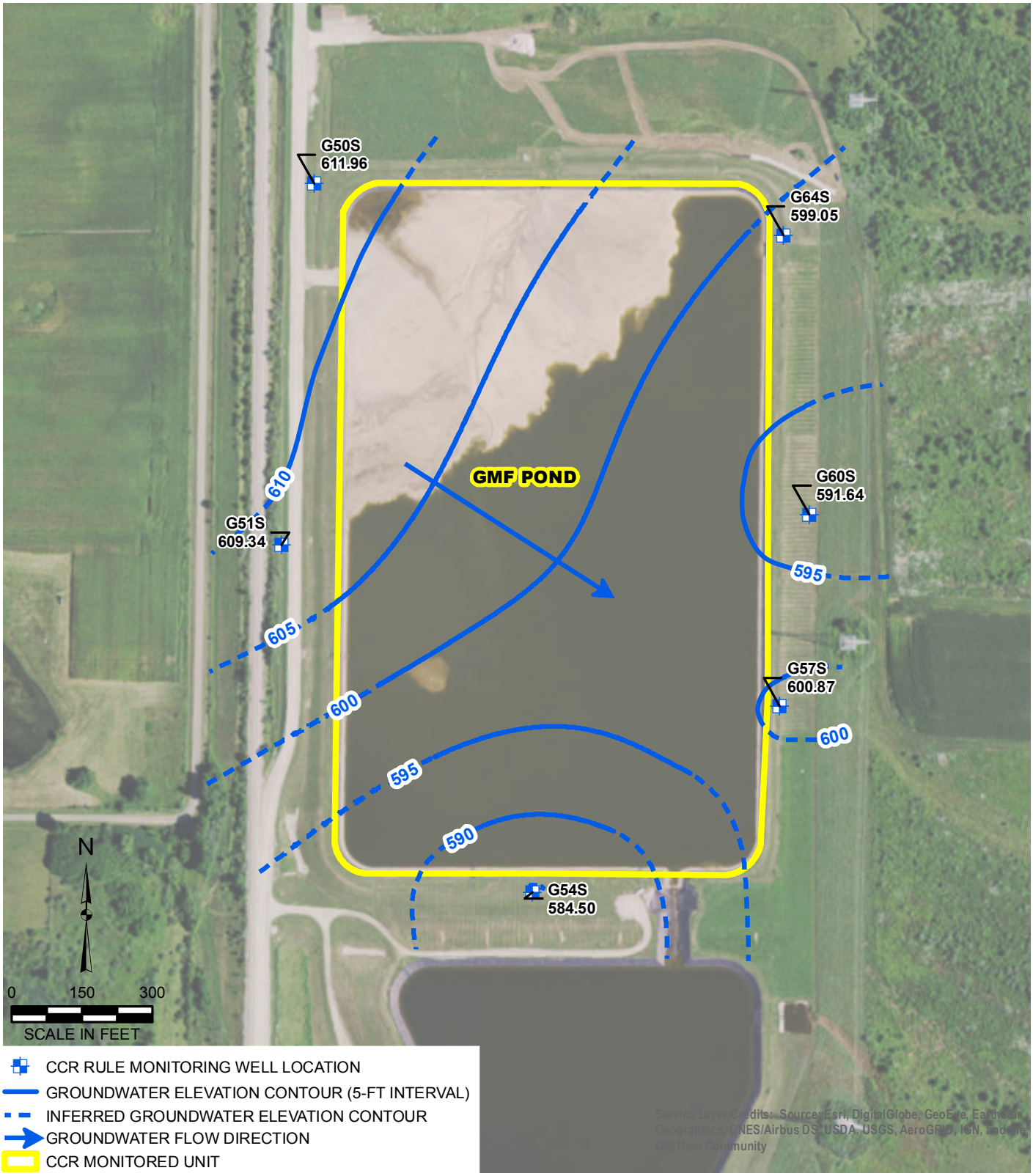

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REVIEWED BY/DATE:
ANS 5/25/17
APPROVED BY/DATE:
JJW 9/1/17

DUCK CREEK GMF POND (UNIT ID: 203)
UPPERMOST AQUIFER UNIT
GROUNDWATER ELEVATION CONTOUR MAP
ROUND 7: APRIL 2, 2017

DYNEGY CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

PROJECT NO: 2285

FIGURE NO: 1

Natural Resource Technology
AN OBG COMPANY

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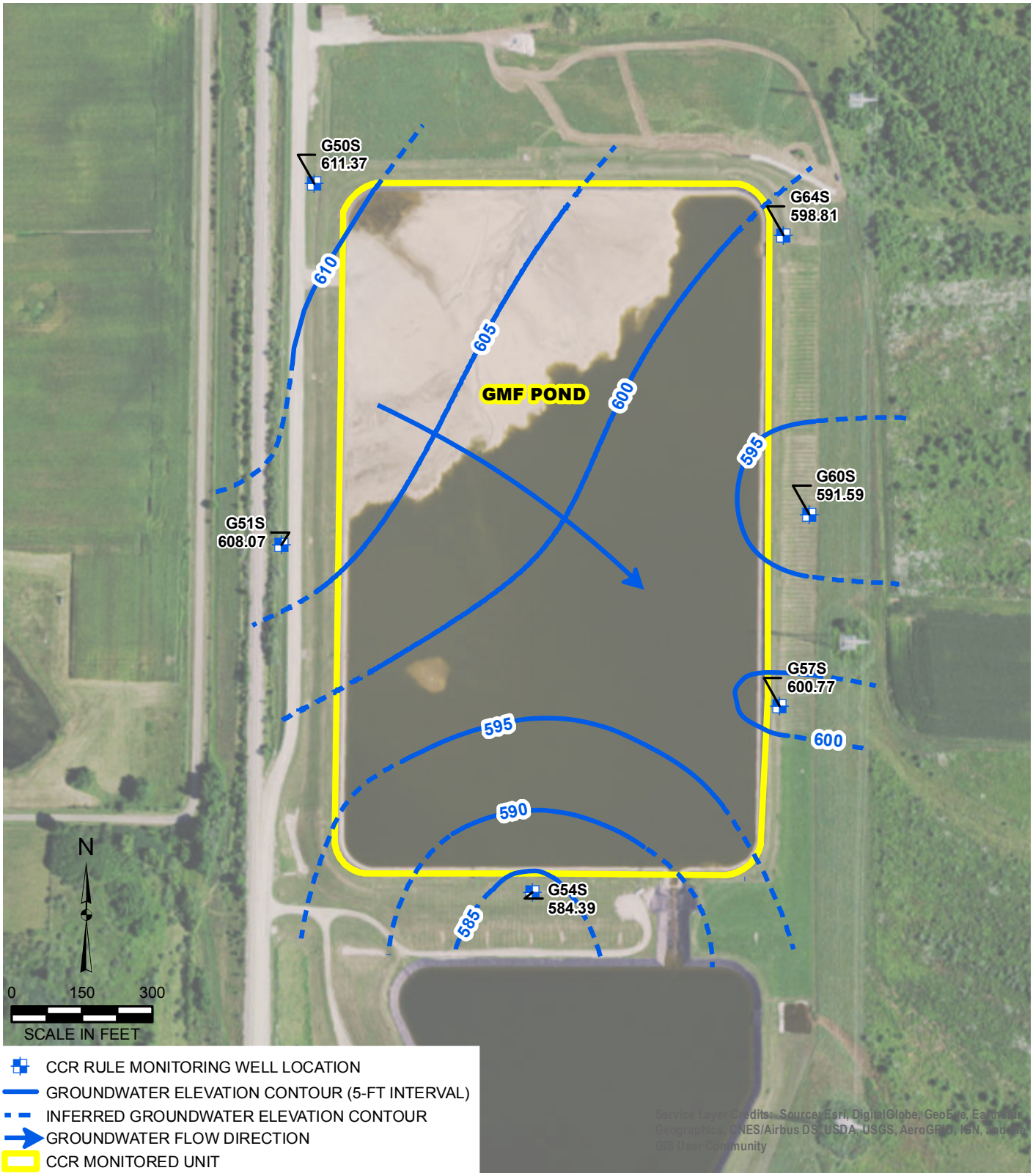

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REVIEWED BY/DATE:
ANS 7/28/17
APPROVED BY/DATE:
JJW 9/1/17

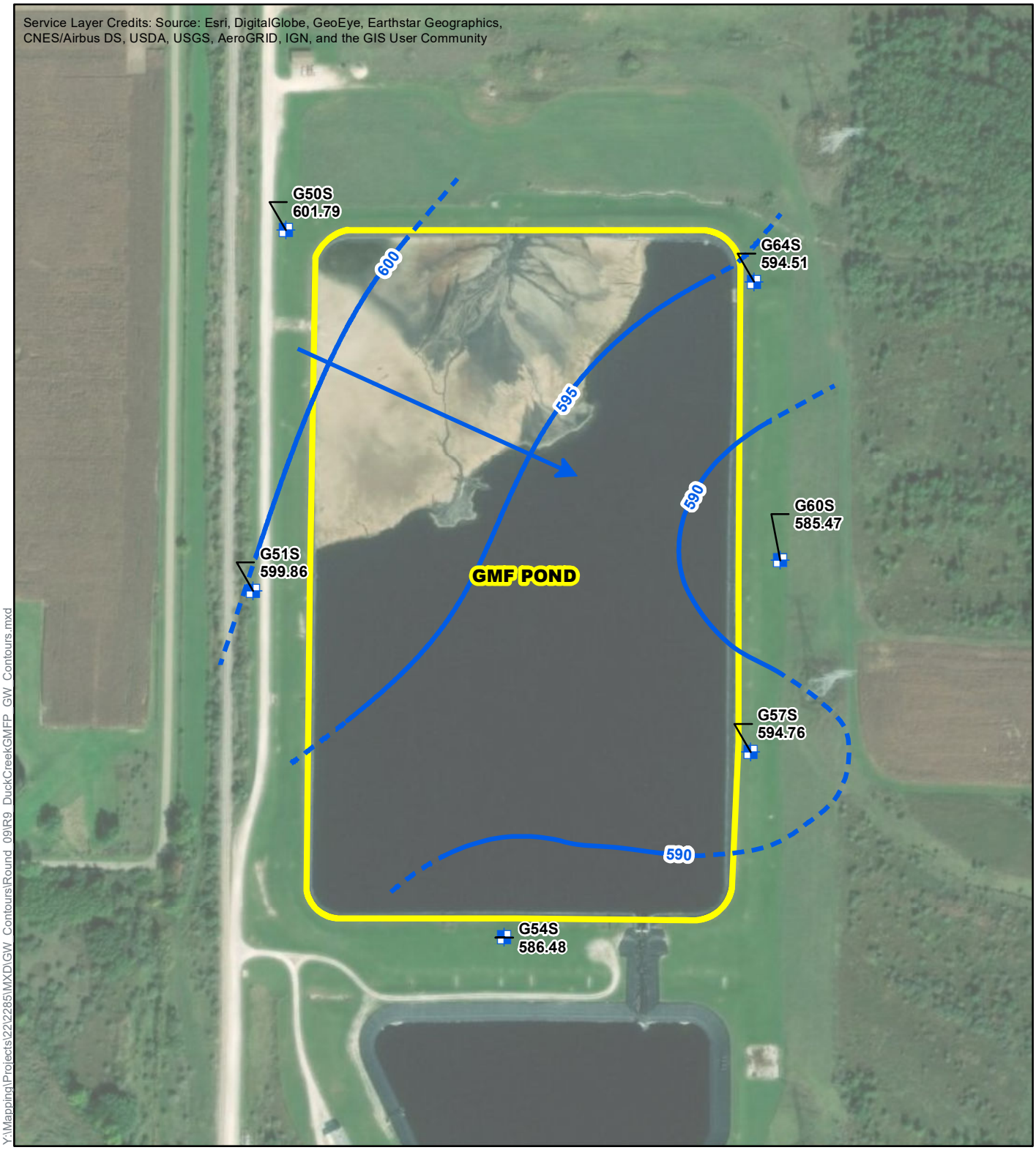
DUCK CREEK GMF POND (UNIT ID: 203)
UPPERMOST AQUIFER UNIT
GROUNDWATER ELEVATION CONTOUR MAP
ROUND 8: JUNE 28, 2017

DYNEGY CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

PROJECT NO: 2285

FIGURE NO: 1

Natural Resource Technology
AN OBG COMPANY



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CCR RULE MONITORING WELL LOCATION

GROUNDWATER ELEVATION CONTOUR (5-FT CONTOUR INTERVAL, NAVD88)

INFERRED GROUNDWATER ELEVATION CONTOUR

GROUNDWATER FLOW DIRECTION

CCR MONITORED UNIT

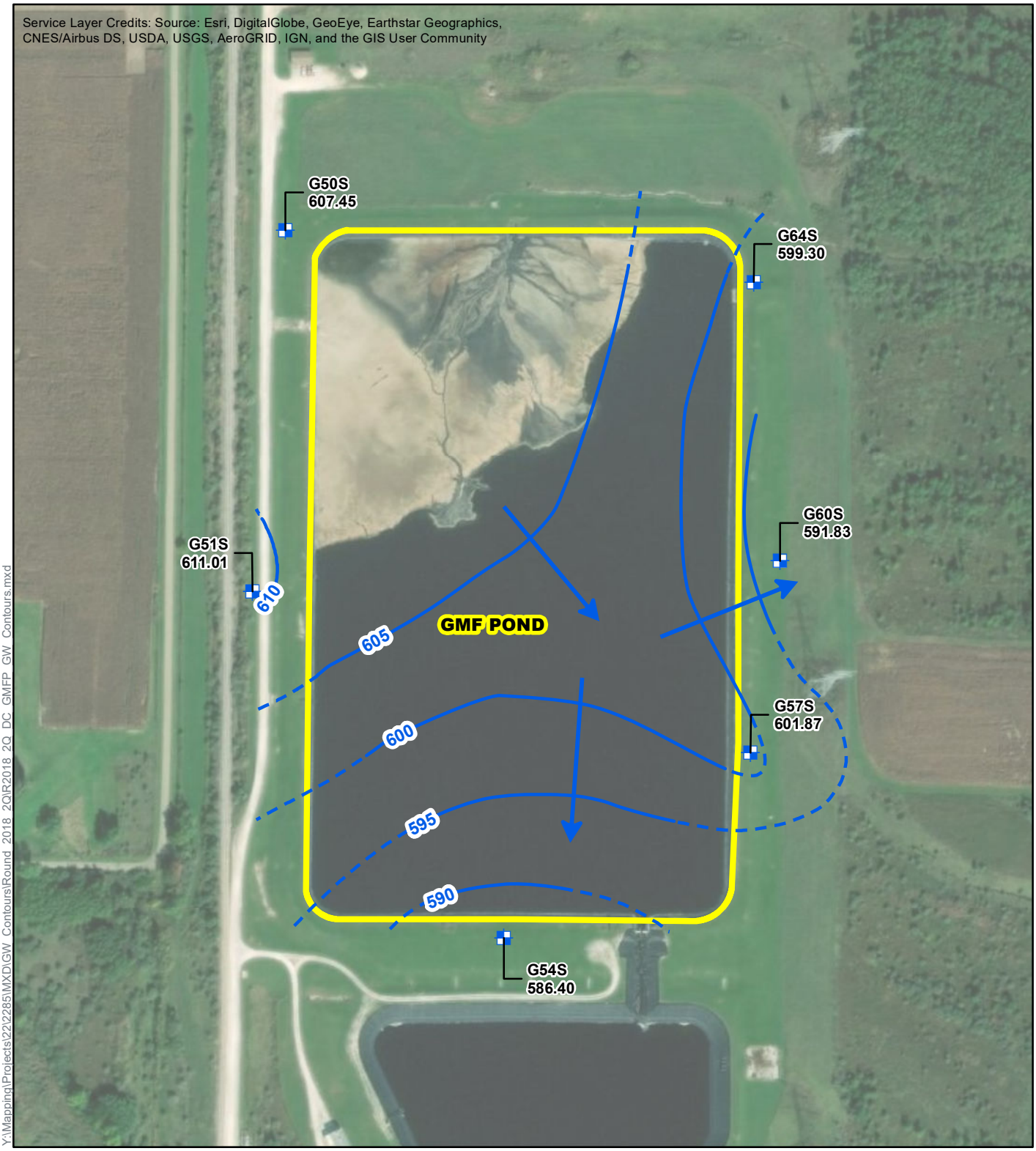
DUCK CREEK GMF POND (UNIT ID: 203)
GROUNDWATER ELEVATION CONTOUR MAP
NOVEMBER 8, 2017

CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

0 62.5 125 250
Feet

N

O'BRIEN & GERE ENGINEERS, INC.



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CCR RULE MONITORING WELL LOCATION

GROUNDWATER ELEVATION CONTOUR (5-FT CONTOUR INTERVAL, NAVD88)

INFERRED GROUNDWATER ELEVATION CONTOUR

GROUNDWATER FLOW DIRECTION

CCR MONITORED UNIT

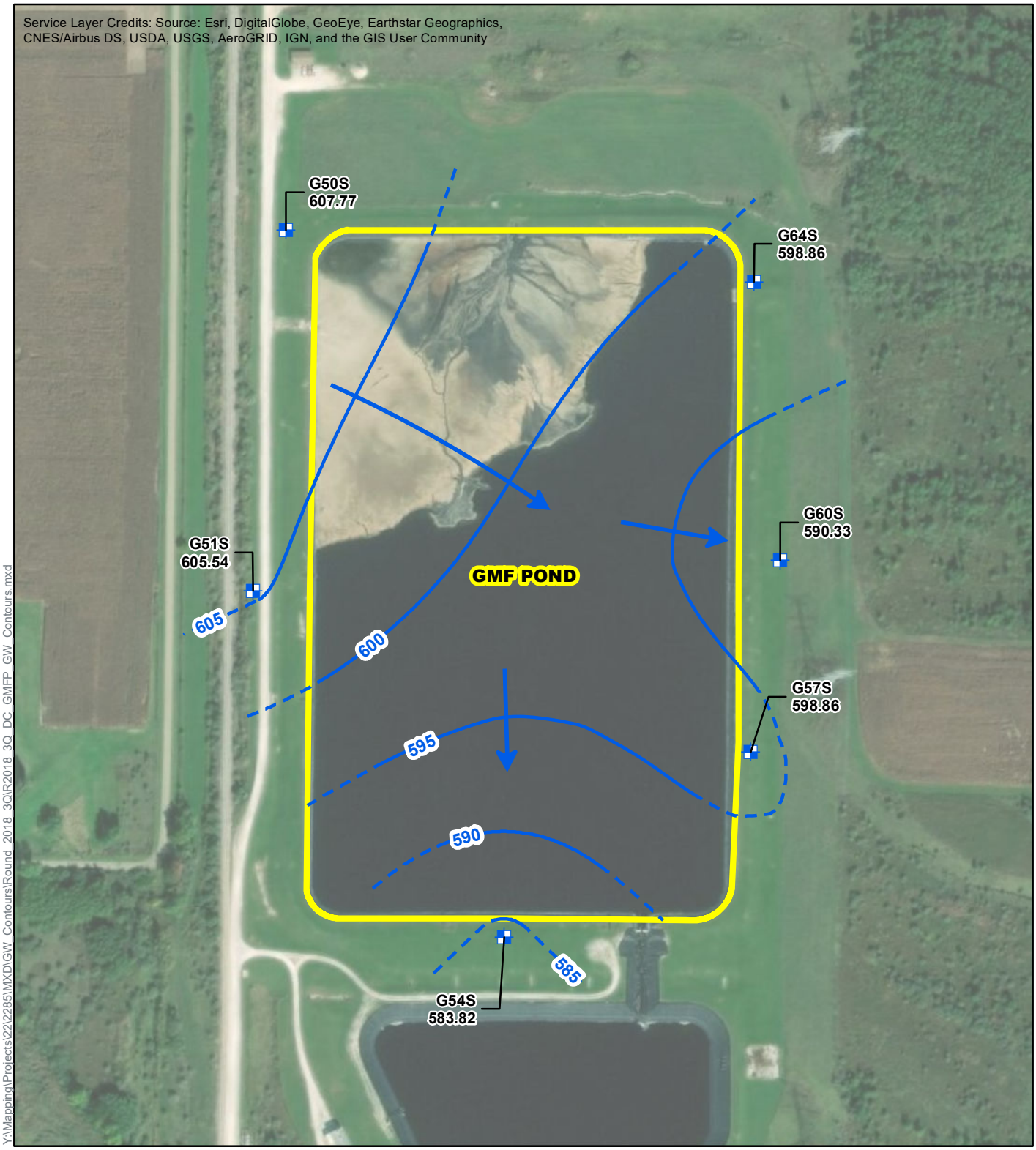
DUCK CREEK GMF POND (UNIT ID: 203)
GROUNDWATER ELEVATION CONTOUR MAP
APRIL 10, 2018

CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

0 62.5 125 250
Feet

N

O'BRIEN & GERE ENGINEERS, INC.



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CCR RULE MONITORING WELL LOCATION

GROUNDWATER ELEVATION CONTOUR (5-FT CONTOUR INTERVAL, NAVD88)

INFERRED GROUNDWATER ELEVATION CONTOUR

GROUNDWATER FLOW DIRECTION

CCR MONITORED UNIT

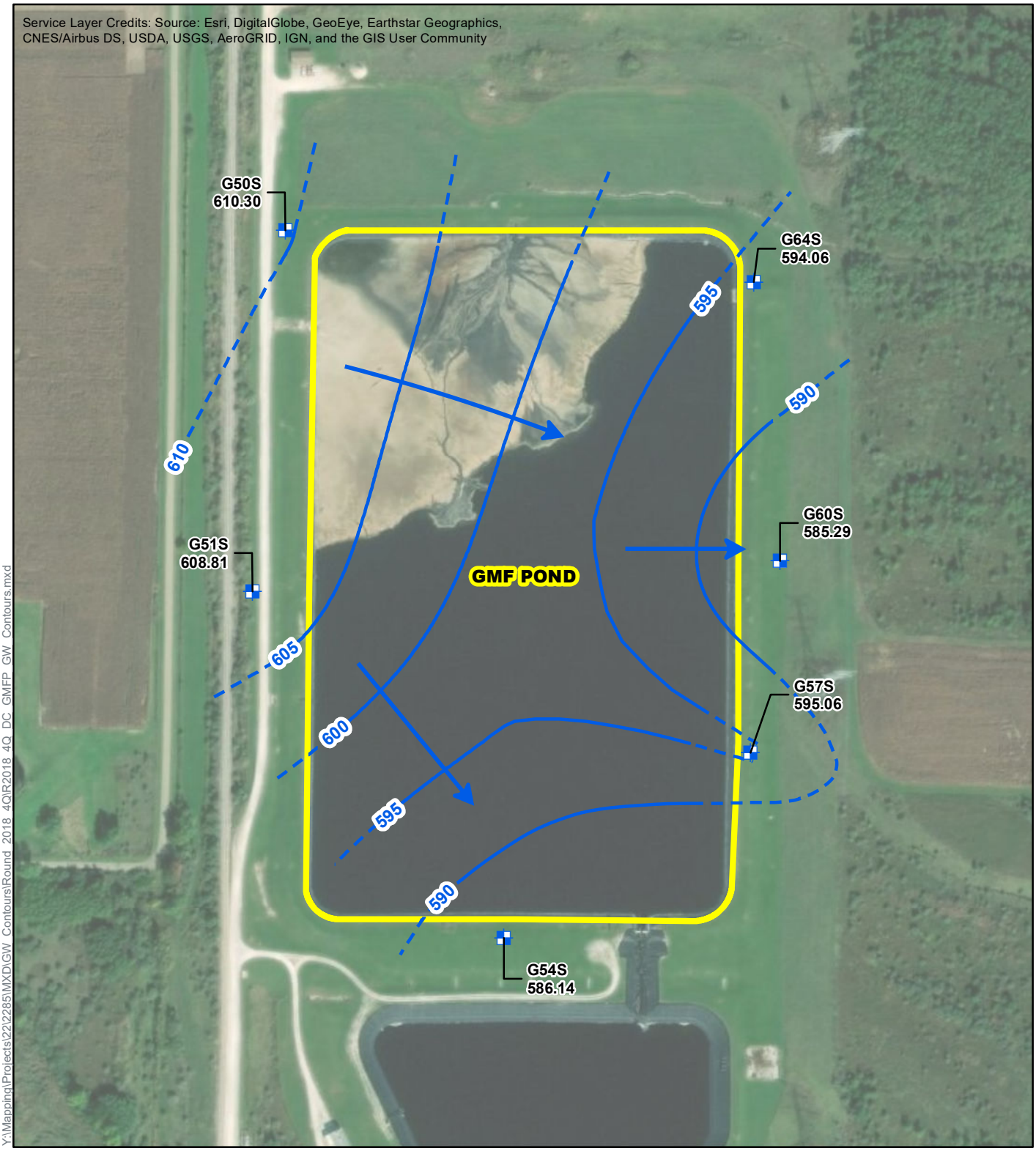
DUCK CREEK GMF POND (UNIT ID: 203)
GROUNDWATER ELEVATION CONTOUR MAP
JULY 2, 2018

CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

0 62.5 125 250
Feet

N

O'BRIEN & GERE ENGINEERS, INC.



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CCR RULE MONITORING WELL LOCATION

GROUNDWATER ELEVATION CONTOUR (5-FT CONTOUR INTERVAL, NAVD88)

INFERRED GROUNDWATER ELEVATION CONTOUR

GROUNDWATER FLOW DIRECTION

CCR MONITORED UNIT

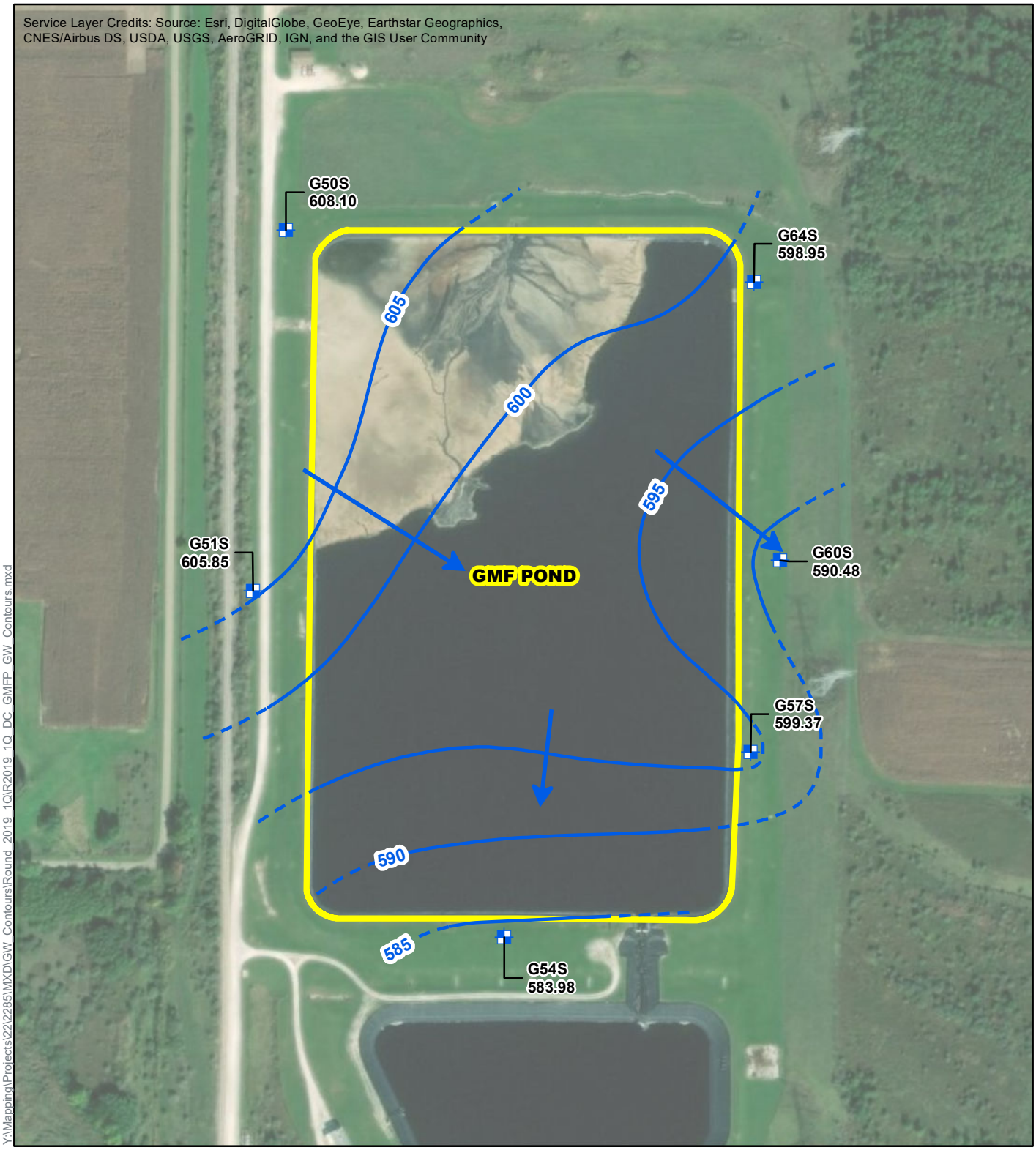
DUCK CREEK GMF POND (UNIT ID: 203)
GROUNDWATER ELEVATION CONTOUR MAP
OCTOBER 2, 2018

CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

0 62.5 125 250
Feet

N

O'BRIEN & GERE ENGINEERS, INC.



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CCR RULE MONITORING WELL LOCATION

GROUNDWATER ELEVATION CONTOUR (5-FT CONTOUR INTERVAL, NAVD88)

INFERRED GROUNDWATER ELEVATION CONTOUR

GROUNDWATER FLOW DIRECTION

CCR MONITORED UNIT

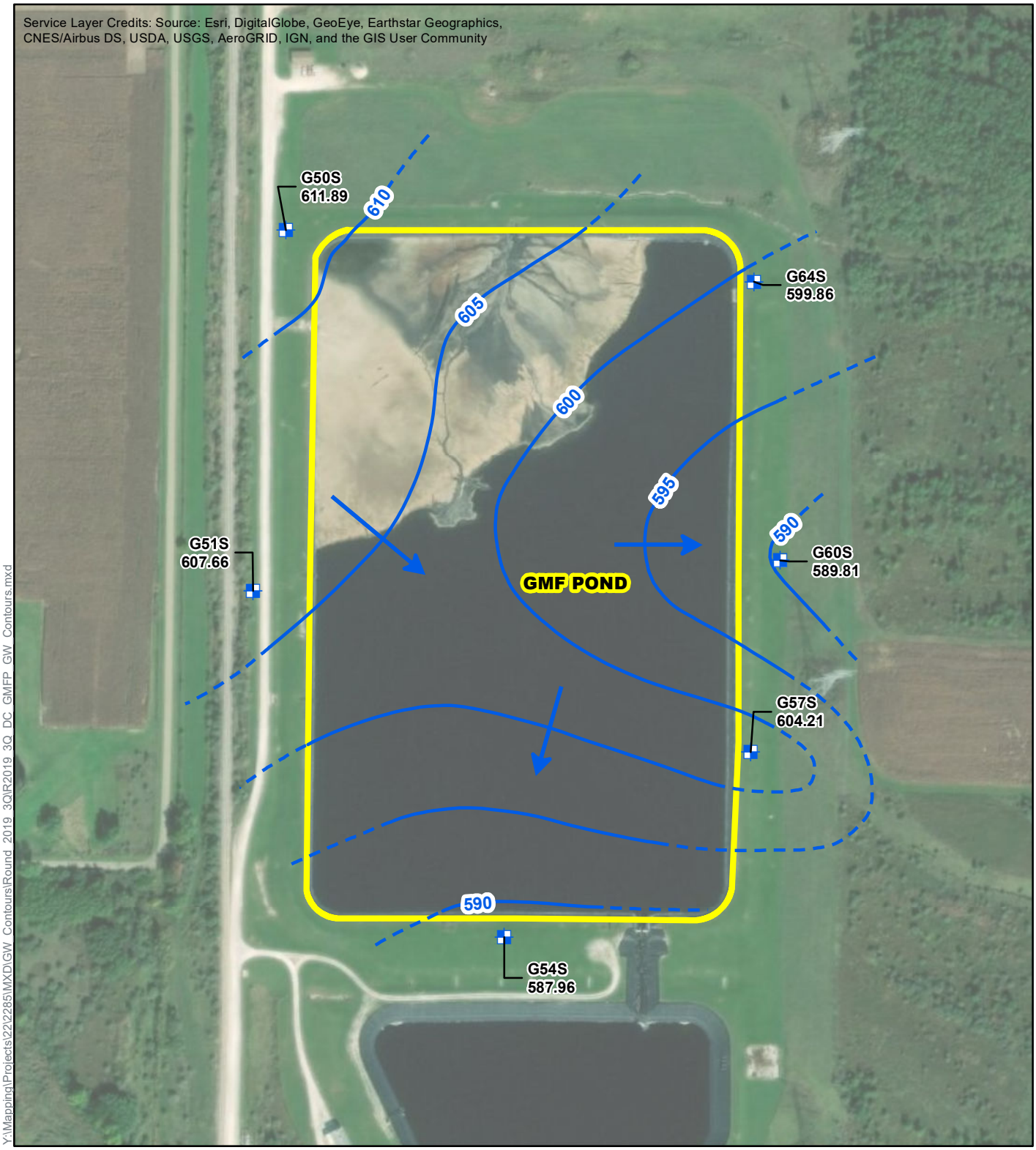
DUCK CREEK GMF POND (UNIT ID: 203)
GROUNDWATER ELEVATION CONTOUR MAP
JANUARY 7, 2019

CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

0 62.5 125 250
Feet

N

O'BRIEN & GERE ENGINEERS, INC.



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CCR RULE MONITORING WELL LOCATION

GROUNDWATER ELEVATION CONTOUR (5-FT CONTOUR INTERVAL, NAVD88)

INFERRED GROUNDWATER ELEVATION CONTOUR

GROUNDWATER FLOW DIRECTION

CCR MONITORED UNIT

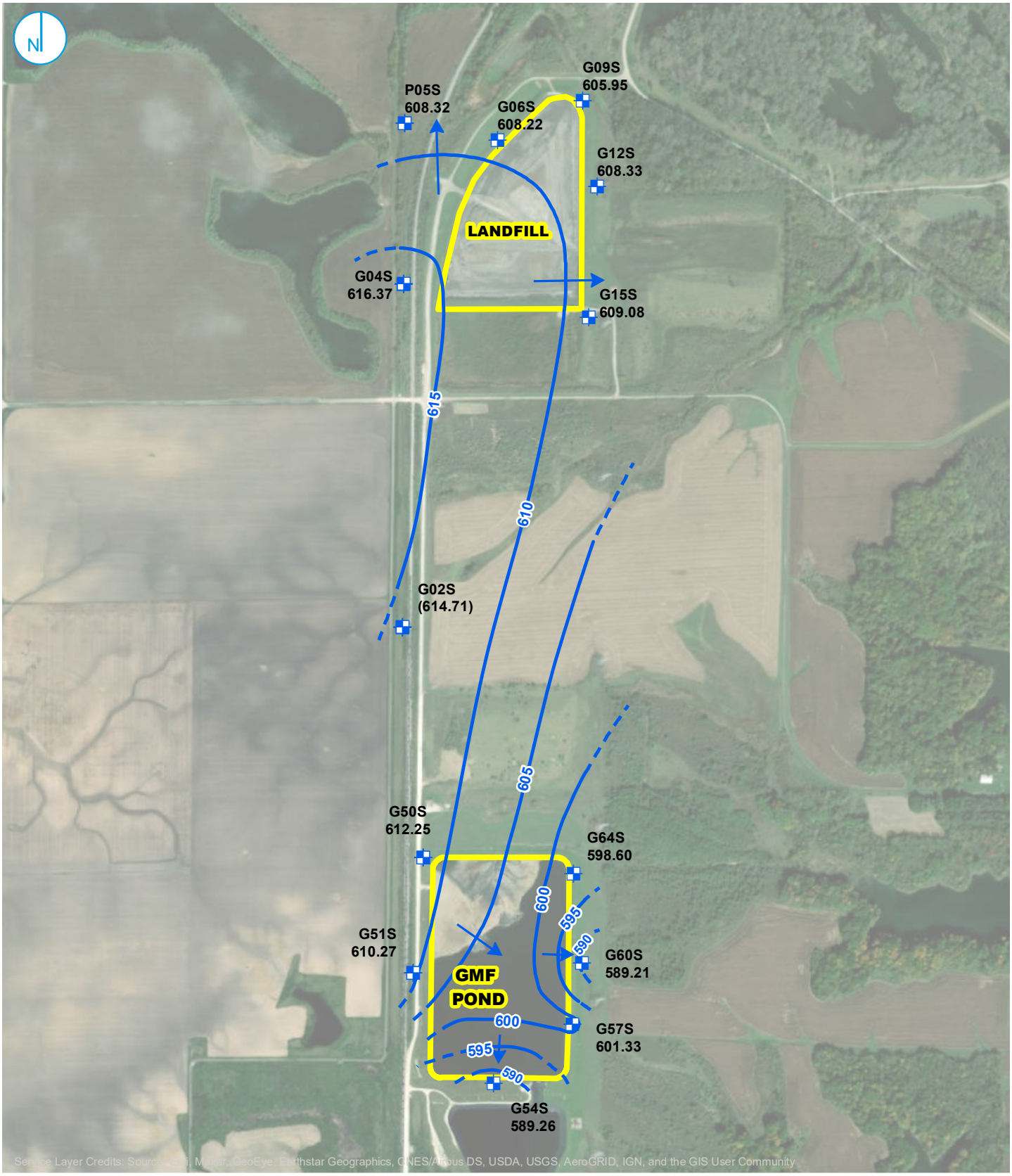
DUCK CREEK GMF POND (UNIT ID: 203)
GROUNDWATER ELEVATION CONTOUR MAP
JULY 1, 2019

CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

0 62.5 125 250
Feet

N

O'BRIEN & GERE ENGINEERS, INC.



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PROJECT: 169000XXXX | DATED: 8/28/2020 | DESIGNER: STOLZSD

- CCR RULE MONITORING WELL
- GROUNDWATER ELEVATION CONTOUR (5-FT CONTOUR INTERVAL, NAVD88)
- INFERRED GROUNDWATER ELEVATION CONTOUR
- GROUNDWATER FLOW DIRECTION
- CCR MONITORED UNIT

0 450 900 Feet

GROUNDWATER ELEVATION CONTOUR MAP
JANUARY 2-3, 2020

DUCK CREEK GMF POND (UNIT ID: 203)
AND LANDFILL (UNIT ID: 204)
VISTRA ENERGY
DUCK CREEK POWER STATION
CANTON, ILLINOIS

RAMBOLL US CORPORATION
A RAMBOLL COMPANY

RAMBOLL

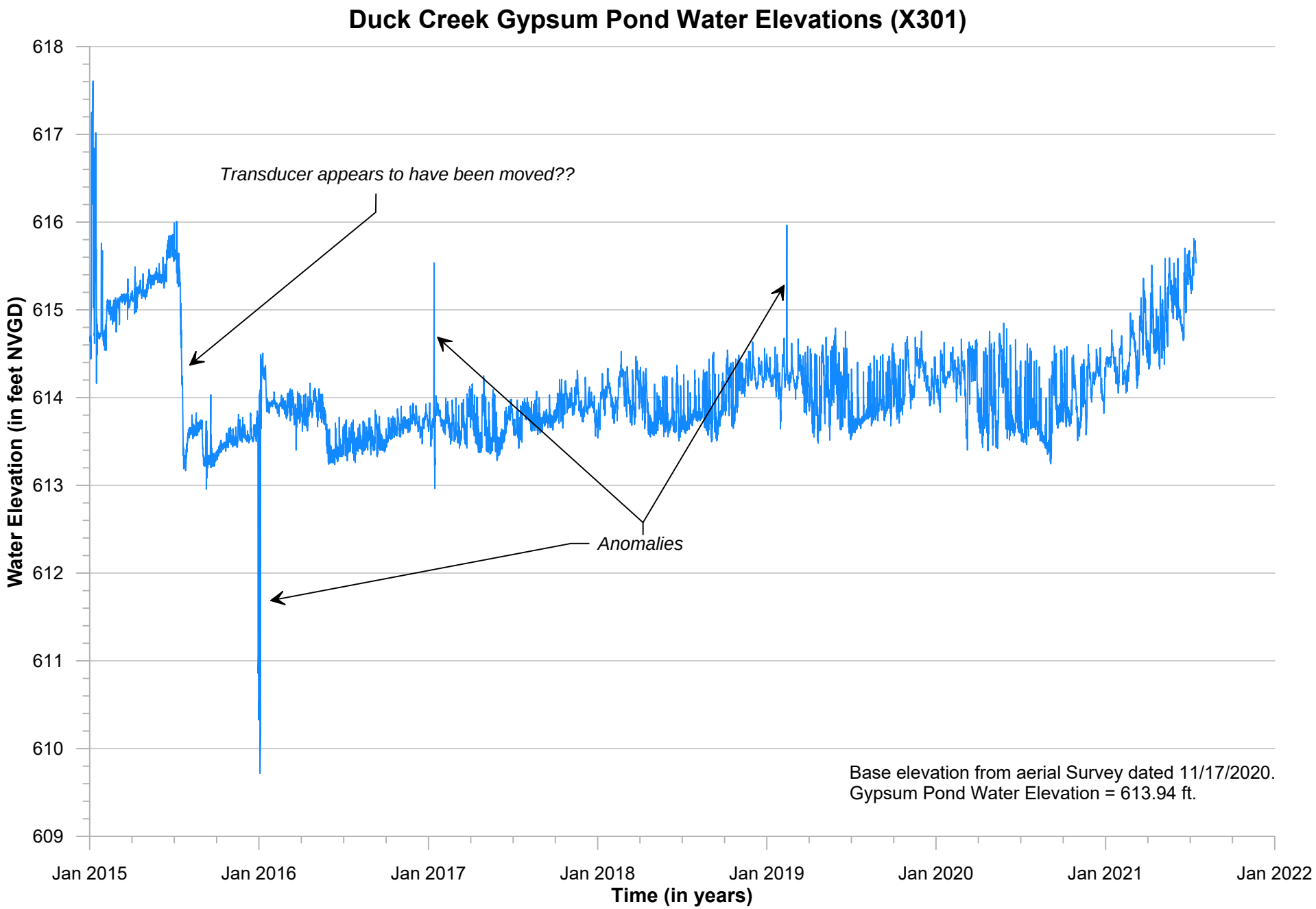

Duck Creek Gypsum Pond Water Elevations (X301)
Water Elevation (in feet NVGD)
618
617
616
615
614
613
612
611
610
609
Transducer appears to have been moved??
Anomalies
Base elevation from aerial Survey dated 11/17/2020.
Gypsum Pond Water Elevation = 613.94 ft.
Jan 2015
Jan 2016
Jan 2017
Jan 2018
Jan 2019
Jan 2020
Jan 2021
Jan 2022
Time (in years)

TABLE D-1. GROUNDWATER ELEVATION RESULTS

TABLE D-1. GROUNDWATER ELEVATIONS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Sample Date	Groundwater Elevation (ft NAVD88)
G02L	02/18/2021	613.08
G02L	05/10/2021	616.01
G02L	08/05/2021	613.14
G02S	12/02/2015	615.45
G02S	01/25/2016	615.35
G02S	04/18/2016	611.81
G02S	08/09/2016	612.03
G02S	10/14/2016	611.55
G02S	01/09/2017	612.30
G02S	04/02/2017	614.75
G02S	06/28/2017	614.07
G02S	11/10/2017	606.10
G02S	01/17/2018	610.75
G02S	04/10/2018	614.73
G02S	07/02/2018	612.82
G02S	10/02/2018	609.88
G02S	01/07/2019	613.19
G02S	07/01/2019	611.06
G02S	01/03/2020	614.71
G02S	08/06/2020	610.89
G02S	11/16/2020	607.52
G02S	02/18/2021	612.97
G02S	02/19/2021	613.24
G02S	04/14/2021	614.98
G02S	04/28/2021	613.94
G02S	04/29/2021	614.65
G02S	05/10/2021	615.30
G02S	05/12/2021	614.97
G02S	06/01/2021	613.85
G02S	06/10/2021	613.50
G02S	06/15/2021	613.10
G02S	06/21/2021	613.84
G02S	07/12/2021	614.73
G02S	07/26/2021	613.93
G02S	07/28/2021	613.80
G02S	08/05/2021	613.30
G50L	11/18/2020	606.44
G50L	02/18/2021	611.14
G50L	02/19/2021	611.31
G50L	04/14/2021	614.31
G50L	04/28/2021	612.60
G50L	04/29/2021	612.43
G50L	05/10/2021	613.80
G50L	05/13/2021	613.27
G50L	06/01/2021	612.96

TABLE D-1. GROUNDWATER ELEVATIONS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Sample Date	Groundwater Elevation (ft NAVD88)
G50L	06/10/2021	612.33
G50L	06/21/2021	612.48
G50L	07/12/2021	614.79
G50L	07/13/2021	616.06
G50L	07/26/2021	613.07
G50L	07/28/2021	612.78
G50L	08/05/2021	612.25
G50S	12/02/2015	612.44
G50S	01/25/2016	612.61
G50S	04/18/2016	610.83
G50S	08/09/2016	612.81
G50S	10/14/2016	608.53
G50S	01/09/2017	606.45
G50S	04/02/2017	611.96
G50S	06/28/2017	611.37
G50S	11/08/2017	601.79
G50S	04/10/2018	607.45
G50S	07/02/2018	607.77
G50S	10/02/2018	610.30
G50S	01/07/2019	608.10
G50S	07/01/2019	611.89
G50S	01/02/2020	612.25
G50S	08/06/2020	608.32
G50S	11/16/2020	605.58
G50S	11/18/2020	605.85
G50S	02/18/2021	610.30
G50S	02/19/2021	610.30
G50S	04/14/2021	612.98
G50S	04/28/2021	611.54
G50S	04/29/2021	614.22
G50S	05/10/2021	612.71
G50S	05/13/2021	612.15
G50S	06/01/2021	611.87
G50S	06/10/2021	611.15
G50S	06/21/2021	611.57
G50S	07/12/2021	613.25
G50S	07/13/2021	614.03
G50S	07/26/2021	612.06
G50S	07/28/2021	611.81
G50S	08/05/2021	611.21
G51L	11/18/2020	602.35
G51L	02/18/2021	606.81
G51L	02/19/2021	606.96
G51L	04/14/2021	610.50
G51L	04/28/2021	609.12

TABLE D-1. GROUNDWATER ELEVATIONS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Sample Date	Groundwater Elevation (ft NAVD88)
G51L	05/10/2021	610.72
G51L	06/01/2021	609.14
G51L	06/10/2021	606.57
G51L	06/21/2021	608.97
G51L	07/12/2021	610.66
G51L	07/26/2021	608.51
G51L	08/05/2021	605.95
G51S	12/02/2015	610.56
G51S	01/25/2016	609.88
G51S	04/18/2016	606.72
G51S	08/09/2016	610.54
G51S	10/14/2016	605.47
G51S	01/09/2017	605.40
G51S	04/02/2017	609.34
G51S	06/28/2017	608.07
G51S	11/08/2017	599.86
G51S	04/10/2018	611.01
G51S	07/02/2018	605.54
G51S	10/02/2018	608.81
G51S	01/07/2019	605.85
G51S	07/01/2019	607.66
G51S	01/02/2020	610.27
G51S	08/06/2020	603.64
G51S	11/16/2020	602.10
G51S	11/18/2020	602.40
G51S	02/18/2021	607.04
G51S	02/19/2021	607.04
G51S	04/14/2021	610.69
G51S	04/28/2021	609.35
G51S	04/29/2021	610.56
G51S	05/10/2021	610.93
G51S	05/13/2021	610.39
G51S	06/01/2021	609.44
G51S	06/10/2021	606.98
G51S	06/15/2021	605.80
G51S	06/21/2021	609.37
G51S	07/12/2021	610.91
G51S	07/26/2021	608.84
G51S	07/27/2021	608.29
G51S	08/05/2021	606.34
G52L	11/18/2020	591.84
G52L	02/18/2021	593.43
G52L	02/19/2021	593.53
G52L	04/14/2021	596.93
G52L	04/28/2021	596.16

TABLE D-1. GROUNDWATER ELEVATIONS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Sample Date	Groundwater Elevation (ft NAVD88)
G52L	05/10/2021	596.82
G52L	06/01/2021	597.15
G52L	06/10/2021	596.04
G52L	06/21/2021	595.09
G52L	07/12/2021	597.20
G52L	07/26/2021	596.89
G52L	08/05/2021	595.67
G52S	02/18/2021	589.65
G52S	05/10/2021	596.45
G52S	08/05/2021	589.39
G53L	11/18/2020	605.53
G53L	02/18/2021	607.98
G53L	02/22/2021	608.43
G53L	05/10/2021	613.90
G53L	08/05/2021	612.79
G53S	11/18/2020	603.70
G53S	02/18/2021	606.48
G53S	02/22/2021	606.81
G53S	05/10/2021	610.80
G53S	08/05/2021	610.14
G54C	04/14/2021	581.99
G54C	04/28/2021	581.10
G54C	04/29/2021	580.28
G54C	05/10/2021	580.11
G54C	05/12/2021	580.11
G54C	06/01/2021	581.00
G54C	06/10/2021	580.47
G54C	06/21/2021	579.83
G54C	07/12/2021	582.36
G54C	07/26/2021	581.64
G54C	08/05/2021	578.99
G54L	11/17/2020	592.43
G54L	02/18/2021	591.36
G54L	02/22/2021	591.69
G54L	04/14/2021	591.47
G54L	04/28/2021	591.11
G54L	04/29/2021	591.30
G54L	05/10/2021	591.22
G54L	05/12/2021	591.22
G54L	06/01/2021	591.52
G54L	06/10/2021	591.78
G54L	06/14/2021	591.77
G54L	06/21/2021	592.11
G54L	07/12/2021	592.97
G54L	07/13/2021	594.53

TABLE D-1. GROUNDWATER ELEVATIONS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Sample Date	Groundwater Elevation (ft NAVD88)
G54L	07/26/2021	592.50
G54L	07/27/2021	592.51
G54L	08/05/2021	592.79
G54S	12/02/2015	584.98
G54S	01/25/2016	586.07
G54S	04/18/2016	585.51
G54S	08/09/2016	584.36
G54S	10/14/2016	586.39
G54S	01/09/2017	588.77
G54S	04/02/2017	584.50
G54S	06/28/2017	584.39
G54S	11/08/2017	586.48
G54S	01/18/2018	585.43
G54S	04/10/2018	586.40
G54S	07/02/2018	583.82
G54S	10/02/2018	586.14
G54S	01/07/2019	583.98
G54S	07/01/2019	587.96
G54S	01/02/2020	589.26
G54S	08/06/2020	591.39
G54S	11/16/2020	591.47
G54S	11/17/2020	591.31
G54S	02/18/2021	590.52
G54S	02/22/2021	590.52
G54S	04/14/2021	590.44
G54S	04/28/2021	590.52
G54S	05/10/2021	590.53
G54S	06/01/2021	590.80
G54S	06/10/2021	591.07
G54S	06/21/2021	591.23
G54S	07/12/2021	591.76
G54S	07/26/2021	591.98
G54S	08/05/2021	592.55
G55L	11/17/2020	597.65
G55L	02/18/2021	595.73
G55L	02/22/2021	596.28
G55L	05/10/2021	597.38
G55L	08/05/2021	599.54
G55S	11/17/2020	597.42
G55S	02/18/2021	595.68
G55S	02/22/2021	596.14
G55S	05/10/2021	597.41
G55S	08/05/2021	599.57
G56L	11/17/2020	598.87
G56L	02/18/2021	597.50

TABLE D-1. GROUNDWATER ELEVATIONS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Sample Date	Groundwater Elevation (ft NAVD88)
G56L	02/22/2021	598.01
G56L	04/14/2021	602.88
G56L	04/28/2021	603.24
G56L	05/10/2021	603.44
G56L	06/01/2021	602.48
G56L	06/10/2021	604.14
G56L	06/21/2021	603.64
G56L	07/12/2021	605.23
G56L	07/26/2021	605.31
G56L	08/05/2021	604.62
G56S	11/17/2020	598.37
G56S	02/18/2021	598.06
G56S	02/22/2021	598.38
G56S	05/10/2021	603.62
G56S	08/05/2021	604.42
G57L	11/17/2020	596.17
G57L	02/18/2021	595.73
G57L	02/22/2021	595.88
G57L	04/14/2021	603.07
G57L	04/28/2021	602.15
G57L	05/10/2021	604.41
G57L	06/01/2021	603.88
G57L	06/10/2021	603.17
G57L	06/21/2021	602.45
G57L	07/12/2021	604.81
G57L	07/26/2021	604.43
G57L	08/05/2021	603.00
G57S	12/02/2015	596.98
G57S	01/25/2016	601.68
G57S	04/18/2016	600.90
G57S	08/09/2016	602.06
G57S	10/14/2016	602.36
G57S	01/09/2017	598.83
G57S	04/02/2017	600.87
G57S	06/28/2017	600.77
G57S	11/08/2017	594.76
G57S	01/18/2018	602.07
G57S	04/10/2018	601.87
G57S	07/02/2018	598.86
G57S	10/02/2018	595.06
G57S	01/07/2019	599.37
G57S	07/01/2019	604.21
G57S	01/02/2020	601.33
G57S	08/06/2020	600.65
G57S	11/16/2020	596.28

TABLE D-1. GROUNDWATER ELEVATIONS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Sample Date	Groundwater Elevation (ft NAVD88)
G57S	11/17/2020	596.21
G57S	02/18/2021	596.21
G57S	02/22/2021	596.21
G57S	04/14/2021	601.83
G57S	04/28/2021	601.99
G57S	05/10/2021	602.61
G57S	06/01/2021	603.89
G57S	06/10/2021	603.20
G57S	06/21/2021	602.52
G57S	07/12/2021	604.68
G57S	07/26/2021	604.41
G57S	08/05/2021	603.51
G58L	11/18/2020	591.87
G58L	02/18/2021	591.24
G58L	02/22/2021	591.55
G58L	05/10/2021	597.62
G58L	08/05/2021	598.92
G58S	11/18/2020	591.87
G58S	02/18/2021	591.54
G58S	02/22/2021	592.02
G58S	05/10/2021	597.67
G58S	08/05/2021	598.87
G59L	11/18/2020	590.59
G59L	02/18/2021	588.96
G59L	02/22/2021	589.09
G59L	05/10/2021	599.77
G59L	08/05/2021	601.28
G59S	11/18/2020	587.04
G59S	02/18/2021	586.43
G59S	02/22/2021	586.88
G59S	05/10/2021	588.40
G59S	08/05/2021	598.43
G60L	11/17/2020	593.09
G60L	02/18/2021	593.56
G60L	02/23/2021	594.34
G60L	04/14/2021	606.78
G60L	04/28/2021	603.75
G60L	04/29/2021	604.10
G60L	05/10/2021	606.16
G60L	05/13/2021	605.30
G60L	06/01/2021	605.20
G60L	06/10/2021	603.76
G60L	06/15/2021	602.71
G60L	06/21/2021	603.43
G60L	07/12/2021	609.27

TABLE D-1. GROUNDWATER ELEVATIONS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Sample Date	Groundwater Elevation (ft NAVD88)
G60L	07/26/2021	605.97
G60L	07/28/2021	605.54
G60L	08/05/2021	604.40
G60S	12/02/2015	587.33
G60S	01/25/2016	590.64
G60S	04/18/2016	588.28
G60S	08/09/2016	586.43
G60S	10/14/2016	591.72
G60S	01/09/2017	587.23
G60S	04/02/2017	591.64
G60S	06/29/2017	591.59
G60S	11/08/2017	585.47
G60S	01/19/2018	599.93
G60S	04/10/2018	591.83
G60S	07/02/2018	590.33
G60S	10/02/2018	585.29
G60S	01/07/2019	590.48
G60S	07/01/2019	589.81
G60S	01/02/2020	589.21
G60S	08/06/2020	588.88
G60S	11/16/2020	587.66
G60S	11/17/2020	587.47
G60S	02/18/2021	587.35
G60S	02/23/2021	587.35
G60S	04/14/2021	590.16
G60S	04/28/2021	589.76
G60S	05/10/2021	590.34
G60S	06/01/2021	590.54
G60S	06/10/2021	590.02
G60S	06/21/2021	589.48
G60S	07/12/2021	591.02
G60S	07/26/2021	590.71
G60S	08/05/2021	590.05
G61S	11/18/2020	595.85
G61S	02/18/2021	594.19
G61S	02/23/2021	594.48
G61S	05/10/2021	601.73
G61S	08/05/2021	604.46
G62L	11/18/2020	597.59
G62L	02/18/2021	595.63
G62L	02/24/2021	595.51
G62L	05/10/2021	603.44
G62L	08/05/2021	603.85
G63L	11/18/2020	596.38
G63L	02/18/2021	595.23

TABLE D-1. GROUNDWATER ELEVATIONS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Sample Date	Groundwater Elevation (ft NAVD88)
G63L	02/24/2021	595.10
G63L	05/10/2021	599.58
G63L	08/05/2021	600.87
G63S	11/18/2020	595.43
G63S	02/18/2021	595.11
G63S	02/24/2021	595.53
G63S	05/10/2021	599.17
G63S	08/05/2021	601.78
G64L	11/18/2020	596.89
G64L	02/18/2021	596.41
G64L	02/25/2021	596.23
G64L	04/14/2021	600.43
G64L	04/28/2021	600.87
G64L	05/10/2021	601.22
G64L	06/01/2021	602.41
G64L	06/10/2021	601.95
G64L	06/21/2021	601.21
G64L	07/12/2021	602.32
G64L	07/26/2021	602.40
G64L	08/05/2021	601.70
G64S	12/02/2015	596.31
G64S	01/25/2016	598.06
G64S	04/18/2016	597.83
G64S	08/09/2016	598.06
G64S	10/14/2016	598.86
G64S	01/09/2017	596.71
G64S	04/02/2017	599.05
G64S	06/29/2017	598.81
G64S	11/08/2017	594.51
G64S	01/19/2018	600.88
G64S	04/10/2018	599.30
G64S	07/02/2018	598.86
G64S	10/02/2018	594.06
G64S	01/07/2019	598.95
G64S	07/01/2019	599.86
G64S	01/02/2020	598.60
G64S	08/06/2020	598.72
G64S	11/16/2020	596.27
G64S	11/18/2020	596.42
G64S	02/18/2021	596.13
G64S	02/24/2021	596.13
G64S	04/14/2021	599.04
G64S	04/28/2021	599.38
G64S	05/10/2021	599.64
G64S	06/01/2021	600.28

TABLE D-1. GROUNDWATER ELEVATIONS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Sample Location	Sample Date	Groundwater Elevation (ft NAVD88)
G64S	06/10/2021	599.97
G64S	06/21/2021	599.51
G64S	07/12/2021	600.50
G64S	07/26/2021	600.60
G64S	08/05/2021	600.04
P60	02/24/2021	591.82
P60	03/24/2021	593.80
P60	05/10/2021	598.86
P60	08/05/2021	601.39
P61	05/10/2021	606.78
P61	08/05/2021	603.86
P62	05/10/2021	602.28
P62	08/05/2021	603.46
P63	05/10/2021	601.64
P63	08/05/2021	601.91
P64	05/10/2021	605.52
P64	08/05/2021	603.10
R61L	11/18/2020	596.19
R61L	02/18/2021	594.59
R61L	02/23/2021	594.27
R61L	05/10/2021	601.43
R61L	08/05/2021	614.47

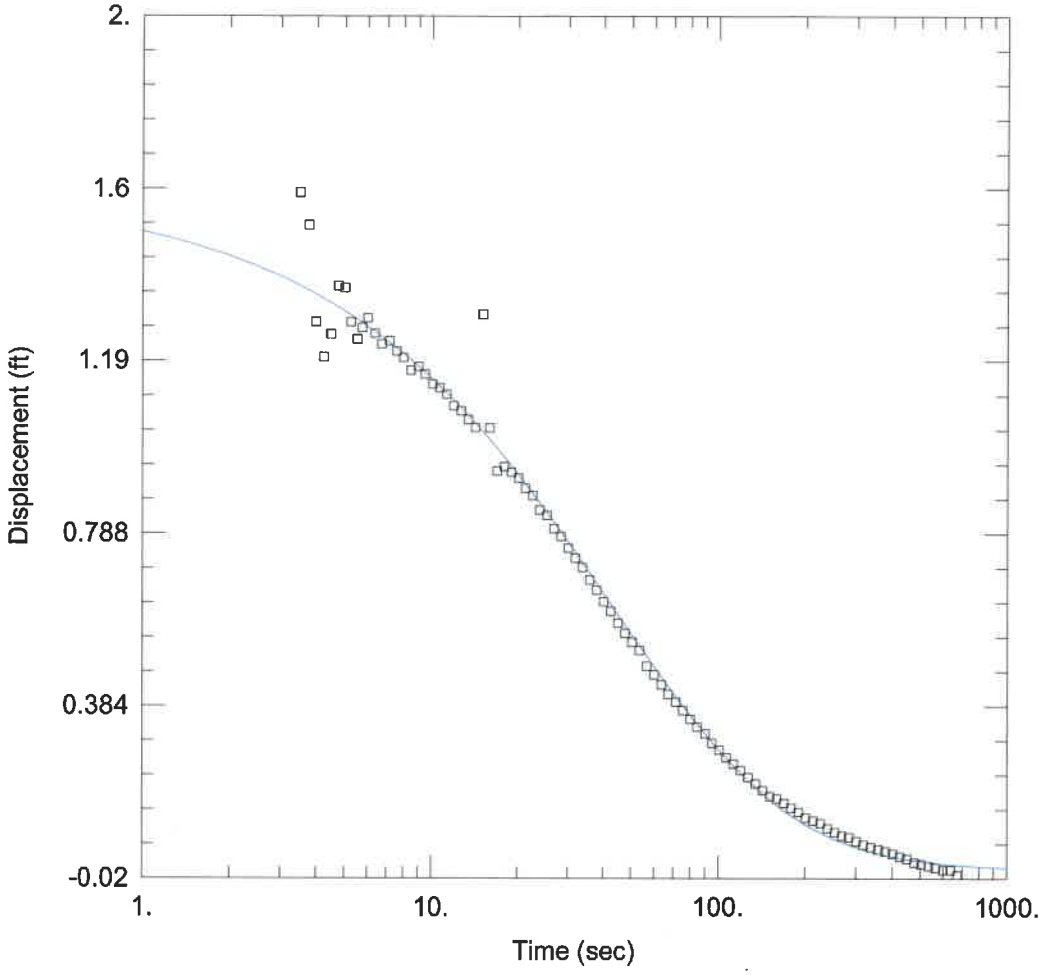
Notes:
ft NAVD88 = feet relative to the North American Vertical Datum 1988, GEOID 12A

generated 10/06/2021, 3:08:25 PM CDT

APPENDIX E
HYDRAULIC CONDUCTIVITY TEST DATA

Slug Test data summary - Duck Creek Gypsum Management Facility

Well ID	Falling Head k (cm/sec)	Specific Storage (1/ft)	FH Solution	Rising Head k (cm/sec)	Specific Storage (1/ft)	RH Solution	Average	Geo. Mean
G50L	2.30E-03	6.00E-03	KGS Model	2.10E-03	5.00E-03	KGS Model	2.20E-03	2.20E-03
G50S	6.50E-05	7.00E-03	KGS Model	1.50E-04	1.40E-05	KGS Model	1.08E-04	9.87E-05
G51L	3.00E-05	1.10E-03	KGS Model	*No test results*			3.00E-05	3.00E-05
G51S	7.20E-05	n/a	Bouwer-Rice	1.10E-04	1.50E-03	KGS Model	9.10E-05	8.90E-05
G53L	1.10E-04	2.90E-04	KGS Model	1.10E-04	1.10E-03	KGS Model	1.10E-04	1.10E-04
G53S	3.80E-03	2.00E-03	KGS Model	3.20E-03	1.00E-03	KGS Model	3.50E-03	3.49E-03
G54C	1.60E-04	n/a	Hvorslev	1.40E-04	n/a	Hvorslev	1.50E-04	1.50E-04
G54L	4.90E-05	n/a	Bouwer-Rice	2.20E-04	n/a	Bouwer-Rice	1.35E-04	1.04E-04
G54S	1.20E-04	n/a	Bouwer-Rice	2.10E-04	n/a	Bouwer-Rice	1.65E-04	1.59E-04
G57S	2.60E-03	7.00E-05	KGS Model	6.80E-04	2.20E-03	KGS Model	1.64E-03	1.33E-03
G60L	2.30E-04	6.00E-02	KGS Model	2.60E-04	3.50E-02	KGS Model	2.45E-04	2.45E-04
G60S	3.90E-03	7.10E-06	KGS Model	3.50E-03	7.00E-05	KGS Model	3.70E-03	3.69E-03
G63S	3.00E-04	2.00E-02	KGS Model	2.90E-04	2.00E-02	KGS Model	2.95E-04	2.95E-04



G50L FALLING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G50L-fh.aqt
Date: 06/02/21 Time: 16:26:20

AQUIFER DATA

Saturated Thickness: 5.04 ft

WELL DATA (G50L)

Initial Displacement: 1.6 ft
Total Well Penetration Depth: 7.64 ft
Casing Radius: 0.08333 ft

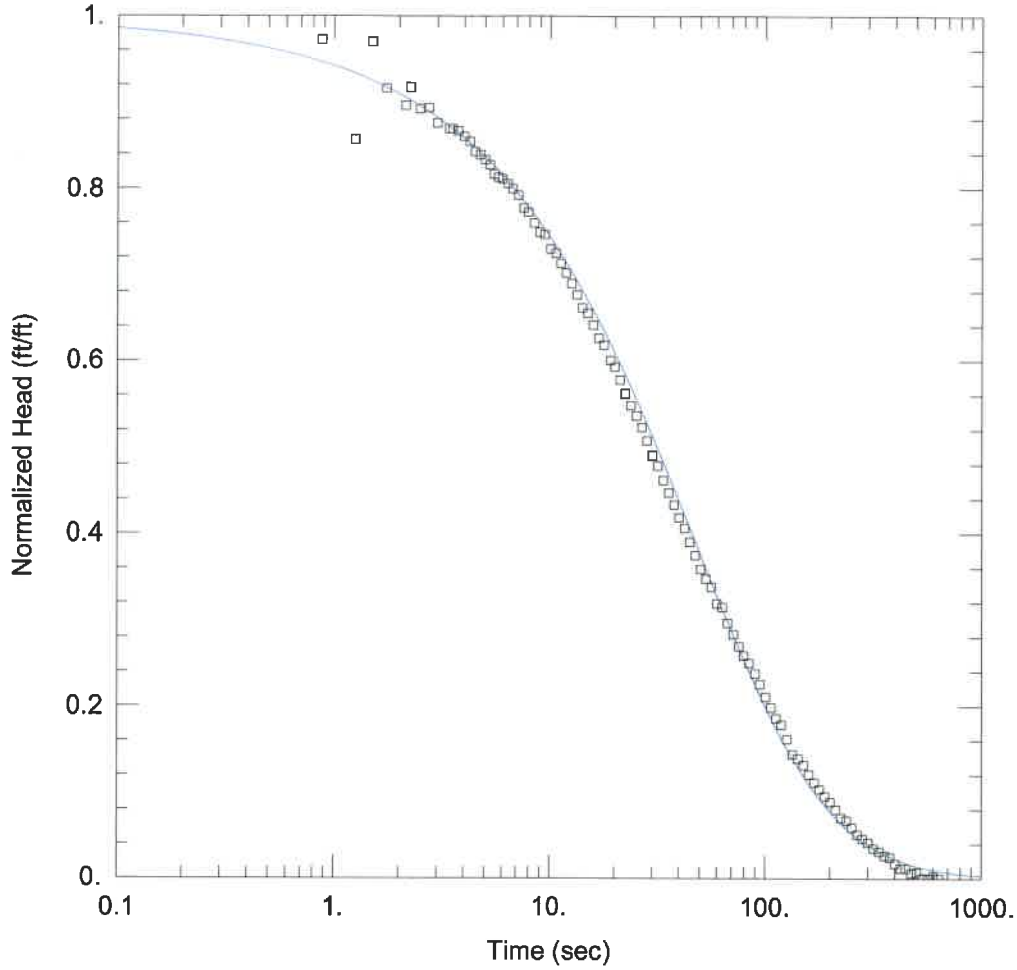
Static Water Column Height: 5.04 ft
Screen Length: 4.71 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.0023 cm/sec
Kz/Kr = 1.

Ss = 0.006 ft^{-1}



G50L RISING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G50L-rh.aqt
Date: 06/02/21 Time: 16:26:22

AQUIFER DATA

Saturated Thickness: 5.04 ft

WELL DATA (G50L)

Initial Displacement: 1.625 ft
Total Well Penetration Depth: 7.64 ft
Casing Radius: 0.08333 ft

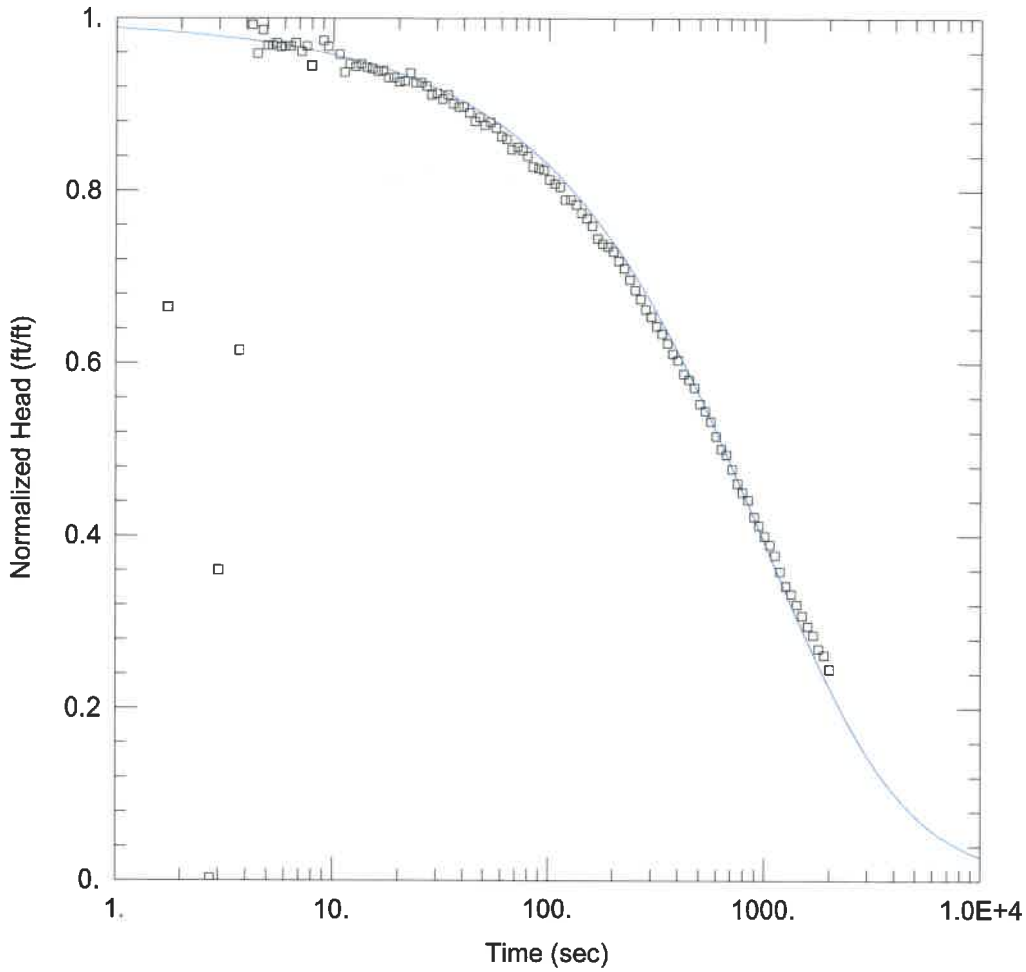
Static Water Column Height: 5.04 ft
Screen Length: 4.71 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.0021 cm/sec
Kz/Kr = 1.

Ss = 0.005 ft^{-1}



G50S FALLING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G50S-fh.aqt
Date: 06/02/21 Time: 16:26:23

PROJECT INFORMATION

Client: Duck Creek Power Statin
Project: 20E0111A
Location: Canton, IL
Test Well: G50S
Test Date: 4 Mar 2021

AQUIFER DATA

Saturated Thickness: 4.3 ft

WELL DATA (G50S)

Initial Displacement: 1.07 ft
Total Well Penetration Depth: 22.57 ft
Casing Radius: 0.08333 ft

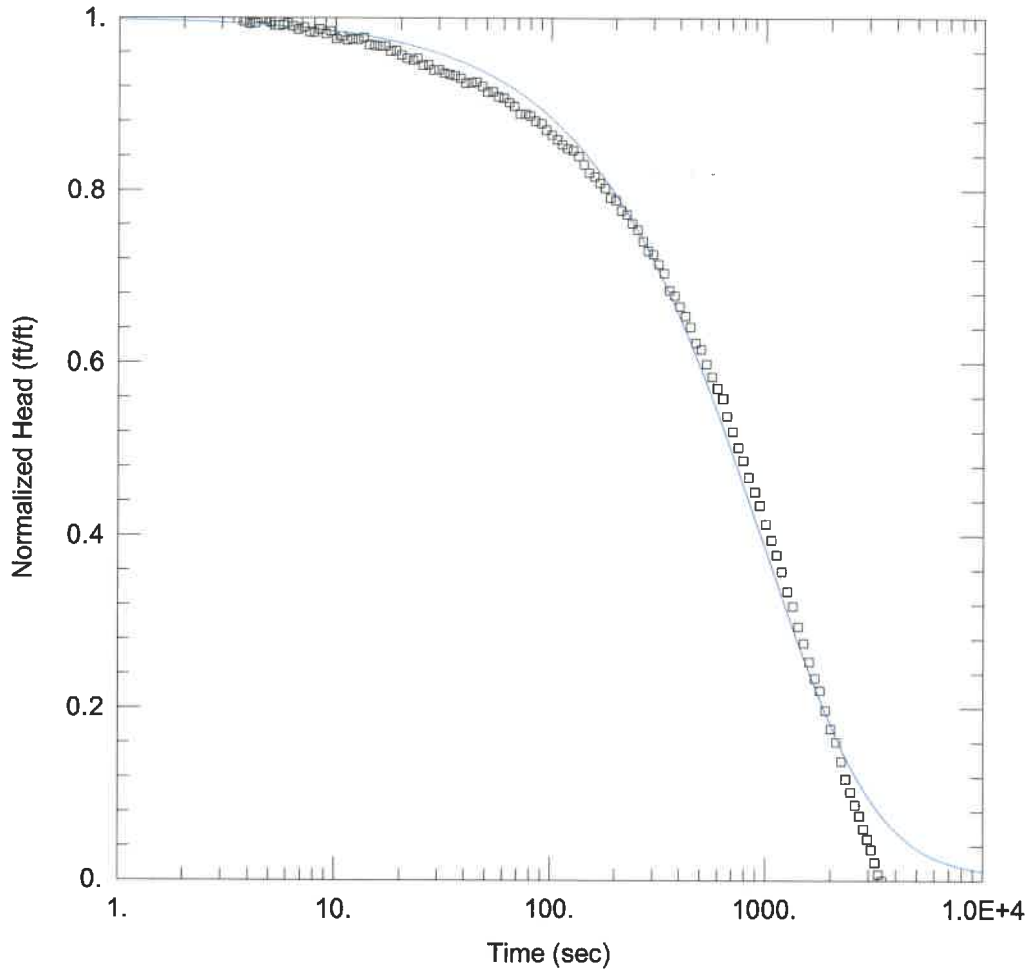
Static Water Column Height: 20.03 ft
Screen Length: 4.71 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 6.5E-5 cm/sec
Kz/Kr = 1.

Ss = 0.007 ft^{-1}



G50S RISING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G50S-rh.aqt
Date: 06/02/21 Time: 16:26:25

AQUIFER DATA

Saturated Thickness: 4.3 ft

WELL DATA (G50S)

Initial Displacement: 1.35 ft
Total Well Penetration Depth: 22.57 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 20.03 ft
Screen Length: 4.71 ft
Well Radius: 0.08333 ft

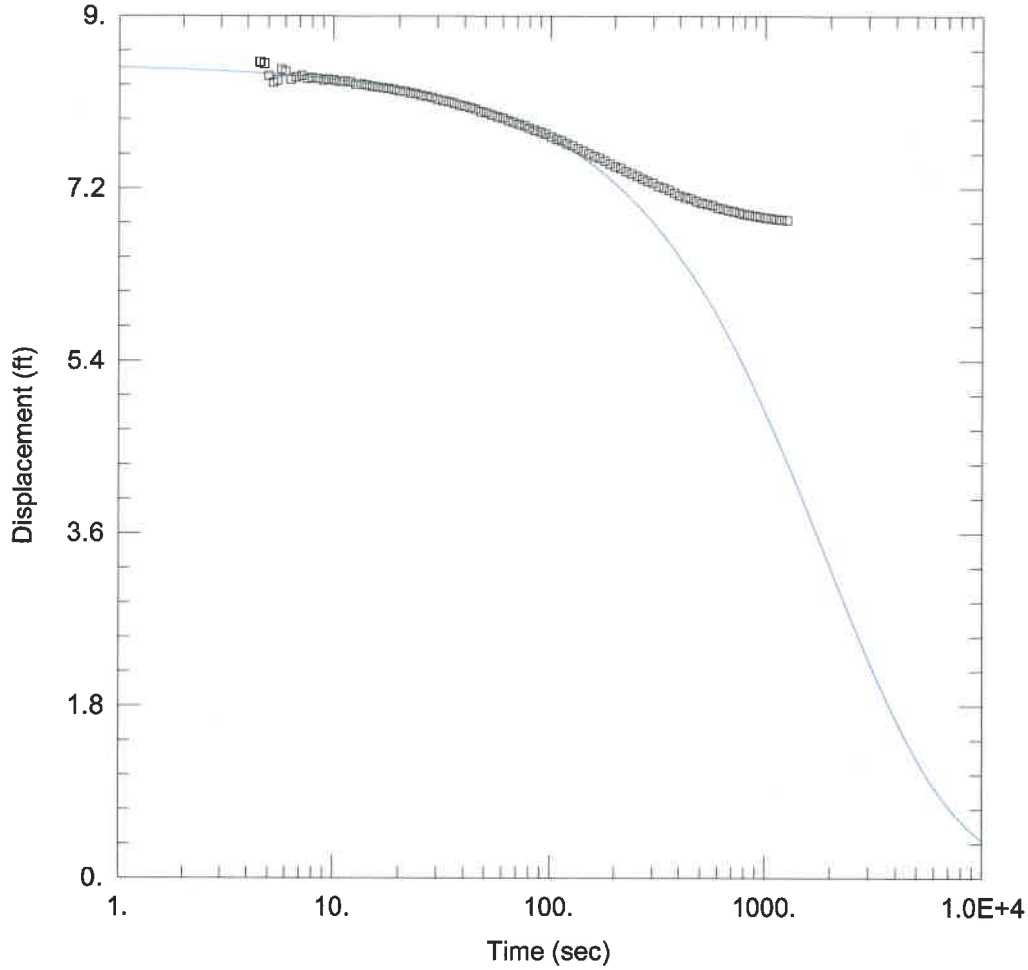
SOLUTION

Aquifer Model: Confined

Kr = 0.00015 cm/sec
Kz/Kr = 1.

Solution Method: KGS Model

Ss = 1.4E-5 ft^{-1}



G51L FALLING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G51L-fh.aqt
Date: 06/02/21 Time: 16:26:26

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: G51L
Test Date: 4 Mar 2021

AQUIFER DATA

Saturated Thickness: 8.5 ft

WELL DATA (G51L)

Initial Displacement: 8.5 ft
Total Well Penetration Depth: 14.11 ft
Casing Radius: 0.08333 ft

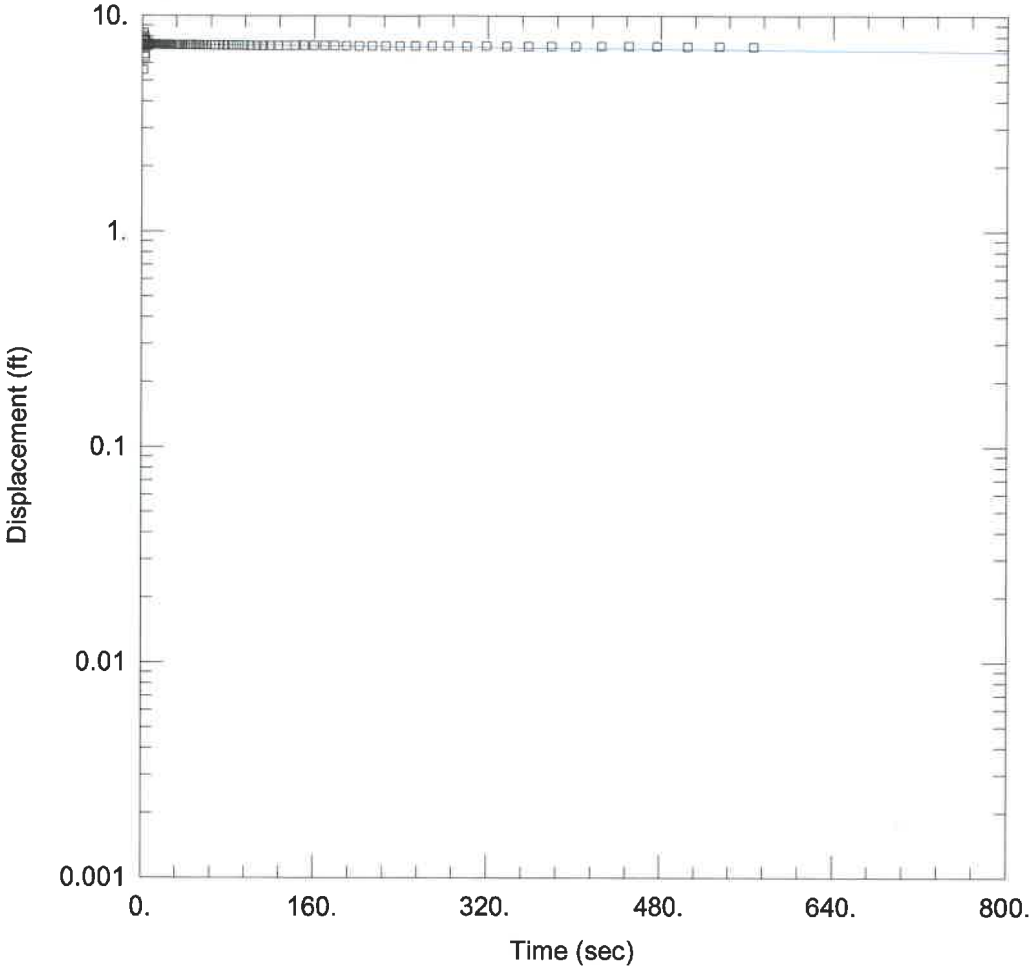
Static Water Column Height: 6.32 ft
Screen Length: 4.79 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 3.0E-5 cm/sec
Kz/Kr = 1.

Ss = 0.0011 ft^{-1}



G51S FALLING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G51S-fh.aqt
Date: 06/02/21 Time: 16:26:27

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: G51S
Test Date: 4 Mar 2021

AQUIFER DATA

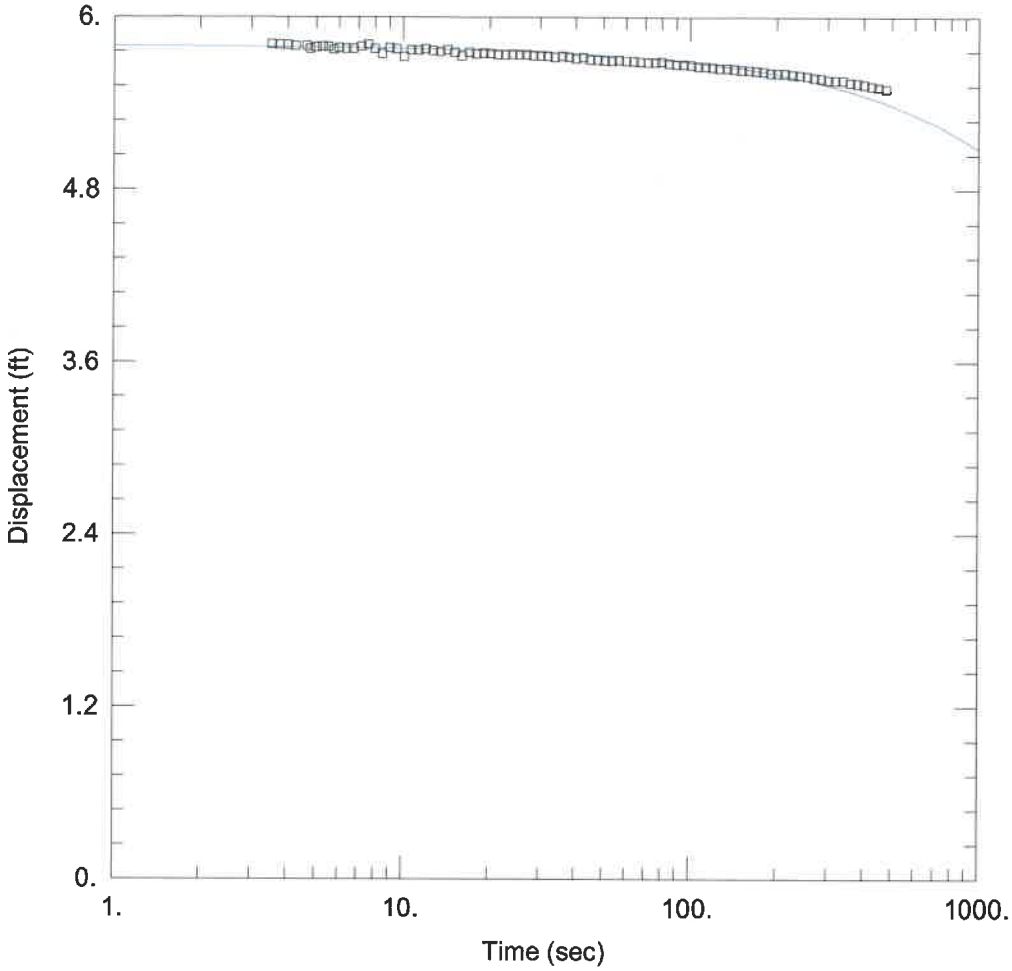
Saturated Thickness: 0.4 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (G51S)

Initial Displacement: 7.4 ft
Total Well Penetration Depth: 20.04 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 17.4 ft
Screen Length: 4.78 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 7.2E-5 cm/sec
y0 = 7.35 ft



G51S RISING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G51S-rh.aqt
Date: 06/02/21 Time: 16:26:29

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: G51S
Test Date: 4 Mar 2021

AQUIFER DATA

Saturated Thickness: 0.4 ft

WELL DATA (G51S)

Initial Displacement: 5.8 ft
Total Well Penetration Depth: 20.04 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 17.4 ft
Screen Length: 4.78 ft
Well Radius: 0.08333 ft

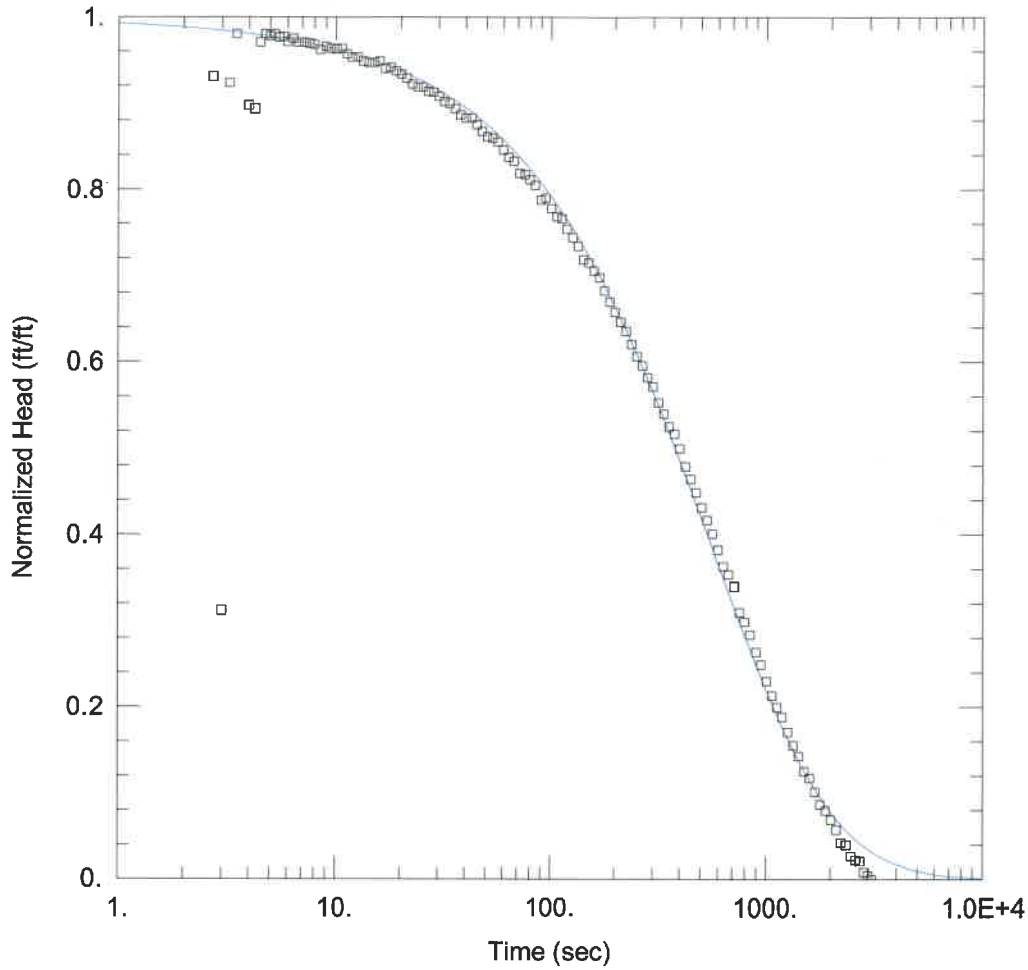
SOLUTION

Aquifer Model: Confined

Kr = 0.00011 cm/sec
Kz/Kr = 1.

Solution Method: KGS Model

Ss = 0.0015 ft^{-1}



G53L FALLING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G53L-fh.aqt
Date: 06/02/21 Time: 16:26:30

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: G53L
Test Date: 5 Mar 2021

AQUIFER DATA

Saturated Thickness: 11.48 ft

WELL DATA (G53L)

Initial Displacement: 1.4 ft
Total Well Penetration Depth: 14.33 ft
Casing Radius: 0.08333 ft

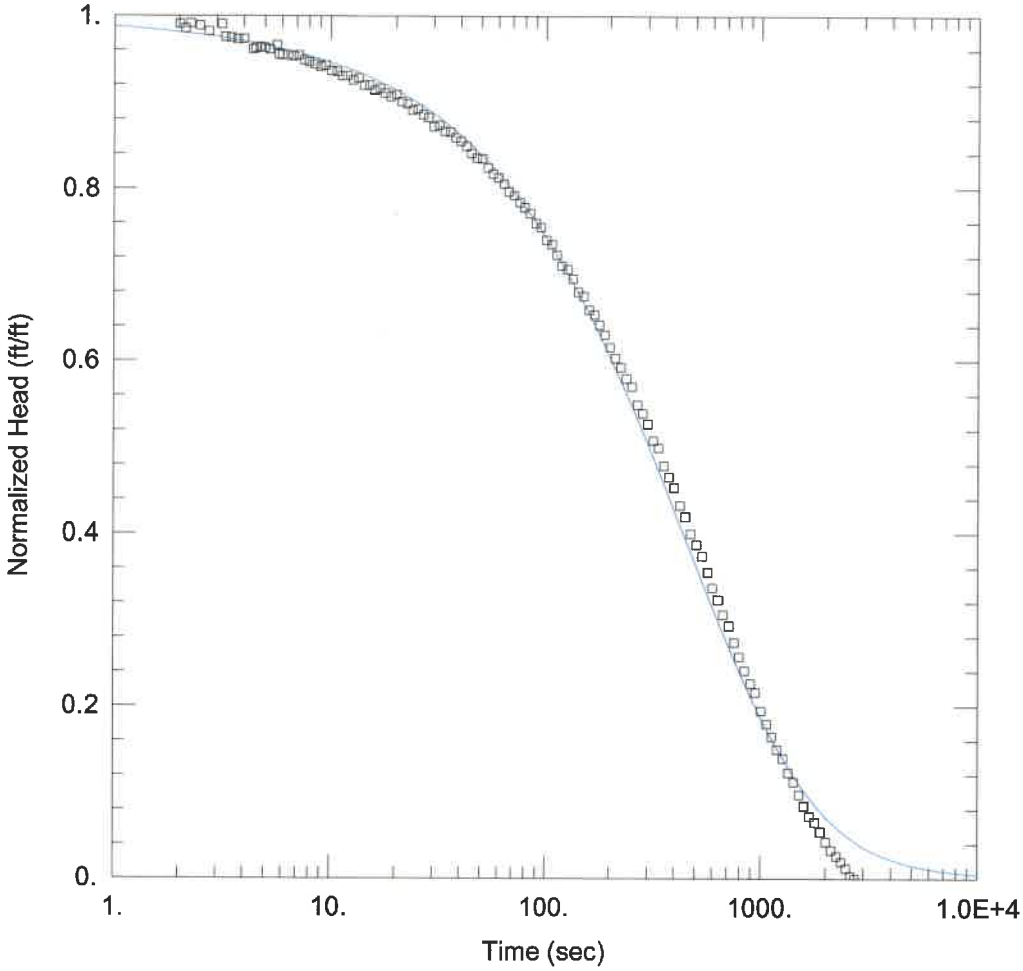
Static Water Column Height: 11.48 ft
Screen Length: 9.35 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.00011 cm/sec
Kz/Kr = 1.

Ss = 0.00029 ft^{-1}



G53L RISING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G53L-rh.aqt
Date: 06/02/21 Time: 16:26:32

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: G53L
Test Date: 5 Mar 2021

AQUIFER DATA

Saturated Thickness: 11.48 ft

WELL DATA (G53L)

Initial Displacement: 1.5 ft
Total Well Penetration Depth: 14.33 ft
Casing Radius: 0.08333 ft

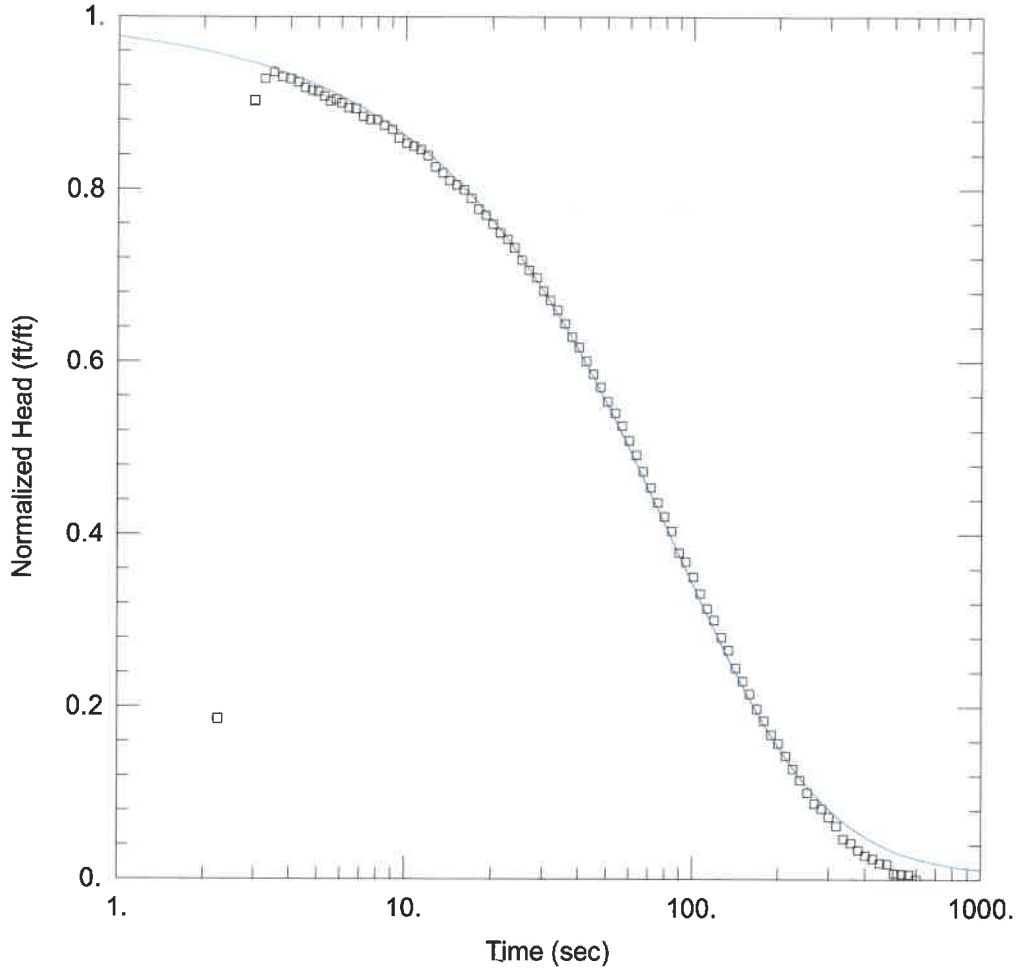
Static Water Column Height: 11.48 ft
Screen Length: 9.35 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.00011 cm/sec
Kz/Kr = 1.

Ss = 0.0011 ft^{-1}



G53S FALLING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G53S-fh.aqt
Date: 06/02/21 Time: 16:26:33

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: G53S
Test Date: 5 Mar 2021

AQUIFER DATA

Saturated Thickness: 1.6 ft

WELL DATA (G53S)

Initial Displacement: 1.6 ft
Total Well Penetration Depth: 21.38 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 18.77 ft
Screen Length: 4.49 ft
Well Radius: 0.08333 ft

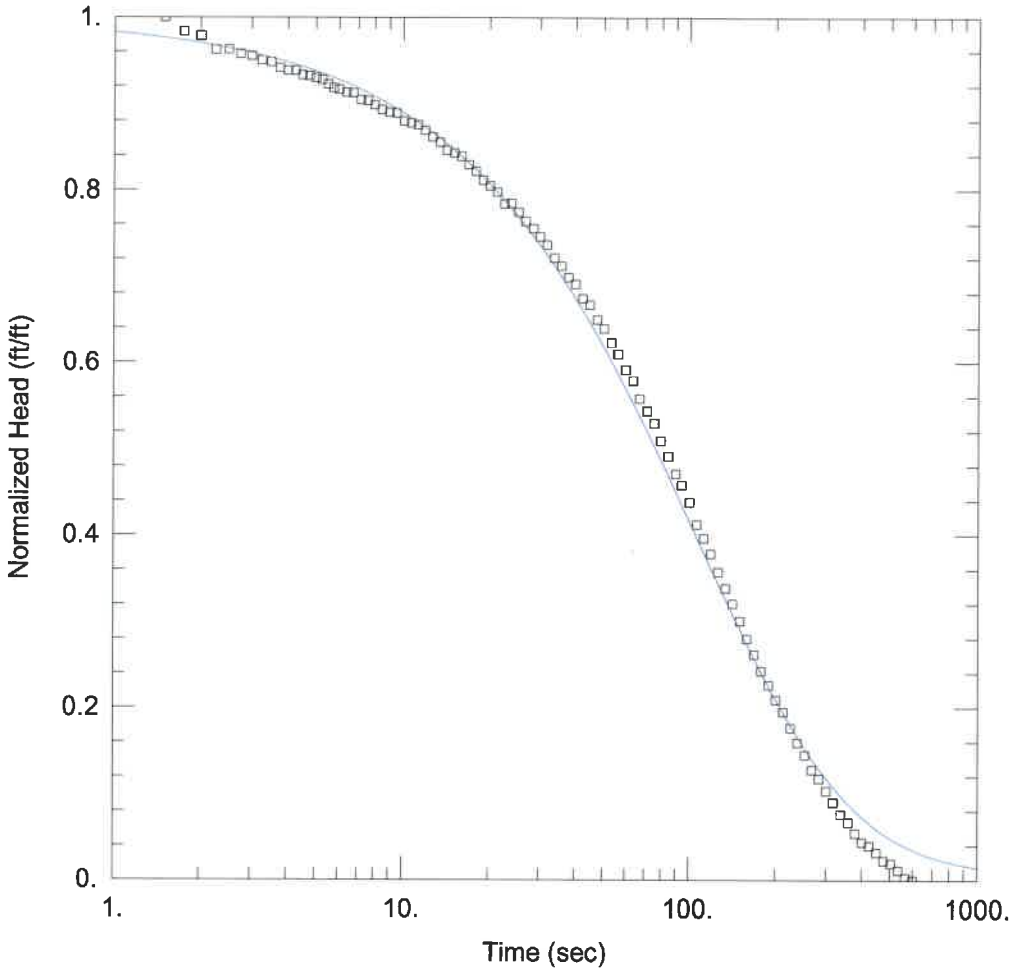
SOLUTION

Aquifer Model: Confined

Kr = 0.0038 cm/sec
Kz/Kr = 1.

Solution Method: KGS Model

Ss = 0.002 ft^{-1}



G53S RISING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G53S-rh.aqt
Date: 06/02/21 Time: 16:26:35

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: G53S
Test Date: 5 Mar 2021

AQUIFER DATA

Saturated Thickness: 1.6 ft

WELL DATA (G53S)

Initial Displacement: 1.75 ft
Total Well Penetration Depth: 21.38 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 18.77 ft
Screen Length: 4.49 ft
Well Radius: 0.08333 ft

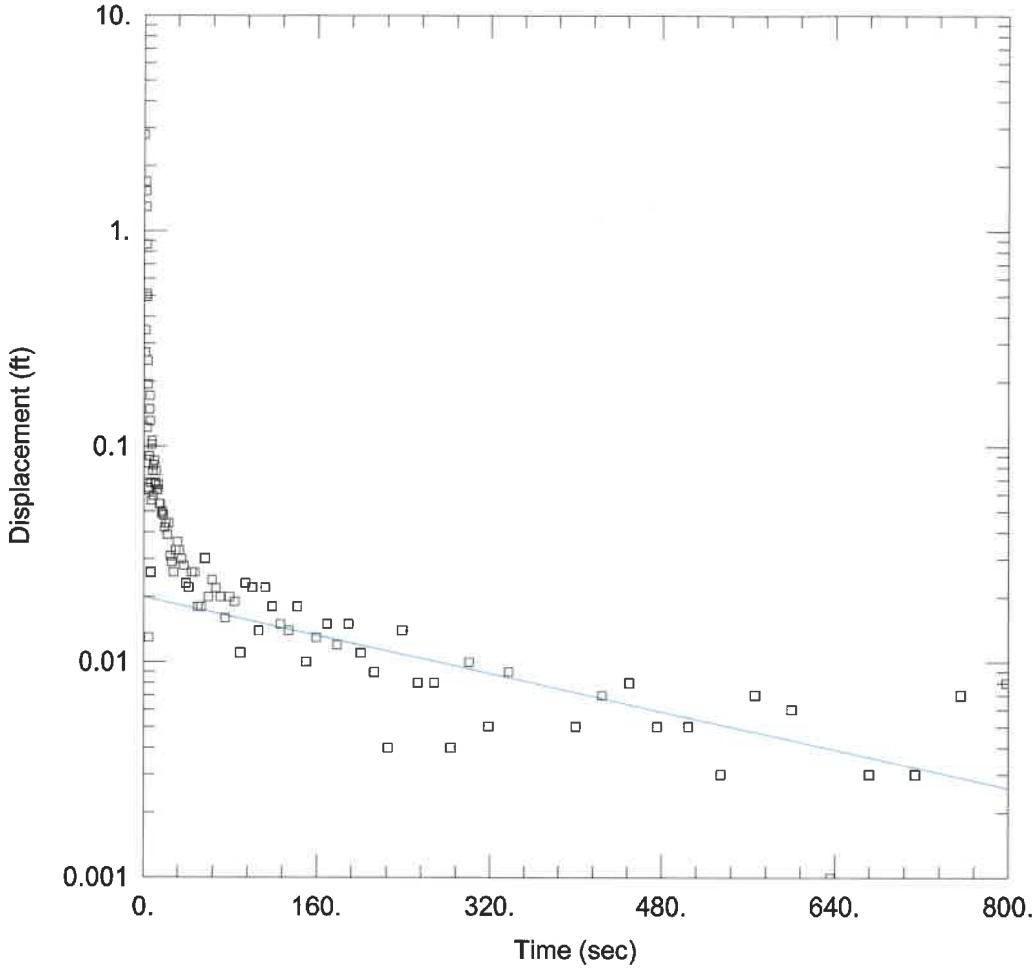
SOLUTION

Aquifer Model: Confined

Kr = 0.0032 cm/sec
Kz/Kr = 1.

Solution Method: KGS Model

Ss = 0.001 ft^{-1}



G54C FALLING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G54C-fh.aqt
Date: 06/02/21 Time: 16:26:36

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: G54C
Test Date: 8 Mar 2021

AQUIFER DATA

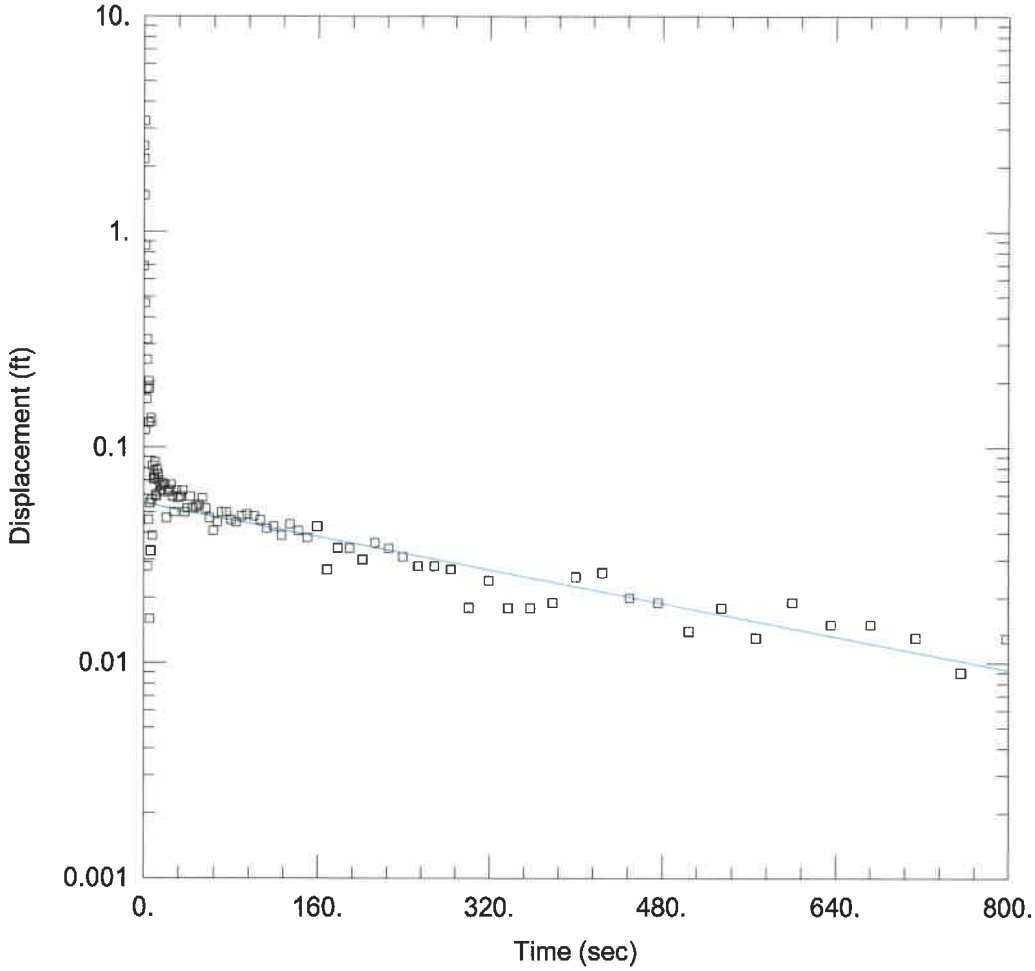
Saturated Thickness: 42.2 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (G54C)

Initial Displacement: 2.8 ft
Total Well Penetration Depth: 44.3 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 42.2 ft
Screen Length: 9.07 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.00016 cm/sec
y0 = 0.02 ft



G54C RISING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G54C-rh.aqt
Date: 06/02/21 Time: 16:26:38

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: G54C
Test Date: 8 Mar 2021

AQUIFER DATA

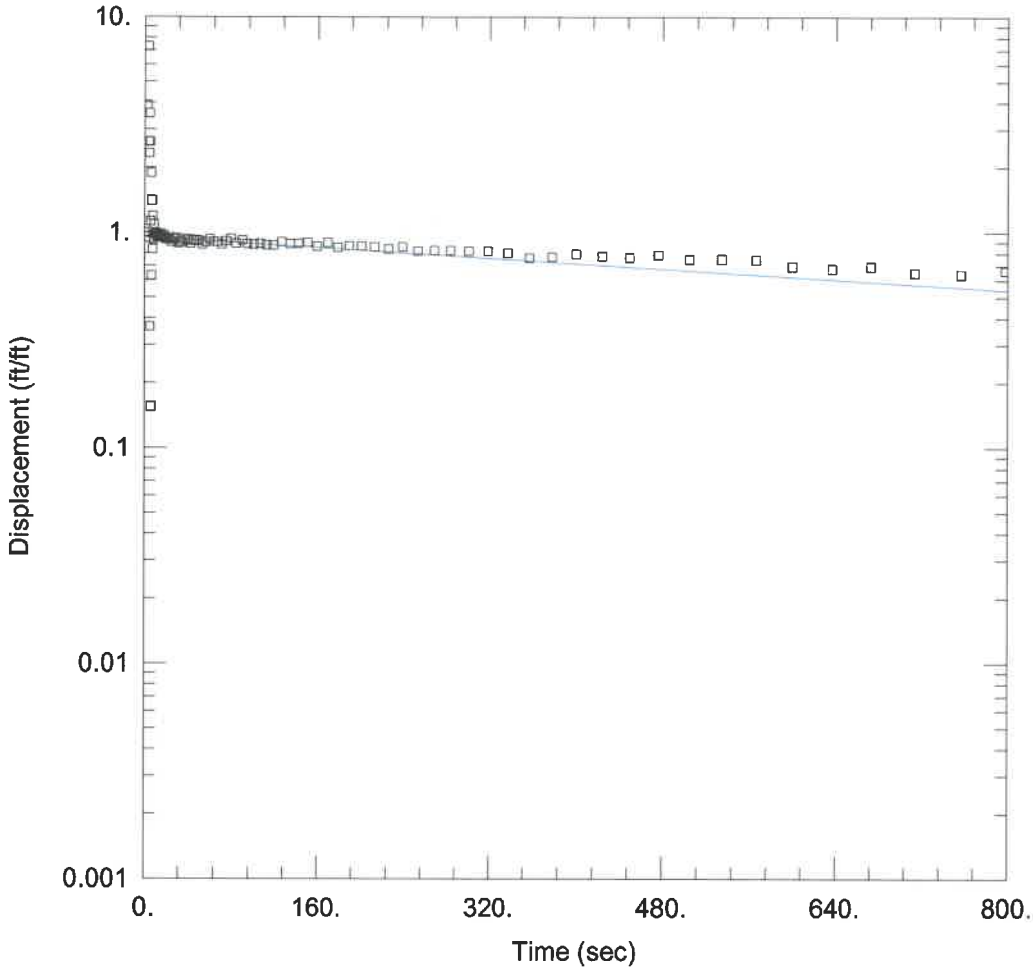
Saturated Thickness: 42.2 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (G54C)

Initial Displacement: 2.5 ft
Total Well Penetration Depth: 44.3 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 42.2 ft
Screen Length: 9.07 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.00014 cm/sec
y0 = 0.055 ft



G54L FALLING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G54L-fh.aqt
Date: 06/02/21 Time: 16:27:18

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: G54L
Test Date: 8 Mar 2021

AQUIFER DATA

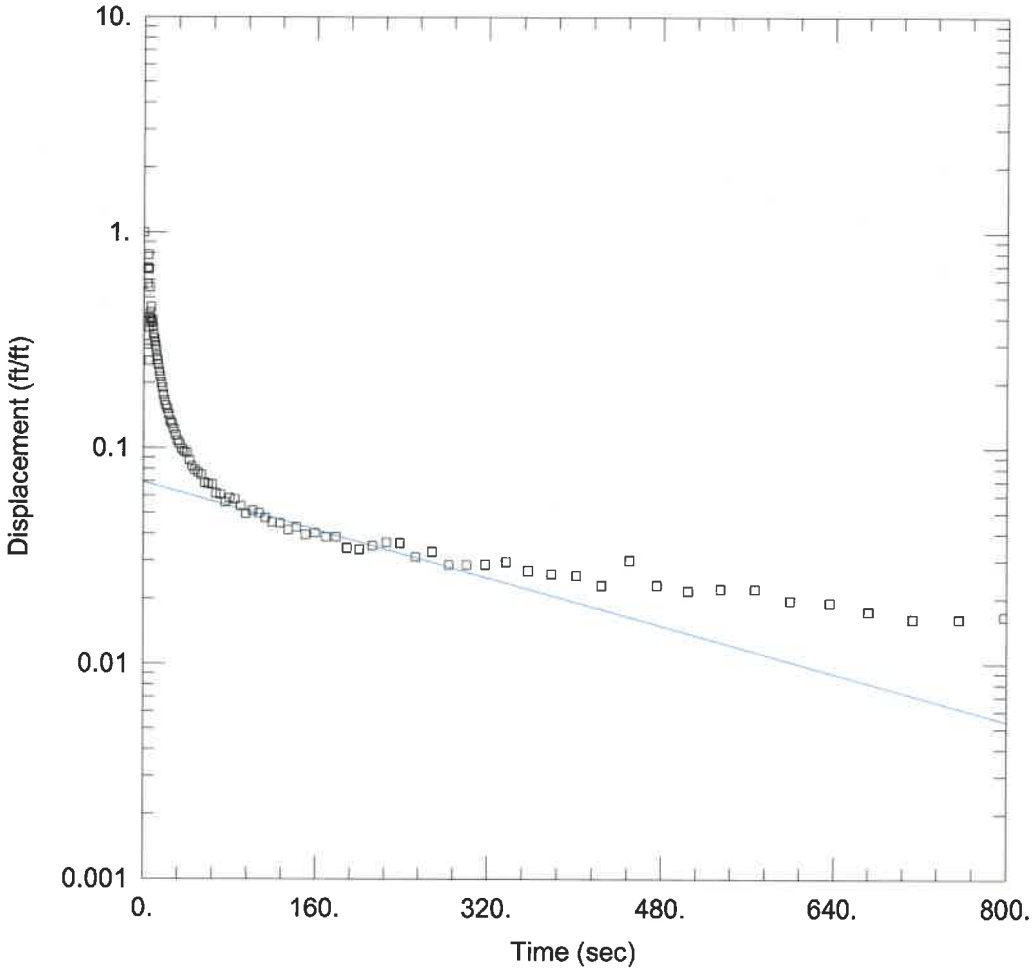
Saturated Thickness: 5.59 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (G54L)

Initial Displacement: 0.2 ft
Total Well Penetration Depth: 10.65 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 5.59 ft
Screen Length: 9.43 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 4.9E-5 cm/sec
y0 = 0.19 ft



G54L RISING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G54L-rh.aqt
Date: 06/02/21 Time: 16:27:20

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: G54L
Test Date: 8 Mar 2021

AQUIFER DATA

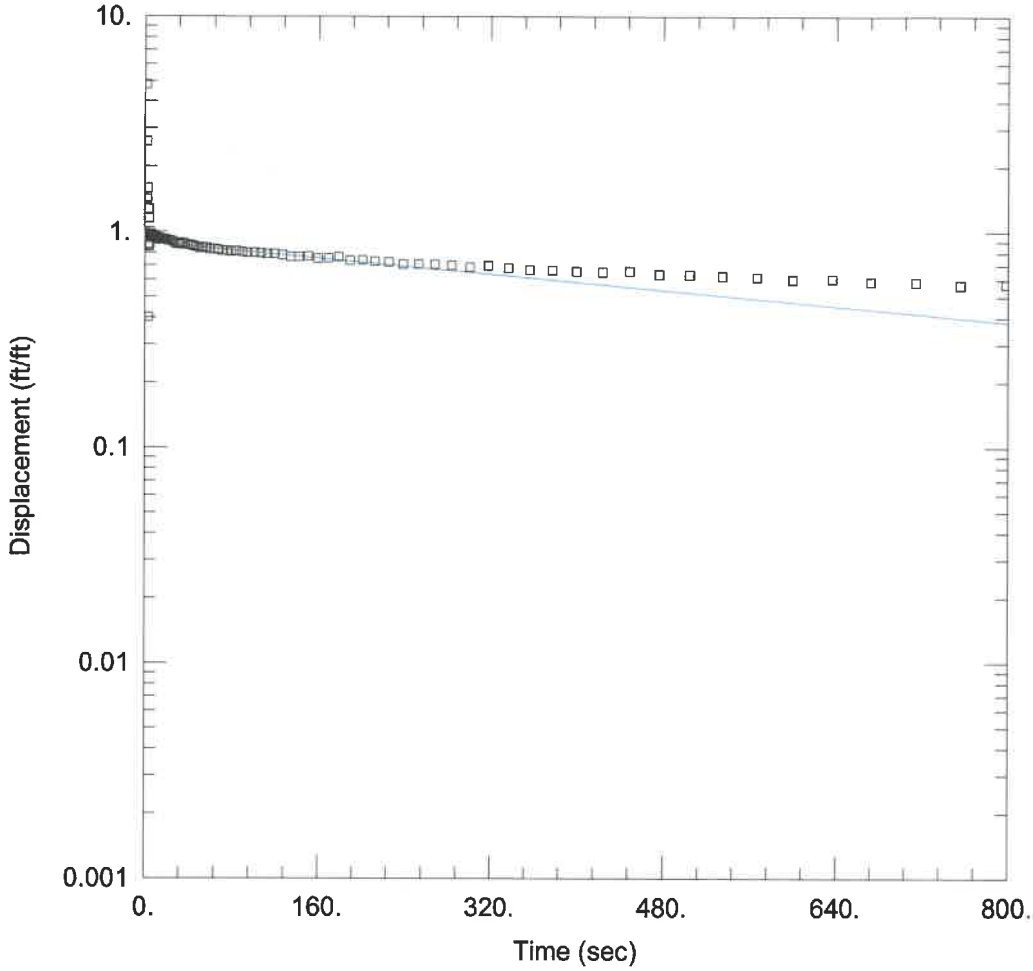
Saturated Thickness: 5.59 ft
Anisotropy Ratio (Kz/Kr): 0.001

WELL DATA (G54L)

Initial Displacement: 2.3 ft
Total Well Penetration Depth: 10.65 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 5.59 ft
Screen Length: 9.43 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.00022 cm/sec
y0 = 0.16 ft



G54S FALLING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G54S-fh.aqt
Date: 06/02/21 Time: 16:27:22

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: G54S
Test Date: 8 Mar 2021

AQUIFER DATA

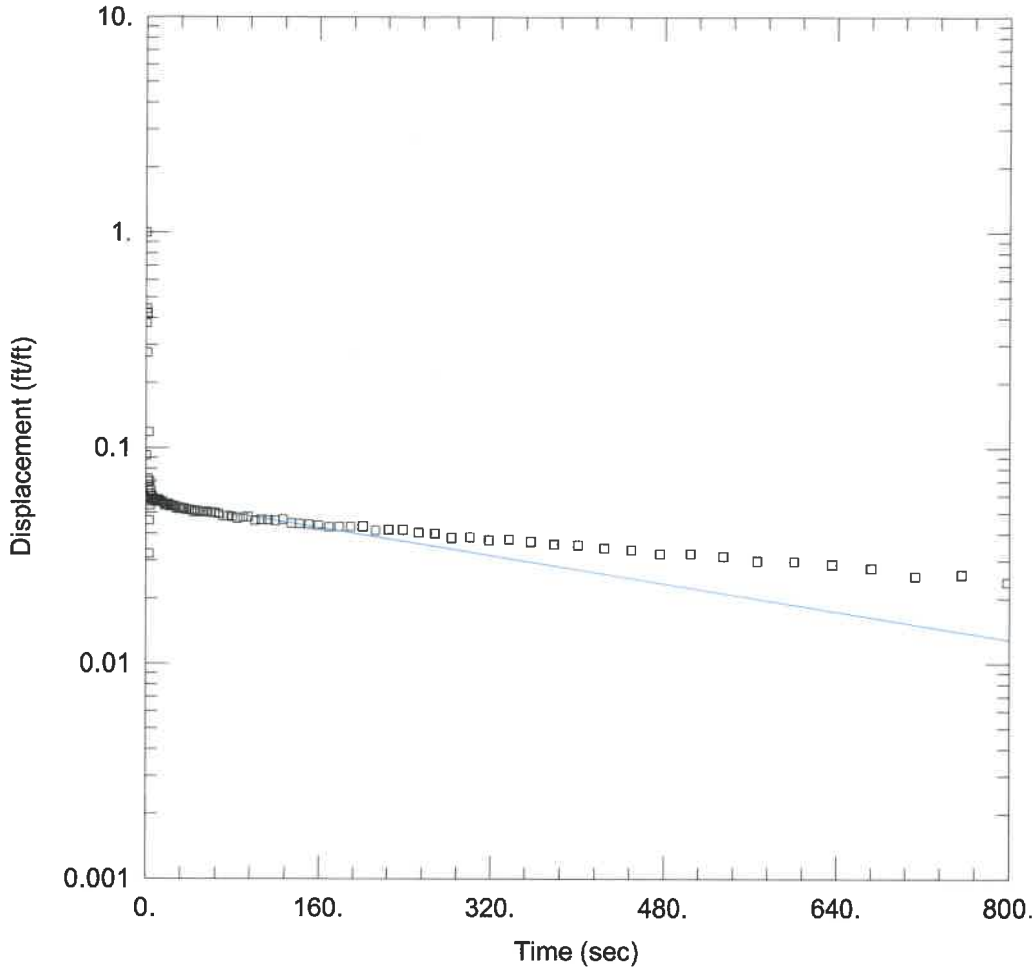
Saturated Thickness: 3.6 ft
Anisotropy Ratio (Kz/Kr): 0.001

WELL DATA (G54S)

Initial Displacement: 0.525 ft
Total Well Penetration Depth: 17.18 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 14.36 ft
Screen Length: 4.47 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.00012 cm/sec
y0 = 0.47 ft



G54S RISING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G54S-rh.aqt
Date: 06/02/21 Time: 16:27:23

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: G54S
Test Date: 8 Mar 2021

AQUIFER DATA

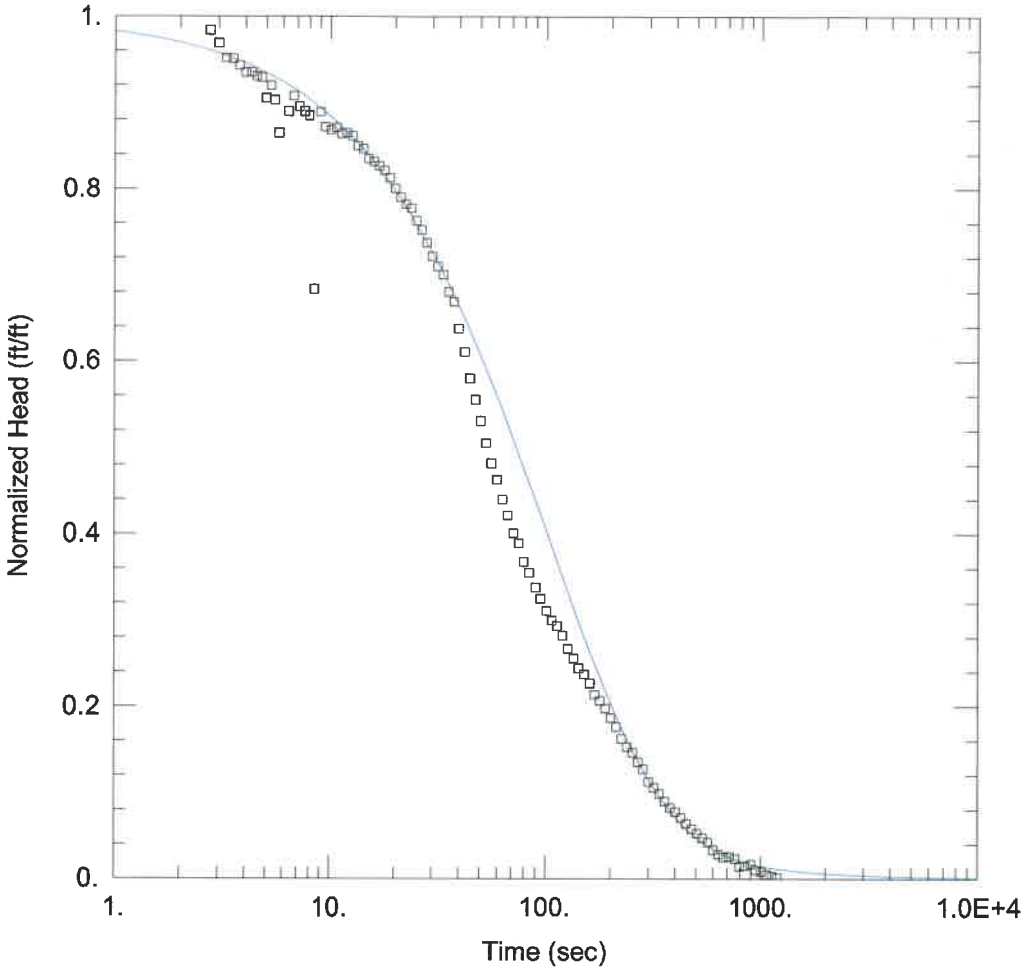
Saturated Thickness: 3.6 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (G54S)

Initial Displacement: 7.8 ft
Total Well Penetration Depth: 17.18 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 14.36 ft
Screen Length: 4.47 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.00021 cm/sec
y0 = 0.45 ft



G57S FALLING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G57S-fh.aqt
Date: 06/02/21 Time: 16:27:25

AQUIFER DATA

Saturated Thickness: 1.9 ft

WELL DATA (G57S)

Initial Displacement: 1.55 ft
Total Well Penetration Depth: 10.16 ft
Casing Radius: 0.08333 ft

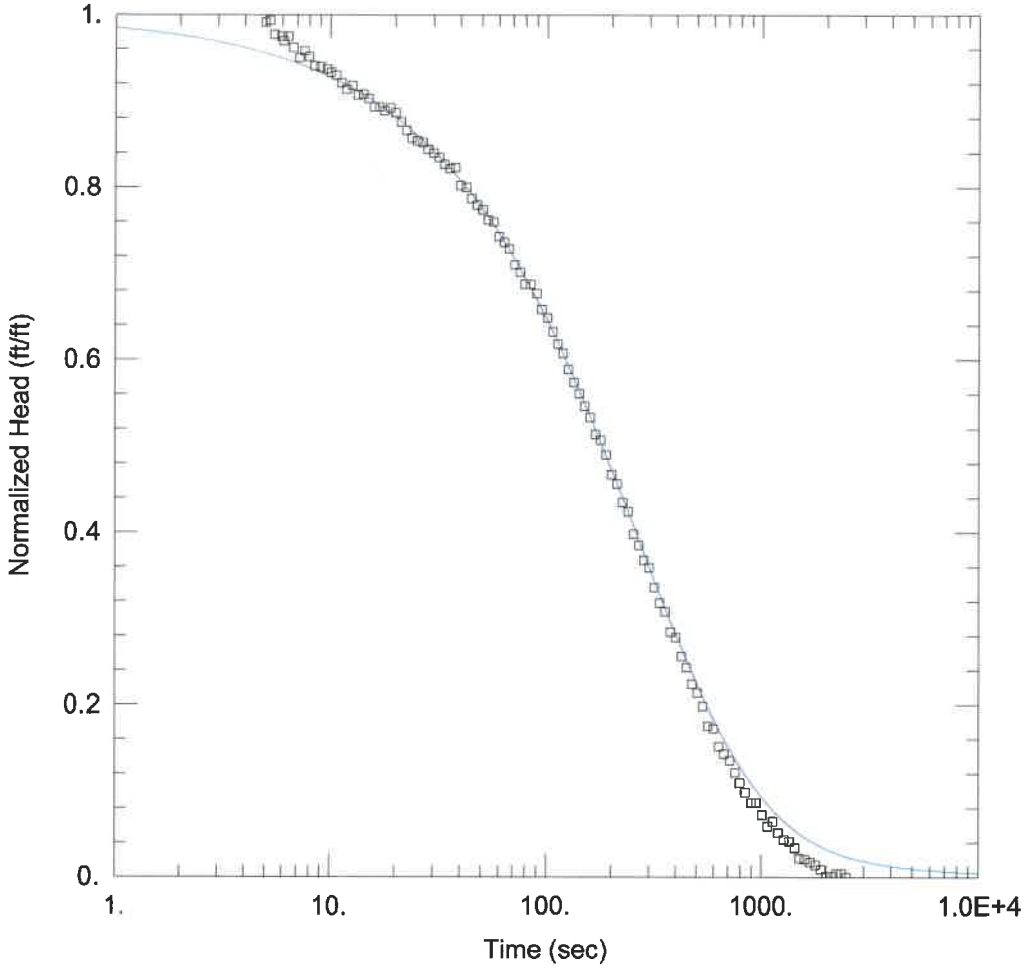
Static Water Column Height: 7.62 ft
Screen Length: 4.53 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0026 cm/sec
Kz/Kr = 1.

Ss = 7.0E-5 ft^{-1}



G57S RISING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G57S-rh.aqt
Date: 06/02/21 Time: 16:27:26

AQUIFER DATA

Saturated Thickness: 1.9 ft

WELL DATA (G57S)

Initial Displacement: 0.925 ft
Total Well Penetration Depth: 10.16 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 7.62 ft
Screen Length: 4.53 ft
Well Radius: 0.08333 ft

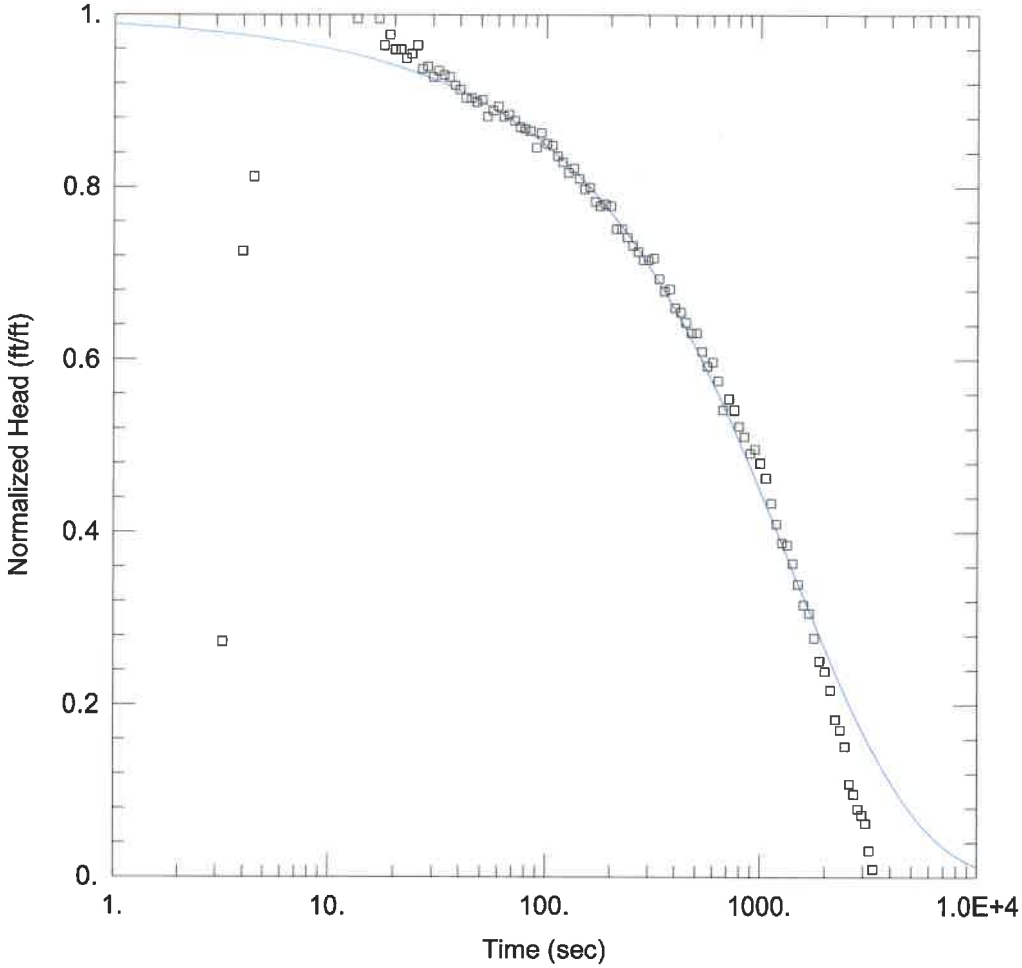
SOLUTION

Aquifer Model: Confined

Solution Method: KGS Model

Kr = 0.00068 cm/sec
Kz/Kr = 0.001

Ss = 0.0022 ft^{-1}



G60L FALLING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G60L-fh.aqt
Date: 06/02/21 Time: 16:27:28

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: G60L
Test Date: 5 Mar 2021

AQUIFER DATA

Saturated Thickness: 1.04 ft

WELL DATA (G60L)

Initial Displacement: 0.415 ft
Total Well Penetration Depth: 5.4 ft
Casing Radius: 0.08333 ft

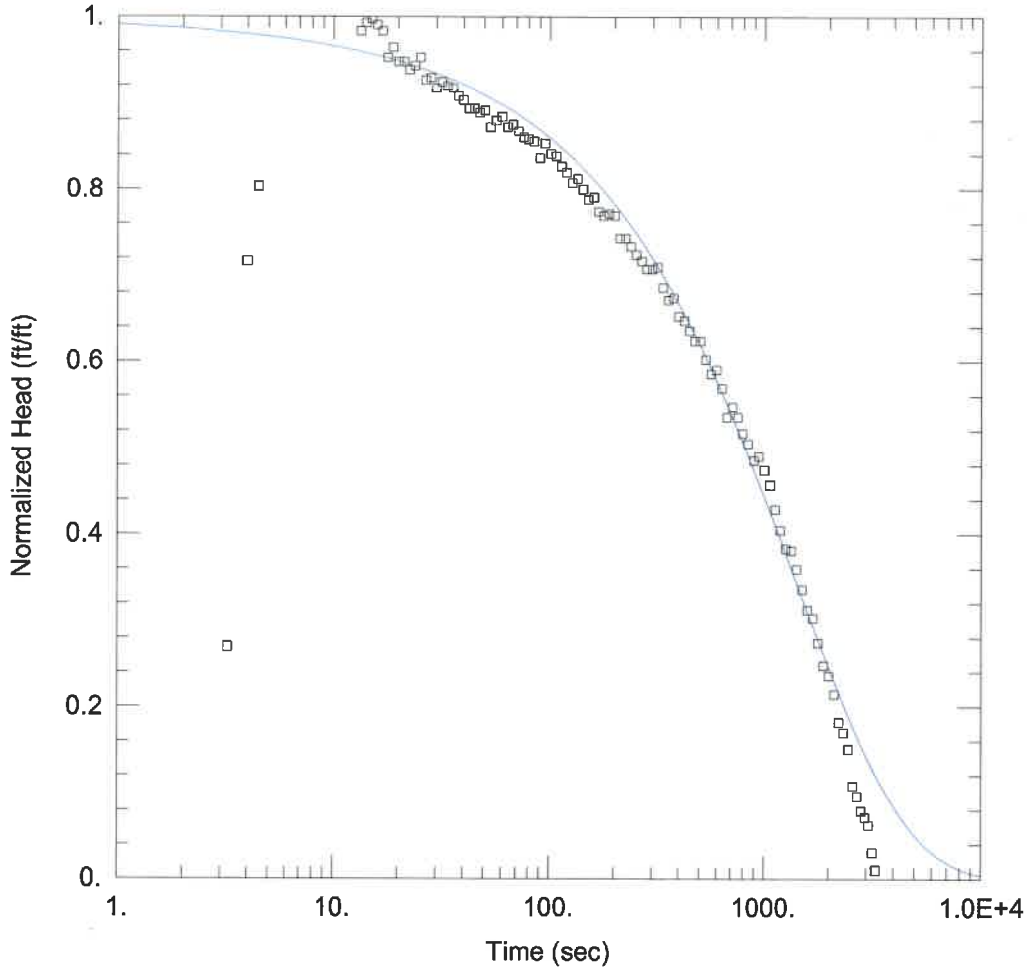
Static Water Column Height: 1.04 ft
Screen Length: 4.74 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.00023 cm/sec
Kz/Kr = 1.

Ss = 0.06 ft^{-1}



G60L RISING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G60L-rh.aqt
Date: 06/02/21 Time: 16:27:30

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: G60L
Test Date: 5 Mar 2021

AQUIFER DATA

Saturated Thickness: 1.04 ft

WELL DATA (G60L)

Initial Displacement: 0.42 ft
Total Well Penetration Depth: 5.4 ft
Casing Radius: 0.08333 ft

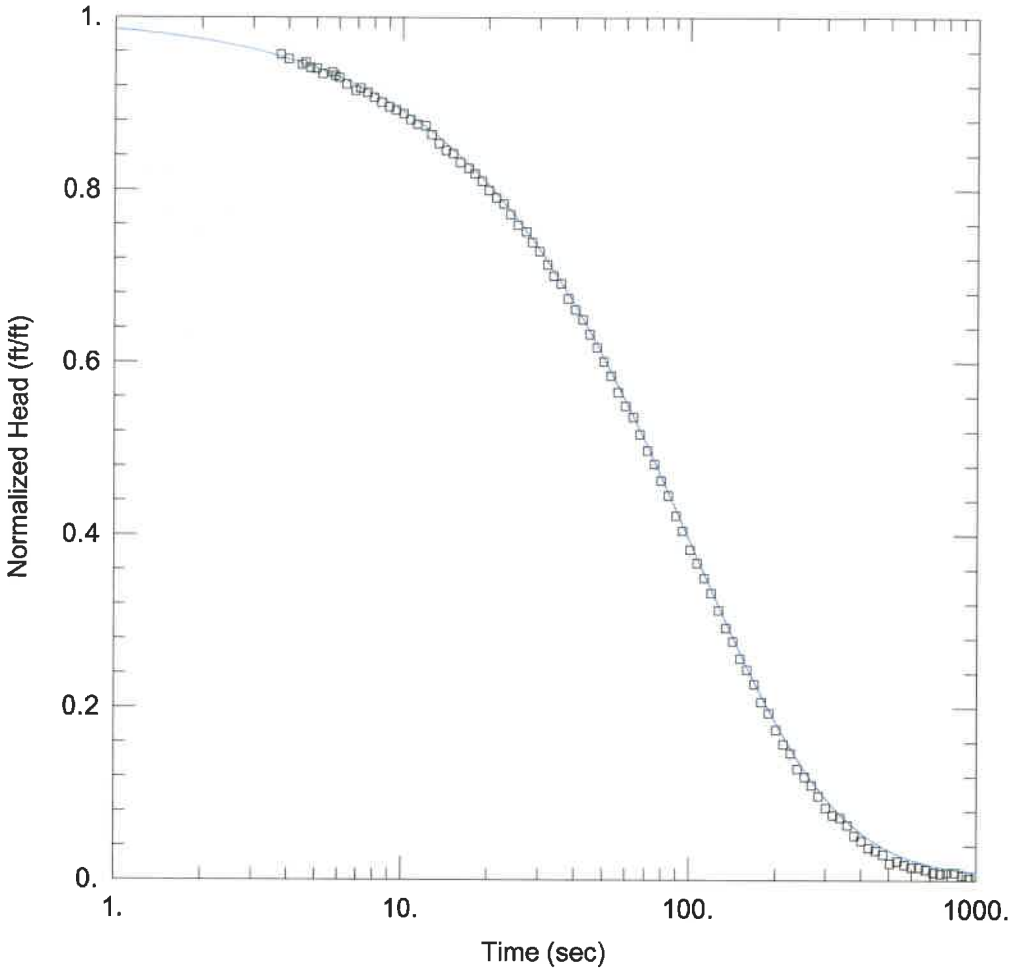
Static Water Column Height: 1.04 ft
Screen Length: 4.74 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.00026 cm/sec
Kz/Kr = 1.

Ss = 0.035 ft^{-1}



G60S FALLING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G60S-fh.aqt
Date: 06/02/21 Time: 16:27:31

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: G60S
Test Date: 5 Mar 2021

AQUIFER DATA

Saturated Thickness: 1.9 ft

WELL DATA (G60S)

Initial Displacement: 1.55 ft
Total Well Penetration Depth: 7.23 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 3.91 ft
Screen Length: 3.95 ft
Well Radius: 0.08333 ft

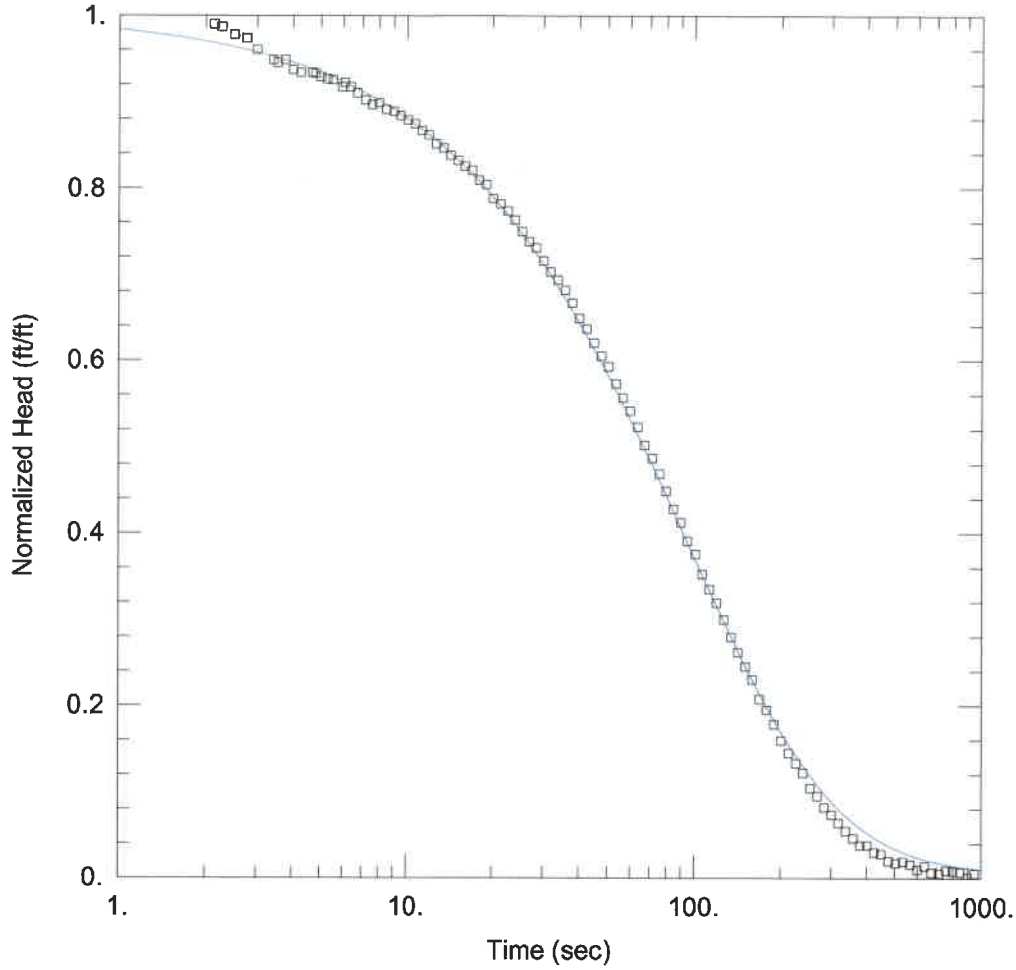
SOLUTION

Aquifer Model: Confined

Kr = 0.0039 cm/sec
Kz/Kr = 1.

Solution Method: KGS Model

Ss = 7.1E-6 ft^{-1}



G60S RISING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G60S-rh.aqt
Date: 06/02/21 Time: 16:27:33

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: G60S
Test Date: 5 Mar 2021

AQUIFER DATA

Saturated Thickness: 1.9 ft

WELL DATA (G60S)

Initial Displacement: 1.85 ft
Total Well Penetration Depth: 7.23 ft
Casing Radius: 0.08333 ft

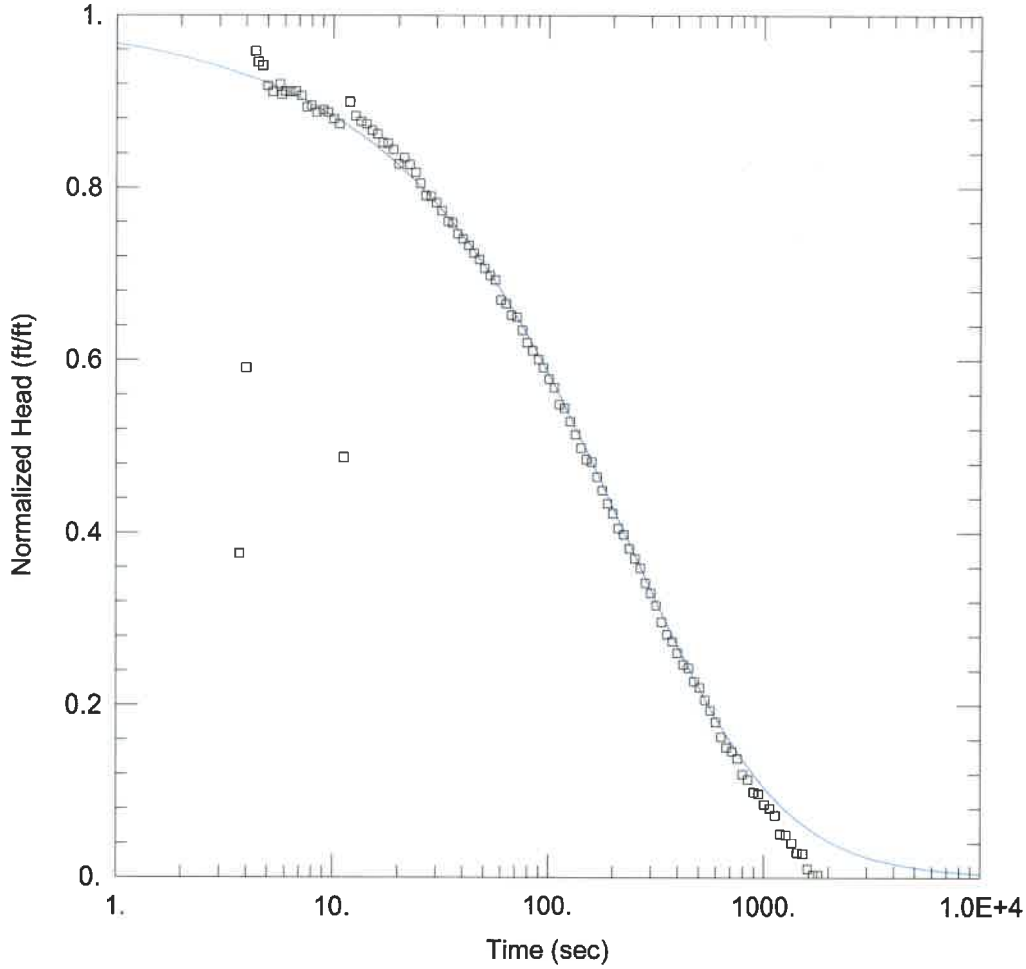
Static Water Column Height: 3.91 ft
Screen Length: 3.95 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0035 cm/sec
Kz/Kr = 1.

Ss = 7.0E-5 ft^{-1}



G63S FALLING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G63S-fh.aqt
Date: 06/02/21 Time: 16:27:35

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: G63L
Test Date: 5 May 2021

AQUIFER DATA

Saturated Thickness: 10.8 ft

WELL DATA (G63S)

Initial Displacement: 0.975 ft
Total Well Penetration Depth: 13.54 ft
Casing Radius: 0.08333 ft

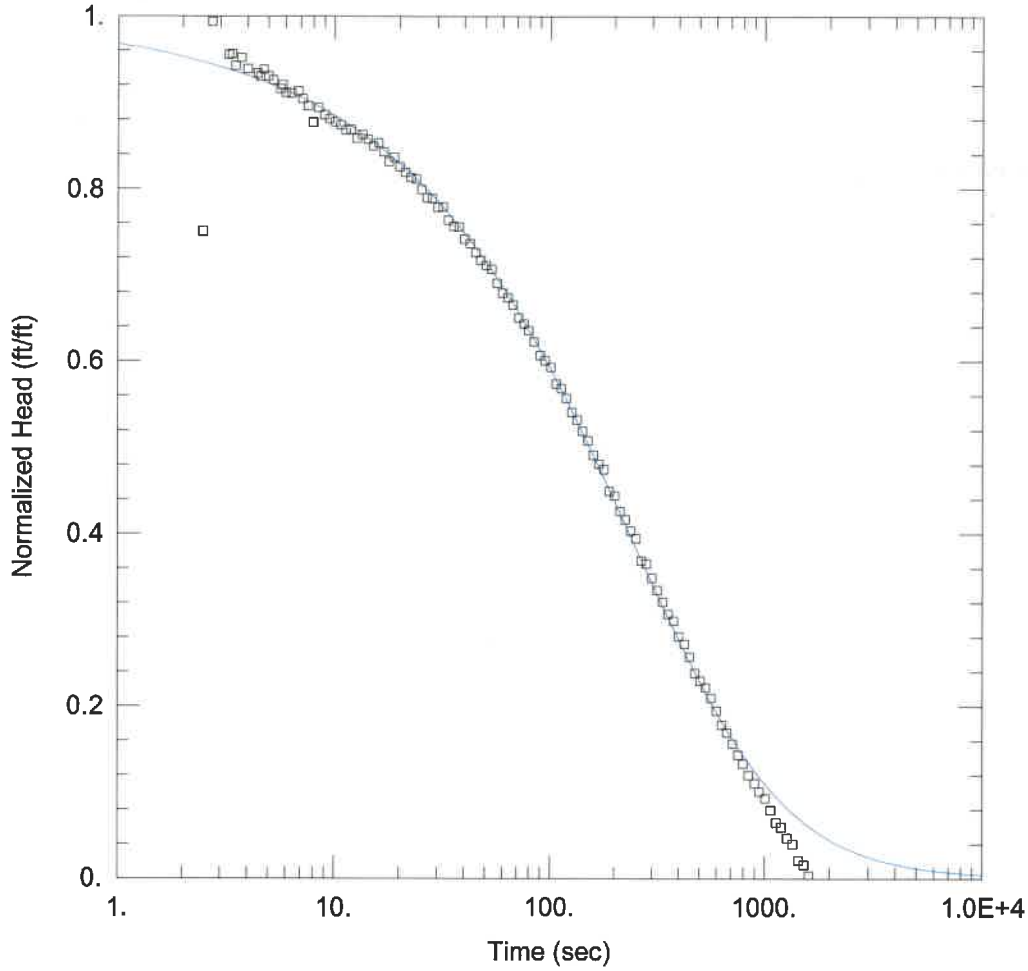
Static Water Column Height: 10.84 ft
Screen Length: 4.49 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.0003 cm/sec
Kz/Kr = 1.

Ss = 0.02 ft^{-1}



G63S RISING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\G63S-rh.aqt
Date: 06/02/21 Time: 16:27:37

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: G63S
Test Date: 5 Mar 2021

AQUIFER DATA

Saturated Thickness: 10.8 ft

WELL DATA (G63S)

Initial Displacement: 1.15 ft
Total Well Penetration Depth: 13.54 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 10.84 ft
Screen Length: 4.49 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00029 cm/sec
Kz/Kr = 1.

Ss = 0.02 ft^{-1}

APPENDIX F
FEMA FLOOD HAZARD MAP

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or flood plain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or flood plain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

In the State of Illinois, any portion of a stream or watercourse that lies within the **floodway fringe** of a studied (AE) stream may have a state regulated floodway. The FIRM may not depict these state regulated floodways.

Floodways restricted by anthropogenic features such as bridges and culverts are drawn to reflect natural conditions and may not agree with the model computed widths listed in the Floodway Data table in the Flood Insurance Study report.

Multiple **topographic sources** may have been used in the delineation of Special Flood Hazard Areas. See Flood Insurance Study report for details on source resolution and geographic extent.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 15. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services, NOAA, N/NGS12
National Geodetic Survey SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at www.ngs.noaa.gov.

Base map information shown on this FIRM was provided in digital format by the United States Geological Survey. Digital orthoimagery with a spatial resolution of 0.5 meter ground sample distance were photogrammetrically compiled from aerial photography acquired during the leaf-off period of spring 2005.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The Special Flood Hazard Areas and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

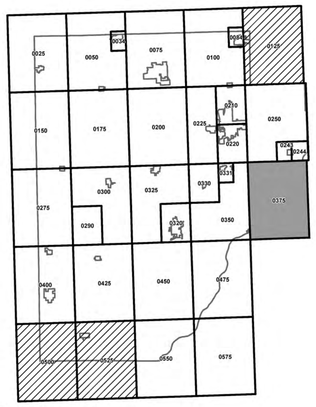
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the Map Service Center (MSC) website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

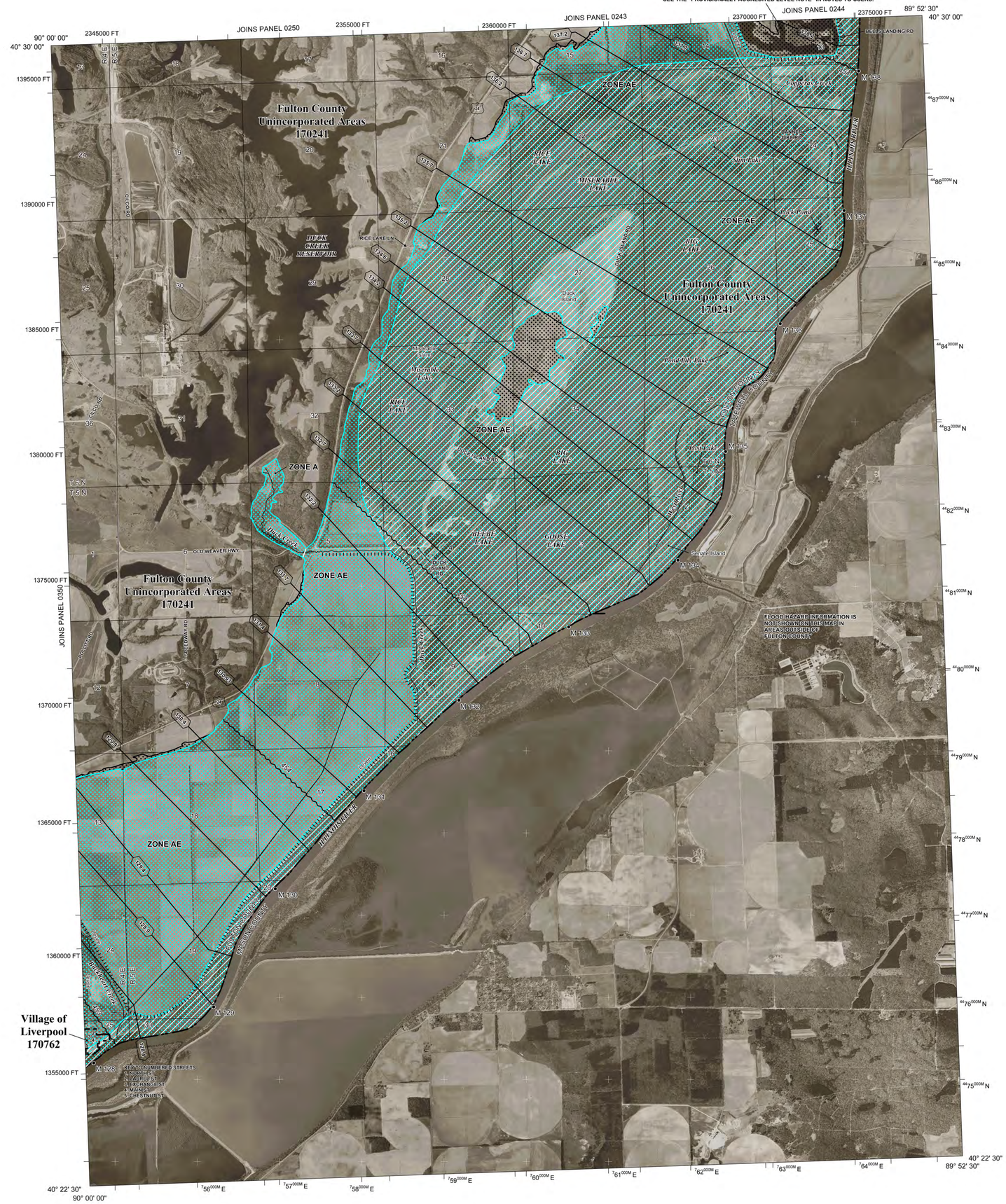
If you have **questions about this map**, how to order products or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

Provisionally Accredited Levee Notes to Users: Check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection for areas on this panel. To maintain accreditation, the levee owner or community is required to submit the data and documentation necessary to comply with Section 65.10 of the NFIP regulations by December 31, 2010. If the community or owner does not provide the necessary data and documentation or if the data and documentation provided indicate the levee system does not comply with Section 65.10 requirements, FEMA will revise the flood hazard and risk information for this area to reflect de-accreditation of the levee system. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA website at http://www.fema.gov/business/nfip/index.shtm.

PANEL INDEX



NOTE: THIS AREA IS SHOWN AS BEING PROTECTED FROM THE 1-PERCENT-ANNUAL-CHANCE OR GREATER FLOOD HAZARD BY A LEVEE SYSTEM THAT HAS BEEN PROVISIONALLY ACCREDITED. OVERTOPPING OR FAILURE OF ANY LEVEE SYSTEM IS POSSIBLE. FOR ADDITIONAL INFORMATION, SEE THE "PROVISIONALLY ACCREDITED LEVEE NOTE" IN NOTES TO USERS.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% annual chance floodplain boundary
	0.2% annual chance floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A	Cross section line
23 - - - - 23	Transect line
45° 02' 08", 93° 02' 12"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4489000M N	1000-meter Universal Transverse Mercator grid values, zone 15
1565000 FT	5000-foot grid tick: Illinois State Plane West Coordinate System, 3801 zone (FIPSZONE 1202) Transverse Mercator
DX5510X	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
FEBRUARY 4, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 2000'

1000 0 2000 4000 FEET

600 0 600 1200 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0375E

FIRM
FLOOD INSURANCE RATE MAP
FULTON COUNTY, ILLINOIS
AND INCORPORATED AREAS

PANEL 375 OF 575

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
FULTON COUNTY	170241	0375	E
LIVERPOOL, VILLAGE OF	170762	0375	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
17057C0375E

EFFECTIVE DATE
FEBRUARY 4, 2011

Federal Emergency Management Agency

APPENDIX E

Evaluation of Potential Exceedances of Groundwater Protection Standards

GOLDER
MEMBER OF WSP

TECHNICAL MEMORANDUM

DATE October 15, 2021 **Project No.** 21454831

TO David Mitchell, Stu Cravens, Vic Modeer
Illinois Power Resources Generating, LLC

CC Brian Hennings - Ramboll

FROM Roberta Russell, Jeffrey Ingram, Pat Behling - Golder

EVALUATION OF POTENTIAL GWPS EXCEEDANCES, GYPSUM MANAGEMENT FACILITY POND, DUCK CREEK POWER PLANT, FULTON COUNTY, ILLINOIS

1.0 INTRODUCTION

Illinois Power Resource Generating, LLC (IPRG) formerly operated the Duck Creek Power Plant (DCPP) located in Fulton County, Illinois. The Gypsum Management Facility Pond (GMFP, Illinois Environmental Protection Agency [IEPA] ID No. W0578010001-04) is a surface impoundment used to manage gypsum and related coal combustion residuals (CCRs) at the DCPP. The GMFP is regulated under Part 845 *"Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments"* (State CCR Rule or Part 845) which was promulgated by the Illinois Pollution Control Board (IPCB) on April 21, 2021.

IPRG is currently preparing an Operating Permit application for the GMFP as required under Section 845.230 which requires that known exceedances of groundwater protection standards (GWPS) be documented as a part of the Operating Permit application. In October 2021, Ramboll Americas Engineering Solutions, Inc. (Ramboll) identified potential GWPS exceedances for pH, arsenic, and lead in groundwater samples collected from selected monitoring wells in the vicinity of the GMFP as presented in the Operating Permit application for the GMFP. This Technical Memorandum was developed to further evaluate these potential GWPS exceedances.

1.1 Site Setting, Geology and Hydrogeology

The Duck Creek Power Plant (Site) is an inactive power plant in Fulton County, located in central Illinois, approximately 9 miles southeast of the town of Canton. The GMFP is located north of the power plant (see Figure 1). Agricultural land surrounds the DCPP.

Regionally, the Site is positioned on the glacial uplands above the Illinois River in the Ancient Illinois Floodplain of the Till Plains Section of the Central Lowland Province. The undisturbed unlithified materials consist of loess, diamictons, and lacustrine/alluvial deposits. The area is flat to gently rolling uplands that are dissected by deeply incised streams that are tributaries to major river systems (NRT/OBG 2017).

Several large former surface coal mines are present in the vicinity; unlithified materials are present in the excavated strip mine spoils and have been mixed due to the surface mining activities. Mining operations in the area have ceased.

The uppermost bedrock stratum in the area is the Carbondale Formation of the Kewanee Group of the Pennsylvanian System. Bedrock in the area is identified as Pennsylvanian-age shale deposits. Bedrock occurs within approximately 50 feet (ft) of the ground surface in this area.

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13515 Barrett Parkway Drive, Suite 260, Ballwin, Missouri, USA 63021 T: +1 314 984-8800 F: +1 314 984-8770

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The following two unlithified water-bearing units are present beneath the GMF Pond (beginning at the ground surface):

- Loess Zone – Moderate to high permeability silts and clayey silts, including: the Peoria and Roxanna Silt (Loess Units); underlain by the low permeability clayey diamictons of the Berry Clay and upper Radnor Till Members of the Glasford Formation.
- Shallow Sand Unit – Thin to moderately thick (6 to 18 ft), moderate to high permeability, medium-grained sand to silt with intercalated till seams; underlain by till sequences of the lower Radnor Till Member of the Glasford Formation.

The Uppermost Aquifer in the area consists of the Loess and Shallow Sand. These hydraulically connected units are underlain by the lower Radnor Till Member of the Glasford Formation. As shown on Figure 1, groundwater typically flows from northwest to southeast in the Uppermost Aquifer (NRT/OBG 2017).

1.2 Gypsum Management Facility Pond Design and Operation History

The GMFP is a 1,500-foot by 900-foot earthen berm double-lined CCR surface impoundment. Construction of the dual composite liner system and a leak detection system layer was completed in 2007-2009 under a rigorous construction quality assurance program (Hanson, 2009), which is an important determinant of liner system performance. The GMFP consists of the following components from top to bottom:

- Primary Composite Liner
  - SOLMAX 460T-1000 60-mil (0.06-inch thick) textured high-density polyethylene (HDPE) geomembrane
  - 1-foot cushion soil layer (2 feet in selected areas on the side slopes)
- Leak detection layer
  - SKAPS GT-142 4-0z/yd^2 geotextile separator
  - 1-foot granular drainage layer
  - SKAPS FE-110 10-oz/yd^2 geotextile cushion
- Secondary composite liner
  - Solmax 460T-4013 60-mil texture HDPE geomembrane
  - CETCO Bentomat SDN reinforced geosynthetic clay liner (GCL)
  - 3-foot compacted clay layer placed in 8-inch lifts, compacted to at least 95% of the standard Proctor maximum dry density at a moisture content between the standard Proctor optimum moisture content (OMC) and 5% of the wet OMC

The GMFP was used to store gypsum and to clarify gypsum transport water for reuse in the wet scrubber system at the DCPP until the plants retirement in 2019. Gypsum materials are the only waste managed in the GMFP.

2.0 POTENTIAL GWPS EXCEEDANCES REVIEW

As required by Section 845.230 (d)(2)(M), an evaluation of the history of potential GWPS exceedances was competed for the Operating Permit application by Ramboll. Data collected from groundwater samples collected from the GMFP monitoring well network since January 30, 2015, were evaluated and potential exceedances of the GWPSs are summarized below.

- Field pH at monitoring well G52L: A field pH GWPS exceedance was noted in a single sample collected from this well in February 2021. The pH value of 6.4 standard units (s.u.) measured in the sample is outside the Part 845 GWPS pH range of 6.5-9.0 s.u. G52L is located cross-gradient/up-gradient from the GMF pond and the screening interval is completed within the Loess unit.
- Field pH at monitoring well G60L: Field pH GWPS exceedances were noted in this well for each of the nine samples collected from this well from March-July 2021. The average pH for the nine samples was 6.1 s.u., which is outside the Part 845 GWPS pH range of 6.5-9.0 s.u. The well is located down-gradient on the east side of the GMFP and the screening interval is completed within the Loess unit.
- Arsenic at monitoring well P60: A total arsenic GWPS exceedance was noted in a single sample collected from this well in March 2021. The arsenic concentration of 0.02 milligrams per liter (mg/L) measured in the sample slightly exceeds the Part 845 GWPS of 0.01 mg/L. P60 is located down-gradient on the east side of the GMFP and the screening interval is completed within the Loess unit.
- Lead at monitoring well P60: A total lead GWPS exceedance was noted in a single sample collected from this well in March 2021. The lead concentration of 0.036 mg/L measured in the sample slightly exceeds the Part 845 GWPS of 0.015 mg/L. P60 is located down-gradient on the east side of the GMFP and the screening interval is completed within the Loess unit.

3.0 EVIDENCE THAT POTENTIAL GWPS EXCEEDANCES ARE NOT RELATED TO THE GMFP

Groundwater data for samples collected from monitoring wells that exhibited potential GWPS exceedances, background monitoring wells and pore water samples from the GMFP were evaluated. The review of these data indicates that the GWPS exceedances are not related to the GMFP, as described in the lines of evidence (LOE) below:

- **The ionic composition of groundwater collected from G52L, G60L and P60 is similar to groundwater collected from background wells G02S, G50S and G52S.**

A Piper diagram is a graphical technique used to classify and compare different groundwater sources based on their ionic composition in aqueous solution. As shown on the Piper diagram presented as Figure 2, the ionic composition of groundwater samples collected from G52L, G60L and P60 is similar to groundwater samples collected from the background wells – both groups of samples exhibit a calcium-bicarbonate water-type. Pore

and surface water samples collected from the GMFP exhibit a magnesium-chloride water-type, which is distinctly different to the background wells and monitoring wells G52L, G60L and P60. It would be expected that if there were a release from the GMFP, the ionic composition of the monitoring wells would show a mixing pattern towards the pore water ionic composition. However, as shown on Figure 2, the compositions of the monitoring wells are clustered with the background well compositions and distant from the pore and surface water compositions. These data support that the GWPS standard exceedances of pH in G52L and G60; the arsenic exceedance in P60; and the lead exceedance in P60 are not related to the GMFP.

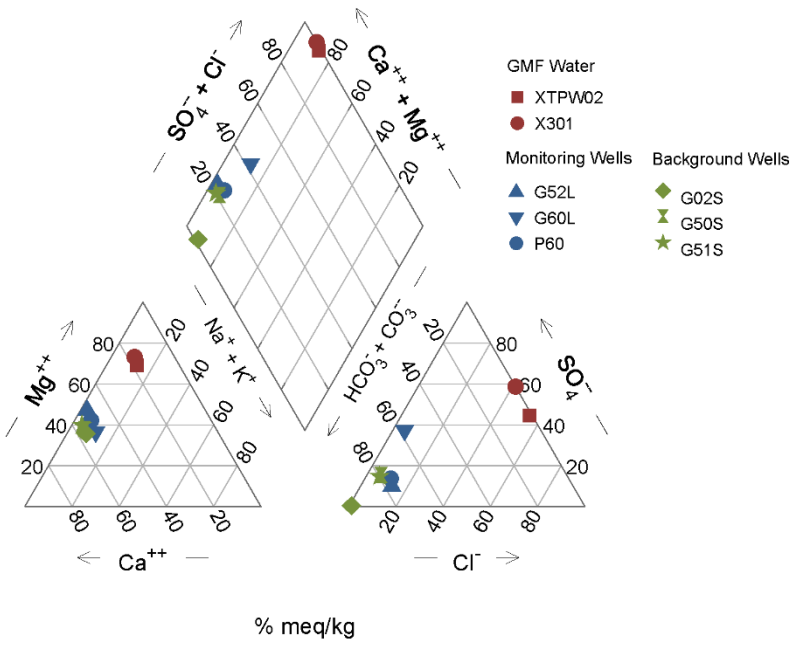


Figure 2: Piper diagram showing water chemistry of GMF Surface and Pore Water, monitoring wells G52L, G60L and P60, and background wells.

- **Concentrations of key GMFP constituents differ significantly in GMFP pore water samples and groundwater samples from monitoring wells G52L, G60L and P60.**

Concentrations of key constituents typically associated with CCR gypsum waste (boron, calcium, chloride, fluoride, sodium and sulfate) differ significantly between pore water/surface water in the GMFP and groundwater samples collected from the monitoring wells (Table 1, Figures 3 and 4). For example, boron, a typical gypsum indicator that is very mobile and non-reactive within a groundwater matrix, is elevated in GMF surface water and pore water samples (29 - 98 mg/L), whereas the monitoring wells G52L, G60L and P60 contain significantly lower concentrations (0.022 – 0.068 mg/L) that are more consistent with background results. Given the geochemical behavior of boron, it would be expected that elevated boron concentrations above background values would be observed in monitoring wells had a release occurred from the GMF pond. Similarly, fluoride and sulfate, other very mobile GMF constituents, would be expected to be observed in monitoring wells above the site GWPS in the event of a release from the GMF Pond. Figures 3 and 4 below and Table 1 show the

differences in concentrations between GMF surface water/pore water and monitoring wells for other key GMF constituents. Table 1 also contains site background and the Part 845 GWPSs. These data support that the GWPS standard exceedances of pH in G52L and G60; the arsenic exceedance in P60; and the lead exceedance in P60 are not related to the GMFP.

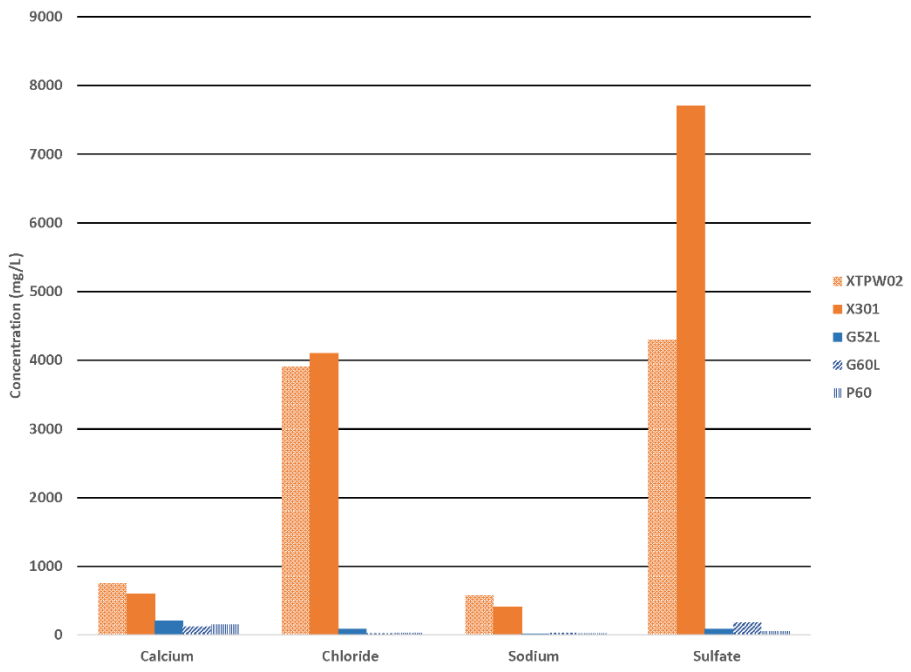


Figure 3: Bar chart showing GMFP constituent concentration comparisons between GMFP Surface and Pore Water and monitoring wells G52L, G60L and P60.

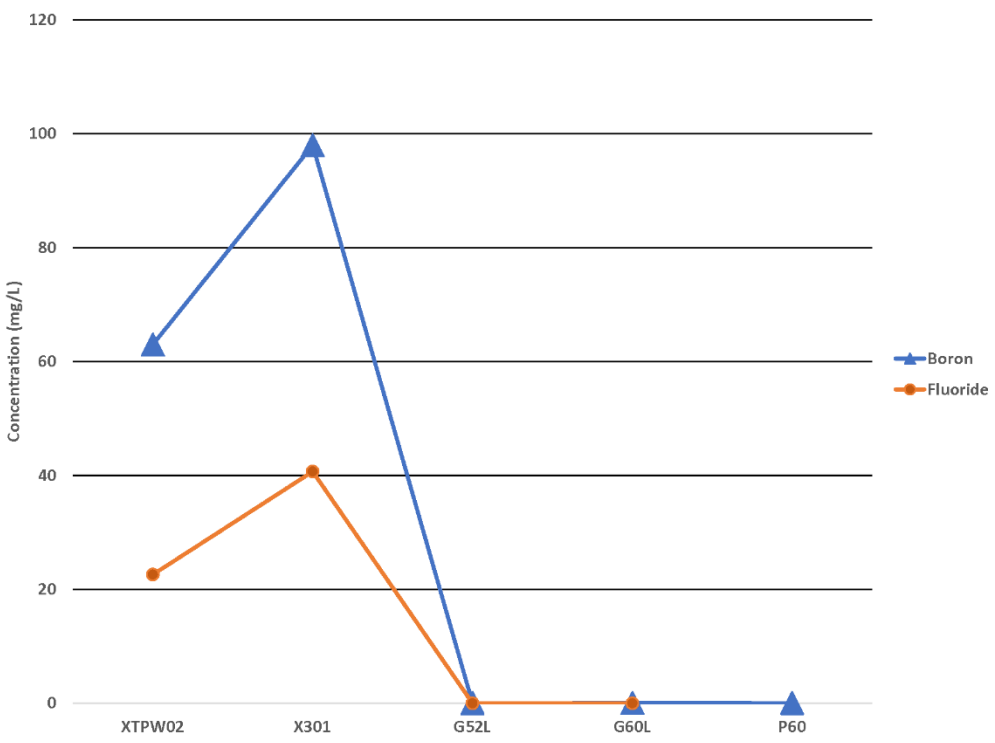


Figure 4: Line chart showing GMFP constituent concentration comparisons between GMFP Surface and Pore Water and monitoring wells G52L, G60L and P60.

- **High turbidity was recorded on the groundwater sampling record for the sample collected from P60.**

The arsenic and lead GWPS exceedances were based on a single sample collected from P60 in March 2021. The groundwater sampling record indicated an unusually high turbidity reading just before sample collection (1620 nephelometric turbidity units (NTU)). According to the sampling record, the sample did not appear to be field filtered, nor was it filtered in the lab. Thus, the arsenic and lead sample concentrations are likely elevated due to the presence of excessive soil and/or colloidal particles in the sample and are not representative of actual groundwater conditions in the vicinity of this well. These circumstances support the conclusion that GWPS standard exceedances of lead and arsenic in P60 are not related to the GMFP.

- **A peat layer ranging in thickness from 1 to 4 feet is present in the immediate vicinity of P60.**

Peat was recorded in the boring log of P60 within the saturated zone (approximately 19.5-20.5 and 24-24.2 feet below ground surface (ft bgs)), but above the screened interval of the well (approximately 29.5-34.5 feet bgs) (Appendix A). Approximately 4 feet of peat was recorded within the saturated zone in a nearby soil boring, B-55 (approximately 13.5-17.5 feet bgs). Given the interconnected nature of the unlithified water-bearing units, it is possible that the peat layer is interacting with the groundwater-bearing unit in the immediate vicinity. Peat is typically associated with low pH and is known to sequester certain metals, including arsenic and lead. In combination with a high turbidity and unfiltered sample, this may be the cause of the slightly elevated arsenic

and lead concentrations in P60. Thus, the GWPS standard exceedances of pH in G60L and the arsenic lead exceedance in P60 may be associated with the peat layer encountered in the immediate vicinity of those wells.

- **Arsenic and lead are not typical CCR indicators and are not present in GMFP pore and surface water above the GWPS.**

Arsenic and lead are not typical coal ash or gypsum indicators (EPRI, 2017). As shown on Table 1, arsenic and lead have been either not detected or detected below the applicable GWPS in GMFP pore and surface water samples. In addition, concentrations in GMFP pore and surface water are lower than concentrations measured in the groundwater sample collected from P60. These data support that GWPS exceedances of lead and arsenic in P60 are not related to the GMFP, as the unit is not a source of elevated arsenic or lead.

- **The GMFP liner was constructed with a dual composite liner system with a leak detection system, has undergone rigorous construction quality assurance and has indicated strong performance**

As discussed in Section 2.0, the GMFP liner was constructed with a primary and secondary liner system with a leak detection layer between the primary and secondary liners. The construction process underwent a detailed construction quality assurance program (Hanson, 2009). The leak detection system has to date shown excellent performance of the primary liner system. Pumps in the leak detection system designed to operate to remove water from the primary liner have only run for a few hours for the lifetime of the facility (beginning in 2009). This indicates that a release from the GMFP has likely not occurred and that the GWPS standard exceedances of pH in G52L and G60; the arsenic exceedance in P60; and the lead exceedance in P60 are not related to the GMFP.

4.0 SUMMARY

The evaluation presented in this document demonstrates that the GWPS exceedances of pH in G52L and G60; the arsenic exceedance in P60; and the lead exceedance in P60 are not related to the GMFP. The following lines of evidence demonstrate the GWPS exceedances are not related to the GMFP:

- The ionic composition of groundwater collected from G52L, G60L and P60 is similar to groundwater collected from background wells G02S, G50S and G52S and not the pore water/surface water in the GMFP.
- Concentrations of key gypsum constituents differ significantly between GMFP pore water samples and groundwater samples collected from monitoring wells G52L, G60L and P60.
- High turbidity was recorded on the groundwater sampling record for the sample collected from P60, which likely resulted in arsenic and lead concentrations that are not representative of actual groundwater conditions in the vicinity of this well.
- Arsenic and lead are not CCR indicators for this CCR unit and are not present in GMFP pore and surface water above their corresponding GWPS.
- The GMFP liner was constructed with a dual composite liner system with a leak detection system, has undergone rigorous construction quality assurance and has indicated strong performance.

- Naturally occurring peat is present within the saturated zone in the immediate vicinity of P60 and G60L and may be causing naturally occurring lower pH in G60L and slightly elevated arsenic and lead concentrations in P60, particularly in a high-turbidity, unfiltered groundwater sample.

5.0 REFERENCES

Electric Power Research Institute (EPRI). 2017, Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites, Report 3002010920, October 2017

Hanson (Hanson) Professional Services Inc. 2009 Acceptance Report, Gypsum Stack, Gypsum Management Facility, AERG Duck Creek Power Generating Station. December.

Natural Resource Technology, an OBG Company (NRT/OBG), October 17, 2017b. Hydrogeologic Monitoring Plan. Duck Creek GMF Pond – CCR Unit ID 203, Duck Creek Landfill – CCR Unit ID 204. Duck Creek Power Station, Canton, Illinois. Illinois Power Resources Generating, LLC.

6.0 CLOSING

Golder appreciates the opportunity to serve as your consultant on this project. If you have any questions concerning this Technical Memorandum or need additional information, please contact the undersigned.

Golder Associates Inc.

Roberta Russell
Senior Geologist
RR/JSI/PJB

Pat Behling
Principal, Practice Leader

Attachments: Table 1 – GMF Pond Surface Water, Pore Water, and Groundwater Monitoring Data
Figure 1 – Gypsum Management Facility Pond Well Locations and Typical Groundwater Flow Direction
Appendix A – Boring Logs

Table

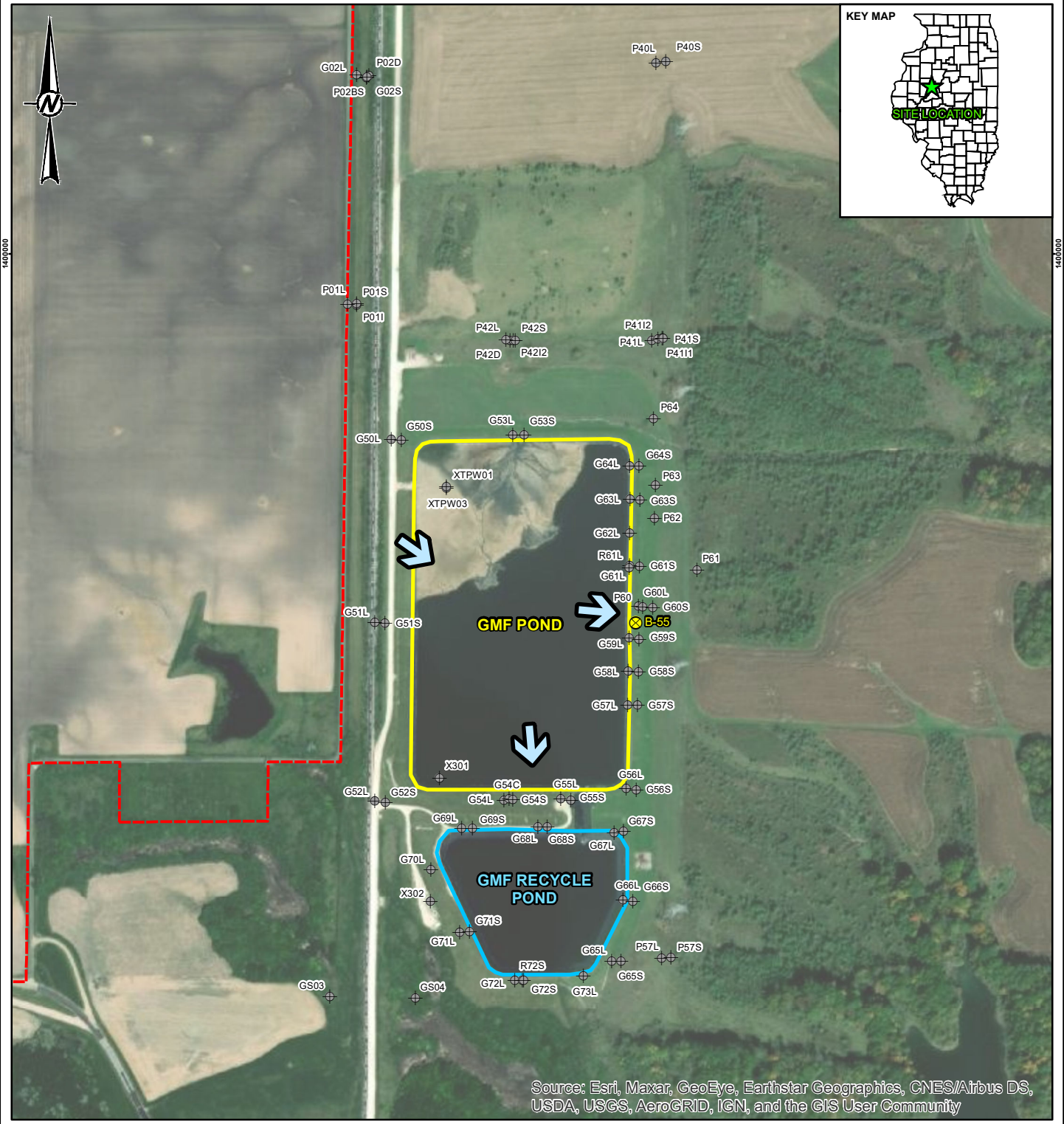
Table 1
GMF Pond Surface Water, Pore Water and Groundwater Monitoring Data
Duck Creek Power Plant
Canton, Illinois

Sampling Information		Potential Exceedance Constituents			Key Flue Gas Desulfurization Material (Gypsum) Constituents					
Well ID	Sampling Date	pH	Arsenic (Total)	Lead (Total)	Boron (Total)	Calcium (Total)	Chloride (Total)	Fluoride (Total)	Sodium (Total)	Sulfate (Total)
Units		SU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Part 845 Groundwater Protection Standards										
Site Background	NA	6.6 - 7.4	0.0092	0.015	0.21	NA	17	0.5	NA	55
Part 845 Standard	NA	6.5 - 9.0	0.01	0.0075	2	NA	200	4	NA	400
Part 845 GWPS	NA	6.5 - 9.0	0.01	0.015	2	NA	200	4	NA	400
GMF Pond Surface Water and Pore Water Samples										
XTPW02	6/23/2021	6.55	0.0026	ND < 0.001	63	750	3,900	22.6	570	4,300
X301	2/24/2021	5.50	NS	NS	29	180	1,200	14.4	110	2,300
X301	4/14/2021	6.70	0.0031	0.0013	97	580	3,700	35.4	390	7,300
X301	4/29/2021	6.60	0.0025	ND < 0.001	88	560	3,600	36.9	400	7,200
X301	5/12/2021	6.48	0.0024	ND < 0.001	84	560	4,100	40.7	410	7,700
X301	6/1/2021	6.64	0.0029	ND < 0.001	98	550	3,700	36.8	400	7,300
X301	7/26/2021	6.22	0.0018	ND < 0.001	85	600	3,600	38.1	370	6,900
Monitoring Wells										
G52L*	2/19/2021	6.39	ND < 0.001	ND < 0.001	0.037	210	30	ND < 0.25	13	87
G60L	4/14/2021	6.20	ND < 0.001	ND < 0.001	0.034	110	19	ND < 0.25	29	ND < 250
G60L	4/29/2021	6.10	ND < 0.001	ND < 0.001	0.029	120	19	ND < 0.25	31	160
G60L	5/13/2021	6.19	ND < 0.001	ND < 0.001	0.025	110	19	ND < 0.25	30	180
G60L	6/1/2021	6.26	ND < 0.001	ND < 0.001	0.029	110	20	ND < 0.25	30	170
G60L	6/15/2021	6.18	ND < 0.001	ND < 0.001	0.029	110	16	ND < 0.25	32	180
G60L	6/21/2021	6.16	ND < 0.001	ND < 0.001	0.068	110	18	ND < 0.25	29	180
G60L	7/12/2021	5.98	ND < 0.001	ND < 0.001	0.027	110	18	ND < 0.25	30	180
G60L	7/28/2021	6.22	ND < 0.001	ND < 0.001	0.022	110	15	ND < 0.25	29	160
P60	3/24/2021	6.60	0.02	0.036	0.056	150	32	NS	22	53

Notes:
1) GMF - Gypsum Management Facility, SU - standard unit, mg/L - milligrams per liter, ND - non-detect, NS - not sampled.
2) X301 samples are collected from a riser pipe from the ring drain beneath the pond.
3) XTPW02 results represent a porewater sample.
4) * - G52L data displays dissolved values.
5) Site background values based on Ramboll Determination of Potential Exceedances Table.
6) GWPS - Groundwater Protection Standard.
7) NA - Not Available.

Created by: BTT
Checked by: GM
Reviewed by: PJB

Figure



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND

- WELL LOCATION
- SOIL BORING LOCATION
- APPROXIMATE PROPERTY BOUNDARY
- TYPICAL GROUNDWATER FLOW DIRECTION

0 250 500 1,000 Feet

NOTE(S)

1. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2. GMF - GYPSUM MANAGEMENT FACILITY.

REFERENCE(S)

1. RAMBOLL 2020. ILLINOIS ADMINISTRATIVE CODE PART 845 DATA GAP ANALYSIS AND WORK PLAN, DUCK CREEK GYPSUM MANAGEMENT FACILITY AND RECYCLE POND - CCR UNIT 203 AND 206.

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC.
DUCK CREEK POWER PLANT

PROJECT
MONITORED NATURAL ATTENUATION EVALUATION

TITLE
GYPSUM MANAGEMENT FACILITY POND WELL LOCATIONS AND TYPICAL GROUND WATER FLOW DIRECTION

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-10-14
DESIGNED	JSI
PREPARED	ETF
REVIEWED	BTT
APPROVED	PJB

PROJECT NO.	PHASE	REV.	FIGURE
21454831	0001	0	1

PATH: C:\Users\ETVFornay\Golder Associates\21454831, Vistra IL MNA Part 845 Support - 5 Technical Work\Phase1 - Duck Creek\1.10 - Figures\Production\Duck Creek Well Locations.mxd PRINTED ON: 2021-10-14 AT: 11:35:53 AM
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A
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Appendix A
Boring Logs

FIELD BORING LOG

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 4/1/407
Finish: 4/4/2007
WEATHER: Overcast, cool

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-55
Well ID: hole abandoned
Surface Elev: 611.07 ft. MSL
Completion: 20.00 ft. BGS
Station: 15,438.7N
987.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 13.00 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	15/18 83%	ss	2-3 3 N=6	29		1.75 B
2A	16/18 89%	ss	3-4 5 N=9	22		0.78 BSh
3A	16/18 89%	ss	3-4 4 N=8	26		
4A	15/18 83%	ss	3-4 5 N=9	26		1.94 BSh
5A	18/18 100%	ss	2-3 4 N=7	33		1.32 B
6A	18/18 100%	ss	3-4 5 N=9	20		1.16 BSh

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark brown, clayey TOPSOIL (OL)	
2	Brown-gray, silty CLAY, trace sand (CL)	610
4	Brown-gray, clayey SILT, trace sand (ML)	608
6		606
8		604
10	Gray-brown, clayey SILT, trace sand (ML)	602
12		600
14	Black, PEAT (PT)	598
16		596
18	Gray, silty CLAY, trace sand and gravel (CL)	594
20	**End of Boring = 20.0 ft. BGS**	592

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Company, LLC
Site: Duck Creek Power Station - Ash Landfill
Location: 17751 N. CILCO Rd., Canton, IL 61520
Project: 17E0057
DATES: **Start:** 3/15/2017
Finish: 3/15/2017
WEATHER: Sunny, cold (lo-30s)

CONTRACTOR: Ramsey Geotechnical Engineering, LLC
Rig mfg/model: Diedrich D-50
Drilling Method: 4¼" Hollow Stem Auger, split spoon sampler
FIELD STAFF: **Driller:** B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: P60
Well ID: P60
Surface Elev: 620.12 ft. MSL
Completion: 34.62 ft. BGS
Station: 15,477.09N
992.24E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 16.80 - During drilling
▼ = Dry - At completion
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
1A	14/24 58%	SS	2-3 3-4 N=6				0–2	FILL - Yellowish brown (10YR5/6), moist, medium, CLAY with some silt and trace sand.	620	
2A	18/24 75%	SS	3-6 8-11 N=14	17.5			2–4		618	
3A	15/24 63%	SS	3-4 6-7 N=10	19.6			4–6		616	
4A	20/24 83%	SS	6-8 11-14 N=19	18.5			6–8		614	
5A	22/24 92%	SS	3-5 6-7 N=11	26.8			8–10	Yellowish brown (10YR5/6), moist, medium, SILT with few clay and trace sand.	612	
6A	21/24 88%	SS	2-4 5-5 N=9	23.8			10–12	Yellowish brown (10YR5/8) with 30% gray (10YR5/1) mottles, moist, medium, SILT with few clay and trace sand.	610	
7A	20/24 83%	SS	4-4 6-7 N=10	22.8			12–14	Gray (10YR5/1) with 20% yellowish brown (10YR5/8) mottles, moist, medium, SILT with few clay and trace sand.	608	
8A	21/24 88%	SS	5-6 7-7 N=13	22.1			14–16		606	
9A	21/24 88%	SS	5-5 6-6 N=11	21.0			16–18	Gray (10YR5/1) with 25% yellowish brown (10YR5/8) mottles, wet, medium, SILT with few clay and trace sand.	604	
10A	24/24 100%	SS	2-3 4-7 N=7	28.1			18–19	Dark yellowish brown (10YR3/4), moist, medium, SILT with few clay and trace sand, trace organics.	602	
10B				61.7			19–20	Dark brown (10YR3/3), moist, medium, PEAT.		

NOTE(S): P60 installed in boring.
Coordinates are on Plant (Local) grid.

FIELD BORING LOG

CLIENT: Illinois Power Generating Company, LLC
Site: Duck Creek Power Station - Ash Landfill
Location: 17751 N. CILCO Rd., Canton, IL 61520
Project: 17E0057
DATES: Start: 3/15/2017
Finish: 3/15/2017
WEATHER: Sunny, cold (lo-30s)

CONTRACTOR: Ramsey Geotechnical Engineering, LLC
Rig mfg/model: Diedrich D-50
Drilling Method: 4¼" Hollow Stem Auger, split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: P60
Well ID: P60
Surface Elev: 620.12 ft. MSL
Completion: 34.62 ft. BGS
Station: 15,477.09N
992.24E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 16.80 - During drilling
▼ = Dry - At completion
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	20/24 83%	SS	2-5 6-7 N=11	31.4		
12A	24/24 100%	SS	9-8 7-6 N=15	33.7		
13A	20/24 83%	SS	4-3 4-4 N=7	23.0		
14A	22/24 92%	SS	4-5 6-6 N=11	20.6		
15A	24/24 100%	SS	3-3 4-5 N=7	17.5		
16A	24/24 100%	SS	1-3 3-3 N=6	20.2		
17A	24/24 100%	SS	5-6 6-7 N=12	15.9		
	0/7 0%	BD				

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark brown (10YR3/3), moist, medium, PEAT. *[Continued from previous page]*	600
22	Very dark gray (10YR3/1), moist, medium, SILT with some clay and trace sand, trace organics.	598
24	Very dark gray (10YR3/1), wet, medium, SILT with some clay and trace sand, trace organics.	596
	Dark brown (10YR3/3), moist, medium, PEAT.	
26	Gray (10YR5/1), moist, medium, CLAY with some silt and trace sand and gravel.	594
28		592
30	Greenish gray (5G6/1), moist, medium, CLAY with some silt and trace sand and gravel.	590
32	Greenish gray (5G6/1), wet, soft, SILT with few clay, little sand, and trace gravel.	588
34		586

Borehole Detail

Remarks

End of Boring = 34.62 ft bgs

NOTE(S): P60 installed in boring.
Coordinates are on Plant (Local) grid.

APPENDIX F

Closure Priority Categorization

Phil Morris
Illinois Power Resources Generating
Luminant
1500 Eastport Plaza Drive
Collinsville, IL 62234

May 19, 2021

Mr. Darin LeCrone, P.E.
Manager, Industrial Unit
Bureau of Water, Division of Water Pollution Control, Permits Section
Illinois Environmental Protection Agency
1021 North Grand Avenue, East
Springfield, IL 62794-9276

Re: CCR Surface Impoundment Category Designation and Justification for Illinois Power Resources Generating, LLC

Dear Mr. LeCrone:

Pursuant to 35 I.A.C. 845.700(c), Illinois Power Resources Generating, LLC submits the information necessary to categorize the CCR surface impoundments located at the Edwards Power Plant and the now retired Duck Creek Power Plant. The following parameters were used in assessing and justifying each assigned category.

- Category 1 – *Impacts to existing potable water supply well or impacts to groundwater quality within the setback of an existing potable water supply well.*
    - This review includes an assessment of potable water wells within 2,500 feet of CCR surface impoundments to determine whether any potential impacts are occurring within the setback zone of any community water supply well established under the Illinois Groundwater Protection Act.
    - This information was developed during the Part 845 rulemaking and is summarized in Attachment 1, Table 2: Impacts to Potable Water Supply.
- Category 2 – *Imminent threat to human health or the environment or have been designated by IEPA under (g)(5)*
    - The surface impoundments at Edwards and Duck Creek Power Plants do not pose an imminent threat to human health or the environment. There are no known conditions at or around the facility where someone or something may be exposed to contaminant concentrations reasonably expected to cause harm
- Category 3 – *Located in areas of environmental justice ("EJ") concern*
    - EJ areas were evaluated using the EJ mapping link from IEPA's webpage located at https://www2.illinois.gov/epa/topics/environmental-justice. Per the IEPA mapping tool, the EJ Status thresholds were determined as twice the state averages for Minority and Low Income consistent with 35 IAC 845.700(g)(6).
    - An EJ map denoting the facilities with impoundments is located in Attachment 2.

- Category 4-7
    - Category 4 - Inactive CCR surface impoundments that have an exceedance of the groundwater protection standards in Section 845.600
    - Category 5 - Existing CCR surface impoundments that have exceedances of the groundwater protection standards in Section 845.600
    - Category 6 - Inactive CCR surface impoundments that are in compliance with the groundwater protection standards in Section 845.600.
    - Category 7 – Existing CCR surface impoundments that are in compliance with the groundwater protection standards in Section 845.600

Based on the information above, category designations have been assigned. The category designations for each CCR impoundment are shown in Attachment 1, Table 1: Category Designations.

If you have any questions regarding this submittal, please contact Phil Morris at 618-343-7794 or phil.morris@vistracorp.com.

Sincerely,

Phil Morris
Senior Environmental Director

Attachments

Attachment 1

Table 1: Category Designation

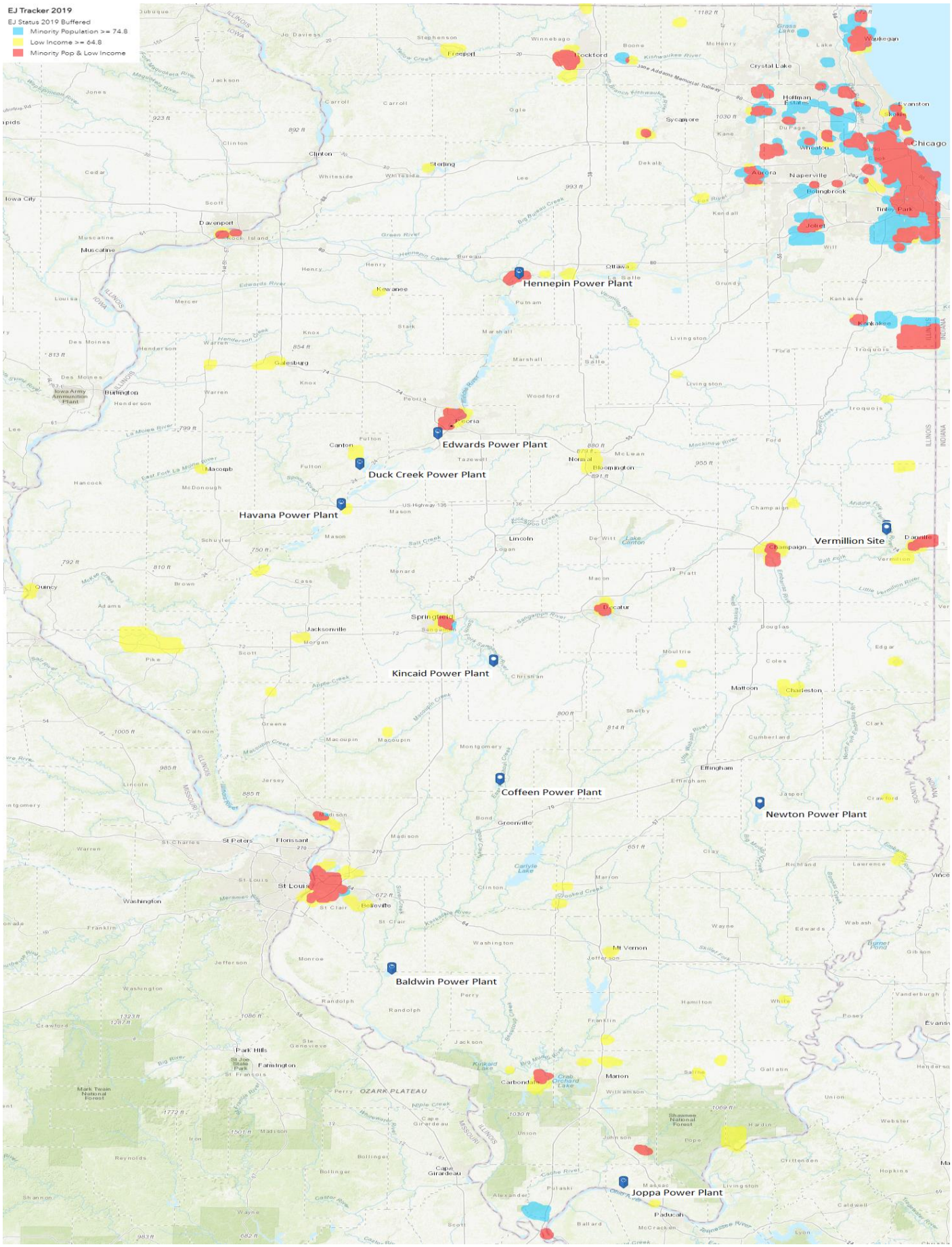
Facility	Pond Description	Classifications	Potable Water Supply Impacts (Category 1)	Human Health or Environment Threat (Category 2)	Located within Environmental Justice Areas[1] (Category 3)	Standards Exceedances[2] (Categories 4,5,6,7)	Impoundment Category 845.700(g)
Edwards	Ash Pond 1	Existing	No	No	No	Yes	5
Duck Creek	Bottom Ash Basin	Inactive	No	No	Yes	NA[3]	3
	GMF Pond	Inactive	No	No	Yes	NA[3]	3
	GMF Recycle Pond	Inactive	No	No	Yes	NA[3]	3

[1] See Attachment 2 Environmental Justice Area Map
[2] Ground water analyses for purposes of categories 4-7, assumptions have been made based on current groundwater data. However, since sampling and analysis is ongoing and subject to IEPA review and approval, IPGC reserves the right to update its category designations for Categories 4-7.
[3] NA for this determination since the CCR surface impoundment was assign a highest priority category

Table 2: Impacts to Potable Water Supply

Site Name	Private and Semi-Private Wells	Non-Community Water Supply (CWS) Wells	Non-CWS Surface Water Intakes	Community Water Supply Wells	CWS Surface Water Intakes
Edwards	**Present, but not at risk** Seven (7) water wells were identified and one (or possibly two) are located potentially downgradient of the site. Based on Ramboll's review of groundwater data, these wells are unlikely to be impacted by coal ash constituents.	**Present, but not at risk** One non-CWS well was identified; however, it is unlikely to be at risk because of its hydrogeologic location relative to the power plant.	Absent	Absent	Absent
Duck Creek	**Present, but not at risk** Three (3) water wells were identified; however, they are unlikely to be at risk because of their hydrogeologic location relative to the power plant and/or they are abandoned. None of the off-site wells are located in a downgradient direction.	Absent	Absent	Absent	Absent

Attachment 2: EJ Mapping Denoting Facilities with Impoundments



APPENDIX G

Groundwater Modeling

Intended for
Illinois Power Resources Generating, LLC

Date
January 28, 2022

Project No.
1940101010 - 002

GROUNDWATER MODELING REPORT

GYPSUM MANAGEMENT FACILITY POND

DUCK CREEK POWER PLANT
CANTON, ILLINOIS

GROUNDWATER MODELING REPORT DUCK CREEK POWER PLANT GYPSUM MANAGEMENT FACILITY POND

Project Name	**Duck Creek Power Plant Gypsum Management Facility Pond**
Project No.	**1940101010 - 002**
Recipient	**Illinois Power Resources Generating, LLC**
Document Type	**Groundwater Modeling Report**
Revision	**Final**
Date	**January 28, 2022**

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Brian G. Hennings, PG
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ACRONYMS AND ABBREVIATIONS

§	Section
±	plus or minus
35 I.A.C.	Title 35 of the Illinois Administrative Code
bgs	below ground surface
CBR	closure by removal
CCR	coal combustion residuals
CIP	closure in place
cm/s	centimeters per second
CSM	conceptual site model
DCPP	Duck Creek Power Plant
$ft^2/d/ft$	square feet per day per foot
ft^3/d	cubic feet per day
ft/d	feet per day
GMF	Gypsum Management Facility
GMP	Groundwater Monitoring Plan
GMR	Groundwater Modeling Report
GWL	groundwater elevation
GWPS	groundwater protection standard
Hanson	Hanson Professional Services, Inc.
HCR	Hydrogeologic Site Characterization Report
HDPE	high-density polyethylene
HELP	Hydrologic Evaluation of Landfill Performance
HUC	Hydrologic Unit Code
ID	identification
IEPA	Illinois Environmental Protection Agency
IPRG	Illinois Power Resources Generating, LLC
K	hydraulic conductivity
K_{eff}	effective hydraulic conductivity
mil	Millimeter
msl	above mean sea level
NA	not applicable
NID	National Inventory of Dams
No.	Number
NRT/OBG	Natural Resource Technology, an OBG Company
oz/yd^2	ounce per square yard
Part 845	Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments: 35 I.A.C. § 845
PMP	potential migration pathway
Ramboll	Ramboll Americas Engineering Solutions, Inc
RMSE	root mean squared error
RQD	rock quality designation
SI	surface impoundment

std	standard deviation
TVD	total-variation-diminishing
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

EXECUTIVE SUMMARY

This Groundwater Modeling Report (GMR) has been prepared to show how proposed closure solutions for the Gypsum Management Facility (GMF) Pond will maintain compliance with the applicable groundwater standards at the Duck Creek Power Plant (DCPP), Fulton County, Illinois. This report integrates existing site data and information with the latest hydrogeology and groundwater quality data to generate a conceptual and numerical model of the GMF Pond. The conceptual site model (CSM) includes hydrogeologic and groundwater quality data specific to the GMF Pond, which has been collected between 2015 and 2021.

The GMF Pond (Vistra identification [ID] number [No.] 203, Illinois Environmental Protection Agency [IEPA] ID No. W0578010001-04, and National Inventory of Dams [NID] No. IL50573) is located at the DCPP southwest of Canton, Illinois (**Figure 1-1**). The DCPP is located near the Duck Creek Cooling Pond, which was used as a source of cooling water for the power plant when it was active, and several small ponds which are remnants of the area's surface mining history. Prior to construction of the power plant and associated facilities, strip mining of coal took place within the property boundary of the DCPP. Currently, land use adjacent to the DCPP is agriculture, pasture, and forest with minimal development.

The GMF Pond is a 1,500-foot by 900-foot earthen berm double-lined coal combustion residual (CCR) surface impoundment (SI) located north of the former power plant. The GMF Pond decant water discharges to the lined GMF Recycle Pond. In addition to the CCR within the lined GMF Pond, there are five layers of unlithified material present above the Pennsylvanian-age shaley siltstone and silty shale bedrock (Carbondale Formation). These materials have been categorized into three hydrostratigraphic units presented below in descending order:

- **Uppermost Aquifer:** this unit includes the Peoria/Roxanna Loess, the upper Radnor Till, and the shallow sands. These units are hydraulically connected and underlain by a thick till sequence of the Radnor Till (Natural Resource Technology, an OBG Company [NRT/OBG], 2017a).
- **Lower Radnor Till/Lower Confining Unit:** Underlying the uppermost aquifer, the lower Radnor Till is approximately 42 to 58 feet thick.
- **Bedrock Confining Unit:** The thick and low permeability shaley siltstone, silty shale, and coal beds of the Carbondale Formation, are estimated to have a thickness of approximately 300 to 400 feet.

While the primary migration pathway is the shallow sand of the uppermost aquifer, the groundwater within the overlying Peoria/Roxanna Loess has the potential to be impacted and is considered a potential migration pathway (PMP).

Groundwater migrates downward through the loess and upper Radnor Till into the shallow sands of the uppermost aquifer. Groundwater flow in the sands is generally in a northwest to southeast direction. Seasonal variation of groundwater levels at the GMF Pond are present and may fluctuate approximately 1 to 10 feet. There is no observable seasonal variation of groundwater flow direction at the GMF Pond associated with the elevation changes. Groundwater flows toward the Duck Creek Cooling Pond located approximately 2,100 feet east of the GMF Pond. The surface water elevation of the Cooling Pond is estimated to range from 562.5 to 565 feet North American

Vertical Datum of 1988 (NAVD88), which is approximately 20 feet lower than water elevations at the GMF Pond.

The CSM for modeling the GMF Pond is as follows:

- All hydrostratigraphic layers are laterally continuous across the area. The flat to gently rolling uplands are dissected by deeply incised streams (into the materials of the uppermost aquifer and lower confining unit) that are tributaries to major river systems in areas that have not been disturbed by strip mining activity.
- The GMF Pond is constructed such that the double liner system is in direct contact with the lower confining unit or backfill of similar properties (i.e., removal of the uppermost aquifer sand below the footprint of the GMF Pond).
- Groundwater migrates vertically through the upper portions of the uppermost aquifer and horizontally within the sands above the lower confining unit to the southeast towards the Duck Creek Cooling Pond. The stage in Duck Creek Cooling Pond is managed with minimal (less than 3 feet) variability throughout the year.
- Vertical gradients measured between the bedrock and uppermost aquifer are generally downward near the GMF Pond, indicating that it is a recharge area.

Groundwater quality parameters were monitored in the shallow sands and the PMP monitoring wells at the GMF Pond as part of the groundwater quality investigations performed between 2015 and 2021. The History of Potential Exceedances attached to the Operating Permit Application summarizes all potential groundwater exceedances following the proposed statistical analysis plan. The following potential exceedances were identified:

- Arsenic and lead – determined from a single sample from well P60 screened in the loess (PMP).
- pH – values less than the lower limit were determined in wells G52L and G60L which are also screened in the loess (PMP).

Multiple lines of evidence that these limited potential groundwater protection standard (GWPS) exceedances are not related to the GMF Pond is provided in the technical memorandum attached to this report, *Evaluation of potential GWPS Exceedances* (Golder, 2021). Based on statistical analysis and evaluation of subsequent potential exceedances it has been determined there are no potential groundwater exceedances of applicable groundwater standards attributable to the GMF Pond.

All available hydrological information were used to construct a conceptual model and numerical model of the GMF Pond. A steady state, 5-layer numerical model was constructed to characterize the long-term groundwater flow conditions at the site. Calibration of the model focused on simulating mean groundwater elevations for 59 wells at the site by modifying hydraulic parameters for the different hydrostratigraphic units, alongside drain and general head boundary conductance. The calibrated model represents a reasonable match to the observed data given the simplicity of the model. Particle tracking was used both for the closure scenario and sensitivity analysis to provide a quantitative estimate of the distance a potential contaminant from the GMF Pond may travel in 100 years.

Particle tracking for the CIP scenario for a 100-year period indicates that contaminants will not migrate beyond the liner system, maintaining compliance with the applicable groundwater standards post closure.

1. INTRODUCTION

1.1 Overview

In accordance with requirements of the Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments: 35 I.A.C. § 845 (Part 845) (IEPA, 2021), Ramboll Americas Engineering Solutions, Inc. (Ramboll) has prepared this GMR on behalf of the DCPP (**Figure 1-1**), operated by Illinois Power Resources Generating, LLC (IPRG). This report will apply specifically to the CCR Unit referred to as the GMF Pond. However, information gathered to evaluate other CCR units in the vicinity regarding geology, hydrogeology, and groundwater quality is included, where appropriate.

1.2 Previous Groundwater Reports

Numerous hydrogeologic investigations have been performed at the DCPP. The information presented in this GMR includes data collected as part of a 2021 field investigation and previous investigations summarized and presented in the Hydrogeologic Site Characterization Report (HCR) (Ramboll, 2021a) which was provided as an attachment to the Initial Operating Permit application required by 35 I.A.C. § 845.230.

1.3 Site Location and Background

The DCPP is located in Fulton County, Illinois and approximately 6 miles southeast of the town of Canton. The GMF Pond is located north of the power plant in Section 18 of Township 6 North, Range 5 East (**Figure 1-1**). The GMF Recycle Pond is located just south of the GMF Pond (**Figure 1-2**). The DCPP is located near the Duck Creek Cooling Pond, which was used as a source of cooling water for the power plant when it was active, and several small ponds which are remnants of the area's surface mining history. The Landfill is located due north of the GMF Pond and the closed units, Ash Pond No. 1 and Ash Pond No. 2, are located south of the GMF Recycle Pond. Prior to construction of the power plant and associated facilities, strip mining of coal took place within the property boundary of the DCPP (**Figure 1-1**). Currently, land use adjacent to the DCPP is agriculture, pasture, and forest with minimal development. The area is flat to gently rolling uplands that are dissected by deeply incised streams that are tributaries to major river systems in areas that have not been disturbed by strip mining activity.

1.4 Site History and CCR Units

Surface preparation for the GMF Pond began in 2007 and construction took place from 2008 to 2009. The GMF Recycle Pond was constructed at the same time.

The GMF Pond, also referred to as the gypsum stack/management system, operates under an IEPA permit (#2017-E0-62640) issued in December 2017. It consists of a 1,500-foot by 900-foot earthen berm with 3.5:1 side slopes, a maximum elevation of 620 feet, a double geomembrane liner consisting of a 60-millimeter (mil) high-density polyethylene (HDPE) geomembrane liner, 12-inch clay cushion, 4 ounce per square yard (oz/yd^2) non-woven geotextile filter fabric, 12-inch highly permeable granular drainage (sand), 10 oz/yd^2 non-woven geotextile filter fabric, 60-mil HDPE geomembrane liner, reinforced bentonite mat, 36-inch compacted clay, all installed over in-situ foundation soil, and all pipes, pumps, and appurtenances necessary for the storage of approximately 3.6 million tons of gypsum at a maximum elevation of 715 feet with discharge to the GMF Recycle Pond.

During construction, shallow sand was encountered and completely removed from underneath the northeast corner and southwest corner of the GMF Pond, putting the liner in contact with clay of the lower Radnor Till. Sand outside the GMF Pond footprint remains. The GMF Pond decant water discharges to the GMF Recycle Pond, which has a capacity of 32.6 million gallons. The GMF Recycle Pond is lined with a 60-mil HDPE geomembrane liner, reinforced bentonite mat and 36 inches of compacted clay (Ramboll, 2021a).

2. SITE GEOLOGY AND HYDROGEOLOGY

2.1 Stratigraphy

The hydrogeology of the GMF Pond is described in detail in the Hydrological Characterization Report (Ramboll, 2021a). A short summary is provided below.

The unlithified stratigraphy within and immediately surrounding the GMF Pond consists of the following in descending order: fill material and CCR; silt and clayey silt loess (Peoria/Roxanna Loess); weathered till (upper Radnor Till); shallow, medium-grained sand to silt zone within the Radnor Till; and till (lower Radnor Till). The unlithified units overlay Pennsylvanian-age shaley siltstone and silty shale bedrock (Carbondale Formation).

CCR (gypsum) is present within the GMF Pond at a maximum thickness of approximately 22 feet, as estimated from topography and the elevation of the base of the liner from available construction details (AECOM, 2016). The range of gypsum thickness is estimated from less than 1 to 22 feet. The thickest areas of gypsum are to the north and west within the GMF Pond and thin toward the south end of the GMF Pond. The base of the liner rests on top of the lower Radnor Till.

The Wisconsinan Stage Peoria/Roxanna Loess extends from beneath the topsoil developed in the loess to depths ranging from 11 to 21 feet. The loess consists predominantly of silt and clayey silt with minor amounts of sand. The loess exhibits iron staining, concretions, and some fracturing. The Loess Unit is saturated below depths varying from approximately 3.5 to 11 feet.

The loess is generally underlain by a relatively thin till sequence consisting of the Berry Clay (where present) and the Illinoian Stage upper Radnor Till. The till sequence ranges in thickness from 9 to 21 feet in the area of the GMF Pond. This shallow till is generally weathered and exhibits signs of oxidation and fracturing. The till is primarily clayey silt with minor amounts of sand and gravel.

The shallow sand zone is laterally extensive within the Radnor Till across the site and varies in thickness from less than 1 to 18 feet near the GMF Pond; the top of the shallow sand zone is generally located at an elevation of 570 to 590 feet msl. The shallow sand zone exhibits lateral facies changes across the site and varies from a medium-grained sand to a silt and often contains intercalated till seams. The shallow sand zone is saturated.

Till sequences underlying the shallow sand zone consist of clay, silt, and sand of the Illinoian Stage lower Radnor Till. The till ranges in thickness from 42 to 58 feet. In some areas of the site, including the area near the GMF Pond, the till sequences typically extend from the base of the shallow sand to the bedrock surface. In other areas of the site, the till sequences extend to intermediate or deep sands. The till sequences are typically high in silt content with varying amounts of clay, sand, and gravel, and are often calcareous.

Pennsylvanian bedrock was encountered at greatly varying depths across the site. Bedrock depths ranged from a minimum of 52 feet to a maximum of 108 feet below ground surface (bgs). The bedrock shows little compositional variation across the site and consists primarily of shaley siltstone and silty shale. The shale bedrock unit is typically weathered near the surface, has low hydraulic conductivity, and underlies the glacial till sequences. These units often contain thin dolomite ledges and nodules and some fractures.

2.2 Hydrogeology

Three distinct water-bearing layers have been identified at the site based on stratigraphic relationships and common hydrogeologic characteristics, which are summarized below:

- **The Uppermost Aquifer**: This unit includes the Peoria/Roxanna Loess, the upper Radnor Till, and the shallow sands described in detail in **Section 2.5.1**. These units are hydraulically connected and underlain by a thick till sequence of the Radnor Till (NRT/OBG, 2017a). The shallow sands are laterally extensive across the site, vary in thickness from less than 1 to 18 feet, and are generally located at an elevation of 570 to 590 feet above mean sea level (msl). The shallow sand is saturated. During construction of the GMF Pond, sand was completely removed everywhere it was encountered (mainly the northeast corner and southwest corner of the pond), putting the base of liner in contact with clay of the lower Radnor Till. Sand outside the GMF Pond footprint remains in place.
- **Lower Radnor Till/Lower Confining Unit**: Underlying the uppermost aquifer, the lower Radnor Till is approximately 42 to 58 feet thick. Previous hydrogeologic studies indicate discontinuous sand lenses observed within the till are not hydraulically connected to the shallow sand unit (NRT/OBG, 2017a).
- **Bedrock Confining Unit**: The thick and low permeability shaley siltstone, silty shale, and coal beds of the Carbondale Formation are estimated to have a thickness of approximately 300 to 400 feet.

2.2.1 Groundwater Flow

Groundwater flow around the GMF Pond is generally in a southeast direction. The Peoria/Roxanna Loess (PMP) and shallow sands of the uppermost aquifer are hydraulically connected. The groundwater flow in the Peoria/Roxanna Loess is expected to be primarily vertical, with the majority of the horizontal migration expected to occur within the shallow sand unit. Groundwater flow across the GMF Pond within the uppermost aquifer (well locations adjacent to the pond are shown in **Figure 2-1**) is consistently in a southeast direction toward the Duck Creek Cooling Pond (as shown by groundwater elevation contours from April 14, 2021, **Figure 2-2**). Groundwater elevations of the uppermost aquifer vary seasonally although flow directions are generally consistently downward (Ramboll, 2021a). Surface water elevations within the GMF Pond are higher than the groundwater. The elevation difference between the phreatic surface and groundwater elevations, in addition to no observations of radial flow, provide evidence that the GMF Pond does not impact groundwater flow directions via recharge to groundwater. Given the low permeability of the liner system, it is more likely that the GMF Pond is a barrier to groundwater flow within the uppermost aquifer, deflecting flow from upgradient areas around the perimeter of the pond toward the downgradient areas.

2.2.2 Hydraulic Properties

Field estimates of the hydraulic properties of the uppermost aquifer (including both the loess and the shallow sand zones) indicated hydraulic conductivities from 3.0×10^{-5} to 3.9×10^{-3} centimeters per second (cm/s) (equivalent to 0.085 to 11.1 feet per day [ft/d]) with a geometric mean of 3.6×10^{-4} cm/s (1.02 ft/d), based on field tests conducted on 12 wells (5 wells were screened in the loess and 7 wells were screened in the sand) (Ramboll, 2021a).

Hydraulic properties for the Loess ranged from 3.0 x 10^{-5} to 2.3 x 10^{-3} cm/s (0.085 to 6.5 ft/d) with a geometric mean of 2.2 x 10^{-4} cm/s (0.62 ft/d). Shallow sand wells ranged from 6.5 x 10^{-5} to 3.9 x 10^{-3} cm/s (0.18 to 11.0 ft/d) with a geometric mean of 4.9 x 10^{-4} cm/s (1.4 ft/d).

Additional laboratory analysis of seven samples from the loess, upper Radnor Till and shallow sand provided vertical hydraulic conductivities ranging from 7.1 x 10^{-8} to 2.3 x 10^{-6} cm/s (0.0002 to 0.0065 ft/d).

Laboratory estimates for the Lower Radnor Till based on two samples indicated a vertical hydraulic conductivity ranging from 4.1 x 10^{-8} to 5.4 x 10^{-6} cm/s (0.00012 to 0.015 ft/d).

Results of field hydraulic conductivity tests conducted in 2021 in the bedrock confining unit by Hanson Professional Services, Inc. (Hanson) at monitoring well G54C ranged from 1.4 x 10^{-4} to 1.6 x10^{-4} cm/s, with a geometric mean of 1.5 x 10^{-4} cm/s. This is high in comparison to the horizontal hydraulic conductivity range of 1.3 x 10^{-6} cm/s to 1.3 x 10^{-9} cm/s, established by Hanson in 2015, which used pressure testing on borehole OM32. The higher values observed at G54C are attributed to the highly weathered nature of the bedrock in the screen interval, which is supported by the low rock quality designation (RQD) N values ranging from 14 to 22 (lower numbers indicating lower percentage of intact rock core recovered).

2.2.3 Groundwater Elevation Data

There are 59 wells located around the GMF Pond, with most wells located around the perimeter of the GMF Pond and the GMF RP. In most of these wells, water level measurement are available from 2004 to 2021 (**Table 2-1**). The data are summarized in **Table 2-2**. The observed range in groundwater elevation (GWL) within the data set is 41.6 feet. For wells with more than 1 reading, the mean variation in GWL within each well is 13.9 feet (mean GWL variation), with an observed minimum and maximum variation of 4.8 and 28.4 feet, respectively.

2.2.4 Mining Activity

Strip mining has occurred in this area since the 1930s. Strip mining in the site vicinity extracted coal from the Springfield (No. 5) coal seam. Mining operations in the area have ceased (NRT/OBG, 2017a). Strip mining has completely disrupted the natural stratigraphy down to the Springfield (No. 5) coal unit at some portions of the site. Previous investigations completed outside of the GMF Pond at the site also indicated that bedrock in the area is overlain by mine spoil ranging in thickness from approximately 10 feet to 75 feet. The mine spoil consists of excavated bedrock (weathered shale, shale fragments, and some coal fines) mixed with the sand, silts, and silty clays of the unconsolidated glacial and aeolian deposits. The GMF Pond is located immediately adjacent to several former large surface mining areas (**Figure 2-3**).

3. GROUNDWATER QUALITY

3.1 Groundwater Classification

Per 35 I.A.C. § 620.210, groundwater within the uppermost aquifer at the GMF Pond meets the definition of a Class I – Potable Resource Groundwater based on the following criteria:

- Groundwater in the uppermost aquifer extends 10 feet or more below the land surface.
- Hydraulic conductivity exceeds the 1×10^{-4} cm/s criterion.

Field hydraulic conductivity tests performed on the unlithified geologic materials that include loess and shallow sand at the GMF Pond had geometric mean hydraulic conductivities exceeding 1×10^{-4} cm/s. Based on this information groundwater is classified as Class I – Potable Resource Groundwater.

However, background (upgradient) groundwater originates from areas north and west of the GMF Pond that have been surface mined and present a significant alternative source for groundwater impacts.

3.2 Potential Groundwater Exceedances

There are no potential groundwater exceedances of applicable groundwater standards attributable to the GMF Pond as described below.

Groundwater concentrations from 2015 to 2021 presented in the HCR Table 4-1 (Ramboll, 2021a), and evaluated and summarized in the History of Potential Exceedance tables (Ramboll, 2021b), are considered potential exceedances because the methodology used to determine them is proposed in the Statistical Analysis Plan (Appendix A to Groundwater Monitoring Plan [GMP]; Ramboll, 2021c), which has not been reviewed or approved by IEPA at the time of submittal of 35 I.A.C. § 845 Operating Permit application.

The History of Potential Exceedances attached to the Operating Permit Application summarizes all potential groundwater exceedances following the proposed Statistical Analysis Plan. The following potential exceedances were identified:

- Arsenic and lead – determined from a single sample from well P60 screened in the loess (PMP)
- pH – values less than the lower limit were determined in wells G52L and G60L, which are also screened in the loess (PMP)

Multiple lines of evidence that these limited potential GWPS exceedances are not related to the GMF Pond is provided in the *Evaluation of potential GWPS Exceedances* (**Appendix A**, Golder, 2021) and summarized below:

- The ionic composition of groundwater collected from G52L, G60L, and P60 is similar to groundwater collected from background wells G02S, G50S, and G52S.
- Concentrations of key GMF Pond constituents differ significantly in GMF Pond pore water samples when compared to groundwater samples from monitoring wells G52L, G60L, and P60.
- High turbidity was recorded on the groundwater sampling record for the one sample collected from P60 that had elevated arsenic and lead concentrations.

- A peat layer ranging in thickness from 1 to 14 feet is present in the immediate vicinity of P60, resulting in lower pH.
- Arsenic and lead are not typical CCR indicators and are not present in GMF Pond porewater and surface water at concentrations above the GWPS.
- The GMF Pond liner was constructed with a dual composite liner system with a leak detection system, has undergone rigorous construction quality assurance, and has indicated strong performance.

4. GROUNDWATER MODEL

4.1 Overview

Data collected at the Site from 2004 to the recent 2021 field investigation were used to construct a groundwater model of the GMF Pond. The model was then used to evaluate how the proposed closure plan would maintain compliance with the applicable groundwater standards following the closure construction. The modeling results are summarized and evaluated in this GMR. A disk containing the associated model files is included as **Appendix B**.

4.2 Conceptual Model

The HCR (Ramboll, 2021a) forms the foundation of the GMF Pond hydrogeological setting. The GMF Pond overlies the recharge area for the underlying transmissive geologic media, which are composed of unlithified deposits.

4.2.1 Hydrogeology

As discussed in **Section 2.2**, groundwater flow around the GMF Pond is generally in a southeast direction. The Peoria/Roxanna Loess and Shallow Sands are hydraulically connected. The groundwater flow in the Peoria/Roxanna Loess is expected to be primarily vertical, with the majority of the horizontal migration expected to occur within the Shallow Sands unit. The geological conceptual model for the site consisted of the following layers:

- Loess – silt and clayey silt of the Wisconsinan Stage Peoria/Roxanna Loess which extends beneath the topsoil.
- Upper Radnor Till – a thin layer of low permeability till consisting of the Berry Clay and the Illinoian Stage upper Radnor Till.
- Shallow Sands – glacial outwash and re-worked glacial deposits at the base of the Upper Radnor Till formation is the lowermost, laterally extensive coarse grained unlithified deposit identified beneath the site.
- Lower Radnor Till – composed of clay, silt, and sand of the Illinoian Stage lower Radnor Till.
- Bedrock Confining Unit – lowermost unit identified at the site and underlies all unlithified deposits. This unit, composed of low permeability shaley siltstone, silty shale, and coal beds, occurs within the Carbondale Formation of the Kewanee Group.

Surfaces for each of the four major geological units (Loess, Upper Radnor Till, shallow sand, and lower Radnor Till) was made by interpolating contacts between the units interpreted from boring logs. Since all boring log information is centered around the ponds, the surfaces were extended to the full model domain by extrapolation. During construction of the pond, it was noted that sand was removed so that the liner was in contact with the Lower Radnor Till or backfill of similar properties.

4.2.2 Extent and Boundaries

The United States Geological Survey (USGS) National Map places the DCPP within the lower Illinois-Lake Chautauqua watershed subbasin (Hydrologic Unit Code [HUC] 07130003). The GMF Pond CSM extent is bounded by a hydrological catchment (watershed) divide to the east based on watershed data from USGS. Along the north, south, and east, the model boundary has been

placed along known waterbodies as much as possible. As such, it is assumed groundwater inflow from adjacent watersheds is negligible through both the uppermost aquifer and lower confining unit.

The Duck Creek Cooling Pond water levels are managed such that they remain at an elevation between 562.5 and 565 feet NAVD88. The Duck Creek Cooling Pond is the receiving body of water for the area encompassed by the CSM.

Infiltration of precipitation to the groundwater table is applied as recharge at the site. Groundwater in the loess and upper Radnor Till migrates downward into the shallow sands (the primary horizontal migration pathway) (discussed in **Section 2.2.1**). Groundwater flow through the loess and upper Radnor Till above the sand zone adjacent to the GMF Pond is considered a PMP.

4.2.3 GMF Pond

The GMF Pond is a 1,500-foot by 900-foot earthen berm and has a double liner system which acts as a low permeability interface (**Table A**) between the gypsum contained within the GMF Pond and the ambient groundwater system. The double liner system was installed along the inner faces of the pond (sides and base of the excavated area).

Table A. Double Liner System Properties from Top to Bottom

Liner Component	Thickness (feet)	Hydraulic Conductivity (ft/d)
HDPE geomembrane	0.005	5.7×10^{-10}
Cushion of soil	1	16.4
4 oz/yd^2 non-woven geotextile filter fabric	NA	high
Drainage layer (sand)	1	28.4
10 oz/yd^2 non-woven geotextile filter fabric	NA	high
HDPE geomembrane	0.005	5.7×10^{-10}
Geosynthetic clay liner (bentonite)	0.005	1×10^{-10} *
Compacted Clay	3	2×10^{-3}
Vertical Harmonic Mean of double-liner system	**5.015**	**2.8×10^{-7}**

* Estimated based on available information
NA = not applicable

Estimates of the hydraulic properties of each of the components within the double-liner system were derived using values from the Hydrologic Evaluation of Landfill Performance (HELP) model Tolaymat and Krause, 2020); see **Section 5-1** for more information about HELP. For flow perpendicular to the layer orientation, as is the case in the liner where the hydraulic gradient is vertical for the base and horizontal for the sides of the pond, the harmonic mean was used to obtain the effective hydraulic conductivity (K_{eff}) (Fetter, 1988). The harmonic mean was determined by:

$$K_{eff} = \frac{\sum b}{\sum \frac{b}{K}}$$

where b is the layer thickness and K is the horizontal hydraulic conductivity.

Findings from the HCR (Ramboll, 2021a) indicate that the GMF Pond does not appear to impact groundwater flow directions via recharge to groundwater. Given the low permeability of the liner system and the removal of sand below the unit, it is more likely that the GMF Pond is a barrier to groundwater flow within the Loess and Shallow Sands aquifers, directing flow from upgradient areas around the perimeter of the pond toward the downgradient areas south and east of the pond toward the Duck Creek Cooling Pond.

If a release to groundwater were to occur, this would be detected by increased boron concentrations (or other parameters included in 35 I.A.C. § 845.600(a)(1)) in the uppermost aquifer or PMP wells. Boron is commonly used as an indicator parameter for contaminant transport modeling for CCR because: (i) it is commonly present in coal ash leachate; (ii) it is mobile and typically not very reactive but conservative (*i.e.*, low rates of sorption or degradation) in groundwater; and (iii) it is less likely than other constituents to be present in background groundwater from natural or other anthropogenic sources. Groundwater quality data shows no boron levels above background levels, therefore there is no meaningful data to use in model calibration. Contaminant transport is therefore modeled with particle tracking, which allows for evaluation of transport times and directions.

4.3 Model Approach

A three-dimensional groundwater flow model was calibrated to represent the conceptual flow system described above. A steady state model was used to simulate the mean groundwater flow conditions at the site. The model was calibrated to match mean groundwater elevations observed between 2004 to 2021 (**Table 2-2**). Prediction simulations were then performed to evaluate the potential impacts to groundwater from closure in place as presented in the *Final Closure Plan for the Gypsum Management Facility Pond, Duck Creek Power Plant* (Golder, 2022) which is an appendix to the Construction Permit Application to which this report is also attached.

Three model codes were used to simulate groundwater flow and contaminant transport:

- Groundwater flow was modeled in three dimensions using MODFLOW 2005.
- Contaminant transport was modeled in three dimensions using MODPATH.
- Percolation (recharge) was modeled using the results of the HELP model.

5. MODEL SETUP AND CALIBRATION

5.1 Model Descriptions

For the construction and calibration of the numerical groundwater flow model for the site, Ramboll selected the model code MODFLOW, a publicly-available groundwater flow simulation program developed by the United States Geological Survey (USGS) (McDonald and Harbaugh, 1988). MODFLOW is thoroughly documented, widely used by consultants, government agencies and researchers, and is consistently accepted in regulatory and litigation proceedings. MODFLOW uses a finite difference approximation to solve a three-dimensional head distribution in a transient, multi-layer, heterogeneous, anisotropic, variable-gradient, variable-thickness, confined or unconfined flow system—given user-supplied inputs of hydraulic conductivity, aquifer/layer thickness, recharge, wells, and boundary conditions. The program also calculates water balance at wells, rivers, and drains.

MODFLOW was developed by the USGS (McDonald and Harbaugh, 1988) and has been updated several times since. Major assumptions of the code are: (1) groundwater flow is governed by Darcy's law; (2) the formation behaves as a continuous porous medium; (3) flow is not affected by chemical, temperature, or density gradients; and (4) hydraulic properties are constant within a grid cell. Other assumptions concerning the finite difference equation can be found in McDonald and Harbaugh (1988). MODFLOW 2005 was used for these simulations with Groundwater Vistas 7 software for model pre- and post- processing tasks (Environmental Simulations, Inc, 2017).

The program uses the standard finite difference method, the particle-tracking-based Eulerian-Lagrangian methods and the higher-order finite-volume total-variation-diminishing (TVD) method for the solution schemes. The finite difference solution has numerical dispersion for low-dispersivity transport scenarios but conserves good mass balance. The particle-tracking method avoids numerical dispersion but was not accurate in conserving mass. Groundwater quality data indicates negligible transport of contaminants from the GMF Pond; therefore, the particle-tracking method was used to provide estimates of groundwater transport in the event of leakage through the pond liner.

The HELP model was developed by USEPA. HELP is a one-dimensional hydrologic model of water movement across, into, through and out of a landfill or soil column based on precipitation, evapotranspiration, runoff, and the geometry and hydrogeologic properties of a layered soil and waste profile. For this modeling, results of the HELP model, HELP Version 4.0 (Tolaymat and Krause, 2020) completed for the groundwater model were used to estimate the hydraulic flux from beneath the GMF Pond.

5.2 Flow and Transport Model Setup

Under current conditions, the groundwater protection standards are being met for the GMF Pond. While no potential exceedances of GWPS have been identified in the monitoring well network for this unit (**Section 3.2**); and, source control will mitigate future groundwater impacts, groundwater modeling of closure in place was completed to demonstrate that closure will maintain compliance with applicable groundwater quality standards following construction. The modeled area was approximately 7,900 feet by 9,950 feet with the GMF Pond located in the southeast quadrant. The model grid and boundary conditions for the five model layers are displayed in **Figures 5-1 through 5-5**.

Evaluation of monitoring well data for the GMF Pond has not identified statistically significant seasonal trends in groundwater flow or quality which could affect model applicability for prediction of transport. The MODFLOW model was calibrated to mean groundwater elevations from 2004 to 2021. Multiple iterations of MODFLOW calibration were performed to achieve an acceptable match to observed flow data. For the GMF Pond, the calibrated flow model was used in predictive modeling to evaluate closure in place (CIP). Because no groundwater impacts attributable to the CCR unit have been observed, there is no need to simulate a closure by removal (CBR) option because no future exceedances would be expected. Details of the proposed CIP are described below:

- The CCR within the GMF Pond will be consolidated in the north end of the pond, graded, and covered with a geomembrane and soil layers with an estimated timeline of completion of 12 months.

5.2.1 Grid and Boundary Conditions

A five-layer, 340 x 220 node grid was established with 25-foot grid spacing (**Figure 5-1 through 5-5**), with a total number of 200,732 active cells. The northern and western edges of the model are no-flow boundaries in all layers of the model. For both the southern and eastern boundaries, where the model boundary is the Duck Creek Cooling Pond, a constant head boundary was placed equal to the surface elevation of the Duck Creek Cooling Pond. In areas where the model boundary deviates inland from the Duck Creek Cooling Pond, a general head boundary with a conductance estimate based on the distance to the Duck Creek Cooling Pond was placed. The southern and eastern boundaries are only present in layer 5 due to the change in elevation.

The bottom of the model was also a no-flow boundary. The top of the model was a time-dependent specified flux boundary, with specified flux rates equal to the mean recharge rate.

Natural (streams) and man-made (associated with the railroad) drainage features are present in the modeled area; these are represented as drains in the model.

5.2.1.1 Layer Top/Bottom

A digital elevation model of the area was used to assign the top of layer one. The elevations for the base of each hydrostratigraphic layer were interpolated from boring log data primarily from logs provided in the HCR (Ramboll, 2021a) and imported as grid data into MODFLOW. The silts and clays of the Upper Radnor Till unit was divided into two layers to accommodate the explicit inclusion of the GMF Pond liner system (see **Section 5.2.1.4**). The Loess, Shallow sands, and Lower Radnor Till were all represented as single layers within the model.

Flow model layer description and parameters are summarized in **Table B** below.

Table B. Flow Model Layer Descriptions

Layer	Hydrostratigraphic unit name	Hydrostratigraphic unit used to determine layer thickness	Top Elevation (feet)	Bottom Elevation (feet)	Thickness (feet)
			Mean (Minimum – Maximum)		
1	uppermost aquifer (PMP)	Loess	616.2 (594.7-663.0)	597.7 (585.0-604.5)	18.6 (0.5-65.6)
2 & 3	uppermost aquifer	Silts and clays of the Upper Radnor Till	597.7 (585.0-604.5)	587.0 (577.0-597.5)	10.2 (1.0-19.8)
4	uppermost aquifer	Shallow sands	587.0 (577.0-597.5)	582.8 (566.8-595.4)	4.2 (0.5-14.3)
5	lower confining unit	Lower Radnor till	582.8 (566.8-595.4)	527.7 (517.3-547.7)	54.9 (34.0-67.1)

PMP = potential migration pathway

5.2.1.2 Hydraulic Conductivity

The spatial distribution of the hydraulic conductivities within each layer was considered homogenous. With the exception that in the strip-mining area to the south of the GMF Pond described in **Section 2.2.4** (**Figure 2-3**), where all hydrostratigraphic units were excavated and the area back-filled, resulting in what is assumed to be a more homogenous fill in the strip-mining area. Therefore, the hydraulic conductivity values for each layer in the mine spoil area are uniform. **Figures 5-6 through 5-11** show the spatial distribution of the hydrostratigraphic units, as well as the mining spoils associated with the strip mining activity, GMF Pond and GMF Recycle Pond, and the GMF Pond liner for each of the model layers.

Where available, hydraulic conductivity values were derived from field measured values reported in the HCR (Ramboll, 2021a) (**Section 2.2.2**). During calibration it became clear that tested values in general were low and therefore hydraulic conductivities for the hydrostratigraphic layers were further refined through model calibration and tend to be greater than the tested values. No horizontal anisotropy was assumed. Vertical anisotropy with ratios between 1/10 and 1/3 were applied to the Loess, Upper Radnor Till, Shallow sands, Lower Radnor Till, and the mine spoils to simulate preferential flow in the horizontal direction in these materials.

5.2.1.3 Recharge

Recharge rates were determined through calibration of the model to observed groundwater elevations. For the calibration model, recharge was applied uniformly across the model. Model inputs are summarized in **Table C** in **Section 5.4**.

5.2.1.4 GMF Pond Parameters

Implementation of the GMF Pond into the model used hydraulic flow barriers to represent the double liner system on the sides of the pond. The bottom of the liner is implemented by assigning the liner system hydraulic conductance to model layer 2 within the footprint of the pond. The base elevation of layer 2 within the footprint of the GMF Pond simulates the base elevation of the liner. The thickness of model layer 2 within the footprint of the pond was set to five feet. Removal of the Shallow Sands below the GMF Pond (as described Section 4.2.3) means that the liner is in direct contact with the Upper Radnor Till or backfill of similar characteristics.

A drain was placed in model layer 1, where the elevation of the base of the drain was equal to the water level monitored in the pond. The drain was included to represent flow to the GMF Recycle Pond. The GMF Recycle Pond was implemented in the same way. The actual recharge to the ponds is unknown, but for simplicity the same values as were used for the surrounding area were applied. The drain conductance was adjusted to allow for enough "runoff" from the ponds to fit expected water levels in both ponds.

The vertical hydraulic conductivity of the double liner system was calculated as 2.8×10^{-7} ft/d (horizontal hydraulic conductivity of 2.8×10^{-6} ft/d) based on the harmonic mean of the hydraulic conductivities for the different components within the liner (**Table A** in **Section 4.2.3**). These values were assigned to model layer 2 within the footprint of the GMF Pond representing the liner system.

5.2.2 Transport Model Input Values

Particle tracking was used both for the sensitivity analysis (discussed in **Section 6.2.1**) and the closure scenario to provide a quantitative estimate of the distance a potential contaminant from the GMF Pond may travel in 100 years.

5.2.2.1 Effective Porosity

MODPATH uses estimates of the effective porosity of the hydrostratigraphic unit to calculate Darcy velocities, which strongly impact the movement of particles. Estimates of porosity for the hydrostratigraphic units provided in the HCR (Ramboll, 2021a) and summarized below:

- Loess - Average total porosity of 37 percent (range of 32.4 to 41.8 percent).
- Upper Radnor Till - Average total porosity of 36.8 percent (range of 30.7 to 41.4 percent).
- Shallow sands - Average total porosity of 29.5 percent (range of 27.4 to 31.4 percent).
- Lower Radnor Till - Average total porosity of 22.3 percent (range of 20.6 to 23.5 percent)

The values from the HCR are based on laboratory testing and are not expected to represent effective porosities, but rather be at the upper level of possible values. The values used in the modeling were chosen based on expected values for the hydrostratigraphic units; the chosen values are shown in **Table C** in **Section 5.4**.

5.2.2.2 Particles

Particles represent a given mass of contaminant and are initially placed within the GMF Pond at the top of model layer 2 (representing the top of the liner). At each cell within the GMF Pond, one particle was started at the top of model layer 2 and allowed to travel for 100 years.

Simplifying assumptions were made while developing this model:

- Except for changes induced by cap construction and ash fill consolidation/removal, the groundwater flow system is at steady state.
- Natural recharge is constant over the long term.
- Fluctuations in Duck Creek Cooling Pond stage do not affect groundwater flow and transport over the long term.
- Hydraulic conductivity is consistent within hydrostratigraphic units.

- The conductance term used to simulate the GMF Pond double liner system adequately represents a composite estimate of the permeability of the liner system.
- Particles represent a mass of Boron which leaves the GMF Pond and enters the groundwater system.
- Boron is not adsorbed and does not decay, and mixing and dispersion are the only attenuation mechanisms.

5.3 Calibration Flow Model

The groundwater model was manually calibrated to best approximate the mean groundwater elevations in 59 wells at the site. The mean elevations used for calibration and locations of wells within the flow model are summarized in **Table 2-2**. Well locations are shown in **Figure 2-1**. This involved modifying the hydraulic conductivities of the different hydrostratigraphic units, recharge rate, and conductance of the drains and general head boundaries within the model to minimize the difference between the mean observed groundwater elevation and simulated groundwater elevation. Where possible, the range of the parameter values used during calibration were based on observed values (*i.e.,* for the range in hydraulic conductivity estimates from the HCR). Where this was not possible, such as for the drain and general head boundary conductance, the range of parameter values were based on other site information or inferred from knowledge from similar sites. Where data were limited, the parameter values were less constrained during calibration (*e.g.,* parameter values had wider ranges). The root mean squared error (RMSE) was used as a metric to identify the optimal values for the different parameters.

The groundwater model is steady state and is therefore only able to simulate the long term mean groundwater flow conditions. It is unable to capture seasonal variability in groundwater elevations. There may be a bias in the groundwater elevation data used to quantify the mean groundwater elevation for the wells, based on the temporal distribution of the data and the frequency of the data collection. The potential for deviation away from mean conditions can be integrated into the calibration process by using the standard deviation of the groundwater levels as an additional metric (**Table 2-2**). This assumes that all groundwater data have a gaussian distribution (normal distribution) such that 95 percent of the observed groundwater elevation would fall within plus or minus (±) 2 standard deviations (std) from the average groundwater elevation. If a simulated groundwater level was within ±2 std of the mean observed groundwater level, the simulation may be considered reasonable.

5.4 Calibration Flow Model Results

Results of the MODFLOW modeling are presented below. A disk containing the model files is attached to this report (**Attachment A**). **Table C** shows the calibrated hydraulic conductivity for the different units shown in **Figures 5-6** to **5-11**.

Groundwater model calibration results are presented in **Figure 5-12** and **Figure 5-13**, which shows the observed GWL and simulated groundwater elevations. The RMSE of the GWL across all wells was 6.22 feet. The mass balance error for the flow model was 0.001 percent and the ratio of the residual std to the range of heads was 20.9 percent, which is above the desired target value of 10 percent. The simulated groundwater elevations within the Loess (**Figure 5-12A**) are generally in good agreement with the observed groundwater elevations. Most of the simulated groundwater elevations fall within ±1 std of the observed groundwater elevation. The simulated groundwater elevations in the shallow sands have a greater tendency to be overestimated

relative to the observed groundwater levels. **Figure 5-13** shows the observed versus simulated concentrations within the model. Overestimation of groundwater elevation in the model is more pronounced in the shallow sands at lower groundwater elevations.

Table C. Calibrated Flow Model Layer Hydraulic Parameters

Parameter	Type	Units	Calibrated Value	Ratio Kh to Kv	Porosity
Recharge	Rate	ft/d	0.001	NA	NA
Layer 1: Uppermost Aquifer (PMP)	Hydraulic conductivity	ft/d	5	7	0.37
Layer 2 & 3: Uppermost Aquifer	Hydraulic conductivity	ft/d	1	5	0.37
Layer 4: Uppermost Aquifer (Sand)	Hydraulic conductivity	ft/d	30	3	0.17
Layer 5: Lower Confining Unit	Hydraulic conductivity	ft/d	0.7	10	0.22
Strip mining area	Hydraulic conductivity	ft/d	5	5	0.20
GMF Pond Base Liner	Hydraulic conductivity	ft/d	2.8×10^{-6}	10	0.20
GMF Pond Horizontal Flow Barrier	Hydraulic conductivity	ft/d	5.68×10^{-7}	NA	NA
General Head	Conductance	$ft^2/d/ft$	1.5	NA	NA
Drains: railway	Conductance	$ft^2/d/ft$	1.8×10^{-2}	NA	NA
Drains: stream	Conductance	$ft^2/d/ft$	8.0×10^{-2}	NA	NA
Drains: GMF Pond	Conductance	$ft^2/d/ft^2$	5.0×10^{-3}	NA	NA

$ft^2/d/ft$ = square feet per day per foot
NA = not applicable
Kh = horizontal Hydraulic Conductivity
Kv = Vertical Hydraulic Conductivity

Figure 5-14 and **Figure 5-15** show the simulated groundwater elevations for layers 1 (Loess) and 4 (Shallow Sands), respectively. In both the Loess and Shallow Sands, the model is able to simulate the groundwater levels around the GMF Pond within 1 standard deviation. This indicates that the model is adequate to simulate the hydraulic head between the GMF Pond and the surrounding groundwater in the uppermost aquifer, which is an important driver of groundwater flow from the pond into the aquifer. The largest errors tend occur in wells to the north and south of the GMF Pond. In general, the flow patterns are comparable to those shown in **Figure 2-2** interpreted from the site well data for May 2021. The GMF Pond forms a barrier to groundwater flow, directing groundwater to flow around the unit in layer 1 of the model. Some impact of the GMF Pond on groundwater flow can be seen in **Figure 5-14**, where the groundwater contours are deflected along the GMF Pond's footprint. **Table D** provides an overview of the GMF Pond water balance. The estimated particle travel distances after 100 years are also provided as a no action scenario for comparison to the proposed closure scenario.

Table D. Water Balance Results from Calibrated GMF Pond and Particle Travel Distances after 100 years for Current Conditions (no action scenario)

Water Balance Components	Calibrated Model
Inflow: Recharge (ft^3/d)	942.5
Outflow: Drain Flow (ft^3/d)	941.0
Outflow: Leakage (ft^3/d)	0.62
Mean distance travelled by particles (feet) ± (std)	0.123±0.039
Mean distance travelled by particles in z direction (feet) ± (std)	0.121±0.035

ft^3/d = cubic feet per day
K = hydraulic conductivity

Review of the model calibration indicates good agreement with observed conditions in the local area around the GMF Pond. The elevated ratio of the residual std to the range of heads suggests that sitewide subsurface heterogeneity (the uppermost aquifer is located in glacial deposits that grade laterally from sand to silt) is not optimally represented by the homogenous layers used in the model. Further, because the shallow sand layer is less than 5-feet thick in most locations, wells monitoring the shallow sand are screened across the shallow sand and into the overlying and/or underlying finer grained deposits of the Radnor Till, which are represented in the model as separate layers. Based on the objective of the model to estimate potential impacts from the GMF Pond, a homogenous representation in hydraulic properties within layers was maintained.

6. CLOSURE SCENARIO MODEL

As discussed in **Section 5.2**, because no groundwater impacts attributable to the CCR unit have been observed, there is no need to simulate a CBR option because no future exceedances would be expected. Modeling for the CIP closure scenario was conducted using particle tracking for a period of 100 years, based on a steady state model of the site under closure conditions. HELP (Version 4.0; (Tolaymat and Krause, 2020) was used to estimate percolation through GMF Pond capping solution (described below). HELP modeling input and output values can be found in **Appendix C**.

The following simplifying assumptions were made for the simulation:

- Cap construction has an instantaneous and constant effect on recharge and percolation through surface materials.
- In the CIP scenario, average annual percolation rates through the cap system were estimated from a 100-year HELP model run. There was no significant change in percolation rates over the 100-year timeframe of HELP-simulated values. This 100-year HELP-calculated percolation rate remained constant over the duration of the closure scenario prediction model runs.
- The design for CIP for the GMF Pond involves pumping out ponded water from the GMF Pond, construction of a berm mid-way (east-west orientation) across the pond (also lined with 60-mil HDPE geomembrane), and collection of all gypsum south of the berm to be deposited north of the berm. The existing double-liner system south of the berm will be disposed.
- Cap construction in the scenario was assumed to be completed with a cover system consisting of the following (listed from ground surface down): a vegetative cover (6 inches thick), protective layer of compacted soil (18 inches thick), geo-composite drainage layer, and 40-mil Linear Low-Density Polyethylene (LLDPE) geomembrane.
- Final grade of the capping system was assumed at or above current top of berms. Proper storm water control systems were assumed to remove excess water from the surface of the capped areas based on design drawings (Golder, 2022).
- Predicted recharge rates for the GMF Pond cover system can be estimated based on the HELP cap system percolation rates.
- All saturated gypsum is consolidated into the designed footprint of the CIP closure scenario. This assumes all gypsum is placed within the final footprint of the caps for the closure-in-place scenario. Local fill materials were assumed to replace the compacted clay liner.
- Local fill materials applied to the CIP models have similar hydraulic properties as the Upper Radnor Till used in the calibrated model.

6.1 Closure in Place Model Setup

Both the HELP and a modified version of the calibrated groundwater flow models were used to evaluate the impact of the CIP scenario. The scenario was simulated as steady state flow model and particle tracking was used to estimate contaminant travel distances from the capped unit. In the modified version of the steady state flow model the horizontal flow boundary and liner properties of layer 1 and 2 are only applied within the CIP footprint.

HELP input data and results are provided in **Appendix C**. The CIP scenario was modeled for a period of 100 years. Climatic inputs were synthetically generated using default equations developed for Indianapolis, Indiana (the closest weather station included in the HELP database), 100-year average precipitation and temperature values recorded at the Peoria, Illinois weather station, and the latitude of the GMF Pond. Soil layering was developed for the CIP scenario using data provided in the closure scenario designs documented in the Golder (2022) report described above.

HELP model results indicated that an average of 0.00025 inches/year (2.1×10^{-5} foot/year) of leakage occurs through the CIP cap system (**Appendix C**). The CIP scenario footprint is shown in **Figure 6-1**, the HELP calculated cap system percolation rate was applied to the CIP footprint as recharge, the recharge rate for the area outside this footprint was set the same as in the calibrated model (**Table C**). The CIP plan also includes surface drainage in the southern area of the GMF Pond footprint, therefore the drainage in this area was simulated with drain cells set equal to the planned surface elevation. The Recycle Pond was removed as part of the CIP model scenario. The CIP scenario model was run as steady state. A particle was placed in each cell in the CIP footprint (**Figure 6-2**) to simulate advective transport.

The groundwater flow from the CIP GMP Pond footprint is correlated to the conductivity of the liner system; therefore, a sensitivity analysis was performed for the CIP scenario to determine the impact of the liner system's hydraulic properties on the leakage from the CIP GMP Pond footprint. The conductance values of the horizontal hydraulic barriers and liner of the pond were increased by an order of magnitude. This simulation approach represents the upper bounds of potential flow rates through the liner and results are presented in **Section 6.2.1**. All other hydraulic parameters were unchanged from the calibrated model in the CIP scenario model.

Two additional CIP sequences were simulated using HELP to support the *Proposed Alternative Final Protective Layer Equivalency Demonstration* (Geosyntec, 2022) which is an appendix to the Construction Permit Application to which this report is also attached. Results of these HELP simulations were not incorporated into the MODFLOW model simulations for CIP:

- One CIP sequence was simulated by increasing the thickness of the proposed Final Protective Layer from 24 to 36 inches. This cap construction scenario consisted of the following (listed from ground surface down): a vegetative cover (6 inches thick), protective layer of compacted soil (30 inches thick), geo-composite drainage layer, and 40-mil LLDPE geomembrane underlain by gypsum.
- The other CIP sequence representing the default cover system provided in 35 I.A.C. § 845.750(c) consisted of the following (listed from ground surface down): a vegetative cover (6 inches thick), protective layer of compacted soil (30 inches thick), and 36 inches of compacted clay with a hydraulic conductivity of 1×10^{-7} cm/sec underlain by gypsum.

HELP simulation inputs and output results are presented in **Appendix C**.

6.2 Closure in Place Model Results

The simulation of the CIP scenario resulted in dry cells within the CIP footprint in both layer 1 (the gypsum) and layer 2 (the basal liner) indicating water is not expected to accumulate in the closed unit following placement of the cap. Low levels of saturation within the capped CIP scenario are anticipated due the unwatering and dewatering of the GMF pond prior to capping and the low infiltration rate through the cap. However, in order to use MODPATH to determine

the travel distance of particles through the basal liner, cells are required to be saturated (active). To get saturated cells in the CIP footprint, the horizontal and vertical hydraulic conductivities of the gypsum unit (see **Table C**) were reduced to 0.1 ft/d and 0.01 ft/d respectively, thus allowing for MODPATH simulations. All water balance and particle tracking results provided below pertain to the groundwater model with the reduced gypsum hydraulic conductivity.

The results of simulated CIP for the GMP Pond at DCPP are shown in **Table E** below. All particles remain within the CIP footprint (liner and gypsum), indicating the proposed closure method is not expected to result in exceedances of the GWPS. The mean travel distance of all particles within the liner system and gypsum was 0.29 feet horizontally and 0.03 feet vertically after 100 years. Reduced head within the closed pond creates variable hydraulic gradients with the surrounding groundwater. This results in simulated groundwater inflow into the CIP footprint and outflow from the CIP footprint. Approximately 57 percent of the particles (in the north-western corner of the unit) move upward from the liner system into the over lying gypsum. The remaining 43 percent move downward while remaining within the liner system.

Estimated vertical flow rates are reduced compared to the calibration model. In the calibrated model, vertical flow is 0.62 ft^3/d (**Table D**); whereas, in the CIP scenario this is reduced to 0.07 ft^3/d (**Table E**).

Of primary interest is the simulation of particles moving downwards within the liner which could potentially enter the groundwater system. Comparison of the downwards advective travel distance of the particles for the calibration model (no action) and CIP scenario show a reduction in travel distance after 100 years. In the calibrated model, the mean distance traveled by the particles was 0.12 feet (**Table D**) into the liner system; whereas, in the CIP scenario this is reduced to 0.04 feet (**Table E**) into the liner system.

Table E. Water Balance Results from Closure-in-Place Scenario and Particle Travel Distances after 100 Years

Water Balance components	CIP Scenario	CIP Increase liner K by 10^1
Inflow: Recharge (ft^3/d)	0.027	0.027
Inflow: Groundwater inflows (ft^3/d)	0.042	0.75
Outflow: Leakage (ft^3/d)	0.068	0.78
Mean distance travelled by all particles (feet)	0.285±0.46	17.21±18.12
Mean distance travelled by all particles in z direction (feet)	0.025±0.019	0.326±0.2
Percentage of particles which moved downward	43	42
Mean distance travelled by downward moving particles in z direction (feet)	0.035±0.02	0.226±0.127
Percentage of particles which moved upward	57	58
Mean distance travelled by upward moving particles in z direction (feet)	0.017±0.0	0.4±0.21

ft^3/d = cubic feet per day
K = hydraulic conductivity

6.2.1 GMF Pond Sensitivity

The impact of changes to the liner conductivity, on the simulated CIP GMP Pond groundwater outflows and particle tracking are shown in **Table E** above. Increasing the hydraulic conductivity of the liner system by an order of magnitude results in a similar increase in outflow from 0.07 to 0.78 ft^3/day. There is a significant lateral component to the particle movement in this sensitivity test leading to an increase in mean distance traveled by particles from 0.29 to 17.21 feet. However, the downward movement of particles only increases from 0.04 feet to 0.23 feet. In both simulations the particles remain within the CIP unit and pond liner system, which is 5 feet thick.

7. CONCLUSIONS

There are no potential groundwater exceedances of applicable groundwater standards attributable to the GMF Pond. This GMR has been prepared to show how proposed CIP for the GMF Pond will maintain compliance with the applicable groundwater standards at the DCPP. This report integrates existing site data and information with the latest hydrogeology and groundwater quality data to generate a conceptual and numerical model of the GMF Pond.

The calibrated numerical model of the GMF Pond successfully simulated the groundwater flows and elevations around the GMF Pond. The water balance for the GMF Pond and particle tracking simulations indicated that the outflow from the GMF Pond will decrease as compared to current conditions and that all particles representing potential contaminant mass will remain within the CIP unit and liner system after 100 years.

In the CIP scenario, estimated vertical flow rates through the GMF Pond liner system were reduced from 0.62 ft^3/day in the calibration model to 0.07 ft^3/day. Particle tracking showed that the hydraulic gradient between the CIP unit and the groundwater in the aquifer moved particles a mean distance of 0.29 feet horizontally and 0.04 feet downward after 100 years and remained within the model layers representing the liner system and gypsum unit. Increasing the conductivity of the liner system for sensitivity testing influenced both the water balance and the travel distances of the particles. With the liner conductivity in the CIP model increased by one order of magnitude for testing, the flow out of the pond increased from 0.07 ft^3/day to 0.8 ft^3/day; likewise, the downwards distance travelled by the particles increased from 0.04 feet to 0.22 feet. This indicates that in both the CIP scenario and sensitivity test simulations, the particles do not migrate beyond the liner system which is 5 feet thick.

Particle tracking for the CIP scenario for a 100-year period indicates that contaminants will not migrate beyond the liner system, maintaining compliance with the applicable groundwater standards post closure.

8. REFERENCES

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TABLES

TABLE 2-1. GROUNDWATER ELEVATION TIMESERIES DATA
GROUNDWATER MODELING REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

	Uppermost Aquifer / PMP (Peoria and Roxana Loess)																													
Date	**G50L**	**G51L**	**G52L**	**G53L**	**G54L**	**G55L**	**G56L**	**G57L**	**G58L**	**G59L**	**G60L**	**G61L**	**G62L**	**G63L**	**G64L**	**G65L**	**G66L**	**G67L**	**G68L**	**G69L**	**G70L**	**G71L**	**G72L**	**G73L**	**P57L**	**R61L**	**P01L**	**G02L**	**P40L**	**P41L**	**P42L**
1/9/2004																												613.73	610.22		
3/12/2004																												614.26	610.29		
7/21/2004																												612.27	609.69	602.99	
10/18/2004																												607.24	602.12		
1/28/2005																												616.13	615.3	606.31	612.39
4/11/2006																												614.51	616.49	606.33	613.74
3/29/2007	615.07																								584.97						
5/17/2007	614.03																								588.35						
6/19/2007	613.02																								587.68						
9/18/2007	606.69																								585.66						
11/27/2007	604.67																								584.47						
1/30/2008	609.25	606.31	587.79								591.38					587.77									584.7						
3/26/2008	611.2	609.08	589.31								590.33														585.14						
5/15/2008	611.53	609.21	591.14								589.46					587.79									586.03						
6/24/2008	611.28	607.9	591.85								589.23														586.41						
9/15/2008	612.67	610.68	590.46																						593.64						
11/5/2008	611.28	606.17	591.29																						586.27						
2/16/2009																											616.89	613.96	608.6	605.99	608.48
3/4/2009	611.8	608.4	592.59	603.4		589.29															588.94				586.76						
4/21/2009	613.44	611.62	596.41	607.24	583.7	589.84							590.87			587.87	597.5	597.46	588.78	589.77	590.29				590.51		618.48	615.33	616.27	603.98	610.42
6/8/2009	612.92	610.29	597.01	606.53	583.47	590.1							590.83			587.88	603.4	600.25		590.54	591.24			582.13	588.94		617.76	614.21	614.42	604.61	610.05
4/30/2013	613.62	610.99	595.09	604.59	583.27	590.16	596.96	595.36	589.57	587.74	588.73	600.79	597.74	599.1	593	587.84	596.84	599.3	588.76	589.52	588.19	584.79	589.88	581.53	609.39	600.79					
7/23/2013																												611.86			
10/16/2013																												606.16			
1/20/2014																												613.26			
1/30/2014																															
4/21/2014																												614.5			
4/22/2014																															
7/14/2014																											616.73	614.21			607.95
7/16/2014																															
10/14/2014																											617.01	614.31	616.23	605.22	609.72
2/24/2015																											616.35	614.04	613.15	605.43	611.27
2/25/2015																															
4/15/2015																											611.2	613.81	611.85	605.41	611
4/16/2015																															
7/21/2015																											617.84	614.69	617.3	606.03	610.08
7/22/2015																															
10/12/2015																											614.59	611.59	612.77		603.95
10/15/2015																															
12/10/2015																															

TABLE 2-1. GROUNDWATER ELEVATION TIMESERIES DATA
GROUNDWATER MODELING REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

	Uppermost Aquifer / PMP (Peoria and Roxana Loess)																														
Date	**G50L**	**G51L**	**G52L**	**G53L**	**G54L**	**G55L**	**G56L**	**G57L**	**G58L**	**G59L**	**G60L**	**G61L**	**G62L**	**G63L**	**G64L**	**G65L**	**G66L**	**G67L**	**G68L**	**G69L**	**G70L**	**G71L**	**G72L**	**G73L**	**P57L**	**R61L**	**P01L**	**G02L**	**P40L**	**P41L**	**P42L**
25/01/2016	614	609.8	599.63	614.2		597.26	603.05	602.98	596.01	600.46			599.53	600.06	599.02	595.86	606.19	606.3		606.12	598.93	589.84	595.23	591.05			618.11	615.51	617.38	606.05	610.18
18/04/2016	611.88	606.81	594.89	611.68		596.57	602.96	600.93	594.87	591.16	589.99		594.03	597.89	600.14	592.18	600.88	603.2	593.13	600.16	596.55	586.6	590.53	589.45			615.25	612.01	612.84		604.44
09/08/2016	612.77	610.26	599.7	614.48	584.55	597.28	603.29	602.42	595.53	599.56	589.85		599.38	599.15	598.93	590.1	606	606.46	589.38	606.69	599.1	586.1	589.87	589.41			615.39	612.48	612.82		606.1
08/09/2016																															
14/10/2016	610.07	605.4	597.28	613.29	586.47	598.88	599.36	602.9	597.28	601.7	590.03		600	599.35	597.12	593.96	604.69	604.92	588.41	606.22	598.73	589.13	589.83	589.57			615.67	614.22	613.08		604.09
09/01/2017	609.05	605.49	594.91	610.14	589.18	596.58	600.82	598.92	592.48	588.03	589.77		595.56	596.3	598.17		602.01	602.2	591.34	604.95	597.67	586.39		586.28			614.89	614.76	612.33		603.14
04/02/2017																															
10/02/2017																															
02/04/2017	613.47	609.21	598.63	614.03	587.35	599.27	599.88	601.57	598.08	601.5	589.44		597.5	599.65	599.64	593.71	605.46	606.07	593.5	606.01	604.32	588.84	593.74	590.13			617.44	615.36	617.11	605.63	609.82
26/07/2017	614.09	610.26	600.87	614.55	588.67	598.08	599.42	599.87	598.84	602.7	590.41		598.58	600.25	600.09	594.18	605.86	606.11	595.34	606.45	605.18	588.64	589.73	592.08		601.52	617.45	615.51	617.18	605.64	610.24
01/09/2017																															
02/10/2017			590.67	604.5	586.85	595.78	598.26	595.47	590.83		588.23		593.83	594.51	596.77	588.86			594.36	595.64	593.87	586.29		586.95		591.29	612.71		607.25		600.97
02/01/2018		603.81	588.46	606.1	584.19	592.28					589.5		593.56	594.19	596.84		TOP		590.37	598	591.2			587.08			614.9		612.23		603.14
01/02/2018																															
07/02/2018																															
10/02/2018																															
06/03/2018																											615.77	606.41	612.45		603.19
10/04/2018	614.39	610.65	596.62	614.12	583.65	594.68	600.32	603.39	598.12	598.86	589.94		597.62	599.97	599.92	589.49	604.52	604.89	593.96	606.02	595.77			585.37			617.32	615.51	616.87	605.28	609.65
03/06/2018																															
02/07/2018	606.86	604.9	588.58	606.43	585.71	594.04	597.47	593.79	590.13	587.32	589.34		593.87	594.15	596.62	587.55	599.04	591.39	590.55	598.12	592.06	584.69	589.79	588.03		591.38	616.84	612.31	616.41	604.26	610.19
02/10/2018	610.77	608.61	592.48	604.41	586.34	594.18		593.52			589.73		595.18	594.14	595.31	587.69	598.74	600.22	590.32	598.18	592.83	584.64		585.13		591.29	616.05	607.93	616.35	605.53	610.134
04/10/2018																															
11/01/2019	607.18	604.98	589.9	607.35	585.76	593.78	597.48	593.95	590.29	587.45	589.48		594.5	594.59	597.16	587.88	598.08	599.37	591.45	598.24	592.55	584.92		588.05		591.32	616.56	612.79	617.38	604.33	610.17
04/04/2019	603.94	600.18	594.28	604.14	587.55	598.17	600.29	597.86	592.44	596.5	592.42		596.29	601.06	596.26	590.74	601.95	605.01	592.46	599.57	597.21	586.2	589.78	587.33		593.79	616.89	616.48	618.56	604.8	610.14
01/07/2019	613.15	607.19	593.65	603.06	588.06	598.16	604.92	603.92	598.49	595.27	592.53		597.95	599.05	600.9	589.84	603.09	604.55	597.81	599.52	599.87	588.55	591.79	583.01		593.14	617.24	609.77	616.73	605.98	610.14
11/11/2019	612.09	608.44	594.53	611.17	589.22	597.64	602.09	600.08	595.74	595.37	599.53		599.4	596.92	598.56	592.48	602.26	603.58	596.24	601.63	598.2	589.34	590.51	589.91		597.07	617.06	612.43	611.91	608.39	610.3
03/01/2020	613.17	610.1	591.63	614.03	591.56	598.31	603.26	601.75	596.44	596	602.53		601.19	598.37	599.97	592.08	604.26	604.88	597.2	602.71	598.9	589.23	589.91	590.51		599.16	617.52	615.78	614.73	607.73	613.71
13/04/2020	612.97	609.82	596.88	613.8	591.01	600.31	605.64	604.11	600.59	602.76	605.49		605.03	611.32	603.52	596.36	604.14	605.58	598.91	604.34	601.69	591.48	591.71	593.52		604.89	616.68	614.51	614.65	608.44	613.87
06/08/2020	609.55	603.54	593.79	610.48	592.39	600.19	602.74	600.58	596.31	597.2	599.81		601.8	599.58	599.98	593.83	599.93	602.69	598.92	600.26	597.43	589.34	590.51	591.48		602.25	611.94	608.31	610.34		610.43
16/11/2020	606.36	602.25	591.67	605.38	592.56	597.8	598.92	596.16	592.08	590.7	593.44		597.64	596.31	596.91	590.2				596.14	594.57	587.72	589.88	588.05		596.68	608.45		601.99		606.24
18/02/2021	611.29	606.99	593.46	607.98	591.56	595.81	597.55	595.8	591.42	589.15	593.7		595.71	595.35	596.57	588.6	597.77	599.69		595.36	593.5	587.08	589.89	586.66		594.89	615.33	613.55	606.5		607.74

TABLE 2-1. GROUNDWATER ELEVATION TIMESERIES DATA
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DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

	Uppermost Aquifer (Shallow Sand)																										
Date	**G02S**	**P01S**	**P40S**	**P41S**	**P42S**	**G50S**	**G51S**	**G52S**	**G53S**	**G54S**	**G55S**	**G56S**	**G57S**	**G58S**	**G59S**	**G60S**	**G61S**	**G63S**	**G64S**	**G65S**	**G66S**	**G67S**	**G68S**	**G69S**	**G71S**	**G72S**	**R72S**	**P57S**
1/9/2004																												
3/12/2004																												
7/21/2004																												
10/18/2004																												
1/28/2005																												
4/11/2006																												
3/29/2007						614.94																						585.925
5/17/2007						613.91																						588.775
6/19/2007						612.95																						588.215
9/18/2007						606.56																						586.355
11/27/2007						603.67																						584.955
1/30/2008						607.7	606.43	583.95								582.43				584.6								585.265
3/26/2008						609.64	609.28	584.79								582.24				584.39								585.635
5/15/2008						609.9	609.35	585.11								581.93				585								586.775
6/24/2008						609.54	608.03	585.16								581.47				585.18								586.945
9/15/2008						611.59	610.87	587.55								584.29				584.79								586.575
11/5/2008						610.2	606.37	585.78								582.7				585.08								586.805
2/16/2009																												
3/4/2009						610.74	608.5	586.45	602.49	583.75	589.7	592.19	591.24	585.59	581.91	581.75	590.22	589.63	590.65	584.08	593.54	594.01	586.17	587.34	580.38			585.415
4/21/2009						612.31	611.51	588.79	604.2	583.47	589.71	592.54	591.87	586.99	582.25	583.02	590.06	590.29	591.44	584.82	598.13	597.24	586.15	588.75	581.29			586.905
6/8/2009						611.82	610.27	588.13	604.77	583.32	590.12	593.19	593.49	587.75	582.81	583.67	589.87	591.14	592.53	586.31	601.71	599.62	586.23	588.93	581.9			588.135
4/30/2013						612.43	611.34	590.21	604.88	582.97	589.69	592.49	592.1	591.71	587.27	588.42	588.37	592.4	593.82	584.2	596.06	595.72	586.51	586.07	584.73	583.6		609.705
7/23/2013																												
10/16/2013																												
1/20/2014																												
1/30/2014						607.77	603.88	587.9	600.4	582.88	589.87	592.24	591.42	586.95	584.3	584.69	586.87	591.5	592.64	584.83	591.94	593.18	586.86	585.48	582.4	584.05		
4/21/2014																												
4/22/2014						607.77	603.88	587.9	600.4	582.88	589.87	592.24	591.42	586.95	584.3	584.69	586.87	591.5	592.64	584.83	591.94	593.18	586.86	585.48	582.4	584.05		
7/14/2014																												
7/16/2014						611.03	609.08	589.59	604.58	583.05	590.39	593.57	592.88	586.03	585.83	586.63	587.37	592.88	594.28	585.45	598.79	598.29	586.94	586.85	584.08	585.88		
10/14/2014						611.6	610.59	590.62	606.97	583.42	591.55	595.61	595.58	591.01	586.83	587.93	588.04	593.93	595.52	588.72	601.8	600.14	587.88	588.58	585.66	589.91		
2/24/2015																												
2/25/2015						611.3	609.66	589.84	606.09	583.2	591.33	595.42	594.52	589.46	585.84	586.63	587.28	593.59	594.94	587.8	598.18	597.79	587.6	588.3	584.02			
4/15/2015																												
4/16/2015						610.54	607.06	589.62	606.85	583.33	591.62	596.29	595.95	590.15	585.86	586.69	587.74	594.13	595.45	587.9	598.38	598.32	587.44	588.46	584.32			
7/21/2015																												
7/22/2015						612.65	610.07	591.37	610.9	584.35	596.51	600.97	601.61	596.81	588.79	590.82	590.02	596.97	598.42	594.45	605.34	605.57	592.96	599.23	588.77	593.79		
10/12/2015																												
10/15/2015						608.15	604.08	589	606.7	584.87	596.13	600.04	597.19	590.61	585.28	586.07	589.2	595.21	596.06	592.02	600.09	601.71	592.36	595	586.34	588.41		
12/10/2015	611.53	614.27	612.3	600.64	603.95																							

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GROUNDWATER MODELING REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

	Uppermost Aquifer (Shallow Sand)																										
Date	**G02S**	**P01S**	**P40S**	**P41S**	**P42S**	**G50S**	**G51S**	**G52S**	**G53S**	**G54S**	**G55S**	**G56S**	**G57S**	**G58S**	**G59S**	**G60S**	**G61S**	**G63S**	**G64S**	**G65S**	**G66S**	**G67S**	**G68S**	**G69S**	**G71S**	**G72S**	**R72S**	**P57S**
25/01/2016						612.71	610.01	591.84	611.37	586.14	596.89	603.05	601.64	596.89	588.65	590.78	589.27	597.73	597.97	596.05	605.92	605.84	591.96	598.87	590.6	595.24		
18/04/2016						610.93	606.85	589.93	609.24	585.58	596.45	602.68	600.86	594.28	586.91	588.42	590.05	597.27	597.74	592.16	600.59	602.81	592.15	595.65	586.83	586.9		
09/08/2016						612.91	610.67	591.69	611.32	584.43	596.99	603.14	602.02	596.07	585.31	586.57	589.66	595.95	597.97	594.07	605.37	605.69	593.01	599.58	588.81			
08/09/2016	612.18	614.87	612.63	601.35	605.61																							
14/10/2016						608.63	605.6	589.92	608.65	586.46	598.82	599.84	602.32	598.08	589.8	591.86	590.49	597.21	598.77	593.96	604.16	604.75	592.8	598.51	589.35		589.57	
09/01/2017						606.55	605.53	589.6	608.37	588.84	596.77	600.84	598.79	593.01	586.65	587.37	591.35	596	596.62	590.63	599.56	601.67	594.64	596.5	586.97		585.71	
04/02/2017	614.9	617.15	616.67	605.75	608.2																							
10/02/2017	603.72	612.77	606.85	594.76	598.97																							
02/04/2017						612.06	609.47	606.84	610.72	584.57	596.26	600.7	600.83	594.8	589.16	591.78	591.16	597.97	598.96	593.61	605.27	605.36	592.46	599.11	589.76		594.05	
26/07/2017						609.36	609.98	608.1	610.46	585.5	596.13	600.72	601.68	597.95	591.75	593.09	592.33	597.8	597.78	594.07	605.46	605.72	592.93	600.18	589.96		594.97	
01/09/2017	612.45	616.13	611.64	600.82	602.2																							
02/10/2017						603.07	599.59	587.48	602.36	586.82	595.47	597.49	594.79	590.14	584.81	588.88	597.8	593.29	595.74	588.78	594.15	597	587.97	593.19	585.9		585.79	
02/01/2018						607.7	601.94	584.78	605.99	583.17	591.82	597.49	599.66	594.99	582.01	590.17	587.88	593.1	598.79	586.97	596.36	598.14	583.05	589.86	583.08		583.96	
01/02/2018	610.56	615.52	611.12	599	603.29																							
07/02/2018	612.97	616.52	615.83	604.57	608.09																							
10/02/2018	610.03	616.42	613.89	604.49	607.97																							
06/03/2018																												
10/04/2018						613.55	611.14	591.82	611.17	586.47	594.59	601.37	601.83	597.86	587.16	591.97	590.9	598.11	599.21	589.24	603.9	604.11	592.81	599.28	587.8		585.61	
03/06/2018	614.38	615.67	611.14	598.47	603.62																							
02/07/2018						607.87	605.67	586.41	606.41	585.61	591.71	597.1	598.82		581.8	590.47	587.85	593.06	598.77		597.11	598.29	581.95	580.08	583.09		583.99	
02/10/2018						610.4	608.94	588.8	603.14	586.21	593.99	596.87	595.02	589.68	584.73	585.43	590.9	593.22	593.97	587.01	598.11	599.5	580.82	588.58	586.2		585.17	
04/10/2018	614.88	616.93	616.49	605.91	608.14																							
11/01/2019						608.2	605.98	589.92	607.34	584.05	591.85	597.14	599.33	595.32	581.81	590.62	589	593.12	598.86	587.3	598.09	599.1	582.11	590.13	583.2		584.15	
04/04/2019								598.42	598.54	587.55	598.66	599.81	597.89	595.46	588.81	590.07	590.02	588.1	593.38	588.17	601.77	605.19	586.9	593.19	589.1		589.77	
01/07/2019						611.99	607.79	591.08	602.97	597.14	587.87	599.05	603.74	604.46	597.2	589.95	592.55	597.12	599.77	588.07	602.66	604.33	596.78	590.09	590.05		588.6	
11/11/2019						611.23	608.69	590.57	608.88	588.58	597.55	602.01	599.92	595.58	587.19	588.4	596.35	596.47	597.24	592.3	601.78	603.06	595.31	597.64	589.28		588.68	
03/01/2020						612.35	610.4	591.65	611.15	589.33	598.19	603.44	601.29	596.73	587.95	589.35	598.96	597.7	598.51	592.68	603.82	604.44	596.35	598.4	589.35		588.35	
13/04/2020						611.99	610.08	591.27	611.31	590.13	600.31	605.46	604.51	600.08	588.73	590.98	604.67	601.11	600.84	596.17	603.73	605.34	597.83	600.47	591.12		591.56	
06/08/2020						608.42	603.77	599.58	608.14	591.46	599.97	602.36	600.61	596.06	587.77	589.02	601.19	598.3	598.63	593.73	599.35	602.26	598.06	597.26	589.25		589.11	
16/11/2020						605.68	602.23	588.69	603.77	591.54	597.54	598.52	596.24	591.88	587.02	587.8	595.95	595.38	596.18	590.11	595.58	598.31	596.29	593.88	587.72		586.38	
18/02/2021						610.4	607.17	589.63	606.58	590.59	595.68	598.09	596.17	591.62	586.45	587.49	594.21	595.22	596.04	588.65	597.52	599.43	594.94	593.14	587.12		585.42	

[O:BP June 2021; C: NLN 10/25/21; C: BGH 10/29/21]

TABLE 2-2. GROUNDWATER ELEVATION DATA
GROUNDWATER MODELING REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Well ID	Easting (feet)	Northing (feet)	X model (feet)	Y model (feet)	Top of Screen (feet)	Bottom of Screen (feet)	Center of Screen (feet)	Standard Deviation (feet)	Number of Readings	Minimum GWL (feet)	Maximum GWL (feet)	Mean GWL (feet)	GWL Variation (feet)
G02L	2345393.92	1400757.03	2543.92	6707.03	609.5	604.5	607.00	2.67	38	606.16	616.48	613.04	10.32
G02S	2345396.37	1400748.81	2546.37	6698.81	596.18	591.18	593.68	2.70	18	603.72	615.5	612.70	11.78
G50L	2345538.178	1399222.503	2688.178	5172.503	609.24	604.53	606.89	2.85	34	603.94	615.07	611.16	11.13
G50S	2345538.017	1399216.604	2688.017	5166.604	591.66	586.85	589.26	4.36	44	586.56	614.94	609.57	28.38
G51L	2345467.956	1398451.651	2617.956	4401.651	604.8	600.01	602.41	2.81	30	600.18	611.62	607.64	11.44
G51S	2345468.02	1398447.042	2618.02	4397.042	592.82	588.04	590.43	4.29	39	587.69	611.51	607.17	23.82
G52L	2345467.443	1397701.96	2617.443	3651.96	587.49	582.9	585.20	3.46	31	587.79	600.87	593.72	13.08
G52S	2345467.996	1397697.133	2617.996	3647.133	577.41	572.63	575.02	5.07	39	583.95	608.1	590.25	24.15
G53L	2346049.245	1399242.023	3199.245	5192.023	603.37	594.02	598.70	4.07	25	603.06	614.55	609.08	11.49
G53S	2346053.266	1399241.972	3203.266	5191.972	589.72	585.23	587.48	3.52	33	598.54	611.37	606.58	12.83
G54L	2346007.979	1397706.511	3157.979	3656.511	592.86	583.43	588.15	2.97	22	583.27	592.56	587.41	9.29
G54S	2346004.479	1397706.819	3154.479	3656.819	576.75	572.28	574.52	3.26	33	582.88	597.14	586.11	14.26
G55L	2346248.805	1397709.746	3398.805	3659.746	584.33	583.85	584.09	3.24	25	589.29	600.31	595.78	11.02
G55S	2346248.641	1397706.061	3398.641	3656.061	579.07	574.62	576.85	3.51	33	587.87	600.31	594.24	12.44
G56L	2346522.917	1397750.899	3672.917	3700.899	606.19	597.85	602.02	2.55	20	596.96	605.64	600.73	8.68
G56S	2346522.742	1397747.224	3672.742	3697.224	586.67	582.18	584.43	3.77	33	592.19	605.46	598.30	13.27
G57L	2346531.002	1398106.794	3681.002	4056.794	604.05	594.6	599.33	3.52	21	593.52	604.11	599.30	10.59
G57S	2346531.145	1398102.358	3681.145	4052.358	590.55	586.02	588.29	3.92	33	591.24	604.51	597.79	13.27
G58L	2346532.815	1398246.776	3682.815	4196.776	599.48	590.07	594.78	3.27	20	589.57	600.59	594.78	11.02
G58S	2346533.675	1398242.523	3683.675	4192.523	588.74	584.26	586.50	4.80	33	582	604.46	592.82	22.46
G59L	2346536.298	1398385.852	3686.298	4335.852	597.2	587.78	592.49	5.45	19	587.32	602.76	595.23	15.44
G59S	2346536.3	1398381.765	3686.3	4331.765	582.73	578.23	580.48	3.13	33	581.8	597.2	586.45	15.4
G60L	2346593.584	1398516.878	3743.584	4466.878	592.57	587.78	590.18	4.53	25	588.23	605.49	592.17	17.26
G60S	2346593.887	1398511.868	3743.887	4461.868	581.21	576.42	578.82	3.27	39	581.47	593.09	587.35	11.62
G61L	2346537.794	1398682.764	3687.794	4632.764	610.56	601.2	600.30	1.00	1	600.79	600.79	600.79	NA
G61S	2346538.331	1398687.195	3688.331	4637.195	589.92	585.48	587.70	4.23	33	586.87	604.67	591.35	17.8
G62L	2346538.232	1398827.136	3688.232	4777.136	600.06	590.71	595.39	3.33	24	590.83	605.03	596.98	14.2
G63L	2346541.313	1398970.834	3691.313	4920.834	601.8	592.38	597.09	3.64	22	594.14	611.32	598.24	17.18
G63S	2346541.905	1398966.566	3691.905	4916.566	585.46	580.97	583.22	2.91	33	588.1	601.11	594.74	13.01
G64L	2346539.146	1399111.488	3689.146	5061.488	602.12	592.76	597.44	2.21	22	593	603.52	598.25	10.52
G64S	2346538.063	1399106.875	3688.063	5056.875	585.75	581.26	583.51	2.60	33	590.65	600.84	596.37	10.19
G65L	2346463.961	1397028.352	3613.961	2978.352	593.01	588.21	590.61	2.78	24	587.55	596.36	590.61	8.81
G65S	2346458.347	1397027.185	3608.347	2977.185	583.17	578.39	580.78	4.16	39	576.99	596.17	588.59	19.18
G66L	2346509.483	1397282.853	3659.483	3232.853	605.14	595.71	600.43	3.02	21	596.84	606.19	602.03	9.35
G66S	2346509.006	1397278.215	3659.006	3228.215	579.94	575.45	577.70	3.96	33	591.94	605.92	599.88	13.98
G67L	2346472.782	1397569.814	3622.782	3519.814	607.41	598.05	602.73	3.66	21	591.39	606.46	602.58	15.07
G67S	2346469.268	1397572.438	3619.268	3522.438	583.72	579.23	581.48	3.84	33	593.18	605.84	600.76	12.66
G68L	2346152.97	1397593.263	3302.97	3543.263	598.8	589.43	594.12	3.36	20	588.41	598.92	593.06	10.51
G68S	2346148.944	1397592.398	3298.944	3542.398	579.49	575.02	577.26	4.81	33	580.82	598.06	590.15	17.24
G69L	2345830.273	1397585.849	2980.273	3535.849	599.25	589.88	594.57	5.25	24	589.52	606.69	600.01	17.17
G69S	2345834.433	1397585.858	2984.433	3535.858	578.6	574.1	576.35	5.40	33	580.08	600.47	592.79	20.39
G70L	2345701.108	1397413.265	2851.108	3363.265	594.89	585.54	590.22	4.41	25	588.19	605.18	595.95	16.99
G71L	2345823.223	1397148.551	2973.223	3098.551	595.33	585.84	590.59	1.94	20	584.64	591.48	587.49	6.84
G71S	2345821.255	1397152.559	2971.255	3102.559	581.28	577.28	579.28	3.02	33	580.38	591.12	586.39	10.74
G72L	2346054.09	1396946.871	3204.09	2896.871	600.21	590.85	595.53	1.55	16	589.73	595.23	590.79	5.5
G72S	2346049.117	1396947.026	3199.117	2897.026	584.87	580.39	582.63	4.49	10	580.12	595.24	587.20	15.12
G73L	2346343.387	1396966.704	3493.387	2916.704	590.15	580.8	585.48	3.04	23	581.53	593.52	587.94	11.99
P01L	2345348.87	1399791.97	2498.87	5741.97	611.71	602.36	607.04	2.17	31	608.45	618.48	615.88	10.03
P01S	2345348.93	1399796.61	2498.93	5746.61	599.35	594.87	597.11	1.21	18	612.77	617.59	616.01	4.82
P40L	2346652.35	1400805.34	3802.35	6755.34	611.81	601.81	606.81	4.05	36	601.99	618.56	613.11	16.57
P40S	2346652.52	1400812.95	3802.52	6762.95	590.68	585.68	588.18	2.71	18	606.85	617.13	613.66	10.28
P41L	2346634.94	1399638.11	3784.94	5588.11	606.47	601.47	603.97	3.00	34	595.48	608.44	603.67	12.96
P41S	2346638.49	1399645.38	3788.49	5595.38	592.83	582.83	587.83	3.20	18	594.76	606.35	602.72	11.59

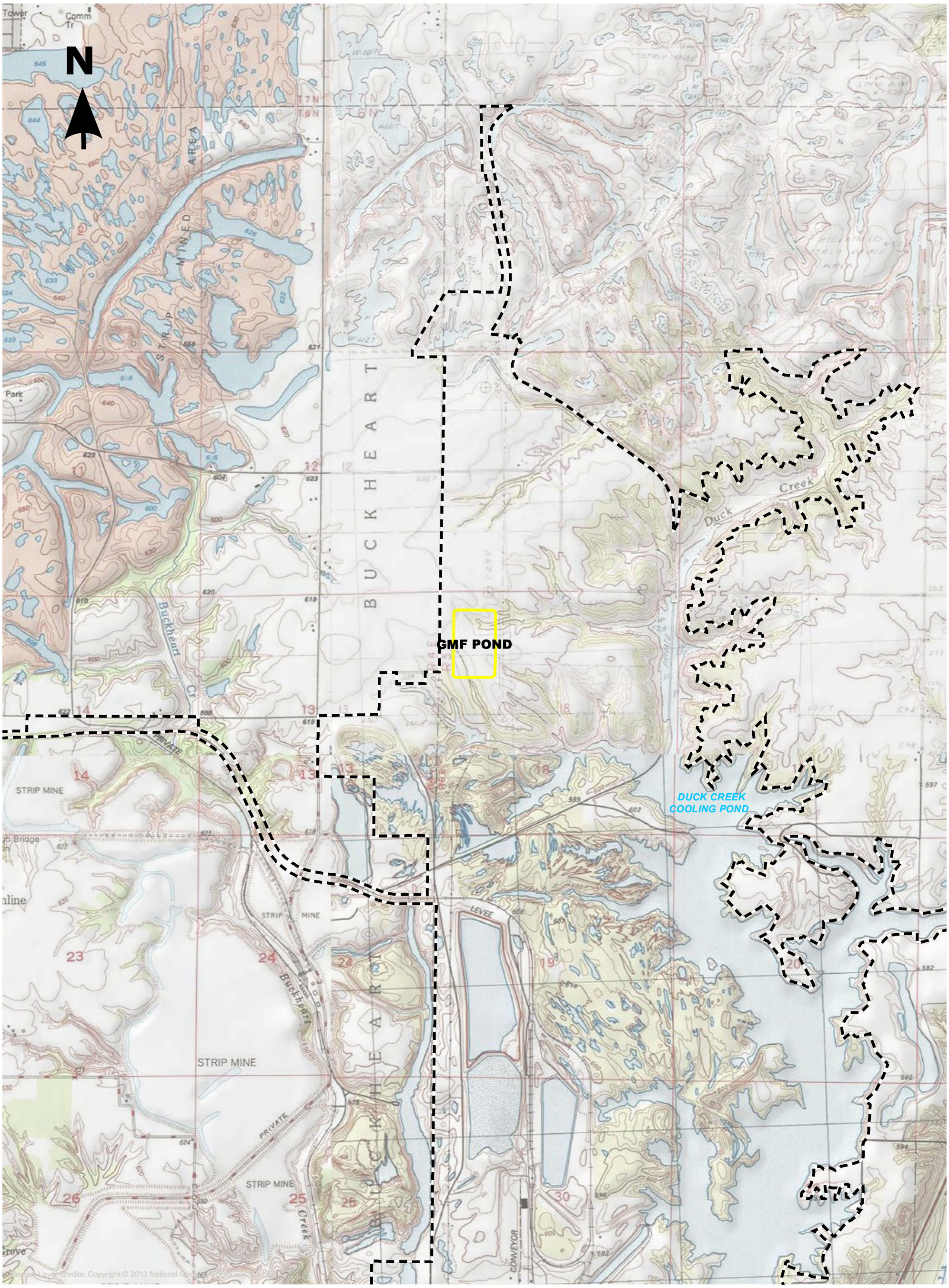
TABLE 2-2. GROUNDWATER ELEVATION DATA
GROUNDWATER MODELING REPORT
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Well ID	Easting (feet)	Northing (feet)	X model (feet)	Y model (feet)	Top of Screen (feet)	Bottom of Screen (feet)	Center of Screen (feet)	Standard Deviation (feet)	Number of Readings	Minimum GWL (feet)	Maximum GWL (feet)	Mean GWL (feet)	GWL Variation (feet)
P42L	2346018.89	1399640.95	3168.89	5590.95	609.03	599.03	604.03	3.31	33	600.97	613.87	608.70	12.9
P42S	2346012.93	1399640.29	3162.93	5590.29	591.21	586.21	588.71	3.10	18	598.97	610.88	606.31	11.91
P57L	2346672.501	1397040.105	3822.501	2990.105	589.44	584.74	587.09	6.05	15	584.469	609.389	588.59	24.92
P57S	2346669.285	1397043.518	3819.285	2993.518	579.92	575.21	577.57	5.86	15	584.955	609.705	588.16	24.75
R61L	2346537.97	1398692.52	3687.97	4642.52	601.12	591.49	596.31	4.50	14	591.29	604.89	596.39	13.6
R72S	2346044.05	1396948.06	3194.05	2898.06	584.98	580.32	582.65	3.21	18	583.96	594.97	587.82	11.01

[O:BP June 2021; C: NLN 10/25/21; C: BGH 10/29/21]

Notes:
GMF - Gypsum Management Facility
GWL = groundwater elevation
NA = Not Applicable
NAVD88 = North American Vertical Datum of 1988

FIGURES



PART 845 REGULATED UNIT (SUBJECT UNIT)
PROPERTY BOUNDARY

0 1,000 2,000 Feet

SITE LOCATION MAP

FIGURE 1-1

GROUNDWATER MODELING REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY

0 150 300 Feet

SITE MAP

FIGURE 1-2

GROUNDWATER MODELING REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

MONITORING WELL
PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY

0 150 300 Feet

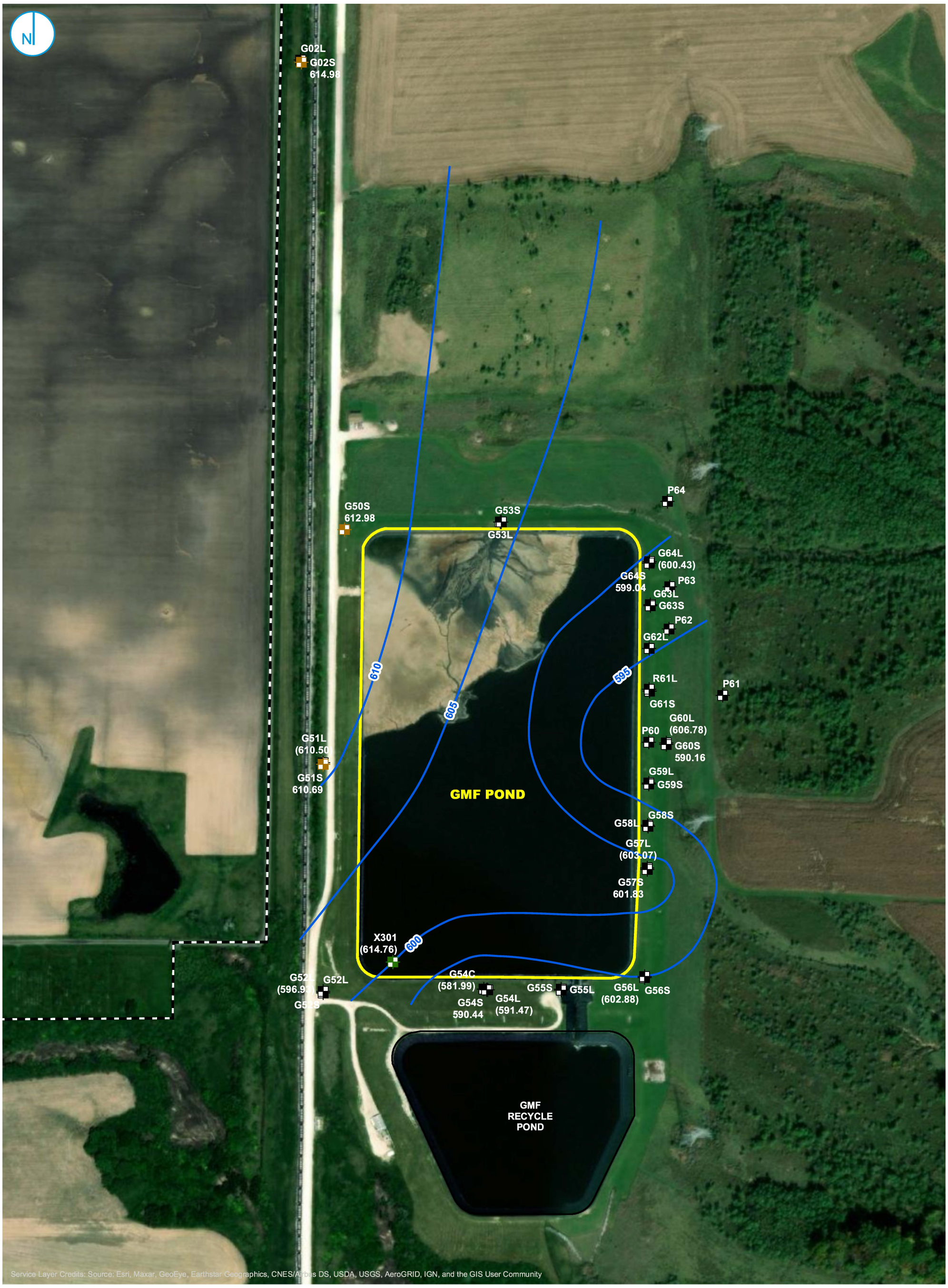
MONITORING WELL LOCATION MAP

FIGURE 2-1

GROUNDWATER MODELING REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



BACKGROUND WELL
MONITORING WELL
SOURCE SAMPLE LOCATION
GROUNDWATER ELEVATION CONTOUR (5-FT CONTOUR INTERVAL, NAVD88)
PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY

0 150 300 Feet

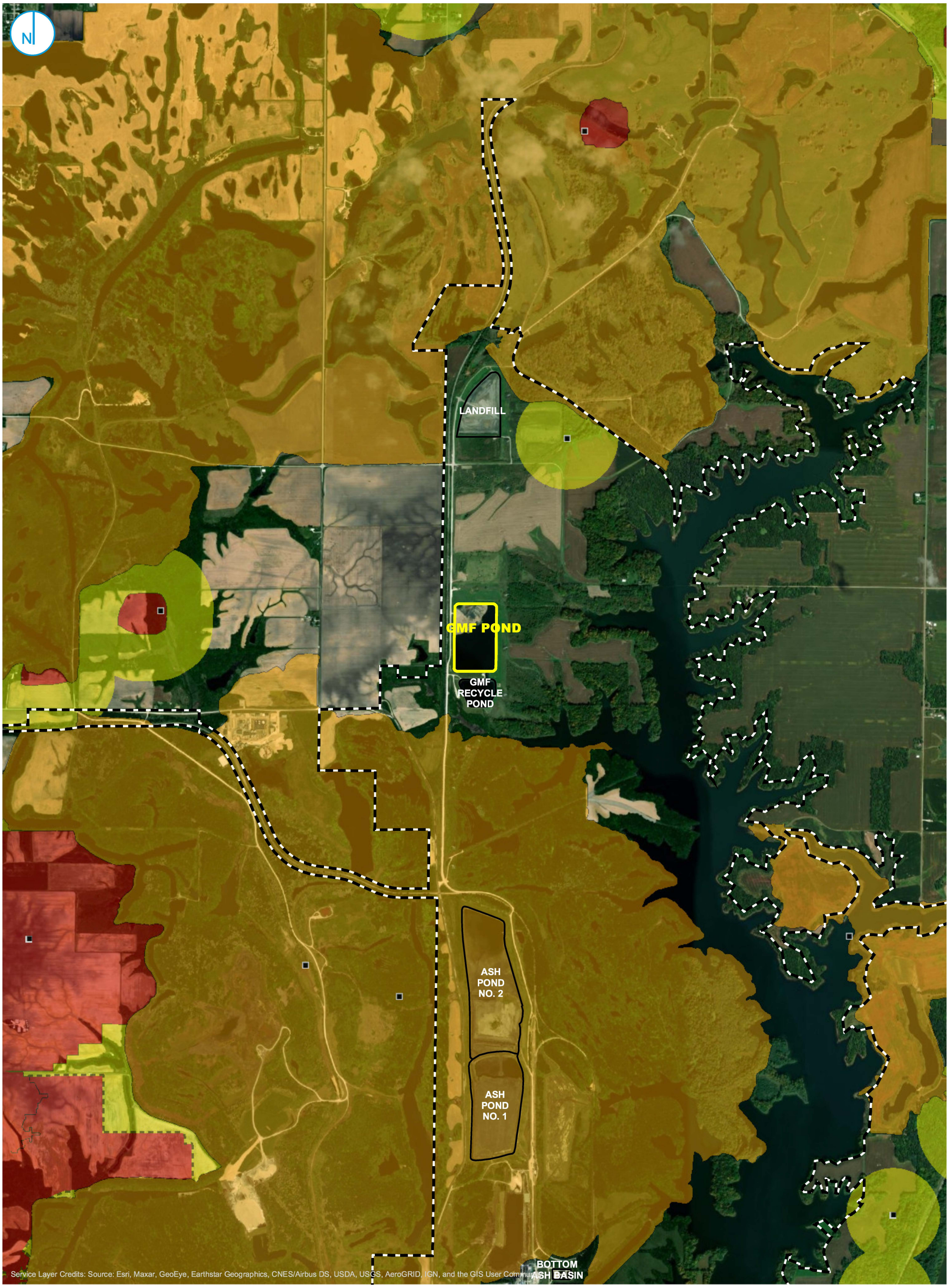
UPPERMOST AQUIFER GROUNDWATER ELEVATION CONTOURS APRIL 14, 2021

FIGURE 2-2

GROUNDWATER MODELING REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

RAMBOLL



- COAL MINE SHAFT
- SURFACE COAL MINE
- UNDERGROUND COAL MINE
- UNDERGROUND MINE BUFFER REGION
- PART 845 REGULATED UNIT (SUBJECT UNIT)
- SITE FEATURE
- PROPERTY BOUNDARY

0 1,000 2,000 Feet

COAL MINE COVERAGE AREA

GROUNDWATER MODELING REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

FIGURE 2-3

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

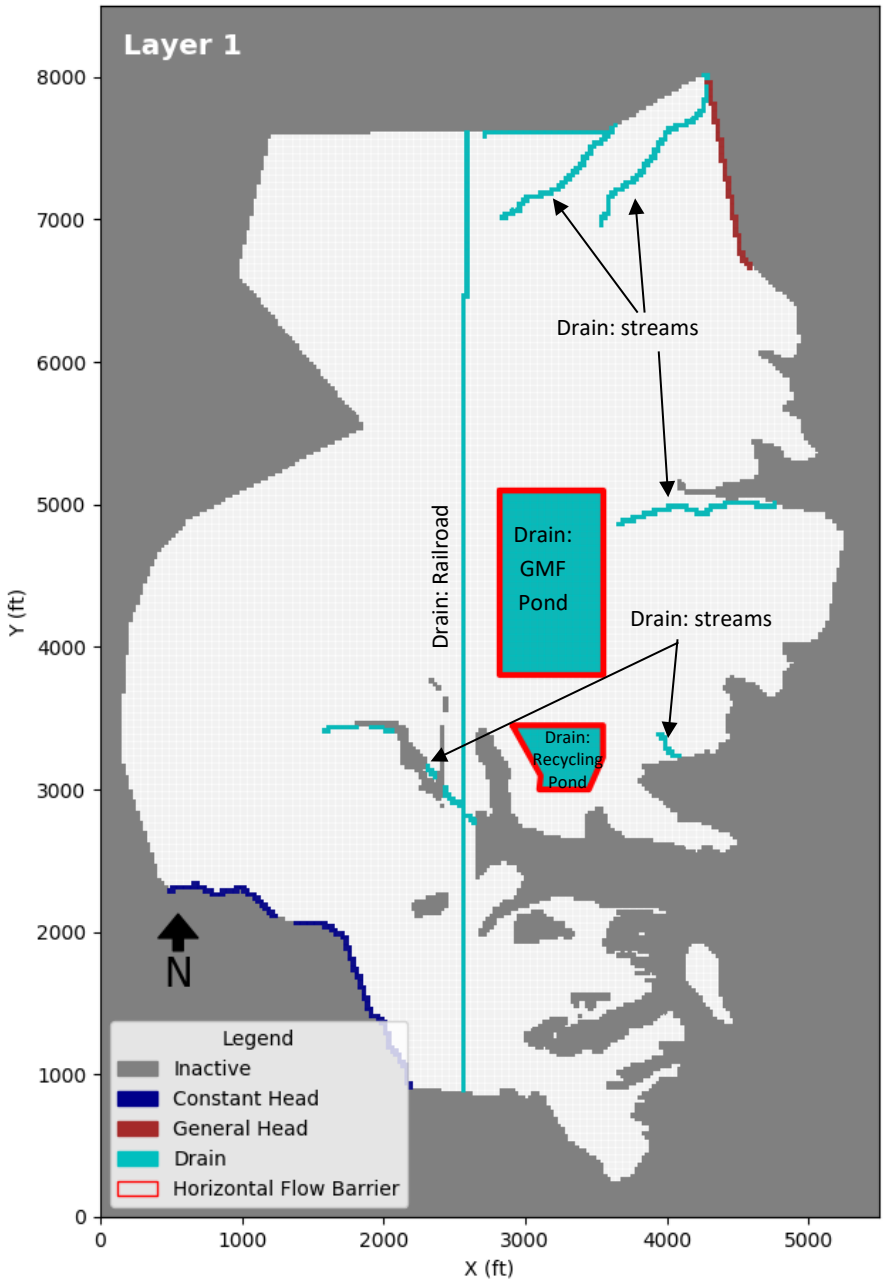


FIGURE 5-1 BOUNDARY CONDITIONS FOR LAYER 1 OF THE CALIBRATED NUMERICAL MODEL

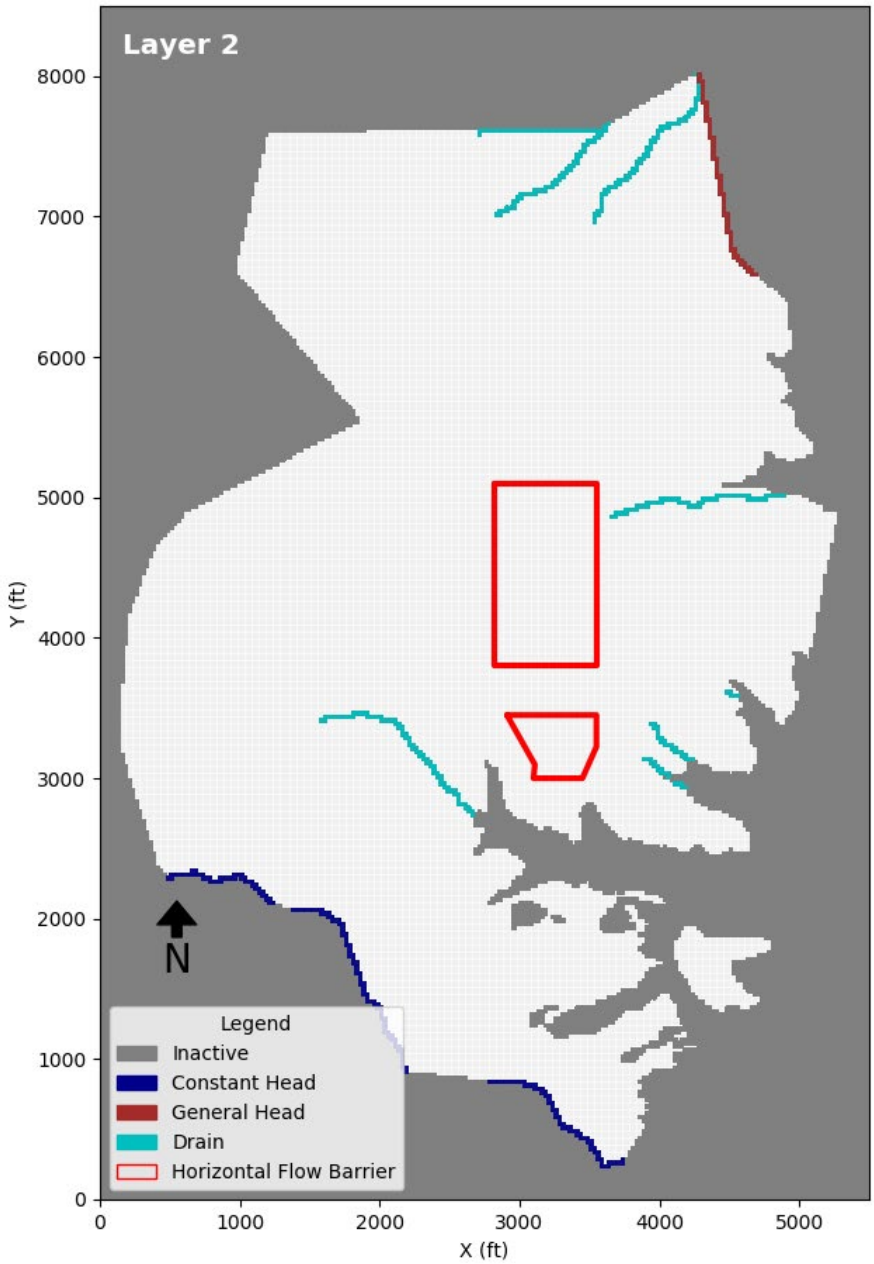


FIGURE 5-2 BOUNDARY CONDITIONS FOR LAYER 2 OF THE CALIBRATED NUMERICAL MODEL

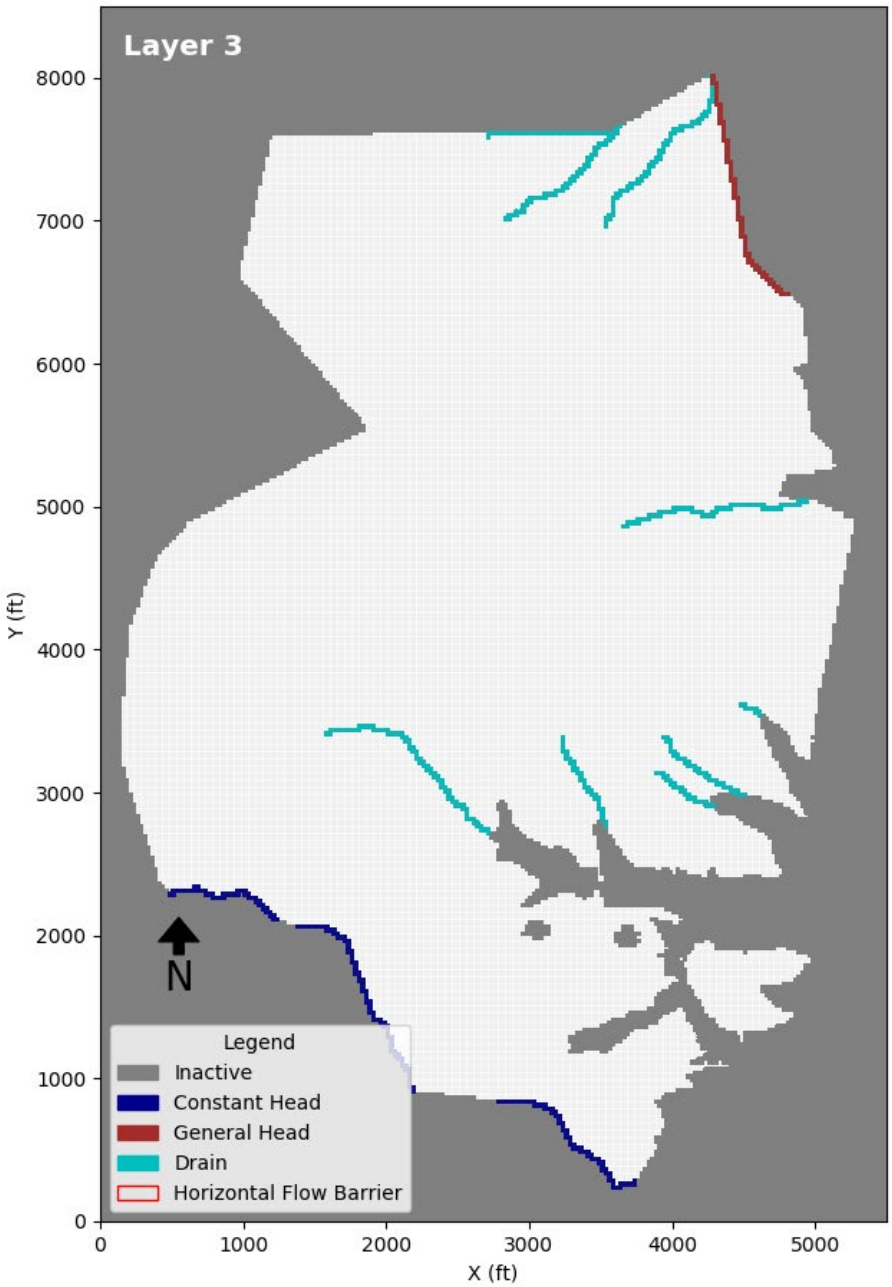


FIGURE 5-3 BOUNDARY CONDITIONS FOR LAYER 3 OF THE CALIBRATED NUMERICAL MODEL

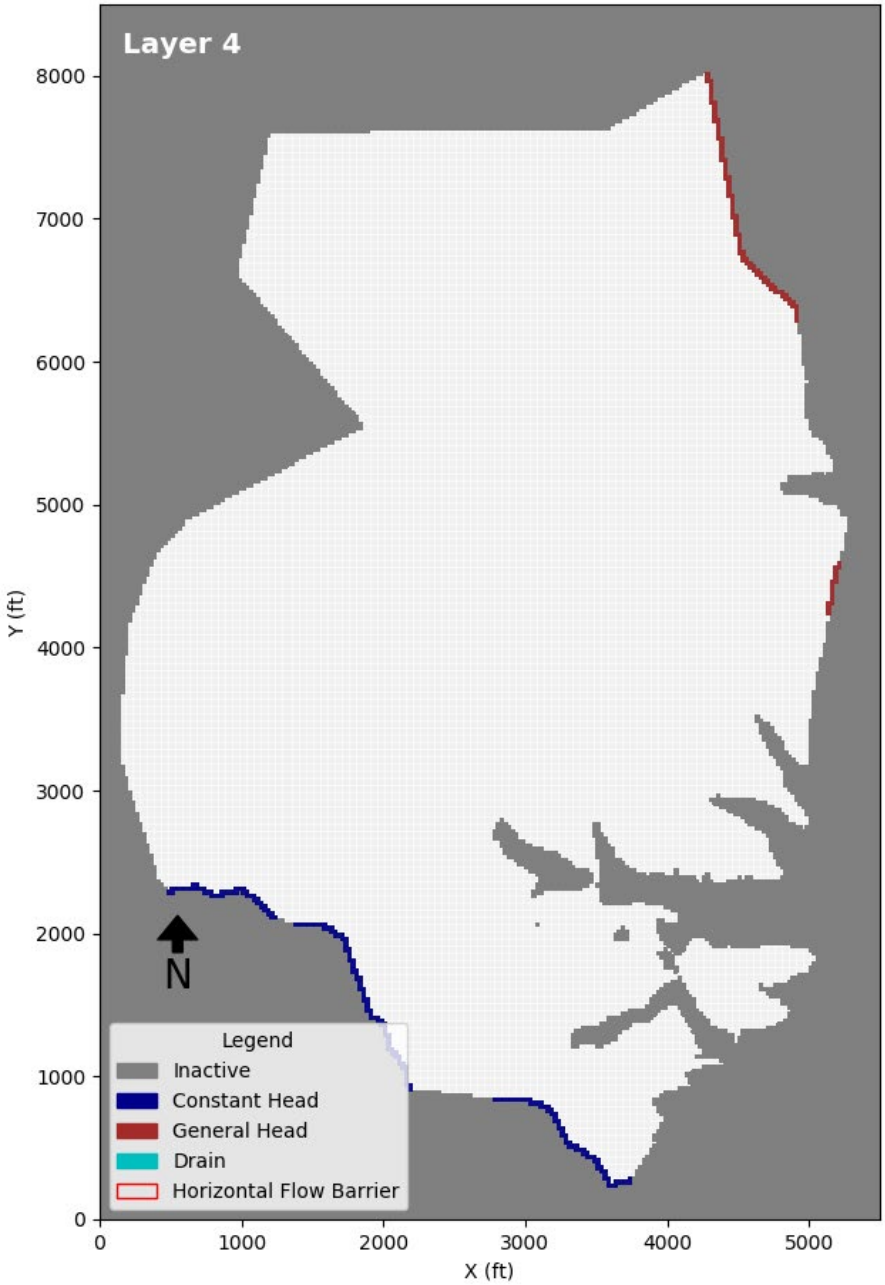


FIGURE 5-4 BOUNDARY CONDITIONS FOR LAYER 4 OF THE CALIBRATED NUMERICAL MODEL

GROUNDWATER MODELING REPORT
GMF POND
DUCK CREEK SITE
CANTON, ILLINOIS

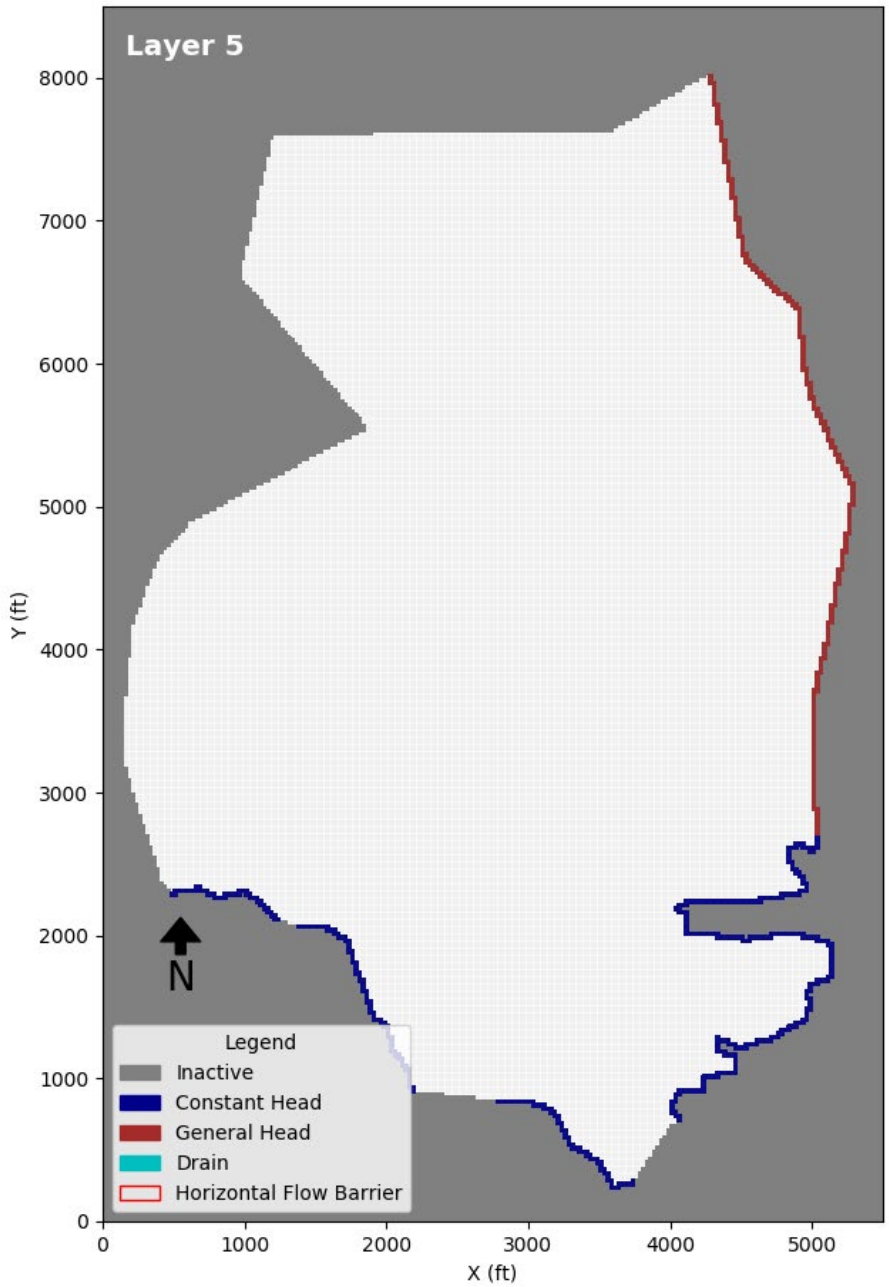


FIGURE 5-5 BOUNDARY CONDITIONS FOR LAYER 5 OF THE CALIBRATED NUMERICAL MODEL

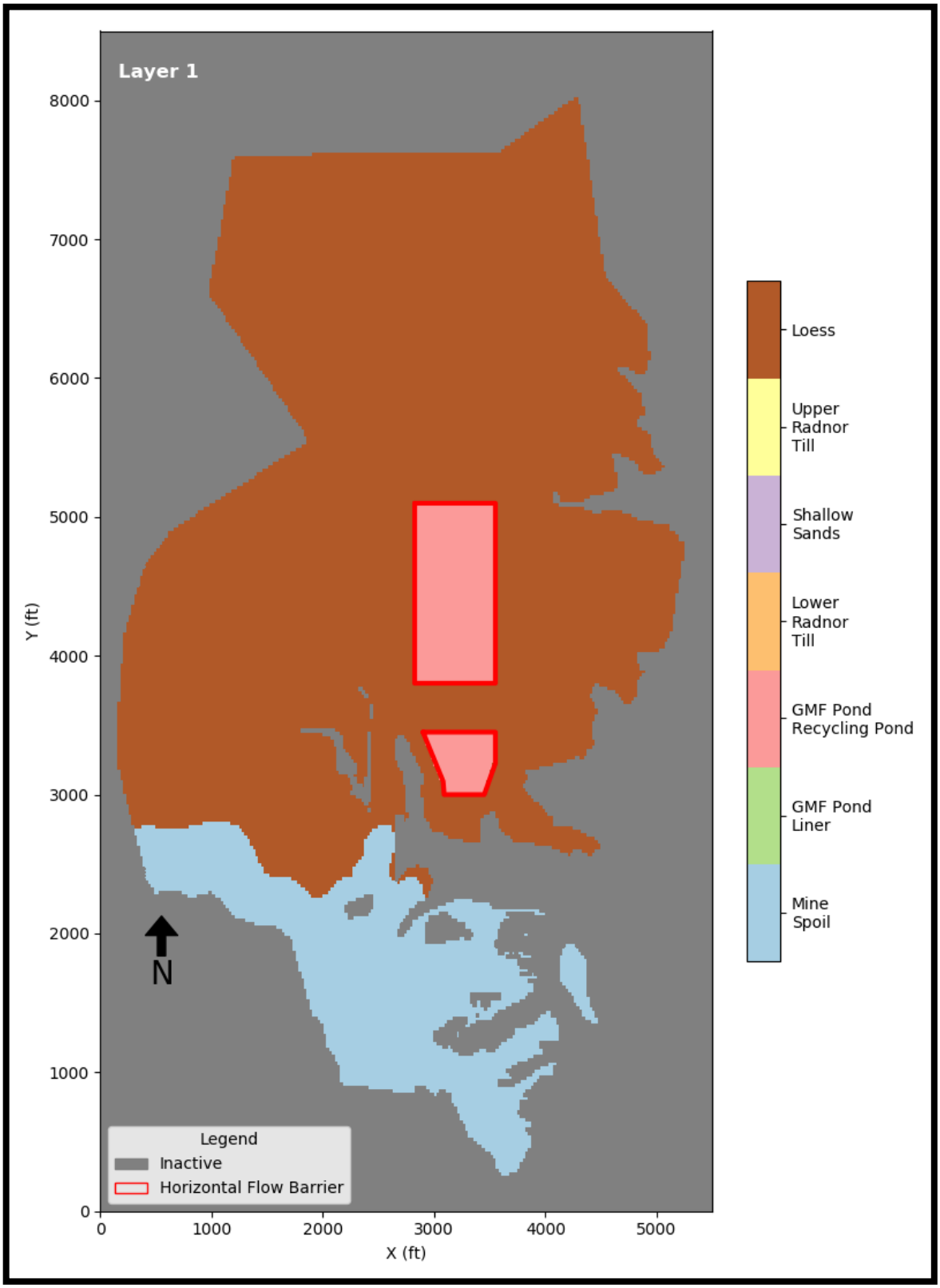


FIGURE 5-6 SPATIAL DISTRIBUTION OF HYDROSTRATIGRAHPIC LAYERS FOR LAYER 1 IN THE NUMERICAL MODEL

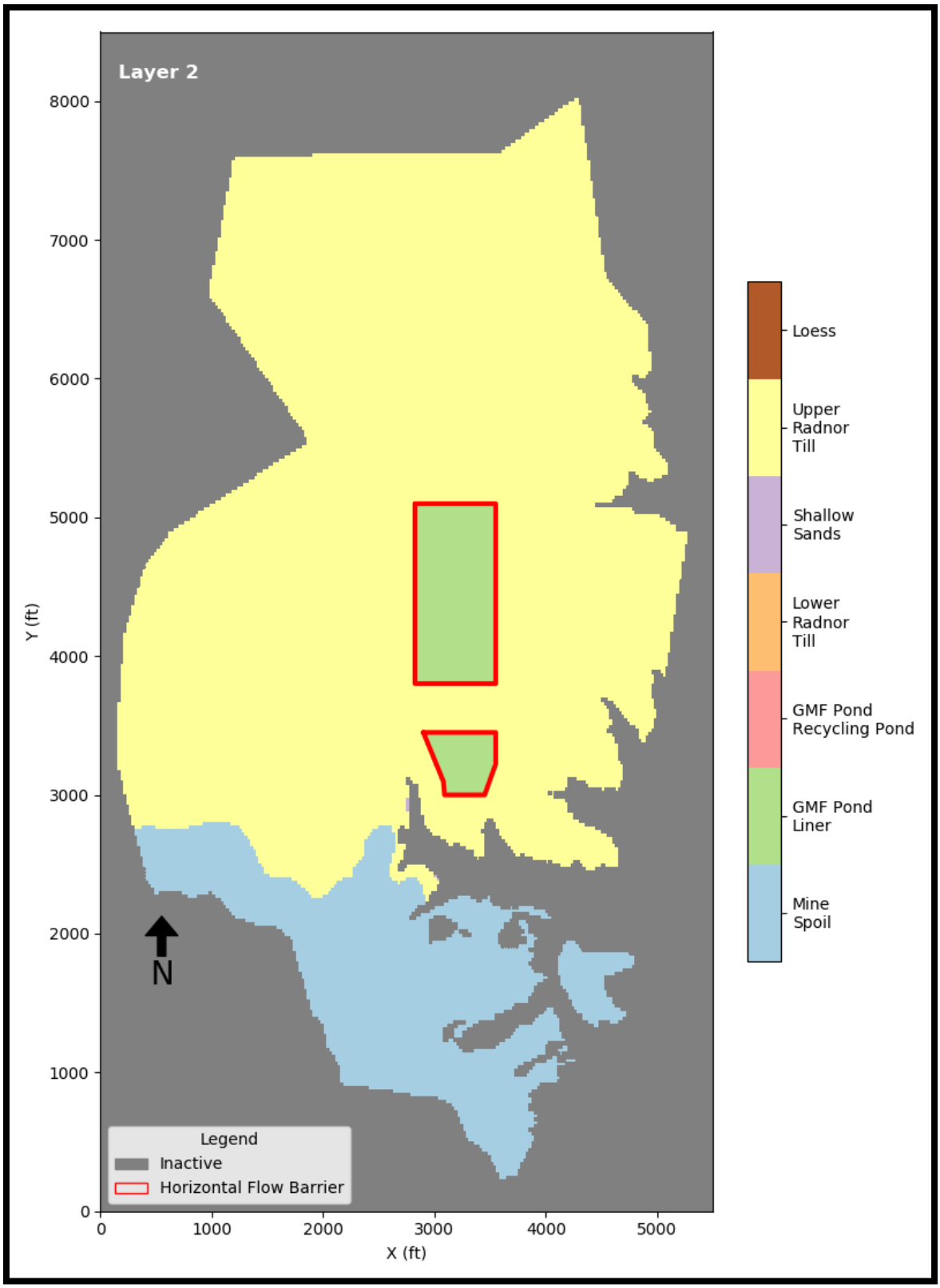


FIGURE 5-7 SPATIAL DISTRIBUTION OF HYDROSTRATIGRAHPIC LAYERS FOR LAYER 2 IN THE NUMERICAL MODEL

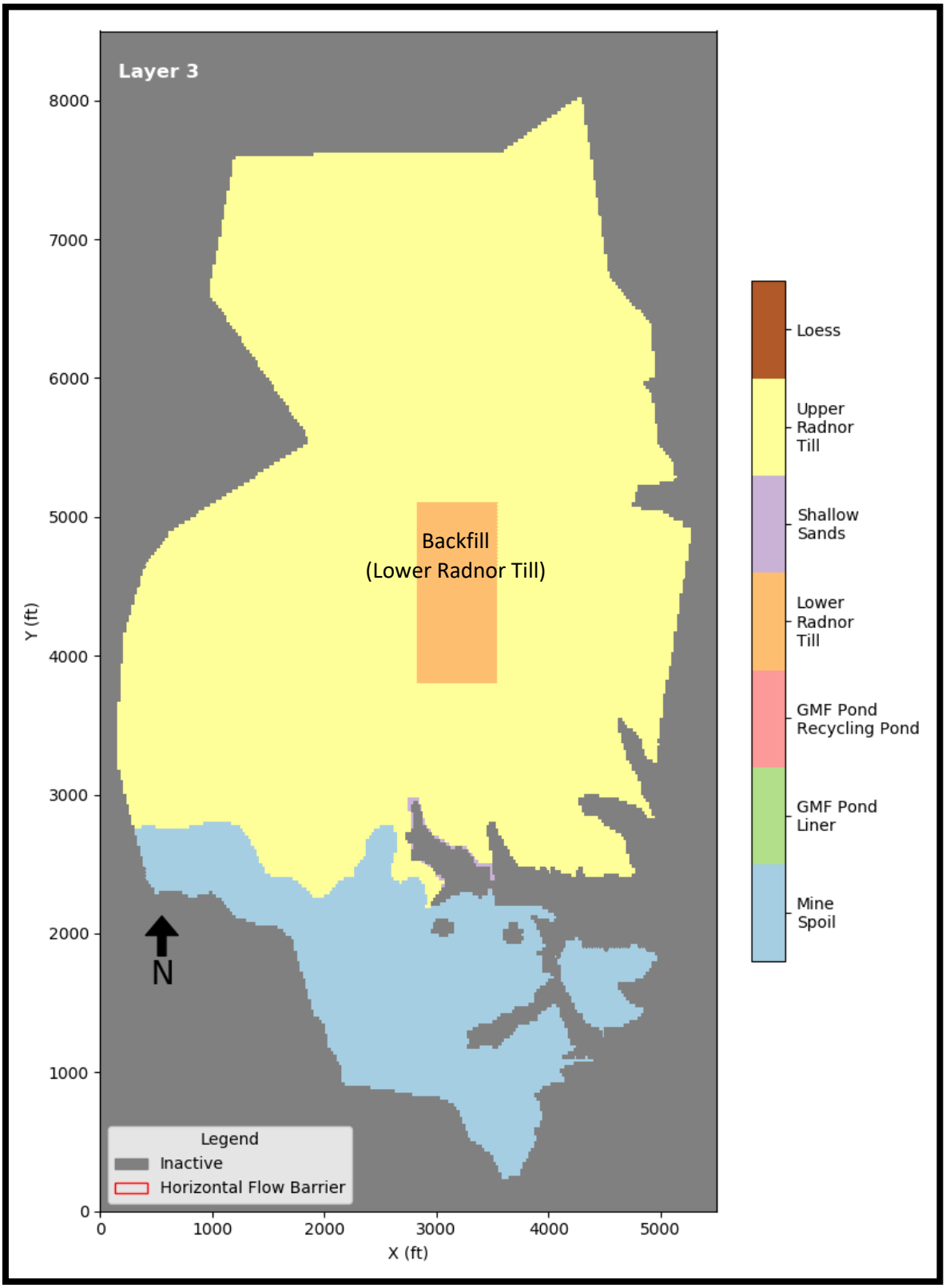


FIGURE 5-8 SPATIAL DISTRIBUTION OF HYDROSTRATIGRAHPIC LAYERS FOR LAYER 3 IN THE NUMERICAL MODEL

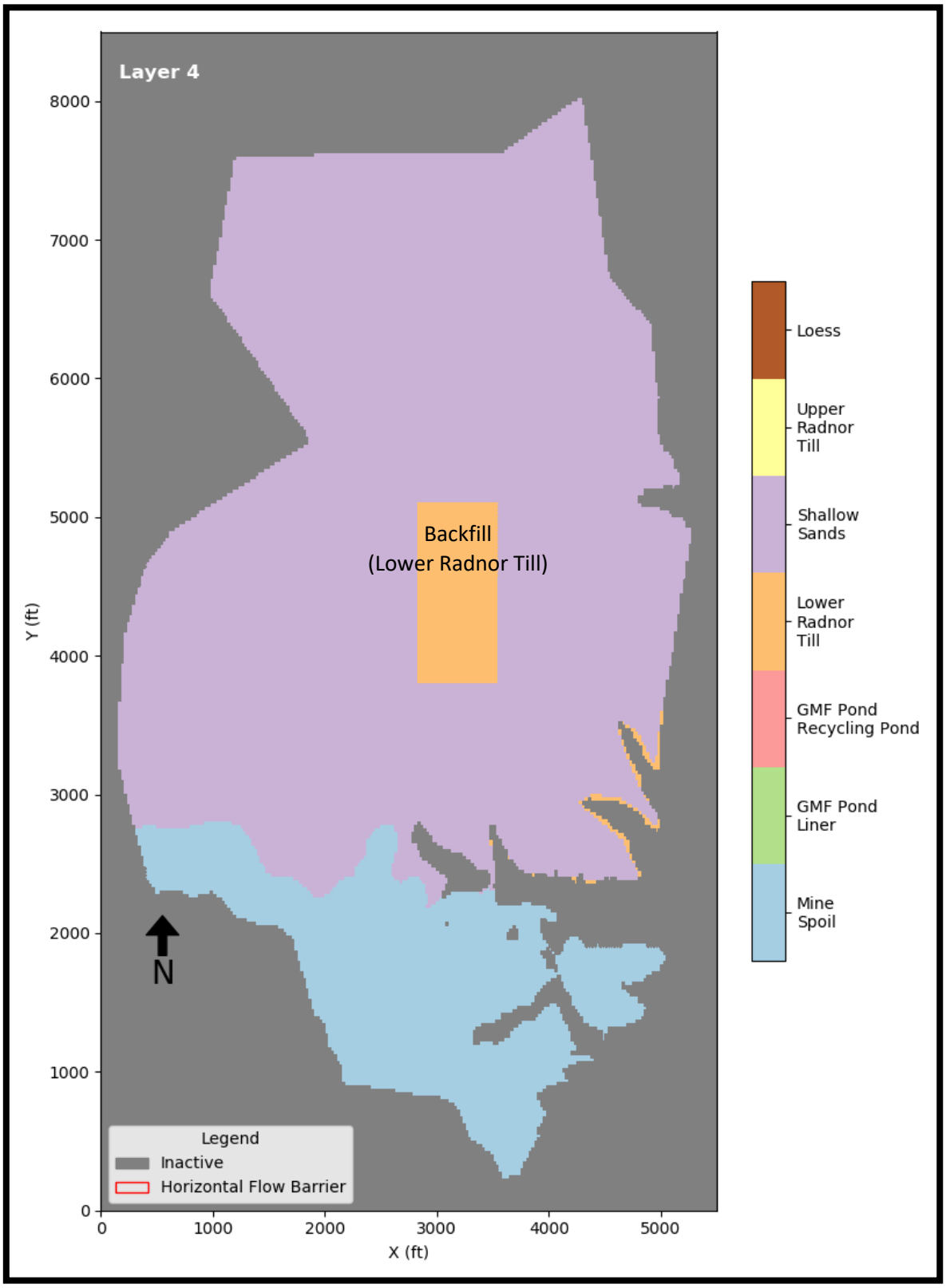


FIGURE 5-9 SPATIAL DISTRIBUTION OF HYDROSTRATIGRAHPIC LAYERS FOR LAYER 4 IN THE NUMERICAL MODEL

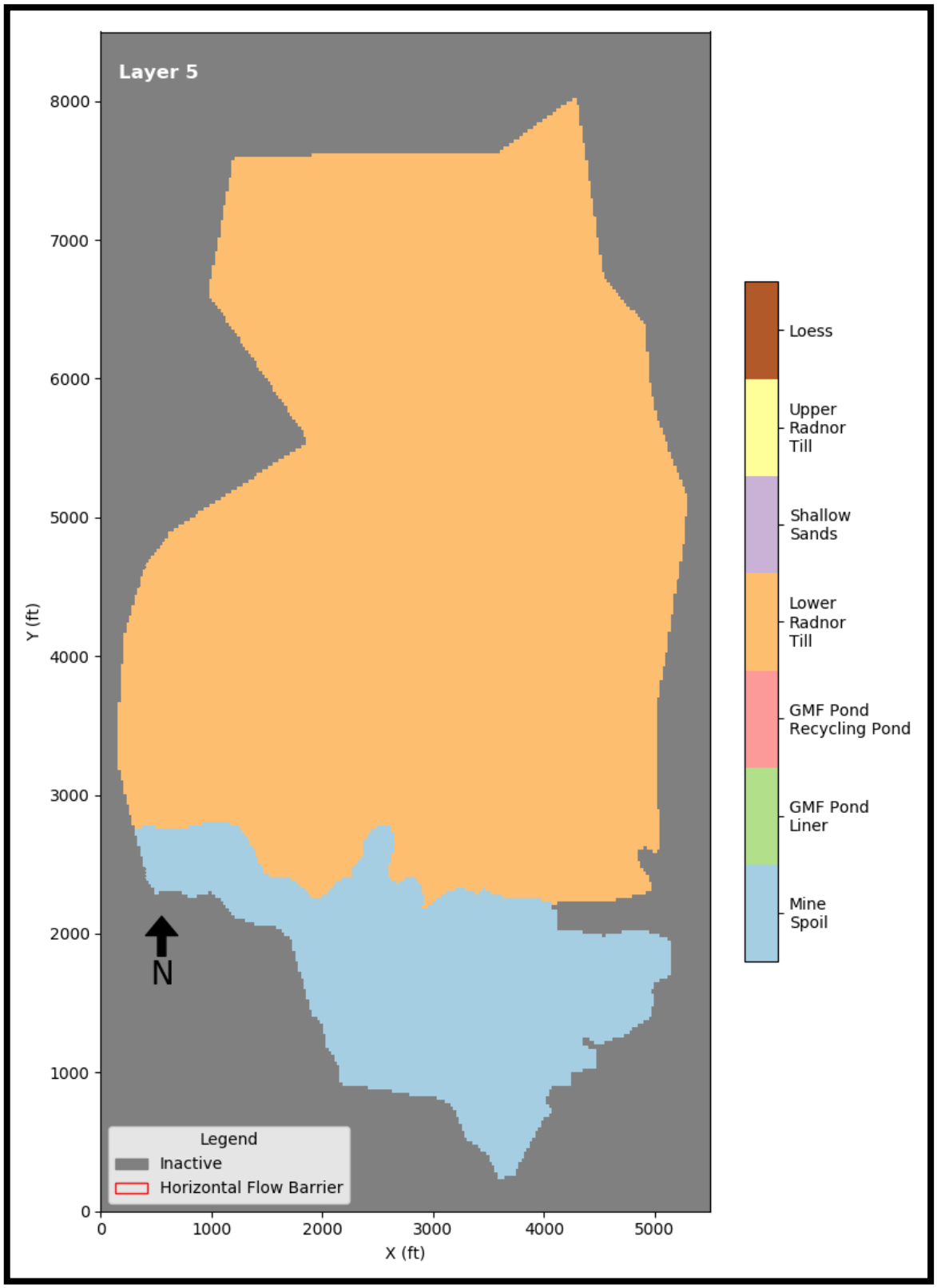


FIGURE 5-10 SPATIAL DISTRIBUTION OF HYDROSTRATIGRAHPIC LAYERS FOR LAYER 5 IN THE NUMERICAL MODEL

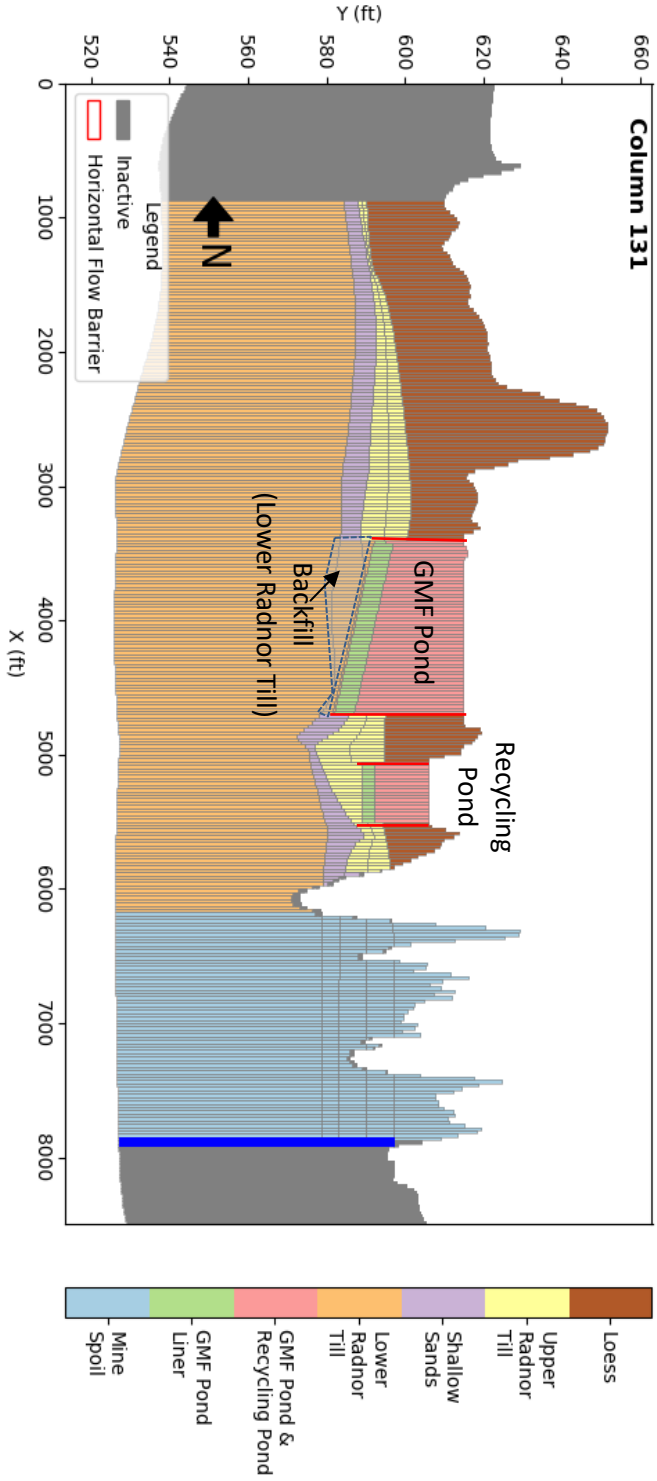
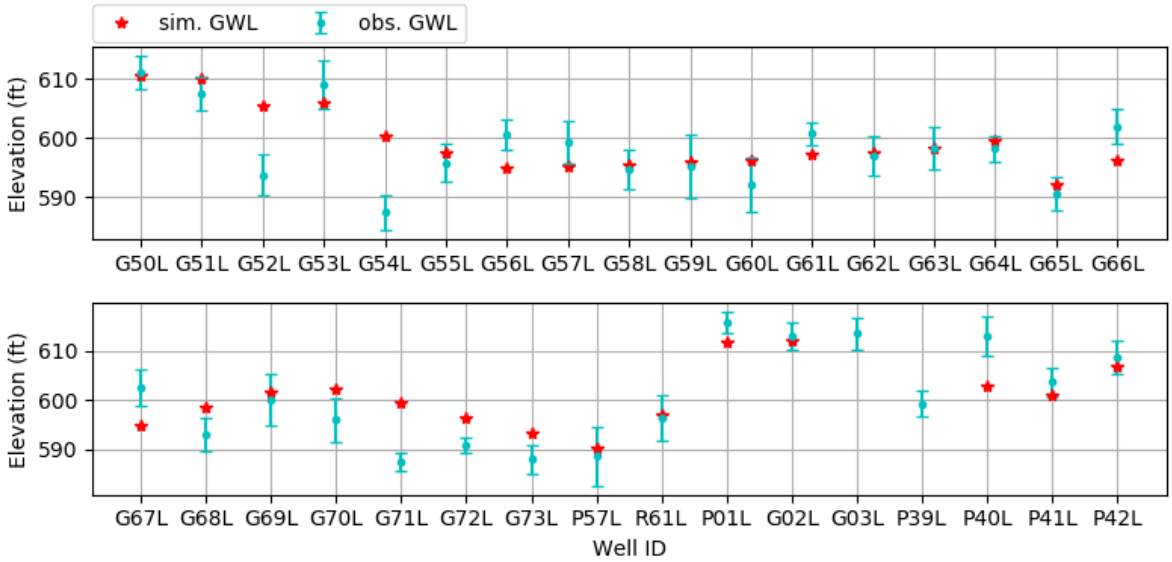


FIGURE 5-11 CROSS SECTION OF THE OF HYDROSTRATIGRAHPIC LAYERS FOR COLUMN 131 IN THE NUMERICAL MODEL

A. Loess



B. Shallow Sands

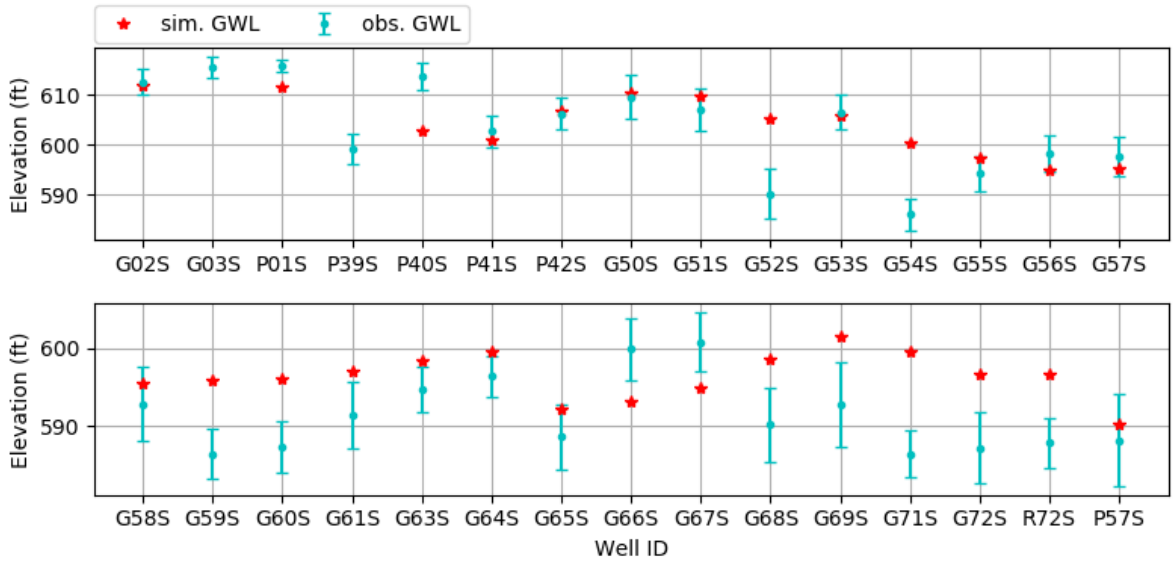


FIGURE 5-12 OBSERVED AND SIMULATED GROUNDWATER LEVELS FROM THE CALIBRATED MODEL FOR WELLS SCREENED IN **A** THE LOESS AND **B** THE SHALLOW SANDS.

(ERROR BARS REPRESENT 1 STANDARD DEVIATION)

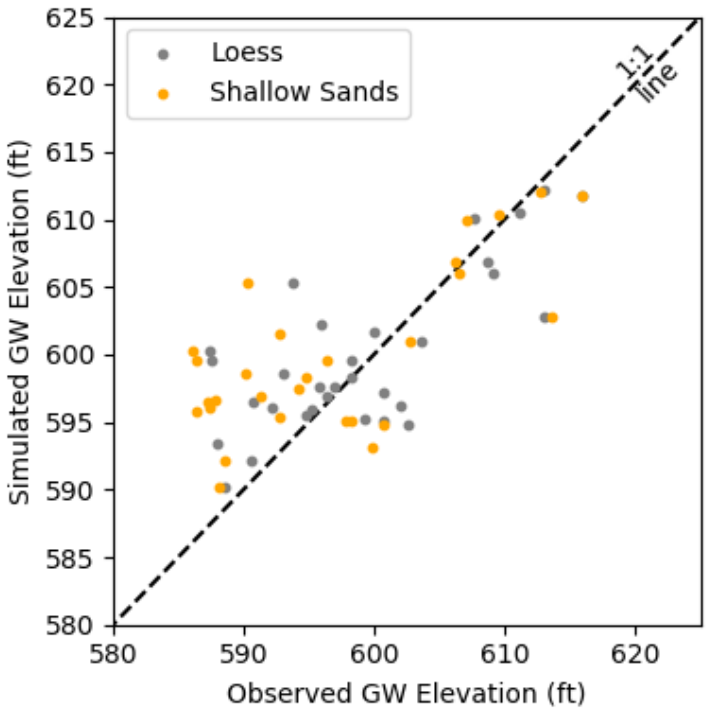


FIGURE 5-13 OBSERVED VERSUS SIMULATED GROUNDWATER ELEVATIONS FROM THE CALIBRATED MODEL

WELLS SCREENED IN THE LOESS ARE GRAY AND THE SHALLOW SANDS ARE ORANGE

GROUNDWATER MODELING REPORT
GMF POND
DUCK CREEK SITE
CANTON, ILLINOIS

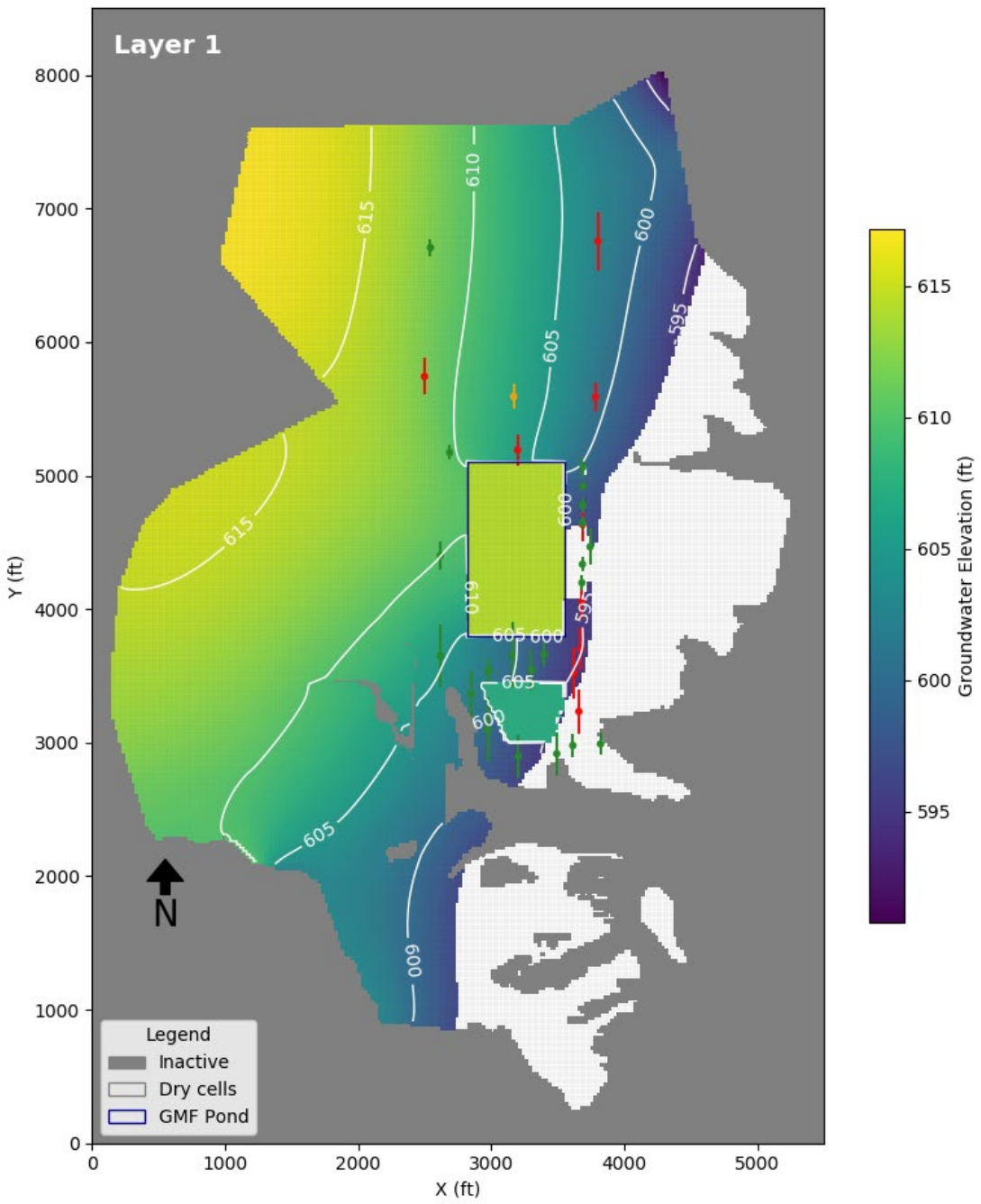


FIGURE 5-14 GROUNDWATER ELEVATION CONTOURS FOR LAYER 1 OF THE CALIBRATED NUMERICAL MODEL. WELL ERROR BARS INDICATE THE SIZE OF THE RESIDUAL BETWEEN SIMULATED AND OBSERVED GROUNDWATER LEVEL (GWL), AND THE COLOR INDICATES IF THE SIMULATED GWL IS ±1 (GREEN), ±2 (ORANGE) OR GREATER THAN ±3 (RED) STANDARD DEVIATIONS FROM THE OBSERVED GWL DATA

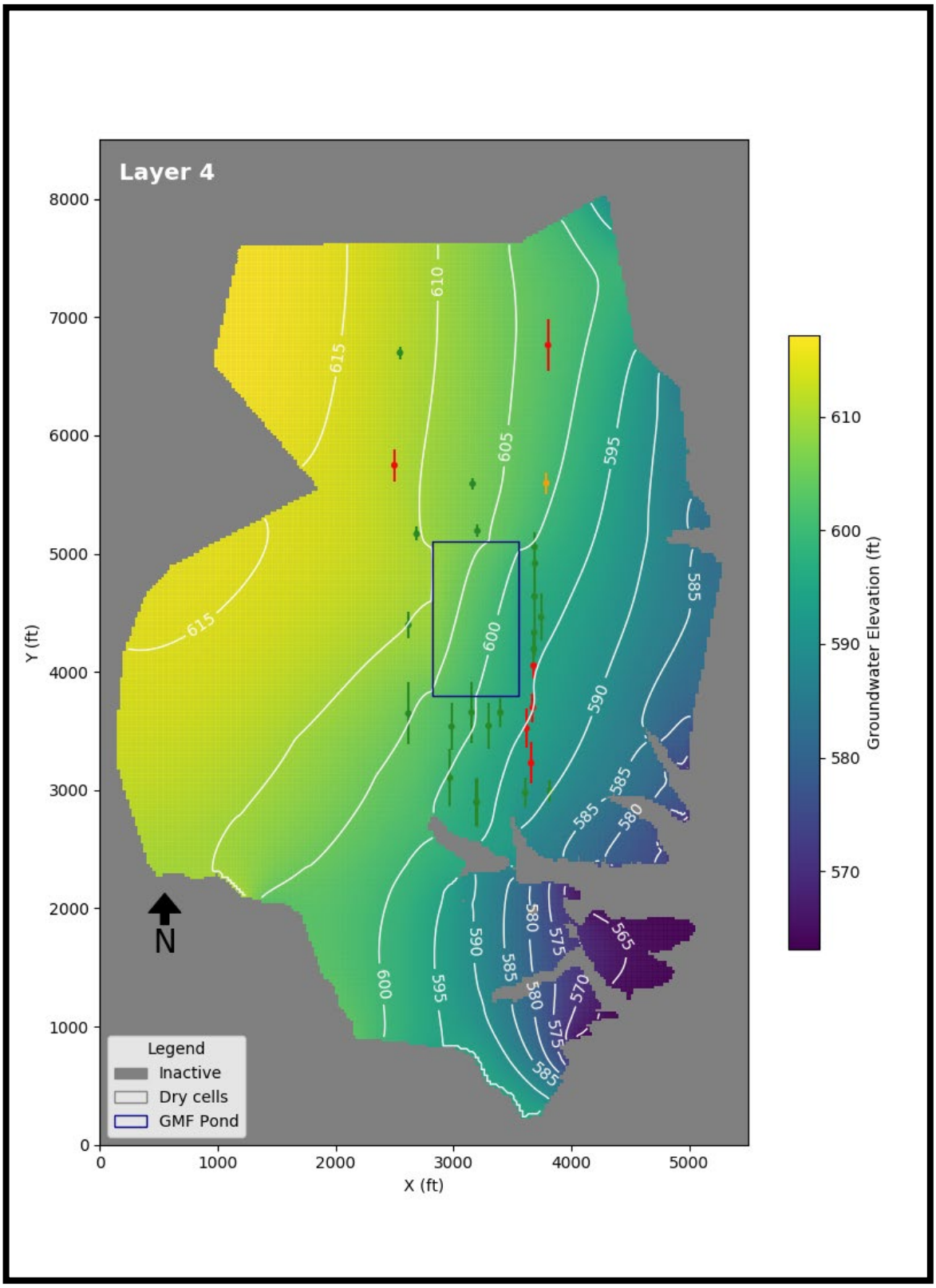


FIGURE 5-15 GROUNDWATER ELEVATION CONTOURS FOR LAYER 4 OF THE CALIBRATED NUMERICAL MODEL. WELL ERROR BARS INDICATE THE SIZE OF THE RESIDUAL BETWEEN SIMULATED AND OBSERVED GROUNDWATER LEVEL (GWL), AND THE COLOR INDICATES IF THE SIMULATED GWL IS ±1 (GREEN), ±2 (ORANGE) OR GREATER THAN ±3 (RED) STANDARD DEVIATIONS FROM THE OBSERVED GWL DATA

PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY

0 150 300 Feet

CLOSURE IN PLACE MODELING SCENARIO

FIGURE 6-1

GROUNDWATER MODELING REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

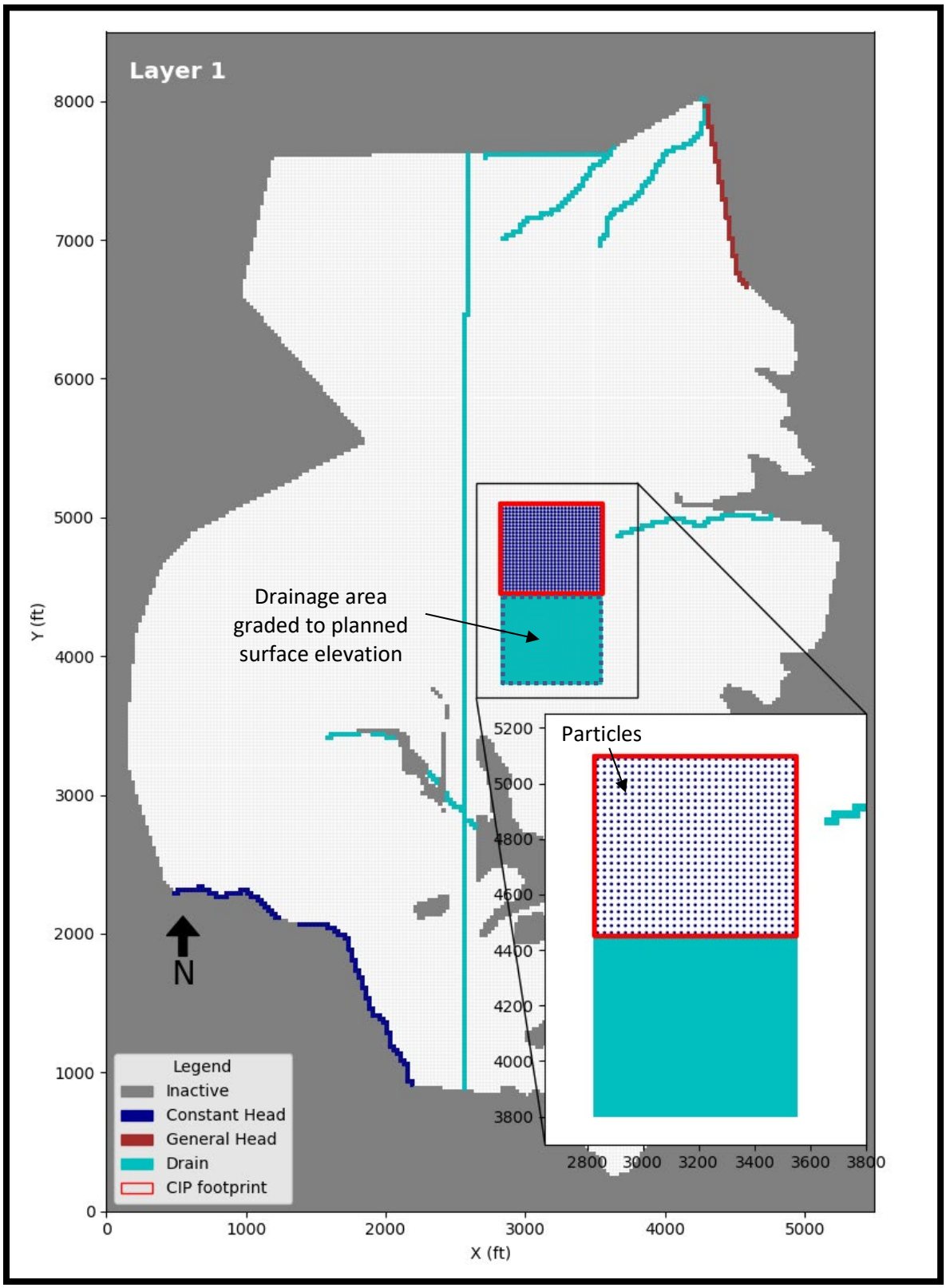


FIGURE 6-2 CLOSURE-IN-PLACE SCENARIO PARTICLE DISTRIBUTION

APPENDIX A
EVALUATION OF POTENTIAL GWPS EXCEEDANCES

GOLDER
MEMBER OF WSP

TECHNICAL MEMORANDUM

DATE October 15, 2021 **Project No.** 21454831

TO David Mitchell, Stu Cravens, Vic Modeer
Illinois Power Resources Generating, LLC

CC Brian Hennings - Ramboll

FROM Roberta Russell, Jeffrey Ingram, Pat Behling - Golder

EVALUATION OF POTENTIAL GWPS EXCEEDANCES, GYPSUM MANAGEMENT FACILITY POND, DUCK CREEK POWER PLANT, FULTON COUNTY, ILLINOIS

1.0 INTRODUCTION

Illinois Power Resource Generating, LLC (IPRG) formerly operated the Duck Creek Power Plant (DCPP) located in Fulton County, Illinois. The Gypsum Management Facility Pond (GMFP, Illinois Environmental Protection Agency [IEPA] ID No. W0578010001-04) is a surface impoundment used to manage gypsum and related coal combustion residuals (CCRs) at the DCPP. The GMFP is regulated under Part 845 *"Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments"* (State CCR Rule or Part 845) which was promulgated by the Illinois Pollution Control Board (IPCB) on April 21, 2021.

IPRG is currently preparing an Operating Permit application for the GMFP as required under Section 845.230 which requires that known exceedances of groundwater protection standards (GWPS) be documented as a part of the Operating Permit application. In October 2021, Ramboll Americas Engineering Solutions, Inc. (Ramboll) identified potential GWPS exceedances for pH, arsenic, and lead in groundwater samples collected from selected monitoring wells in the vicinity of the GMFP as presented in the Operating Permit application for the GMFP. This Technical Memorandum was developed to further evaluate these potential GWPS exceedances.

1.1 Site Setting, Geology and Hydrogeology

The Duck Creek Power Plant (Site) is an inactive power plant in Fulton County, located in central Illinois, approximately 9 miles southeast of the town of Canton. The GMFP is located north of the power plant (see Figure 1). Agricultural land surrounds the DCPP.

Regionally, the Site is positioned on the glacial uplands above the Illinois River in the Ancient Illinois Floodplain of the Till Plains Section of the Central Lowland Province. The undisturbed unlithified materials consist of loess, diamictons, and lacustrine/alluvial deposits. The area is flat to gently rolling uplands that are dissected by deeply incised streams that are tributaries to major river systems (NRT/OBG 2017).

Several large former surface coal mines are present in the vicinity; unlithified materials are present in the excavated strip mine spoils and have been mixed due to the surface mining activities. Mining operations in the area have ceased.

The uppermost bedrock stratum in the area is the Carbondale Formation of the Kewanee Group of the Pennsylvanian System. Bedrock in the area is identified as Pennsylvanian-age shale deposits. Bedrock occurs within approximately 50 feet (ft) of the ground surface in this area.

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The following two unlithified water-bearing units are present beneath the GMF Pond (beginning at the ground surface):

- Loess Zone – Moderate to high permeability silts and clayey silts, including: the Peoria and Roxanna Silt (Loess Units); underlain by the low permeability clayey diamictons of the Berry Clay and upper Radnor Till Members of the Glasford Formation.
- Shallow Sand Unit – Thin to moderately thick (6 to 18 ft), moderate to high permeability, medium-grained sand to silt with intercalated till seams; underlain by till sequences of the lower Radnor Till Member of the Glasford Formation.

The Uppermost Aquifer in the area consists of the Loess and Shallow Sand. These hydraulically connected units are underlain by the lower Radnor Till Member of the Glasford Formation. As shown on Figure 1, groundwater typically flows from northwest to southeast in the Uppermost Aquifer (NRT/OBG 2017).

1.2 Gypsum Management Facility Pond Design and Operation History

The GMFP is a 1,500-foot by 900-foot earthen berm double-lined CCR surface impoundment. Construction of the dual composite liner system and a leak detection system layer was completed in 2007-2009 under a rigorous construction quality assurance program (Hanson, 2009), which is an important determinant of liner system performance. The GMFP consists of the following components from top to bottom:

- Primary Composite Liner
  - SOLMAX 460T-1000 60-mil (0.06-inch thick) textured high-density polyethylene (HDPE) geomembrane
  - 1-foot cushion soil layer (2 feet in selected areas on the side slopes)
- Leak detection layer
  - SKAPS GT-142 4-0z/yd^2 geotextile separator
  - 1-foot granular drainage layer
  - SKAPS FE-110 10-oz/yd^2 geotextile cushion
- Secondary composite liner
  - Solmax 460T-4013 60-mil texture HDPE geomembrane
  - CETCO Bentomat SDN reinforced geosynthetic clay liner (GCL)
  - 3-foot compacted clay layer placed in 8-inch lifts, compacted to at least 95% of the standard Proctor maximum dry density at a moisture content between the standard Proctor optimum moisture content (OMC) and 5% of the wet OMC

The GMFP was used to store gypsum and to clarify gypsum transport water for reuse in the wet scrubber system at the DCPP until the plants retirement in 2019. Gypsum materials are the only waste managed in the GMFP.

2.0 POTENTIAL GWPS EXCEEDANCES REVIEW

As required by Section 845.230 (d)(2)(M), an evaluation of the history of potential GWPS exceedances was competed for the Operating Permit application by Ramboll. Data collected from groundwater samples collected from the GMFP monitoring well network since January 30, 2015, were evaluated and potential exceedances of the GWPSs are summarized below.

- Field pH at monitoring well G52L: A field pH GWPS exceedance was noted in a single sample collected from this well in February 2021. The pH value of 6.4 standard units (s.u.) measured in the sample is outside the Part 845 GWPS pH range of 6.5-9.0 s.u. G52L is located cross-gradient/up-gradient from the GMF pond and the screening interval is completed within the Loess unit.
- Field pH at monitoring well G60L: Field pH GWPS exceedances were noted in this well for each of the nine samples collected from this well from March-July 2021. The average pH for the nine samples was 6.1 s.u., which is outside the Part 845 GWPS pH range of 6.5-9.0 s.u. The well is located down-gradient on the east side of the GMFP and the screening interval is completed within the Loess unit.
- Arsenic at monitoring well P60: A total arsenic GWPS exceedance was noted in a single sample collected from this well in March 2021. The arsenic concentration of 0.02 milligrams per liter (mg/L) measured in the sample slightly exceeds the Part 845 GWPS of 0.01 mg/L. P60 is located down-gradient on the east side of the GMFP and the screening interval is completed within the Loess unit.
- Lead at monitoring well P60: A total lead GWPS exceedance was noted in a single sample collected from this well in March 2021. The lead concentration of 0.036 mg/L measured in the sample slightly exceeds the Part 845 GWPS of 0.015 mg/L. P60 is located down-gradient on the east side of the GMFP and the screening interval is completed within the Loess unit.

3.0 EVIDENCE THAT POTENTIAL GWPS EXCEEDANCES ARE NOT RELATED TO THE GMFP

Groundwater data for samples collected from monitoring wells that exhibited potential GWPS exceedances, background monitoring wells and pore water samples from the GMFP were evaluated. The review of these data indicates that the GWPS exceedances are not related to the GMFP, as described in the lines of evidence (LOE) below:

- **The ionic composition of groundwater collected from G52L, G60L and P60 is similar to groundwater collected from background wells G02S, G50S and G52S.**

A Piper diagram is a graphical technique used to classify and compare different groundwater sources based on their ionic composition in aqueous solution. As shown on the Piper diagram presented as Figure 2, the ionic composition of groundwater samples collected from G52L, G60L and P60 is similar to groundwater samples collected from the background wells – both groups of samples exhibit a calcium-bicarbonate water-type. Pore

and surface water samples collected from the GMFP exhibit a magnesium-chloride water-type, which is distinctly different to the background wells and monitoring wells G52L, G60L and P60. It would be expected that if there were a release from the GMFP, the ionic composition of the monitoring wells would show a mixing pattern towards the pore water ionic composition. However, as shown on Figure 2, the compositions of the monitoring wells are clustered with the background well compositions and distant from the pore and surface water compositions. These data support that the GWPS standard exceedances of pH in G52L and G60; the arsenic exceedance in P60; and the lead exceedance in P60 are not related to the GMFP.

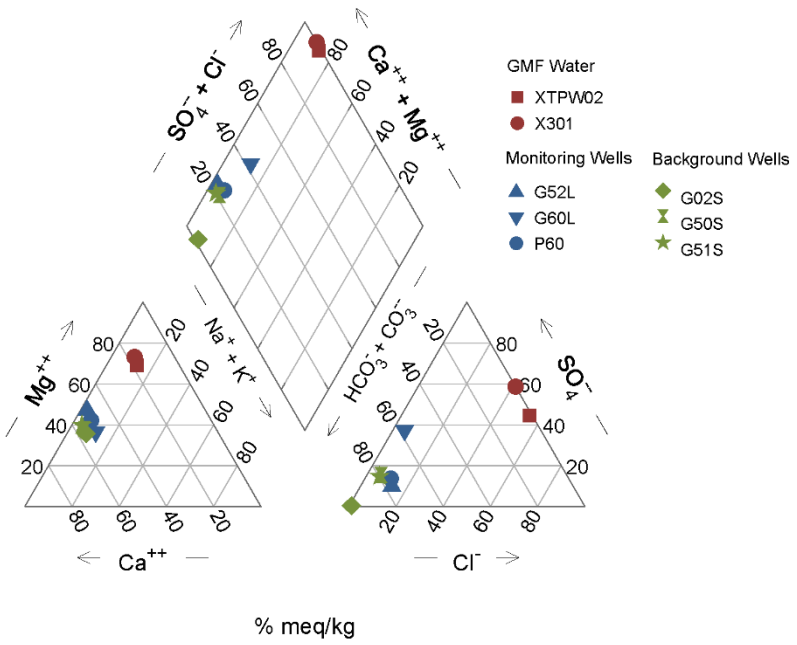


Figure 2: Piper diagram showing water chemistry of GMF Surface and Pore Water, monitoring wells G52L, G60L and P60, and background wells.

- **Concentrations of key GMFP constituents differ significantly in GMFP pore water samples and groundwater samples from monitoring wells G52L, G60L and P60.**

Concentrations of key constituents typically associated with CCR gypsum waste (boron, calcium, chloride, fluoride, sodium and sulfate) differ significantly between pore water/surface water in the GMFP and groundwater samples collected from the monitoring wells (Table 1, Figures 3 and 4). For example, boron, a typical gypsum indicator that is very mobile and non-reactive within a groundwater matrix, is elevated in GMF surface water and pore water samples (29 - 98 mg/L), whereas the monitoring wells G52L, G60L and P60 contain significantly lower concentrations (0.022 – 0.068 mg/L) that are more consistent with background results. Given the geochemical behavior of boron, it would be expected that elevated boron concentrations above background values would be observed in monitoring wells had a release occurred from the GMF pond. Similarly, fluoride and sulfate, other very mobile GMF constituents, would be expected to be observed in monitoring wells above the site GWPS in the event of a release from the GMF Pond. Figures 3 and 4 below and Table 1 show the

differences in concentrations between GMF surface water/pore water and monitoring wells for other key GMF constituents. Table 1 also contains site background and the Part 845 GWPSs. These data support that the GWPS standard exceedances of pH in G52L and G60; the arsenic exceedance in P60; and the lead exceedance in P60 are not related to the GMFP.

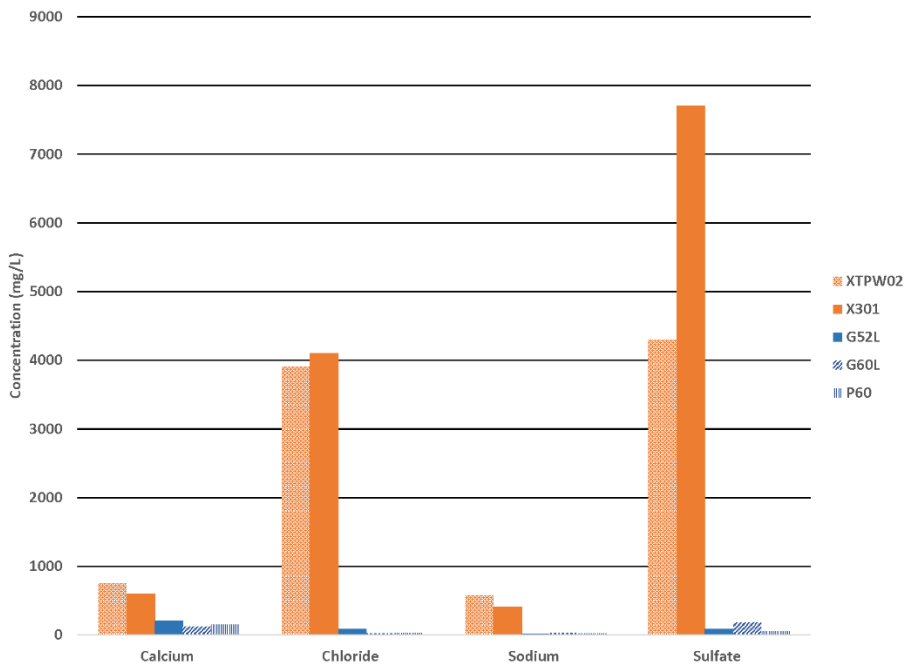


Figure 3: Bar chart showing GMFP constituent concentration comparisons between GMFP Surface and Pore Water and monitoring wells G52L, G60L and P60.

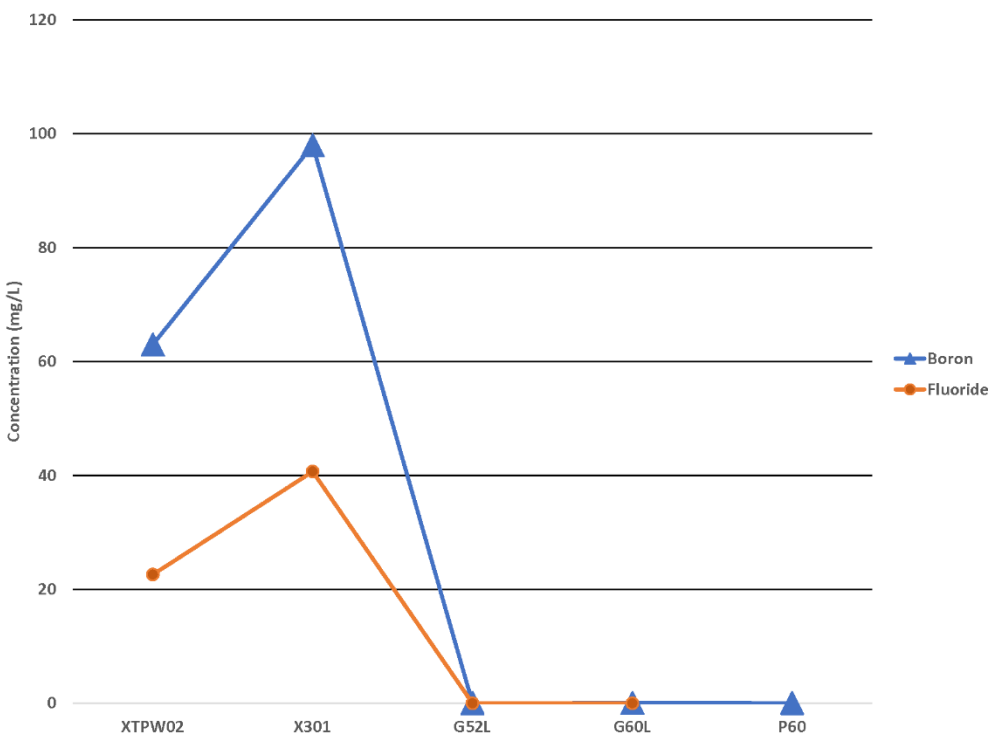


Figure 4: Line chart showing GMFP constituent concentration comparisons between GMFP Surface and Pore Water and monitoring wells G52L, G60L and P60.

- **High turbidity was recorded on the groundwater sampling record for the sample collected from P60.**

The arsenic and lead GWPS exceedances were based on a single sample collected from P60 in March 2021. The groundwater sampling record indicated an unusually high turbidity reading just before sample collection (1620 nephelometric turbidity units (NTU)). According to the sampling record, the sample did not appear to be field filtered, nor was it filtered in the lab. Thus, the arsenic and lead sample concentrations are likely elevated due to the presence of excessive soil and/or colloidal particles in the sample and are not representative of actual groundwater conditions in the vicinity of this well. These circumstances support the conclusion that GWPS standard exceedances of lead and arsenic in P60 are not related to the GMFP.

- **A peat layer ranging in thickness from 1 to 4 feet is present in the immediate vicinity of P60.**

Peat was recorded in the boring log of P60 within the saturated zone (approximately 19.5-20.5 and 24-24.2 feet below ground surface (ft bgs)), but above the screened interval of the well (approximately 29.5-34.5 feet bgs) (Appendix A). Approximately 4 feet of peat was recorded within the saturated zone in a nearby soil boring, B-55 (approximately 13.5-17.5 feet bgs). Given the interconnected nature of the unlithified water-bearing units, it is possible that the peat layer is interacting with the groundwater-bearing unit in the immediate vicinity. Peat is typically associated with low pH and is known to sequester certain metals, including arsenic and lead. In combination with a high turbidity and unfiltered sample, this may be the cause of the slightly elevated arsenic

and lead concentrations in P60. Thus, the GWPS standard exceedances of pH in G60L and the arsenic lead exceedance in P60 may be associated with the peat layer encountered in the immediate vicinity of those wells.

- **Arsenic and lead are not typical CCR indicators and are not present in GMFP pore and surface water above the GWPS.**

Arsenic and lead are not typical coal ash or gypsum indicators (EPRI, 2017). As shown on Table 1, arsenic and lead have been either not detected or detected below the applicable GWPS in GMFP pore and surface water samples. In addition, concentrations in GMFP pore and surface water are lower than concentrations measured in the groundwater sample collected from P60. These data support that GWPS exceedances of lead and arsenic in P60 are not related to the GMFP, as the unit is not a source of elevated arsenic or lead.

- **The GMFP liner was constructed with a dual composite liner system with a leak detection system, has undergone rigorous construction quality assurance and has indicated strong performance**

As discussed in Section 2.0, the GMFP liner was constructed with a primary and secondary liner system with a leak detection layer between the primary and secondary liners. The construction process underwent a detailed construction quality assurance program (Hanson, 2009). The leak detection system has to date shown excellent performance of the primary liner system. Pumps in the leak detection system designed to operate to remove water from the primary liner have only run for a few hours for the lifetime of the facility (beginning in 2009). This indicates that a release from the GMFP has likely not occurred and that the GWPS standard exceedances of pH in G52L and G60; the arsenic exceedance in P60; and the lead exceedance in P60 are not related to the GMFP.

4.0 SUMMARY

The evaluation presented in this document demonstrates that the GWPS exceedances of pH in G52L and G60; the arsenic exceedance in P60; and the lead exceedance in P60 are not related to the GMFP. The following lines of evidence demonstrate the GWPS exceedances are not related to the GMFP:

- The ionic composition of groundwater collected from G52L, G60L and P60 is similar to groundwater collected from background wells G02S, G50S and G52S and not the pore water/surface water in the GMFP.
- Concentrations of key gypsum constituents differ significantly between GMFP pore water samples and groundwater samples collected from monitoring wells G52L, G60L and P60.
- High turbidity was recorded on the groundwater sampling record for the sample collected from P60, which likely resulted in arsenic and lead concentrations that are not representative of actual groundwater conditions in the vicinity of this well.
- Arsenic and lead are not CCR indicators for this CCR unit and are not present in GMFP pore and surface water above their corresponding GWPS.
- The GMFP liner was constructed with a dual composite liner system with a leak detection system, has undergone rigorous construction quality assurance and has indicated strong performance.

- Naturally occurring peat is present within the saturated zone in the immediate vicinity of P60 and G60L and may be causing naturally occurring lower pH in G60L and slightly elevated arsenic and lead concentrations in P60, particularly in a high-turbidity, unfiltered groundwater sample.

5.0 REFERENCES

Electric Power Research Institute (EPRI). 2017, Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites, Report 3002010920, October 2017

Hanson (Hanson) Professional Services Inc. 2009 Acceptance Report, Gypsum Stack, Gypsum Management Facility, AERG Duck Creek Power Generating Station. December.

Natural Resource Technology, an OBG Company (NRT/OBG), October 17, 2017b. Hydrogeologic Monitoring Plan. Duck Creek GMF Pond – CCR Unit ID 203, Duck Creek Landfill – CCR Unit ID 204. Duck Creek Power Station, Canton, Illinois. Illinois Power Resources Generating, LLC.

6.0 CLOSING

Golder appreciates the opportunity to serve as your consultant on this project. If you have any questions concerning this Technical Memorandum or need additional information, please contact the undersigned.

Golder Associates Inc.

Roberta Russell
Senior Geologist
RR/JSI/PJB

Pat Behling
Principal, Practice Leader

Attachments: Table 1 – GMF Pond Surface Water, Pore Water, and Groundwater Monitoring Data
Figure 1 – Gypsum Management Facility Pond Well Locations and Typical Groundwater Flow Direction
Appendix A – Boring Logs

Table

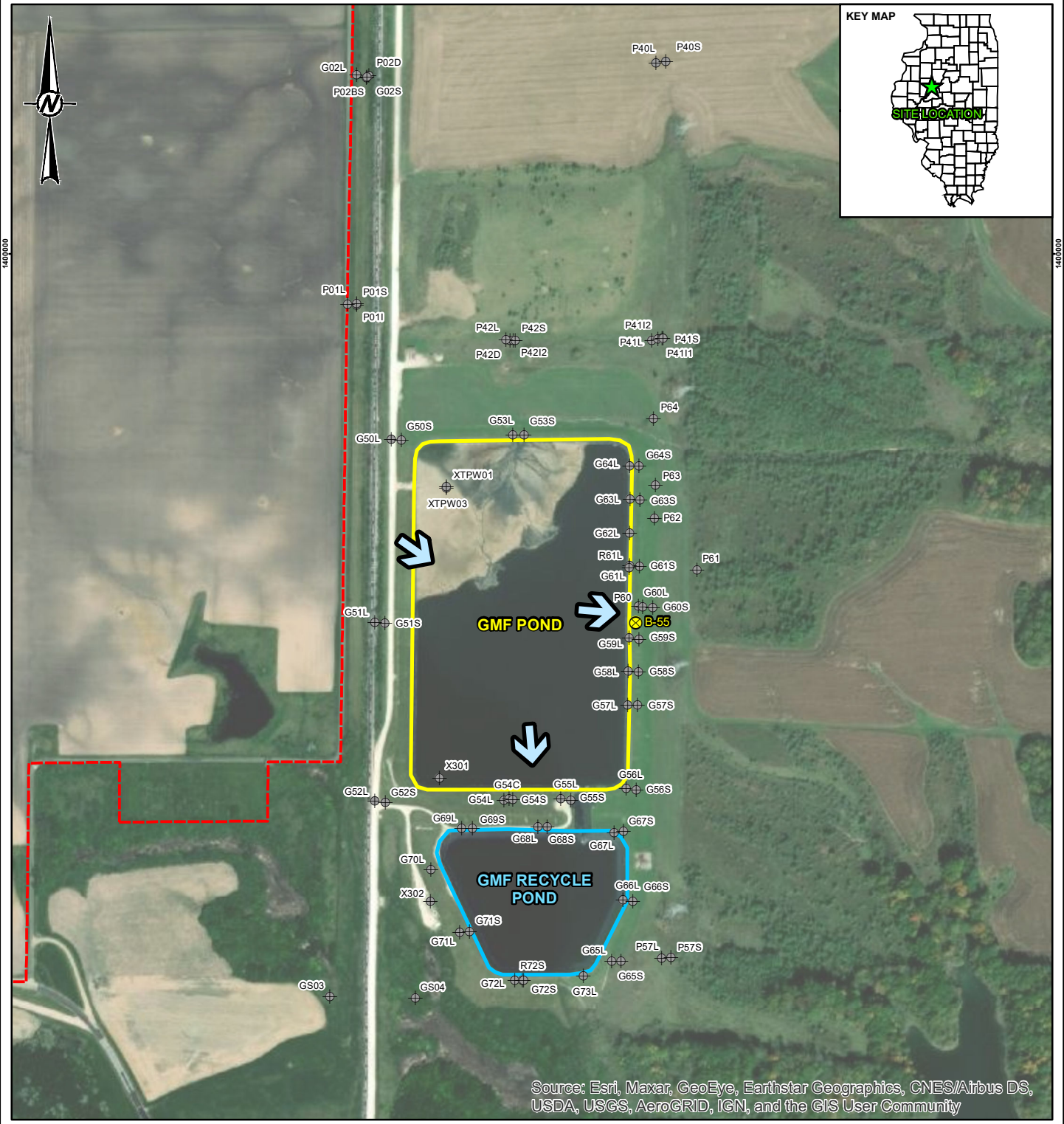
Table 1
GMF Pond Surface Water, Pore Water and Groundwater Monitoring Data
Duck Creek Power Plant
Canton, Illinois

Sampling Information		Potential Exceedance Constituents			Key Flue Gas Desulfurization Material (Gypsum) Constituents					
Well ID	Sampling Date	pH	Arsenic (Total)	Lead (Total)	Boron (Total)	Calcium (Total)	Chloride (Total)	Fluoride (Total)	Sodium (Total)	Sulfate (Total)
Units		SU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Part 845 Groundwater Protection Standards										
Site Background	NA	6.6 - 7.4	0.0092	0.015	0.21	NA	17	0.5	NA	55
Part 845 Standard	NA	6.5 - 9.0	0.01	0.0075	2	NA	200	4	NA	400
Part 845 GWPS	NA	6.5 - 9.0	0.01	0.015	2	NA	200	4	NA	400
GMF Pond Surface Water and Pore Water Samples										
XTPW02	6/23/2021	6.55	0.0026	ND < 0.001	63	750	3,900	22.6	570	4,300
X301	2/24/2021	5.50	NS	NS	29	180	1,200	14.4	110	2,300
X301	4/14/2021	6.70	0.0031	0.0013	97	580	3,700	35.4	390	7,300
X301	4/29/2021	6.60	0.0025	ND < 0.001	88	560	3,600	36.9	400	7,200
X301	5/12/2021	6.48	0.0024	ND < 0.001	84	560	4,100	40.7	410	7,700
X301	6/1/2021	6.64	0.0029	ND < 0.001	98	550	3,700	36.8	400	7,300
X301	7/26/2021	6.22	0.0018	ND < 0.001	85	600	3,600	38.1	370	6,900
Monitoring Wells										
G52L*	2/19/2021	6.39	ND < 0.001	ND < 0.001	0.037	210	30	ND < 0.25	13	87
G60L	4/14/2021	6.20	ND < 0.001	ND < 0.001	0.034	110	19	ND < 0.25	29	ND < 250
G60L	4/29/2021	6.10	ND < 0.001	ND < 0.001	0.029	120	19	ND < 0.25	31	160
G60L	5/13/2021	6.19	ND < 0.001	ND < 0.001	0.025	110	19	ND < 0.25	30	180
G60L	6/1/2021	6.26	ND < 0.001	ND < 0.001	0.029	110	20	ND < 0.25	30	170
G60L	6/15/2021	6.18	ND < 0.001	ND < 0.001	0.029	110	16	ND < 0.25	32	180
G60L	6/21/2021	6.16	ND < 0.001	ND < 0.001	0.068	110	18	ND < 0.25	29	180
G60L	7/12/2021	5.98	ND < 0.001	ND < 0.001	0.027	110	18	ND < 0.25	30	180
G60L	7/28/2021	6.22	ND < 0.001	ND < 0.001	0.022	110	15	ND < 0.25	29	160
P60	3/24/2021	6.60	0.02	0.036	0.056	150	32	NS	22	53

Notes:
1) GMF - Gypsum Management Facility, SU - standard unit, mg/L - milligrams per liter, ND - non-detect, NS - not sampled.
2) X301 samples are collected from a riser pipe from the ring drain beneath the pond.
3) XTPW02 results represent a porewater sample.
4) * - G52L data displays dissolved values.
5) Site background values based on Ramboll Determination of Potential Exceedances Table.
6) GWPS - Groundwater Protection Standard.
7) NA - Not Available.

Created by: BTT
Checked by: GM
Reviewed by: PJB

Figure



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND

- WELL LOCATION
- SOIL BORING LOCATION
- APPROXIMATE PROPERTY BOUNDARY
- TYPICAL GROUNDWATER FLOW DIRECTION

0 250 500 1,000 Feet

NOTE(S)

1. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2. GMF - GYPSUM MANAGEMENT FACILITY.

REFERENCE(S)

1. RAMBOLL 2020. ILLINOIS ADMINISTRATIVE CODE PART 845 DATA GAP ANALYSIS AND WORK PLAN, DUCK CREEK GYPSUM MANAGEMENT FACILITY AND RECYCLE POND - CCR UNIT 203 AND 206.

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC.
DUCK CREEK POWER PLANT

PROJECT
MONITORED NATURAL ATTENUATION EVALUATION

TITLE
GYPSUM MANAGEMENT FACILITY POND WELL LOCATIONS AND TYPICAL GROUND WATER FLOW DIRECTION

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-10-14
DESIGNED	JSI
PREPARED	ETF
REVIEWED	BTT
APPROVED	PJB

PROJECT NO.	PHASE	REV.	FIGURE
21454831	0001	0	1

PATH: C:\Users\ETVFornay\Golder Associates\21454831, Vistra IL MNA Part 845 Support - 5 Technical Work\Phase1 - Duck Creek\1.10 - Figures\Production\Duck Creek Well Locations.mxd PRINTED ON: 2021-10-14 AT: 11:35:53 AM
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A
1 in
0

Appendix A
Boring Logs

FIELD BORING LOG

CLIENT: Ameren
Site: Gypsum Stack
Location: Duck Creek Generating Station
Project: 03S5010
DATES: Start: 4/1/407
Finish: 4/4/2007
WEATHER: Overcast, cool

CONTRACTOR: Testing Service Corporation
Rig mfg/model: CME-650 Track Rig
Drilling Method: 3¼" hollow stem auger w/split spoon sampler

FIELD STAFF: Driller: B. Williamson
Helper: R. Keedy
Eng/Geo: R. Hasenyager

BOREHOLE ID: B-55
Well ID: hole abandoned
Surface Elev: 611.07 ft. MSL
Completion: 20.00 ft. BGS
Station: 15,438.7N
987.3E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 13.00 - during drilling
▼ =
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Failure Type
1A	15/18 83%	ss	2-3 3 N=6	29		1.75 B
2A	16/18 89%	ss	3-4 5 N=9	22		0.78 BSh
3A	16/18 89%	ss	3-4 4 N=8	26		
4A	15/18 83%	ss	3-4 5 N=9	26		1.94 BSh
5A	18/18 100%	ss	2-3 4 N=7	33		1.32 B
6A	18/18 100%	ss	3-4 5 N=9	20		1.16 BSh

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark brown, clayey TOPSOIL (OL)	
2	Brown-gray, silty CLAY, trace sand (CL)	610
4	Brown-gray, clayey SILT, trace sand (ML)	608
6		606
8		604
10	Gray-brown, clayey SILT, trace sand (ML)	602
12		600
14	Black, PEAT (PT)	598
16		596
18	Gray, silty CLAY, trace sand and gravel (CL)	594
20	**End of Boring = 20.0 ft. BGS**	592

Remarks

NOTE(S):

FIELD BORING LOG

HANSON

CLIENT: Illinois Power Generating Company, LLC
Site: Duck Creek Power Station - Ash Landfill
Location: 17751 N. CILCO Rd., Canton, IL 61520
Project: 17E0057
DATES: **Start:** 3/15/2017
Finish: 3/15/2017
WEATHER: Sunny, cold (lo-30s)

CONTRACTOR: Ramsey Geotechnical Engineering, LLC
Rig mfg/model: Diedrich D-50
Drilling Method: 4¼" Hollow Stem Auger, split spoon sampler
FIELD STAFF: **Driller:** B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: P60
Well ID: P60
Surface Elev: 620.12 ft. MSL
Completion: 34.62 ft. BGS
Station: 15,477.09N
992.24E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 16.80 - During drilling
▼ = Dry - At completion
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type	Depth ft. BGS	Lithologic Description	Elevation ft. MSL	Remarks
1A	14/24 58%	SS	2-3 3-4 N=6				0–2	FILL - Yellowish brown (10YR5/6), moist, medium, CLAY with some silt and trace sand.	620	
2A	18/24 75%	SS	3-6 8-11 N=14	17.5			2–4		618	
3A	15/24 63%	SS	3-4 6-7 N=10	19.6			4–6		616	
4A	20/24 83%	SS	6-8 11-14 N=19	18.5			6–8		614	
5A	22/24 92%	SS	3-5 6-7 N=11	26.8			8–10	Yellowish brown (10YR5/6), moist, medium, SILT with few clay and trace sand.	612	
6A	21/24 88%	SS	2-4 5-5 N=9	23.8			10–12	Yellowish brown (10YR5/8) with 30% gray (10YR5/1) mottles, moist, medium, SILT with few clay and trace sand.	610	
7A	20/24 83%	SS	4-4 6-7 N=10	22.8			12–14	Gray (10YR5/1) with 20% yellowish brown (10YR5/8) mottles, moist, medium, SILT with few clay and trace sand.	608	
8A	21/24 88%	SS	5-6 7-7 N=13	22.1			14–16		606	
9A	21/24 88%	SS	5-5 6-6 N=11	21.0			16–18	Gray (10YR5/1) with 25% yellowish brown (10YR5/8) mottles, wet, medium, SILT with few clay and trace sand.	604	
10A	24/24 100%	SS	2-3 4-7 N=7	28.1			18–19	Dark yellowish brown (10YR3/4), moist, medium, SILT with few clay and trace sand, trace organics.	602	
10B				61.7			19–20	Dark brown (10YR3/3), moist, medium, PEAT.		

NOTE(S): P60 installed in boring.
Coordinates are on Plant (Local) grid.

FIELD BORING LOG

CLIENT: Illinois Power Generating Company, LLC
Site: Duck Creek Power Station - Ash Landfill
Location: 17751 N. CILCO Rd., Canton, IL 61520
Project: 17E0057
DATES: Start: 3/15/2017
Finish: 3/15/2017
WEATHER: Sunny, cold (lo-30s)

CONTRACTOR: Ramsey Geotechnical Engineering, LLC
Rig mfg/model: Diedrich D-50
Drilling Method: 4¼" Hollow Stem Auger, split spoon sampler
FIELD STAFF: Driller: B. Williamson
Helper: D. Crump
Eng/Geo: R. Hasenyager

BOREHOLE ID: P60
Well ID: P60
Surface Elev: 620.12 ft. MSL
Completion: 34.62 ft. BGS
Station: 15,477.09N
992.24E

TOPOGRAPHIC MAP INFORMATION:
Quadrangle: Banner, IL
Township: Banner
Section 18, **Tier** 6N; **Range** 5E

WATER LEVEL INFORMATION:
▼ = 16.80 - During drilling
▼ = Dry - At completion
▽ =

SAMPLE Number	Recov / Total (in) % Recovery	Type	TESTING Blows / 6 in N - Value RQD	Moisture (%)	Dry Den. (lb/ft³)	Qu (tsf) Qp (tsf) Failure Type
11A	20/24 83%	SS	2-5 6-7 N=11	31.4		
12A	24/24 100%	SS	9-8 7-6 N=15	33.7		
13A	20/24 83%	SS	4-3 4-4 N=7	23.0		
14A	22/24 92%	SS	4-5 6-6 N=11	20.6		
15A	24/24 100%	SS	3-3 4-5 N=7	17.5		
16A	24/24 100%	SS	1-3 3-3 N=6	20.2		
17A	24/24 100%	SS	5-6 6-7 N=12	15.9		
	0/7 0%	BD				

Depth ft. BGS	Lithologic Description	Elevation ft. MSL
	Dark brown (10YR3/3), moist, medium, PEAT. *[Continued from previous page]*	600
22	Very dark gray (10YR3/1), moist, medium, SILT with some clay and trace sand, trace organics.	598
24	Very dark gray (10YR3/1), wet, medium, SILT with some clay and trace sand, trace organics.	596
	Dark brown (10YR3/3), moist, medium, PEAT.	
26	Gray (10YR5/1), moist, medium, CLAY with some silt and trace sand and gravel.	594
28		592
30	Greenish gray (5G6/1), moist, medium, CLAY with some silt and trace sand and gravel.	590
32	Greenish gray (5G6/1), wet, soft, SILT with few clay, little sand, and trace gravel.	588
34		586

Borehole Detail

Remarks

End of Boring = 34.62 ft bgs

NOTE(S): P60 installed in boring.
Coordinates are on Plant (Local) grid.

APPENDIX B
MODFLOW AND HELP MODEL FILES
(ELECTRONIC ONLY)

APPENDIX C
HELP MODEL INPUT AND OUTPUT

Appendix C: Inputs and Summary of HELP Closure-In-Place cap simulation
(40mil LLDPE and 2ft soil cover)

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: Duck Creek Coversystem CIP **Simulated On:** 1/12/2022 9:32

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
SiL - Silty Loam(Moderate)
Material Texture Number 23

Thickness	=	6	inches
Porosity	=	0.461	vol/vol
Field Capacity	=	0.36	vol/vol
Wilting Point	=	0.203	vol/vol
Initial Soil Water Content	=	0.4073	vol/vol
Effective Sat. Hyd. Conductivity	=	9.00E-06	cm/sec

Layer 2
Type 1 - Vertical Percolation Layer
SiL - Silty Loam(Moderate)
Material Texture Number 23

Thickness	=	18	inches
Porosity	=	0.461	vol/vol
Field Capacity	=	0.36	vol/vol
Wilting Point	=	0.203	vol/vol
Initial Soil Water Content	=	0.3829	vol/vol
Effective Sat. Hyd. Conductivity	=	9.00E-06	cm/sec

Layer 3
Type 2 - Lateral Drainage Layer
Drainage Net (0.5 cm)
Material Texture Number 20

Thickness	=	0.2	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.0338	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E+01	cm/sec
Slope	=	4	%
Drainage Length	=	450	ft

Layer 4

Type 4 - Flexible Membrane Liner
LDPE Membrane
Material Texture Number 36

Thickness	=	0.04	inches
Effective Sat. Hyd. Conductivity	=	4.00E-13	cm/sec
FML Pinhole Density	=	1	Holes/Acre
FML Installation Defects	=	1	Holes/Acre
FML Placement Quality	=	3	Good

Layer 5

Type 1 - Vertical Percolation Layer
Gypsum waste material (Sandy Loam)
Material Texture Number 43

Thickness	=	240	inches
Porosity	=	0.437	vol/vol
Field Capacity	=	0.105	vol/vol
Wilting Point	=	0.047	vol/vol
Initial Soil Water Content	=	0.105	vol/vol
Effective Sat. Hyd. Conductivity	=	6.70E-04	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	90.1	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	15	acres
Evaporative Zone Depth	=	8	inches
Initial Water in Evaporative Zone	=	3.294	inches
Upper Limit of Evaporative Storage	=	3.688	inches
Lower Limit of Evaporative Storage	=	1.624	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	34.543	inches
Total Initial Water	=	34.543	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	40.5	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	120	days

End of Growing Season (Julian Date)	=	300	days
Average Wind Speed	=	9	mph
Average 1st Quarter Relative Humidity	=	72	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	74	%
Average 4th Quarter Relative Humidity	=	75	%

Note: Evapotranspiration data was obtained for ,

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
2.01298	1.895696	2.373253	3.597322	4.095479	4.395065
3.769391	3.145982	3.272523	2.912689	2.788342	2.489949

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.5/-89.98

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
32.4	34.2	41.9	56.4	69.6	79
83.5	81	72.5	61.4	45.9	35.6

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.5/-89.98
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.5/-89.98

Average Annual Totals Summary

Title: Duck Creek Coversystem CIP
Simulated on: 1/12/2022 9:36

	Average Annual Totals for Years 1 - 100*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	36.75	[5.46]	2,000,965.1	100.00
Runoff	12.581	[3.246]	685,044.7	34.24
Evapotranspiration	23.227	[2.957]	1,264,727.0	63.21
Subprofile1				
Lateral drainage collected from Layer 3	0.9541	[0.7929]	51,952.6	2.60
Percolation/leakage through Layer 4	0.000247	[0.00019]	13.5	0.00
Average Head on Top of Layer 4	0.0005	[0.0004]	---	---
Subprofile2				
Percolation/leakage through Layer 5	0.000248	[0.00019]	13.5	0.00
Water storage				
Change in water storage	-0.0142	[1.0912]	-772.6	-0.04

* Note: Average inches are converted to volume based on the user-specified area.

Appendix C: Inputs and Summary of HELP Closure-In-Place cap simulation
(40mil LLDPE and 3ft soil cover)

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: Duck Creek Coversystem CIP **Simulated On:** 1/13/2022 15:36

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
SiL - Silty Loam(Moderate)
Material Texture Number 23

Thickness	=	6	inches
Porosity	=	0.461	vol/vol
Field Capacity	=	0.36	vol/vol
Wilting Point	=	0.203	vol/vol
Initial Soil Water Content	=	0.4073	vol/vol
Effective Sat. Hyd. Conductivity	=	9.00E-06	cm/sec

Layer 2
Type 1 - Vertical Percolation Layer
SiL - Silty Loam(Moderate)
Material Texture Number 23

Thickness	=	30	inches
Porosity	=	0.461	vol/vol
Field Capacity	=	0.36	vol/vol
Wilting Point	=	0.203	vol/vol
Initial Soil Water Content	=	0.3834	vol/vol
Effective Sat. Hyd. Conductivity	=	9.00E-06	cm/sec

Layer 3
Type 2 - Lateral Drainage Layer
Drainage Net (0.5 cm)
Material Texture Number 20

Thickness	=	0.2	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.0156	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E+01	cm/sec
Slope	=	4	%
Drainage Length	=	450	ft

Layer 4

Type 4 - Flexible Membrane Liner
LDPE Membrane
Material Texture Number 36

Thickness	=	0.04	inches
Effective Sat. Hyd. Conductivity	=	4.00E-13	cm/sec
FML Pinhole Density	=	1	Holes/Acre
FML Installation Defects	=	1	Holes/Acre
FML Placement Quality	=	3	Good

Layer 5

Type 1 - Vertical Percolation Layer
Gypsum waste material (Sandy Loam)
Material Texture Number 43

Thickness	=	240	inches
Porosity	=	0.437	vol/vol
Field Capacity	=	0.105	vol/vol
Wilting Point	=	0.047	vol/vol
Initial Soil Water Content	=	0.105	vol/vol
Effective Sat. Hyd. Conductivity	=	6.70E-04	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	90.1	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	15	acres
Evaporative Zone Depth	=	8	inches
Initial Water in Evaporative Zone	=	3.294	inches
Upper Limit of Evaporative Storage	=	3.688	inches
Lower Limit of Evaporative Storage	=	1.624	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	39.149	inches
Total Initial Water	=	39.149	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	40.5	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	120	days

End of Growing Season (Julian Date)	=	300	days
Average Wind Speed	=	9	mph
Average 1st Quarter Relative Humidity	=	72	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	74	%
Average 4th Quarter Relative Humidity	=	75	%

Note: Evapotranspiration data was obtained for ,

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
2.01298	1.895696	2.373253	3.597322	4.095479	4.395065
3.769391	3.145982	3.272523	2.912689	2.788342	2.489949

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.5/-89.98

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
32.4	34.2	41.9	56.4	69.6	79
83.5	81	72.5	61.4	45.9	35.6

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.5/-89.98
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.5/-89.98

Average Annual Totals Summary

Title: Duck Creek Coversystem CIP
Simulated on: 1/13/2022 15:40

	Average Annual Totals for Years 1 - 100*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	36.75	[5.46]	2,000,965.1	100.00
Runoff	12.581	[3.246]	685,044.7	34.24
Evapotranspiration	23.227	[2.957]	1,264,727.0	63.21
Subprofile1				
Lateral drainage collected from Layer 3	0.9570	[0.8034]	52,108.0	2.60
Percolation/leakage through Layer 4	0.000258	[0.0002]	14.1	0.00
Average Head on Top of Layer 4	0.0005	[0.0004]	---	---
Subprofile2				
Percolation/leakage through Layer 5	0.000258	[0.0002]	14.1	0.00
Water storage				
Change in water storage	-0.0171	[1.1899]	-928.6	-0.05

* Note: Average inches are converted to volume based on the user-specified area.

Appendix C: Inputs and Summary of HELP Closure-In-Place cap simulation
(3ft clay and 3ft soil cover)

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: Duck Creek Coversystem CIP **Simulated On:** 1/13/2022 15:07

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
SiL - Silty Loam(Moderate)
Material Texture Number 23

Thickness	=	6	inches
Porosity	=	0.461	vol/vol
Field Capacity	=	0.36	vol/vol
Wilting Point	=	0.203	vol/vol
Initial Soil Water Content	=	0.461	vol/vol
Effective Sat. Hyd. Conductivity	=	9.00E-06	cm/sec

Layer 2
Type 1 - Vertical Percolation Layer
SiL - Silty Loam(Moderate)
Material Texture Number 23

Thickness	=	30	inches
Porosity	=	0.461	vol/vol
Field Capacity	=	0.36	vol/vol
Wilting Point	=	0.203	vol/vol
Initial Soil Water Content	=	0.461	vol/vol
Effective Sat. Hyd. Conductivity	=	9.00E-06	cm/sec

Layer 3
Type 3 - Barrier Soil Liner
Liner Soil (High)
Material Texture Number 16

Thickness	=	36	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Layer 4
Type 1 - Vertical Percolation Layer
Gypsum waste material (Sandy Loam)
Material Texture Number 43

Thickness	=	240	inches
Porosity	=	0.437	vol/vol
Field Capacity	=	0.105	vol/vol

Wilting Point	=	0.047	vol/vol
Initial Soil Water Content	=	0.1135	vol/vol
Effective Sat. Hyd. Conductivity	=	6.70E-04	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	90.1	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	15	acres
Evaporative Zone Depth	=	8	inches
Initial Water in Evaporative Zone	=	3.688	inches
Upper Limit of Evaporative Storage	=	3.688	inches
Lower Limit of Evaporative Storage	=	1.624	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	59.2	inches
Total Initial Water	=	59.2	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	40.5	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	120	days
End of Growing Season (Julian Date)	=	300	days
Average Wind Speed	=	9	mph
Average 1st Quarter Relative Humidity	=	72	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	74	%
Average 4th Quarter Relative Humidity	=	75	%

Note: Evapotranspiration data was obtained for ,

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
2.01298	1.895696	2.373253	3.597322	4.095479	4.395065
3.769391	3.145982	3.272523	2.912689	2.788342	2.489949

Note: Precipitation was simulated based on HELP V4 weather simulation for: Lat/Long: 40.5/-89.98

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
32.4	34.2	41.9	56.4	69.6	79
83.5	81	72.5	61.4	45.9	35.6

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.5/-89.98
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.5/-89.98

Average Annual Totals Summary

Title: Duck Creek Coversystem CIP
Simulated on: 1/13/2022 15:10

	Average Annual Totals for Years 1 - 100*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	36.75	[5.46]	2,000,965.1	100.00
Runoff	6.844	[2.987]	372,642.1	18.62
Evapotranspiration	27.772	[3.713]	1,512,183.1	75.57
Subprofile1				
Percolation/leakage through Layer 3	2.147626	[0.073824]	116,938.2	5.84
Average Head on Top of Layer 3	26.2293	[2.126]	---	---
Subprofile2				
Percolation/leakage through Layer 4	1.973425	[0.573329]	107,453.0	5.37
Water storage				
Change in water storage	0.1595	[1.2078]	8,686.9	0.43

* Note: Average inches are converted to volume based on the user-specified area.

APPENDIX H

Final Closure Plan

APPENDIX H

Final Closure Plan for the Gypsum Management Facility Pond

Duck Creek Power Plant

Submitted to:

Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276

Submitted by:

Illinois Power Resources Generating, LLC
1500 Eastport Plaza Drive
Collinsville, Illinois 62234

Prepared by:

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21454861-13-R-1

January 25, 2022

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1.0 INTRODUCTION

This Final Closure Plan has been prepared to address certain requirements of Illinois Administrative Code Title 35, Part 845, Standards for the Disposal of Coal Combustion Residuals (CCR) in Surface Impoundments (Part 845) for Illinois Power Resources Generating, LLC's (IPRG's) Gypsum Management Facility (GMF) Pond at the Duck Creek Power Plant near Canton, Illinois. Specifically, this document addresses requirements pertaining to the development of a Final Closure Plan for the GMF Pond. The GMF Pond has identification codes as follow:

- IPRG ID Number: CCR Unit ID 203
- IEPA ID Number: W0578010001-04
- IDNR Dam ID Number: IL50573

1.1 Selected Closure Method

Part 845.720 (b)(3): The final closure plan must identify the proposed selected closure method, and must include the information required in subsection (a)(1) and the closure alternatives analysis specified in Section 845.710.

IPRG evaluated closure with a final cover system (hereafter referred to as closure in place or CIP) (Section 845.750) and closure by removal of CCR (CBR) (Section 845.740). An analysis of these closure alternatives is summarized in Attachment 1. Based on the Closure Alternatives Analysis, CIP with a final cover system has been identified as the most appropriate closure method. In combination with the existing dual composite liner system beneath the GMF Pond, the final cover system will provide complete encapsulation of gypsum in the GMF Pond, physically isolating it from contact with surrounding soils, groundwater, surface water, and the atmosphere, and minimizing the potential for release of CCR or leachate. The final cover system has been designed to minimize the post-closure infiltration of liquids into the waste.

2.0 FINAL CLOSURE PLAN

2.1 Narrative Closure Description

Part 845.720(a)(1)(A): A narrative description of how the CCR surface impoundment will be closed in accordance with this Part.

Closure grades and details are shown in the Drawings included as Attachment 2. The CIP concept was developed to reduce the gypsum footprint at closure, while also recognizing the complications associated with handling and stacking gypsum materials. Free liquids will be eliminated by removing liquid wastes or solidifying the remaining wastes prior to final cover system installation. The final cover system will have slopes of 4% to accommodate settlement, with an earthen berm constructed at the south end of the closure footprint to enhance stability. The location of the berm, as shown in Drawing 4, has been selected to accommodate the estimated volume of gypsum to be contained within the closure footprint based on the grading plan presented. The general sequencing plan for CIP is as follows:

- Ponded water will be pumped out from the GMF Pond. Approximately 112 million gallons of water were contained in the GMF Pond as of a December 2020 survey by IngenAE, not including the pore water within the roughly 400,000 cubic yards (cy) of gypsum. Pumping out the ponded water will enable gravity drainage of the gypsum to begin. Water pumped out of the GMF Pond will be routed to the Recycle Pond immediately south of the GMF Pond and then to Duck Creek Reservoir, where it will be managed in accordance with the National Pollutant Discharge Elimination System (NPDES) permit for the site.

- The upper gypsum layer will be dewatered within the northern portion of the GMF Pond as necessary to allow mobile equipment traffic across the surface using a series of trenches and sumps. Free liquids in the gypsum will be eliminated by removing liquid wastes or solidifying gypsum remaining in place. Liquid wastes and water flowing to sumps will be managed in accordance with the NPDES permit for the site.
- Where required to allow construction of the new berm in an east–west orientation at the south end of the closure footprint, gypsum will be excavated and relocated. The upstream face of the berm will be lined with a composite liner system, which will tie into the existing liner system. The new liner system will include (from bottom to top):
  - 2-foot-thick compacted soil liner (permeability of 1 x 10^{-7} cm/sec or less)
  - 60-mil high-density polyethylene (HDPE) geomembrane
- Liquid wastes will be removed from the remaining gypsum south of the berm, and the gypsum will be excavated and deposited north of the berm (i.e., within the closure footprint) to achieve the approximate closure grades shown in Attachment 2. This may be accomplished by traditional earthwork methods and/or by washing the material towards sumps at the south end of the GMF Pond, where the material can be collected and liquid wastes can be removed.
- In portions of the GMF Pond that are outside of (i.e., generally south of) the closure footprint, the geosynthetic components of the existing liner system will be removed and disposed in the closure footprint or in the existing permitted on-site landfill. The existing permitted on-site landfill has sufficient capacity to accept the removed materials. The earthen components of the existing primary liner system and leachate collection and removal system will be removed and stockpiled on site. Up to 1 foot of subsoil may also be removed. The subsoils will be visually observed for signs of CCR staining. If subsoils with CCR staining are observed, they will be removed and disposed.
- Once all gypsum is contained within the closure footprint and appropriate grades for closure have been achieved (with grading fill used as necessary), a final cover system will be installed over the closure footprint in accordance with Part 845.750. The final cover system will consist of (from top to bottom) the following:
  - Based on the demonstration provided in Attachment 3, pursuant to Section 845.750(c)(2), a 2-foot-thick final protective layer consisting of locally available soils compacted to between 80% and 95% of the standard Proctor maximum dry density. The uppermost 6 inches of the final protective layer will be tracked in place with a density suitable for establishment of vegetation. Soils are expected to consist primarily of low-plasticity silt or clay based on a review of site geotechnical information.
  - Drainage geocomposite.
  - 40-mil linear low-density polyethylene (LLDPE) geomembrane.
- Surface water channels will be excavated as shown in Attachment 2 to route stormwater flows away from the closure footprint.

2.2 Decontamination of CCR Surface Impoundment

Part 845.720(a)(1)(B): If closure of the CCR surface impoundment will be accomplished through removal of CCR from the CCR surface impoundment, a description of the procedures to remove the CCR and decontaminate the CCR surface impoundment in accordance with Section 845.740.

After gypsum south of the berm has been relocated to within the closure footprint, the geosynthetic components of the existing liner system will be removed and disposed in the closure footprint or in the existing permitted on-site landfill. The earthen components of the existing primary liner system and leachate collection and removal system will be removed and stockpiled on site. Up to 1 foot of subsoil may also be removed. The subsoils will be visually observed for signs of CCR staining. If subsoils with CCR staining are observed, they will be removed and disposed.

2.3 Final Cover System Performance Standards

Part 845.720(a)(1)(C): If closure of the CCR surface impoundment will be accomplished by leaving CCR in place, a description of the final cover system, designed in accordance with Section 845.750, and the methods and procedures to be used to install the final cover. The closure plan must also discuss how the final cover system will achieve the performance standards specified in Section 845.750.

The final cover system is described in Section 2.1 and shown in the Drawings (Attachment 2). Documentation in support of the final cover system achieving the performance standards of Section 845.750 is provided in Section 4.7.

2.4 Maximum CCR Inventory Estimate

Part 845.720(a)(1)(D): An estimate of the maximum inventory of CCR ever on-site over the active life of the CCR surface impoundment.

Based on a comparison between the permitted top-of-liner-system grades and the bathymetric and topographic data obtained by IngenAE in December 2020, the estimated volume of gypsum in the GMF Pond is approximately 400,000 cy. No additional CCR will be placed in the GMF Pond before it is closed.

2.5 Largest Surface Area Estimate

Part 845.720(a)(1)(E): An estimate of the largest area of the CCR surface impoundment ever requiring a final cover (see Section 845.750), at any time during the CCR surface impoundment's active life.

In the Closure Plan developed for compliance with the United States Environmental Protection Agency's (USEPA's) CCR Rule (40 CFR 257, Subpart D), the largest area of the GMF Pond ever requiring a final cover system was estimated to be approximately 31 acres. This area represents the entire footprint of the GMF Pond. The area of the closure footprint requiring a final cover system under this Final Closure Plan is approximately 15 acres.

2.6 Closure Completion Schedule

Part 845.720(a)(1)(E): A schedule for completing all activities necessary to satisfy the closure criteria in this Section, including an estimate of the year in which all closure activities for the CCR surface impoundment will be completed. The schedule should provide sufficient information to describe the sequential steps that will be taken to close the CCR surface impoundment, including identification of major milestones such as coordinating with and obtaining necessary approvals and permits from other agencies, the dewatering and stabilization phases of CCR surface impoundment closure, or installation of the final cover system, and the estimated timeframes to complete each step or phase of CCR surface impoundment closure. When preparing the preliminary written closure plan, if the owner or operator of a CCR surface impoundment estimates that the time required to complete closure will exceed the timeframes specified in Section 845.760(a), the preliminary written closure plan must include the site-specific information, factors and considerations that would support any time extension sought under Section 845.760(b).

Table 1: Closure Completion Milestone Schedule

Milestone	Timeframe (all preliminary estimates)
Final Closure Plan Submittal	February 2022
Final Design and Bid Process	6 to 12 months after Final Closure Plan approval
Agency Coordination and Permit Acquisition ▪ State permits for dewatering/water treatment (NPDES), land disturbance, and dam modification	
Dewater and Stabilize CCR ▪ Pump water from GMF Pond ▪ Dewater and stabilize gypsum	12 to 18 months after issuance of necessary permits, design completion, and bid award
Consolidate Gypsum Footprint ▪ Construct berm ▪ Install new liner system on upstream face of berm ▪ Relocate gypsum south of berm to closure footprint	3 to 6 months after dewatering and gypsum stabilization
Installation of Final Cover System ▪ Prepare top of gypsum for final cover system installation ▪ Install geomembrane ▪ Install geocomposite ▪ Place final protective layer	3 to 6 months after gypsum relocation to closure footprint
Site Restoration ▪ Remove existing liner system south of berm ▪ Excavate drainage channel ▪ Seed and mulch final cover system and disturbed areas	3 to 6 months after final cover system installation
Timeframe to Complete Closure	Prior to April 2026

3.0 AMENDMENT OF THE FINAL CLOSURE PLAN

Part 845.720(b)(4): If a final written closure plan revision is necessary after closure activities have started for a CCR surface impoundment, the owner or operator must submit a request to modify the construction permit within 60 days following the triggering event.

IPRG will submit a written request to modify the construction permit within 60 days of a triggering event.

4.0 CLOSURE WITH A FINAL COVER SYSTEM

4.1 Minimization of Post-closure Infiltration and Releases

Part 845.750(a): The owner or operator of a CCR surface impoundment must ensure that, at a minimum, the CCR surface impoundment is closed in a manner that will:

1) Control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere.

Post-closure infiltration into the GMF Pond will be minimized by the construction of a final cover system. The final cover system will consist of (from top to bottom) the following:

- Based on the demonstration provided in Attachment 3, pursuant to Section 845.750(c)(2), a 2-foot-thick final protective layer consisting of locally available soils compacted to between 80% and 95% of the standard Proctor maximum dry density. The uppermost 6 inches of the final protective layer will be tracked in place with a density suitable for establishment of vegetation. Soils are likely to consist primarily of low-plasticity silt or clay based on a review of site geotechnical information.
- Drainage geocomposite. This layer will provide lateral drainage to limit the potential for the final protective layer to become saturated.
- 40-mil LLDPE geomembrane.

The use of HDPE geomembrane was considered, but LLDPE geomembrane was selected because it can be installed more easily in a wider range of cold-temperature conditions. This final cover system is compliant with the Part 845 requirements, as described in Section 4.7, and will minimize the post-closure infiltration of liquids into the waste. After closure, the gypsum stored in the facility will be completely encapsulated by the final cover and liner systems, physically isolating it from contact with surrounding soils, groundwater, surface water, and the atmosphere, and minimizing the potential for release of CCR or leachate. This is supported by groundwater modeling, as presented in Appendix G to the Part 845 Construction Permit Application for the GMF Pond.

4.2 Preclusion of Future Impoundment

Part 845.750(a): The owner or operator of a CCR surface impoundment must ensure that, at a minimum, the CCR surface impoundment is closed in a manner that will:

2) Preclude the probability of future impoundment of water, sediment, or slurry.

The final cover system will be crowned with 4% slopes to direct surface water away from the facility. Beyond the final cover system, channels will direct surface water away from the GMF Pond to existing site drainages.

4.3 Provisions for Preventing Instability, Sloughing and Movement

Part 845.750(a): The owner or operator of a CCR surface impoundment must ensure that, at a minimum, the CCR surface impoundment is closed in a manner that will:

3) Include measures that provide for major slope stability to prevent the sloughing or movement of the final cover system during the closure and post-closure care period.

An assessment of the GMF Pond structural stability was completed as part of compliance with USEPA's CCR Rule (AECOM 2016). This assessment concluded that the GMF Pond meets stability factor of safety requirements and does not pose a significant risk of instability.

An earthen berm is provided in the closure design to enhance stability along the southern end of the closure footprint. Slope stability calculations are included in Attachment 4 to demonstrate that factors of safety for static and seismic stability after closure are acceptable. The slope stability calculations also considered veneer stability to verify that the final cover system will not be susceptible to instability, sloughing, or movement during the closure and post-closure care period.

4.4 Minimize the Need for Future Maintenance

Part 845.750(a): The owner or operator of a CCR surface impoundment must ensure that, at a minimum, the CCR surface impoundment is closed in a manner that will:

4) Minimize the need for further maintenance of the CCR surface impoundment

The 4% design closure slopes are sufficient to adequately shed water from the facility but are flat enough to limit erosion of the final protective layer. Minor maintenance of the final cover system (potentially including filling of low areas, reseeding, fertilizing, etcetera) will likely be necessary for several years after completion of final cover system construction, as described in the Post-closure Care Plan (Appendix J to the Part 845 Construction Permit Application for the GMF Pond). The need for long-term future maintenance is expected to be minimal after installation of the final cover system has been completed and vegetation has been established.

The channels designed to convey surface water runoff away from the closed facility have been sized to accommodate the 25-year, 24-hour storm event. The design calculations are provided in Attachment 5.

4.5 Be Completed in the Shortest Amount of Time

Part 845.750(a): The owner or operator of a CCR surface impoundment must ensure that, at a minimum, the CCR surface impoundment is closed in a manner that will:

5) Be completed in the shortest amount of time consistent with recognized and generally accepted engineering practices.

The CIP method will require significantly less material handling compared with a CBR approach. Both approaches require the removal of liquid wastes, but the CIP method will require relocation of less than 25% of the gypsum present in the GMF Pond. This reduced material handling volume means that the CIP construction can be completed in approximately 24 to 30 months, compared with 36 to 48 months, or possibly more, for CBR.

4.6 Drainage and Stabilization

Part 845.750(b): Drainage and Stabilization of CCR Surface Impoundments. The owner or operator of a CCR surface impoundment or any lateral expansion of a CCR surface impoundment must meet the requirements of this subsection (b) before installing the final cover system required by subsection (c).

1) Free liquids must be eliminated by removing liquid wastes or solidifying the remaining wastes and waste residues.

2) Remaining wastes must be stabilized sufficiently to support the final cover system.

Approximately 112 million gallons of water will be pumped from the GMF Pond as the initial step for facility closure. After removal of the ponded water, the gypsum will still be unsuitable for supporting heavy construction traffic over much of the footprint. Careful planning will be required to safely work on the wet gypsum within the GMF Pond. The planned gypsum removal and relocation will rely on a series of trenches or other engineering measures to remove liquid wastes or solidify the remaining wastes. Trenches will shorten drainage routes to facilitate gravity removal of liquid wastes in the gypsum (i.e., liquid that is readily separable from the gypsum under ambient temperature and pressure) in the vicinity of each trench and direct the liquid wastes to sumps. Other engineering measures may be considered to facilitate removal of liquid wastes. Sumps will be used to collect liquid wastes, which will be managed in accordance with the NPDES permit for the site. Using the process described or other engineering measures for removal of liquid wastes or solidification of the remaining wastes, the gypsum remaining in place will be stabilized sufficiently to support the final cover system.

4.7 Final Cover System

Part 845.750(c): Final Cover System. If a CCR surface impoundment is closed by leaving CCR in place, the owner or operator must install a final cover system that is designed to minimize infiltration and erosion, and, at a minimum, meets the requirements of this subsection (c). The final cover system must consist of a low permeability layer and a final protective layer. The design of the final cover system must be included in the preliminary and final written closure plans required by Section 845.720 and the construction permit application for closure submitted to the Agency.

4.7.1 Low-Permeability Layer

Part 845.750(c)(1) Standards for the Low Permeability Layer. The low permeability layer must have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present, or a hydraulic conductivity no greater than 1 x 10^{-7} cm/sec, whichever is less. The low permeability layer must be constructed in accordance with the standards in either subsection (c)(1)(A) or (c)(1)(B), unless the owner or operator demonstrates that another low permeability layer construction technique or material provides equivalent or superior performance to the requirements of either subsection (c)(1)(A) or (c)(1)(B) and is approved by the Agency.

A) A compacted earth layer constructed in accordance with the following standards:

i) The minimum allowable thickness must be 0.91 meter (three feet); and

ii) The layer must be compacted to achieve a hydraulic conductivity of 1 x 10^{-7} cm/sec or less and minimize void spaces.

B) A geomembrane constructed in accordance with the following standards:

i) The geosynthetic membrane must have a minimum thickness of 40 mil (0.04 inches) and, in terms of hydraulic flux, must be equivalent or superior to a three-foot layer of soil with a hydraulic conductivity of 1 x 10^{-7} cm/sec;

ii) The geomembrane must have strength to withstand the normal stresses imposed by the waste stabilization process; and

iii) The geomembrane must be placed over a prepared base free from sharp objects and other materials that may cause damage.

The final cover system will include a 40-mil LLDPE geomembrane placed on a prepared subgrade of gypsum (see the Drawings in Attachment 2). The prepared subgrade will be free of sharp objects prior to geomembrane installation. The geomembrane material will conform with the specifications of Geosynthetic Institute GRI-GM17 "Test Methods, Test Properties and Testing Frequency for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes" and will be installed per GRI-GM19a "Seam Strength and Related Properties of Thermally Bonded Homogeneous Polyolefin Geomembranes/Barriers" to help ensure that the material itself and the seams between panels will withstand the expected normal and tensile stress conditions. Furthermore, a 40-mil LLDPE geomembrane manufactured and installed to these specifications is widely accepted to be equivalent or superior to a 3-foot-thick layer of soil with a hydraulic conductivity of 1×10^{-7} cm/sec.

4.7.2 Final Protective Layer

Part 845.750(c)(2): Standards for the Final Protective Layer. The final protective layer must meet the following requirements, unless the owner or operator demonstrates that another final protective layer construction technique or material provides equivalent or superior performance to the requirements of this subsection (c)(2) and is approved by the Agency.

A) Cover the entire low permeability layer;

B) Be at least three feet thick, be sufficient to protect the low permeability layer from freezing, and minimize root penetration of the low permeability layer;

C) Consist of soil material capable of supporting vegetation;

D) Be placed as soon as possible after placement of the low permeability layer; and

E) Be covered with vegetation to minimize wind and water erosion.

Based on the demonstration provided in Attachment 3, pursuant to Section 845.750(c)(2), a 2-foot-thick final protective layer will be installed for the final cover system, immediately overlaying the drainage geocomposite and covering the entire low-permeability layer (see the Drawings in Attachment 2). The final protective layer will comprise locally available soils compacted to between 80% and 95% of the standard Proctor maximum dry density. The uppermost 6 inches of the final protective layer will be tracked in place to a density suitable for establishment of vegetation. This soil is expected to consist primarily of low-plasticity silt or clay based on a review of site geotechnical information. This soil is capable of supporting vegetation, will be placed as soon as possible after placement of the low-permeability layer, and will be covered with vegetation to limit wind and water erosion.

4.8 Final Cover System Settling

Part 845.750(c)(3): The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.

The closure slopes are designed at 4% to accommodate settlement while still maintaining positive drainage off the facility. Additional discussion on this subject is provided in Section 4.4.

4.9 Use of CCR in Closure

Part 845.750(d): This subsection specifies the allowable uses of CCR in the closure of CCR surface impoundments closing under Section 845.700. Notwithstanding the prohibition on further placement in Section

845.700, CCR may be placed in these surface impoundments, but only for purposes of grading and contouring in the design and construction of the final cover system, if:

1) The CCR placed was generated at the facility and is located at the facility at the time closure was initiated;

2) CCR is placed entirely above the elevation of CCR in the surface impoundment, following dewatering and stabilization (see subsection (b));

3) The CCR is placed entirely within the perimeter berms of the CCR surface impoundment; and

4) The final cover system is constructed with either:

A) A slope not steeper than 5% grade after allowance for settlement; or

B) At a steeper grade, if the Agency determines that the steeper slope is necessary, based on conditions at the site, to facilitate run-off and minimize erosion, and that side slopes are evaluated for erosion potential based on a stability analysis to evaluate possible erosion potential. The stability analysis, at a minimum, must evaluate the site geology; characterize soil shear strength; construct a slope stability model; establish groundwater and seepage conditions, if any; select loading conditions; locate critical failure surface; and iterate until minimum factor of safety is achieved.

The GMF Pond is not closing under Section 845.700. Nevertheless, closure of the GMF Pond is anticipated to comply with the requirements of Subsection 845.750(d). Following dewatering of the GMF Pond, gypsum currently located within the facility (which was generated at Duck Creek Power Plant) will be relocated to within the closure footprint. A berm will be constructed in an east–west orientation at the south end of the closure footprint. The upstream face of the berm will be lined with a liner system compliant with Section 845.400, which will tie into the existing composite liner system. Gypsum currently located south of this berm (approximately 85,000 cy) will be removed and relocated to within the closure footprint, above the elevation of existing gypsum and completely within the perimeter berms, to achieve final grades. The final cover system has been designed with 4% slopes.

5.0 ADDITIONAL INFORMATION

According to the Hydrogeologic Site Characterization Report by Ramboll (Appendix D to the construction permit application), the base of the closed GMF Pond is within a geologic formation with the following characteristics in the vicinity of the GMF Pond:

- geometric mean hydraulic conductivity of 3.6×10^{-4} centimeters per second
- groundwater flow generally in a southeasterly direction
- average groundwater flow velocity of 2.4×10^{-1} feet per day

The base and sides of the GMF Pond have a robust dual composite liner system consisting of the following components (from top to bottom):

- primary composite liner system
  - 60-mil textured HDPE geomembrane
  - 1-foot-thick (minimum) cushion soil layer

- leak detection layer
  - geotextile separator
  - 1-foot-thick granular drainage layer
  - geotextile cushion
- secondary composite liner system
  - 60-mil textured HDPE geomembrane
  - reinforced geosynthetic clay liner
  - 3-foot-thick compacted clay layer

The liner system was subjected to a rigorous construction quality assurance program during installation. The leak detection layer has not detected infiltration since initial facility construction, either from the gypsum or from outside the facility (i.e., lateral infiltration). The liner system prevents lateral infiltration of groundwater into the gypsum.

6.0 CERTIFICATION

Part 845.750(c)(4): The owner or operator of the CCR surface impoundment must obtain and submit with its construction permit application for closure a written certification from a qualified professional engineer that the design of the final cover system meets the requirements of this Section.

The undersigned qualified professional engineer registered in Illinois certifies that the design of the final cover system meets the requirements of Section 845.750.

Signature Page

Golder Associates USA Inc.

I, Mark Haddock, being a registered professional engineer in good standing in the State of Illinois, certify to the best of my knowledge that this Final Closure Plan meets the requirements of Illinois Administrative Code Title 35, Part 845.

Mark Haddock
Principal

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https://golderassociates.sharepoint.com/sites/141778/project files/6 deliverables/reports/13-r-closure_plan_gypsum_mgmt_facility_pond/13-r-1/21454861-13-r-1-closure_plan_gypsum_mgmt_facility_pond_25jan22.docx

7.0 REFERENCES

AECOM. 2016. CCR Rule Report: Initial Structural Stability Assessment for GMF Pond at Duck Creek Power Station. [Accessed January 25, 2022.] https://www.luminant.com/ccr.

ATTACHMENT 1

Closure Alternatives Analysis

Closure Alternatives Analysis
Duck Creek Power Plant
Gypsum Management Facility (GMF) and Bottom Ash Basin (BAB)
Canton, Illinois

January 28, 2022

GRADIENT

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Abbreviations

AACE	Association for the Advancement of Cost Engineering
BAB	Bottom Ash Basin
bgs	Below Ground Surface
BMP	Best Management Practice
CAA	Closure Alternatives Analysis
CBR	Closure-by-Removal
CBR-Offsite	Closure-by-Removal with Off-Site CCR Disposal
CBR-Onsite	Closure-by-Removal with On-Site CCR Disposal
CCR	Coal Combustion Residual
CIP	Closure-in-Place
CO	Carbon Monoxide
CO_2	Carbon Dioxide
EJ	Environmental Justice
GHG	Greenhouse Gas
GMF	Gypsum Management Facility
GWPS	Groundwater Protection Standard
HDPE	High-Density Polyethylene
IAC	Illinois Administrative Code
IDNR	Illinois Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
IPRG	Illinois Power Resources Generating, LLC
LLDPE	Linear Low-Density Polyethylene
N_2O	Nitrous Oxide
NID	National Inventory of Dams
NO_x	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System
PM	Particulate Matter
SFWA	State Fish and Wildlife Area
TVA	Tennessee Valley Authority
US BLS	United States Bureau of Labor Statistics
US DOT	United States Department of Transportation
US EPA	United States Environmental Protection Agency
US FWS	United States Fish & Wildlife Service
USGS	United States Geological Survey
VOC	Volatile Organic Compound
WPC Permit	Water Pollution Control Construction and Operating Permit

Summary of Findings

Title 35, Part 845, of the Illinois Administrative Code (IAC; IEPA, 2021a) requires the development of a Closure Alternatives Analysis (CAA) prior to undertaking closure activities at certain surface impoundments containing coal combustion residuals (CCRs) in the State of Illinois. Pursuant to requirements under IAC Section 845.710, this report presents a CAA for the Gypsum Management Facility (GMF) and the Bottom Ash Basin (BAB) located on the Illinois Power Resources Generating, LLC (IPRG) Duck Creek Power Plant property near Canton, Illinois. The GMF contains synthetic gypsum generated historically by the plant's flue gas desulfurization system. No significant volume of CCR remains in the BAB. CCR that was historically contained within the BAB has already been excavated from the impoundment.

The goal of a CAA is to holistically evaluate potential closure scenarios with respect to a wide range of factors, including the efficiency, reliability, and ease of implementation of the closure scenario; its potential positive and negative short- and long-term impacts on human health and the environment; and its ability to address concerns raised by residents (IAC Part 845; IEPA, 2021a). For the GMF, Gradient evaluated three closure scenarios: Closure-in-Place (CIP), Closure-by-Removal with On-Site CCR Disposal (CBR-Onsite), and Closure-by-Removal with Off-Site CCR Disposal (CBR-Offsite). For the BAB, Gradient evaluated two closure scenarios: CBR-Onsite and CBR-Offsite. CIP was not evaluated for the BAB because there is no significant CCR remaining in the unit. The CIP scenario for the GMF entails consolidating all of the gypsum in the northern portion of the impoundment, then capping the impoundment with a new cover system. The CBR-Onsite scenario entails excavating the CCR and liner system materials from the GMF and/or the BAB and transporting these materials to an on-Site landfill for disposal. The CBR-Offsite scenario entails excavating the CCR and liner system materials from the GMF and/or the BAB and transporting these materials to an off-Site landfill. IPRG will also continue to evaluate potential opportunities for beneficial re-use of CCR excavated from the GMF as an alternative to disposal.

Table S.1 summarizes the expected impacts of the CIP, CBR-Onsite, and CBR-Offsite closure scenarios at the GMF with regard to each of the factors specified under IAC Section 845.710 (IEPA, 2021a). Table S.2 summarizes the expected impacts of the CBR-Onsite and CBR-Offsite closure scenarios at the BAB with regard to each of the factors specified under IAC Section 845.710 (IEPA, 2021a). Based on Table S.1 and the additional details provided in Section 2 of this report, CIP has been identified as the most appropriate closure scenario for the GMF. Key benefits of CIP at the GMF include the more rapid re-development of the Site for use in utility-scale solar generation and reduced impacts on workers, community members, and the environment during construction (*e.g.*, fewer construction-related accidents, lower energy demands, less air pollution and greenhouse gas [GHG] emissions, and less traffic). Based on Table S.2 and the additional details provided in Section 3 of this report, CBR-Onsite has been identified as the most appropriate closure scenario for the BAB. Key benefits of CBR-Onsite at the BAB are that no off-Site hauling is required and, consequently, that this scenario will result in reduced impacts to the community (due to, *e.g.*, accidents, traffic, noise, and air pollution) compared to CBR-Offsite.

Table S.1 Comparison of Proposed Closure Scenarios for the GMF

Evaluation Factor (Report Section; Part 845 Section)	GMF Closure Scenario		
	CIP	**CBR-Onsite**	**CBR-Offsite**
Closure Alternative Descriptions (Section 2.1; IAC Section 845.710(c))	The CIP scenario would entail consolidating all of the gypsum in the GMF in the northern portion of the impoundment, then capping the impoundment with a new cover system consisting of, from bottom to top, a geomembrane layer, a geocomposite layer, and 24 inches of protective cover soil capable of supporting vegetative growth.	For CBR-Onsite, CCR and existing liner system materials would be excavated from the GMF and sent *via* truck to the on-Site landfill for disposal. The gypsum, the primary composite liner system, the leachate collection and removal system, the geosynthetic components of the secondary composite liner system, and the underlying 3-foot compacted clay liner would be hauled to the on-Site landfill for disposal. The on-Site landfill does not have sufficient capacity for these materials and would require expansion. This scenario meets the requirements of IAC Section 845.710(c)(2) (IEPA, 2021a), which requires an assessment be included in the CAA of whether the Site has an on-Site landfill with available capacity or whether an on-Site landfill can be constructed.	For CBR-Offsite, CCR and existing liner system materials would be excavated from the GMF and sent *via* truck to an off-Site landfill for disposal. The gypsum, the primary composite liner system, the leachate collection and removal system, the geosynthetic components of the secondary composite liner system, and the underlying 3-foot compacted clay liner would be hauled to the off-Site landfill for disposal. Expansion of the off-Site landfill may be necessary in order to accept all of the CCR and liner materials from the GMF.
Type and Degree of Long-Term Management, Including Monitoring, Operation, and Maintenance (Section 2.2.3; IAC Section 845.710(b)(1)(C))	Monitoring would be performed at the GMF for at least 30 years post-closure, or until GWPSs have been achieved, whichever is longer. The post-closure care plan under the CIP scenario additionally includes periodic inspections and mowing and maintenance of the final cover system for the GMF.	Monitoring would be performed at the GMF for at least 3 years post-closure, or until GWPSs have been achieved, whichever is longer.	Monitoring would be performed at the GMF for at least 3 years post-closure, or until GWPSs have been achieved, whichever is longer.
Magnitude of Reduction of Existing Risks (Section 2.2.1; IAC Sections 845.710(b)(1)(A) and 845.710(b)(1)(F))	There are no current risks to any human or ecological receptors associated with the GMF. Because groundwater concentrations are expected to remain stable and/or decline under all closure scenarios, no risks to human or ecological receptors are expected post-closure.	There are no current risks to any human or ecological receptors associated with the GMF. Because groundwater concentrations are expected to remain stable and/or decline under all closure scenarios, no risks to human or ecological receptors are expected post-closure.	There are no current risks to any human or ecological receptors associated with the GMF. Because groundwater concentrations are expected to remain stable and/or decline under all closure scenarios, no risks to human or ecological receptors are expected post-closure.

Evaluation Factor (Report Section; Part 845 Section)	GMF Closure Scenario		
	CIP	**CBR-Onsite**	**CBR-Offsite**
Likelihood of Future Releases of CCR (Section 2.2.2; IAC Sections 845.710(b)(1)(B) and 845.710(b)(1)(F))	During closure, there would be minimal risk of dike failure occurring (due to, *e.g.*, flooding or seismic activity) and minimal risk of dike overtopping during flood conditions. Post-closure, the risks of overtopping and dike failure would be even smaller than they are currently, due to the installation of a protective soil cover and new stormwater control structures. Dikes, final cover, and stormwater control features have been designed to withstand earthquakes and storm events.	During closure, there would be minimal risk of dike failure occurring (due to, *e.g.*, flooding or seismic activity) and minimal risk of dike overtopping during flood conditions. Following excavation, there would be no risk of CCR releases due to dike failure.	During closure, there would be minimal risk of dike failure occurring (due to, *e.g.*, flooding or seismic activity) and minimal risk of dike overtopping during flood conditions. Following excavation, there would be no risk of CCR releases due to dike failure.

Evaluation Factor (Report Section; Part 845 Section)	GMF Closure Scenario		
	CIP	**CBR-Onsite**	**CBR-Offsite**
Worker Risks (Section 2.2.4.1; IAC Sections 845.710(b)(1)(D) and 845.710(b)(1)(F))	An estimated 0.17 injuries and 0.0011 fatalities would be expected to occur to workers due to major on-Site construction activities under this scenario. Overall, risks to workers would likely be highest under the CBR-Offsite scenario and lowest under the CIP scenario. Simultaneous with closure activities, the Site will be re-developed for use in utility-scale solar generation. The simultaneous pursuit of two large construction projects may lead to significant traffic congestion on Site access roads, resulting in greater overall risks to workers than would result from either project alone. The CIP scenario is expected to result in less traffic congestion – and, hence, a smaller increase in risks to workers – than the two CBR scenarios.	An estimated 0.30 injuries and 0.0020 fatalities would be expected to occur to workers due to major on-Site construction activities under this scenario. Overall, risks to workers would likely be highest under the CBR-Offsite scenario and lowest under the CIP scenario. Simultaneous with closure activities, the Site will be re-developed for use in utility-scale solar generation. The simultaneous pursuit of two large construction projects may lead to significant traffic congestion on Site access roads, resulting in greater overall risks to workers than would result from either project alone. The two CBR scenarios are expected to result in more traffic congestion – and, hence, a greater increase in risks to workers – than the CIP scenario.	An estimated 0.41 injuries and 0.0027 fatalities would be expected to occur to workers due to major on-Site construction activities under this scenario. An additional estimated 0.42 injuries and 0.0096 fatalities would be expected to occur to workers due to off-Site hauling under this scenario. In total, a minimum of 0.84 worker injuries and 0.012 worker fatalities would be expected under this scenario. Overall, risks to workers would likely be highest under the CBR-Offsite scenario and lowest under the CIP scenario. Simultaneous with closure activities, the Site will be re-developed for use in utility-scale solar generation. The simultaneous pursuit of two large construction projects may lead to significant traffic congestion on Site access roads, resulting in greater overall risks to workers than would result from either project alone. The two CBR scenarios are expected to result in more traffic congestion – and, hence, a greater increase in risks to workers – than the CIP scenario.

Evaluation Factor (Report Section; Part 845 Section)	GMF Closure Scenario		
	CIP	**CBR-Onsite**	**CBR-Offsite**
Community Risks (Section 2.2.4.2; IAC Sections 845.710(b)(1)(D) and 845.710(b)(1)(F)) *Off-Site Impacts on Nearby Residents and Environmental Justice (EJ) Communities*	Off-Site impacts on nearby residents under this scenario (including accidents, traffic, noise, and air pollution) will be small relative to off-Site impacts under the CBR-Offsite scenario, because no off-Site hauling is required under this scenario. The on-Site landfill, the borrow site, and a portion of the GMF are all located within the one-mile buffer zone of the nearest EJ community (near Canton). All possible closure scenarios are therefore associated with potential negative impacts on this EJ community.	Off-Site impacts on nearby residents under this scenario (including accidents, traffic, noise, and air pollution) will be small relative to off-Site impacts under the CBR-Offsite scenario, because no off-Site hauling is required under this scenario. The on-Site landfill, the borrow site, and a portion of the GMF are all located within the one-mile buffer zone of the nearest EJ community (near Canton). All possible closure scenarios are therefore associated with potential negative impacts on this EJ community.	Off-Site impacts on nearby residents under this scenario (including accidents, traffic, noise, and air pollution) will be large relative to off-Site impacts under the CIP and CBR-Onsite scenarios, because off-Site hauling is required under this scenario. In total, an estimated 1.2 injuries and 0.044 fatalities are expected to occur among community members due to off-Site hauling under this scenario. Additionally, a haul truck is likely to pass a location near the Site every 7.2 minutes on average during working hours for the duration of excavation activities, resulting in substantial traffic demands for an extended period of time. The on-Site landfill, the borrow site, and a portion of the GMF are all located within the one-mile buffer zone of the nearest EJ community (near Canton). This EJ community is also located along the primary haul routes from the Site to the off-Site landfill. All possible closure scenarios are therefore associated with potential negative impacts on this EJ community.
Impacts on Scenic, Historical, and Recreational Value	There are no notable scenic, historical, or recreational areas located in the immediate vicinity of the GMF, the borrow soil location, or the on-Site landfill. Construction activities at the Site are therefore not expected to have direct negative impacts on any scenic, historical, or recreational areas under any closure scenario.	There are no notable scenic, historical, or recreational areas located in the immediate vicinity of the GMF, the borrow soil location, or the on-Site landfill. Construction activities at the Site are therefore not expected to have direct negative impacts on any scenic, historical, or recreational areas under any closure scenario.	There are no notable scenic, historical, or recreational areas located in the immediate vicinity of the GMF, the borrow soil location, or the on-Site landfill. Construction activities at the Site are therefore not expected to have direct negative impacts on any scenic, historical, or recreational areas under any closure scenario.

Evaluation Factor (Report Section; Part 845 Section)	GMF Closure Scenario		
	CIP	**CBR-Onsite**	**CBR-Offsite**
Environmental Risks (Section 2.2.4.3; IAC Sections 845.710(b)(1)(D) and 845.710(b)(1)(F))	Total energy demands and GHG emissions would be smaller under this closure scenario than under the two CBR scenarios, because the CIP scenario would have the shortest duration of construction activities and require the least amount of CCR dewatering and handling.	Total energy demands and GHG emissions would be greater under the two CBR closure scenarios than under the CIP scenario, because the two CBR scenarios would have longer durations of construction activities and require a greater amount of CCR dewatering and handling.	Total energy demands and GHG emissions would be greater under the two CBR closure scenarios than under the CIP scenario, because the two CBR scenarios would have longer durations of construction activities and require a greater amount of CCR dewatering and handling.
Impacts on Greenhouse Gas Emissions and Energy Consumption	The CIP scenario would have an additional, unquantified carbon footprint due to the need to manufacture geomembranes for the new GMF berm and the final GMF cover system. At the grid scale, construction of a solar facility at the Site will put energy back on the grid and reduce reliance on non-renewable energy sources. Re-development of the Site for solar would occur more rapidly under the CIP scenario than under the two CBR scenarios.	Because expansion of the on-Site landfill would be necessary in order to accept all of the CCR and liner materials from the GMF, the CBR-Onsite scenario would have an additional, unquantified carbon footprint due to the need to manufacture geomembranes for use in the expanded landfill liner. At the grid scale, construction of a solar facility at the Site will put energy back on the grid and reduce reliance on non-renewable energy sources. Re-development of the Site for solar would occur more slowly under the two CBR scenarios than under the CIP scenario.	If expansion of the off-Site landfill became necessary in order to accept all of the CCR and liner materials from the GMF, then the CBR-Offsite scenario would have an additional, unquantified carbon footprint due to the need to manufacture geomembranes for use in the expanded landfill liner. At the grid scale, construction of a solar facility at the Site will put energy back on the grid and reduce reliance on non-renewable energy sources. Re-development of the Site for solar would occur more slowly under the two CBR scenarios than under the CIP scenario.
Impacts on Natural Resources and Habitat	Construction may have a negative short-term impact on terrestrial species in the vicinity of the GMF and the on-Site borrow soil location. The duration of time over which impacts will occur (*i.e.*, the duration of construction activities) is longest under the two CBR scenarios (24-48 months) and shortest under the CIP scenario (12-24 months).	Construction may have a negative short-term impact on terrestrial species in the vicinity of the GMF and the on-Site borrow soil location. The duration of time over which impacts will occur (*i.e.*, the duration of construction activities) is longest under the two CBR scenarios (24-48 months) and shortest under the CIP scenario (12-24 months).	Construction may have a negative short-term impact on terrestrial species in the vicinity of the GMF and the on-Site borrow soil location. The duration of time over which impacts will occur (*i.e.*, the duration of construction activities) is longest under the two CBR scenarios (24-48 months) and shortest under the CIP scenario (12-24 months).

Evaluation Factor (Report Section; Part 845 Section)	GMF Closure Scenario		
	CIP	CBR-Onsite	CBR-Offsite
Time Until Groundwater Protection Standards Are Achieved (Section 2.2.5; IAC Sections 845.710(b)(1)(E) and 845.710(d)(2 and 3))	Based on statistical analysis and evaluation of potential exceedances, it has been determined that there are no potential groundwater exceedances of applicable groundwater standards attributable to the GMF.	Based on statistical analysis and evaluation of potential exceedances, it has been determined that there are no potential groundwater exceedances of applicable groundwater standards attributable to the GMF.	Based on statistical analysis and evaluation of potential exceedances, it has been determined that there are no potential groundwater exceedances of applicable groundwater standards attributable to the GMF.
Long-Term Reliability of the Engineering and Institutional Controls (Section 2.2.7; IAC Section 845.710(b)(1)(G))	CIP would be expected to be a reliable closure alternative over the long term.	CBR-Onsite would be expected to be a reliable closure alternative over the long term.	CBR-Offsite would be expected to be a reliable closure alternative over the long term.
Potential Need for Future Corrective Action (Section 2.2.8; IAC Section 845.710(b)(1)(H))	Corrective action is not expected to be required at this Site.	Corrective action is not expected to be required at this Site.	Corrective action is not expected to be required at this Site.
Effectiveness of the Alternative in Controlling Future Releases (Section 2.3; IAC Section 845.710(b)(2)(A and B))	There are no current or future risks to any human or ecological receptors associated with the GMF. During closure, there would be minimal risk of dike failure occurring and minimal risk of dike overtopping during flood conditions. Post-closure, the risks of overtopping and dike failure would be even smaller than they are currently, due to the installation of a protective soil cover and new stormwater control structures. Dikes, final cover, and stormwater control features have been designed to withstand earthquakes and storm events.	There are no current or future risks to any human or ecological receptors associated with the GMF. During closure, there would be minimal risk of dike failure occurring and minimal risk of dike overtopping during flood conditions. Following excavation, there would be no risk of CCR releases due to dike failure.	There are no current or future risks to any human or ecological receptors associated with the GMF. During closure, there would be minimal risk of dike failure occurring and minimal risk of dike overtopping during flood conditions. Following excavation, there would be no risk of CCR releases due to dike failure.

Evaluation Factor (Report Section; Part 845 Section)	GMF Closure Scenario		
	CIP	**CBR-Onsite**	**CBR-Offsite**
Ease or Difficulty of Implementing the Alternative (Section 2.4; IAC Section 845.710(b)(3)) *Degree of Difficulty Associated with Construction*	CIP is a reliable and standard method for closing impoundments. However, dewatering and relocating saturated gypsum as part of closure activities at the GMF may be moderately challenging. Careful planning would be required to work safely on the wet gypsum within the GMF.	Relative to CIP, CBR-Onsite and CBR-Offsite pose additional implementation difficulties due to higher earthwork volumes, higher dewatering volumes, and longer construction schedules, and the need to remove and dispose of the existing bottom liner geomembrane. The construction schedule for excavation may be negatively impacted under the CBR-Onsite scenario, because the on-Site landfill will need to be expanded in order to receive all of the materials excavated from the GMF.	Relative to CIP, CBR-Onsite and CBR-Offsite pose additional implementation difficulties due to higher earthwork volumes, higher dewatering volumes, and longer construction schedules, and the need to remove and dispose of the existing bottom liner geomembrane. Hauling would be more difficult to implement under the CBR-Offsite scenario than under the CBR-Onsite scenario, due to the need to use public roadways for hauling. Because the CCR would be hauled on public roads (*i.e.*, intrastate travel), it would also need to be dewatered to a greater extent than would be necessary under the CBR-Onsite scenario. Off-Site landfilling would additionally require the development of a disposal plan and could raise issues related to the co-disposal of CCR and other non-hazardous wastes. The construction schedule for excavation may be negatively impacted under the CBR-Offsite scenario if, during the course of closure, it is determined that the off-Site landfill must be expanded in order to receive all of the materials excavated from the GMF.
Expected Operational Reliability	Operational reliability would be expected under all closure scenarios.	Operational reliability would be expected under all closure scenarios.	Operational reliability would be expected under all closure scenarios.

Evaluation Factor (Report Section; Part 845 Section)	GMF Closure Scenario		
	CIP	**CBR-Onsite**	**CBR-Offsite**
Need for Permits and Approvals	Permits required under all closure scenarios include: a modification to the existing NPDES permit; a construction permit from the IDNR Dam Safety Program to allow the embankment and spillways of the impoundment to be modified; a construction stormwater permit through IEPA; and a joint water pollution control construction and operating permit.	Permits required under all closure scenarios include: a modification to the existing NPDES permit; a construction permit from the IDNR Dam Safety Program to allow the embankment and spillways of the impoundment to be modified; a construction stormwater permit through IEPA; and a joint water pollution control construction and operating permit. The existing on-Site landfill will also require expansion under the CBR-Onsite scenario; however, the on-Site landfill has already been permitted for an expansion of an additional 2 acres of waste disposal area.	Permits required under all closure scenarios include: a modification to the existing NPDES permit; a construction permit from the IDNR Dam Safety Program to allow the embankment and spillways of the impoundment to be modified; a construction stormwater permit through IEPA; and a joint water pollution control construction and operating permit. Under the CBR-Offsite scenario, additional permitting may be required for transport of the CCR and to expand the off-Site landfill.
Availability of Equipment and Specialists	Global supply chains have been disrupted due to the COVID-19 pandemic, resulting in shortages in the availability of construction equipment and parts. There may be some shortages in construction equipment or delays in the construction schedule under all scenarios, if supply chain resilience does not improve by the time of construction. A national shortage of truck drivers has also developed during the COVID-19 pandemic. Due to higher earthwork volumes and a longer construction schedule under the two CBR scenarios than under the CIP scenario, shortages in construction equipment may cause greater challenges under the CBR scenarios than under the CIP scenario. The current shortage of truck drivers may be particularly impactful under the CBR-Offsite scenario, due to the large volume of CCR and liner materials to be hauled from the Site.	Global supply chains have been disrupted due to the COVID-19 pandemic, resulting in shortages in the availability of construction equipment and parts. There may be some shortages in construction equipment or delays in the construction schedule under all scenarios, if supply chain resilience does not improve by the time of construction. A national shortage of truck drivers has also developed during the COVID-19 pandemic. Due to higher earthwork volumes and a longer construction schedule under the two CBR scenarios than under the CIP scenario, shortages in construction equipment may cause greater challenges under the CBR scenarios than under the CIP scenario. The current shortage of truck drivers may be particularly impactful under the CBR-Offsite scenario, due to the large volume of CCR and liner materials to be hauled from the Site.	Global supply chains have been disrupted due to the COVID-19 pandemic, resulting in shortages in the availability of construction equipment and parts. There may be some shortages in construction equipment or delays in the construction schedule under all scenarios, if supply chain resilience does not improve by the time of construction. A national shortage of truck drivers has also developed during the COVID-19 pandemic. Due to higher earthwork volumes and a longer construction schedule under the two CBR scenarios than under the CIP scenario, shortages in construction equipment may cause greater challenges under the CBR scenarios than under the CIP scenario. The current shortage of truck drivers may be particularly impactful under the CBR-Offsite scenario, due to the large volume of CCR and liner materials to be hauled from the Site.

Evaluation Factor (Report Section; Part 845 Section)	GMF Closure Scenario		
	CIP	**CBR-Onsite**	**CBR-Offsite**
Available Capacity and Location of Treatment, Storage, and Disposal Services	Under the CIP scenario, the gypsum currently within the GMF will be consolidated and stored within the existing footprint of the impoundment. The GMF will be unwatered at the start of construction *via* pumping. Pumped water will be managed in accordance with the facility's NPDES permit.	The on-Site landfill does not have sufficient capacity to receive all of the CCR and liner materials that are currently slated for landfilling under the CBR-Onsite scenario. Expansion of the on-Site landfill would thus be necessary. The on-Site landfill is already permitted for a potential expansion, which would create an additional 2 acres of waste disposal area. The landfill expansion could be completed in a single construction season during the removal of ponded water at the GMF.	The Peoria City-County Landfill in Brimfield, Illinois, has sufficient capacity to receive all of the CCR and liner materials from the GMF. However, due to the limited space remaining in this landfill and the short time frame over which CCR would be received at the landfill, vertical and/or lateral expansions may become necessary. Additionally, the landfill operators may need to develop a disposal plan to account for the increased volume of material that will be received and the unique CCR waste characteristics. If expansion of the Peoria City-County Landfill is impractical or infeasible, then an alternative landfill located farther from the Site would need to be identified. A likely alternative to the Peoria City-County Landfill is the Envirofil of IL Landfill in Macomb, Illinois.
Impact of Alternative on Waters of the State (Section 2.5; IAC Section 845.710(d)(4))	No current or future exceedances of any screening benchmarks for surface water would be anticipated.	No current or future exceedances of any screening benchmarks for surface water would be anticipated.	No current or future exceedances of any screening benchmarks for surface water would be anticipated.

Evaluation Factor (Report Section; Part 845 Section)	GMF Closure Scenario		
	CIP	**CBR-Onsite**	**CBR-Offsite**
Potential Modes of Transportation Associated with CBR (Section 2.1; IAC Section 845.710(c)(1))	This factor is not relevant for CIP.	This factor is not relevant for CBR-Onsite.	Loadout facilities do not exist on-Site that would facilitate off-Site rail or barge CCR transport. Rail lines or waterbodies connecting to a potential off-Site disposal location also do not exist. Thus, transport *via* rail or barge is considered infeasible. Only transport *via* on-road haul trucks was assumed for the CBR-Offsite scenario. The local availability and use of natural gas-powered trucks, or other low-polluting trucks, will be evaluated prior to the start of construction.
Concerns of Residents Associated with Alternatives (Section 2.6; IAC Section 845.710(b)(4))	Despite the preference for CBR that has been expressed by nonprofits representing community interests near the Site, CIP will effectively address residents' concerns regarding potential impacts to groundwater and surface water quality associated with the GMF. Relative to CBR-Offsite, CIP also presents fewer risks to workers and community members during construction in the form of accidents, traffic, and air pollution. Moreover, under the CIP scenario, the Site could be more rapidly re-developed for use in utility-scale solar generation. A public meeting was held on December 7, 2021, pursuant to requirements under IAC Section 845.710(e) (IEPA, 2021a). Questions raised by attendees were answered at the meeting; subsequently, a written summary of all questions and responses was emailed to interested parties.	Nonprofits representing community interests near the Site have expressed a preference for CBR over CIP. However, CBR has several disadvantages with regard to potential community concerns. Relative to CIP, the two CBR scenarios present greater risks to workers and community members during construction in the form of accidents, traffic, and air pollution. Moreover, under the two CBR scenarios, the Site could take longer to re-develop for use in utility-scale solar generation. A public meeting was held on December 7, 2021, pursuant to requirements under IAC Section 845.710(e) (IEPA, 2021a). Questions raised by attendees were answered at the meeting; subsequently, a written summary of all questions and responses was emailed to interested parties.	Nonprofits representing community interests near the Site have expressed a preference for CBR over CIP. However, CBR has several disadvantages with regard to potential community concerns. Relative to CIP, the two CBR scenarios presents greater risks to workers and community members during construction in the form of accidents, traffic, and air pollution. Moreover, under the two CBR scenarios, the Site could take longer to re-develop for use in utility-scale solar generation. A public meeting was held on December 7, 2021, pursuant to requirements under IAC Section 845.710(e) (IEPA, 2021a). Questions raised by attendees were answered at the meeting; subsequently, a written summary of all questions and responses was emailed to interested parties.

Evaluation Factor (Report Section; Part 845 Section)	GMF Closure Scenario		
	CIP	**CBR-Onsite**	**CBR-Offsite**
Class 4 Cost Estimate (Section 2.7; IAC Section 845.710(d)(1))	The CIP scenario can be implemented at a lower total cost (approximately $6.21 million) than the CBR-Onsite scenario (approximately $8.87 million) and the CBR-Offsite scenario (approximately $82.4 million). Cost estimates were prepared consistent with a Class 4 Estimate under the AACE Classification Standard.	The CIP scenario can be implemented at a lower total cost (approximately $6.21 million) than the CBR-Onsite scenario (approximately $8.87 million) and the CBR-Offsite scenario (approximately $82.4 million). Cost estimates were prepared consistent with a Class 4 Estimate under the AACE Classification Standard.	The CIP scenario can be implemented at a lower total cost (approximately $6.21 million) than the CBR-Onsite scenario (approximately $8.87 million) and the CBR-Offsite scenario (approximately $82.4 million). Cost estimates were prepared consistent with a Class 4 Estimate under the AACE Classification Standard.

Notes:
AACE = Association for the Advancement of Cost Engineering; CBR-Offsite = Closure-by-Removal with Off-Site Disposal; CBR-Onsite = Closure-by-Removal with On-Site Disposal; CCR = Coal Combustion Residual; CIP = Closure-in-Place; EJ = Environmental Justice; GHG = Greenhouse Gas; GMF = Gypsum Management Facility; IAC = Illinois Administrative Code; IDNR = Illinois Department of Natural Resources; IEPA = Illinois Environmental Protection Agency; NPDES = National Pollutant Discharge Elimination System.

Table S.2 Comparison of Proposed Closure Scenarios for the BAB

Evaluation Factor (Report Section; Part 845 Section)	BAB Closure Scenario	
	CBR-Onsite	**CBR-Offsite**
Closure Alternative Descriptions (Section 3.1; IAC Section 845.710(c))	For CBR-Onsite, the concrete, compacted clay, and geomembrane components of the existing liner system, and any remaining CCR, will be excavated from the BAB and sent *via* truck to the on-Site landfill for disposal. This scenario meets the requirements of IAC Section 845.710(c)(2) (IEPA, 2021a), which requires an assessment be included in the CAA of whether the Site has an on-Site landfill with available capacity or whether an on-Site landfill can be constructed.	For CBR-Offsite, the concrete, compacted clay, and geomembrane components of the existing liner system, and any remaining CCR, will be excavated from the BAB and sent *via* truck to an off-Site landfill for disposal.
Type and Degree of Long-Term Management, Including Monitoring, Operation, and Maintenance (Section 3.2.3; IAC Section 845.710(b)(1)(C))	Monitoring would be performed at the BAB for at least 3 years post-closure, or until GWPSs have been achieved.	Monitoring would be performed at the BAB for at least 3 years post-closure, or until GWPSs have been achieved.
Magnitude of Reduction of Existing Risks (Section 3.2.1; IAC Sections 845.710(b)(1)(A) and 845.710(b)(1)(F))	There are no current risks to any human or ecological receptors associated with the BAB. Because groundwater concentrations are expected to remain stable and/or decline under all closure scenarios, no risks to human or ecological receptors are expected post-closure.	There are no current risks to any human or ecological receptors associated with the BAB. Because groundwater concentrations are expected to remain stable and/or decline under all closure scenarios, no risks to human or ecological receptors are expected post-closure.
Likelihood of Future Releases of CCR (Section 3.2.2; IAC Sections 845.710(b)(1)(B) and 845.710(b)(1)(F))	There is no current or future risk of CCR releases occurring at the BAB under either closure scenario. No significant volume of CCR currently remains in the BAB.	There is no current or future risk of CCR releases occurring at the BAB under either closure scenario. No significant volume of CCR currently remains in the BAB.
Worker Risks (Section 3.2.4.1; IAC Sections 845.710(b)(1)(D) and 845.710(b)(1)(F))	An estimated 0.056 injuries and 0.00036 fatalities would be expected to occur to workers due to major on-Site construction activities under this scenario. Overall, risks to workers would likely be of similar magnitude for both closure scenarios.	An estimated 0.050 injuries and 0.00033 fatalities would be expected to occur to workers due to major on-Site construction activities under this scenario. An additional estimated 0.0041 injuries and 0.000093 fatalities would be expected to occur to workers due to off-Site hauling. In total, a minimum of 0.054 worker injuries and 0.00042 worker fatalities would be expected under this scenario. Overall, risks to workers would likely be of similar magnitude for both closure scenarios.

Evaluation Factor (Report Section; Part 845 Section)	BAB Closure Scenario	
	CBR-Onsite	**CBR-Offsite**
Community Risks (Section 3.2.4.2; IAC Sections 845.710(b)(1)(D) and 845.710(b)(1)(F)) *Off-Site Impacts on Nearby Residents and Environmental Justice (EJ) Communities*	Off-Site impacts on nearby residents under this scenario (including accidents, traffic, noise, and air pollution) will be smaller than off-Site impacts under the CBR-Offsite scenario, because no off-Site hauling is required under this scenario. The on-Site landfill and the borrow site are both located within the one-mile buffer zone of the nearest EJ community (near Canton). Both closure scenarios are therefore associated with potential negative impacts on this EJ community.	Off-Site impacts on nearby residents under this scenario (including accidents, traffic, noise, and air pollution) will be larger than off-Site impacts under the CBR-Onsite scenario, because off-Site hauling is required under this scenario. In total, an estimated 0.012 injuries and 0.00043 fatalities are expected to occur among community members due to off-Site hauling under this scenario. A haul truck is likely to pass a location near the Site every 49 minutes on average during working hours for the duration of excavation activities under this scenario. The on-Site landfill and the borrow site are both located within the one-mile buffer zone of the nearest EJ community (near Canton). This EJ community is also located along the primary haul routes from the Site to the off-Site landfill. Both closure scenarios are therefore associated with potential negative impacts on this EJ community.
Impacts on Scenic, Historical, and Recreational Value	There are no notable scenic, historical, or recreational areas located in the immediate vicinity of the BAB, the borrow soil location, or the on-Site landfill. Construction activities at the Site are therefore not expected to have direct negative impacts on any scenic, historical, or recreational areas under either closure scenario.	There are no notable scenic, historical, or recreational areas located in the immediate vicinity of the BAB, the borrow soil location, or the on-Site landfill. Construction activities at the Site are therefore not expected to have direct negative impacts on any scenic, historical, or recreational areas under either closure scenario.
Environmental Risks (Section 3.2.4.3; IAC Sections 845.710(b)(1)(D) and 845.710(b)(1)(F)) *Impacts on Greenhouse Gas Emissions and Energy Consumption*	Total energy demands and GHG emissions would likely be similar under the CBR-Onsite and CBR-Offsite scenarios, because both scenarios would have the same expected duration of construction activities and required earthwork volumes.	Total energy demands and GHG emissions would likely be similar under the CBR-Onsite and CBR-Offsite scenarios, because both scenarios would have the same expected duration of construction activities and required earthwork volumes.

Evaluation Factor (Report Section; Part 845 Section)	BAB Closure Scenario	
	CBR-Onsite	**CBR-Offsite**
Impacts on Natural Resources and Habitat	Construction may have a negative short-term impact on terrestrial species in the vicinity of the BAB and the on-Site borrow soil location and may also cause long-term shifts in the habitat atop these locations. Both BAB closure scenarios are expected to have similar short- and long-term impacts on natural resources and habitat.	Construction may have a negative short-term impact on terrestrial species in the vicinity of the BAB and the on-Site borrow soil location and may also cause long-term shifts in the habitat atop these locations. Both BAB closure scenarios are expected to have similar short- and long-term impacts on natural resources and habitat.
Time Until Groundwater Protection Standards Are Achieved (Section 3.2.5; IAC Sections 845.710(b)(1)(E) and 845.710(d)(2 and 3))	There are no exceedances of potentially applicable groundwater standards attributable to the BAB.	There are no exceedances of potentially applicable groundwater standards attributable to the BAB.
Long-Term Reliability of the Engineering and Institutional Controls (Section 3.2.7; IAC Section 845.710(b)(1)(G))	CBR-Onsite would be expected to be a reliable closure alternative over the long term.	CBR-Offsite would be expected to be a reliable closure alternative over the long term.
Potential Need for Future Corrective Action (Section 3.2.8; IAC Section 845.710(b)(1)(H))	Corrective action is not expected to be required at this Site.	Corrective action is not expected to be required at this Site.
Effectiveness of the Alternative in Controlling Future Releases (Section 3.3; IAC Section 845.710(b)(2)(A and B))	There are no current or future risks to any human or ecological receptors associated with the BAB. There is no current or future risk of sudden CCR releases occurring at the BAB under either closure scenario. There is no significant volume of CCR remaining in the BAB.	There are no current or future risks to any human or ecological receptors associated with the BAB. There is no current or future risk of sudden CCR releases occurring at the BAB under either closure scenario. There is no significant volume of CCR remaining in the BAB.
Ease or Difficulty of Implementing the Alternative (Section 3.4; IAC Section 845.710(b)(3))	Hauling would be easier to implement under the CBR-Onsite scenario than under the CBR-Offsite scenario, since it would not require the use of public roadways.	Hauling would be more difficult to implement under the CBR-Offsite scenario than under the CBR-Onsite scenario, since it would require the use of public roadways.
Degree of Difficulty Associated with Construction		

Evaluation Factor (Report Section; Part 845 Section)	BAB Closure Scenario	
	CBR-Onsite	**CBR-Offsite**
Expected Operational Reliability	Operational reliability would be expected under both closure scenarios.	Operational reliability would be expected under both closure scenarios.
Need for Permits and Approvals	A construction stormwater permit through IEPA may be required for closure. A joint water pollution control construction and operating permit may also be needed. Under the CBR-Onsite scenario, a landfill permit modification would be needed for the landfill to receive the BAB contents.	A construction stormwater permit through IEPA may be required for closure. A joint water pollution control construction and operating permit may also be needed. Additional permitting and approvals may be required under the CBR-Offsite scenario for waste transport.
Availability of Equipment and Specialists	Global supply chains have been disrupted due to the COVID-19 pandemic, resulting in shortages in the availability of construction equipment and parts. There may be some shortages in construction equipment or delays in the construction schedule under both closure scenarios, if supply chain resilience does not improve by the time of construction. A national shortage of truck drivers has also developed during the COVID-19 pandemic. The current shortage of truck drivers may be particularly impactful under the CBR-Offsite scenario, due to the materials that will be hauled from the Site.	Global supply chains have been disrupted due to the COVID-19 pandemic, resulting in shortages in the availability of construction equipment and parts. There may be some shortages in construction equipment or delays in the construction schedule under both closure scenarios, if supply chain resilience does not improve by the time of construction. A national shortage of truck drivers has also developed during the COVID-19 pandemic. The current shortage of truck drivers may be particularly impactful under the CBR-Offsite scenario, due to the materials that will be hauled from the Site.
Available Capacity and Location of Treatment, Storage, and Disposal Services	The on-Site landfill has sufficient capacity to receive all of the materials that would be excavated from the BAB.	The Peoria City-County Landfill in Brimfield, Illinois has sufficient capacity to receive all of the materials that would be excavated from the BAB.
Impact of Alternative on Waters of the State (Section 3.5; IAC Section 845.710(d)(4))	No current or future exceedances of any screening benchmarks for surface water would be anticipated.	No current or future exceedances of any screening benchmarks for surface water would be anticipated.

Evaluation Factor (Report Section; Part 845 Section)	BAB Closure Scenario	
	CBR-Onsite	**CBR-Offsite**
Potential Modes of Transportation Associated with CBR (Section 3.1; IAC Section 845.710(c)(1)	This factor is not relevant for CBR-Onsite.	Loadout facilities do not exist on-Site that would facilitate off-Site rail or barge transport of materials excavated from the BAB. Rail lines or waterbodies connecting to a potential off-Site disposal location also do not exist. Thus, transport *via* rail or barge is considered infeasible. Only transport *via* on-road haul trucks was assumed for the CBR-Offsite scenario. The local availability and use of natural gas-powered trucks, or other low-polluting trucks, will be evaluated prior to the start of construction.
Concerns of Residents Associated with Alternatives (Section 3.6; IAC Section 845.710(b)(4))	Nonprofits representing community interests near the Site have expressed a preference for CBR over CIP. Both closure scenarios are equally responsive to this concern. Nearly all of the CCR that was historically contained within the BAB has already been excavated from the impoundment. A public meeting was held on December 7, 2021, pursuant to requirements under IAC Section 845.710(e) (IEPA, 2021a). Questions raised by attendees were answered at the meeting; subsequently, a written summary of all questions and responses was emailed to interested parties.	Nonprofits representing community interests near the Site have expressed a preference for CBR over CIP. Both closure scenarios are equally responsive to this concern. Nearly all of the CCR that was historically contained within the BAB has already been excavated from the impoundment. A public meeting was held on December 7, 2021, pursuant to requirements under IAC Section 845.710(e) (IEPA, 2021a). Questions raised by attendees were answered at the meeting; subsequently, a written summary of all questions and responses was emailed to interested parties.
Class 4 Cost Estimate (Section 3.7; IAC Section 845.710(d)(1))	The CBR-Onsite scenario can be implemented at a lower total cost (approximately $479,000) than the CBR-Offsite scenario (approximately $1,360,000). Cost estimates were prepared consistent with a Class 4 Estimate under the AACE Classification Standard.	The CBR-Onsite scenario can be implemented at a lower total cost (approximately $479,000) than the CBR-Offsite scenario (approximately $1,360,000). Cost estimates were prepared consistent with a Class 4 Estimate under the AACE Classification Standard.

Notes:
AACE = Association for the Advancement of Cost Engineering; BAB = Bottom Ash Basin; CBR-Offsite = Closure-by-Removal with Off-Site Disposal; CBR-Onsite = Closure-by-Removal with On-Site Disposal; CCR = Coal Combustion Residual; CIP = Closure-in-Place; CY = Cubic Yard; EJ = Environmental Justice; GHG = Greenhouse Gas; IAC = Illinois Administrative Code; IEPA = Illinois Environmental Protection Agency; NPDES = National Pollutant Discharge Elimination System.

1 Introduction

1.1 Site Description and History

1.1.1 Site Location and History

The Illinois Power Resources Generating, LLC (IPRG) Duck Creek Power Plant is an electric-power-generating facility with coal-fired units located approximately 9 miles southeast of the City of Canton in Fulton County, Illinois (AECOM, 2016a; Ramboll, 2021a). Beginning in the 1930s, strip mining took place within the boundaries of the Site. Mining operations on the property have since ceased (AECOM, 2016a; Ramboll, 2021b). The Duck Creek Power Plant began operating in 1976 and was retired in December 2019 (AECOM, 2016a; Appendix B).

1.1.2 CCR Impoundments

The Duck Creek Power Plant produced and stored coal combustion residuals (CCRs) as a part of its historical operations. The subjects of this report are the Gypsum Management Facility (GMF; Vistra CCR Unit ID No. 203; Illinois Environmental Protection Agency [IEPA] ID No. W0578010001-04; National Inventory of Dams [NID] No. IL50573) and the Bottom Ash Basin (BAB; Vistra CCR Unit ID No. 205; IEPA ID No. W0578010001-03; NID No. 50716) (Figure 1.1).

The GMF is a 31-acre lined surface impoundment constructed between 2007 and 2009 that operated from 2009 until the plant was retired in 2019. This facility was historically used to store gypsum and to clarify gypsum transport water for reuse (Appendix B; Golder, 2022a). The GMF has a dual-composite liner system with a leak detection layer (Appendix B). The GMF Recycle Pond, which is located immediately south of the GMF, historically received decanted water from the GMF and leachate from the on-Site landfill (described below). The GMF Recycle Pond never received CCR. A set of pumps on the western side of the GMF Recycle Pond were used to transport decanted water back to the flue gas desulfurization system for re-use (Appendix B). The GMF Recycle Pond has a liner system consisting of a 60-mil high-density polyethylene (HDPE) geomembrane, a reinforced bentonite mat, and a 36-inch layer of compacted clay (Natural Resource Technology, 2017). The GMF Recycle Pond has been closed, and the closure was approved by IEPA.

The BAB is a 2.2-acre lined surface impoundment constructed in late 2007 or early 2008 for the management of sluiced bottom ash. It operated from 2008 until the plant was retired in 2019 (Appendix B; Golder, 2022b). There are three cells within the BAB: Primary Pond 1, Primary Pond 2, and the Secondary Pond (Appendix B). Historically, ash was sluiced to either Primary Pond 1 or Primary Pond 2. The Secondary Pond received decanted water from the two primary ponds (Appendix B; Golder, 2022b). Decanted water from the Secondary Pond flowed to the Duck Creek Cooling Pond *via* a discharge channel to the south of the pond (Appendix B). During operation of the BAB, Primary Ponds 1 and 2 were cleaned out frequently *via* excavation, and excavated bottom ash was sent to the on-Site landfill for disposal (Appendix B; Golder, 2022b). Bottom ash was also removed from the BAB when the plant was retired in 2019, such that no significant bottom ash currently remains (Appendix B). The BAB is a lined impoundment. The components of the liner system include (from bottom to top): compacted native soils,

a 60-mil HDPE geomembrane, a 1-foot compacted clay layer, and an 8-inch reinforced concrete layer (Appendix B).

Figure 1.1 Site Location Map. Adapted from Stantec (2017).

1.1.3 Surface Water Hydrology

Surface water bodies on the Site include the Duck Creek Cooling Pond, which is the cooling water impoundment for the plant, and various small ponds resulting from historical surface mining on the property, including Long Lake (AECOM, 2016a; Natural Resource Technology, 2017). Surface water in the vicinity of the GMF and the BAB drains into the Duck Creek Cooling Pond (Natural Resource Technology, 2017), which drains to the Illinois River *via* National Pollutant Discharge Elimination System (NPDES)-permitted outfalls (IEPA, 2013). Other surface water bodies in the vicinity of the Site include various backwater lakes of the Illinois River, including Buckheart Creek to the west and Rice Lake, Miserable Lake, Big Lake, and Goose Lake to the east (Ramboll, 2021b,c).

1.1.4 Hydrogeology

1.1.4.1 GMF

Three major hydrostratigraphic units have been identified near the GMF: (a) the uppermost aquifer, (b) the lower Radnor till/lower confining unit, and (c) the bedrock confining unit. The first of these layers, the uppermost aquifer, is composed of three units: (i) the Peoria/Roxanna loess, (ii) the upper Radnor till, and (iii) the shallow sand unit (Ramboll, 2021c). The Peoria/Roxanna loess zone is composed of silt, clayey silt, and minor amounts of sand. The upper Radnor till is composed of clayey silt with minor amounts of sand and gravel. The shallow sand unit is composed of medium-grained sand and silt with interbedded till seams. The shallow sand unit, which varies from less than 1- to 18-feet thick in the vicinity of the GMF, is the primary conduit for horizontal migration of shallow groundwater near the impoundment (Ramboll, 2021c). The Peoria/Roxanna loess has also been identified as a potential migration pathway (Ramboll, 2021c). The lower Radnor till layer has high silt content with varying amounts of clay, sand, and gravel. The bedrock confining unit is composed primarily of low-

permeability, shaley siltstone and silty shale. The Hydrogeological Site Characterization Report prepared by Ramboll for the GMF (Ramboll, 2021c) provides more details regarding the hydrostratigraphic units in the vicinity of the GMF.

Near the GMF, shallow groundwater flows southeast through the uppermost aquifer toward the Duck Creek Cooling Pond (Natural Resource Technology, 2017; Ramboll, 2021a,c). The preferential flow of groundwater is horizontal rather than vertical because the underlying till and shale bedrock layers restrict vertical groundwater flow (Natural Resource Technology, 2017). Groundwater within the uppermost aquifer near the GMF flows into the Duck Creek Cooling Pond. No other potential groundwater transport pathways exist. Because the Duck Creek Cooling Pond serves as a sink for groundwater discharge in the area, shallow groundwater migration beneath or beyond the Duck Creek Cooling Pond is unlikely (Ramboll, 2021c).

Groundwater monitoring is ongoing at the GMF. The Hydrogeologic Site Characterization Report prepared by Ramboll for the GMF includes a summary of the groundwater data collected from GMF monitoring wells between 2015 and 2021 (Ramboll, 2021c).

1.1.4.2 BAB

Two distinct hydrostratigraphic units have been identified near the BAB: the uppermost aquifer and a confining shale bedrock unit (Ramboll, 2021b). The first of these layers, the uppermost aquifer, consists of the Peoria/Roxanna loess, which is characterized by medium to very stiff silt with little clay and trace very fine- to fine-grained sand, and the Radnor till, which is characterized by silty clay with trace very fine- to coarse-grained sand and trace small gravel to hard clay with little silt, few very fine- to coarse-grained sand, and trace small gravel (Ramboll, 2021b). The most permeable portion of the uppermost aquifer is the shallow sand unit, a two- to seven-foot-thick sand zone located within the Radnor till. The shallow sand unit, which is encountered at a depth of 18-40 feet below ground surface (bgs), forms the primary conduit for horizontal migration of shallow groundwater near the BAB (Ramboll, 2021b). The Peoria/Roxanna loess has also been identified as a potential migration pathway. A confining unit composed of Pennsylvanian shaley siltstone and silty shale bedrock underlies the uppermost aquifer from approximately 26-46 feet bgs (top of bedrock; Ramboll, 2021b). The bedrock acts as an aquitard due to its low hydraulic conductivity (AECOM, 2016a; Ramboll, 2021b). The Hydrogeological Site Characterization Report prepared by Ramboll for the BAB (Ramboll, 2021b) provides more details regarding the hydrostratigraphic units in the vicinity of the BAB.

Near the BAB, shallow groundwater flows southwards through the uppermost aquifer toward an unnamed drainage channel, which leads to the Duck Creek Cooling Pond (Ramboll, 2021b). Groundwater flows horizontally rather than vertically through the uppermost aquifer because: (i) vertical hydraulic conductivities within the uppermost aquifer are several orders of magnitude lower than horizontal hydraulic conductivities, and (ii) the underlying shale bedrock acts as an aquitard (AECOM, 2016a; Ramboll, 2021b). Groundwater within the uppermost aquifer near the BAB flows into the Duck Creek Cooling Pond. No other potential groundwater transport pathways exist. Because the Duck Creek Cooling Pond serves as a sink for groundwater discharge in the area, shallow groundwater migration beneath or beyond the Duck Creek Cooling Pond is unlikely (Ramboll, 2021b).

Groundwater monitoring is ongoing at the BAB. The Hydrogeologic Site Characterization Report prepared by Ramboll for the BAB includes a summary of the groundwater data collected from BAB monitoring wells between 2015 and 2021 (Ramboll, 2021b).

1.1.5 Site Vicinity

The Duck Creek property is surrounded by agricultural fields, pastures, and forests (Ramboll, 2021b). There are several scenic, recreational, and historical areas within a few miles of the Site, including the Rice Lake State Fish and Wildlife Area (SFWA) to the east and the Orendorf and Rice Lake Terrace Archaeological Sites to the east/northeast. The Rice Lake SFWA, which spans approximately 5,660 acres, was established in 1945 and includes Big Lake, Slim Lake, Goose Lake, Pond Lily Lake, Lock Pond, and the Copperas Creek Management Unit. Popular activities at the Rice Lake SFWA include picnicking, fishing, camping, and hunting (IDNR, c. 2008). The Orendorf Archaeological Site, which was added to the National Register of Historic Places in 1977 (National Park Service, 2021), encompasses at least four distinct Middle Mississippian settlement areas with known trade and migration linkages to the Mississippian city of Cahokia, the largest archaeological site in North America (Archaeological Institute of America, 2021; Emerson, c. 2016). The Rice Lake Terrace Archaeological Site is located south of the Orendorf Archaeological Site on the shore of Rice Lake and includes evidence of Archaic (8000-500 BC), Woodland (500 BC-1000 AD) and Mississippian (1000-1673 AD) cultures (Archaeological Institute of America, 2021). In addition to the sites listed above, there are several high-value scenic and recreational areas within 10 miles downstream along the Illinois River, including the Spring Lake SFWA, the Sand Ridge State Forest, the Chautauqua National Wildlife Refuge, and the Emiquon Preserve.

1.2 Part 845 Regulatory Review and Requirements

Title 35, Part 845, of the Illinois Administrative Code (IAC; IEPA, 2021a) requires the development of a Closure Alternatives Analysis (CAA) prior to undertaking closure activities at certain CCR-containing surface impoundments in the State of Illinois. Section 2 of this report presents a CAA for the GMF pursuant to requirements under IAC Section 845.710. Section 3 of this report presents a CAA for the BAB. The goal of a CAA is to holistically evaluate each potential closure scenario with respect to a wide range of factors, including the efficiency, reliability, and ease of implementation of the closure scenario; its potential positive and negative short- and long-term impacts on human health and the environment; and its ability to address concerns raised by residents (IEPA, 2021a). A CAA is a decision-making tool that is designed to aid in the selection of an optimal closure alternative for the impoundments at a site.

2 Closure Alternatives Analysis – GMF

2.1 Closure Alternative Descriptions (IAC Section 845.710(c))

This section of the report presents a CAA for the GMF pursuant to requirements under IAC Section 845.710 (IEPA, 2021a). Gradient evaluated three closure scenarios: Closure-in-Place (CIP), Closure-by-Removal with On-Site CCR Disposal (CBR-Onsite), and Closure-by-Removal with Off-Site CCR Disposal (CBR-Offsite). Sections 2.1.1 through 2.1.3 describe the CIP, CBR-Onsite, and CBR-Offsite closure scenarios. These scenarios are based on information conveyed to Gradient by Golder (Appendix B; Golder, 2022c,d).

2.1.1 Closure-in-Place

Under the CIP scenario, the gypsum in the GMF will be consolidated in the northern portion of the impoundment and the impoundment will be capped with a new cover system. This scenario includes the following work elements for the closure of the GMF (Appendix B; Golder, 2022c):

- Elimination of free liquids by solidifying waste residues, as needed, or by removing liquid waste, including *via* pumping. Water will be managed in accordance with the NPDES permit for the facility.
- Dewatering of the upper gypsum layer within the northern portion of the GMF *via* trenches and sumps in order to support construction traffic across the surface.
- Construction of a new internal berm with an east-west orientation. The upstream slope of the berm will be lined with a new composite liner, which will tie into the existing primary composite liner system for the facility.
- Consolidation of all gypsum in an approximately 15-acre area north of the berm. All gypsum from the area south of the berm will be removed and placed north of the berm.
- Contouring and grading to promote stormwater management.
- Construction of an alternative cover system north of the berm that will consist of a 40-mil linear low-density polyethylene (LLDPE) geomembrane layer, a geocomposite layer, and 24 inches of protective soil cover suitable for supporting vegetative growth. The performance of this alternative cover system relative to a default cover is presented in Geosyntec Consultants (2022).
- Removal of the geosynthetic components of the dual-composite liner system south of the berm. Liner system materials will be disposed of in the northern portion of the capped GMF. Soil materials located between these components will be removed and stockpiled south of the GMF.
- Excavation of a surface water channel south of the GMF, including removal of sections of the GMF Recycle Pond perimeter dike, in order to promote passive stormwater drainage to the southeast of the impoundment.
- Long-term (post-closure) monitoring and maintenance, including:
    - Groundwater monitoring at the impoundment for a minimum of 30 years, or until groundwater protection standards (GWPSs) are achieved.

- Post-closure care for the final cover system, including cap inspections, mowing, and maintenance, for a minimum of 30 years.

This CIP plan meets all closure requirements of Part 845.750 (Golder, 2022a). Key closure elements that address the Part 845 closure requirements are summarized below. Further details are provided in the Closure Plan (Golder, 2022a).

- An alternative cover system will be installed over the CCR that remains in the GMF. The cover, consisting of a 40-mil LLDPE geomembrane low-permeability layer, a geocomposite cushion if needed, and 24 inches of soil, will minimize vertical infiltration of precipitation into the basin [Part 845.750(a)(1)].
- The final cover system will be crowned with 4% slopes to direct surface water away from the facility. Beyond the final cover system, channels will direct surface water away from the GMF to existing site drainages [Part 845.750(a)(2)].
- Impounded water will be removed from the GMF and managed in accordance with the NPDES permit for the facility [845.750(b)(1) and 845.750(b)(2)].
- Free liquids in the CCR will be eliminated by removing liquid wastes or solidifying the remaining wastes. Trenches will facilitate gravity drainage of liquid wastes in the gypsum and direct the liquid wastes to sumps. Other engineering measures may be considered to facilitate removal of liquid wastes and stabilization of wastes. Sumps will be used to collect liquid wastes which will be managed in accordance with the NPDES permit for the site [845.750(b)(1) and 845.750(b)(2)].

As an additional consideration, the proposed alternative cover system and the existing bottom liner system will provide complete encapsulation of the CCR, physically isolating it from contact with surrounding soils, groundwater, surface water and the atmosphere. Lateral infiltration of groundwater into the basin will also be controlled due to the presence of the existing dual-composite bottom liner system which will prevent groundwater from flowing into the basin (Golder, 2022a).

Approximately 85,000 cubic yards of gypsum will be relocated from south of the berm to north of the berm under this scenario (an assumed travel distance of 0.2 miles; Appendix B). Hauling will also be required to relocate 17 acres of geosynthetic liner materials north of the berm and 55,700 cubic yards of liner soils excavated from south of the berm to a stockpile located south of the closure footprint (an assumed travel distance of 0.2 miles).

Soil required for construction of the new berm and the final GMF cover system will be sourced from a location on the property; a borrow location will not need to be established off-Site. The selected borrow soil location is approximately 0.4 miles north of the GMF (Appendix B). The estimated volume of borrow soil required for GMF closure *via* CIP is 76,100 cubic yards (Appendix B). Additionally, approximately 81,000 cubic yards of soil will be excavated during construction of the stormwater channel south of the GMF during Site restoration. This material will be hauled to the borrow soil location for stockpiling (Appendix B).

Under the CIP scenario, the expected duration of major construction activities at the GMF is 12-24 months (Appendix B; Golder, 2022c). Key parameters for the CIP scenario are shown in Table 2.1.

Table 2.1 Key Parameters for the Closure-in-Place Scenario – GMF

Parameter	Value	Notes
Surface Area of Impoundment (acres)	31	
Surface Area of Final Cover System (acres)	15	Area north of the proposed berm.
In-Place Volume of CCR (CY)	400,000	CCR contained in the GMF is gypsum from flue gas desulfurization.
Volume of CCR to be Relocated (CY)	85,000	Amount of gypsum to be removed from the southern portion of the GMF and relocated north of the berm.
Travel Distance for Relocation of CCR (miles)	0.2	
Required Volume of Borrow Soil (CY)	76,100	Required for berm construction and the final cover system.
Volume of Material Stockpiled On-Site (CY)	137,000	Excavated during construction of the stormwater channel and removal of existing liner system components south of the berm (Site restoration).
Distance to the Borrow Soil Location (miles)	0.4	
Duration of Construction Activities (months)	12-24	
Total On-Site Labor Hours for Major Construction[a]	14,600	
Required On-Site Hauling Truckloads (Loaded)	10,200	
Required Off-Site Hauling Truckloads (Loaded)	0	
Required On-Site Hauling Miles	6,270	
Required Off-Site Hauling Miles	0	

Notes:
CCR = Coal Combustion Residual; CY = Cubic Yards; GMF = Gypsum Management Facility.
Sources: Appendix B; Golder (2022c).
(a) Major construction is defined as any operation occurring on-Site that requires one or more of the following equipment types: breaker, compactor, dozer, excavator, haul truck, loader, and telehandler. Labor is not included if it is limited to the use of one or more of the following equipment types: diesel pump, flatbed truck, generator, miscellaneous, pickup truck, and seed drill or hydroseeder. Labor performed by haul truck operators is only included in calculations if the hauling occurs on-Site. Workers assigned to relevant activities are assumed to work full-time (40 hours per week) on that activity for the duration of the activity.

2.1.2 Closure-by-Removal with On-Site Disposal

Under the CBR-Onsite scenario, CCR and existing liner system materials will be excavated from the GMF and sent to the on-Site landfill for final disposal. Excavation at the GMF will include all of the gypsum in the impoundment and the existing dual-composite liner system. The gypsum excavated from the GMF is currently expected to be hauled to the on-Site landfill. IPRG will also continue to evaluate potential opportunities for beneficial re-use of CCR excavated from the GMF as an alternative to disposal. The primary composite liner system, the leachate collection and removal system, the geosynthetic components of the secondary composite liner system, and the 3-foot compacted clay layer beneath the GMF will also be hauled to the on-Site landfill for disposal.

This scenario includes the following work elements for the closure of the GMF (Appendix B; Golder, 2022c,d):

- Free water removal and dewatering of the GMF.
- Excavation and transport of CCR and liner system materials to the on-Site landfill, as detailed above. All areas affected by CCR releases will be decontaminated, including potential over-excavation below the bottom of the liner system.

- Grading and filling to convey runoff away from the impoundments. This process will include excavation of a surface water channel south of the GMF and removal of sections of the GMF Recycle Pond perimeter dike in order to promote passive stormwater drainage to the southeast of the impoundment.
- Site restoration, including revegetation with native grasses.
- Monitoring at the impoundments for at least 3 years, or until GWPSs are achieved.

Approximately 31 acres of geosynthetic liner system materials, 283,000 cubic yards of earthen liner system materials, 50,000 cubic yards of subsoil overexcavation, and 400,000 cubic yards of gypsum will be excavated from the GMF and hauled to the on-Site landfill for disposal. The on-Site landfill is located approximately 1.2 miles north of the GMF (Appendix B). Excavated materials will be hauled to the landfill using off-road haul trucks with an assumed capacity of 34 cubic yards. The on-Site landfill currently has approximately 445,000 cubic yards of available capacity. Of this, approximately 7,000 cubic yards may be used for the disposal of materials associated with excavation of the BAB. Thus, the on-Site landfill does not have sufficient capacity to receive all of the CCR and liner materials from the GMF that are slated for disposal under the CBR-Onsite scenario. Expansion of the landfill would thus be necessary. The on-Site landfill is already permitted for a potential expansion, which could create an additional 2-acre landfill cell (Appendix B). This scenario meets the requirements of IAC Section 845.710(c)(2) (IEPA, 2021a), which requires an assessment be included in the CAA of whether the Site has an on-Site landfill with available capacity or whether an on-Site landfill can be constructed.

No borrow soil is required for grading and filling the GMF under the CBR-Onsite scenario (Appendix B). However, approximately 9,700 cubic yards of compacted clay is required for landfill expansion; this material will be hauled in from the borrow site, which is located 0.7 miles from the landfill. Finally, approximately 86,000 cubic yards of soil will be excavated during construction of the stormwater channel south of the GMF during Site restoration. This material will be hauled to the borrow soil location for stockpiling (Appendix B).

Under the CBR-Onsite scenario, the expected duration of major construction activities is expected to be 24-36 months at the GMF (Appendix B; Golder, 2022c,d). Key parameters for the CBR-Onsite scenario are shown in Table 2.2.

Table 2.2 Key Parameters for the Closure-by-Removal with On-Site Disposal Scenario – GMF

Parameter	Value	Notes
Surface Area of Impoundment (acres)	31	
In-Place Volume of CCR (CY)	400,000	CCR contained in the GMF is gypsum from flue gas desulfurization.
Volume of Earthen Components of Existing Liner System (CY)	283,000	
Distance to the On-Site Landfill (miles)	1.2	
Required Volume of Borrow Soil (CY)	9,700	Required for landfill expansion.
Volume of Soil Stockpiled at Borrow Soil Location (CY)	86,000	Soil excavated south of the impoundment during construction of the stormwater channel (Site restoration).
Distance to the Borrow Soil Location from the GMF (miles)	0.4	
Distance to the Borrow Soil Location from the On-Site Landfill (miles)	0.7	
Duration of Construction Activities (months)	24-36	
Total On-Site Labor Hours for Major Construction[a]	26,400	
Required On-Site Hauling Truckloads (Loaded)	28,000	
Required Off-Site Hauling Truckloads (Loaded)	0	
Required On-Site Hauling Miles	62,100	
Required Off-Site Hauling Miles	0	

Notes:
CCR = Coal Combustion Residual; CY = Cubic Yards; GMF = Gypsum Management Facility.
Sources: Appendix B; Golder (2022c,d).
(a) Major construction is defined as any operation occurring on-Site that requires one of the following equipment types: breaker, compactor, dozer, excavator, haul truck, loader, and telehandler. Labor is not included if it is limited to use of the following equipment types: diesel pump, flatbed truck, generator, miscellaneous, pickup truck, and seed drill or hydroseeder. Labor performed by haul truck operators is only included in calculations if the hauling occurs on-Site. Workers assigned to relevant activities are assumed to work full-time (40 hours per week) on that activity for the duration of the activity.

2.1.3 Closure-by-Removal with Off-Site Disposal

Under the CBR-Offsite scenario, CCR and existing liner system materials will be excavated from the GMF and sent to an off-Site landfill for final disposal. All of the gypsum in the GMF and the primary composite liner system, the leachate collection and removal system, the geosynthetic components of the secondary composite liner system, and the 3-feet-thick compacted clay layer underlying the GMF will be hauled to the off-Site landfill for disposal (Golder, 2022c,d). IPRG will also continue to evaluate potential opportunities for beneficial re-use of CCR excavated from the GMF as an alternative to disposal.

Excavated materials will be sent to the Peoria City-County Landfill in Brimfield, Illinois (11501 W Cottonwood Road), which is approximately 33 miles from the Site (Appendix B). As is described below in Section 2.4.5, it is possible that the Peoria City-County Landfill will have to be expanded in order to accept all of the CCR and liner materials.

IAC Section 845.710(c)(1) requires Closure-by-Removal (CBR) alternatives to consider multiple methods for transporting CCR off-site, including rail, barge, and trucks. Golder evaluated the feasibility of transporting CCR to the off-Site landfill *via* rail or barge and found that neither option is viable at this Site. Existing loadout facilities, which would facilitate off-Site rail or barge CCR transport, are not present on the property, and the construction of new loadout facilities is considered infeasible. Only transport *via* on-road haul trucks (with a 16.5-cubic-yard capacity) is considered feasible for CBR-Offsite.

The local availability and use of natural gas-powered trucks, or other low-polluting trucks, will be evaluated prior to the start of construction.

The work elements included in this scenario are largely the same as those listed above in Section 2.1.2 for the CBR-Onsite scenario (Appendix B; Golder, 2022c,d):

- Free water removal and dewatering of the GMF.
- Excavation and transport of CCR and liner system materials to the off-Site landfill, as detailed above. All areas affected by CCR releases will be decontaminated, including potential over-excavation below the bottom of the liner system.
- Grading and filling to convey runoff away from the impoundments. This process will include excavation of a surface water channel south of the GMF and removal of sections of the GMF Recycle Pond perimeter dike in order to promote passive stormwater drainage to the southeast of the impoundment.
- Site restoration, including revegetation with native grasses.
- Monitoring at the impoundments for at least 3 years, or until GWPSs are achieved.

Approximately 31 acres of geosynthetic liner system materials, 283,000 cubic yards of earthen liner system materials, 50,000 cubic yards of subsoil overexcavation, and 400,000 cubic yards of gypsum will be excavated from the GMF and hauled to the off-Site landfill for disposal. No borrow soil is required for grading and filling of the GMF under the CBR-Offsite scenario (Appendix B). Finally, approximately 86,000 cubic yards of soil will be excavated during construction of the stormwater channel south of the GMF during Site restoration. This material will be hauled to the borrow soil location for stockpiling (Appendix B).

Under the CBR-Offsite scenario, the expected duration of major construction activities is expected to be 36-48 months at the GMF (Appendix B; Golder, 2022c,d). Key parameters for the CBR-Offsite scenario are shown in Table 2.3.

Table 2.3 Key Parameters for the Closure-by-Removal with Off-Site Disposal Scenario – GMF

Parameter	Value	Notes
Surface Area of Impoundment (acres)	31	
In-Place Volume of CCR (CY)	400,000	CCR contained in the GMF is gypsum from flue gas desulfurization.
Volume of Earthen Components of Existing Liner System (CY)	283,000	
Distance to the Off-Site Landfill (miles)	33	Peoria City-County Landfill in Brimfield, IL.
Required Volume of Borrow Soil (CY)	0	
Volume of Soil Stockpiled at Borrow Soil Location (CY)	86,000	Soil excavated south of the impoundment during construction of the stormwater channel (Site restoration).
Distance to the Borrow Soil Location (miles)	0.4	
Duration of Construction Activities (months)	36-48	
Total On-Site Labor Hours for Major Construction[a]	35,700	
Required On-Site Hauling Truckloads (Loaded)	2,980	
Required Off-Site Hauling Truckloads (Loaded)	50,900	
Required On-Site Hauling Miles	2,380	
Required Off-Site Hauling Miles	3,320,000	

Notes:
CCR = Coal Combustion Residual; CY = Cubic Yards; GMF = Gypsum Management Facility.
Sources: Appendix B; Golder (2022c,d).
(a) Major construction is defined as any operation occurring on-Site that requires one of the following equipment types: breaker, compactor, dozer, excavator, haul truck, loader, and telehandler. Labor is not included if it is limited to use of the following equipment types: diesel pump, flatbed truck, generator, miscellaneous, pickup truck, and seed drill or hydroseeder. Labor performed by haul truck operators is only included in calculations if the hauling occurs on-Site. Workers assigned to relevant activities are assumed to work full-time (40 hours per week) on that activity for the duration of the activity.

2.2 Long- and Short-Term Effectiveness of Closure Alternative (IAC Section 845.710(b)(1))

2.2.1 Magnitude of Reduction of Existing Risks (IAC Section 845.710(b)(1)(A))

This section of the report addresses the potential risks to human and ecological receptors due to exposure to CCR-associated constituents in groundwater or surface water. Gradient has performed a Human Health and Ecological Risk Assessment for the Site (Appendix A of this report), which provides a detailed evaluation of the magnitude of existing risks to human and ecological receptors associated with the GMF. This report concluded that there are no current unacceptable risks to any human or ecological receptors. Because groundwater concentrations are expected to remain stable and/or decline under all closure scenarios, there will also be no unacceptable risks to human health or the environment during or following closure at the GMF. Thus, there is no current risk or future risk under any closure scenario at the GMF, and the magnitude of reduction of existing risks is the same under all scenarios.

2.2.2 Likelihood of Future Releases of CCR (IAC Section 845.710(b)(1)(B))

This section of the report quantifies the risk of future CCR releases that may occur during dike failure and storm-related events.

Storm-Related Releases and Dike Failure During Flood Conditions

Engineering analyses show that the existing dikes at the GMF are expected to remain stable under static, seismic, and flood conditions (AECOM, 2016b; Burns & McDonnell, 2021a). Prior to closure (*i.e.*, under current conditions), the risk of dike failure occurring during floods or other storm-related events is therefore minimal. Engineering analyses similarly show that the current risk of sudden CCR releases occurring at the GMF due to overtopping during flood conditions is minimal (AECOM, 2016c; Burns & McDonnell, 2021a). Post-closure, the risks of overtopping and dike failure occurring at the GMF will be even smaller than they are currently. Under the CIP scenario, all free water will be pumped from the GMF and a new cover system will be installed, which will include 24 inches of soil and a geomembrane liner. Construction activities at the GMF under the CIP scenario will also result in improved stormwater management. Relative to current conditions, this cover system and the associated stormwater management improvements will provide increased protection against berm and surface erosion, groundwater infiltration, and other adverse effects that could potentially trigger a dike slope failure event. Under the CBR-Onsite and CBR-Offsite scenarios, all of the CCR in the GMF will be excavated and relocated, eliminating the risk of a sudden CCR release occurring under a dike failure or flood overtopping event. In summary, there is minimal risk of sudden CCR releases occurring during or prior to closure (*i.e.*, under current conditions). Additionally, post-closure there is minimal risk of sudden CCR releases occurring under the CIP scenario, and there is no risk of sudden CCR releases occurring under the CBR-Onsite or CBR-Offsite scenarios.

Dike Failure Due to Seismicity

Sites in Illinois may be subject to seismic risks arising from the Wabash Valley Seismic Zone and the New Madrid Seismic Zone (IEMA, 2020). However, the Duck Creek property does not lie within a seismic impact zone. The property is also believed to have a "low risk level" for seismic risks based on the 2018 United States Geological Survey (USGS) National Seismic Hazard Map. Additionally, the GMF does not lie within 200 feet of an active fault or fault damage zone at which displacement has occurred within the current geological epoch (*i.e.*, within the last ~11,650 years; Burns & McDonnell, 2021b,c; Haley & Aldrich, Inc., 2018a,b). The nearest known fault is the Sicily Fault, which is located about 66 miles southeast of the GMF. The Sicily Fault does not have known recent activity (Haley & Aldrich, Inc., 2018a,b). Thus, the risk of dike failure occurring during or following closure activities due to seismic activity is exceedingly low at the GMF.

2.2.3 Type and Degree of Long-Term Management, Including Monitoring, Operation, and Maintenance (IAC Section 845.710(b)(1)(C))

The long-term operation and management plans for the GMF are described in Section 2.1 for each closure scenario. In summary, under the CIP scenario, the GMF will undergo monitoring for at least 30 years post-closure, or until such time as GWPSs are achieved. The post-closure care plan under the CIP scenario additionally includes periodic inspections and mowing and maintenance of the final cover system for the GMF. Under the CBR-Onsite and CBR-Offsite scenarios, the GMF will undergo monitoring for 3 years post-closure, or until such time as GWPSs are achieved.

2.2.4 Short-Term Risks to the Community or the Environment During Implementation of Closure (IAC Section 845.710(b)(1)(D))

2.2.4.1 Worker Risks

Best practices will be employed during construction in order to ensure worker safety and comply with all relevant regulations, permit requirements, and safety plans. However, it is impossible to completely eliminate risks to workers during construction activities, both on- and off-Site. On-Site accidents include injuries and deaths arising from the use of heavy equipment and/or earthmoving operations during construction activities. Off-Site accidents include injuries and deaths due to vehicle accidents during labor and equipment mobilization and demobilization, material deliveries, and the hauling of CCR and liner system materials to the on-Site landfill and the off-Site landfill.

Risk of Worker Accidents Occurring On-Site

For the GMF, three closure scenarios were considered: CIP, CBR-Offsite, and CBR-Onsite. Based on labor requirements reported in Appendix B of this report, Gradient estimates that 14,600 total on-Site labor hours are required for major construction activities under the CIP scenario, 26,400 on-Site labor hours are required for major construction activities under the CBR-Onsite disposal scenario, and 35,700 on-Site labor hours are required for major construction activities under the CBR-Offsite scenario. The CIP scenario therefore requires the smallest number of on-Site labor hours for major construction activities across all scenarios.

The United States Bureau of Labor Statistics (US BLS) (US DOL, 2020a,b) provides an estimate of the hourly fatality and injury rates for construction workers. Based on the accident rates reported by US BLS and the on-Site labor hours reported above, we estimate that approximately 0.17 worker injuries and 0.0011 worker fatalities will occur on-Site under the CIP scenario due to major construction activities at the GMF (Table 2.4). Approximately 0.30 worker injuries and 0.0020 worker fatalities are expected to occur under the CBR-Onsite scenario, and approximately 0.41 worker injuries and 0.0027 worker fatalities are expected to occur under the CBR-Offsite scenario (Table 2.4). Thus, the expected number of worker accidents occurring on-Site due to major construction activities is smallest under the CIP scenario and is largest under the CBR-Offsite scenario. Note that the calculations presented here focus on major construction activities (*e.g.*, excavation, loading, and hauling). They therefore do not account for the additional accidents that could occur on-Site during less intensive construction activities (*e.g.*, surveying, erosion control, and hydroseeding).

Table 2.4 Expected Number of On-Site Worker Accidents Under Each Closure Scenario – GMF

Closure Scenario	Injuries	Fatalities
CIP	0.17	0.0011
CBR-Onsite	0.30	0.0020
CBR-Offsite	0.41	0.0027

Notes:
CBR-Offsite = Closure-by-Removal with Off-Site CCR Disposal; CBR-Onsite = Closure-by-Removal with On-Site CCR Disposal; CIP = Closure-in-Place; GMF = Gypsum Management Facility.

Concurrently with closure activities, a utility-scale solar facility will be constructed on the Duck Creek Site. The simultaneous pursuit of closure-related construction and solar facility construction may lead to significant traffic congestion on Site access roads, resulting in greater overall risks to workers than would result from closure or solar re-development alone. Conflicts are particularly likely to arise during GMF closure (relative to BAB closure), because it is expected to take 1-4 years to complete and involve major

earthmoving operations. For the GMF, the CIP scenario requires less total hauling activity than either of the two CBR scenarios (Tables 2.1-2.3). The CIP scenario can also be completed within a shorter time frame than the two CBR scenarios (12-24 months *versus* 24-48 months). The CIP scenario is therefore expected to result in less congestion on Site access roads during Site re-development – and, hence, a smaller increase in the risks to workers – than either the CBR-Onsite or CBR-Offsite scenarios.

Risk of Worker Accidents Occurring Off-Site

The CBR-Offsite scenario is the only scenario which requires any off-Site hauling. Under the CBR-Offsite scenario, 3,320,000 vehicle travel miles are required to haul excavated materials from the GMF to the off-Site landfill (Tables 2.1-2.3). The United States Department of Transportation (US DOT, 2020) provides an estimate of the expected number of fatalities and injuries "per vehicle mile driven" for drivers and passengers of large trucks. Based on US DOT's statistics, an estimated 0.42 injuries and 0.0096 fatalities are expected to occur to drivers and passengers of haul trucks due to off-Site hauling under the CBR-Offsite scenario during closure of the GMF (Table 2.5).

Table 2.5 Expected Number of Off-Site Worker Accidents Due to Hauling Under Each Closure Scenario – GMF

Closure Scenario	Injuries	Fatalities
CIP	0	0
CBR-Onsite	0	0
CBR-Offsite	0.42	0.0096

Notes:
CBR-Offsite = Closure-by-Removal with Off-Site CCR Disposal; CBR-Onsite = Closure-by-Removal with On-Site CCR Disposal; CIP = Closure-in-Place; Gypsum Management Facility.

These estimates reflect the minimum number of worker accidents that are likely to occur off-Site under each scenario, because they do not account for the additional vehicle accidents that may occur during non-hauling activities such as labor mobilization and demobilization, equipment mobilization and demobilization, and material deliveries. The vehicle mileages associated with these off-Site activities are not known. However, the mileages associated with these activities are expected to scale with the duration and intensity of the planned construction activities under each scenario. The CIP scenario is the closure scenario with the shortest expected duration of construction activities, the smallest required volume of CCR dewatering and handling, the least amount of total on-Site labor hours for major construction, and the least amount of required hauling truckloads (Tables 2.1-2.3). This scenario is therefore also likely to have the smallest amount of off-Site activity due to labor and equipment mobilization/demobilization and material deliveries – and, hence, the smallest number of off-Site vehicle accidents arising from these activities.

Taking into account both (i) accidents occurring on-Site due to major construction activities and (ii) accidents occurring off-Site due to hauling, a minimum of 0.17 worker injuries and 0.0011 worker fatalities are expected to occur during GMF closure under the CIP scenario. An estimated 0.30 worker injuries and 0.0020 worker fatalities are expected to occur during GMF closure under the CBR-Onsite scenario, and an estimated 0.84 worker injuries and 0.012 worker fatalities are expected to occur during GMF closure under the CBR-Offsite scenario. Thus, for the GMF, the overall risks to workers are likely to be highest under the CBR-Offsite scenario and lowest under the CIP scenario.

2.2.4.2 Community Risks

Accidents

Vehicle accidents that occur off-Site can result in injuries or fatalities among community members, as well as workers. Based on the accident statistics for large trucks reported by US DOT (2020) and the off-Site haul truck mileages reported above for the GMF, haul truck accidents could result in an estimated 1.2 injuries and 0.044 fatalities among community members (*i.e.*, people involved in haul truck accidents that are neither haul truck drivers nor passengers, including pedestrians, drivers of other vehicles, *etc.*) under the CBR-Offsite scenario due to hauling of excavated materials from the GMF (Table 2.6). In contrast, no fatalities or injuries are expected to occur among community members under the CBR-Onsite or CIP scenarios due to haul truck accidents, because borrow soil will be taken from a location on the property and any excavated materials will be hauled to an off-Site landfill.

Table 2.6 Expected Number of Community Accidents Due to Hauling Under Each Closure Scenario – GMF

Closure Scenario	Injuries	Fatalities
CIP	0	0
CBR-Onsite	0	0
CBR-Offsite	1.2	0.044

Notes:
CBR-Offsite = Closure-by-Removal with Off-Site CCR Disposal; CBR-Onsite = Closure-by-Removal with On-Site CCR Disposal; CIP = Closure-in-Place; GMF = Gypsum Management Facility.

In addition to impacts due to off-Site hauling, all scenarios may have off-Site impacts due to labor mobilization and demobilization, equipment and vehicle mobilization and demobilization, and material deliveries. As described above (Risk of Worker Accidents Occurring Off-Site), the CIP scenario is likely to require the smallest amount of off-Site activity due to these off-Site vehicle uses – and, hence, the smallest number of off-Site vehicle accidents arising from these activities – across all scenarios evaluated for the GMF.

Traffic

Haul routes are expected to use major arterial roads and highways wherever possible, which will reduce the incidence of traffic. However, the heavy use of local roads for construction operations may result in traffic near the Site and, in the case of the CBR-Offsite scenario, the off-Site landfill.

Traffic may increase temporarily around the Site under all three closure scenarios due to the daily arrival and departure of the workforce, equipment mobilization/demobilization, and material deliveries. However, these impacts are expected to largely occur at the beginning or end of each work day (for the arrival/departure of the work force), at the beginning or end of the construction period (for equipment mobilization/demobilization), and at specific times throughout the construction period (for material deliveries). These impacts will therefore likely be less disruptive to community members than the constant and steady movement of haul trucks to and from the Site under the CBR-Offsite scenario.

Under the CBR-Offsite scenario, Golder estimates that approximately 50,900 truckloads will be required to transport excavated materials from the GMF to the off-Site landfill over 1,220 hauling days (Appendix B). Assuming a 10-hour work day, 6 work days per week, and 26 work days per month, a haul truck would therefore need to pass a given location near the Site once every 7.2 minutes on average for the duration of excavation activities under the CBR-Offsite scenario for the GMF. Thus, traffic demands are

considerable. This level of traffic (one truck passing a location approximately once every 7.2 minutes) could potentially cause traffic delays on local roads and cause damage to local roadways. It could also cause delays in the re-development of the Site for use in utility-scale solar generation.

Noise

Construction generates a great deal of noise, both in the vicinity of the Site and along haul routes. In a closure impact analysis performed by the Tennessee Valley Authority (TVA, 2015), the authors found that "[T]ypical noise levels from construction equipment used for closure are expected to be 85 dBA or less when measured at 50 ft. These types of noise levels would diminish with distance … at a rate of approximately 6 dBA per each doubling of distance and therefore would be expected to attenuate to the recommended EPA noise guideline of 55 dBA at 1,500 ft." Because there are no residences or businesses within 1,500 feet of any of the construction areas on the Site (the GMF, the proposed borrow site, and the on-Site landfill), we do not anticipate that any residences or businesses will be adversely impacted by noise pollution at the Site under any closure scenario. Moreover, although there are several scenic, recreational, and historical areas located within a few miles of the Site (the Rice Lake SFWA and the Orendorf and Rice Lake Terrace Archaeological Sites), there are no notable scenic or recreational areas located within 1,500 feet of any of the construction areas on the Site. Noise impacts are therefore expected to be relatively minor under all closure scenarios.

In addition to impacts in the immediate vicinity of the GMF, local roads near the Site and the off-Site landfill (CBR-Offsite scenario only) may experience noise pollution due to high volumes of truck traffic. As described above (Traffic), the construction schedule under the CBR-Offsite scenario requires haul trucks to pass by a given location every 7.2 minutes on average for 10 hours each day while excavation is occurring at the GMF. Dump trucks generate significant noise pollution, with noise levels of approximately 88 decibels or higher expected within a 50-foot radius of the truck (Exponent, 2018). This noise level is similar to the noise level of a gas-powered lawnmower or leaf blower (CDC, 2019). Decibel levels above 80 can damage hearing after 2 hours of exposure (CDC, 2019). In addition to haul truck impacts, noise pollution may also arise along local roads from the daily arrival and departure of the workforce, equipment mobilization/demobilization, and material deliveries. These impacts are expected to largely occur at the beginning or end of each work day (for the arrival/departure of the work force), at the beginning or end of the construction period (for equipment mobilization/demobilization), and at specific times throughout the construction period (for material deliveries); these impacts will therefore likely be less disruptive to community members than the constant and steady movement of haul trucks to and from the Site.

Air Quality

Construction can adversely impact air quality. Air pollution can occur both on-Site and off-Site (*e.g.*, along haul routes), potentially impacting workers as well as community members. With regards to construction activities, two categories of air pollution are of particular concern: equipment emissions and fugitive dust. The equipment emissions of greatest concern are those found in diesel exhaust. Most construction equipment is diesel-powered, including the dump trucks used to haul material to and from the Site. Diesel exhaust contains hundreds of air pollutants, including nitrogen oxides (NO_x), particulate matter (PM), carbon monoxide (CO), and volatile organic compounds (VOCs) (Hesterberg *et al*., 2009; Mauderly and Garshick, 2009). Fugitive dust, another major air pollutant at construction sites, is generated by earthmoving operations and other soil- and CCR-handling activities. Along haul routes, an additional source of fugitive dust is road dust along unpaved dirt roads. Careful planning and the use of Best Management Practices (BMPs) such as wet suppression are used to minimize and control fugitive dust during construction activities; however, it is not possible to prevent dust generation entirely.

The air pollutant mass released under a given closure scenario will be proportional to the expected duration and intensity of construction activities under that scenario. As initially described in Section 2.2.4.1 (Worker Risks), the CIP scenario is the GMF closure scenario with the shortest expected duration of construction activities, the smallest required volumes of CCR dewatering and handling, the least amount of total on-Site labor hours for major construction, and the least amount of required hauling truckloads. This scenario is therefore likely to result in the least amount of air emissions of the three closure scenarios.

Environmental Justice

The State of Illinois defines environmental justice (EJ) communities to be those communities with a minority population above twice the state average and/or a total population below twice the state poverty rate (IEPA, 2019). Relative to other communities, EJ communities experience an increased risk of adverse health impacts due to environmental pollution and other factors associated with remediation activities (US EPA, 2016).

As shown in a map of EJ communities throughout the state (Figure 2.1; IEPA, 2019), the on-Site landfill, the borrow site, and a portion of the GMF are all located within the one-mile buffer zone of the nearest EJ community (near Canton). Due to its close proximity to the Site, the EJ community near Canton may be disproportionately impacted by air emissions, traffic, accidents and other factors arising from various closure activities occurring on or near the Site. Activities occurring near the GMF, the borrow site, and the on-Site landfill may have particularly negative impacts. Unfortunately, each of the evaluated closure scenarios requires significant construction activity in at least one of these three on-Site areas.

In addition to impacts arising from construction activity on or near the Site, EJ communities may be also impacted by off-Site activities, including the hauling of CCR and liner materials from the Site to the off-Site landfill, labor and equipment mobilization/demobilization, and material deliveries. Unfortunately, in addition to being located near the on-Site landfill, the borrow site, and the GMF, the EJ community near Canton is also located along the three primary haul routes from the Site to the off-Site landfill suggested by Google Maps (Google LLC, 2021). In summary, due to both on-Site and off-Site activities, all possible closure scenarios are associated with potential negative impacts on the EJ community near Canton (Figure 2.1).

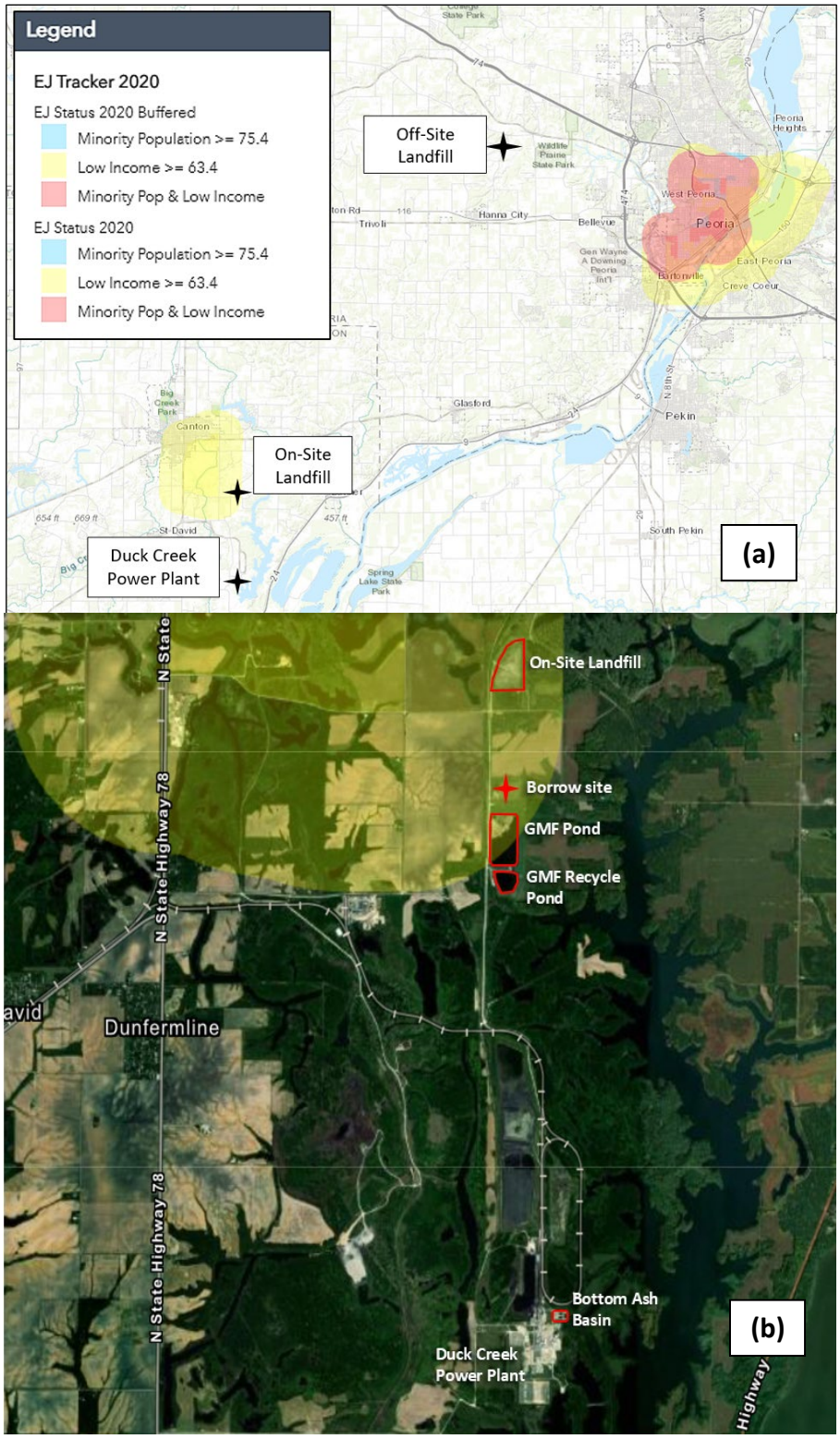

Figure 2.1 Environmental Justice Communities in the Vicinity of Site Features and the Off-Site Landfill – GMF. Adapted from IEPA (2019). (a) Regional map. (b) Site map.

Scenic, Historical, and Recreational Value

There are several scenic, recreational, and historical areas located within a few miles of the Site, including the Rice Lake SFWA and the Orendorf and Rice Lake Terrace Archaeological Sites (Google LLC, 2021; Ramboll, 2021b,c). However, there are no notable scenic or recreational areas located in the immediate vicinity of the GMF, the borrow soil location, or the on-Site landfill. The nearest scenic, recreational, or historical area is the Rice Lake SFWA, which is located over 2.5 miles from the GMF, the borrow soil location, and the on-Site landfill. We therefore do not expect construction activities at the Site to have any direct negative impacts on the scenic, historical, or recreational value of the areas listed above (due to, *e.g.*, noise, obstructions of the view, or restricted access), regardless of the closure scenario.

2.2.4.3 Environmental Risks

Greenhouse Gas Emissions

In addition to the air pollutants listed above in Section 2.2.4.2, construction equipment emits greenhouse gas emissions (GHGs), including carbon dioxide (CO_2) and possibly nitrous oxide (N_2O). The potential impact of each closure scenario on GHG emissions is similar to the potential impact of each closure scenario on other emissions from construction vehicles and equipment, as described above in Section 2.2.4.2. For the GMF, the CIP scenario has the shortest duration of construction activities and requires the least amount of CCR dewatering and handling; this scenario is therefore likely to have the lowest amount of predicted GHG emissions.

We did not quantify the carbon footprint of the approximately 31 acres of 40-mil LLDPE geomembrane liner required for the final GMF cover system under the CIP scenario, or the carbon footprint of the additional composite liner that will be required for the upstream slope of the berm to be constructed under this scenario (Appendix B). The carbon footprint of these geomembranes (*i.e.*, the fossil fuel emissions required to manufacture them) is an additional source of GHG emissions at the Site under the CIP scenario. Expansion of the on-Site landfill and the potential expansion of the off-Site landfill under the CBR-Onsite and CBR-Offsite scenarios would have an additional, unquantified carbon footprint due to the manufacture of geomembranes used in the expanded landfill liners.

Energy Consumption

Energy consumption at a construction site is synonymous with fossil fuel consumption, because the energy to power construction vehicles and equipment comes from the burning of fossil fuels. Fossil fuel demands considered in this analysis include the burning of diesel fuel during construction activities and the carbon footprint of manufacturing geomembrane textiles. Because GHG emission impacts and energy consumption impacts both arise from the same sources at construction sites, the trends discussed above with respect to GHG emissions also apply to the evaluation of energy demands. In summary, for the GMF, the energy requirements of construction are expected to be smallest under the CIP scenario. We did not quantify the energy demands of the geomembranes required for the construction of the final GMF cover system or the new GMF berm under the CIP scenario, the geomembranes required for the expansion of the on-Site landfill under the CBR-Onsite scenario, or, potentially, the geomembranes required for expansion of the off-Site landfill under the CBR-Offsite scenario.

The Duck Creek Site is slated for re-development as a utility-scale solar power generating facility. At the grid scale, solar generation will add energy back onto the grid and reduce reliance on non-renewable energy sources. In the short-term, closure activities at the Site may delay and obstruct these re-development efforts. The magnitude of expected delays will scale with the expected duration and

intensity of construction activities during closure. For the GMF, the CIP scenario requires less total hauling activity than either of the two CBR scenarios (Tables 2.1-2.3). The CIP scenario can also be completed within a shorter time frame than the two CBR scenarios (12-24 months *versus* 24-48 months). The CIP scenario is therefore expected to result in fewer delays to re-development than either the CBR-Onsite or CBR-Offsite scenarios.

Natural Resources and Habitat

Construction is likely to have a negative short-term impact on the natural resources and habitat in the vicinity of the GMF and the on-Site borrow soil location. For example, excavation of the impoundment and the borrow soil location could result in the destruction of some habitat that may currently overlie these areas under all closure scenarios. Closure could also result in long-term shifts in the habitat overlying the impoundment and the borrow soil location (*e.g.*, areas of the impoundment that are not currently grassland would be converted to grassland). Use of the on-Site and off-Site landfill under the CBR-Onsite and CBR-Offsite scenarios, in contrast, is not expected to result in significant habitat changes, because these landfills are already in use.

In addition to direct impacts on the existing habitat atop the impoundment and the borrow soil location, construction activities may have indirect impacts by causing alarm and escape behavior in wildlife near these locations. For the GMF, the duration of time over which the direct and indirect habitat impacts of construction will occur (*i.e.*, the duration of construction activities) is longest under the two CBR scenarios (24-48 months) and shortest under the CIP scenario (12-24 months). Thus, negative short-term impacts on natural resources and habitat are expected to be smallest under the CIP scenario.

The GMF is not located immediately adjacent to wetlands or notable surface water bodies, such as rivers or lakes (US FWS, 2021). For this reason, construction activities in the vicinity of the GMF are not expected to have a significant negative impact on any wetland or aquatic species (due to, *e.g.*, erosion and sediment runoff). Impacts are expected to be limited to terrestrial species. According to the Illinois Department of Natural Resources (IDNR) Natural Heritage Database and the United States Fish & Wildlife Service (US FWS) Environmental Conservation Online System, there are 11 state threatened species, 12 state endangered species, three federally threatened species, and one federally endangered species within Fulton County (Ramboll, 2021b,c). To our knowledge, however, no threatened or endangered species have been identified at the Site (Ramboll, 2021b,c). Based on the information that is currently available, we do not expect construction activities to have negative impacts on any threatened or endangered species.

2.2.5 Time Until Groundwater Protection Standards Are Achieved (IAC Sections 845.710(b)(1)(E) and 845.710(d)(2 and 3))

The primary groundwater migration pathway near the GMF is within the shallow sand unit within the uppermost aquifer. Groundwater flow in the shallow sand unit is generally in a northwest to southeast direction. Seasonal variation in groundwater levels at the GMF occurs and can result in groundwater elevation fluctuations of approximately 1-10 feet. There is no observable seasonal variation in groundwater flow direction at the GMF associated with these groundwater elevation changes. Groundwater flows toward the Duck Creek Cooling Pond, which is located approximately 2,100 feet east of the GMF (Ramboll, 2022).

Based on a statistical analysis and evaluation of potential exceedances, it was determined that there are no potential groundwater exceedances of applicable groundwater standards attributable to the GMF (Ramboll, 2022). However, a groundwater model was developed to evaluate whether groundwater

concentrations would maintain compliance with the GWPSs post-closure under the CIP scenario. For this evaluation, a groundwater flow model was developed and calibrated in MODFLOW. Contaminant transport was evaluated using MODPATH, and vertical percolation from the GMF into groundwater was evaluated using the HELP model (Ramboll, 2022).

The results of contaminant transport modeling *via* particle tracking for the CIP scenario at the GMF indicate that all particles will remain within the footprint of the GMF. Over a model-simulated period of 100 years following closure by CIP, the mean travel distance of all particles within the liner system and gypsum in the GMF was 0.29 feet horizontally and 0.03 feet vertically (Ramboll, 2022). Based on these modeling results, it was concluded that groundwater concentrations under the CIP scenario are expected to maintain compliance with the GWPSs well into the future (Ramboll, 2022).

2.2.6 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, Containment, or Changes in Groundwater Flow (IAC Section 845.710(b)(1)(F))

Section 2.2.1 evaluates potential risks to human and ecological receptors arising from the potential leaching of CCR-associated constituents from the GMF. Section 2.2.2 evaluates the potential for sudden CCR releases to occur at the GMF due to, *e.g.*, dike failure or overtopping during floods or other storm-related events. In summary, under all evaluated closure scenarios, there is no current or future risk to any human or ecological receptors associated with the GMF. Additionally, there is minimal current or future risk of overtopping due to flood conditions. Dike failure due to, *e.g.*, seismic activity and storm-related events is also exceedingly unlikely.

Section 2.2.4 evaluates several potential risks to human health and the environment during closure activities, including risks of accidents occurring among workers; risks to nearby residents and EJ communities related to accidents, traffic, noise, and air pollution; and risks to natural resources and wildlife. The findings from this section of the text are summarized in Table S.1.

2.2.7 Long-Term Reliability of the Engineering and Institutional Controls (IAC Section 845.710(b)(1)(G))

As described in Section 2.2.2, there is minimal risk of engineering or institutional failures leading to sudden releases of CCR from the GMF post-closure under the CIP scenario. Under the CBR-Onsite and CBR-Offsite scenarios, there is no risk of engineering or institutional failures leading to sudden releases of CCR post-closure. Additionally, there are no current or future unacceptable risks to any human or ecological receptors associated with the GMF under any of the closure scenarios (see Section 2.2.1 above). Moreover, reliable engineering and institutional controls (*e.g.*, a bottom liner, a leachate management system, and groundwater monitoring) will be implemented at the on-Site and off-Site landfills under the CBR-Onsite and CBR-Offsite scenarios. All of the evaluated closure scenarios are therefore reliable with respect to long-term engineering and institutional controls.

2.2.8 Potential Need for Future Corrective Action Associated with the Closure (IAC Section 845.710(b)(1)(H))

At this time, we do not anticipate a need for corrective action at the GMF under any closure scenario.

2.3 Effectiveness of the Closure Alternative in Controlling Future Releases (IAC Section 845.710(b)(2))

2.3.1 Extent to Which Containment Practices Will Reduce Further Releases (IAC Section 845.710(b)(2)(A))

The gypsum in the GMF currently poses no unacceptable risks to human health or the environment (Section 2.2.1). Because current conditions do not present a risk to human health or the environment, and groundwater concentrations are expected to remain stable and/or decline post-closure, there will also be no unacceptable risks to human health or the environment following closure of the impoundments, regardless of the closure scenario.

Section 2.2.2 discussed the potential for dike failure or flood overtopping to occur during or following closure activities, resulting in a sudden release of CCR. That analysis showed that there is minimal risk of CCR releases occurring at the GMF following closure under any closure scenario.

2.3.2 Extent to Which Treatment Technologies May Be Used (IAC Section 845.710(b)(2)(B))

At this time, we do not anticipate a need for the use of treatment technologies other than source control (*i.e.*, CIP, CBR-Onsite, and CBR-Offsite) at the GMF under any closure scenario.

2.4 Ease or Difficulty of Implementing Closure Alternative (IAC Section 845.710(b)(3))

2.4.1 Degree of Difficulty Associated with Constructing the Closure Alternative

CIP using a final cover system is a reliable and standard method for closing impoundments. However, dewatering and relocating saturated gypsum as part of closure activities at the GMF may be moderately challenging. Careful planning will be required to work safely on the wet gypsum within the GMF.

Excavation and landfilling of CCR is also a reliable and standard method for closing impoundments. However, relative to CIP, CBR-Onsite, and CBR-Offsite pose additional implementation difficulties due to higher earthwork volumes, higher dewatering volumes, and longer construction schedules. Dewatering the gypsum in the GMF prior to excavation will require considerable effort and time. Removal and disposal of the existing bottom liner geomembranes may also prove challenging during CBR activities. Specifically, it may be difficult to remove and handle the geomembranes. Additionally, the geomembranes may need to be decontaminated prior to disposal. Finally, the geomembranes may not be accepted for disposal at the off-Site landfill.

Hauling will be easier to implement under the CBR-Onsite scenario than under the CBR-Offsite scenario, due to less haul traffic on public roadways. Additionally, because the CBR-Offsite scenario involves hauling CCR off-Site (*i.e.*, intrastate travel), a higher level of dewatering will be required compared to the CBR-Onsite scenario. As described in Section 2.2.4.2 ("Community Risks"), off-Site hauling may also have detrimental community impacts due to an increased incidence of vehicle accidents, truck traffic, noise, and air pollution.

In addition to off-Site hauling, off-Site landfilling under the CBR-Offsite scenario may pose particular challenges. A disposal plan will need to be developed between IPRG and the owner/operator of the third-party landfill in order to outline acceptable waste conditions upon delivery, daily waste production rates, and the expected duration of the project. Off-Site landfilling may additionally raise issues related to the co-disposal of CCR and liner materials and other non-hazardous wastes. Finally, the construction schedule for excavation may be negatively impacted if, during the course of closure, it is determined that the off-Site landfill must be expanded in order to receive all of the materials excavated from the GMF.

2.4.2 Expected Operational Reliability of the Closure Alternative

The operational reliability of the CIP scenario, the CBR-Onsite scenario, and the CBR-Offsite scenario is expected to be similar. The GMF currently includes a bottom liner system, and CIP will utilize a final cover system that includes a geomembrane. Under the CIP scenario, the gypsum in the GMF will therefore be surrounded by an engineered containment system on the top, sides, and bottom. The CBR-Offsite and CBR-Onsite scenarios similarly involve placing the gypsum from the GMF in an engineered landfill system that has a bottom liner, leachate collection system, and final cover system, resulting in the gypsum being surrounded by an engineered containment system on the top, sides, and bottom. The operational reliability of all three closure scenarios is therefore expected to be similar for both impoundments. Moreover, high operational reliability is expected under all scenarios due to the full containment of CCR and liner materials.

2.4.3 Need to Coordinate with and Obtain Necessary Approvals and Permits from Other Agencies

Permits and approvals will be needed under all closure scenarios. Components of the three closure scenarios that are expected to require a permit include:

- A modification to the existing NPDES permit through IEPA to allow the disposal of water generated from unwatering and dewatering operations to the Illinois River *via* the existing NPDES-permitted outfall for the Site;
- A construction permit from the IDNR, Office of Water Resources, Dam Safety Program to allow the embankment and spillways of the impoundment to be modified as part of closure;
- A construction stormwater permit through IEPA, including construction stormwater controls and other BMPs such as silt fences and other measures; and
- A joint water pollution control construction and operating permit (WPC permit).

As discussed below in Section 2.4.5, the existing on-Site landfill will require expansion under the CBR-Onsite scenario in order to accommodate all of the material excavated from the GMF. The on-Site landfill has already been permitted for an expansion of an additional 2 acres of waste disposal area. Under the CBR-Offsite scenario, it may similarly be necessary to expand the off-Site landfill. Additional permitting may be required under this scenario for transport of the CCR and to expand the off-Site landfill. It may also be necessary to modify the operating plan for the off-Site landfill in order to accommodate the increased rate of filling of the landfill and the likely need for additional equipment and personnel to manage the receipt and disposal of the CCR and liner system materials.

2.4.4 Availability of Necessary Equipment and Specialists

CIP, CBR-Onsite, and CBR-Offsite are reliable and standard methods for managing waste that rely on common construction equipment and materials and typically do not require the use of specialists, outside of typical construction labor and equipment operators. However, global supply chains have been disrupted due to the COVID-19 pandemic, resulting in shortages in the availability of construction equipment and parts. There may be some shortages in construction equipment under all scenarios, if supply chain resilience does not improve by the time of construction. Alternatively, extended downtime may be required for equipment repairs and maintenance. A national shortage of truck drivers has also developed during the COVID-19 pandemic. Due to higher earthwork volumes and a longer construction schedule under the CBR-Onsite and CBR-Offsite scenarios than under the CIP scenario, shortages in construction equipment may cause greater challenges under the CBR-Onsite and CBR-Offsite scenarios than under the CIP scenario. The current shortage of truck drivers may be particularly impactful under the CBR-Offsite scenario, due to the large volume of CCR and liner materials to be hauled from the Site. If sufficient trucks and truck drivers are not available, the construction schedule at both impoundments may lengthen based on hauling-related delays.

The availability of critical materials such as metal, wood, and electronic chips has also been impacted by the COVID-19 pandemic. However, soil materials and geomembrane liner materials have generally been available during 2021 for landfill development and closure projects.

2.4.5 Available Capacity and Location of Needed Treatment, Storage, and Disposal Services

Under the CIP scenario, the gypsum currently within the GMF will be consolidated and stored within the existing footprint of the impoundment. The GMF will be unwatered at the start of construction *via* pumping. Pumped water will be managed in accordance with the facility's NPDES permit. Treatment is not expected to be necessary prior to discharge.

The existing landfill on the Duck Creek property does not have sufficient capacity to receive all of the CCR and liner materials that are currently slated for landfilling under the CBR-Onsite scenario. Expansion of the on-Site landfill would thus be necessary. The on-Site landfill is already permitted for added waste disposal capacity, which would create an additional 2 acres of landfill area (Appendix B). The landfill expansion could be completed in a single construction season during the removal of ponded water at the GMF.

Under the CBR-Offsite scenario, up to 733,000 cubic yards of gypsum, liner materials, and additional subsoil overexcavation and 31 acres of geosynthetic liner system materials excavated from the GMF will require disposal at an off-Site landfill. An additional 7,000 cubic yards of material excavated from the BAB would also require disposal at the off-Site landfill, if CBR-Offsite were selected for the BAB. According to the IEPA "Illinois Landfill Disposal Capacity Report" for 2020 (IEPA, 2021b), the closest third-party landfill with the ability to receive and dispose of CCR from the Site is the Peoria City-County Landfill in Brimfield, Illinois. This facility has 750,000 cubic yards of remaining capacity in its current permitted footprint. It receives 230,000 cubic yards of waste annually, and is located 33 miles from the Site. The Peoria City-County Landfill therefore has sufficient capacity to receive all of the CCR and liner materials from the GMF. However, due to the limited space remaining in this landfill and the short time frame over which CCR would be received at the landfill, vertical and/or lateral expansions may become necessary. Additionally, the landfill operators may need to develop a disposal plan to account for the increased volume of material that will be received and the unique CCR and liner system waste characteristics. Elements of this disposal plan might include increasing daily operational capacity and procedures, expediting planned airspace construction, and potentially expediting landfill expansion. If

expansion of the Peoria City-County Landfill is impractical or infeasible, then an alternative landfill located farther from the Site would need to be identified. A likely alternative to the Peoria City-County Landfill is the Envirofil of IL Landfill in Macomb, Illinois. It has 7,700,000 cubic yards of remaining capacity in its current permitted footprint, receives 97,000 cubic yards of waste annually, and is located approximately 45 miles from the Site (IEPA, 2021b).

2.5 Impact of Closure Alternative on Waters of the State (IAC Section 845.710(d)(4))

As demonstrated in Gradient's Human Health and Ecological Risk Assessment (Appendix A of this report), modeled surface water concentrations in the Illinois River in the vicinity of the Site are all below relevant human health and ecological screening benchmarks. Due to closure activities, surface water concentrations of CCR-associated constituents are expected to remain stable and/or decline over time under all three closure scenarios. Thus, no future exceedances of any human health or ecological screening benchmarks are anticipated under any closure scenario. Additionally, the lined landfills that will receive any materials excavated from the GMF under the CBR-Onsite and CBR-Offsite scenarios will be managed to ensure that no surface water impacts occur in the vicinity of the landfills.

2.6 Concerns of Residents Associated with Closure Alternatives (IAC Section 845.710(b)(4))

Several nonprofits representing community interests near the Site have raised concerns regarding the potential impacts of coal ash impoundments at this Site on groundwater and surface water quality, including Earthjustice, the Prairie Rivers Network, and the Sierra Club (Earthjustice *et al*., 2018; Sierra Club, 2014; Sierra Club and CIHCA, 2014). These parties generally prefer CBR to CIP, citing fears that allowing CCR to remain in place "allows the widespread groundwater contamination to continue indefinitely" (Earthjustice *et al*., 2018, p. 24). For the GMF, both CIP and CBR are being considered; however, it is not the case that closing the GMF *via* CIP rather than CBR would result in undue risks to groundwater and surface water post-closure. As described in Sections 2.2.1 and 2.2.2, no current or future unacceptable risks to human or ecological receptors are associated with the GMF under any closure scenario. There is also minimal risk of future CCR releases occurring under any closure scenario. Furthermore, based on a model-simulated period of 100 years, groundwater concentrations under the CIP scenario are expected to maintain compliance with the GWPSs post-closure (Ramboll, 2022). In summary, all closure scenarios are responsive to residents' concerns regarding groundwater and surface water quality.

For the GMF, the CIP scenario has advantages over the CBR-Offsite and CBR-Onsite scenarios with regard to likely community concerns. Specifically, compared to the other evaluated alternatives, CIP presents fewer risks to workers and community members during construction in the form of accidents, traffic, and air pollution (Section 2.2.4 above) and is also associated with the shortest time to closure. By minimizing the expected time to closure, CIP minimizes the duration of negative impacts arising from construction activities and minimizes the time required to re-develop the Site for use in utility-scale solar generation. Re-development of the Site for use in solar generation and storage will bring new jobs to the community and contribute positively to Illinois's growing renewable energy portfolio.

A public meeting was held on December 7, 2021, pursuant to requirements under IAC Section 845.710(e) (IEPA, 2021a). Questions raised by attendees were answered at the meeting; subsequently, a written summary of all questions and responses was emailed to interested parties.

2.7 Class 4 Cost Estimate (IAC Section 845.710(d)(1))

A cost estimate has been prepared for each of the closure scenarios (Appendix B). A summary of these estimates is provided in Table 2.7. The total expected cost of closure under the CIP scenario is $6,210,000. The total expected cost of closure under the CBR-Onsite scenario is $8,870,000. The total expected cost of closure under the CBR-Offsite scenario is $82,400,000. Costs under the CIP scenario are therefore considerably smaller than costs under the CBR-Onsite and CBR-Offsite scenarios.

Table 2.7 Expected Costs of Closure – GMF

Work Element	CIP	CBR-Onsite	CBR-Offsite
Mobilization/Demobilization	$488,000	$727,000	$6,810,000
Surveying and Site Preparation	$125,000	$50,000	$25,000
Dewatering, Unwatering, and Stormwater Management	$2,260,000	$2,310,000	$2,280,000
Impoundment Closure and Site Restoration	$2,800,000	$4,660,000	$65,800,000
Landfill Expansion	$0	$331,000	$0
Miscellaneous Construction	$537,000	$800,000	$7,490,000
Total:	**$6,210,000**	**$8,870,000**	**$82,400,000**

Notes:
CBR-Offsite = Closure-by-Removal with Off-Site Disposal; CBR-Onsite = Closure-by-Removal with On-Site Disposal; CIP = Closure-in-Place; GMF = Gypsum Management Facility.
Costs are for comparative purposes only. Actual costs will be paid based on actual quantities and may vary from those calculated.
Source: Appendix B.

All three closure scenarios meet or exceed a Class 4 estimate under the Association for the Advancement of Cost Engineering (AACE) Classification Standard (or a comparable classification practice as provided in the AACE Classification Standard), as required by IAC Section 845.710 (IEPA, 2021a).

2.8 Summary

Table S.1 (Summary of Findings) summarizes the expected impacts of the CIP, CBR-Onsite, and CBR-Offsite closure scenarios with regard to each of the factors specified under IAC Section 845.710 (IEPA, 2021a). Based on this evaluation and the details provided in Section 2 above, CIP has been identified as the most appropriate closure scenario for the GMF. Key benefits relative to other closure scenarios include the more rapid re-development of the Site for use in utility-scale solar generation and reduced impacts on workers, community members, and the environment during construction (*e.g.*, fewer constructed-related accidents, lower energy demands, less air pollution and GHG emissions, and less traffic).

3 Closure Alternatives Analysis – BAB

3.1 Closure Alternative Descriptions (IAC Section 845.710(c))

This section of the report presents a CAA for the BAB pursuant to requirements under IAC Section 845.710 (IEPA, 2021a). For the BAB, Gradient evaluated two closure scenarios: CBR-Onsite and CBR-Offsite. CIP was not evaluated for the BAB because no significant CCR remains in the impoundment. Sections 3.1.1 and 3.1.2 describe the CBR-Onsite and CBR-Offsite closure scenarios. These scenarios are based on information and analyses conveyed to Gradient by Golder (Appendix B; Golder, 2022c,d).

3.1.1 Closure-by-Removal with On-Site Disposal

Under the CBR-Onsite scenario, CCR and existing liner system materials will be excavated from the BAB and sent to the on-Site landfill for final disposal. Excavation activities at the BAB will include any residual CCR that is still present in the impoundment; the concrete, compacted clay, and geomembrane components of the existing liner system; and additional subsoil overexcavation (Golder, 2022c,d). Excavated materials from the BAB will be hauled to the on-Site landfill (Appendix B; Golder, 2022d).

The on-Site landfill is located approximately 3.7 miles north of the BAB *via* Site roads (Appendix B). Excavated materials will be hauled to the landfill using haul trucks. The landfill on the property is currently expected to have sufficient capacity to receive all of the materials from the BAB slated for disposal under the CBR-Onsite scenario. This scenario meets the requirements of IAC Section 845.710(c)(2) (IEPA, 2021a) which requires an assessment be included in the CAA of whether the Site has an on-Site landfill with available capacity or whether an on-Site landfill can be constructed.

This scenario includes the following work elements for the closure of the BAB (Appendix B; Golder, 2022c,d):

- Excavation and transport of CCR and liner system materials to the on-Site landfill, as detailed above.
- Grading and filling to convey runoff away from the impoundments.
- Site restoration, including revegetation with native grasses.
- Three years of monitoring at the impoundments, or until such time as GWPSs are achieved.

In total, approximately 3,550 cubic yards of concrete and compacted clay, 1 acre of geomembrane materials from the existing liner system, and 3,200 cubic yards of overexcavated subsoil will be excavated from the BAB under the CBR-Onsite scenario and hauled to the on-Site landfill for disposal. The selected borrow soil location is approximately 3.4 miles north of the BAB *via* Site roads (Appendix B). A total of 17,500 cubic yards of borrow soil are required for grading and filling of the BAB (Appendix B).

Under the CBR-Onsite scenario, the expected duration of major construction activities is approximately 12-18 weeks (Appendix B; Golder, 2022c,d). Key parameters for the CBR-Onsite scenario are shown in Table 3.1.

Table 3.1 Key Parameters for the Closure-by-Removal with On-Site Disposal Scenario – BAB

Parameter	Value	Notes
Surface Area of Impoundment (acres)	2.2	Includes all three cells and the area around the cells.
In-Place Volume of CCR (CY)	Minimal	The CCR in the impoundment has been excavated previously.
Distance to the On-Site Landfill (miles)	3.7	
Required Volume of Borrow Soil (CY)	17,500	Required for grading and filling.
Volume of Soil Stockpiled at Borrow Soil Location (CY)	0	
Distance to the Borrow Soil Location (miles)	3.4	
Duration of Construction Activities (weeks)	12-18	
Total On-Site Labor Hours for Major Construction[a]	4,820	
Required On-Site Hauling Truckloads (Loaded)	843	
Required Off-Site Hauling Truckloads (Loaded)	0	
Required On-Site Hauling Miles	5,870	
Required Off-Site Hauling Miles	0	

Notes:
BAB = Bottom Ash Basin; CCR = Coal Combustion Residual; CY = Cubic Yards.
Sources: Appendix B; Golder (2022c,d).
(a) Major construction was defined as any operation occurring on-Site that required one of the following equipment types: breaker, compactor, dozer, excavator, haul truck, loader, and telehandler. Labor was not included if it was limited to use of the following equipment types: diesel pump, flatbed truck, generator, miscellaneous, pickup truck, and seed drill or hydroseeder. Labor performed by haul truck operators was only included in calculations if the hauling occurred on-Site. Workers assigned to relevant activities were assumed to work full-time (40 hours per week) on that activity for the duration of the activity.

3.1.2 Closure-by-Removal with Off-Site Disposal

Under the CBR-Offsite scenario, CCR and existing liner system materials will be excavated from the BAB and sent to an off-Site landfill for final disposal. Excavation activities at the BAB will include any residual CCR that is still present in the impoundment; the concrete, compacted clay, and geomembrane components of the existing liner system; and additional subsoil overexcavation (Golder, 2022c,d). Excavated materials in the BAB will be sent to the Peoria City-County Landfill (11501 W Cottonwood Road, Brimfield, IL 61517), which is approximately 33 miles from the Site (Appendix B).

IAC Section 845.710(c)(1) requires CBR alternatives to consider multiple methods for transporting excavated materials off-Site, including rail, barge, and trucks. Golder evaluated the feasibility of transporting excavated materials to the off-Site landfill *via* rail or barge and found that neither option is viable at this Site. Existing loadout facilities, which would facilitate off-Site rail or barge transport, are not present on the property, and the construction of new loadout facilities is considered infeasible. Only transport *via* on-road haul trucks (with a 16.5-cubic-yard capacity) is considered feasible for CBR-Offsite. The local availability and use of natural gas-powered trucks, or other low-polluting trucks, will be evaluated prior to the start of construction.

The work elements included in this scenario are largely the same as those listed above in Section 3.1.1 for the CBR-Onsite scenario (Appendix B; Golder, 2022c,d):

- Excavation and transport of CCR and liner system materials to the off-Site landfill, as detailed above. All areas affected by CCR releases will be decontaminated, including potential over-excavation below the bottom of the liner system.
- Grading and filling to convey runoff away from the impoundments.
- Site restoration, including revegetation with native grasses.
- Three years of monitoring at the impoundments, or until such time as GWPSs are achieved.

In total, approximately 3,550 cubic yards of concrete and compacted clay, 1 acre of geomembrane materials from the existing liner system, and 3,200 cubic yards of overexcavated subsoil will be excavated from the BAB under the CBR-Offsite scenario and hauled to the off-Site landfill for disposal. The selected borrow soil location is approximately 3.4 miles north of the BAB *via* Site roads (Appendix B). A total of 17,500 cubic yards of borrow soil are required for grading and filling of the BAB (Appendix B).

Under the CBR-Offsite scenario, the expected duration of major construction activities is expected to be approximately 12 to 18 weeks for the BAB (Appendix B; Golder, 2022c,d). Key parameters for the CBR-Offsite scenario are shown in Table 3.2.

Table 3.2 Key Parameters for the Closure-by-Removal with Off-Site Disposal Scenario – BAB

Parameter	Value	Notes
Surface Area of Impoundment (acres)	2.2	Includes all three cells and the area around the cells.
In-Place Volume of CCR (CY)	Minimal	The CCR in the impoundment has been excavated previously.
Distance to the Off-Site Landfill (miles)	33	Peoria City-County Landfill in Brimfield, IL.
Required Volume of Borrow Soil (CY)	17,500	Required for grading and filling.
Volume of Soil Stockpiled at Borrow Soil Location (CY)	0	
Distance to the Borrow Soil Location (miles)	3.4	
Duration of Construction Activities (weeks)	12 to 18	
Total On-Site Labor Hours for Major Construction[a]	4,360	
Required On-Site Hauling Truckloads (Loaded)	606	
Required Off-Site Hauling Truckloads (Loaded)	489	
Required On-Site Hauling Miles	4,120	
Required Off-Site Hauling Miles	31,900	

Notes:
BAB = Bottom Ash Basin; CCR = Coal Combustion Residual; CY = Cubic Yards.
Sources: Appendix B; Golder (2022c,d).
(a) Major construction was defined as any operation occurring on-Site that required one of the following equipment types: breaker, compactor, dozer, excavator, haul truck, loader, and telehandler. Labor was not included if it was limited to use of the following equipment types: diesel pump, flatbed truck, generator, miscellaneous, pickup truck, and seed drill or hydroseeder. Labor performed by haul truck operators was only included in calculations if the hauling occurred on-Site. Workers assigned to relevant activities were assumed to work full-time (40 hours per week) on that activity for the duration of the activity.

3.2 Long- and Short-Term Effectiveness of Closure Alternative (IAC Section 845.710(b)(1))

3.2.1 Magnitude of Reduction of Existing Risks (IAC Section 845.710(b)(1)(A))

This section of the report addresses the potential risks to human and ecological receptors due to exposure to CCR-associated constituents in groundwater or surface water. Gradient has performed a Human Health and Ecological Risk Assessment for the Site (Appendix A of this report), which provides a detailed evaluation of the magnitude of existing risks to human and ecological receptors associated with the BAB. This report concluded that there are no current unacceptable risks to any human or ecological receptors associated with the BAB. Moreover, because groundwater concentrations are expected to remain stable and/or decline over time under both closure scenarios, there will also be no unacceptable risks to human health or the environment during or following closure. Thus, there is no current risk or future risk under either closure scenario at the BAB, and the magnitude of reduction of existing risks is the same under both scenarios.

3.2.2 Likelihood of Future Releases of CCR (IAC Section 845.710(b)(1)(B))

This section of the report quantifies the risk of future releases of CCR that may occur during dike failure and storm-related events.

Storm-Related Releases and Dike Failure During Flood Conditions

There is no current or future risk of sudden CCR releases occurring at the BAB under either closure scenario. No significant amount of CCR remains in the impoundment.

Dike Failure Due to Seismicity

Sites in Illinois may be subject to seismic risks arising from the Wabash Valley Seismic Zone and the New Madrid Seismic Zone (IEMA, 2020). However, the Duck Creek property does not lie within a seismic impact zone. The property is also believed to have a "low risk level" for seismic risks based on the 2018 USGS National Seismic Hazard Map. Additionally, the BAB does not lie within 200 feet of an active fault or fault damage zone at which displacement has occurred within the current geological epoch (*i.e.*, within the last ~11,650 years; Burns & McDonnell, 2021b,c; Haley & Aldrich, Inc., 2018a,b). The nearest known fault is the Sicily Fault, which is located about 64 miles southeast of the BAB. The Sicily Fault does not have known recent activity (Haley & Aldrich, Inc., 2018a,b). Thus, the risk of dike failure occurring during or following closure activities due to seismic activity is exceedingly low at the BAB.

3.2.3 Type and Degree of Long-Term Management, Including Monitoring, Operation, and Maintenance (IAC Section 845.710(b)(1)(C))

The long-term operation and management plans for the BAB are described in Section 3.1 for each closure scenario. Under both the CBR-Onsite and CBR-Offsite scenarios, the BAB will undergo monitoring for 3 years post-closure, or until such time as GWPSs are achieved.

3.2.4 Short-Term Risks to the Community or the Environment During Implementation of Closure (IAC Section 845.710(b)(1)(D))

3.2.4.1 Worker Risks

Best practices will be employed during construction in order to ensure worker safety and comply with all relevant regulations, permit requirements, and safety plans. However, it is impossible to completely eliminate risks to workers during construction activities, both on- and off-Site. On-Site accidents include injuries and deaths arising from the use of heavy equipment and/or earthmoving operations during construction activities. Off-Site accidents include injuries and deaths due to vehicle accidents during labor and equipment mobilization and demobilization, material deliveries, and the hauling of CCR and liner system materials to the on-Site landfill and the off-Site landfill.

Risk of Worker Accidents Occurring On-Site

For the BAB, two closure scenarios were considered: CBR-Offsite and CBR-Onsite. Based on labor requirements reported in Appendix B of this report, Gradient estimates that 4,820 total on-Site labor hours are required for major construction activities under the CBR-Onsite scenario and 4,360 total on-Site labor hours are required for major construction activities under the CBR-Offsite scenario. The labor requirements under both scenarios are therefore similar. Slightly fewer on-Site labor hours are required under the CBR-Offsite scenario than under the CBR-Onsite scenario, because a greater percentage of hauling (a major construction activity) occurs off-Site rather than on-Site under the former scenario. Based on these values and US BLS labor statistics (US DOL, 2020a,b), we estimate that approximately 0.056 worker injuries and 0.00036 worker fatalities will occur on-Site under the CBR-Onsite scenario due to major construction activities at the BAB (Table 3.3). A slightly smaller number of worker injuries and fatalities (0.050 worker injuries and 0.00033 worker fatalities) are expected to occur on-Site under the CBR-Offsite scenario (Table 3.3). Note that the calculations presented here focus on major construction activities (*e.g.*, excavation, loading, and hauling). They therefore do not account for the additional accidents that could occur on-Site during less intensive construction activities (*e.g.*, surveying, erosion control, and hydroseeding).

Table 3.3 Expected Number of On-Site Worker Accidents Under Each Closure Scenario – BAB

Closure Scenario	Injuries	Fatalities
CBR-Onsite	0.056	0.00036
CBR-Offsite	0.050	0.00033

Notes:
BAB = Bottom Ash Basin; CBR-Offsite = Closure-by-Removal with Off-Site CCR Disposal; CBR-Onsite = Closure-by-Removal with On-Site CCR Disposal.

Risk of Worker Accidents Occurring Off-Site

The CBR-Offsite scenario is the only scenario which requires any off-Site hauling. Under the CBR-Offsite scenario, 31,900 vehicle travel miles are required to haul excavated materials to the off-Site landfill (Table 3.2). The US DOT (2020) provides an estimate of the expected number of fatalities and injuries "per vehicle mile driven" for drivers and passengers of large trucks. Based on US DOT's statistics, 0.0041 injuries and 0.000093 fatalities are expected to occur to drivers and passengers of haul trucks due to hauling under the CBR-Offsite scenario (Table 3.4).

Table 3.4 Expected Number of Off-Site Worker Accidents Due to Hauling Under Each Closure Scenario – BAB

Closure Scenario	Injuries	Fatalities
CBR-Onsite	0	0
CBR-Offsite	0.0041	0.000093

Notes:
BAB = Bottom Ash Basin; CBR-Offsite = Closure-by-Removal with Off-Site CCR Disposal; CBR-Onsite = Closure-by-Removal with On-Site CCR Disposal.

These estimates reflect the minimum number of worker accidents that are likely to occur off-Site under each scenario, because they do not account for the additional vehicle accidents that may occur during non-hauling activities such as labor mobilization and demobilization, equipment mobilization and demobilization, and material deliveries. The vehicle mileages associated with these off-Site activities are not known. For the BAB, both scenarios (CBR-Onsite and CBR-Offsite) have the same expected duration of construction activities, the same required earthwork volumes, similar on-Site labor hours for major construction, and a similar total number of required hauling truckloads (on-Site + off-Site). These two scenarios are therefore likely to have similar impacts with regard to off-Site vehicle accidents arising from labor and equipment mobilization/demobilization and material deliveries.

Taking into account both (i) accidents occurring on-Site due to major construction activities and (ii) accidents occurring off-Site due to hauling, an estimated 0.056 worker injuries and 0.00036 worker fatalities are expected under the CBR-Onsite scenario, and an estimated 0.054 worker injuries and 0.00042 worker fatalities are expected to occur under the CBR-Offsite scenario. Thus, overall risks to workers are likely to be of similar magnitude for both closure scenarios.

3.2.4.2 Community Risks

Accidents

Vehicle accidents that occur off-Site can result in injuries or fatalities among community members, as well as workers. Based on the accident statistics for large trucks reported by US DOT (2020) and the off-Site haul truck mileages reported above for the BAB, haul truck accidents could result in an estimated 0.012 injuries and 0.00043 fatalities among community members (Table 3.5). In contrast, no fatalities or injuries are expected to occur among community members under the CBR-Onsite scenarios due to haul truck accidents, because borrow soil will be taken from a location on the property and any excavated materials will be hauled to an on-Site landfill.

Table 3.5 Expected Number of Community Accidents Due to Hauling Under Each Closure Scenario – BAB

Closure Scenario	Injuries	Fatalities
CBR-Onsite	0	0
CBR-Offsite	0.012	0.00043

Notes:
BAB = Bottom Ash Basin; CBR-Offsite = Closure-by-Removal with Off-Site CCR Disposal; CBR-Onsite = Closure-by-Removal with On-Site CCR Disposal.

In addition to impacts due to off-Site hauling, both scenarios may have off-Site impacts due to labor mobilization and demobilization, equipment and vehicle mobilization and demobilization, and material deliveries. For the BAB, both scenarios (CBR-Onsite and CBR-Offsite) have the same expected duration of construction activities, the same required earthwork volumes, similar on-Site labor hours for major

construction, and a similar total number of required hauling truckloads (on-Site + off-Site). Both scenarios are therefore also likely to have similar impacts with regard to these off-Site activities.

Traffic

Haul routes are expected to use major arterial roads and highways wherever possible, which will reduce the incidence of traffic. However, the heavy use of local roads for construction operations may result in traffic near the Site and, in the case of the CBR-Offsite scenario, the off-Site landfill.

Traffic may increase temporarily around the Site under both closure scenarios due to the daily arrival and departure of the workforce, equipment mobilization/demobilization, and material deliveries. However, these impacts are expected to largely occur at the beginning or end of each work day (arrival/departure of the work force), at the beginning or end of the construction period (equipment mobilization/demobilization), and at specific times throughout the construction period (material deliveries). These impacts will therefore likely be less disruptive to community members than the constant and steady movement of haul trucks to and from the Site under the CBR-Offsite scenario.

Under the CBR-Offsite scenario, Golder estimates that approximately 489 truckloads will be required to transport materials excavated from the BAB to the off-Site landfill over approximately 80 hauling days (Appendix B). Assuming a 10-hour work day, 6 work days per week, and 26 work days per month, a haul truck would need to pass a given location near the Site once every 49 minutes on average for the duration of excavation activities.

Noise

Construction generates a great deal of noise, both in the vicinity of the Site and along haul routes. In a closure impact analysis performed by the TVA (2015), the authors found that "[T]ypical noise levels from construction equipment used for closure are expected to be 85 dBA or less when measured at 50 ft. These types of noise levels would diminish with distance … at a rate of approximately 6 dBA per each doubling of distance and therefore would be expected to attenuate to the recommended EPA noise guideline of 55 dBA at 1,500 ft." Because there are no residences or businesses within 1,500 feet of any of the construction areas on the Site (the BAB, the proposed borrow site, and the on-Site landfill), we do not anticipate that any residences or businesses will be adversely impacted by noise pollution at the Site under either closure scenario. Moreover, although there are several scenic, recreational, and historical areas located within a few miles of the Site (the Rice Lake SFWA and the Orendorf and Rice Lake Terrace Archaeological Sites), there are no notable scenic or recreational areas located within 1,500 feet of any of the construction areas on the Site. Noise impacts are therefore expected to be relatively minor at the BAB under both closure scenarios.

In addition to impacts in the immediate vicinity of the BAB, local roads near the Site and the off-Site landfill (CBR-Offsite scenario only) may experience noise pollution due to truck traffic. As described above (Traffic), a haul truck must pass a given location every 49 minutes on average for 10 hours a day while excavation is occurring. Dump trucks generate significant noise pollution, with noise levels of approximately 88 decibels or higher expected within a 50-foot radius of the truck (Exponent, 2018). This noise level is similar to the noise level of a gas-powered lawnmower or leaf blower (CDC, 2019). Decibel levels above 80 can damage hearing after 2 hours of exposure (CDC, 2019). In addition to haul truck impacts, noise pollution may also arise along local roads from the daily arrival and departure of the workforce, equipment mobilization/demobilization, and material deliveries. These impacts are expected to largely occur at the beginning or end of each work day (arrival/departure of the work force), at the beginning or end of the construction period (equipment mobilization/demobilization), and at specific times throughout the construction period (material deliveries); these impacts will therefore likely be less

disruptive to community members than the constant and steady movement of haul trucks to and from the Site.

Air Quality

Construction can adversely impact air quality. Air pollution can occur both on-Site and off-Site (*e.g.*, along haul routes), potentially impacting workers as well as community members. With regards to construction activities, two categories of air pollution are of particular concern: equipment emissions and fugitive dust. The equipment emissions of greatest concern are those found in diesel exhaust. Most construction equipment is diesel-powered, including the dump trucks used to haul material to and from the Site. Diesel exhaust contains hundreds of air pollutants, including NO_x, PM, CO, and VOCs (Hesterberg *et al*., 2009; Mauderly and Garshick, 2009). Fugitive dust, another major air pollutant at construction sites, is generated by earthmoving operations and other soil- and CCR-handling activities. Along haul routes, an additional source of fugitive dust is road dust along unpaved dirt roads. Careful planning and the use of BMPs such as wet suppression are used to minimize and control fugitive dust during construction activities; however, it is not possible to prevent dust generation entirely.

The air pollutant mass released under a given closure scenario will be proportional to the expected duration and intensity of construction activities under that scenario. For the BAB, both scenarios (CBR-Onsite and CBR-Offsite) have the same expected duration of construction activities, the same required earthwork volumes, similar on-Site labor hours for major construction, and a similar total number of required hauling truckloads (on-Site + off-Site). These two scenarios therefore most likely have similar impacts with regard to air emissions.

Environmental Justice

The State of Illinois defines EJ communities to be those communities with a minority population above twice the state average and/or a total population below twice the state poverty rate (IEPA, 2019). Relative to other communities, EJ communities experience an increased risk of adverse health impacts due to environmental pollution and other factors associated with remediation activities (US EPA, 2016).

As shown in a map of EJ communities throughout the state (Figure 3.1; IEPA, 2019), the on-Site landfill and the borrow site are located within the 1-mile buffer zone of the nearest EJ community (near Canton). The BAB lies approximately 2.5 miles from the outer perimeter of this buffer zone. Due to its close proximity to the Site, the EJ community near Canton may be disproportionately impacted by air emissions, traffic, accidents and other factors arising from various closure activities occurring on or near the Site. Each of the evaluated closure scenarios requires some construction activity in at least one of these on-Site areas.

In addition to impacts arising from construction activity on or near the Site, EJ communities may be also impacted by off-Site activities, including the hauling of CCR and liner materials from the Site to the off-Site landfill, labor and equipment mobilization/demobilization, and material deliveries. Unfortunately, in addition to being located near the on-Site landfill and the borrow site, the EJ community near Canton is also located along the three primary haul routes from the Site to the off-Site landfill suggested by Google Maps (Google LLC, 2021). In summary, due to both on-Site and off-Site activities, both closure scenarios are associated with potential negative impacts on the EJ community near Canton (Figure 3.1).

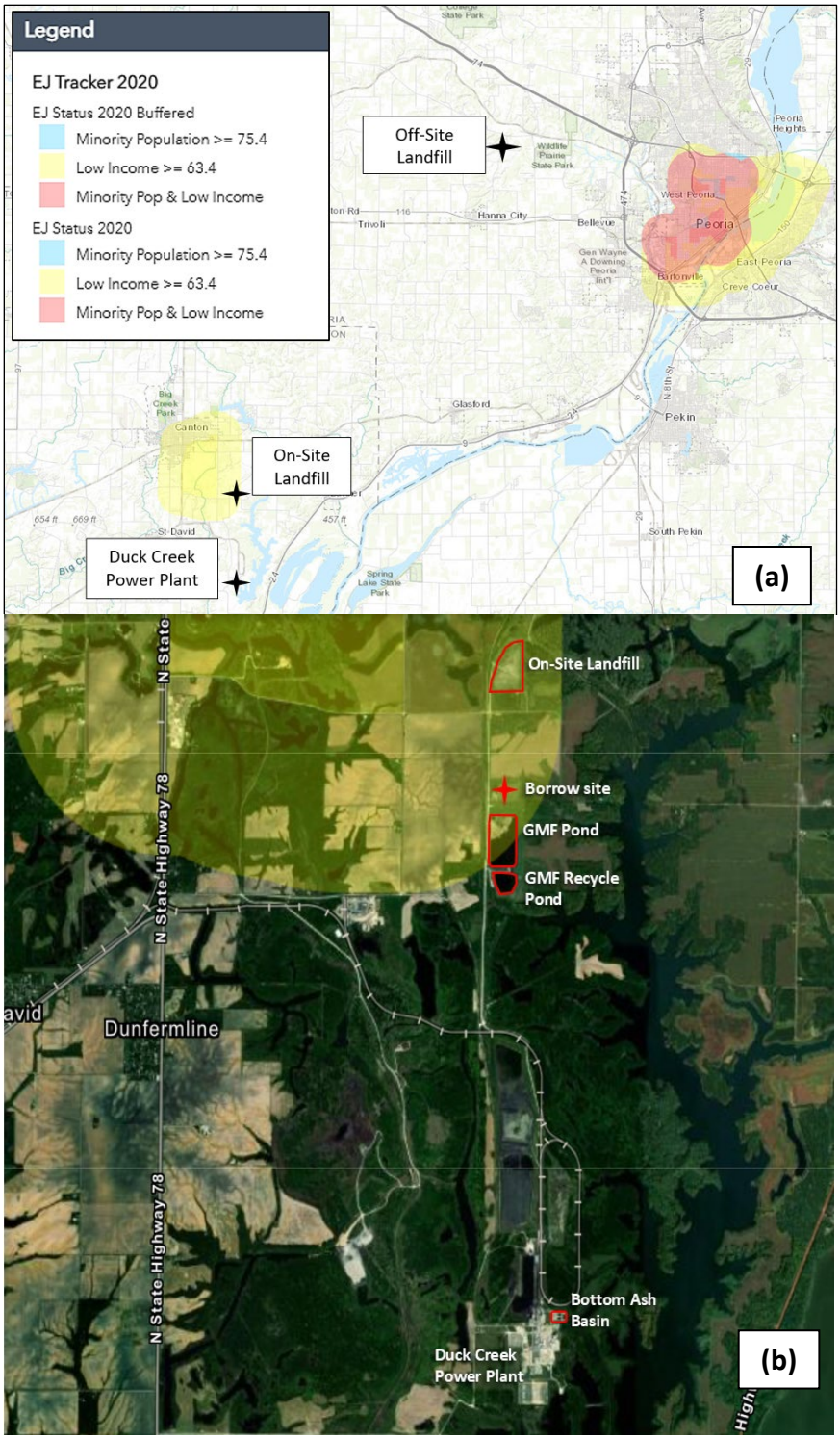

Figure 3.1 Environmental Justice Communities in the Vicinity of Site Features and the Off-Site Landfill – BAB. Adapted from IEPA (2019). (a) Regional map. (b) Site map.

Scenic, Historical, and Recreational Value

There are several scenic, recreational, and historical areas located within a few miles of the Site, including the Rice Lake SFWA and the Orendorf and Rice Lake Terrace Archaeological Sites (Google LLC, 2021; Ramboll, 2021b,c). However, there are no notable scenic or recreational areas located in the immediate vicinity of the BAB, the borrow soil location, or the on-Site landfill. The nearest scenic, recreational, or historical area is the Rice Lake SFWA, which is located over a mile away from the BAB and even further away from the borrow soil location and the on-Site landfill. We therefore do not expect construction activities at the Site to have any direct negative impacts on the scenic, historical, or recreational value of the areas listed above (due to, *e.g.*, noise, obstructions of the view, or restricted access), regardless of the closure scenario.

3.2.4.3 Environmental Risks

Greenhouse Gas Emissions

In addition to the air pollutants listed above in Section 3.2.4.2, construction equipment emits GHGs, including CO_2 and possibly N_2O. The potential impact of each closure scenario on GHG emissions is similar to the potential impact of each closure scenario on other emissions from construction vehicles and equipment, as described above in Section 3.2.4.2. For the BAB, both scenarios (CBR-Onsite and CBR-Offsite) have the same expected duration of construction activities and the same required earthwork volumes. These two scenarios therefore most likely have similar impacts with regard to GHG emissions.

Energy Consumption

Energy consumption at a construction site is synonymous with fossil fuel consumption, because the energy to power construction vehicles and equipment comes from the burning of fossil fuels. Fossil fuel demands considered in this analysis include the burning of diesel fuel during construction activities and the carbon footprint of manufacturing geomembrane textiles. Because GHG emission impacts and energy consumption impacts both arise from the same sources at construction sites, the trends discussed above with respect to GHG emissions also apply to the evaluation of energy demands. For the BAB, energy requirements are expected to be similar under both the CBR-Onsite and CBR-Offsite scenarios.

Natural Resources and Habitat

Construction is likely to have a negative short-term impact on the natural resources and habitat in the vicinity of the BAB and the on-Site borrow soil location (due to, *e.g.*, the temporary destruction of any existing habitat atop these locations, and/or alarm and escape behavior in wildlife found near these locations). For BAB closure, the duration of time over which short-term negative impacts will occur (*i.e.*, the duration of construction activities) is limited to 12-18 weeks under both closure scenarios. Because both closure scenarios have the same expected duration of construction, both scenarios are expected to have similar short-term impacts on natural resources and habitat.

In addition to short-term impacts, closure may also result in long-term shifts in the habitat overlying the BAB and the borrow soil location (*i.e.*, any areas that are not currently grassland will be converted to grassland). Since both BAB closure scenarios (CBR-Onsite and CBR-Offsite) entail excavation followed by site restoration, both scenarios are also expected to have similar long-term impacts on natural resources and habitat.

The BAB is not located immediately adjacent to wetlands or notable surface water bodies, such as rivers or lakes (US FWS, 2021). For this reason, construction activities are not expected to have a significant negative impact on any wetland or aquatic species (due to, *e.g.*, erosion and sediment runoff). Impacts are expected to be limited to terrestrial species. According to the IDNR Natural Heritage Database and the US FWS Environmental Conservation Online System, there are 11 state threatened species, 12 state endangered species, three federally threatened species, and one federally endangered species within Fulton County (Ramboll, 2021b,c). To our knowledge, however, no threatened or endangered species have been identified at the Site (Ramboll, 2021b,c). Based on the information that is currently available, we do not expect construction activities to have negative impacts on any threatened or endangered species.

3.2.5 Time Until Groundwater Protection Standards Are Achieved (IAC Sections 845.710(b)(1)(E) and 845.710(d)(2 and 3))

Based on a statistical analysis and evaluation of potential exceedances, it was determined that there are no potential groundwater exceedances of applicable groundwater standards attributable to the BAB. Because there are no exceedances of the GWPSs and there is no significant CCR remaining within the impoundment, modeling was not performed for either of the closure scenarios. Because groundwater concentrations are expected to remain stable and/or decline post-closure, groundwater exceedances of applicable groundwater standards that are attributable to the BAB are also not expected to occur in the future, regardless of the closure scenario.

3.2.6 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, Containment, or Changes in Groundwater Flow (IAC Section 845.710(b)(1)(F))

Section 3.2.1 evaluates potential risks to human and ecological receptors arising from the leaching of CCR-associated constituents from the BAB. Section 3.2.2 evaluates the potential for sudden CCR releases to occur at the BAB due to, *e.g.*, dike failure or overtopping during floods or other storm-related events. In summary, under both closure scenarios, there is no current or future risk to any human or ecological receptors associated with the BAB. Additionally, there is minimal current or future risk of overtopping due to flood conditions. Dike failure due to, *e.g.*, seismic activity and storm-related events is also exceedingly unlikely.

Section 3.2.4 evaluates several potential risks to human health and the environment during closure activities, including risks of accidents occurring among workers; risks to nearby residents and EJ communities related to accidents, traffic, noise, and air pollution; and risks to natural resources and wildlife. The findings from this section of the text are summarized in Table S.2.

3.2.7 Long-Term Reliability of the Engineering and Institutional Controls (IAC Section 845.710(b)(1)(G))

As described in Section 3.2.2, there is no risk of engineering or institutional failures leading to sudden releases of CCR from the BAB post-closure under either closure scenario. Additionally, there are no current or future unacceptable risks to any human or ecological receptors associated with the BAB under either closure scenario (see Section 3.2.1 above). Moreover, reliable engineering and institutional controls (*e.g.*, a bottom liner, a leachate management system, and groundwater monitoring) will be

implemented at the on-Site and off-Site landfills under the CBR-Onsite and CBR-Offsite scenarios. Both closure scenarios are therefore reliable with respect to long-term engineering and institutional controls.

3.2.8 Potential Need for Future Corrective Action Associated with the Closure (IAC Section 845.710(b)(1)(H))

At this time, we do not anticipate a need for corrective action at the BAB under any closure scenario.

3.3 Effectiveness of the Closure Alternative in Controlling Future Releases (IAC Section 845.710(b)(2))

3.3.1 Extent to Which Containment Practices Will Reduce Further Releases (IAC Section 845.710(b)(2)(A))

There are no unacceptable risks to human health or the environment associated with the BAB (Section 3.2.1). Because current conditions do not present a risk to human health or the environment, and because groundwater concentrations are expected to remain stable and/or decline post-closure, there will also be no unacceptable risks to human health or the environment following closure of the BAB, regardless of the closure scenario.

Section 3.2.2 discussed the potential for dike failure or flood overtopping to occur during or following closure activities, resulting in a sudden release of CCR. That analysis showed that there is no risk of CCR releases occurring at the BAB following closure under either closure scenario.

3.3.2 Extent to Which Treatment Technologies May Be Used (IAC Section 845.710(b)(2)(B))

At this time, we do not anticipate a need for the use of treatment technologies other than source control (*i.e.*, CBR-Onsite and CBR-Offsite) at the BAB under either closure scenario.

3.4 Ease or Difficulty of Implementing Closure Alternative (IAC Section 845.710(b)(3))

3.4.1 Degree of Difficulty Associated with Constructing the Closure Alternative

Excavation and landfilling are reliable and standard methods for closing impoundments; we therefore do not expect these activities to pose any special challenges during BAB closure.

Hauling will be more difficult to implement under the CBR-Offsite scenario than under the CBR-Onsite scenario, due to greater haul traffic on public roadways. As described in Section 3.2.4.2 ("Community Risks"), off-Site hauling may also have detrimental community impacts due to an increased incidence of vehicle accidents, truck traffic, noise, and air pollution.

3.4.2 Expected Operational Reliability of the Closure Alternative

CCR and liner system materials excavated from the BAB will be fully contained after final disposal, regardless of which closure scenario is chosen (CBR-Onsite or CBR-Offsite). The operational reliability of both closure scenarios is therefore expected to be similar. Moreover, high operational reliability is expected under both scenarios due to the full containment of CCR and liner materials.

3.4.3 Need to Coordinate with and Obtain Necessary Approvals and Permits from Other Agencies

A construction stormwater permit through IEPA may be needed under both closure scenarios; this permit would include construction stormwater controls and BMPs such as silt fences and other measures. A joint WPC permit may also be needed under both closure scenarios. Under the CBR-Onsite scenario, a landfill permit modification would additionally be needed for the landfill to receive the material excavated from the BAB. Under the CBR-Offsite scenario, an additional permit and approval may be required for waste transport.

3.4.4 Availability of Necessary Equipment and Specialists

CBR-Onsite and CBR-Offsite are reliable and standard methods for managing waste that rely on common construction equipment and materials and typically do not require the use of specialists, outside of typical construction labor and equipment operators. However, global supply chains have been disrupted due to the COVID-19 pandemic, resulting in shortages in the availability of construction equipment and parts. There may be some shortages in construction equipment under all scenarios, if supply chain resilience does not improve by the time of construction. Alternatively, extended downtime may be required for equipment repairs and maintenance. A national shortage of truck drivers has also developed during the COVID-19 pandemic. The current shortage of truck drivers may be particularly impactful under the CBR-Offsite scenario, due to the materials that will be hauled from the Site. If sufficient trucks and truck drivers are not available, delays in the construction schedule may arise.

3.4.5 Available Capacity and Location of Needed Treatment, Storage, and Disposal Services

The existing landfill on the Duck Creek property has sufficient capacity to receive all of the CCR and liner materials that are currently slated for landfilling under the CBR-Onsite scenario. Under the CBR-Offsite scenario, approximately 7,000 cubic yards of materials excavated from the BAB will require disposal at an off-Site landfill. According to the IEPA "Landfill Disposal Capacity Report" for 2020 (IEPA, 2021b), the closest nearby third-party landfill with the ability to receive and dispose of CCR from the Site is the Peoria City-County Landfill in Brimfield, Illinois. This facility has 750,000 cubic yards of remaining capacity in its current permitted footprint. It receives 230,000 cubic yards of waste annually and is located 33 miles from the Site. The Peoria City-County Landfill therefore has sufficient capacity to receive all of the CCR and liner materials excavated from the BAB.

3.5 Impact of Closure Alternative on Waters of the State (IAC Section 845.710(d)(4))

As demonstrated in Gradient's Human Health and Ecological Risk Assessment (Appendix A of this report), modeled surface water concentrations in the Illinois River in the vicinity of the Site are all below

relevant human health and ecological screening benchmarks. Post-closure, surface water concentrations of CCR-associated constituents are expected to remain stable and/or decline over time under both closure scenarios. Thus, no future exceedances of any human health or ecological screening benchmarks are anticipated under either closure scenario. Additionally, the lined landfills that will receive any materials excavated from the BAB under the CBR-Onsite and CBR-Offsite scenarios will be managed to ensure that no surface water impacts occur in the vicinity of the landfills.

3.6 Concerns of Residents Associated with Closure Alternatives (IAC Section 845.710(b)(4))

Several nonprofits representing community interests near the Site have raised concerns regarding the potential impacts of coal ash impoundments at this Site on groundwater and surface water quality, including Earthjustice, the Prairie Rivers Network, and the Sierra Club (Earthjustice *et al*., 2018; Sierra Club, 2014; Sierra Club and CIHCA, 2014). These parties generally prefer CBR to CIP, citing fears that allowing CCR to remain in place "allows the widespread groundwater contamination to continue indefinitely" (Earthjustice *et al*., 2018, p. 24). Most of the CCR that was historically contained within the BAB has already been excavated from the impoundment; no significant CCR remains. Moreover, only CBR is being considered at this impoundment. Thus, both closure scenarios (CBR-Offsite and CBR-Onsite) are equally responsive to community concerns regarding potential groundwater and surface water impacts.

A public meeting was held on December 7, 2021, pursuant to requirements under IAC Section 845.710(e) (IEPA, 2021a). Questions raised by attendees were answered at the meeting; subsequently, a written summary of all questions and responses was emailed to interested parties.

3.7 Class 4 Cost Estimate (IAC Section 845.710(d)(1))

A cost estimate has been prepared for each of the closure scenarios (Appendix B). A summary of these estimates is provided in Table 3.6. The total expected cost of closure under the CBR-Onsite scenario is $479,000; the total expected cost of closure under the CBR-Offsite scenario is $1,360,000. Costs under the CBR-Onsite scenario are smaller than costs under the CBR-Offsite scenario.

Table 3.6 Expected Costs of Closure – BAB

Work Element	CBR-Onsite	CBR-Offsite
Mobilization/Demobilization	$37,500	$110,000
Surveying and Site Preparation	$25,000	$25,000
Dewatering, Unwatering, and Stormwater Management	$5,000	$5,000
Impoundment Closure and Site Restoration	$370,000	$1,100,000
Miscellaneous Construction	$41,300	$122,000
Total:	**$479,000**	**$1,360,000**

Notes:
BAB = Bottom Ash Basin; CBR-Offsite = Closure-by-Removal with Off-Site Disposal; CBR-Onsite = Closure-by-Removal with On-Site Disposal.
Costs are for comparative purposes only. Actual costs will be paid based on actual quantities, and may vary from those calculated.
Source: Appendix B.

Both closure scenarios meet or exceed a Class 4 estimate under the AACE Classification Standard (or a comparable classification practice as provided in the AACE Classification Standard), as required by IAC Section 845.710 (IEPA, 2021a).

3.8 Summary

Table S.2 (Summary of Findings) summarizes the expected impacts of the CBR-Onsite and CBR-Offsite closure scenarios for the BAB with regard to each of the factors specified under IAC Section 845.710 (IEPA, 2021a). Based on this evaluation and the details provided in Section 3 above, the CBR-Onsite scenario has been identified as the most appropriate closure scenario for the BAB. Key benefits of the CBR-Onsite scenario at the BAB include that off-Site hauling would not be required and, consequently, this scenario would result in reduced impacts to the community (due to, *e.g.*, accidents, traffic, noise, and air pollution) compared to the CBR-Offsite scenario.

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Appendix A

Human Health and Ecological Risk Assessment

Appendix A

Human Health and Ecological Risk Assessment

Human Health and Ecological Risk Assessment
Duck Creek Power Plant
Gypsum Management Facility (GMF) and Bottom Ash Basin (BAB)
Canton, Illinois

January 28, 2022

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Abbreviations

BAB	Bottom Ash Basin
bgs	Below Ground Surface
CAA	Closure Alternatives Assessment
CCR	Coal Combustion Residual
CEM	Conceptual Exposure Model
COI	Constituent of Interest
COPC	Constituent of Potential Concern
CSM	Conceptual Site Model
DCCP	Duck Creek Cooling Pond
DCPP	Duck Creek Power Plant
DWW	Drinking Water Watch
ESV	Ecological Screening Value
GMF	Gypsum Management Facility
GWPS	Groundwater Protection Standard
IAC	Illinois Administrative Code
ID	Identification
IEPA	Illinois Environmental Protection Agency
ILWATER	Illinois Water and Related Wells
IPRG	Illinois Power Resources Generating, LLC
ISGS	Illinois State Geological Survey
K_d	Equilibrium Partitioning Coefficient
NGWMN	National Groundwater Monitoring Network
NID	National Inventory of Dams
No.	Number
NPDES	National Pollutant Discharge Elimination System
SDWIS	Safe Drinking Water Information System
SI	Surface Impoundment
TEC	Threshold Effect Concentration
US DOE	United States Department of Energy
US EPA	United States Environmental Protection Agency
USGS	United States Geological Survey

1 Introduction

The Duck Creek Power Plant (DCPP, or "the Site") is an electric power-generating facility with coal-fired units located in Fulton County, Illinois, approximately 6 miles southeast of the town of Canton. The DCPP is owned by Illinois Power Resources Generating, LLC (IPRG). The facility began operation in 1976 and was retired in December 2019 (AECOM, 2016). The DCPP produced and stored coal combustion residuals (CCRs) as a part of its historical operations in several CCR ash ponds located north and east of the power plant. Two ash ponds are planned for closure and are the subject of this report; these include the Gypsum Management Facility (GMF; Vistra identification [ID] number [No.] 203, Illinois Environmental Protection Agency (IEPA) ID No. W0578010001-04, and National Inventory of Dams [NID] No. IL50573) and the Bottom Ash Basin (BAB; Vistra ID No. 205, IEPA ID No. W0578010001-03, and NID No. IL50716). The BAB is an inactive 2.2-acre lined CCR surface impoundment (SI) formerly used to manage CCR and non-CCR waste streams at the DCPP. The BAB consisted of three cells; the bottom and side slopes of all three cells are concrete lined. All bottom ash (*i.e.,* CCR) was removed from the BAB when the plant was retired; thus, the BAB currently contains no impounded water or CCR materials (Ramboll, 2021a). The GMF is located 2.4 miles north of the power plant, in Section 18 of Township 6 North, Range 5 East. The GMF is a 1,500 ft × 900 ft earthen berm double-lined CCR SI, which retains wet-sluiced gypsum produced in the flue-gas scrubber. The decant water from the GMF discharges to the lined GMF Recycle Pond located to the south of the GMF (Ramboll, 2021b). The Duck Creek Cooling Pond (DCCP) is a 719-acre surface water body (US Fish and Wildlife Service, 1983) located downgradient of the BAB and GMF. The DCCP was formed by damming Duck Creek (Ramboll, 2021a,b). The DCCP is part of the plant property and was used as a source of cooling water for the power plant when it was active. Currently, land adjacent to the DCPP is used for agriculture, pasture, and forest with minimal development (Ramboll, 2021b).

This report presents the results of an evaluation that characterizes potential risks to human and ecological receptors that may be exposed to CCR constituents in environmental media potentially impacted by the GMF and BAB. This risk evaluation was performed to support the Closure Alternatives Assessment (CAA) for the GMF and BAB in accordance with requirements in Title 35, Part 845, of the Illinois Administrative Code (IAC) (IEPA, 2021a). While this report specifically evaluates current risks, it also informs potential future risks under the different closure scenarios. Human and ecological risks were evaluated for Site-specific constituents of interest (COIs) that have the potential to migrate to the DCCP and affect DCCP surface water and sediment.

Consistent with United States Environmental Protection Agency (US EPA) guidance (US EPA, 1989), we used a tiered approach to evaluate potential risks, which included the following steps:

1. Identify complete exposure pathways and develop a conceptual exposure model (CEM).
2. Identify Site-related COIs: Compare maximum detected groundwater concentrations over the period from 2015 to 2021 to groundwater protection standards (GWPSs) listed in Title 35, Part 845.600 of the IAC (IEPA, 2021a), and relevant surface water quality standards (IEPA, 2019; US EPA, 2018).
3. Screening-level Risk Analysis: Compare maximum measured or modeled COI concentrations in surface water and sediment to conservative, health-protective benchmarks to determine constituents of potential concern (COPCs).

4. Refined Risk Analysis: If COPCs are identified, perform a refined analysis to evaluate potential risks associated with the COPCs.
5. Formulate risk conclusions and discuss any associated uncertainties.

This assessment relies on a conservative (*i.e.*, health-protective) approach and is consistent with the risk approaches outlined in US EPA guidance. Specifically, we considered evaluation criteria detailed in IEPA guidance documents (*e.g.*, IEPA, 2013a, 2019), incorporating principles and assumptions consistent with the Federal CCR Rule (US EPA, 2015) and US EPA's "Human and Ecological Risk Assessment of Coal Combustion Residuals" (US EPA, 2014).

Based on the evaluation presented in this report, no unacceptable risks to human and ecological receptors resulting from CCR exposures associated with either the GMF or the BAB were identified. Specific risk assessment results include the following:

- No complete exposure pathways were identified for human receptors such as recreators.
- No unacceptable risks were identified for ecological receptors exposed to surface water or sediment.
- No bioaccumulative ecological risks were identified.

It should be noted that this evaluation incorporates a number of conservative assumptions that tend to overestimate exposure and risk. Moreover, it should be noted that because current conditions do not present a risk to human health or the environment, there will also be no unacceptable risk to human health or the environment for future conditions when the GMF and BAB are closed. For all future closure scenarios, potential releases of CCR-related constituents will decline over time and consequently potential exposures to CCR-related constituents in the environment will also decline.

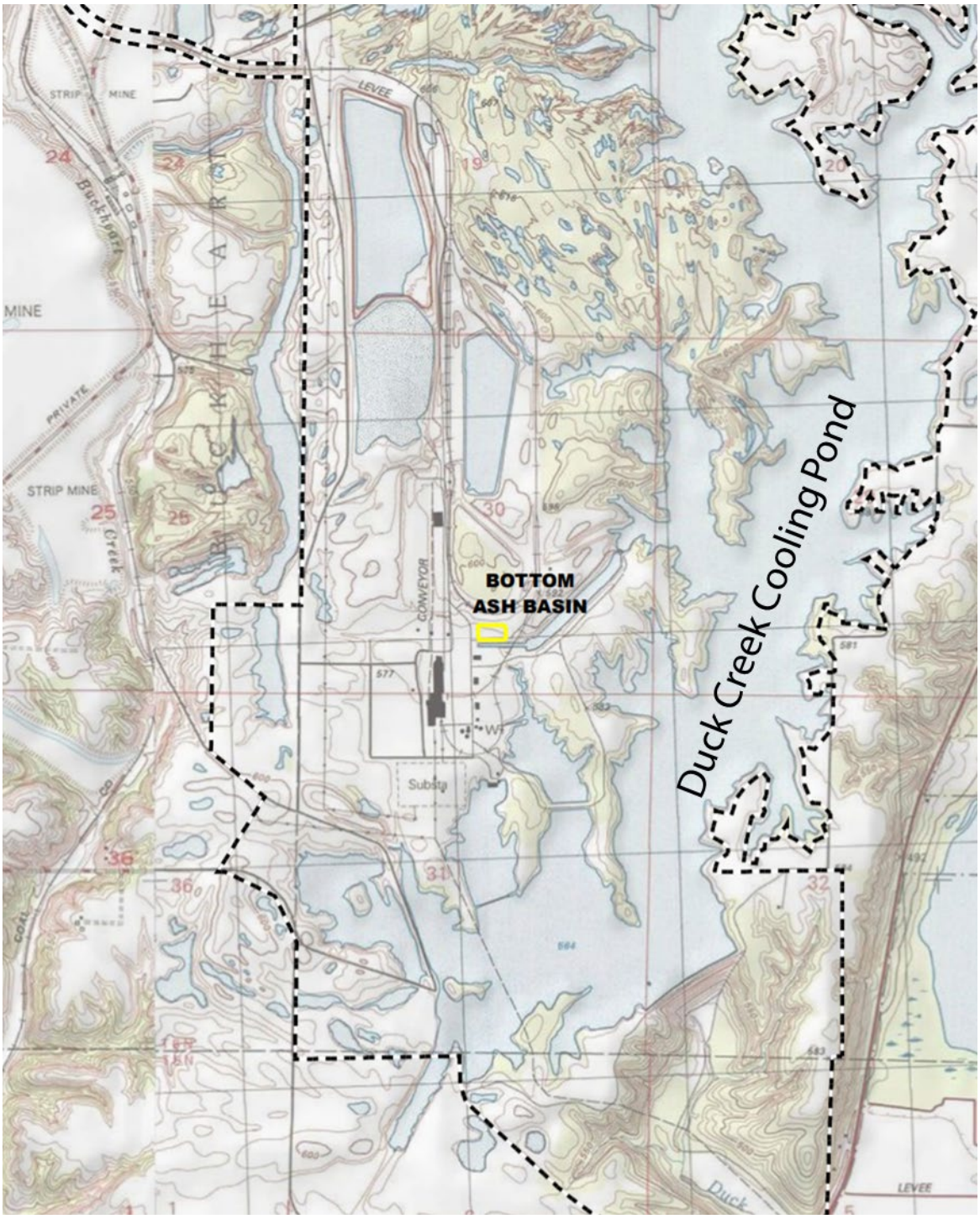

Figure 1.1 Location of BAB. BAB = Bottom Ash Basin; DCPP = Duck Creek Power Plant. DCPP property outline is shown with a dashed line. Source: Ramboll (2021c).

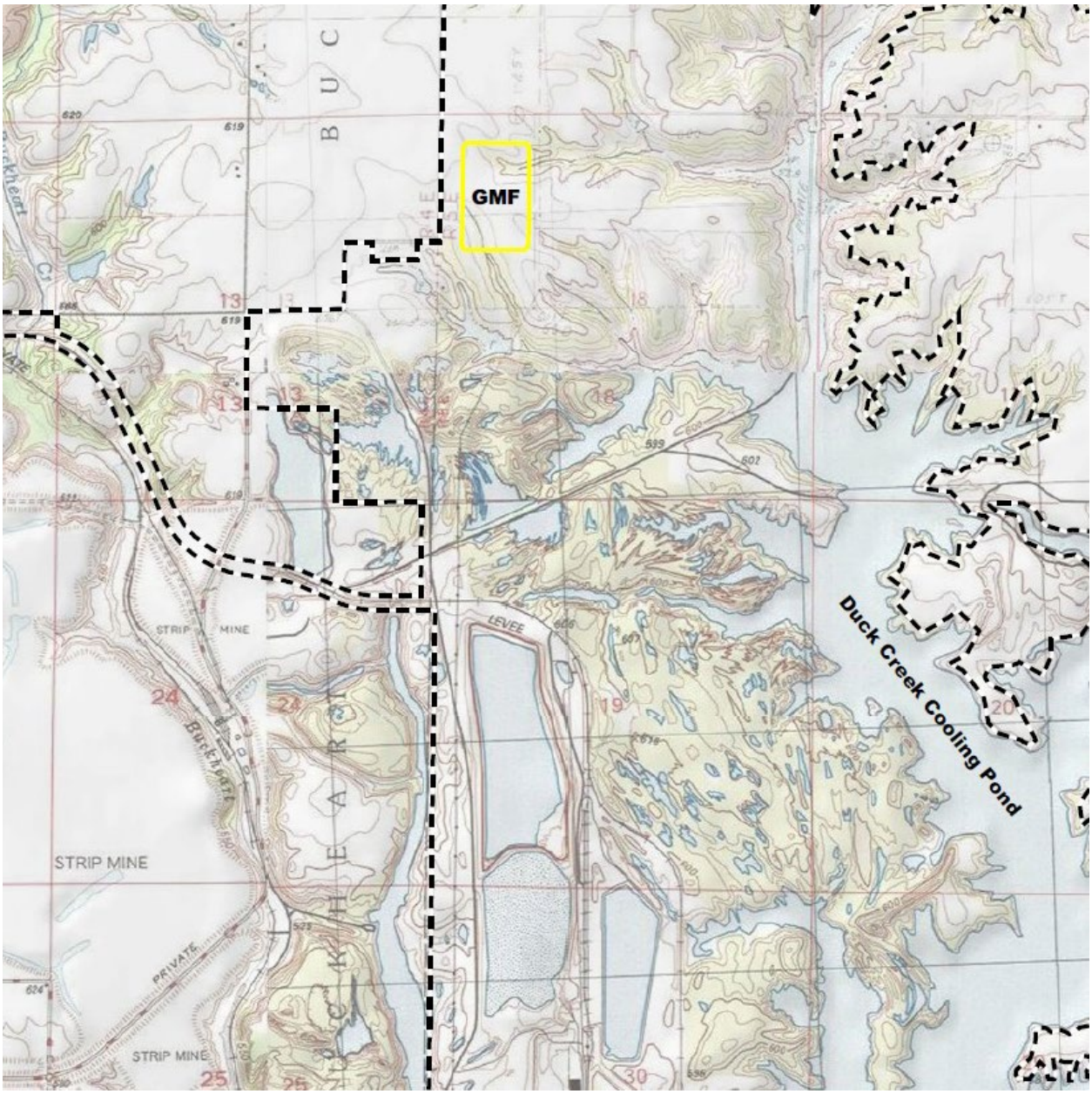

Figure 1.2 Location of GMF. DCPP = Duck Creek Power Plant; GMF = Gypsum Management Facility. DCPP property outline is shown with a dashed line. Source: Ramboll (2021d).

2 Site Overview

2.1 Site Description

2.1.1 Bottom Ash Basin (BAB)

Geology/Hydrogeology

The BAB is located just northeast of the DCPP. The geology underlying the Site in the vicinity of the BAB primarily consists of unconsolidated unlithified materials of loess and till deposits that overlie a Pennsylvanian-age shale bedrock unit (Ramboll, 2021a). Previous investigations completed outside of the BAB indicate that bedrock in the area is overlain by deposits of coal mine spoils[1] (AECOM, 2016). The DCCP, located approximately 500 ft to the east of the BAB, is the nearest major surface water body that is hydraulically downgradient of the BAB. The DCCP water flows south into Duck Creek *via* National Pollutant Discharge Elimination System (NPDES) outfalls and ultimately drains into the Illinois River (IEPA, 2013b).

Two distinct hydrostratigraphic units were identified near the BAB: (a) the uppermost aquifer and (b) a confining shale bedrock unit. A detailed description of these two units is provided below.

The uppermost aquifer consists of loess and till (Ramboll, 2021a). The most permeable portion of the uppermost aquifer is a 2- to 7-feet-thick sand layer located within the till. This sand unit, encountered at a depth of 18-40 ft below ground surface (bgs), forms the primary conduit for horizontal migration of shallow groundwater near the BAB (Ramboll, 2021a).

The geometric mean of field hydraulic conductivities measured in the uppermost aquifer is about 6.33×10^{-4} cm/sec (Ramboll, 2021a). However, the more permeable sand layer within the till has an average conductivity value of 3.4×10^{-2} cm/sec. Groundwater in the uppermost aquifer flows in the south-southeasterly direction toward the DCCP at a velocity of approximately 0.04 ft/day[2] (Ramboll, 2021a). An average horizontal hydraulic head gradient of approximately 0.01 ft/ft was estimated within the uppermost aquifer near the BAB[3] (Ramboll, 2021a).

Shale bedrock lies beneath the unconsolidated deposits between 26 and 46 ft bgs (Ramboll, 2021a). The bedrock acts as an aquitard with mean hydraulic conductivity values ranging between 2×10^{-6} and 9×10^{-6} cm/sec (AECOM, 2016; Ramboll, 2021a). Bedrock packer tests within the top 100 ft yielded virtually no water (AECOM, 2016). These results, indicate that the shale bedrock is a significant barrier to vertical migration of groundwater.

[1] Several large-scale surface water coal mine operations had been reported in the vicinity of the BAB since the 1930s (AECOM, 2016; Ramboll, 2021); however, those mining activities ceased by 1984 (AECOM, 2016).
[2] The average velocities measured between BA05 and BA04, BA01 and BA03, and BA06 and BA02 were 0.032, 0.050, and 0.030 ft/day, respectively (Ramboll, 2021).
[3] The average head gradients measured between BA05 and BA04, BA01 and BA03, and BA06 and BA02 were 0.0132, 0.0062, and 0.0078 ft/ft, respectively (Ramboll, 2021).

2.1.2 Gypsum Management Facility (GMF)

Geology/Hydrogeology

The GMF is located 2.4 miles north of the DCPP. The geology underlying the Site near the GMF primarily consists of unlithified materials of loess and till deposits that overlie a Pennsylvanian-age shale bedrock unit (Ramboll, 2021b,e; Natural Resource Technology, 2017). The unlithified deposits are present in former coal mine spoils and form shallow water-bearing units beneath the GMF (Ramboll, 2021e; Natural Resource Technology, 2017).

Much of the surface water drainage in the vicinity of the GMF flows into the DCCP (Natural Resource Technology, 2017). The DCCP water drains into Duck Creek *via* NPDES-permitted outfalls and ultimately discharges to the Illinois River (IEPA, 2013b).

The three major hydrostratigraphic units near the GMF are: (a) the uppermost aquifer, (b) the lower confining unit, and (c) the shale bedrock confining unit. A detailed description of these three units is provided below.

Shallow groundwater occurs within two unconsolidated water-bearing units that form the uppermost aquifer: (i) the Peoria/Roxanna loess zone and (ii) the shallow sand unit (Ramboll, 2021b,e; Natural Resource Technology, 2017). The Peoria/Roxanna loess zone, composed of silt, silty-clay, and minor amounts of sand, is hydraulically connected to the 1- to 18-ft-thick shallow sand unit that is laterally extensive across the Site (Ramboll, 2021b,e; Natural Resource Technology, 2017). The shallow sand unit is the primary conduit for horizontal migration of shallow groundwater (Ramboll, 2021b). The geometric mean of field-measured hydraulic conductivities within the uppermost aquifer in the GMF area is 3.58×10^{-4} cm/sec (Ramboll, 2021b).

Groundwater in the uppermost aquifer flows to the east-southeast toward the DCCP from topographically high- to low-lying areas (Ramboll, 2021b; Natural Resource Technology, 2017). Groundwater in the uppermost aquifer flows at a velocity of approximately 0.24 ft/day[4] (Ramboll, 2021b). An average horizontal hydraulic head gradient of approximately 0.02 ft/ft was estimated within the uppermost aquifer near the GMF[5] (Ramboll, 2021b).

The lower confining unit consists of till that underlies the uppermost aquifer (Natural Resource Technology, 2017). The till layer restricts vertical migration of groundwater due to its low hydraulic conductivity value of 1.9×10^{-7} cm /sec (Ramboll, 2021b; Natural Resource Technology, 2017). Shale bedrock lies beneath the till in this area (Natural Resource Technology, 2017; Ramboll, 2021e). The bedrock is not hydraulically connected to the uppermost aquifer due to the presence of the till (Natural Resource Technology, 2017).

2.2 Conceptual Site Model

A Conceptual Site Model (CSM) describes the sources of contamination, hydrogeological units, and physical processes that control the transport of water and solutes. In this case, the CSM describes how groundwater underlying the BAB and GMF may migrate and interact with surface water and sediment in

[4] The average groundwater velocities measured between G50S and G64S, G50S and G60S, and G51S and G54S were 0.045, 0.625, and 0.041 ft/day, respectively (Ramboll, 2021b). [5] The average head gradients measured between G50S and G64S, G50S and G60S, and G51S and G54S were 0.0121, 0.0172, and 0.0199 ft/ft, respectively (Ramboll, 2021b).

[5] The average head gradients measured between G50S and G64S, G50S and G60S, and G51S and G54S were 0.0121, 0.0172, and 0.0199 ft/ft, respectively (Ramboll, 2021b).

the adjacent DCCP. The CSM was developed using available hydrogeological data (Natural Resource Technology, 2017; Ramboll, 2021e), including information on groundwater flow and surface water characteristics.

Near the BAB, shallow groundwater flows through the uppermost aquifer in a southward direction toward a surface water channel, located about 50 ft to the south, that leads to the DCCP (Ramboll, 2021a). The primary horizontal migration pathway is within the sand layers of the uppermost aquifer. Groundwater flows horizontally rather than vertically through the uppermost aquifer because: (i) vertical hydraulic conductivities within the uppermost aquifer are several orders of magnitude lower than horizontal hydraulic conductivities, and (ii) the underlying shale bedrock acts as an aquitard preventing downward migration (AECOM, 2016; Ramboll, 2021a). Groundwater within the uppermost aquifer near the BAB flows into the DCCP. No other potential groundwater transport pathways exist. At its discharge location, groundwater mixes with surface water in the DCCP. Because the DCCP serves as a sink for groundwater discharge in the area, shallow groundwater migration beneath or beyond the DCCP is unlikely.

Near the GMF, shallow groundwater flows horizontally through the uppermost aquifer from northwest to southeast toward the DCCP (Natural Resource Technology, 2017; Ramboll, 2021b,e). The preferential flow of groundwater is horizontal rather than vertical because the underlying till and shale bedrock restrict groundwater flow (Natural Resource Technology, 2017). Groundwater within the uppermost aquifer near the GMF flows into the DCCP. No other potential groundwater transport pathways exist. At its discharge location, groundwater mixes with surface water in the DCCP. Because the DCCP serves as a sink for groundwater discharge in the area, shallow groundwater migration beneath or beyond the DCCP is unlikely.

2.3 Groundwater Monitoring

The analyses presented in this report relied upon the data from the wells used to monitor the BAB and GMF. A total of ten wells were used to monitor the BAB (Table 2.1); of these, six wells are screened in the uppermost aquifer (UA), one well is screened in the bedrock unit (BR), and three wells are screened in a sandy layer within the uppermost aquifer that has been identified as the primary conduit for groundwater flow (Ramboll, 2021a). A total of 31 wells were used to monitor the GMF (Table 2.2); of these, 15 wells are screened in the uppermost aquifer (UA), 1 well is screened in the BR, 13 wells are screened in a sandy layer within the uppermost aquifer that has been identified as the primary conduit for groundwater flow; and the location of 2 wells is unspecified (Ramboll, 2021b).

The analyses presented in this report relied on all available data from the specified wells collected between 2015 and 2021, which is the period subsequent to the promulgation of the Federal CCR Rule (US EPA, 2015). Groundwater samples were analyzed for a suite of constituents specified in Illinois CCR Rule Part 845.600 (IEPA, 2021a). A summary of the groundwater data used in this risk evaluation is presented in Table 2.3 (for the BAB) and Table 2.4 (for the GMF).

Table 2.1 Groundwater Monitoring Wells Related to the BAB

Well	Date Constructed	Screen Top Depth (ft bgs)	Screen Bottom Depth (ft bgs)	Well Depth from Ground Surface (ft bgs)	Hydrogeologic Unit[a]
BA01	12/16/2015	33.06	37.73	38.20	UA
BA01C	02/08/2021	35.81	45.26	45.90	BR
BA01L	02/05/2021	11.90	21.37	22.15	UA-PMP
BA02	12/30/2015	23.63	28.43	28.80	UA
BA02L	02/04/2021	6.98	11.66	12.09	UA-PMP
BA03	12/29/2015	16.11	25.57	26.20	UA
BA03L	02/02/2021	5.25	9.94	10.29	UA-PMP
BA04	12/29/2015	24.58	29.38	29.80	UA
BA05	07/28/2016	36.48	46.08	46.60	UA
BA06	08/03/2016	32.32	41.93	42.40	UA

Notes:
BAB = Bottom Ash Basin; bgs = Below Ground Surface.
(a) BR = bedrock unit; UA = uppermost aquifer; UA-PMP = sandy layer within the uppermost aquifer that has been identified as the primary conduit for groundwater flow.

Table 2.2 Groundwater Monitoring Wells Related to the GMF

Well Number	Date Constructed	Screen Top Depth (ft bgs)	Screen Bottom Depth (ft bgs)	Well Depth (ft bgs)	Hydrogeologic Unit[a]
G02S	09/29/2003	23.00	28.00	28.00	UA
G50S	03/13/2007	–	33.98	34.30	UA
G51L	01/28/2008	12.04	16.83	17.21	UA-PMP
G51S	01/28/2008	24.01	28.79	29.16	UA
G52L	01/22/2008	29.21	33.80	34.17	UA-PMP
G52S	01/22/2008	39.15	43.93	44.20	UA
G53L	02/05/2009	16.97	26.32	26.79	UA-PMP
G53S	02/05/2009	30.64	35.13	35.56	UA
G54C	02/05/2021	91.59	101.50	102.00	BR
G54L	02/12/2009	27.32	36.75	37.22	UA-PMP
G54S	02/12/2009	43.50	47.97	48.41	UA
G55L	02/19/2009	36.12	36.60	36.60	UA-PMP
G55S	02/19/2009	41.04	45.49	45.96	UA
G56L	02/16/2009	13.77	22.11	22.89	UA-PMP
G56S	02/16/2009	33.17	37.66	38.29	UA
G57L	01/30/2009	16.17	25.62	26.00	UA-PMP
G57S	01/30/2009	29.65	34.18	34.62	UA
G58L	01/26/2009	20.69	30.10	30.56	UA-PMP
G58S	01/26/2009	31.32	35.80	36.43	UA
G59L	01/23/2009	22.91	32.33	33.03	UA-PMP
G59S	01/23/2009	37.38	41.88	42.49	UA
G60L	01/17/2008	20.12	24.91	25.28	UA-PMP
G60S	01/16/2008	31.12	35.91	36.29	UA
G61S	01/21/2009	30.19	34.63	35.26	UA
G62L	01/22/2009	20.31	29.66	30.12	UA-PMP
G63L	02/02/2009	18.47	27.89	28.36	UA-PMP
G63S	02/02/2009	34.52	39.01	39.47	UA
G64L	01/22/2009	18.12	27.48	27.95	UA-PMP
G64S	01/22/2009	34.50	38.99	39.48	UA
P60	03/15/2017	29.55	34.14	34.60	–
R61L	03/14/2017	18.54	28.17	28.70	–

Notes:
bgs = Below Ground Surface; GMF = Gypsum Management Facility.
(a) – = data not available; BR = bedrock; UA = uppermost aquifer; UA-PMP = sandy layer within the uppermost aquifer that has been identified as the primary conduit for groundwater flow.

Figure 2.1 Groundwater Monitoring Well Locations – BAB. BAB = Bottom Ash Basin. Source: Ramboll US Corp. (2021a).

Figure 2.2 Groundwater Monitoring Well Locations – GMF. GMF = Gypsum Management Facility. Adapted from: Ramboll US Corp. (2021b).

Table 2.3 Groundwater Data Summary – BAB, 2015-2021

Constituent	Samples with Constituent Detected	Samples Analyzed	Minimum Detect	Maximum Detect	Maximum Detection Limit
Total Metals (mg/L)					
Antimony	0	80	–	–	0.003
Arsenic	61	80	0.001	0.024	0.001
Barium	80	80	0.046	0.48	0.001
Beryllium	4	80	0.0015	0.0068	0.001
Boron	128	128	0.017	7.8	0.015
Cadmium	0	80	–	–	0.001
Chromium	17	80	0.0044	0.073	0.004
Cobalt	29	80	0.002	0.037	0.002
Lead	34	80	0.0011	0.042	0.001
Lithium	10	80	0.011	0.068	0.02
Mercury	3	80	0.0002	0.0012	0.0002
Molybdenum	77	80	0.001	0.015	0.001
Selenium	12	80	0.0011	0.015	0.001
Thallium	1	80	0.001	0.001	0.001
Dissolved Metals (mg/L)					
Arsenic	1	2	0.0045	0.0045	0.001
Radionuclides (pCi/L)					
Radium-226+228	76	76	0.0508	9.64	0.944
Other (mg/L, unless otherwise specified)					
Chloride	127	128	2	700	250
Fluoride	71	128	0.25	0.692	0.25
pH (SU)	136	136	6.2	7.7	–
Sulfate	128	128	1.3	890	250
Total Dissolved Solids	128	128	200	2,300	26

Note:
– = Not Applicable; BAB = Bottom Ash Basin; SU = Standard Unit.

Table 2.4 Groundwater Data Summary – GMF, 2015-2021

Constituent	Samples with Constituent Detected	Samples Analyzed	Minimum Detect	Maximum Detect	Maximum Detection Limit
Total Metals (mg/L)					
Antimony	2	82	0.0037	0.0064	0.003
Arsenic	118	182	0.001	0.051	0.001
Barium	82	82	0.014	0.47	0.001
Beryllium	2	82	0.0013	0.0027	0.001
Boron	217	237	0.01	1.9	0.01
Cadmium	1	83	0.0016	0.0016	0.001
Chromium	7	82	0.0052	0.015	0.004
Cobalt	11	82	0.0021	0.0052	0.002
Lead	79	182	0.0011	0.041	0.001
Lithium	4	82	0.01	0.018	0.02
Mercury	4	82	0.00021	0.0004	0.0002
Molybdenum	42	82	0.001	0.041	0.001
Selenium	4	82	0.0013	0.0031	0.001
Thallium	3	82	0.001	0.0033	0.001
Dissolved Metals (mg/L)					
Antimony	4	665	0.0034	0.012	0.003
Arsenic	209	672	0.001	0.035	0.002
Barium	665	665	0.0076	0.47	0.001
Beryllium	0	18	–	–	0.001
Boron	561	666	0.011	3	0.02
Cadmium	7	666	0.0012	0.0085	0.002
Chromium	20	665	0.0043	0.041	0.004
Cobalt	63	642	0.0021	0.028	0.002
Lead	20	666	0.0011	0.19	0.002
Lithium	0	5	–	–	0.01
Mercury	2	665	0.00024	0.00026	0.0002
Selenium	19	107	0.0011	0.25	0.001
Radionuclides (pCi/L)					
Radium-226+228	83	83	0	5.38	5
Other (mg/L, unless otherwise specified)[a]					
Chloride	228	230	1.1	75	50
Fluoride	86	139	0.25	0.465	0.25
pH (SU)	299	299	6.1	7.5	–
Sulfate	231	232	1.2	540	250
Total Dissolved Solids	134	134	280	900	26

Notes:
– = Not Applicable; GMF = Gypsum Management Facility; SU = Standard Unit
(a) Results for analytes in the "other" group are based on unfiltered samples.

3 Risk Evaluation

3.1 Risk Evaluation Process

A risk evaluation was conducted to determine whether constituents present in groundwater underlying and downgradient of the GMF and BAB have the potential to pose adverse health effects to human and ecological receptors. The risk evaluation is consistent with the principles of risk assessment established by US EPA and has considered evaluation criteria detailed in Illinois guidance documents (*e.g.*, IEPA, 2013a, 2019).

The general risk evaluation approach is summarized in Figure 3.1 and discussed below.

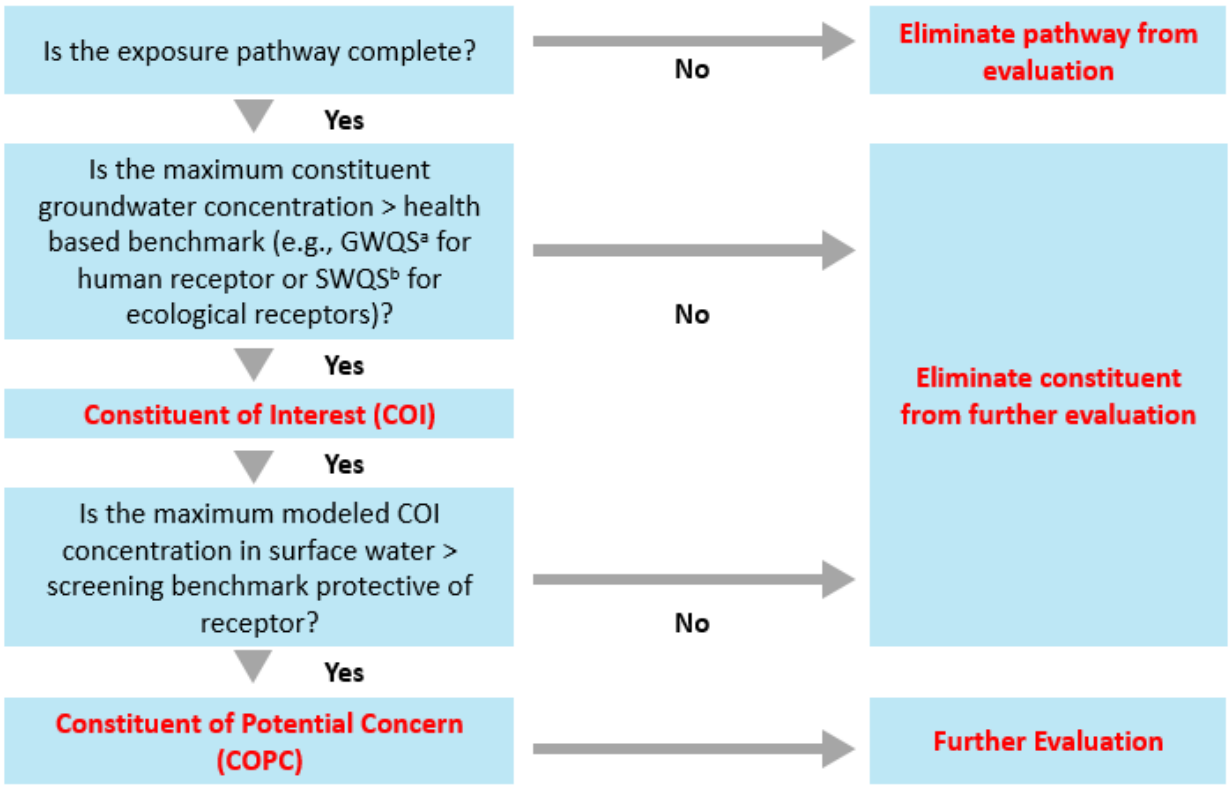

Figure 3.1 Overview of Risk Evaluation Methodology. CCR = Coal Combustion Residuals; COI = Constituent of Interest; IEPA = Illinois Environmental Protection Agency; GWQS = Groundwater Quality Standard; SWQS = Surface Water Quality Standard; US EPA = United States Environmental Protection Agency. (a) The Illinois CCR Rule Part 845.600 GWPS are used to identify human health COIs if human health exposure pathways are complete. (b) IEPA SWQS protective of chronic exposures are used to identify ecological COIs. In the absence of a SWQS, US EPA Region IV ecological screening values are used.

The first step in the risk evaluation was to develop the CEMs and identify complete exposure pathways. All potential receptors and exposure pathways based on groundwater use and surface water use in the vicinity of the Site were considered. Exposure pathways that are incomplete were excluded from the evaluation. As described in Section 3.2, none of the human exposure pathways were considered complete; therefore, risks to human health were not evaluated further.

The risk assessment evaluated ecological risks in the DCCP. Ecological COIs were identified as constituents with maximum concentrations in groundwater in excess of a surface water quality standard (SWQS) for ecological receptors. Based on the CSM (Section 3.2.2), groundwater underlying the BAB and GMF flows east into the DCCP. Therefore, any potential CCR-related constituents in groundwater would flow toward and discharge into the DCCP.

Surface water and sediment samples have not been collected from the DCCP. Therefore, Gradient modeled the potential migration of COIs from groundwater to surface water and sediment to evaluate potential risks to ecological receptors (see Section 3.3.3). Gradient modeled the COI concentrations in surface water and sediment separately for BAB and GMF, based on the groundwater data from the wells associated with those two CCR management units. The modeled COI concentrations in surface water and sediment were compared to conservative, generic risk-based screening benchmarks for ecological receptors. These generic screening benchmarks rely on default assumptions with limited consideration of Site-specific characteristics. Ecological benchmarks are medium-specific values designed to be protective of all potential ecological receptors exposed to surface water. Ecological screening benchmarks are inherently conservative because they are intended to screen out chemicals that are of no concern with a high level of confidence. Therefore, a modeled COI concentration exceeding a screening benchmark does not indicate an unacceptable risk, but does indicate that further risk evaluation is warranted. COIs with maximum concentrations exceeding a conservative screening benchmark are identified as COPCs requiring further evaluation.

As described in more detail below, this evaluation relied on the screening assessment to demonstrate that constituents present in groundwater underlying the BAB and GMF do not pose an unacceptable ecological risk. That is, after the screening step, no COPCs were identified and further assessment was not warranted.

3.2 Human Conceptual Exposure Model

A CEM provides an overview of the receptors and exposure pathways requiring risk evaluation. The CEM describes the source of the contamination, the mechanism that may lead to a release of contamination, the environmental media to which a receptor may be exposed, the route of exposure (exposure pathway), and the types of receptors that may be exposed to these environmental media.

The human CEM for the Site depicts the relationships between the off-Site environmental media potentially impacted by constituents in groundwater and human receptors that could be exposed to these media. Figure 3.2 presents a human CEM for the Site. It considers a human receptor who could be exposed to COIs hypothetically released from the BAB and the GMF into groundwater, surface water, sediment, and fish. The following human receptors and exposure pathways were considered for inclusion in the Site-specific CEM.

- Residents – exposure to groundwater/surface water as drinking water
- Residents – exposure to groundwater/surface water used for irrigation
- Recreators in the DCCP to the east of the Site
  - Boaters – exposure to surface water and sediment while boating
  - Swimmers – exposure to surface water and sediment while swimming
  - Anglers – exposure to surface water and sediment *via* consumption of locally caught fish

3.2.1 Exposure from Recreational Activities in Surface Water

As shown in Figure 3.2, all of the exposure pathways related to recreational activities in surface water were considered incomplete, and thus were not evaluated in this risk assessment. Groundwater beneath the BAB and GMF flows into the DCCP. The DCCP is owned by IPRG, and access to it is restricted, thus the DCCP is not used for any recreational activities, including boating, swimming, or fishing.

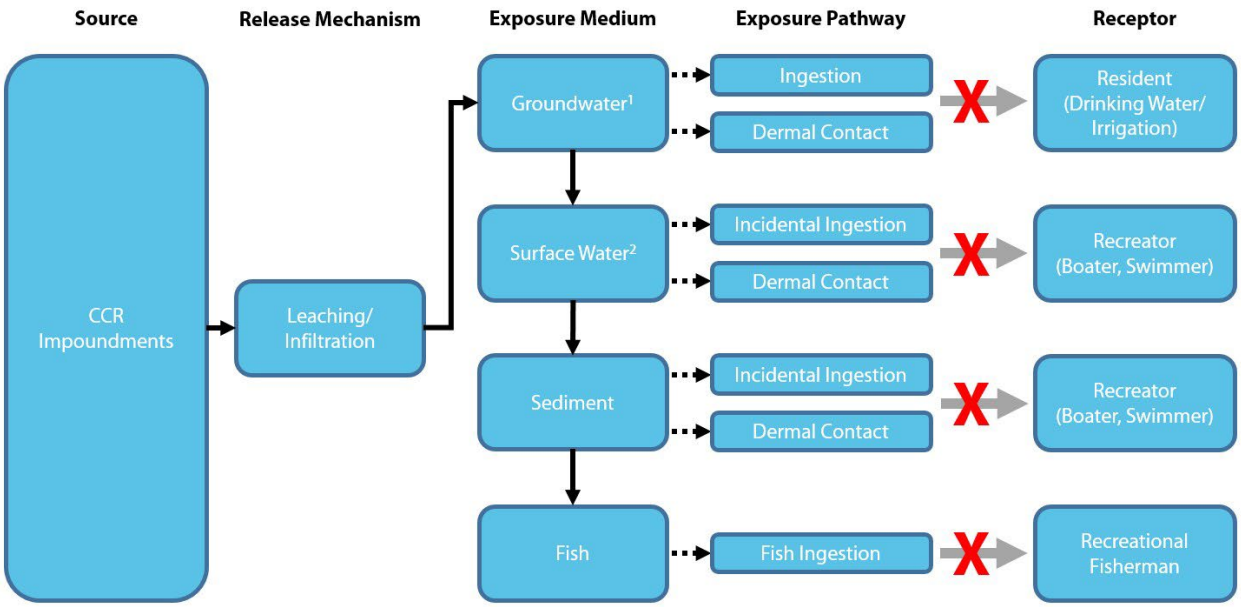

Figure 3.2 Human Conceptual Exposure Model. CCR = Coal Combustion Residual. Dashed line/Red X = Incomplete or insignificant exposure pathway. (1) Groundwater in the vicinity of the Site is not used as a drinking water or irrigation source. (2) Surface water is not used as a drinking water source.

3.2.2 Exposure from Groundwater or Surface Water as a Drinking Water/Irrigation Source

The following sections explain why the residential drinking water and irrigation pathways are incomplete.

3.2.2.1 BAB

Groundwater as a source of drinking water and/or irrigation water is not a complete exposure pathway for potential CCR-related constituents that originated from the BAB. Specifically, shallow groundwater from

the uppermost aquifer in the vicinity of the BAB is not used as a source of drinking water, and no public groundwater systems are downgradient of the DCPP. Further, the downward migration of groundwater from the uppermost aquifer is largely restricted due to the presence of a thick, shale bedrock unit (Ramboll, 2021a; AECOM, 2016). A summary of the evidence supporting the conclusion that residential uses of the shallow groundwater and DCCP water adjacent to the BAB as sources of drinking water are incomplete exposure pathways is presented below.

- **No potential groundwater receptors are in the vicinity of the BAB**. To identify drinking water receptors within a 1,000 m radius of the BAB, a potable water well survey was completed in 2021 utilizing the following federal and state databases (as cited in Ramboll, 2021a): United States Geological Survey (USGS) National Groundwater Monitoring Network (NGWMN) (USGS, 2021); Illinois State Geological Survey (ISGS) Illinois Water and Related Wells (ILWATER) Map (ISGS, 2020); US EPA Safe Drinking Water Information System (SDWIS) (US EPA, 2021); and IEPA Illinois Drinking Water Watch (DWW) (IEPA, 2021b).
    - No potable public supply wells or intakes were identified within a 1,000 m radial distance from the BAB (Ramboll, 2021a).
    - In a prior investigation, only one water supply well was detected one mile north-northwest of Ash Pond 2, but that well is not located downgradient of the BAB (AECOM, 2016).
- **There is no potential off-Site migration of constituents in groundwater to nearby wells because all shallow groundwater discharges into the DCCP.** The DCCP is the discharge point for groundwater from the uppermost aquifer. Groundwater hydraulic head measurements in the uppermost aquifer indicate that groundwater flows southward toward a channel that is connected to the DCCP (Ramboll, 2021a). Because the DCCP serves as the regional groundwater discharge location in the area, constituents present in groundwater are not likely to migrate underneath or beyond the DCCP.
- **The DCCP adjacent to the Site is not used as a public water supply.** The DCCP is owned and maintained by IPRG. IPRG restricts the use of the pond as a source of drinking water or for recreation. Therefore, the human exposure pathway *via* surface water ingestion in the DCCP was not evaluated further.
- **The uppermost aquifer has a limited hydraulic connection to the underlying bedrock unit.** The bedrock acts as an aquitard with mean hydraulic conductivity values ranging between 2×10^{-6} and 9×10^{-6} cm /sec (AECOM, 2016; Ramboll, 2021a) and bedrock packer tests within the top 100 ft yielded virtually no water (AECOM, 2016). Based on these results, it was concluded that the shale bedrock is a significant barrier to groundwater migration.

3.2.2.2 GMF

Groundwater as a source of drinking water and/or irrigation water is not a complete exposure pathway for CCR-related constituents originating from the GMF. Specifically, shallow groundwater from the uppermost aquifer in the vicinity of the GMF is not used as a source of drinking water, and no public groundwater systems are downgradient of Duck Creek. Additionally, the downward migration of groundwater from the uppermost water-bearing unit is largely restricted due to the presence of underlying low-permeability till and shale bedrock. A summary of the evidence supporting the conclusion that residential uses of the shallow groundwater and DCCP water adjacent to the GMF as sources of drinking water are incomplete exposure pathways is presented below.

- **No potential groundwater receptors are in the vicinity of the GMF.** To identify drinking water receptors within a 1,000 m radius of the GMF, a potable water well survey was completed in 2021 utilizing the following federal and state databases (Ramboll, 2021b): USGS NGWMN (USGS, 2021); ISGS ILWATER Map (ISGS, 2020); US EPA SDWIS (US EPA, 2021); and IEPA Illinois DWW (IEPA, 2021b).
  - One private well was identified within a 1,000 m radial distance from the GMF (Ramboll, 2021b). However, the well is located southwest of the GMF, while the groundwater flow within the uppermost aquifer is toward the southeast (Ramboll, 2021b); therefore, this well is not considered to be downgradient of the GMF (Ramboll, 2021b).
- **There is no off-Site groundwater migration to any off-Site wells because all shallow groundwater flows into the DCCP.** The DCCP is the discharge point for groundwater from the uppermost aquifer. Groundwater hydraulic head measurements in a total of 7 wells[6] screened within the uppermost aquifer at the GMF indicate that groundwater flows toward the DCCP (Ramboll, 2021b,e). Because the DCCP serves as the regional groundwater discharge location, shallow groundwater near the GMF is not likely to migrate underneath or beyond the DCCP.
- **The DCCP adjacent to the Site is not used as a public water supply.** The DCCP is owned and maintained by IPRG. IPRG restricts the use of the pond as a source of drinking water and/or for recreation. Therefore, the human exposure pathway *via* surface water ingestion adjacent to the GMF was not evaluated further.
- **The GMF has a limited hydraulic connection to deep groundwater.** Three laboratory permeability tests on the lower confining till unit underlying the uppermost aquifer yielded a low mean hydraulic conductivity value of 1.9×10^{-7} cm/sec (Natural Resource Technology, 2017). In addition, the underlying shale bedrock acts as a low-permeability aquitard that restricts vertical intrusion of shallow groundwater. These results indicate that the till and shale bedrock are a significant barrier to groundwater migration.

3.3 Ecological Conceptual Exposure Model

The ecological CEM for the Site depicts the relationships between off-Site environmental media (surface water and sediment) potentially impacted by COIs in groundwater and ecological receptors that may be exposed to these media. The ecological risk evaluation considered both direct toxicity as well as secondary toxicity *via* bioaccumulation. Figure 3.3 presents the ecological CEM for the Site. The following ecological receptor groups and exposure pathways were considered.

- **Ecological Receptors Exposed to Surface Water:**
  - Aquatic plants, amphibians, reptiles, and fish.
- **Ecological Receptors Exposed to Sediment:**
  - Benthic invertebrates (*e.g.*, insects, crayfish, mussels).

[6] Three CCR Rule background monitoring wells (G02S, G50S, and G51S), four CCR Rule downgradient monitoring wells (G54S, G57S, G60S, and G64S) (Ramboll, 2021e).

- **Ecological Receptors Exposed to Bioaccumulative COIs:**
  - Higher trophic-level wildlife (avian and mammalian) *via* direct exposures (surface water and sediment exposure) and secondary exposures through the consumption of prey (*e.g.*, plants, invertebrates, small mammals, fish).

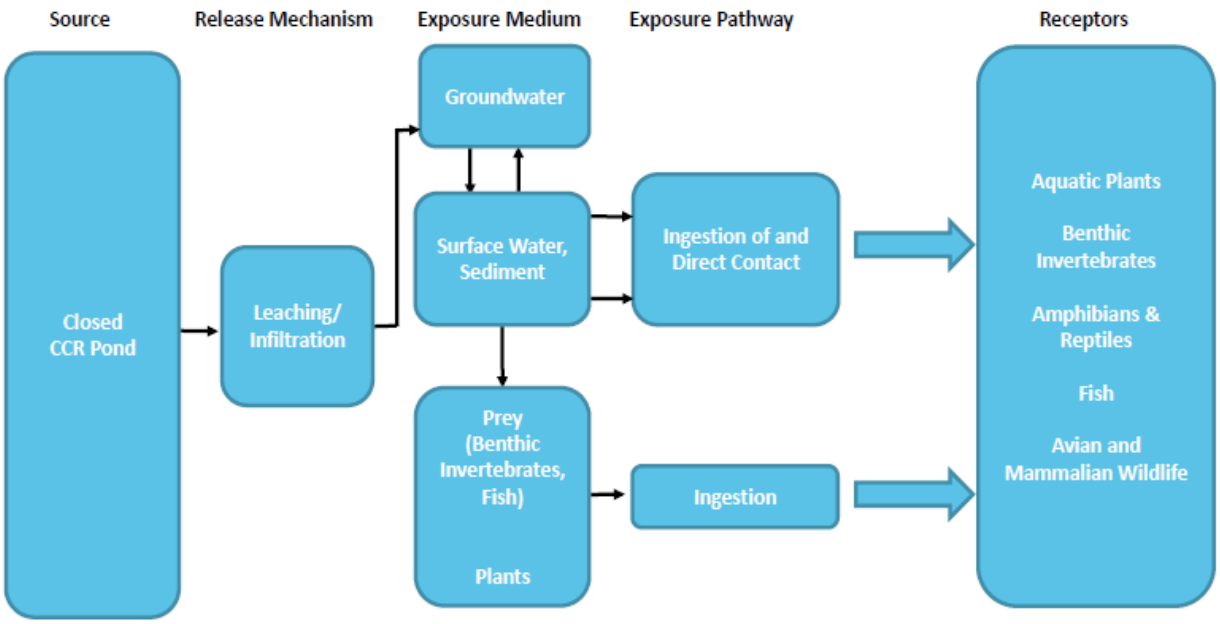

Figure 3.3 Ecological Conceptual Exposure Model. CCR = Coal Combustion Residual.

3.4 Identification of Ecological Constituents of Interest

Risks were evaluated for ecological COIs. A constituent was considered a COI if the maximum detected constituent concentration in groundwater exceeded a benchmark protective of ecological receptors. According to US EPA Risk Assessment Guidance (US EPA, 1989), this screening step is designed to reduce the number of constituents carried through the risk evaluation that are anticipated to have a minimal contribution to the overall risk. Identified COIs are the constituents that are most likely to pose a risk concern in DCCP surface water and sediment. As described above, there were no complete human health exposure pathways. Therefore, COIs were identified to support an ecological risk evaluation only.

3.4.1 Ecological Constituents of Interest

The Illinois GWPSs, as defined in IEPA's guidance, were developed to protect human health, but not necessarily ecological receptors. While ecological receptors are not exposed to groundwater, groundwater can potentially migrate into the adjacent surface water and impact ecological receptors. Therefore, the maximum concentrations of analytes detected in groundwater were compared to ecological surface water benchmarks protective of aquatic life to identify ecological COIs.

The surface water screening benchmarks for freshwater organisms were obtained from the following hierarchy of sources:

- IEPA (2019) SWQSs. IEPA SWQSs are health-protective benchmarks for aquatic life exposed to surface water on a long-term basis (*i.e.*, chronic exposure). The SWQSs for several metals are hardness-dependent (in this case cadmium and lead). Screening benchmarks for these constituents were calculated assuming US EPA's (2019) default hardness of 100 mg/L because hardness data are not available for the DCCP.
- NRWQC – Aquatic Life Criteria Table (US EPA, 2019).
- US EPA Region IV (2018) surface water Ecological Screening Values (ESVs) for hazardous waste sites.

For radium, benchmarks from the United States Department of Energy (US DOE) guidance document "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota" (US DOE, 2019) were used. US DOE presents benchmarks for radium-226 and radium-228 separately (4 and 3 pCi/L, respectively) (US DOE, 2019). Given that radium concentrations are expressed as total radium (radium-226+228, *i.e.*, the sum of radium-226 and radium-228), Gradient used the lower of the two benchmarks (3 pCi/L for radium-228) to evaluate total radium concentrations. The IEPA (2019, Section 302.207) general Surface Water Quality Standard for radium notes that the annual average combined concentration of radium-226+228 must not exceed 3.75 pCi/L; however, this value is not necessarily based on protection of ecological receptors, therefore the benchmark of 3 pCi/L from US DOE (2019) was used.

Gradient used the maximum detected concentrations from groundwater samples collected from the wells associated with the BAB and GMF, without considering spatial or temporal representativeness for ecological receptor exposures. The use of the maximum constituent concentrations in this evaluation is designed to conservatively identify COIs that warrant further investigation.

Boron, cobalt, lead, mercury, radium-226+228, and chloride were identified as COIs for ecological receptors in the BAB (Table 3.1). Cadmium and cobalt were identified as COIs for ecological receptors in the GMF (Table 3.2).

Table 3.1 Ecological Constituents of Interest – BAB

Analyte[a]	Maximum Detected Concentration	Ecological Benchmark[b]	Basis	Ecological COI[c]
Dissolved Metals (mg/L)				
Arsenic	0.0045	0.19	US EPA Region IV ESV	No
Total Metals (mg/L)				
Arsenic	0.024	0.19	IEPA SWQC	No
Barium	0.48	5	IEPA SWQC	No
Beryllium	0.0068	0.064	US EPA Region IV ESV	No
Boron	7.8	7.6	IEPA SWQC	Yes
Chromium	0.073	0.21	IEPA SWQC	No
Cobalt	0.037	0.019	US EPA Region IV ESV	Yes
Lead	0.042	0.02	IEPA SWQC	Yes
Lithium	0.068	0.44	US EPA Region IV ESV	No
Mercury	0.0012	0.0011	IEPA SWQC	Yes
Molybdenum	0.015	7.2	US EPA Region IV ESV	No
Selenium	0.015	1	IEPA SWQC	No
Thallium	0.001	0.006	US EPA Region IV ESV	No
Radionuclides (pCi/L)				
Radium-226+228	9.64	3	US DOE	Yes
Other (mg/L unless otherwise specified)				
Chloride	700	500	IEPA SWQC	Yes
Fluoride	0.692	4	US EPA Region IV ESV	No
pH (SU)	7.7	6.5-9	US EPA NRWQC	No
Sulfate	890	NA	NA	No
Total Dissolved Solids	2,300	NA	NA	No

Notes:

BAB = Bottom Ash Basin; COI = Constituent of Interest; DL = Detection Limit; ESV = Ecological Screening Value; IEPA = Illinois Environmental Protection Agency; NA = Not Applicable; NRWQC = National Recommended Water Quality Criteria; SU = Standard Units; SWQC = Surface Water Quality Criteria; US DOE = United States Department of Energy; US EPA = United States Environmental Protection Agency.

(a) The list of constituents includes those with IL Part 845.600 Groundwater Protection Standards (IEPA, 2021a).

(b) Ecological benchmarks are from the hierarchy of sources discussed in Section 3.3.2: IEPA SWQS (IEPA, 2019), US EPA Region IV "Ecological Risk Assessment Supplemental Guidance" (US EPA Region IV, 2018), US EPA NRWQC (2021), and US DOE's guidance document, "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota" (US DOE, 2019).

(c) COIs are constituents for which the maximum concentration exceeds the surface water criterion.

Table 3.2 Ecological Constituents of Interest – GMF

Analyte[a]	Maximum Detected Concentration	Ecological Benchmark[b]	Basis	Ecological COI[c]
Dissolved Metals (mg/L)				
Antimony	0.012	0.19	US EPA Region IV ESV	No
Arsenic	0.035	0.19	IEPA SWQC	No
Barium	0.47	5.00	IEPA SWQC	No
Boron	3	7.60	IEPA SWQC	No
Cadmium	0.0085	0.001	IEPA SWQC	Yes
Chromium	0.041	0.18	IEPA SWQC	No
Cobalt	0.028	0.02	US EPA Region IV ESV	Yes
Lead	0.19	0.02	IEPA SWQC	No
Mercury	0.00026	0.001	IEPA SWQC	No
Selenium	0.25	1.00	IEPA SWQC	No
Total Metals (mg/L)				
Antimony	0.0064	0.19	US EPA Region IV ESV	No
Arsenic	0.051	0.19	IEPA SWQC	No
Barium	0.47	5.00	IEPA SWQC	No
Beryllium	0.0027	0.06	US EPA Region IV ESV	No
Boron	1.9	7.60	IEPA SWQC	No
Cadmium	0.0016	0.001	IEPA SWQC	No
Chromium	0.015	0.21	IEPA SWQC	No
Cobalt	0.0052	0.02	US EPA Region IV ESV	No
Lead	0.041	0.02	IEPA SWQC	No
Lithium	0.018	0.44	US EPA Region IV ESV	No
Mercury	0.0004	0.001	IEPA SWQC	No
Molybdenum	0.041	7.20	US EPA Region IV ESV	No
Selenium	0.0031	1.00	IEPA SWQC	No
Thallium	0.0033	0.01	US EPA Region IV ESV	No
Radionuclides (pCi/L)				
Radium-226+228	5.38	3	US DOE	No[d]
Other (mg/L, unless otherwise specified)[e]				
Chloride	75	500	IEPA SWQC	No
Fluoride	0.465	4.0	IEPA SWQC	No
pH (SU)	7.5	5-9	US EPA NRWQC	No
Sulfate	540	NA	NA	No
Total Dissolved Solids	900	NA	NA	No

Notes:
COI = Constituent of Interest; DL = Detection Limit; ESV = Ecological Screening Value; GMF = Gypsum Management Facility; IEPA = Illinois Environmental Protection Agency; NA = Not Applicable; NRWQC = National Recommended Water Quality Criteria; SWQC = Surface Water Quality Criteria; US DOE = United States Department of Energy; US EPA = United States Environmental Protection Agency.
(a) The list of constituents includes those with IL Part 845.600 groundwater protection standards (IEPA, 2021a).
(b) Ecological benchmarks are from the hierarchy of sources discussed in Section 3.3.2: IEPA SWQS (IEPA, 2019), US EPA Region IV "Ecological Risk Assessment Supplemental Guidance" (US EPA Region IV, 2018), US EPA NRWQC (2021), and US DOE's guidance document "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota" (US DOE, 2019).
(c) COIs are constituents for which the maximum concentration exceeds the surface water criterion.
(d) Of the 83 groundwater samples analyzed for radium-226+228, only 1 sample was detected above the ecological benchmark. Given that the maximum result is considered an outlier at the 1% and 5% significance levels, radium-226+228 was not considered an ecological COI.
(e) Results for analytes in the "other" group are based on unfiltered samples.

3.4.2 Surface Water and Sediment Modeling for the GMF and BAB

Surface water and sediment sampling has not been conducted in the DCCP. Many of the COIs are expected to be present in surface water or sediment from natural or non-Site-related anthropogenic sources. It would be difficult to attribute concentrations of these COIs to a particular source given the dynamic nature of the DCCP (as it flows south and discharges to Duck Creek, which drains into the Illinois River) and the multitude of potential sources. Gradient modeled concentrations in DCCP surface water and sediment as a result of groundwater discharge to the DCCP for all constituents that exceeded ecological benchmarks in groundwater. Surface water and sediment concentrations were modeled based on the maximum detected concentrations in groundwater[7] (from 2015 to 2021, regardless of well location).

For this evaluation, we adapted a simplified and conservative form of US EPA's indirect exposure assessment methodology (US EPA, 1998) that was used in US EPA's coal combustion waste risk assessment (US EPA, 2014). The original model is a mass balance calculation based on surface water and groundwater mixing and the concept that the dissolved and sorbed concentrations can be related through an equilibrium partitioning coefficient (K_d). The model assumes a well-mixed groundwater-surface water location, with partitioning among total suspended solids, dissolved water column, sediment porewater, and solid sediments.

Sorption to soil and sediment is highly dependent on the surrounding geochemical conditions. To be conservative, we ignored the natural attenuation capacity of soil and sediment and estimated the surface water concentration based only on the physical mixing of groundwater and surface water (*i.e.*, dilution) at the point of discharge of groundwater to the surface water.

The aquifer and surface water properties used to estimate the volume of groundwater flowing into the DCCP and surface water concentrations from the BAB and GMF are presented in Tables 3.3 and 3.5, respectively. The COI concentrations in sediment were modeled using the COI-specific sediment-to-water partition coefficients and the sediment properties presented in Tables 3.4 and 3.6 for the BAB and GMF, respectively. In the absence of Site-specific information for the DCCP, we used default assumptions (*e.g.*, depth of the upper benthic layer and bed sediment porosity) to model sediment concentrations. A description of the surface water and sediment modeling and the detailed results are presented in Appendix A.

The modeled surface water and sediment concentrations are discussed in Section 3.4. As described earlier, the modeled concentrations reflect conservative contributions from groundwater discharge.

[7] The maximum concentrations were taken, regardless of "total" or "dissolved" concentrations.

Table 3.3 Groundwater and Surface Water Properties Used in Modeling – BAB

Parameter	Unit	Value	Notes/Source
Groundwater			
COI Concentration	mg/L	Constituent-specific	Maximum detected dissolved or total concentration in groundwater.
Cross Section Area	m^2	260	Estimated by multiplying the maximum thickness of the permeable sand unit (7 ft or ~2.1 m) within the uppermost aquifer (Ramboll, 2021a) by the length of the BAB (400 ft or ~122 m).
Hydraulic Gradient	m/m	0.01	Average of field-measured hydraulic gradients reported in Ramboll (2021a).
Hydraulic Conductivity	cm/s	6.33×10^{-4}	Average of field-measured hydraulic conductivity values reported in Ramboll (2021a).
Surface Water			
Surface Water Flow Rate	L/yr	2.5×10^{10}	The rate of surface water discharge from the DCCP to Duck Creek *via* NPDES outfalls 1 and 2 (NPDES Permit No. IL0055620) (IEPA, 2013b).
TSS	mg/L	6	6 mg/L is the representative average river concentration (Hanson Professional Services Inc., 2019).
Depth of the Water Column	m	1.5	Conservative estimate of 5 ft or ~1.5 m near the edge of the DCCP (Bist LLC, 2021). Model results were not sensitive to an increase in the water column depth.
Suspended Sediment to Water Partition Coefficients	mg/L	Constituent-specific	Values based on US EPA (2014).

Note:
BAB = Bottom Ash Basin; COI = Constituent of Interest; DCCP = Duck Creek Cooling Pond; NPDES = National Pollutant Discharge Elimination System; TSS = Total Suspended Solids; US EPA = United States Environmental Protection Agency.

Table 3.4 Sediment Properties Used in Modeling – BAB

Parameter	Unit	Value	Notes/Source
Sediment			
Depth of Upper Benthic Layer	m	0.03	Default (US EPA, 2014).
Depth of Water Body	m	1.55	Sum of depth of the water column and depth of the upper benthic layer.
Bed Sediment Particle Concentration	g/cm^3	1	Default (US EPA, 2014).
Bed Sediment Porosity	-	0.6	Default (US EPA, 2014).
TSS Mass Per Unit Area	kg/m^2	0.009	Depth of the water column × TSS × conversion factors (10^{-6} kg/mg and 1,000 L/m^3).
Sediment Mass Per Unit Area	kg/m^2	30	Depth of the upper benthic layer × bed sediment particulate concentration × conversion factors (0.001 kg/g, 10^6 cm^3/m^3).
Sediment to Water Partition Coefficients	mg/L	Constituent-specific	Values based on US EPA (2014).

Note:
BAB = Bottom Ash Basin; TSS = Total Suspended Solids; US EPA = United States Environmental Protection Agency.

Table 3.5 Groundwater and Surface Water Properties Used in Modeling – GMF

Parameter	Unit	Values	Notes/Source
Groundwater			
COI Concentration	mg/L	Constituent-specific	Maximum detected dissolved or total concentration in groundwater.
Cross Section Area	m^2	2,488	Estimated by multiplying the maximum thickness of the "shallow sand unit" of the uppermost aquifer (18 ft or 5.5 m) (Ramboll, 2021b) and the diagonal (NE-SW) length of the GMF (~453.5 m).
Hydraulic Gradient	m/m	0.02	Average hydraulic gradient within the uppermost aquifer (Ramboll, 2021b).
Hydraulic Conductivity	cm/s	3.58×10^{-4}	As reported by Ramboll for the uppermost aquifer (Ramboll, 2021b).
Surface Water			
Surface Water Flow Rate	L/yr	2.5×10^{10}	The rate of surface water discharge from the DCCP to Duck Creek *via* NPDES outfalls 1 and 2 (NPDES Permit No. IL0055620) (IEPA, 2013b).
TSS	mg/L	6	6 mg/L is the representative average river concentration (Hanson Professional Services Inc., 2019).
Depth of the Water Column	m	1.5	Conservative estimate of 5 ft or ~1.5 m near the edge of the DCCP (Bist LLC, 2021). Model results were not sensitive to an increase in the depth of the water column.
Suspended Sediment to Water Partition Coefficients	mg/L	Constituent-specific	Values based on US EPA (2014).

Note:
COI = Constituent of Interest; GMF = Gypsum Management Facility; TSS = Total Suspended Solids; US EPA = United States Environmental Protection Agency.

Table 3.6 Sediment Properties Used in Modeling – GMF

Parameter	Unit	Value	Notes/Source
Sediment			
Depth of Upper Benthic Layer	m	0.03	Default (US EPA, 2014).
Depth of Water Body	m	1.55	Sum of depth of water column and depth of upper benthic layer.
Bed Sediment Particle Concentration	g/cm^3	1	Default (US EPA, 2014).
Bed Sediment Porosity	-	0.6	Default (US EPA, 2014).
TSS Mass Per Unit Area	kg/m^2	0.009	Depth of water column × TSS × conversion factors (10^{-6} kg/mg and 1,000 L/m^3).
Sediment Mass Per Unit Area	kg/m^2	30	Depth of upper benthic layer × bed sediment particulate concentration × conversion factors (0.001 kg/g, 10^6 cm^3/m^3).
Sediment to Water Partition Coefficients	mg/L	Constituent-specific	Values based on US EPA (2014).

Note:
GMF = Gypsum Management Facility; TSS = Total Suspended Solids; US EPA = United States Environmental Protection Agency.

3.5 Ecological Risk Evaluation

Based on the ecological CEM (Figure 3.3), ecological receptors could be exposed to surface water, sediment, and dietary items (*i.e.*, prey and plants) potentially impacted by identified COIs (boron, cobalt, lead, and mercury in the BAB; cadmium and cobalt in the GMF).

3.5.1 Ecological Receptors Exposed to Surface Water

Screening Exposures: The ecological evaluation considered aquatic communities in the DCCP potentially impacted by identified ecological COIs. In the absence of surface water data, the maximum of the total and dissolved COI concentrations detected in groundwater was used to model surface water concentrations. Modeled surface water concentrations were compared to risk-based ecological screening benchmarks.

Screening Benchmarks: Surface water screening benchmarks protective of aquatic life were obtained from the following hierarchy of sources:

- IEPA SWQS (IEPA, 2019), regulatory standards that are intended to protect aquatic life exposed to surface water on a long-term basis (*i.e.*, chronic exposure). For lead, the surface water benchmark is hardness-dependent and calculated using a default hardness of 100 mg/L. While IEPA's general water quality standard for chloride of 500 mg/L (IEPA, 2019) is not specified to be protective of ecological receptors, it was used because it is on the same order of magnitude as US EPA's NRWQC for chloride (230 and 860 mg/L for chronic and acute exposures, respectively), which is protective of aquatic life (US EPA, 2021).
- US EPA Region IV (2018) surface water ESVs for hazardous waste sites.
- For radium, US DOE presents benchmarks for radium-226 and radium-228 separately (4 and 3 pCi/L, respectively). Given that radium concentrations are expressed as total radium (the sum of radium-226 and radium-228), Gradient used the lower of the two US DOE benchmarks (3 pCi/L for radium-228) to evaluate the total radium concentrations. In addition, this benchmark is protective of bioaccumulative effects in higher trophic-level wildlife discussed further in Section 3.4.3.

Risk Evaluation: The maximum modeled COI concentrations in surface water were compared to the above hierarchy of benchmarks protective of aquatic life (Table 3.7). All modeled surface water concentrations were below their respective benchmarks. Thus, none of the COIs evaluated are expected to pose an unacceptable risk to aquatic life in the DCCP.

Table 3.7 Risk Evaluation for Ecological Receptors Exposed to Surface Water

COI[a]	Maximum Surface Water Concentration, Modeled	Ecological Freshwater Benchmark	Basis	COPC
BAB				
Boron (mg/L)	1.7×10^{-4}	7.6	IEPA (2019)	No
Cobalt (mg/L)	7.9×10^{-7}	0.019	US EPA Region IV (2018)	No
Lead[b] (mg/L)	8.9×10^{-7}	0.016	IEPA (2019)	No
Mercury (mg/L)	2.5×10^{-8}	0.8	US EPA Region IV (2018)	No
Chloride (mg/L)	1.5×10^{-2}	500	IEPA (2019)	No
Radium-226+228 (pCi/L)	2.1×10^{-4}	3	US DOE (2019)	No
GMF				
Cadmium[b] (mg/L)	2.0×10^{-6}	0.0009	IEPA (2019)	No
Cobalt (mg/L)	6.4×10^{-6}	0.019	US EPA Region IV (2018)	No

Notes:
BAB = Bottom Ash Basin; COI = Constituent of Interest; COPC = Constituent of Potential Concern; GMF = Gypsum Management Facility; IEPA = Illinois Environmental Protection Agency; US DOE = United States Department of Energy; US EPA = United States Environmental Protection Agency.
(a) Modeled COI concentrations reflect the potential maximum COI surface water concentrations from groundwater mixing with surface water.
(b) A default hardness value of 100 mg/L was used to calculate this hardness-dependent benchmark.

3.5.2 Ecological Receptors Exposed to Sediment

Screening Exposures: COIs in impacted groundwater discharging into the DCCP can sorb to sediments *via* chemical partitioning. In the absence of sediment data, sediment concentrations were modeled using maximum detected groundwater concentrations. Therefore, the modeled COI sediment concentrations reflect the potential maximum Site-related sediment concentration from groundwater discharge. Chloride was not modeled in sediment as it does not have a K_d value and is not expected to partition into sediment.

Screening Benchmarks: Sediment screening benchmarks were obtained from US EPA Region IV (2018). The majority of the sediment ESVs are based on threshold effect concentrations (TECs) from MacDonald *et al.* (2000), which provide consensus values that identify concentrations below which harmful effects on sediment-dwelling organisms are unlikely to be observed.

For radium, benchmarks from US DOE's guidance document "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota" (US DOE, 2019), were used. US DOE (2019) presents benchmarks for radium-226 and radium-228 separately (101 and 876 pCi/kg, respectively). Similar to surface water, given that modeled radium is presented as the combined radium-226+228, the lower of the two benchmarks was used as the benchmark to be protective of ecological receptors for both radium-226 and radium-228. In addition, this benchmark is protective of bioaccumulative effects in the higher trophic-level wildlife discussed further in Section 3.4.3. The benchmarks used in this evaluation are listed in Table 3.8.

Screening Risk Results: The maximum modeled COI sediment concentrations were below their respective sediment screening benchmarks, for both the BAB and GMF (Table 3.8). The modeled sediment concentrations attributed to potential contributions from Site groundwater for all COIs were less than 1.5% of the sediment screening benchmark. Therefore, the modeled sediment concentrations attributed to potential contributions from Site groundwater are not expected to significantly contribute to ecological exposures in the DCCP adjacent to the Site.

Table 3.8 Risk Evaluation for Ecological Receptors Exposed to Sediment

COI	Modeled Sediment Concentration	ESV[a]	COPC	Percentage of Benchmark
BAB				
Boron (mg/kg)	0.00100	38[b]	No	0.0026%
Cobalt (mg/kg)	0.00072	50	No	0.0014%
Lead (mg/kg)	0.0089	35.8	No	0.025%
Mercury (mg/kg)	0.00092	0.18	No	0.51%
Radium-226+228 (pCi/kg)	1.5	101	No	1.4%
GMF				
Cadmium (mg/kg)	0.0026	0.99	No	0.27%
Cobalt (mg/kg)	0.0059	50	No	0.012%

Notes:
BAB = Bottom Ash Basin; COI = Constituent of Interest; COPC = Constituent of Potential Concern; ESV = Ecological Screening Value; GMF = Gypsum Management Facility; NOEC = No Observed Effect Concentration; US DOE = United States Department of Energy; US EPA = United States Environmental Protection Agency.
(a) ESVs were taken from US EPA Region IV (2018) for all metal COIs. The benchmark for radium-226+228 is the lower of the US DOE (2019) benchmarks for Ra-226 and Ra-228.
(b) Boron NOEC of 38 mg/kg was used as a conservative benchmark for boron in the absence of an ESV (ECHA, 2019).

3.5.3 Ecological Receptors Exposed to Bioaccumulative Constituents of Interest

Screening Exposures: COIs with bioaccumulative properties can impact higher trophic-level wildlife exposed to these COIs *via* direct exposures (surface water and sediment exposure) and secondary exposures through the consumption of dietary items (*e.g.*, plants, invertebrates, small mammals, and fish).

Screening Benchmark: US EPA Region IV (2018) guidance and IEPA (2019) SWQS guidance were used to identify analytes with potential bioaccumulative effects.

Risk Evaluation: Mercury was the only COI[8] identified as having potential bioaccumulative effects. The modeled mercury concentration in surface water (1.3×10^{-8} mg/L) is well below the US EPA Region IV (2018) ecological benchmark for wildlife (0.0013 mg/L) that is protective of bioaccumulative effects. Therefore, mercury is not considered to pose an ecological risk *via* bioaccumulation.

Radium is not described in US EPA Region IV guidance, but it has been identified as bioaccumulative by other entities (*e.g.*, ATSDR, 1990). However, the benchmark used to screen radium concentrations in surface water and sediment already considers bioaccumulative exposures. Given that the modeled concentrations are below benchmarks which account for bioaccumulative exposures, radium-226+228 is not expected to pose a risk concern to ecological receptors based on its bioaccumulative properties.

3.6 Uncertainties and Conservatisms

A number of uncertainties and their potential impacts on the risk evaluation are discussed below. Wherever possible, conservative assumptions were used in an effort to minimize uncertainties and overestimate rather than underestimate risks.

[8] US EPA Region IV (2018) identifies only mercury (including methyl mercury) and selenium as having potential bioaccumulative effects. IEPA (2019) identifies mercury as the only metal with bioaccumulative properties.

Exposure Estimates:

- The risk evaluation included the Illinois Part 845.600 (IEPA, 2021a) constituents detected in groundwater samples collected from wells downgradient of the BAB and GMF. However, it is possible that none of the detected constituents are related specifically to these ash ponds.
- The ecological risk characterization was based on the maximum modeled COI concentrations, rather than on average concentrations. Thus, the variability in exposure concentrations was not considered. Assuming continuous exposure to the maximum concentration overestimates ecological exposures, given that receptors are mobile and concentrations change over time. For example, US EPA guidance states that risks should be estimated using average exposure concentrations as represented by the 95% upper confidence limit on the mean (US EPA, 1992). Given that exposure estimates based on the maximum concentrations did not exceed risk benchmarks, we have greater confidence that there is no risk concern.
- Only analytes detected in groundwater were used to identify COIs and model COI concentrations in surface water and sediment. For the constituents that were not detected in groundwater, the detection limits were below the Illinois Part 845.600 GWPS (IEPA, 2021a) and thus do not require further evaluation.
- COI concentrations in surface water were modeled using the maximum detected total or dissolved COI concentrations in groundwater. Surface water concentrations for the BAB were modeled using the maximum detected total groundwater COI concentrations, and maximum detected dissolved groundwater COI concentrations for the GMF. Modeling surface water concentrations using total metal concentrations for BAB COIs may overestimate surface water concentrations because dissolved concentrations, which are lower than total concentrations, represent the mobile fractions of constituents that could likely flow into and mix with surface water.
- The COIs identified in this evaluation also occur naturally in the environment. Contributions to exposure from natural or other non-BAB/GMF related sources were not considered in the evaluation of modeled concentrations; only exposure contributions potentially attributable to Site groundwater mixing with surface water were evaluated. While not quantified, exposures from potential BAB/GMF-related groundwater contributions are likely to represent only a small fraction of the overall human and ecological exposure to COIs that also have natural or non-BAB/GMF-related sources.

Toxicity Benchmarks:

- Screening level ecological benchmarks were compiled from IEPA and US EPA guidance and designed to be protective of the majority of site conditions, leaving the option for site-specific refinement. In some cases, these benchmarks may not be representative of the Site-specific conditions or receptors found at the Site, or may not accurately reflect concentration-response relationships encountered at the Site. For example, the ecological benchmark for cadmium is hardness-dependent and US EPA's default hardness of 100 mg/L was used due to a lack of hardness data for the DCCP. Regardless of the hardness, the maximum modeled cadmium concentration is orders of magnitude below the SWQS.
- In addition, for the ecological evaluation, we conservatively assumed all constituents to be 100% bioavailable. Modeled COI concentrations in surface water are considered total COI concentrations. US EPA recommends using dissolved metals as a measure of exposure to ecological receptors because it represents the bioavailable fraction of metal in water (US EPA,

1993). Therefore, the modeled surface water COI concentrations may be an overestimation of exposure concentrations to ecological receptors.

- For radium, groundwater concentrations were calculated as the sum of radium-226 and radium-228. US DOE (2019) presents surface water and sediment benchmarks protective of ecological receptors for radium-226 and radium-228 separately. Gradient relied on the lower of the two benchmarks to evaluate risks for radium-226+228. By comparing the total radium-226+228 concentration to the most stringent benchmark, it is assuming that all of the total radium concentrations has the toxicity of the more toxic isotope, which is an overestimation of risk. Despite the overestimation, the modeled exposure estimates are at least an order of magnitude lower than the conservative benchmark.

4 Summary and Conclusions

A screening-level risk evaluation was performed for Site-related constituents in groundwater at the DCPP in Canton, Illinois. The CSM developed for the Site indicates that groundwater beneath the GMF and BAB flows into the DCCP and may potentially impact surface water and sediment.

CEMs were developed for human and ecological receptors. There are no complete exposure pathways for humans, because the DCCP is part of the Site and does not have any recreational uses. Based on the local hydrogeology, residential exposure to groundwater used for drinking water or irrigation is not a complete pathway and was not evaluated. The complete exposure pathways for ecological receptors include aquatic life (including aquatic and marsh plants, amphibians, reptiles, and fish) exposed to surface water; benthic invertebrates exposed to sediment; and avian and mammalian wildlife exposed to bioaccumulative COIs in surface water, sediment, and dietary items.

Groundwater data collected between 2015 and 2021 were used to estimate exposures. Gradient used the maximum detected concentrations from groundwater samples collected from the wells associated with the BAB and GMF, without considering spatial or temporal representativeness for ecological receptor exposures. The use of the maximum constituent concentrations in this evaluation is designed to conservatively identify COIs that warrant further investigation. For constituents identified as COIs for ecological receptors, surface water and sediment concentrations in the DCCP were modeled using the maximum detected groundwater concentration.

Ecological receptors exposed to surface water include aquatic and marsh plants, amphibians, reptiles, and fish. Surface water and sediment exposure estimates were screened against benchmarks protective of ecological receptors for this risk evaluation. The risk evaluation showed that none of the modeled COIs in surface water exceeded protective screening benchmarks. Ecological receptors exposed to sediment include benthic invertebrates. The modeled sediment COIs did not exceed the conservative screening benchmarks, therefore, none of the COIs evaluated in sediment are expected to pose an unacceptable risk to ecological receptors. Ecological receptors were also evaluated for exposure to bioaccumulative COIs. This evaluation considered higher-trophic-level wildlife with direct exposure to surface water and sediment and secondary exposure through the consumption of dietary items (*e.g.*, plants, invertebrates, small mammals, fish). Based on the modeled concentration, mercury is not considered to pose an ecological risk *via* bioaccumulation. Overall, this evaluation demonstrated that none of the COIs evaluated are expected to pose an unacceptable risk to ecological receptors.

It should be noted that this evaluation incorporates a number of conservative assumptions that tend to overestimate exposure and risk. The risk evaluation was based on the maximum detected COI concentration; however, US EPA guidance states that risks should be based on a representative average concentration such as the 95% upper confidence limit on the mean; thus, using the maximum concentration tends to overestimate exposure. Although the COIs identified in this evaluation also occur naturally in the environment, the contributions to exposure from natural background sources and nearby industry were not considered; thus, CCR-related exposures were likely overestimated. Exposure estimates assumed 100% metal bioavailability, which likely results in overestimates of exposure and risks. Exposure estimates were based on inputs to evaluate the "reasonable maximum exposure"; thus, most individuals will have lower exposures than those estimated in this risk assessment.

Finally, it should be noted that because current conditions do not present a risk to human health or the environment, there will also be no unacceptable risk to human health or the environment for future conditions when the GMF or BAB are closed. For all future closure scenarios, potential releases of CCR-related constituents will decline over time and consequently potential exposures to CCR-related constituents in the environment will also decline.

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Appendix A

Surface Water and Sediment Modeling

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Table A.8 Input Groundwater Concentrations and Output Surface Water and Sediment Concentrations for the GMF

Abbreviations

BAB	Bottom Ash Basin
CCR	Coal Combustion Residual
COI	Constituent of Interest
DCCP	Duck Creek Cooling Pond
GMF	Gypsum Management Facility
MGD	Million Gallons Per Day
NPDES	National Pollutant Discharge Elimination System
US EPA	United States Environmental Protection Agency

Gradient modeled concentrations in the Duck Creek Cooling Pond (DCCP) surface water and sediment based on available groundwater data. First, we estimated the flow rate of constituents of interest (COIs) potentially discharged to the DCCP *via* groundwater. Then, we adapted United States Environmental Protection Agency's (US EPA's) indirect exposure assessment methodology (US EPA, 1998) in order to model surface water and sediment water concentrations in the DCCP.

Model Overview

The groundwater flow into the DCCP is represented by a one-dimensional steady-state model. In this model, the groundwater migrates horizontally in the uppermost aquifer in the direction of the DCCP. For the Bottom Ash Basin (BAB), the groundwater flow entering the DCCP is the flow going through a cross-sectional area that has a length equal to the length of the DCCP adjacent to the BAB with potential coal combustion residual (CCR)-related impacts and a height equal to the saturated thickness of the permeable sand unit within the uppermost aquifer (Table 3.3). For the Gypsum Management Facility (GMF), the groundwater flow entering the DCCP is the flow going through a cross-sectional area that has a length equal to the length of the DCCP adjacent to the GMF with potential CCR-related impacts and a height equal to the saturated thickness of the "Shallow Sand Unit" of the uppermost aquifer (Table 3.5). It was assumed that all the groundwater flowing through the uppermost aquifer discharges to the DCCP.

The groundwater flow into the DCCP mixes with the surface water in the DCCP. The COIs potentially entering the DCCP *via* groundwater can dissolve into the water column, sorb to suspended sediments, or sorb to benthic sediments. Using US EPA's indirect exposure assessment methodology (US EPA, 1998), the model evaluates the surface water and sediment concentrations at a location downstream of the groundwater discharge, assuming a well-mixed water column.

Groundwater Discharge Rate

Gradient used conservative assumptions to evaluate the potential groundwater discharge rate of the COIs. We conservatively assumed that the groundwater concentrations were uniformly equal to the maximum detected concentration for each individual COI. We ignored adsorption by subsurface soil and assumed that all the groundwater flowing through the uppermost aquifer was discharged into the DCCP.

For each groundwater unit, the groundwater flow rate into the river was derived using Darcy's Law:

$$Q = KiA$$

where:

Q = Groundwater flow rate (m^3/s)
K = Hydraulic conductivity (m/s)
i = Hydraulic gradient (m/m)
A = Cross-sectional area (m^2)

For each COI, the mass discharge rate into the DCCP was then calculated by:

$$m_c = C_c \times Q \times CF$$

where:

m_c = Mass discharge rate of the COI (mg/year)
C_c = Maximum groundwater concentration of the COI (mg/L)
Q = Groundwater flow rate (m^3/s)
CF = Conversion factors needed for unit conversion: 1,000 L/m^3; 31,557,600 s/year

The values of the aquifer parameters used for these calculations are provided in Table A.1 for the BAB and Table A.2 for the GMF. The calculated mass discharge rates were then used as inputs for the surface water and sediment partitioning model.

Surface Water and Sediment Concentration

Groundwater discharged into the DCCP gets diluted in the surface water. Constituents transported by groundwater into the surface water migrate into the water column and the bed sediments. The surface water model we used to estimate the surface water and sediment concentrations is a steady-state model described in US EPA's indirect exposure assessment methodology (US EPA, 1998) and also used in US EPA's "Human and Ecological Risk Assessment of Coal Combustion Residuals" (US EPA, 2014). This model describes the partitioning of constituents between surface water, suspended sediments, and benthic sediments based on equilibrium partition coefficients. It estimates the concentrations of constituents in surface water, suspended sediments, and benthic sediments at steady-state equilibrium at a theoretical location downstream of the discharge point after complete mixing of the water column. In our analysis, we used the partitioning coefficients given in Table J-1 of the US EPA CCR Risk Assessment for all COIs (US EPA, 2014) except radium (Sheppard, 2009). These coefficients are presented in Table A.3.

To be conservative, we assume that the constituents are not affected by dissipation or degradation once they enter the water body. The total water body concentration of the COI is calculated using the following equation from US EPA (1998):

$$C_{wtot} = \frac{m_c}{V_f \times f_{water}}$$

where:

C_{wtot} = Total water body concentration of the constituent (mg/L)
V_f = Water body annual flow (L/year)
f_{water} = Fraction of COI in the water column (unitless)
m_c = Mass discharge rate of the COI (mg/year)

For the DCCP flow rate, we used a discharge rate of about 18 million gallons per day (MGD), based on the estimated DCCP surface water discharge rates to Duck Creek *via* outfall 001 (0.038 MGD) and outfall 002 (18 MGD), as indicated in National Pollutant Discharge Elimination System (NPDES) Permit No. IL0055620 (IEPA, 2013b).

The fraction of COIs in the water column was calculated for each COI using the sediment/water and suspended solids/water partition coefficients (US EPA, 2014, Table J-1). The fraction of COIs in the water column is calculated using the following equation from US EPA (2014):

$$f_{water} = \frac{(1 + [K_{dsw} \times TSS \times 0.000001]) \times \frac{d_w}{d_z}}{\left([1 + (K_{dsw} \times TSS \times 0.000001)] \times \frac{d_w}{d_z}\right) + ([bsp + K_{dbs} \times bsc] \times \frac{d_b}{d_z})}$$

where:

f_{water}	=	fraction of COI in the water column
K_{dsw}	=	Suspended sediment-water partition coefficient (mL/g)
K_{dbs}	=	Sediment-water partition coefficient (mL/g)
TSS	=	Total suspended solids in the surface water body (mg/L), set equal to the representative average concentration of 6 mg/L (Hanson Professional Services Inc., 2019)
0.000001	=	Units conversion factor
d_w	=	Depth of the water column (m)
d_b	=	Depth of the upper benthic layer (m), set equal to 0.03 m (US EPA, 2014)
$d_z = d_w + d_b$	=	Depth of the water body (m)
bsp	=	Bed sediment porosity (unitless), set equal to 0.6 (US EPA, 2014)
bsc	=	Bed sediment particle concentration (g/cm^3), set equal to 1.0 g/cm^3 (US EPA, 2014)

The fraction of COIs dissolved in the water column (f_d) is calculated as (US EPA 2014):

$$f_d = \frac{1}{1 + K_{dsw} \times TSS \times 0.000001}$$

The values of the fraction of COIs in the water column and other calculated parameters are presented in Table A.4 for the BAB and in Table A.5 for the GMF. Other water body parameters are presented in Table A.6, which apply to both the BAB and GMF.

The total water column concentration (C_{wcTot}) of the COIs, comprising both the dissolved and suspended sediment phases, is then calculated using the following equation from US EPA (2014):

$$C_{wcTot} = C_{wtot} \times f_{water} \times \frac{d_z}{d_w}$$

Finally, the dissolved water column concentration (C_{dw}) for the COIs is calculated using the following equation from US EPA (2014):

$$C_{dw} = f_d \times C_{wcTot}$$

The dissolved water column concentration is then used to calculate the concentration of COIs sorbed to suspended solids in the water column (US EPA, 1998):

$$C_{sw} = C_{dw} \times K_{dsw}$$

where:

C_{sw}	=	Concentration sorbed to suspended solids (mg/kg)
C_{dw}	=	Concentration dissolved in the water column (mg/L)
K_{dsw}	=	Suspended solids/water partition coefficient (mL/g)

In the same way, using the total water body concentration and the fraction of COIs in the benthic sediments, the model derives the total concentration in benthic sediments (US EPA 2014, Table J-1-12):

$$C_{bstot} = f_{benth} \times C_{wtot} \times \frac{d_z}{d_b}$$

where:

C_{bstot}	=	Total concentration in bed sediment (mg/L or g/m^3)
C_{wtot}	=	Total water body concentration of the constituent (mg/L)
f_{benth}	=	Fraction of contaminant in benthic sediments (unitless)
d_b	=	Depth of the upper benthic layer (m)
$d_z = d_w + d_b$	=	Depth of the water body (m)

This value can be used to calculate dry weight sediment concentration as follows:

$$C_{sed-dw} = \frac{C_{bstot}}{bsc}$$

where:

C_{sed-dw}	=	Dry weight sediment concentration (mg/kg)
C_{bstot}	=	Total sediment concentration (mg/L)
bsc	=	Bed sediment bulk density (used the default value of 1 g/cm^3 from US EPA, 2014)

The total sediment concentration is composed of the concentration dissolved in the bed sediment pore water (equal to the concentration dissolved in the water column) and the concentration sorbed to benthic sediments (US EPA, 1998).

The concentration sorbed to benthic sediments is calculated using the following equation from US EPA (1998):

$$C_{sb} = C_{dbs} \times K_{dbs}$$

where:

C_{sb}	=	Concentration sorbed to bottom sediments (mg/kg)
C_{dbs}	=	Concentration dissolved in the sediment pore water (mg/L)
K_{dbs}	=	Sediments/water partition coefficient (mL/kg)

For each COI, the modeled total water column concentration, the modeled dry weight sediment concentration, and the modeled concentration sorbed to sediment are presented in Table A.7 for the BAB and in Table A.8 for the GMF.

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Tables

Table A.1 Parameters Used to Estimate Groundwater Discharge to Surface Water - BAB

GW Unit	Parameter	Full Name	Value	Unit
Uppermost Aquifer	A	Cross-Sectional Area	260	m^2
Uppermost Aquifer	i	Hydraulic Gradient	0.01	m/m
Uppermost Aquifer	K	Hydraulic Conductivity	0.00063	cm/s

Notes:
BAB = Bottom Ash Basin; GW = Groundwater.
Source: Hydraulic gradient and hydraulic conductivity values from Ramboll (2021).

Table A.2 Parameters Used to Estimate Groundwater Discharge to Surface Water - GMF

GW Unit	Parameter	Full Name	Value	Unit
Uppermost Aquifer	A	Cross-Sectional Area	2,488	m^2
Uppermost Aquifer	i	Hydraulic Gradient	0.02	m/m
Uppermost Aquifer	K	Hydraulic Conductivity	0.00036	cm/s

Notes:
GMF = Gypsum Management Facility; GW = Groundwater.
Source: Hydraulic gradient and hydraulic conductivity values from Ramboll (2021).

Table A.3 Partition Coefficients

Constituent	Sediment-Water, Mean, K_{dbs}		Suspended Sediment-Water, Mean, K_{dsw}	
	Value (log_{10}) (mL/g)	Value (mL/g)	Value (log_{10}) (mL/g)	Value (mL/g)
Antimony	3.6	3.98E+03	4.8	6.31E+04
Arsenic	2.4	2.51E+02	3.9	7.94E+03
Beryllium	2.8	6.31E+02	4.2	1.58E+04
Boron	0.8	6.31E+00	3.9	7.94E+03
Cadmium	3.3	2.00E+03	4.9	7.94E+04
Cobalt	3.1	1.26E+03	4.8	6.31E+04
Lead	4.6	3.98E+04	5.7	5.01E+05
Mercury	4.9	7.94E+04	5.3	2.00E+05
Radium-226 + 228	3.9	7.40E+03	3.9	7.40E+03
Selenium	0.6	3.98E+00	3.8	6.31E+03
Thallium	1.3	2.00E+01	4.1	1.26E+04

Notes:
Lithium was not modeled because it lacks a Kd value in US EPA (2014).
Sources: US EPA (2014); Sheppard (2009).

Table A.4 Calculated Parameters for the BAB

Constituent	Fraction of Constituent in the Water Column f_{water}	Fraction of Constituent in the Benthic Sediments $f_{benthic}$	Fraction of Constituent Dissolved in the Water Column $f_{dissolved}$
Arsenic	0.1741	0.8259	0.9545
Beryllium	0.0808	0.9192	0.9132
Boron	0.8848	0.1152	0.9545
Cobalt	0.0525	0.9475	0.7254
Lead	0.0051	0.9949	0.2496
Mercury	0.0014	0.9986	0.4551
Radium 226 + 228	0.0071	0.9929	0.9575

Note:
BAB = Bottom Ash Basin.

Table A.5 Calculated Parameters for the GMF

Constituent	Fraction of Constituent in the Water Column f_{water}	Fraction of Constituent in the Benthic Sediments $f_{benthic}$	Fraction of Constituent Dissolved in the Water Column $f_{dissolved}$
Antimony	0.0172	0.9828	0.7254
Arsenic	0.1741	0.8259	0.9545
Boron	0.8848	0.1152	0.9545
Cadmium	0.0361	0.9639	0.6772
Cobalt	0.0525	0.9475	0.7254
Lead	0.0051	0.9949	0.2496
Selenium (IV)	0.9199	0.0801	0.9635
Thallium	0.7261	0.2739	0.9298

Note:
GMF = Gypsum Management Facility.

Table A.6 Surface Water Parameters

Parameter	Full Name	Value	Unit
TSS	Total Suspended Solids	6	mg/L
V_{fx}	Surface Water Flow Rate	2.5E+10	L/yr
db	Depth of Upper Benthic Layer (default: 0.03)	0.03	m
dw	Depth of Water Column	1.52	m
dz	Depth of Water Body	1.55	m
bsc	Bed Sediment Bulk Density (default: 1.0)	1	g/cm^3
bsp	Bed Sediment Porosity (default: 0.6)	0.6	-
M_{TSS}	TSS Mass per Unit Area	0.009	kg/m^2
M_S	Sediment Mass per Unit Area	30	kg/m^2

Note:
Sources of default values: US EPA (1998, 2014).

Table A.7 Input Groundwater Concentrations and Output Surface Water and Sediment Concentrations for the BAB

Constituent	Groundwater Concentration (mg/L)	Mass Discharge Rate to Surface Water (mg/year)	Total Water Column Concentration (mg/L)	Concentration Sorbed to Bottom Sediments (mg/kg)
Arsenic	2.40E-02	1.25E+04	5.10E-07	1.22E-04
Beryllium	6.80E-03	3.53E+03	1.44E-07	8.32E-05
Boron	7.80E+00	4.05E+06	1.66E-04	9.98E-04
Chloride	7.00E+02	3.64E+08	1.49E-02	Not Applicable
Cobalt	3.70E-02	1.92E+04	7.86E-07	7.18E-04
Lead	4.20E-02	2.18E+04	8.92E-07	8.86E-03
Lithium	6.80E-02	3.53E+04	1.44E-06	Not Applicable
Mercury	1.20E-03	6.23E+02	2.55E-08	9.22E-04
Constituent	**Groundwater Concentration (pCi/L)**	**Mass Discharge Rate to Surface Water (pCi/year)**	**Total Water Column Concentration (pCi/L)**	**Concentration Sorbed to Bottom Sediments (pCi/kg)**
Radium-226 + 228	9.64E+00	5.01E+06	2.05E-04	1.45E+00

Notes:
BAB = Bottom Ash Basin; K_d = Equilibrium Partitioning Coefficient.
Chloride and lithium were not modeled due to lack of K_d value in US EPA (2014).

Table A.8 Input Groundwater Concentrations and Output Surface Water and Sediment Concentrations for the GMF

Constituent	Groundwater Concentration (mg/L)	Mass Discharge Rate to Surface Water (mg/year)	Total Water Column Concentration (mg/L)	Concentration Sorbed to Bottom Sediments (mg/kg)
Antimony	1.20E-02	6.75E+04	2.76E-06	7.97E-03
Arsenic	5.10E-02	2.87E+05	1.17E-05	2.81E-03
Boron	3.00E+00	1.69E+07	6.90E-04	4.15E-03
Cadmium	8.50E-03	4.78E+04	1.95E-06	2.64E-03
Cobalt	2.80E-02	1.57E+05	6.44E-06	5.88E-03
Lead	1.90E-01	1.07E+06	4.37E-05	4.34E-01
Selenium (VI)	2.50E-01	1.41E+06	5.75E-05	2.20E-04
Thallium	3.30E-03	1.86E+04	7.59E-07	1.41E-05

Notes:
GMF = Gypsum Management Facility.
Source: US EPA (2014).

Appendix B

Supporting Information

Supporting Information for Closure Alternatives Analysis – Gypsum Management Facility at Duck Creek Power Plant

GOLDER
MEMBER OF WSP

TECHNICAL MEMORANDUM

DATE January 25, 2022 **Reference No.** 21454861-13-R-1

TO Illinois Power Resources Generating, LLC

FROM Golder Associates USA Inc.

SUPPORTING INFORMATION FOR CLOSURE ALTERNATIVES ANALYSIS – GYPSUM MANAGEMENT FACILITY POND AT DUCK CREEK POWER PLANT

Golder Associates USA Inc. (Golder), a Member of WSP, has prepared this technical memorandum for Illinois Power Resources Generating, LLC (IPRG) to support the Closure Alternatives Analysis for the Gypsum Management Facility (GMF) Pond at Duck Creek Power Plant (DCPP). The GMF Pond was used for containment of gypsum produced at DCPP and has not received gypsum since the power plant was retired in 2019. The Closure Alternatives Analysis is being completed in accordance with Illinois Administrative Code Title 35, Part 845, Standards for the Disposal of Coal Combustion Residuals (CCR) in Surface Impoundments (Part 845), by Gradient. With this technical memorandum, Golder summarizes the design basis and references used in developing the closure concepts evaluated by the Closure Alternatives Analysis.

1.0 GMF POND HISTORY

1.1 Existing Liner System Information

Golder reviewed several documents related to the design, construction, and operation of the GMF Pond. Notable documents included the History of Construction (AECOM 2016), the Gypsum Stack Acceptance Report (Hanson 2009a), and the Initial Facility Report Volumes 1–4 (Hanson 2009b). Based on review of these documents, a dual composite liner system with a leak detection layer was installed for the GMF Pond consisting of (from top to bottom):

- primary composite liner
  - Solmax 460T-1000 60-mil textured high-density polyethylene (HDPE) geomembrane
  - 1-foot cushion dirt layer (2 feet in select areas on the sideslopes)
- leak detection layer
  - SKAPS GT-142 4-oz/yd^2 geotextile separator
  - 1-foot granular drainage layer
  - SKAPS GE-110 10-oz/yd^2 geotextile cushion
- secondary composite liner
  - Solmax 460T-4013 60-mil textured HDPE geomembrane

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- CETCO Bentomat SDN reinforced geosynthetic clay liner (GCL)
- 3-foot compacted clay layer placed in 8-inch lifts, compacted to at least 95% of the standard Proctor maximum dry density at a moisture content between the standard Proctor optimum moisture content (OMC) and 5% wet of the OMC

According to the Acceptance Report (Hanson 2009a), the liner system was subjected to a rigorous construction quality assurance (CQA) program.

The GMF Pond was constructed by excavating the natural ground a minimum of 5.4 feet to reach foundation grades. During preparation of the foundation grades, unsuitable sand materials were removed from several areas and stockpiled separately. These areas were then backfilled with suitable material previously stockpiled or locally available. Backfilled areas were compacted to at least 95% of the standard Proctor maximum dry density at a moisture content within 2% of the OMC. Eight Shelby tube samples collected from the foundation grade berms were used for hydraulic conductivity testing, with results ranging from 2.2×10^{-8} centimeters per second (cm/s) to 1.0×10^{-7} cm/s.

After certification of the foundation grades, the 3-foot compacted clay layer was constructed in 8-inch lifts. Eighteen Shelby tube samples were collected during construction. Hydraulic conductivity results from tests on the Shelby tube samples ranged from 8.6×10^{-9} cm/s to 9.8×10^{-7} cm/s, significantly less than the construction specification of 1.0×10^{-4} cm/s. The compacted clay layer was proof rolled prior to installation of the overlying GCL.

After placement of the compacted clay layer, geosynthetic components of the secondary liner system were installed. Certified properties for the geosynthetic materials are provided in the Geosynthetics Quality Assurance Report (Feezor 2009).

A leak detection layer with leachate collection and recovery system (LD/LCRS) was installed above the lower geomembrane. The LD/LCRS included a 10-oz/yd^2 geotextile overlain by a 1-foot granular drainage layer with 6-inch- and 12-inch-diameter HDPE piping embedded. Laboratory hydraulic conductivity test results for the granular drainage layer soil ranged from 1.5×10^{-2} to 5.7×10^{-2} cm/s. Test reports from hydraulic conductivity and particle-size distribution testing are provided in the Acceptance Report (Hanson 2009a). The piping within the LD/LCRS directs leachate to two sumps at the toe of the south berm of the GMF Pond, with risers to facilitate removal of leachate. A 4-oz/yd^2 geotextile was installed above the 1-foot granular drainage layer. Certified properties for the geosynthetic materials are provided in the Geosynthetics Quality Assurance Report (Feezor 2009).

A 1-foot cushion soil layer compacted to at least 90% of the standard Proctor maximum dry density was placed above the 4-oz/yd^2 geotextile. According to the Acceptance Report (Hanson 2009a), the layer was constructed of general fill transported from a stockpile or borrow to the work area by truck and graded with a dozer to a depth of approximately 1 foot. The local stockpiles generally consisted of fine-grained soils, predominantly low-plasticity silts and clays (classified as CL and ML under the United Soil Classification System [USCS]). The cushion layer was then overlain by a 60-mil HDPE geomembrane constructed with the same installation specifications as the lower geomembrane. Certified properties for the upper geomembrane are provided in the Geosynthetics Quality Assurance Report (Feezor 2009).

In addition to the dual composite liner system, the GMF Pond has a ring drain system above the primary liner system that was used to recover and recycle water used for hydraulic conveyance of gypsum to the GMF Pond. The ring drain system consists of a rectangular array of 6-inch-diameter perforated HDPE pipe installed above the

upper geomembrane around the perimeter of the GMF Pond floor. The pipe is surrounded by coarse aggregate and wrapped in a geotextile. The ring drain pipe network directs water to five sumps (one each along the toes of the north, east, and west embankments and two along the toe of the south embankment).

1.2 Operational History

The GMF Pond was constructed between 2007 and 2009 and was put into operation in 2009. The GMF Pond was used to store gypsum and to clarify gypsum transport water for reuse in the wet scrubber system until DCPP was retired in December 2019. Gypsum was hydraulically conveyed to the GMF Pond at approximately 20% solids (Hanson 2009b). It was deposited from the north end of the GMF Pond and in the northwest corner, which formed a delta or beach of built-up gypsum in these locations during the operational life. The gypsum would build up to the water level and then expand laterally (rather than vertically) due to the relatively weak nature of the subaqueous gypsum. During the operational life, the beach expanded so that roughly one-third of the GMF Pond footprint had gypsum built up to the typical water level. The water level was (and still is) controlled by an overflow channel at the southeast corner of the GMF Pond. The overflow elevation was adjustable and could be as low as El. 614 feet or as high as approximately El. 616 feet. Water decanted (or was siphoned early in the life of the GMF Pond) from the GMF Pond into the Recycle Pond, which is located immediately south of the GMF Pond. A set of pumps situated on the west side of the Recycle Pond was used to transfer the decanted water back to the wet scrubber system for reuse. The Operation and Maintenance Manual for the GMF Pond provides additional information and is included in the History of Construction (AECOM 2016).

It is Golder's understanding that the pumps for the LD/LCRS are controlled by the hydraulic head in the 1-foot granular drainage layer (i.e., they only operate when there has been enough infiltration into the LD/LCRS to build up the hydraulic head to a trigger level) and that the pumps have rarely needed to operate. This anecdotal information suggests that the primary composite liner is intact and provides an effective barrier to infiltration from the GMF Pond and that the secondary composite liner is intact and provides an effective barrier to lateral infiltration.

1.3 Type and Volume of Materials

Based on Golder's comparison (using Autodesk Civil 3D) of the existing conditions (December 2020 survey by IngenAE) and the approximate top-of-liner-system grades developed from the as-built top of cushion layer (Hanson 2009a), approximately 400,000 cubic yards (cy) of gypsum are present in the GMF Pond. The GMF Pond footprint is approximately 31 acres, with approximately 60,800 cy of cushion dirt, 55,500 cy of granular drainage material, and 166,500 cy of compacted clay used in construction of the GMF Pond.

The wet scrubber system used for flue gas desulfurization at DCPP produced synthetic gypsum (calcium sulfate). The synthetic gypsum is generally of the same chemical structure as natural gypsum. Because the material was sluiced, the particle-size distribution of the gypsum in the GMF Pond is expected to be variable, becoming finer with increased distance from the deposition locations. Based on geotechnical testing Golder conducted on a composite of three samples of gypsum collected near the north end of the GMF Pond, the material is non-plastic with more than 97% by weight passing the No. 200 sieve (ML under the USCS) and a specific gravity of 2.66. Slurry consolidation testing conducted by Golder on a reconstituted sample of gypsum from the GMF Pond indicated a range of hydraulic conductivities from 6×10^{-5} cm/s to 1×10^{-4} cm/s under typical confining stresses in the GMF Pond.

1.4 Water Levels

At the time of the December 2020 survey by IngenAE, the water level in the GMF Pond was at El. 613.9 (North American Vertical Datum of 1988). Although the water level would be expected to respond to wet or dry climate conditions, this water level is likely typical for the GMF Pond. Based on this water level, approximately 95% of the gypsum in the GMF Pond is below the water level. Based on Golder's site observations, gypsum below the water level can be considered saturated. The gypsum above the water level forms a plateau at the north end of the GMF Pond with the highest point at approximately El. 616 feet. Based on Golder's site observations, gypsum above the water level is moist, but not saturated, and is capable of supporting foot traffic, but likely not equipment traffic without dewatering.

2.0 CLOSURE CONCEPT INFORMATION

To provide necessary information for the Closure Alternatives Analysis, Golder developed a closure concept that would involve closure with CCR remaining in place and a closure concept that would involve closure by removal of CCR. These closure concepts are described in this section.

2.1 Closure in Place

2.1.1 Final Cover System Materials

For closure with CCR in place, Part 845 requires installation of a final cover system over the CCR. Based on a demonstration to be submitted to the Illinois Environmental Protection Agency for approval pursuant to Section 845.750(c)(2), an alternative final cover system is incorporated into the closure-in-place concept. The final cover system consists of (from top to bottom):

- 2-foot final protective layer—locally available soils compacted to between 80% and 95% of the standard Proctor maximum dry density for establishment of vegetation and protection of the underlying geomembrane. Material is likely to be primarily low-plasticity silt or clay based on review of site geotechnical information (e.g., Hanson 2009b).
- Geocomposite.
- 40-mil LLDPE geomembrane.

To the extent possible, the gypsum would be graded to achieve final cover subgrade, and the final cover system would be constructed directly on the gypsum surface in most areas. Compacted fill, composed of locally available soils, would be placed only as needed to achieve final cover subgrade. The compacted fill is anticipated to be compacted to a minimum of 95% of the standard Proctor maximum dry density to provide a firm subgrade.

2.1.2 Closure Construction Plan

Conceptual final cover system grades and details are shown in Exhibit 1. The closure-in-place concept was developed to reduce the waste footprint at closure, while also recognizing the complications associated with handling and stacking wet gypsum materials. The proposed closure-in-place option would have final cover slopes of 4% to accommodate moderate settlement, with a berm constructed at the south end of the consolidated footprint to enhance stability. The location of the berm has been selected to accommodate the estimated volume

of gypsum to be contained within the consolidated footprint based on the grading plan presented. The general sequencing plan for the closure-in-place option is as follows:

- Pump out ponded water from the GMF Pond. Approximately 112 million gallons of water was contained in the GMF Pond as of the December 2020 survey by IngenAE, not including the pore water within the roughly 400,000 cy of gypsum. Pumping out the ponded water will enable gravity drainage of the gypsum to begin, but there will be a significant amount of saturated material that will need to be relocated.
- Once the ponded water has been removed from the GMF Pond, shallow gypsum zones in the consolidated footprint will be dewatered as needed to enable equipment trafficking. Gypsum south of the consolidated footprint will be dewatered as needed to enable relocation. Free liquids in the gypsum will be eliminated by removing liquid wastes or solidifying gypsum remaining in place.
- Gypsum will be removed from the berm footprint and relocated into the consolidated footprint. The berm will be constructed in an east-west orientation at the south end of the consolidated footprint. The upstream face of the berm will be lined with a composite liner system consisting of a 60-mil HDPE geomembrane overlying a compacted clay layer, which will tie into the existing dual composite liner system.
- The remaining gypsum south of the berm will be collected and deposited north of the berm.
- Geosynthetic components of the existing dual composite liner system south of the berm will be removed and hauled away for disposal. Soil materials that must be removed to expose the geosynthetic layers will be stockpiled on site.

Ponded water removal from the GMF Pond will be a significant effort. Removal of the ponded water at the GMF Pond may take three to six months, depending on pumping rates, operating hours, and weather conditions. Once the ponded water is removed, Golder anticipates that the removal of liquid waste will take 12 to 18 months. The final cover system could be installed during the following construction season.

2.1.3 Stormwater Management

Stormwater runoff from the GMF Pond closure area will be managed by sheet flow off the cover system. Runoff will be routed into existing drainage channels northeast and southeast of the GMF Pond. A new channel will be excavated along the northern perimeter of the consolidated footprint to route water into the existing drainage channel northeast of the GMF Pond. To prevent impoundment of water in the south end of the current GMF Pond footprint, existing earthen embankments will be removed in the southeast corner of the GMF Pond and in the Recycle Pond to allow stormwater to passively flow into the existing drainage southeast of the GMF Pond. No new stormwater management ponds or other features would be needed for closure.

2.2 Closure by Removal

Under the closure-by-removal option, the gypsum in the GMF Pond will be dewatered and all gypsum will be hauled by truck from the GMF Pond to the existing permitted on-site landfill located approximately 1 mile north of the GMF Pond. Alternatively, the gypsum may be disposed of at an off-site landfill approximately 33 miles away. Additionally, the dual composite liner system described in Section 1.1 will be removed as required under 845.740(a) and disposed. Subsoil beneath the liner system will be excavated to a depth of up to 1 foot and disposed. Additional details on the closure-by-removal option are shown in Exhibit 2.

2.2.1 Material Removal Phasing

To completely remove the gypsum material from the GMF Pond, the gypsum will need to be dewatered. As described in Section 2.1.2, removal of ponded water from the GMF Pond is expected to take several months. After removal of the ponded water, the gypsum will still be unsuitable for supporting heavy construction traffic over much of the footprint. Careful planning will be required to safely remove the wet gypsum from the GMF Pond. The gypsum removal will likely be accomplished in phases, relying on a series of trenches to facilitate dewatering of the material. The trenches will shorten drainage routes to facilitate gravity dewatering of gypsum in the vicinity of each trench and will direct the water to sumps from which the water can be pumped. Exact dewatering means and methods would be determined by the gypsum removal contractor. The dewatering and closure-by-removal concept evaluated in the Closure Alternatives Analysis follows:

- Pump out ponded water from the GMF Pond. Approximately 112 million gallons of water was contained in the GMF Pond as of the December 2020 survey by IngenAE, not including the pore water within the roughly 400,000 cy of gypsum. Pumping out the ponded water will enable gravity drainage of the gypsum to begin, but there will be a significant amount of saturated material that will need to be relocated.
- Excavate a series of trenches from north to south in the gypsum. Conceptually, the trenches may be on the order of 5 feet deep at regular spacing (potentially every 50 feet) and graded to allow water to drain to the south. Sumps in the trenches along the south end of the gypsum deposit will be used to collect water, which will be pumped from the GMF Pond to the Recycle Pond. The trenches will remain open until the top layer of gypsum across the GMF Pond is sufficiently dewatered to enable removal and transport without producing free water when disturbed. This process will repeat until all gypsum has been removed from the GMF Pond. Each layer may take several weeks or months to dewater and remove. Active dewatering or multiple handling of the gypsum may be an option to expedite the closure construction. The ring drain system may also be used to facilitate dewatering of the gypsum.
- Once all gypsum has been removed from the GMF Pond, the existing dual composite liner system described in Section 1.1 will be removed as required under 845.740(a). The earthen and geosynthetic materials will be disposed in a permitted landfill.
- A tentative schedule for the closure-by-removal process is:
  - three to six months to pump ponded water out of the GMF Pond
  - between one and two construction seasons to dewater and remove saturated gypsum
  - one or two construction seasons to remove the existing liner system and establish final reclamation grades, depending on on-site or off-site disposal

2.2.2 Surface Reconstruction

Once the GMF Pond is completely dewatered and all gypsum has been removed, the site will be reconfigured to allow passive surface water flow. Earthen embankments in the southeast corner of the GMF Pond and in the Recycle Pond will be removed to allow surface water to flow into an existing drainage channel southeast of the GMF Pond.

2.2.3 Stormwater Management

Surface water will shed to the south across the footprint and will be directed to an existing drainage southeast of the GMF Pond. To prevent impoundment of water in the south end of the footprint, existing earthen embankments will be removed in the southeast corner of the GMF Pond and in the Recycle Pond to allow stormwater to passively flow into the existing drainage southeast of the GMF Pond. No new stormwater management ponds or other features would be needed for closure.

3.0 ADDITIONAL INFORMATION

Gradient provided a request for additional information to support the Closure Alternatives Analysis. The additional information compiled by Golder in response to the request is provided in Tables 1 through 4. Table 1 provides narrative responses for information requests based largely on Part 845 requirements for the Closure Alternatives Analysis. Table 2 summarizes conceptual-level estimates of material quantities, costs, equipment and vehicle usage, labor resources, and haul truck trips for the closure-in-place approach. Table 3 summarizes conceptual-level estimates of material quantities, costs, equipment and vehicle usage, labor resources, and haul truck trips for the closure-by-removal approach with disposal in a permitted on-site landfill, which would require an approximate 2-acre expansion to the existing on-site landfill. Table 4 summarizes conceptual-level estimates of material quantities, costs, equipment and vehicle usage, labor resources, and haul truck trips for the closure-by-removal approach with disposal in an off-site landfill.

In accordance with Part 845, the cost estimates meet the criteria for a Class 4 estimate under the AACE classification standard (feasibility-level, -30% to +50% expected accuracy range). Cost estimates are presented in 2022 United States dollars. cost estimates for many of the cost components, whereby a labor and heavy equipment spread was assigned to the activity. That is, the number and classification (e.g., operator, laborer) of personnel carrying out the activity and the number and type of heavy equipment pieces (e.g., dozer, loader, haul truck) was estimated based on our experience with similar construction operations. This information, combined with an estimate of production rate (e.g., number of cubic yards placed per day), yields a unit cost for the operation (e.g., cost per cubic yard placed). Golder developed production rates based on equipment capabilities (e.g., haul truck capacity, estimated load and unload times, estimates of average speed) and checked them against experience from similar projects. The hourly heavy equipment rates used in the cost estimates were from an internal database of heavy equipment ownership and operating costs by type and size (capacity) of equipment. The internal database reflects the estimated cost associated with owned heavy equipment in the central United States. The hourly labor rates used in the cost estimates were from an internal database of typical labor rates from similar projects in the north-central United States. Unit prices for some cost components (e.g., furnishing and installation of geosynthetics, seeding and mulching) were estimated based on typical unit prices from similar recent projects. Material quantities correspond with the closure approaches shown in Exhibits 1 and 2 and were developed primarily in Autodesk Civil3D. At a conceptual level of cost estimating, project costs other than direct construction costs (e.g., mobilization and demobilization, miscellaneous construction items not captured elsewhere) were estimated as a proportion of the direct construction cost. Experience on similar projects was used as the basis for the proportions applied.

4.0 REFERENCES

AECOM. 2016. History of Construction, USEPA Final CCR Rule, 40 CFR § 257.73(c), Duck Creek Power Station. October. Available online: https://www.luminant.com/ccr/?wpdf_download_file=L25hcy9jb250ZW50L2xpdmUvbHVtaW5hbnQzL2RvY3VtZW50cy9jY3IvSWxsaW5vaXMvRHVjay1DcmVlay8yMDE2L0hpc3Rvcnkgb2YgQ29uc3RydWN0aW9uLnBkZg%3D%3D).

Feezor (Feezor Engineering, Inc.). 2009. Geosynthetics Quality Assurance Report, Gypsum Stack, AERG (Ameren) Duck Creek Power Station. July.

Hanson (Hanson Professional Services Inc.). 2009a. Acceptance Report, Gypsum Stack, Gypsum Management Facility, AERG Duck Creek Power Generating Station. December.

Hanson. 2009b. Initial Facility Report, Gypsum Stack, Gypsum Management Facility, Duck Creek Generating Station. February.

Exhibits: Tables
- Table 1: Information Summary
- Table 2: Closure Estimates – Closure in Place
- Table 3: Closure Estimates – Closure by Removal with On-Site Disposal
- Table 4: Closure Estimates – Closure by Removal with Off-Site Disposal

Exhibits 1 and 2
- Exhibit 1: Closure-in-Place Figures
- Exhibit 2: Closure-by-Removal Figures

https://golderassociates.sharepoint.com/sites/141778/project files/6 deliverables/reports/13-r-closure_plan_gypsum_mgmt_facility_pond/13-r-1/att1/app b/caa_supporting_info-gmf_pond.docx

Tables

Table 1: Information Summary

Background/Current Site Conditions	
Surface area of impoundment	30.8 acres
Volume of CCR in impoundment	400,000 cy
Published or draft engineering evaluations undertaken at the site to date	
Conceptual site models	Refer to the Groundwater Modeling Report.
Regional well (receptor) survey information	Refer to the Groundwater Modeling Report.
History of construction report	See [1].
Dike stability report	Observations and stability factors of safety described by AECOM [2] and [3] were adequate.
Hydraulic evaluation of basins (evaluation of possibility of overtopping and/or emergency spillway releases during flood conditions)	Hydraulic and hydrologic analyses performed by AECOM [4] found that the geomembrane-lined spillway can adequately manage flow during peak discharge from the 1,000-year storm event without overtopping of the embankments. This also means that the spillway is adequate to carry sustained flows.
Surface impoundment hazard assessment/hazard category determination	A hazard potential classification assessment performed by Stantec [5] found the GMF Pond to have significant hazard potential. 40 CFR 257.53 defines a significant hazard potential CCR surface impoundment as a diked surface impoundment for which failure or misoperation would result in no probable loss of human life but could cause economic loss, environmental damage, disruption of lifeline facilities, and/or impact other concerns.
Habitat survey	During site development, it was confirmed that the site did not contain wild or scenic rivers (per the National Park Service), the facility did not restrict the flow of a 100-year flood, the site did not qualify for listing on the National Register of Historic Places (per the Illinois Historic Preservation Agency), the site did not pose a threat to a dedicated nature preserve persuant to the Illinois Natural Areas Preservation Act (per the Illinois Nature Preserves Commission), and there were no records of the presence of endangered/threatened species or natural areas in the vicinity of the facility [6].
Wetlands survey	In March and May of 2007, field surveys were conducted to determine and delineate the existence of any potential wetland areas in accordance with the 1987 Corps of Engineers Wetland Delineation Manual. It was determined that six unnamed tributaries, a linear ditch wetland, and two headwater drainages were within the facility boundary. No defined hydrologic connection to Duck Creek was identified, so these were determined to be isolated waters and wetlands and not regulated under the Clean Water Act [6].

Table 1: Information Summary

Closure Design and Implementation	
Copy of draft of closure report, if available	Provided.
Engineering spreadsheet containing breakdown of labor, equipment/vehicle, and material requirements for each closure alternative, if available (expected on-site and off-site vehicle and equipment mileages, labor hours, etc.)	See Tables 2 through 4.
Overview of planned activities under each closure alternative	Closure in place: Under this scenario, gypsum will be contained in the northern portion of the GMF Pond, which will necessitate relocation of gypsum currently in the southern portion of the GMF Pond to this final containment area, followed by final cover installation. The general sequence is: -Ponded water will be pumped out of the GMF Pond. Approximately 112 million gallons of water was contained in the GMF Pond as of the December 2020 survey by IngenAE, not including the pore water within the roughly 400000 cy of gypsum. Pumping out the ponded water will allow gravity drainage of the gypsum to begin. -Gypsum within the final containment area will be dewatered using trenches and sumps and possibly the existing ring drain system. -Once the ponded water has been removed from the GMF Pond, a berm will be constructed across the GMF Pond in an east-west orientation at the south end of the final containment area. Gypsum in the berm footprint will need to be removed before the berm is constructed. The upstream face of the berm will be lined with a composite liner system, which will tie into the existing dual liner system. -The remaining gypsum south of the berm will be collected and deposited north of the berm. -Geosynthetic components of the existing dual composite liner system south of the berm will be removed and disposed in the closure footprint. Soil materials between these components will be removed and stockpiled south of the GMF Pond. -Compacted fill will be used as needed to achieve subgrade and a final cover system consisting of the following components (from top to bottom) will be constructed over the final containment area: -2-foot-thick final protective layer composed of locally available soils -Geocomposite -40-mil LLDPE geomembrane -A channel will be excavated, including removal of sections of the perimeter embankment around the Recycle Pond, to allow surface water flow into an existing drainage channel southeast of the GMF Pond.

Table 1: Information Summary

Closure Design and Implementation	
Overview of planned activities under each closure alternative	Closure by removal: Under this scenario, the gypsum in the GMF Pond will be dewatered and hauled by truck from the GMF Pond to the existing permitted on-site landfill, which will require a 2-acre expansion, or to a permitted off-site landfill. Additionally, the existing dual composite liner system will be removed as required under Part 845.740(a). The general sequence is: -Ponded water will be pumped out of the GMF Pond. Approximately 112 million gallons of water was contained in the GMF Pond as of the December 2020 survey by IngenAE, not including the pore water within the roughly 400000 cy of gypsum. Pumping out the ponded water will allow gravity drainage of the gypsum to begin. -A series of trenches will be excavated from north to south in the gypsum. The trenches will likely be on the order of 5 feet deep at regular spacing (such as every 50 feet) and graded to allow water to drain to the south. Sumps will be excavated in the trenches along the south end of the gypsum deposit to collect water, which will be pumped from the GMF Pond to the Recycle Pond. The trenches will remain open until the surrounding gypsum is sufficiently dewatered to enable removal and transport without producing free water. This process will repeat until all gypsum has been removed from the GMF Pond. Each layer may take several weeks or months to dewater and remove. The ring drain system may also be used to facilitate dewatering of the gypsum. -Once all gypsum has been removed from the GMF Pond, the existing dual composite liner system will be removed and the subsoil will be overexcavated up to an additional 1 foot. The geosynthetic materials and soils will be disposed in the on-site landfill or in an off-site landfill. -A channel will be excavated, including removal of sections of the perimeter embankment around the Recycle Pond, to allow surface water flow into an existing drainage channel southeast of the GMF Pond.
Expected duration of major construction activities under each closure activity	Closure in place: Approximately three years. Removal of ponded water from the GMF Pond may take 3 to 6 months, depending on pumping rates, operating hours, and weather conditions. Once the ponded water is removed, it is anticipated that the removal of liquid waste will take 12 to 18 months. It is anticipated that final cover construction and establishment of final grades efforts could be completed during the following construction season.
	Closure by removal: Approximately three years for on-site disposal and four years for off-site disposal. Removal of ponded water from the GMF Pond may take 3 to 6 months, depending on pumping rates, operating hours, and weather conditions. Expansion of the existing landfill can take place during this time. It is anticipated that dewatering and removal of the gypsum will take one or two construction seasons for on-site disposal or two full years for off-site disposal. It is anticipated that removal of the dual composite liner system and establishment of final grades will require an additional construction season for on-site disposal or 18 months for off-site disposal.

Table 1: Information Summary

Closure Design and Implementation	
If an on-site landfill will be constructed on the site under a given closure alternative, please include the years required to construct and later close the on-site landfill	Closure in place: Not applicable. The existing permitted on-site landfill has sufficient capacity to accept waste generated from closure in place without expansion of the existing landfill or construction of a new on-site landfill.
	Closure by removal: If disposal will be on site, the landfill expansion could be completed in a single construction season. Landfill closure could be completed in a single construction season following closure of the GMF Pond.
If an on-Site landfill must first be constructed on the Site, please estimate the anticipated delay in the commencement of excavation activities while the landfill is being sited, designed, and constructed. Will dewatering/unwatering of the ponds begin immediately, or after the landfill is constructed?	Closure in place: Not applicable.
	Closure by removal: The landfill has already been sited and permitted, including the expansion area. Final design and construction of the expansion could be completed while removal of ponded water and gypsum dewatering are occurring at the GMF Pond.
Proposed location of the on-site landfill if on-site disposal is being considered for CBR scenario	The existing on-site landfill is approximately 1 mile north of the GMF Pond via site roads.
Surface area of the on-site landfill, if a new landfill must be constructed at the site	If a landfill expansion is required (on-site disposal), the additional surface area is estimated as 2 acres.
Name and location of proposed off-site landfill	If an off-site landfill were to be used, the Peoria City-County Landfill is the nearest suitable facility (33 miles away). An alternate off-site landfill is the Envirofill of IL Landfill.
Location of borrow area, if a borrow area will be established (for either the impoundment or construction/closure of an on-Site landfill). If location is unknown, please estimate a likely distance to the borrow area.	The anticipated on-site borrow source location is approximately 0.4 miles north of the GMF via site roads and approximately 0.7 miles south of the on-site landfill by site roads.
Estimated volume of soil to be hauled from the borrow area under each closure alternative	Closure in place: The amount of borrow material required is estimated as 73,800 cubic yards.
	Closure by removal: If a landfill expansion is not required, no borrow material will be needed. If a landfill expansion is required (on-site disposal), the maximum amount of borrow material required is estimated as 18,000 cubic yards.
Difficulty associated with implementation of each closure alternative (e.g., do any alternatives pose particular engineering/implementation challenges?)	Closure in place: Dewatering and relocation of gypsum will require considerable effort and time. Establishing the surface water drainage channel through the Gypsum Recycle Pond perimeter berm will be challenging because of the excavation depths involved.
	Closure by removal: Dewatering of the gypsum prior to removal will require considerable effort and time. Establishing the surface water drainage channel through the Gypsum Recycle Pond perimeter berm will be challenging because of the excavation depths involved.
Availability of necessary equipment and specialists for each closure alternative	Good availability of equipment and services is anticipated for all closure alternatives.
Available capacity and location of needed treatment, storage, and disposal services for each closure alternative	The distance to the nearest off-site landfill (approximately 33 miles) presents a significant challenge for the option that involves off-site disposal.
Estimated cost of each closure alternative	Closure in place: $6.2 million.
	Closure by removal: $8.9 million (on-site disposal); $82.4 million (off-site disposal).

Table 1: Information Summary

Post-Closure Plan/Long-Term Management Plan	
Planned duration of post-closure care activities	Closure in place: The owner or operator of the CCR surface impoundment must conduct post-closure care for 30 years. The owner or operator must continue to conduct post-closure care beyond the 30-year post-closure care period until groundwater monitoring data shows the concentrations are (a) below groundwater protection standards given in Section 845.600 of Part 845 or (b) not increasing for those constiuents over background using the statistical procedures and performance standards in Section 845.640(f) and (g), provided that concentrations have been reduced to the maximum extent feasible and they are protective of human health and the environment.
	Closure by removal: An owner or operator of a CCR surface impoundment that elects to close a CCR surface impoundment by removing CCR as provided in Section 845.740 must continue groundwater monitoring for three years after the completion of closure or until concentrations have been reduced to the maximum extent feasible and they are protective of human health and the environment.
Expected frequency of groundwater and surface water monitoring during post-closure period	Closure in place: Quarterly for 5 years and semi-annually thereafter.
	Closure by removal: Quarterly.
Expected frequency of inspections post closure	Monthly for the first year and annually thereafter [6].
Summary of planned maintenance activities post-closure	Closure in place: Groundwater monitoring will be conducted. Site inspections will be conducted on a quarterly basis for a minimum of 5 years after closure. An annual site inspection will be performed until settlement has ceased and there are no eroded or scoured areas or until the end of the 30-year post-closure care period. Over these 30 years, repair and maintenance, including soil filling and reseeding, will be performed if ponding is observed, cracks greater than 1 inch wide or gullies 6 inches or deeper have formed, vegetative or vector problems arise, or leachate seeps are present. Areas susceptible to erosion will be recontoured and reseeded. Eroded and scoured drainage channels will be repaired and the liner material replaced if necessary. Vegetation will be mowed annually. Areas of failed or eroded vegetation in excess of 100 square feet will be revegetated. Minor repairs to ensure the integrity and proper function of fencing, surface water drainage features, monitoring points, and groundwater monitoring wells may be required. Leachate will be pumped from the leachate collection sumps into storage tanks or tanker trucks and transported to a wastewater treatment plant for treatment and disposal [6].
	Closure by removal: Groundwater monitoring will be conducted.
Summary of planned post-closure care activities at the on-site landfill, if a new on-site landfill is going to be constructed	Not applicable.

Table 1: Information Summary

Corrective Measures Assessment	
Corrective measures being considered post-closure	None anticipated.
Overview of planned activities for each corrective measure	None anticipated.

References

1) AECOM. (2016). History of Construction, USEPA Final CCR Rule, 40 CFR 257.73(c), Duck Creek Power Station, Canton, Illinois. Available online: https://www.luminant.com/ccr.

2) AECOM (2016). CCR Rule Report: Initial Structural Stability Assessment for GMF Pond at Duck Creek Power Station. Available online: https://www.luminant.com/ccr.

3) AECOM (2016). CCR Rule Report: Initial Safety Factor Assessment for GMF Pond at Duck Creek Power Station. Available online: https://www.luminant.com/ccr.

4) AECOM (2016). CCR Rule Report: Initial Inflow Design Flood Control System Plan for GMF Pond at Duck Creek Power Station. Available online: https://www.luminant.com/ccr.

5) Stantec. (2016). Initial Hazard Potential Classification Assessment, EPA Final CCR Rule, GMF Pond, Duck Creek Power Station, Fulton County, Illinois. Available online: https://www.luminant.com/ccr.

6) Hanson (Hanson Professional Services, Inc.) 2009. Geosynthetics Quality Assurance Report, Gypsum Stack, AERG (Ameren) Duck Creek Power Station.

Table 2: Closure Estimates - Closure In Place

Description	Unit	Quantity	Unit Price	Total	Labor	Equipment	Truck Trips
Mobilization/Demobilization	LS	1	10%	$ 488,170	1 superintendent	Pickup truck, flatbed truck	
Survey	LS	1	$ 75,000	$ 75,000	1 surveyor	Pickup truck	
Borrow Area Preparation and Reclamation	LS	1	$ 50,000	$ 50,000	2 equipment operators	Dozer, seed drill or hydroseeder	
Ponded Water Removal	LS	1	$ 128,000	$ 128,000	1 superintendent (part-time), 1 laborer (part-time)	Pickup truck (part-time), diesel pump, generator	
Pipe Removal/Abandonment	LS	1	$ 15,000	$ 15,000	2 equipment operators, 2 laborers	Excavator, haul truck	
Embankment Fill/Compacted Clay - Berm	CY	25,700	$ 4.50	$ 115,650	7 equipment operators	Excavator, dozer, compactor, water truck, 3 haul trucks	889 (0.4 miles one way)
Geomembrane - Berm	SF	58,600	$ 0.85	$ 49,810	5 laborers, 1 equipment operator, 1 superintendent, 1 quality assurance technician	Pickup truck, telehandler	
Gypsum Dewatering	LS	1	$ 1,700,000	$ 1,700,000	1 superintendent, 1 laborer, 1 operator (part-time)	Excavator, diesel pumps	
Gypsum Relocation	CY	85,000	$ 8.20	$ 697,000	9 equipment operators	2 excavators, dozer, 2 loaders, 4 haul trucks, diesel pump	2,778 (0.2 miles one way)
Geosynthetics Removal and Disposal	AC	17	$ 4,000	$ 68,000	4 equipment operators, 2 laborers	Loader, 3 haul trucks	100 (0.2 miles one way)
Cushion Soil Removal and Stockpiling	CY	29,100	$ 2.90	$ 84,390	5 equipment operators	Excavator, dozer, 3 haul trucks, diesel pump	1,007 (0.2 miles one way)
Drainage Soil Removal and Stockpiling	CY	26,600	$ 2.90	$ 77,140	5 equipment operators	Excavator, dozer, 3 haul trucks, diesel pump	920 (0.2 miles one way)
Geomembrane - Final Cover	SF	679,600	$ 0.75	$ 509,700	5 laborers, 1 equipment operator, 1 superintendent, 1 quality assurance	Pickup truck, telehandler	
Geocomposite- Final Cover	SF	679,600	$ 0.75	$ 509,700			
Protective Soil Layer	CY	50,400	$ 3.90	$ 196,560	8 equipment operators	2 excavators, dozer, water truck, 4 haul trucks	1,744 (0.4 miles one way)
Fertilize, Seed, and Mulch	AC	35	$ 5,000	$ 175,000	2 equipment operators	Seed drill or hydroseeder	
Stormwater Channel Excavation	CY	81,000	$ 4.70	$ 380,700	3 equipment operators	Excavator, 2 haul trucks, diesel pump	2,803 (0.4 miles one way)
Erosion Controls	LS	1	$ 50,000	$ 50,000	2 laborers		
Construction Quality Assurance	LS	1	$ 300,000	$ 300,000	1 to 2 technicians	1 to 2 pickup trucks	
Miscellaneous Construction	LS	1	10%	$ 536,980	Miscellaneous	Miscellaneous	
			Total	**$ 6,206,800**			

Notes:
Miscellaneous Construction includes other work not captured in the items shown.
Soil components were assumed to be taken from the stockpile north of the GMF (0.4-mile haul).
Disposal was assumed to occur in the on-site landfill (1.2-mile haul).
Stockpiling was assumed to occur south of the closure footprint (0.2-mile haul).
Soil excavated for the stormwater channel was assumed to be stockpiled 0.4 miles from the excavation.

Table 3: Closure Estimates - Closure by Removal with On-Site Disposal

Description	Unit	Quantity	Unit Price	Total	Labor	Equipment	Truck Trips
Mobilization/Demobilization	LS	1	10%	$ 727,240	1 superintendent	Pickup truck, flatbed truck	
Survey	LS	1	$ 50,000	$ 50,000	1 surveyor	Pickup truck	
Ponded Water Removal	LS	1	$ 128,000	$ 128,000	1 superintendent (part-time), 1 laborer (part-time)	Pickup truck (part-time), diesel pump	
Pipe Removal/Abandonment	LS	1	$ 25,000	$ 25,000	2 equipment operators, 2 laborers	Excavator, haul truck	
Gypsum Dewatering	LS	1	$ 1,700,000	$ 1,700,000	1 superintendent, 1 laborer, 1 operator (part-time)	Excavator, diesel pumps	
Gypsum Loading and Disposal	CY	400,000	$ 7.00	$ 2,800,000	11 equipment operators	2 excavators, dozer, 2 loaders, 6 haul trucks, diesel pump	13,072 (1.2 miles one way)
Geosynthetics Removal and Disposal	AC	31	$ 8,000	$ 248,000	4 equipment operators, 2 laborers	Loader, 3 haul trucks	119 (1.2 miles one way)
Cushion Soil Removal and Disposal	CY	60,800	$ 4.00	$ 243,200	6 equipment operators	Excavator, dozer, 4 haul trucks, diesel pump	2,104 (1.2 miles one way)
Drainage Soil Removal and Disposal	CY	55,500	$ 4.00	$ 222,000	6 equipment operators	Excavator, dozer, 4 haul trucks, diesel pump	1,920 (1.2 miles one way)
Compacted Clay Removal and Disposal	CY	166,500	$ 4.00	$ 666,000	6 equipment operators	Excavator, dozer, 4 haul trucks, diesel pump	5,761 (1.2 miles one way)
Subsoil Overexcavation and Disposal	CY	50,000	$ 4.00	$ 200,000	6 equipment operators	Excavator, dozer, 4 haul trucks, diesel pump	1,731 (1.2 miles one way)
Fertilize, Seed, & Mulch	AC	36	$ 5,000	$ 180,000	2 equipment operators	Seed drill or hydroseeder	
Stormwater Channel Excavation	CY	86,000	$ 4.70	$ 404,200	3 equipment operators	Excavator, 2 haul trucks, diesel pump	2,976 (0.4 miles one way)
Erosion Controls	LS	1	$ 75,000	$ 75,000	2 laborers		
Subgrade Preparation - Landfill Expansion	AC	2	$ 10,000	$ 20,000	2 equipment operators, laborer	Dozer, loader	
Compacted Clay - Landfill Expansion	CY	9,700	$ 4.50	$ 43,650	7 equipment operators	Excavator, dozer, compactor, water truck, 3 haul trucks	336 (0.7 miles one way)
Geomembrane - Landfill Expansion	SF	87,100	$ 0.85	$ 74,035	5 laborers, 1 equipment operator, 1 superintendent, 1 quality assurance technician	Pickup truck, telehandler	
Geosynthetic Clay Liner - Landfill Expansion	SF	87,100	$ 0.95	$ 82,745		Pickup truck, telehandler	
Geotextile - Landfill Expansion	SF	174,200	$ 0.15	$ 26,130		Pickup truck, telehandler	
Drainage Soil - Landfill Expansion	CY	3,200	$ 17.00	$ 54,400	2 equipment operators	Dozer, loader	
Leachate Collection System - Landfill Expansion	LS	1	$ 30,000	$ 30,000	5 laborers		
Construction Quality Assurance	LS	1	$ 75,000	$ 75,000	1 to 2 technicians	1 to 2 pickup trucks	
Miscellaneous Construction	LS	1	10%	$ 799,960	Miscellaneous	Miscellaneous	
			Total	**$ 8,874,560**			

Notes:

Miscellaneous Construction includes other work not captured in the items shown.

Disposal was assumed to occur in the on-site landfill (1.2-mile haul).

Soil excavated for the stormwater channel was assumed to be stockpiled 0.4 miles from the excavation.

Soil components for landfill expansion except drainage soil (imported) were assumed to be taken from the stockpile north of the GMF (0.7-mile haul).

Table 4: Closure Estimates - Closure by Removal with Off-Site Disposal

Description	Unit	Quantity	Unit Price	Total	Labor	Equipment	Truck Trips
Mobilization/Demobilization	LS	1	10%	$ 6,806,150	1 superintendent	Pickup truck, flatbed truck	
Survey	LS	1	$ 25,000	$ 25,000	1 surveyor	Pickup truck	
Ponded Water Removal	LS	1	$ 128,000	$ 128,000	1 superintendent (part-time), 1 laborer (part-time)	Pickup truck (part-time), diesel pump	
Pipe Removal/Abandonment	LS	1	$ 25,000	$ 25,000	2 equipment operators, 2 laborers	Excavator, haul truck	
Gypsum Dewatering	LS	1	$ 1,700,000	$ 1,700,000	1 superintendent, 1 laborer, 1 operator (part-time)	Excavator, diesel pumps	
Gypsum Removal	CY	400,000	$ 3.40	$ 1,360,000	5 equipment operators	2 excavators, dozer, 2 loaders, diesel pump	
Gypsum Disposal	CY	400,000	$ 79	$31,600,000	8 equipment operators	8 on-highway trucks	26,846 (32.6 miles one way)
Geosynthetics Removal	AC	31	$ 6,000	$ 186,000	Equipment operator, 2 laborers	Loader	
Geosynthetics Hauling and Disposal	AC	31	$ 5,000	$ 155,000	3 equipment operators	3 on-highway trucks	245 (32.6 miles one way)
Cushion Soil Removal	CY	60,800	$ 2.90	$ 176,320	2 equipment operators	2 excavators, diesel pump	
Cushion Soil Hauling and Disposal	CY	60,800	$ 94	$ 5,715,200	8 equipment operators	8 on-highway trucks	4,343 (32.6 miles one way)
Drainage Soil Removal	CY	55,500	$ 2.90	$ 160,950	2 equipment operators	2 excavators, diesel pump	
Drainage Soil Hauling and Disposal	CY	55,500	$ 94	$ 5,217,000	8 equipment operators	8 on-highway trucks	3,964 (32.6 miles one way)
Compacted Clay Removal	CY	166,500	$ 2.90	$ 482,850	2 equipment operators	2 excavators, diesel pump	
Compacted Clay Hauling and Disposal	CY	166,500	$ 94	$15,651,000	8 equipment operators	8 on-highway trucks	11,893 (32.6 miles one way)
Subsoil Overexcavation	CY	50,000	$ 2.90	$ 145,000	2 equipment operators	2 excavators, diesel pump	
Subsoil Hauling and Disposal	CY	50,000	$ 94	$ 4,700,000	8 equipment operators	8 on-highway trucks	3,571 (32.6 miles one way)
Fertilize, Seed, & Mulch	AC	36	$ 5,000	$ 180,000	2 equipment operators	Seed drill or hydroseeder	
Stormwater Channel Excavation	CY	86,000	$ 4.70	$ 404,200	3 equipment operators	Excavator, 2 haul trucks, diesel pump	2,976 (0.4 miles one way)
Erosion Controls	LS	1	$ 50,000	$ 50,000	2 laborers		
Miscellaneous Construction	LS	1	10%	$ 7,486,770	Miscellaneous	Miscellaneous	
			Total	**$ 82,354,440**			

Notes:

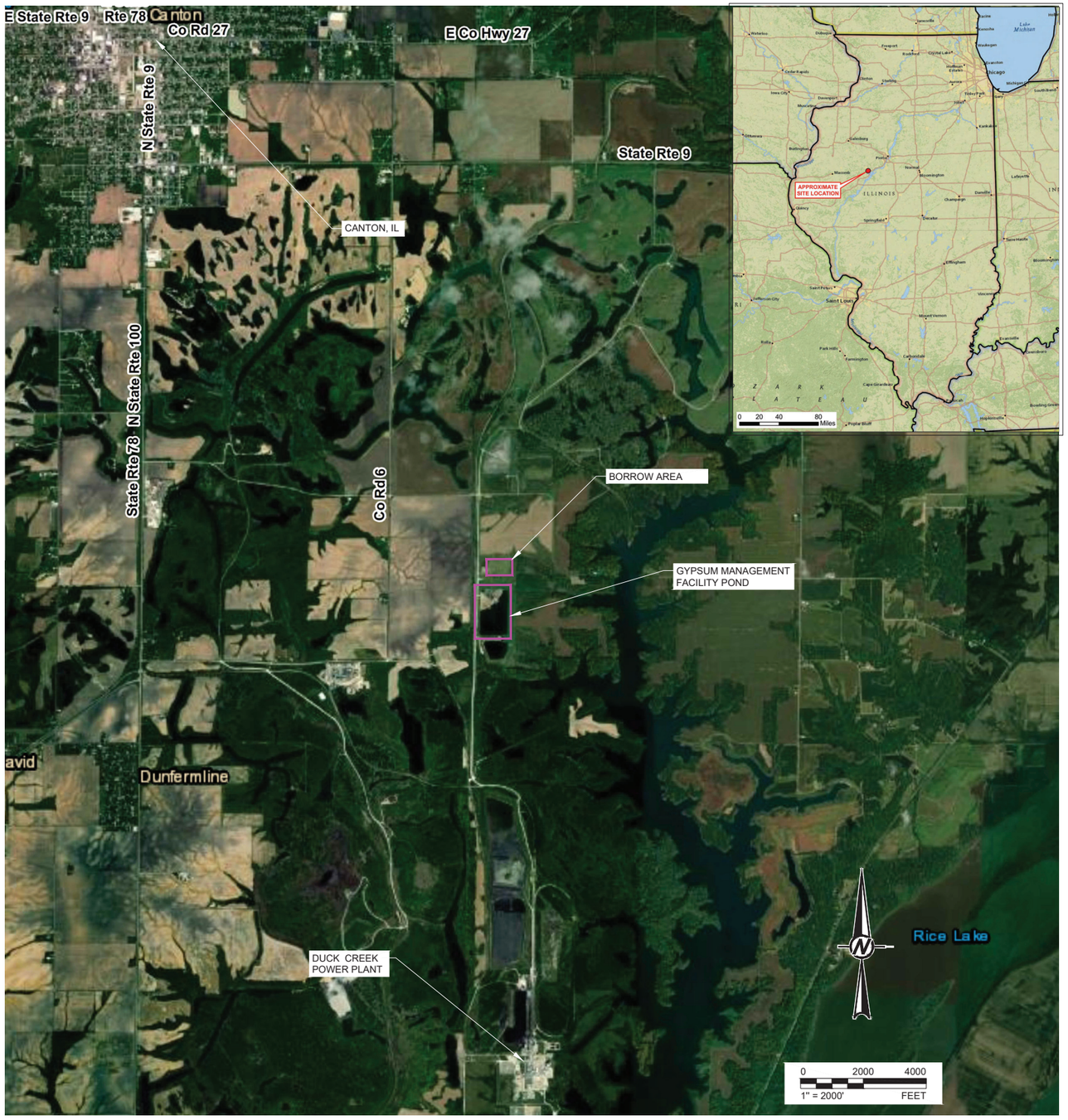
Miscellaneous Construction includes other work not captured in the items shown.

Disposal was assumed to occur in an off-site landfill (32.6-mile haul).

Soil excavated for the stormwater channel was assumed to be stockpiled 0.4 miles from the excavation.

EXHIBIT 1

Closure-in-Place Figures



ILLINOIS POWER RESOURCES GENERATING, LLC DUCK CREEK POWER PLANT GYPSUM MANAGEMENT FACILITY POND CONSTRUCTION PERMIT APPLICATION

PREPARED BY:

GOLDER ASSOCIATES INC.
13515 BARRETT PARKWAY DRIVE, SUITE 260
BALLWIN, MISSOURI USA 63021

PERMIT APPLICATION DRAWING LIST

NUMBER	TITLE	REVISION
1	TITLE SHEET	A
2	EXISTING CONDITIONS	A
3	GYPSUM REGRADING AND CONTAINMENT PLAN	A
4	FINAL COVER AND STORMWATER PLAN	A
5	SECTIONS	A
6	DETAILS (1 OF 2)	A
7	DETAILS (2 OF 2)	A

NOTE(S)

1. AERIAL IMAGERY FROM ESRI-PROVIDED BASEMAP SERVICE. IMAGERY COLLECTED 5/14/2017, 10/21/2017, 8/22/2018, AND 4/1/2019.
2. INSET MAP BOUNDARIES FROM ESRI-PROVIDED FEATURE SERVICE. USA STATE BOUNDARIES. 2021
3. INSET MAP BACKGROUND FROM ESRI-PROVIDED BASEMAP SERVICE. NATIONAL GEOGRAPHIC BASEMAP. 2021.

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2022-01-25	ISSUED FOR PERMIT APPLICATION	DVS	DVS	JJS	JEO

SEAL

CLIENT
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PROJECT
GYPSUM MANAGEMENT FACILITY POND
CONSTRUCTION PERMIT APPLICATION

TITLE
TITLE SHEET

PROJECT NO. 21454861 | REV. A | 1 of 7 | DRAWING 1

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LEGEND

- 600 — EXISTING GROUND ELEVATION CONTOURS (NOTE 1)
- EXISTING ROAD
- LIMIT OF GMF POND LINER SYSTEM (NOTE 2)
- WATER LEVEL LINE (NOTE 3)
- EXISTING PIPING (NOTE 3)

NOTES

1. EXISTING CONTOURS ARE A COMPOSITE OF AN AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 11/17/2020, TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 11/4/2020 & 11/5/2020, AND U.S. GEOLOGICAL SURVEY LIDAR POINT CLOUD DATA DATED 2/12/2018.
2. LIMIT OF LINER SYSTEM ESTIMATED FROM CONSTRUCTION RECORD DRAWINGS PREPARED BY HANSON PROFESSIONAL SERVICES, DATED 03/05/2009.
3. WATER LEVEL LINE AND EXISTING PIPING FROM INGENAE SURVEY RECORD DRAWING DATED 3/19/2021.
4. AERIAL IMAGERY FROM DRAGONFLY AEROSOLUTIONS DATED 11/17/2020.

0 120 240
1" = 120' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
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PROJECT
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TITLE
EXISTING CONDITIONS

PROJECT NO. 21454861 | REV. A | 2 of 7 | DRAWING 2

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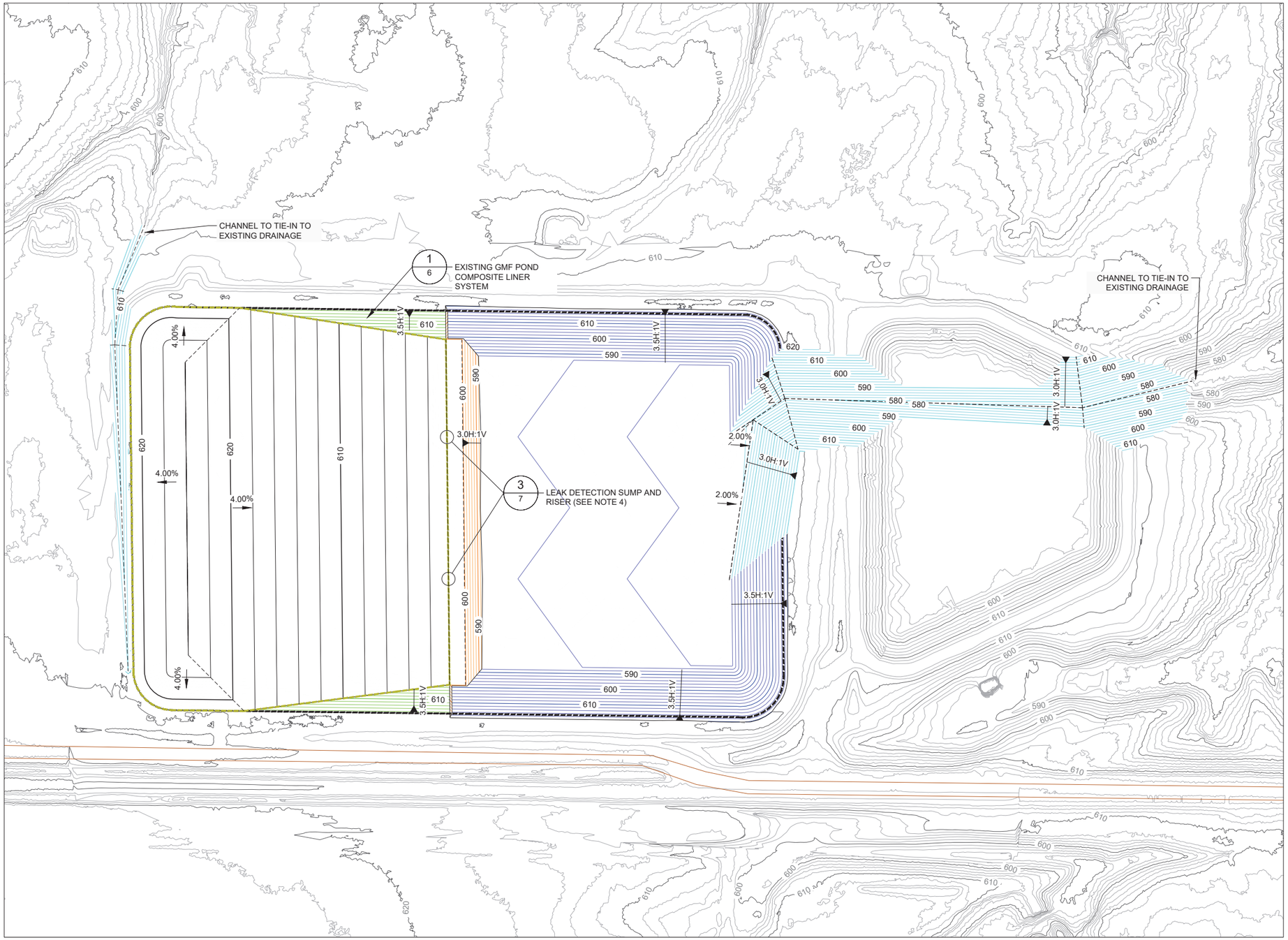

LEGEND

- 600 — TOP OF RELOCATED GYPSUM
- 600 — TOP OF EXISTING COMPOSITE LINER SYSTEM (SEE NOTE 1)
- 600 — TOP OF EXISTING CLAY LINER (SEE NOTE 1)
- 600 — DRAINAGE CHANNEL GRADES
- 600 — EARTHEN BERM GRADES
- 600 — EXISTING GROUND CONTOURS (SEE NOTE 2)
- EXISTING ROAD
- LIMIT OF EXISTING GMF POND LINER SYSTEM (NOTE 1)
- LIMIT OF WASTE

NOTES

1. GYPSUM MANAGEMENT FACILITY (GMF) POND BASE GRADES AND LIMIT OF LINER SYSTEM WERE DEVELOPED FROM CONSTRUCTION RECORD DRAWINGS PREPARED BY HANSON PROFESSIONAL SERVICES.
2. EXISTING CONTOURS ARE A COMPOSITE OF AN AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 11/17/2020, TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 11/4/2020 & 11/5/2020, AND U.S. GEOLOGICAL SURVEY LIDAR POINT CLOUD DATA DATED 2/12/2018.
3. CLOSURE WILL INVOLVE REMOVAL OF PONDED WATER AND LIQUID WASTE, CONSTRUCTION OF AN EARTHEN BERM WITH A LINER SYSTEM ON THE UPSTREAM SLOPE, REMOVAL AND RELOCATION OF GYPSUM SOUTH OF THE BERM TO WITHIN THE CLOSURE FOOTPRINT, AND FINAL COVER SYSTEM CONSTRUCTION.
4. THE EXISTING LEAK DETECTION SYSTEM WILL BE ADAPTED TO THE CLOSURE FOOTPRINT. EXISTING LEACHATE COLLECTION PIPING WILL BE TERMINATED IN NEW SUMPS (TWO LOCATIONS WITH NEW RISERS FOR CONTINUED LEAK DETECTION CAPABILITY.

0 120 240
1" = 120' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
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PROJECT
GYPSUM MANAGEMENT FACILITY POND
CONSTRUCTION PERMIT APPLICATION

TITLE
GYPSUM REGRADING AND CONTAINMENT PLAN

PROJECT NO. 21454861 | REV. A | 3 of 7 | DRAWING 3

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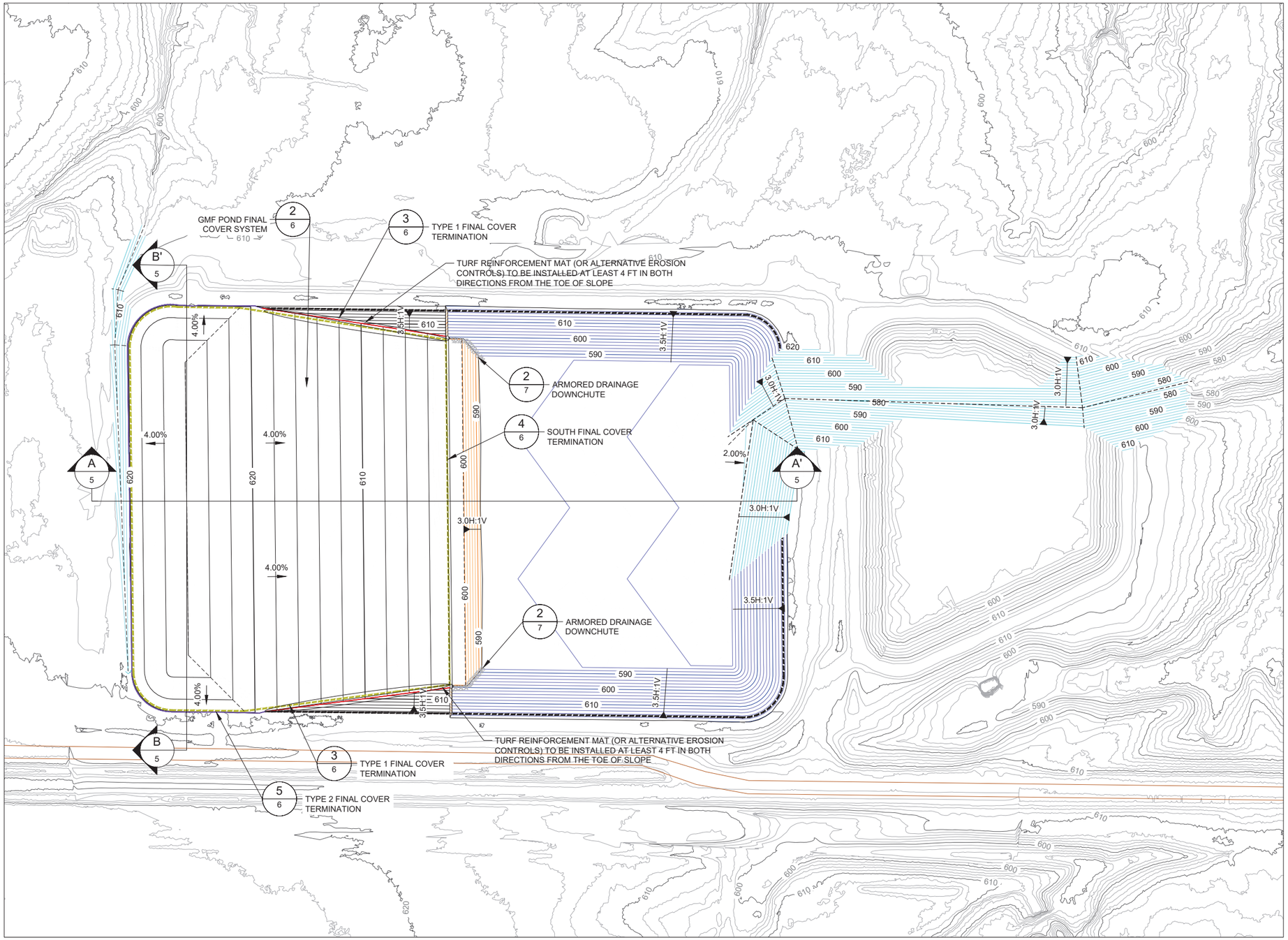

LEGEND

- 600 — TOP OF FINAL COVER SYSTEM
- 600 — TOP OF EXISTING COMPOSITE LINER SYSTEM (SEE NOTE 1)
- 600 — TOP OF EXISTING CLAY LINER (SEE NOTE 1)
- 600 — EARTHEN BERM GRADES
- 600 — EXISTING GROUND CONTOURS (SEE NOTE 2)
- EXISTING ROAD
- LIMIT OF EXISTING GMF POND LINER SYSTEM (NOTE 1)
- LIMIT OF WASTE AT CLOSURE
- TYPE 1 FINAL COVER TERMINATION
- TYPE 2 FINAL COVER TERMINATION

NOTES

1. GYPSUM MANAGEMENT FACILITY (GMF) POND BASE GRADES AND LIMIT OF LINER SYSTEM WERE DEVELOPED FROM CONSTRUCTION RECORD DRAWINGS PREPARED BY HANSON PROFESSIONAL SERVICES.
2. EXISTING CONTOURS ARE A COMPOSITE OF AN AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 11/17/2020, TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 11/4/2020 & 11/5/2020, AND U.S. GEOLOGICAL SURVEY LIDAR POINT CLOUD DATA DATED 2/12/2018.
3. CLOSURE WILL INVOLVE REMOVAL OF PONDED WATER AND LIQUID WASTE, CONSTRUCTION OF AN EARTHEN BERM WITH A LINER SYSTEM ON THE UPSTREAM SLOPE, REMOVAL AND RELOCATION OF GYPSUM SOUTH OF THE BERM TO WITHIN THE CLOSURE FOOTPRINT, AND FINAL COVER SYSTEM CONSTRUCTION.

0 120 240
1" = 120' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
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CONSTRUCTION PERMIT APPLICATION

TITLE
FINAL COVER AND STORMWATER PLAN

PROJECT NO. 21454861 | REV. A | 4 of 7 | DRAWING 4

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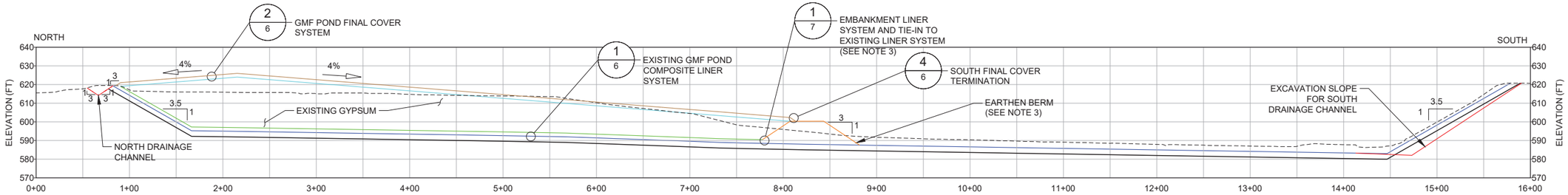

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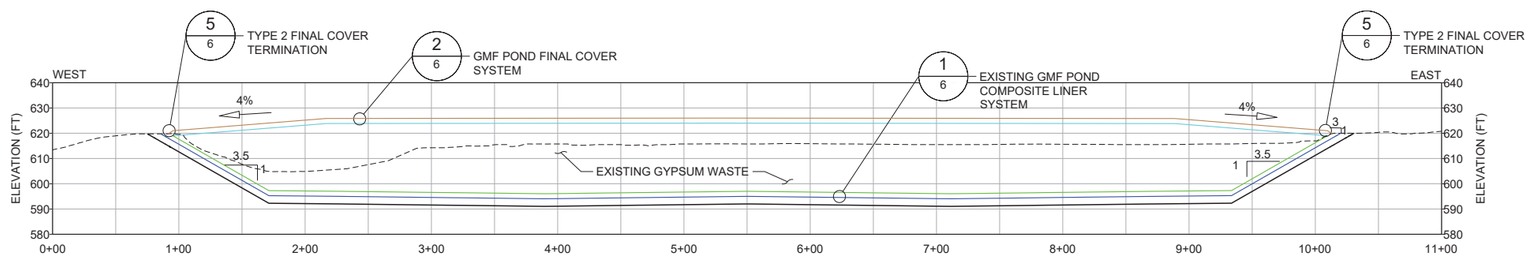
1" = 60' FEET



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VERT. SCALE X2

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1" = 60' FEET

LEGEND

- TOP OF FINAL COVER SYSTEM
- TOP OF RELOCATED GYPSUM
- TOP OF EXISTING COMPOSITE LINER SYSTEM (SEE NOTE 1)
- TOP OF EXISTING CLAY LINER (SEE NOTE 1)
- BOTTOM OF EXISTING COMPOSITE LINER SYSTEM (SEE NOTE 1)
- EXISTING GROUND CONTOURS (SEE NOTE 2)
- EARTHEN BERM (SEE NOTE 3)
- DRAINAGE CHANNEL GRADING

NOTES

1. GYPSUM MANAGEMENT FACILITY (GMF) POND BASE GRADES SHOWN WERE DEVELOPED FROM CONSTRUCTION RECORD DRAWINGS PREPARED BY HANSON PROFESSIONAL SERVICES.
2. EXISTING CONTOURS ARE A COMPOSITE OF AN AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 11/17/2020, TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 11/4/2020 & 11/5/2020, AND U.S. GEOLOGICAL SURVEY LIDAR POINT CLOUD DATA DATED 2/12/2018.
3. CLOSURE WILL INVOLVE REMOVAL OF PONDED WATER AND LIQUID WASTE, CONSTRUCTION OF AN EARTHEN BERM WITH A LINER SYSTEM ON THE UPSTREAM SLOPE, REMOVAL AND RELOCATION OF GYPSUM SOUTH OF THE BERM TO WITHIN THE CLOSURE FOOTPRINT, AND FINAL COVER SYSTEM CONSTRUCTION.

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2022-01-25	ISSUED FOR PERMIT APPLICATION	DVS	DVS	JJS	JEO

SEAL

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC
DUCK CREEK POWER PLANT

CONSULTANT
GOLDER MEMBER OF WSP
13515 BARRETT PARKWAY DRIVE, SUITE 260
BALLWIN, MO 63021
UNITED STATES
(313) 984 8770
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PROJECT
GYPSUM MANAGEMENT FACILITY POND
CONSTRUCTION PERMIT APPLICATION

TITLE
SECTIONS

PROJECT NO. 21454861 | REV. A | 5 of 7 | DRAWING 5

Path: \\golder.gds\complexdata\office\Denver\acad\VISTRA\Duck Creek\99_PROJECTS\21454861\Gypsum Management Facility\02_PRODUCTION\DWGs\A_CIP Permit DWGs_rev6 2 ft cover\ | File Name: 21454861A005.dwg | Last Edited By: jsauer Date: 2022-01-25 Time:3:30:28 PM | Printed By: JSauer Date: 2022-01-25 Time:4:41:48 PM
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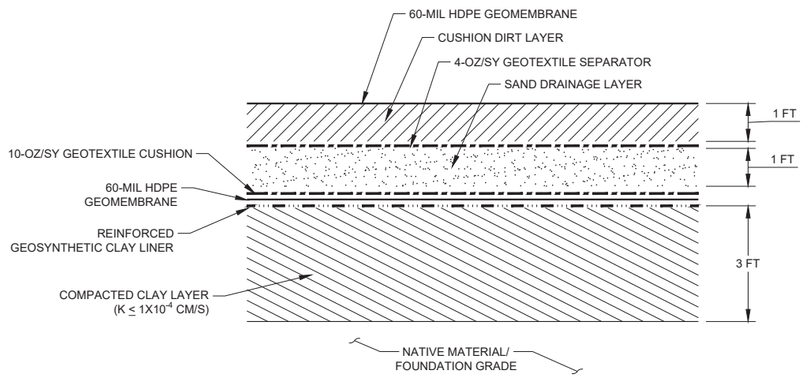

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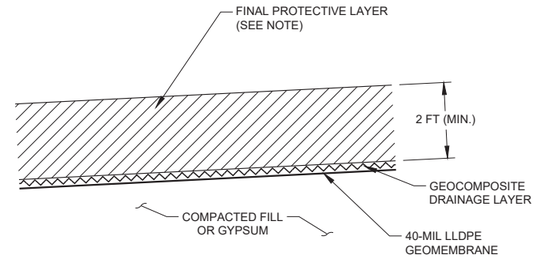

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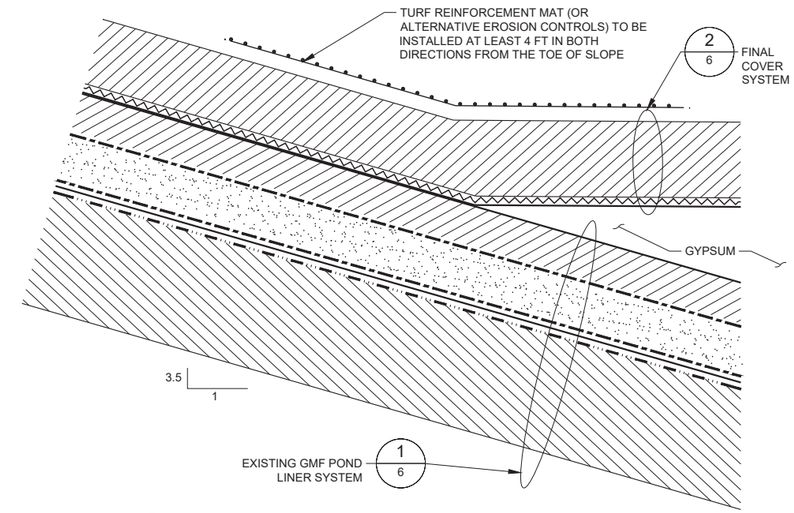
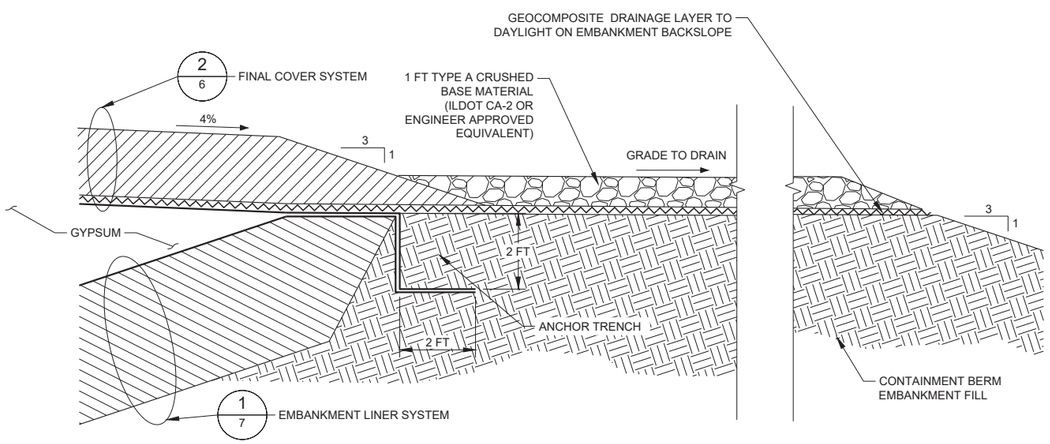
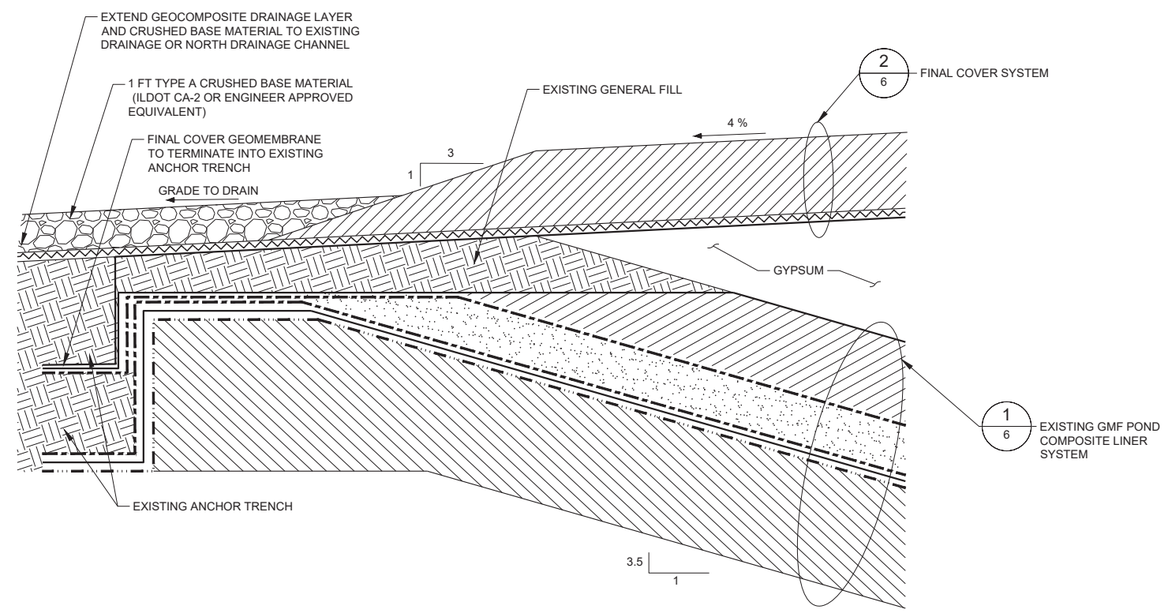


SCALE N.T.S. 3/6 TYPE 1 FINAL COVER TERMINATION



SCALE N.T.S. 4/6 SOUTH FINAL COVER TERMINATION



SCALE N.T.S. 5/6 TYPE 2 COVER TERMINATION

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2022-01-25	ISSUED FOR PERMIT APPLICATION	DVS	DVS	JJS	JEO

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PROJECT
GYPSUM MANAGEMENT FACILITY POND
CONSTRUCTION PERMIT APPLICATION

TITLE
DETAILS (1 OF 2)

PROJECT NO. 21454861 | REV. A | 6 of 7 | DRAWING 6

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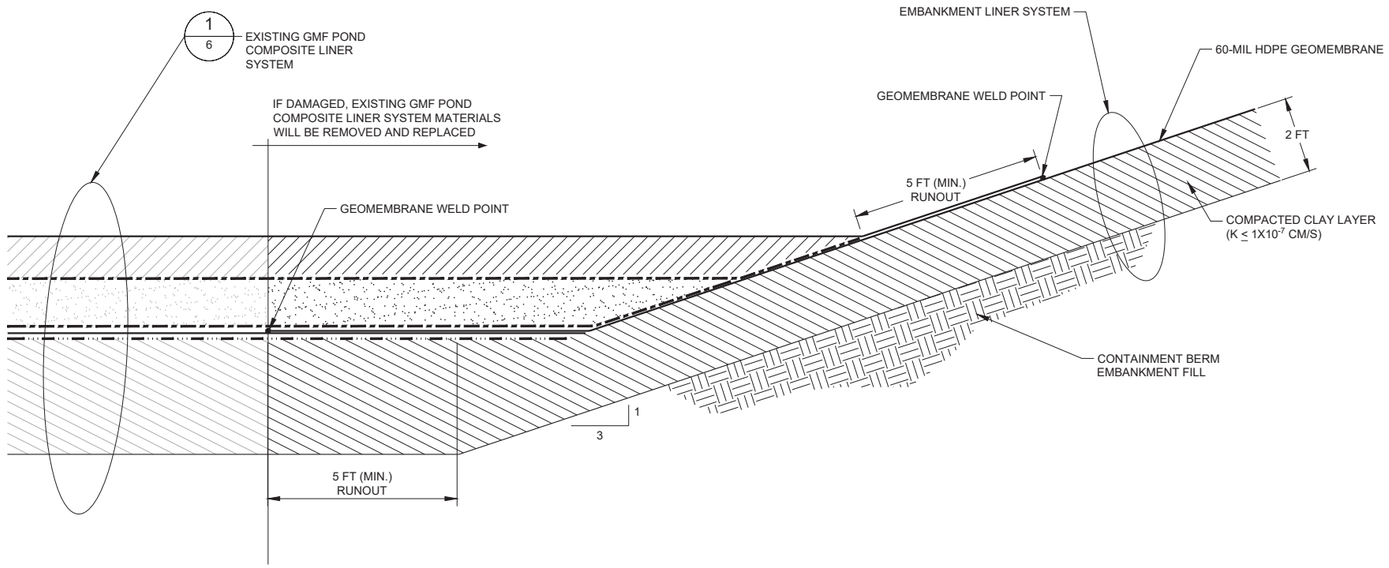
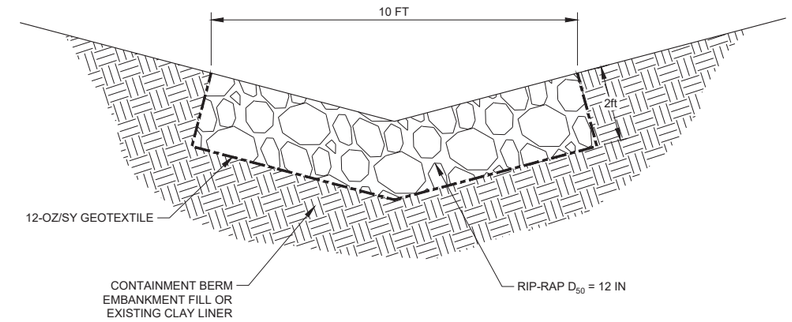
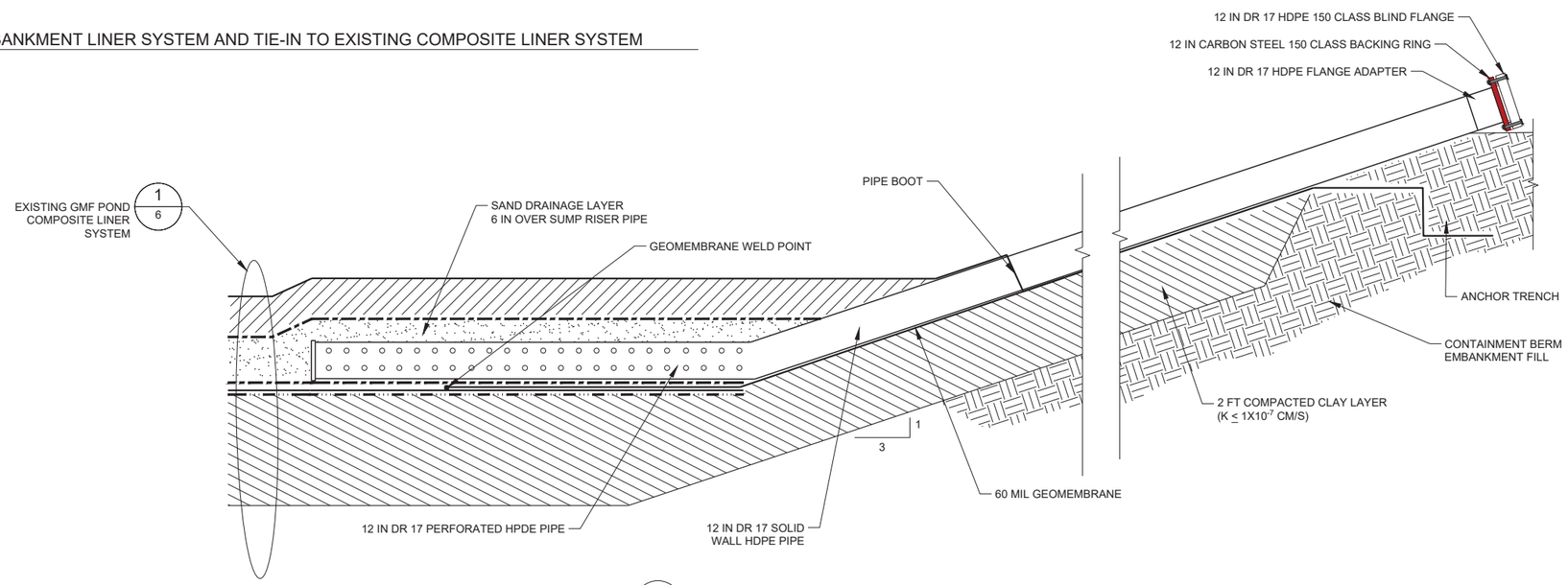


SCALE N.T.S. 1/7 EMBANKMENT LINER SYSTEM AND TIE-IN TO EXISTING COMPOSITE LINER SYSTEM



SCALE N.T.S. 2/7 ARMORED DRAINAGE DOWNCHUTE



SCALE N.T.S. 3/7 LEAK DETECTION SYSTEM SUMP AND RISER

NOTE

EXISTING 6 INCH LEACHATE COLLECTION PIPE NOT SHOWN IN DETAIL.
LEACHATE COLLECTION PIPE WILL TERMINATE AND BE CAPPED AT THE TOE OF THE CONTAINMENT BERM

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2022-01-25	ISSUED FOR PERMIT APPLICATION	DVS	DVS	JJS	JEO

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ILLINOIS POWER RESOURCES GENERATING, LLC
DUCK CREEK POWER PLANT

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GOLDER MEMBER OF WSP
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BALLWIN, MO 63021
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PROJECT
GYPSUM MANAGEMENT FACILITY POND
CONSTRUCTION PERMIT APPLICATION

TITLE
DETAILS (2 OF 2)

PROJECT NO. 21454861 | REV. A | 7 of 7 | DRAWING 7

Path: \\golder.gds\complexdata\office\Denver\acad\VISTRA\Duck Creek\09_PROJECTS\21454861\Gypsum Management Facility\02_PRODUCTION\DWGs_CIP Permit DWGs_rev\B 2 ft cover\ | File Name: 21454861A007.dwg | Last Edited By: jsauer Date: 2022-01-25 Time:3:50:26 PM | Printed By: JSauer Date: 2022-01-25 Time:4:42:31 PM
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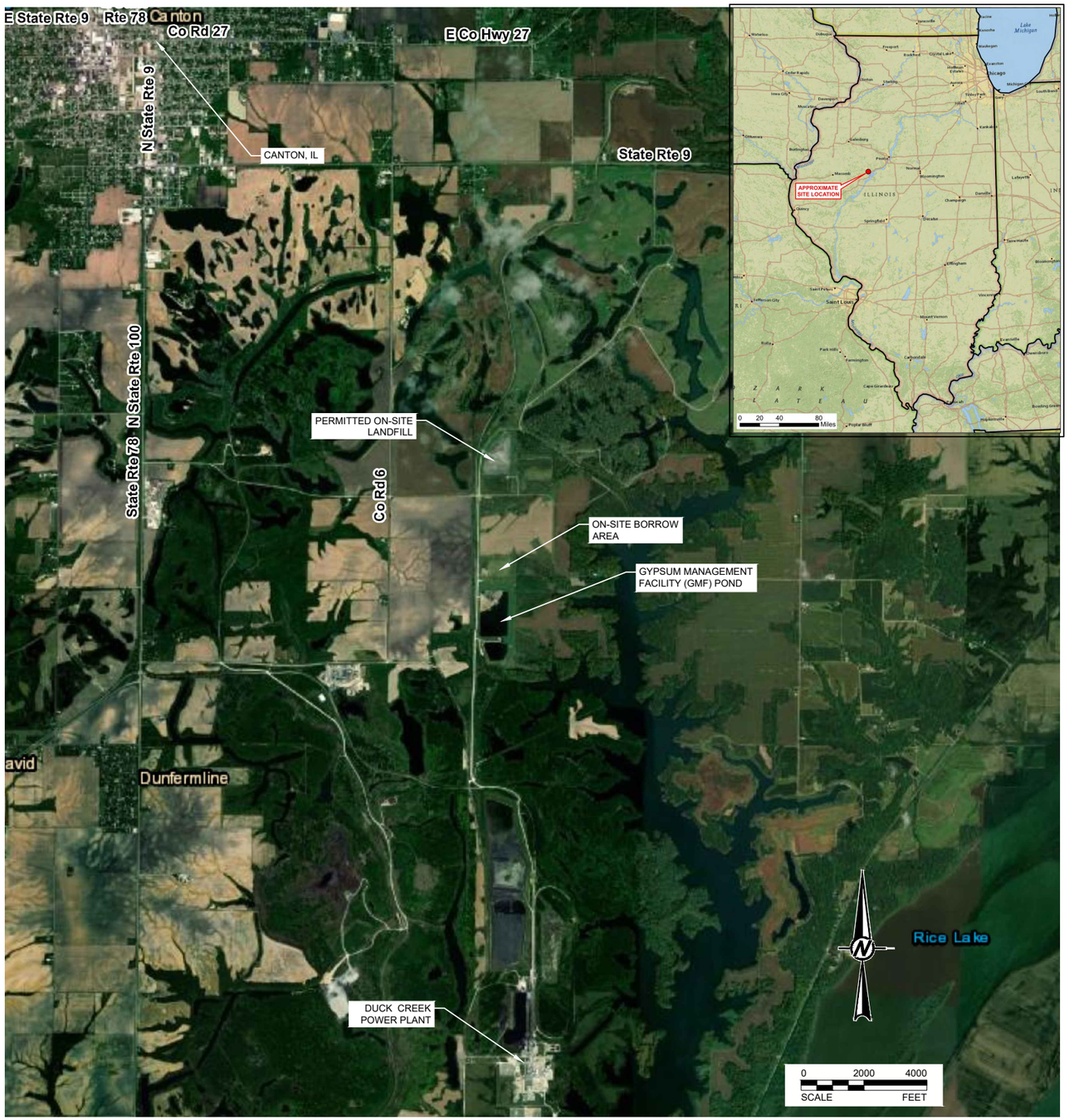
EXHIBIT 2

Closure-by-Removal Figures



ILLINOIS POWER RESOURCES GENERATING, LLC
DUCK CREEK POWER PLANT
GYPSUM MANAGEMENT FACILITY POND
CLOSURE-BY-REMOVAL

PREPARED BY:

GOLDER ASSOCIATES INC.
13515 BARRETT PARKWAY DRIVE, SUITE 260
BALLWIN, MISSOURI USA 63021

DRAWING LIST		
NUMBER	TITLE	REVISION
1	TITLE SHEET	A
2	EXISTING CONDITIONS	A
3	EXCAVATION PLAN	A
4	SECTIONS	A
5	DETAILS	A

NOTE(S)

1. AERIAL IMAGERY FROM ESRI-PROVIDED BASEMAP SERVICE. IMAGERY COLLECTED 5/14/2017, 10/21/2017, 8/22/2018, AND 4/1/2019.
2. INSET MAP BOUNDARIES FROM ESRI-PROVIDED FEATURE SERVICE. USA STATE BOUNDARIES. 2021

   INSET MAP BACKGROUND FROM ESRI-PROVIDED BASEMAP SERVICE. NATIONAL GEOGRAPHIC BASEMAP. 2021.

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2022-01-25	ISSUED FOR PERMIT APPLICATION	DVS	DVS	JJS	JEO

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ILLINOIS POWER RESOURCES GENERATING, LLC
DUCK CREEK POWER PLANT

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PROJECT
GYPSUM MANAGEMENT FACILITY POND

TITLE
TITLE SHEET

PROJECT NO.	CONTROL	REV.	of	DRAWING
21454861		A		1

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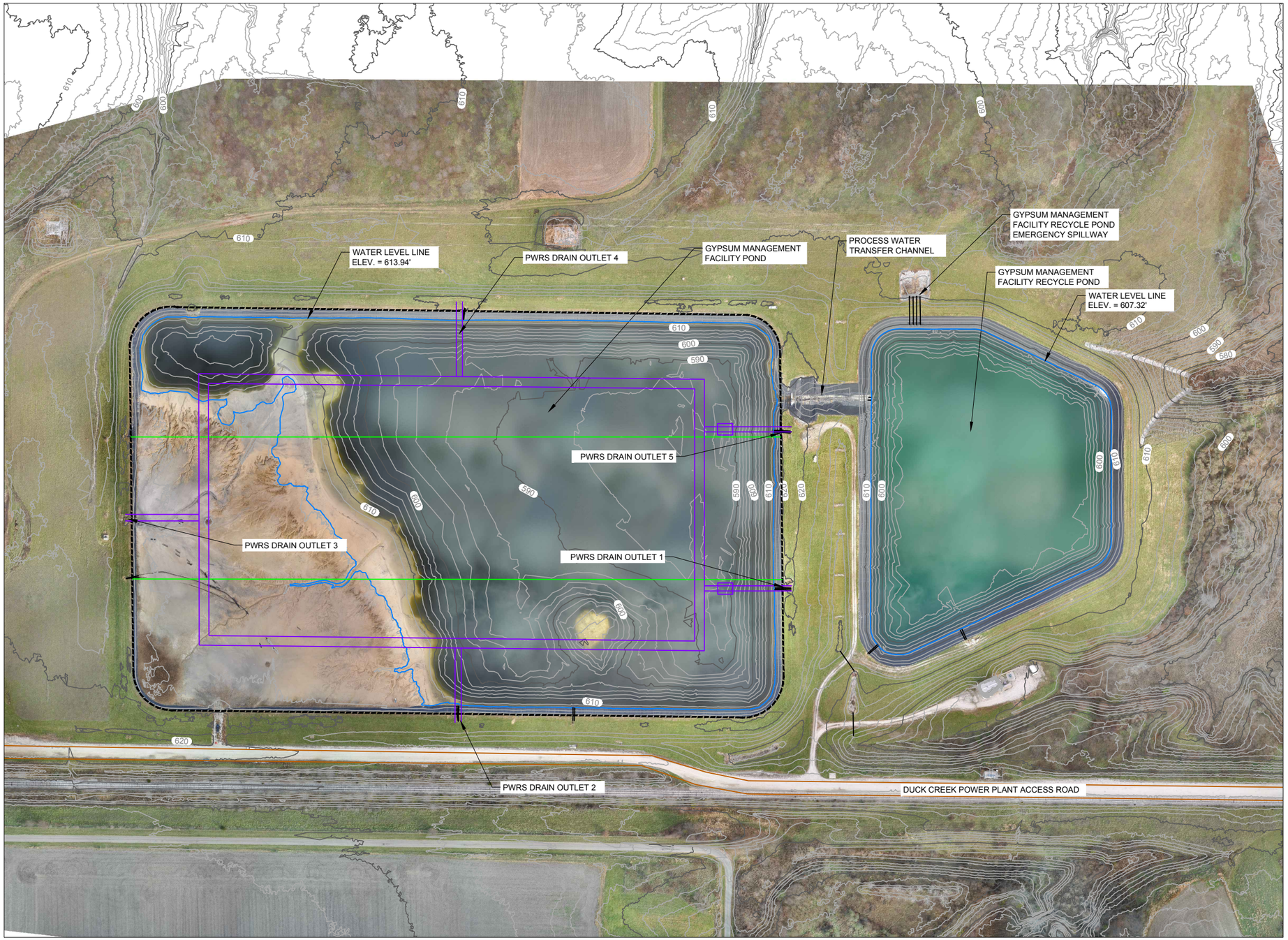

LEGEND

- 600 — EXISTING GROUND ELEVATION CONTOURS (NOTE 1)
- EXISTING ROAD
- LIMIT OF EXISTING GMF POND LINER SYSTEM (NOTE 2)
- WATER LEVEL LINE (NOTE 3)
- EXISTING PIPING (NOTE 3)
- EXISTING LCRS PIPING (SEE NOTE 4)
- EXISTING PWRS RING DRAIN SYSTEM (NOTE 4)

NOTES

1. EXISTING CONTOURS ARE A COMPOSITE OF AN AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 11/17/2020, TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 11/4/2020 & 11/5/2020, AND U.S. GEOLOGICAL SURVEY LIDAR POINT CLOUD DATA DATED 2/12/2018.
2. LIMIT OF LINER SYSTEM ESTIMATED FROM CONSTRUCTION RECORD DRAWINGS PREPARED BY HANSON PROFESSIONAL SERVICES, DATED 03/05/2009.
3. WATER LEVEL LINE AND EXISTING PIPING FROM INGENAE SURVEY RECORD DRAWING DATED 3/19/2021.
4. LEACHATE COLLECTION AND REMOVAL SYSTEM (LCRS) PIPING AND PROCESS WATER RECOVERY SYSTEM (PWRS) RING DRAIN INFRASTRUCTURE LOCATIONS ARE ESTIMATED FROM CONSTRUCTION RECORD DRAWINGS PREPARED BY HANSON PROFESSIONAL SERVICES, DATED 03/05/2009. LCRS PIPING AND PWRS RING DRAIN MATERIALS WILL BE REMOVED AND DISPOSED.
5. AERIAL IMAGERY FROM DRAGONFLY AEROSOLUTIONS DATED 11/17/2020.

0 120 240
SCALE FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2022-01-25	ISSUED FOR PERMIT APPLICATION	DVS	DVS	JJS	JEO

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CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC
DUCK CREEK POWER PLANT

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GOLDER MEMBER OF WSP

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BALLWIN, MISSOURI 63021
UNITED STATES
(313) 984 8770
www.golder.com

PROJECT
GYPSUM MANAGEMENT FACILITY POND

TITLE
EXISTING CONDITIONS

PROJECT NO. 21454861 | CONTROL | REV. A | of | DRAWING 2

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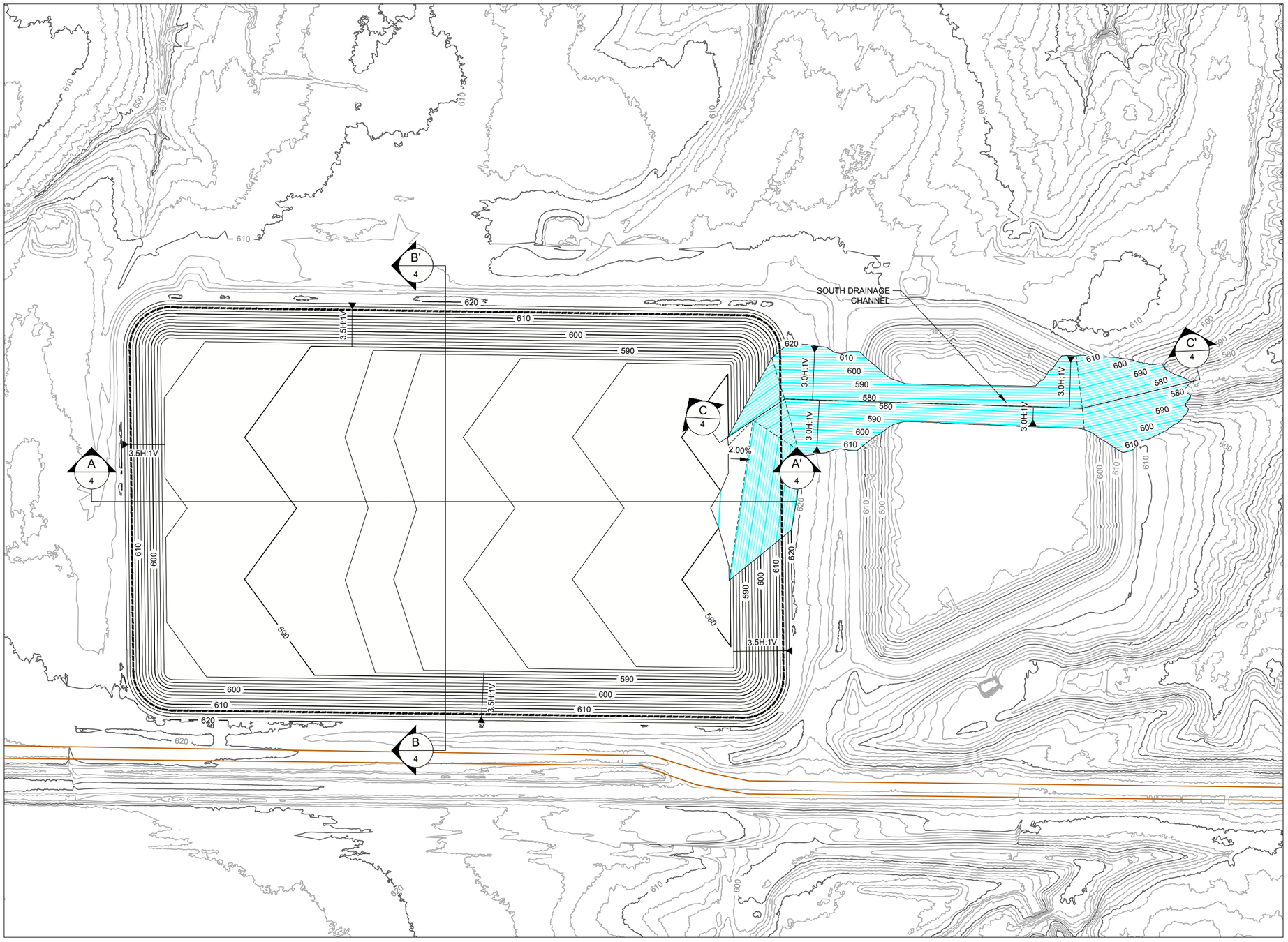

LEGEND

- 600 — BOTTOM OF EXISTING GMF POND COMPOSITE LINER SYSTEM (NOTE 1)
- 600 — EXISTING GROUND ELEVATION CONTOURS (NOTE 2)
- 600 — DRAINAGE CHANNEL GRADES
- EXISTING ROAD
- LIMIT OF EXISTING GMF POND LINER SYSTEM (NOTE 1)

NOTES

1. GYPSUM MANAGEMENT FACILITY (GMF) POND BASE GRADES AND LIMIT OF LINER SYSTEM SHOWN WERE DEVELOPED FROM CONSTRUCTION RECORD DRAWINGS PREPARED BY HANSON PROFESSIONAL SERVICES. SOUTH DRAINAGE CHANNEL DESIGNED BY GOLDER.
2. EXISTING CONTOURS ARE A COMPOSITE OF AN AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 11/17/2020, TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 11/4/2020 & 11/5/2020, AND U.S. GEOLOGICAL SURVEY LIDAR POINT CLOUD DATA DATED 2/12/2018.
3. CLOSURE BY REMOVAL INCLUDES REMOVAL OF PONDED WATER, REMOVAL OF GYPSUM, AND REMOVAL OF THE EXISTING GMF POND LINER SYSTEM. GYPSUM REMOVED FROM THE GMF POND WILL BE DISPOSED IN THE EXISTING PERMITTED ON-SITE LANDFILL OR TRANSPORTED FOR OFF-SITE DISPOSAL.

0 120 240
SCALE FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2022-01-25	ISSUED FOR PERMIT APPLICATION	DVS	DVS	JJS	JEO

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PROJECT
GYPSUM MANAGEMENT FACILITY POND

TITLE
EXCAVATION PLAN

PROJECT NO. 21454861 | CONTROL | REV. A | of | DRAWING 3

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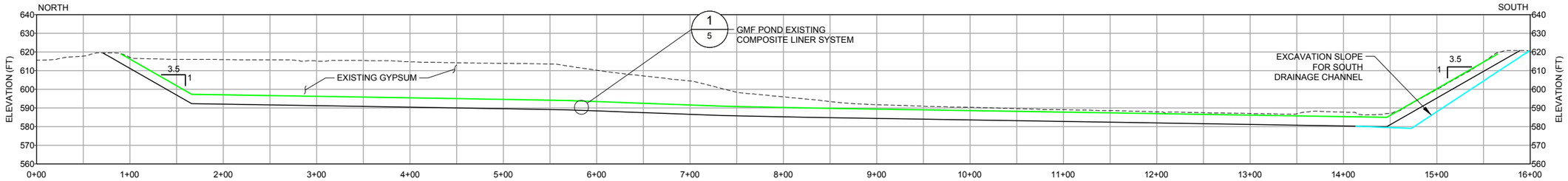

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A / 4 SECTION A-A'
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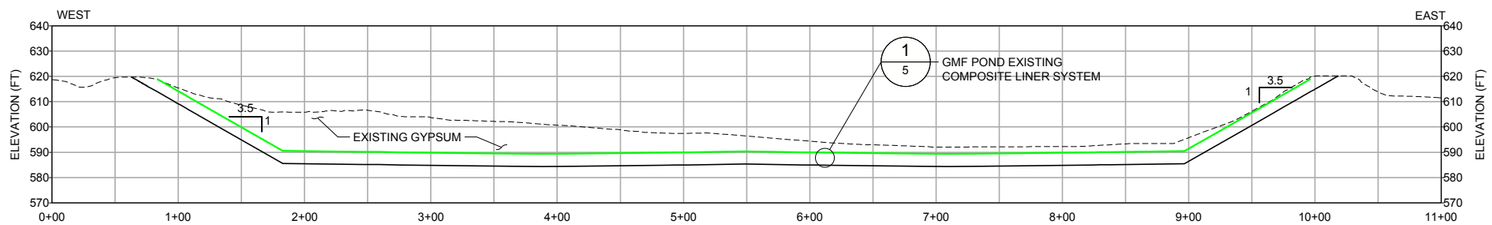
SCALE FEET



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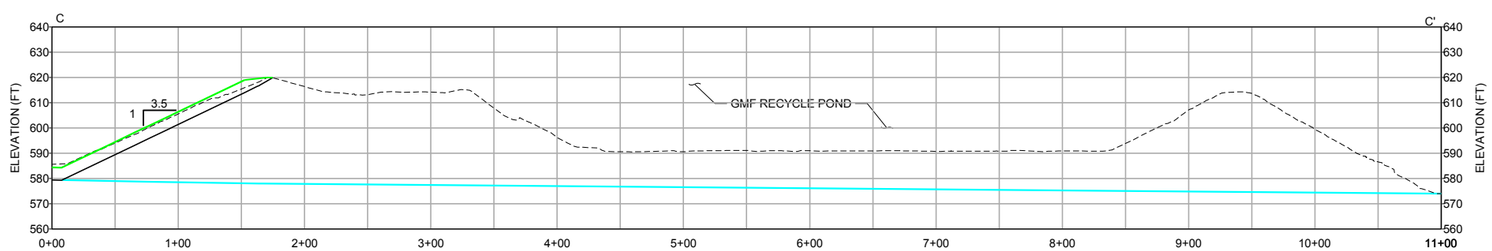
SCALE FEET



SCALE AS SHOWN
VERT. SCALE X2
C / 4 SECTION C-C'
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SCALE FEET

LEGEND

- TOP OF EXISTING GMF POND COMPOSITE LINER SYSTEM (SEE NOTE 1)
- BOTTOM OF GMF POND EXISTING COMPOSITE LINER SYSTEM (SEE NOTE 1)
- DRAINAGE CHANNEL GRADING
- EXISTING GROUND CONTOURS (SEE NOTE 2)

NOTES

1. GYPSUM MANAGEMENT FACILITY (GMF) POND BASE GRADES SHOWN WERE DEVELOPED FROM CONSTRUCTION RECORD DRAWINGS PREPARED BY HANSON PROFESSIONAL SERVICES.
2. EXISTING CONTOURS ARE A COMPOSITE OF AN AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 11/17/2020, TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 11/4/2020 & 11/5/2020, AND U.S. GEOLOGICAL SURVEY LIDAR POINT CLOUD DATA DATED 2/12/2018.
3. CLOSURE BY REMOVAL INCLUDES REMOVAL OF PONDED WATER, REMOVAL OF GYPSUM, AND REMOVAL OF THE EXISTING GMF POND LINER SYSTEM. GYPSUM REMOVED FROM THE GMF POND WILL BE DISPOSED IN THE EXISTING PERMITTED ON-SITE LANDFILL OR TRANSPORTED FOR OFF-SITE DISPOSAL.

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SEAL

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PROJECT
GYPSUM MANAGEMENT FACILITY POND

TITLE
SECTIONS

PROJECT NO. 21454861 | CONTROL | REV. A of | DRAWING 4

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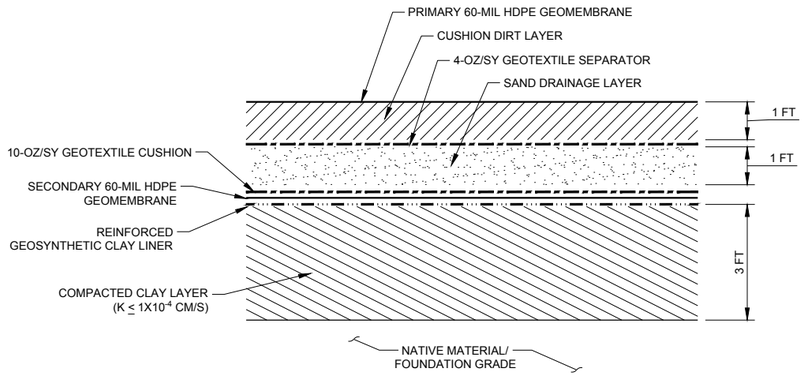

SCALE N.T.S. 1/5 GMF POND EXISTING COMPOSITE LINER SYSTEM

NOTE: ALL COMPONENTS OF THE EXISTING LINER SYSTEM WILL BE REMOVED AND DISPOSED IN THE EXISTING PERMITTED ON-SITE LANDFILL OR TRANSPORTED FOR OFF-SITE DISPOSAL. UP TO AN ADDITIONAL 12 INCHES OF SOIL MAY BE EXCAVATED FROM BENEATH THE EXISTING LINER SYSTEM AND DISPOSED.

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GYPSUM MANAGEMENT FACILITY POND

TITLE
DETAILS

PROJECT NO. 21454861 | CONTROL | REV. A | of | DRAWING 5

Path: \\golder.gds\complexdata\office\Denver\acad\VISTRA\Duck Creek\99_PROJECTS\21454861\Gypsum Management Facility\02_PRODUCTION\DWG\B_CBR Permit DWGs\ | File Name: 21454861B005.dwg | Last Edited By: jjauer Date: 2021-11-05 Time:3:51:00 PM | Printed By: JObermeyer Date: 2022-01-25 Time:3:35:26 PM
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Supporting Information for Closure Alternatives Analysis – Bottom Ash Basin at Duck Creek Power Plant

GOLDER
MEMBER OF WSP

TECHNICAL MEMORANDUM

DATE January 25, 2022 **Reference No.** 21454861-12-R-0

TO Illinois Power Resources Generating, LLC

FROM Golder Associates USA Inc.

SUPPORTING INFORMATION FOR CLOSURE ALTERNATIVES ANALYSIS – BOTTOM ASH BASIN AT DUCK CREEK POWER PLANT

Golder Associates USA Inc. (Golder), a Member of WSP, has prepared this technical memorandum for Illinois Power Resources Generating, LLC (IPRG) to support the Closure Alternatives Analysis for the Bottom Ash Basin at Duck Creek Power Plant (DCPP). The Bottom Ash Basin was used to temporarily store and dewater sluiced bottom ash produced at DCPP and has not received bottom ash since the power plant was retired in 2019. The Closure Alternatives Analysis is being completed in accordance with Illinois Administrative Code Title 35, Part 845, Standards for the Disposal of Coal Combustion Residuals (CCR) in Surface Impoundments (Part 845) by Gradient. With this technical memorandum, Golder summarizes the design basis and references used in developing the closure concepts evaluated by the Closure Alternatives Analysis.

1.0 BOTTOM ASH BASIN HISTORY

1.1 Existing Liner System Information

Based on construction drawings by Sargent & Lundy (2007a), the existing liner system for the facility consists of (from top to bottom):

- 8 inches of reinforced concrete
- 1 foot of compacted clay, placed in 6-inch-thick lifts to at least 95% of the standard Proctor maximum dry density
- 60-mil HDPE geomembrane
- minimum 6 inches of prepared subgrade (presumably native soils) compacted to at least 95% of the standard Proctor maximum dry density

According to the Bottom Ash and Low Volume Sump Water Basin and Piping General Work Contract Specifications (Sargent & Lundy 2007b), the liner system was subjected to a rigorous construction quality assurance (CQA) program.

According to the technical specifications for the reinforced concrete layer from Sargent & Lundy (2007b), the concrete appears to have used a conventional mix design (28-day compressive strength of 4,000 pounds per square inch, water-to-cement ratio of 0.5 or less).

Golder Associates Inc.
7245 W Alaska Drive, Suite 200, Lakewood, Colorado, USA 80226 T: +1 303 980-0540 F: +1 303 985-2080

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The technical specifications for composite-lined ponds from Sargent & Lundy (2007b) required a hydraulic conductivity of 1 x 10^{-6} centimeters per second (cm/s) or less for the compacted clay.

According to the technical specifications for geomembrane liner from Sargent & Lundy (2007b), the geomembrane was specified to conform to GRI GM 13, which is a common HDPE geomembrane product for waste containment. According to the technical specifications (Sargent & Lundy 2007b), the CQA program for the liner system included destructive and non-destructive testing of geomembrane seams.

Based on borehole logs from the area of the Bottom Ash Basin (Hanson 2006), native soils at the subgrade elevations (roughly El. 568 to 580 feet) generally consist of clayey silt with trace sand (ML under the Unified Soil Classification System). The hydraulic conductivity of these soils at the degree of compaction required by the technical specifications ranged from 6.0 x 10^{-7} to 2.4 x 10^{-5} cm/s, with a geometric mean of 6.1 x 10^{-6} cm/s, in permeability testing reported by Hanson (2006).

1.2 Operational History

The Bottom Ash Basin is an incised CCR surface impoundment with reinforced concrete slopes and floor. It was used to manage sluiced bottom ash at DCPP from the time construction of the Bottom Ash Basin was completed in 2009 until the power plant was retired in December 2019. During operation, bottom ash was hydraulically conveyed (sluiced) from the power plant in 10-inch-diameter basalt-lined piping and deposited at the Bottom Ash Basin in one of the two western cells, known as Primary Pond 1 and Primary Pond 2. Coarse bottom ash particles settled by gravity in the cell where they were deposited, and the sluice water was decanted via 12-inch-diameter corrugated high-density polyethylene (HDPE) piping into the eastern cell, known as the Secondary Pond. Further gravity settling occurred in the Secondary Pond before the clarified water was decanted via 12-inch-diameter corrugated HDPE piping into the Discharge Canal, which flows into Duck Creek Reservoir, with discharge at a permitted outfall in accordance with the site's National Pollutant Elimination System (NPDES) permit. Bottom ash particles accumulated in Primary Pond 1 and Primary Pond 2, requiring periodic cleanout events. During cleanout events, mobile equipment was used to excavate bottom ash out of the cell, stage it on the concrete apron for dewatering as needed, and load it into trucks for beneficial reuse or permanent disposal at the on-site landfill. Primary Pond 1 and Primary Pond 2 could operate alternately, so that bottom ash could be deposited into one cell while the other cell was being cleaned out. When DCPP was retired, nearly all of the remaining bottom ash was removed and disposed, with no appreciable bottom ash remaining at the Bottom Ash Basin.

1.3 Type and Volume of Materials

The Bottom Ash Basin does not contain appreciable amounts of CCR. Precipitation is stored in the Bottom Ash Basin when it occurs.

2.0 CLOSURE CONCEPT INFORMATION

Although appreciable amounts of CCR are not present in the Bottom Ash Basin, two concepts have been developed regarding closure of the facility. The first option for closure of the Bottom Ash Basin is to leave the existing concrete structure and underlying liner system intact, place fill to establish positive surface water drainage, and construct a final cover system compliant with Part 845 (i.e., closure in place). The second option for the closure of the Bottom Ash Basin is to remove and dispose the existing liner system components and place fill to promote positive surface water drainage (i.e., closure by removal). Additional discussion of these concepts is presented in the following sections.

2.1 Closure in Place

Under this scenario, the liner system for the Bottom Ash Basin described in Section 1.1 is to remain in place. Because 845.740(a) requires removal of the liner system for closure by removal, Golder interprets that this concept would be subject to the requirements for closure in place (845.750), including installation of a final cover system, even though no CCR would remain in place. Fill will be brought in to reach subgrade elevations designed to promote positive drainage. The facility will then be closed as described in the following section.

2.1.1 Final Cover System Materials

For closure with CCR in place, Part 845 requires installation of a final cover system over the CCR. Based on a demonstration to be submitted to the Illinois Environmental Protection Agency for approval pursuant to Section 845.750(c)(2), an alternative final cover system is incorporated into the closure-in-place concept. The final cover system consists of (from top to bottom):

- 2-foot final protective layer—locally available soils compacted to between 80% and 95% of the standard Proctor maximum dry density for establishment of vegetation and protection of the geomembrane. Material is likely to be primarily low-plasticity silt based on review of site geotechnical information (Hanson 2006).
- Geocomposite.
- 40-mil linear low-density polyethylene (LLDPE) geomembrane.

Compacted fill, composed of locally available soils, would be placed as needed to achieve final cover subgrade. The compacted fill is anticipated to be compacted to a minimum of 95% of the standard Proctor maximum dry density to provide a firm subgrade.

2.1.2 Cover System Grades

The closure design consists of the final cover system covering the concrete-lined areas. The final cover system is sloped at a 2% grade, and then terminates at the edge of concrete. A 4H:1V slope composed of compacted fill ties the final cover system at the edge of concrete into existing ground. Cover system grades and details are provided in Figures 1 and 2.

2.1.3 Closure Construction Timeline

The closure construction will require approximately 10,750 cubic yards (cy) of import fill to reach subgrade, followed by installation of 87,500 square feet (sf) of geomembrane and geocomposite. Approximately 6,500 cy of soil fill will be installed for the final protective layer. The area is not currently ponding water, and significant dewatering is not anticipated prior to beginning closure construction. Based on these construction quantities, closure is anticipated to be completed in a single construction season, and a phased construction plan is unnecessary.

2.1.4 Stormwater Management

Stormwater runoff from the Bottom Ash Basin closure area will be managed by sheet flow off the cover system into an existing stormwater channel (Sargent & Lundy 2007a). Stormwater in this channel is routed into the existing Discharge Canal south of the Bottom Ash Basin. No new stormwater management ponds or features are planned for closure.

2.2 Closure by Removal

Under this scenario, the concrete, compacted clay, and geomembrane components of the liner system for the Bottom Ash Basin, as described in Section 1.1, will be removed as required under 845.740(a) and disposed of in the existing permitted on-site landfill located approximately 3.7 miles north of the Bottom Ash Basin. Alternatively, the materials may be disposed of at an off-site landfill approximately 33 miles away. Subsoil beneath the liner system will be excavated to a depth of up to 1 foot and disposed. Fill will be brought in to reach subgrade elevations designed to promote positive surface water drainage. The facility will then be closed as described in the following section.

2.2.1 Closure Materials

Because no appreciable amounts of bottom ash remain in the Bottom Ash Basin, once the concrete, compacted clay, geomembrane, and subsoil are removed, closure will consist of grading of the area to promote positive drainage and prevent significant ponding. The closed area will be seeded and mulched to promote long-term vegetation.

Based on a review of the soil materials available on site, the fill to reach closure grades is anticipated to consist of low-plasticity silts (Hanson 2006). To limit the potential for excessive settlement, the fill will be compacted to a minimum of 95% of the standard Proctor maximum dry density.

2.2.2 Closure Grades

Because no engineered final cover is necessary for this concept, the closure grades for the closure by removal option are lower in elevation compared to those shown for the closure in place concept. The final grades are still sloped at a 2% grade, and then terminate at the edge of concrete. A 4H:1V slope composed of compacted fill will be used to tie the final surface at the edge of concrete into existing ground. The plan grades and details for this concept are provided in Figures 3 and 4.

2.2.3 Closure Construction Timeline

The closure construction will require removal of approximately 1,950 cy of concrete, 1,600 cy of compacted clay, 3,200 cy of subsoil, and 1 acre of geomembrane. Approximately 17,500 cy of fill will be required to reach closure grades. No final cover system is needed for this closure scenario. The area is not currently ponding water, and significant dewatering is not anticipated prior to beginning closure construction. Based on these construction quantities, the closure is anticipated to be completed in a single construction season, and a phased construction plan was deemed unnecessary.

2.2.4 Stormwater Management

Stormwater runoff from the Bottom Ash Basin closure area will be managed by sheet flow off the final surface into an existing stormwater channel (Sargent & Lundy 2007a). Stormwater in this channel is routed into the existing Discharge Canal south of the Bottom Ash Basin. No new stormwater management ponds or features are planned for closure.

3.0 ADDITIONAL INFORMATION

Gradient provided a request for additional information to support the Closure Alternatives Analysis. The additional information compiled by Golder in response to the request is provided in Tables 1 through 4. Table 1 provides narrative responses for information requests based largely on Part 845 requirements for the Closure Alternatives Analysis. Table 2 summarizes conceptual-level estimates of material quantities, costs, equipment and vehicle usage, labor resources, and haul truck trips for the closure-in-place approach. Table 3 summarizes conceptual-

level estimates of material quantities, costs, equipment and vehicle usage, labor resources, and haul truck trips for the closure-by-removal approach with disposal in the existing permitted on-site landfill, which has ample remaining capacity to accept these materials. Table 4 summarizes conceptual-level estimates of material quantities, costs, equipment and vehicle usage, labor resources, and haul truck trips for the closure-by-removal approach with disposal in an off-site landfill.

In accordance with Part 845, the cost estimates meet the criteria for a Class 4 estimate under the AACE classification standard (feasibility-level, -30% to +50% expected accuracy range). Cost estimates are presented in 2022 United States dollars. cost estimates for many of the cost components, whereby a labor and heavy equipment spread was assigned to the activity. That is, the number and classification (e.g., operator, laborer) of personnel carrying out the activity and the number and type of heavy equipment pieces (e.g., dozer, loader, haul truck) was estimated based on our experience with similar construction operations. This information, combined with an estimate of production rate (e.g., number of cubic yards placed per day), yields a unit cost for the operation (e.g., cost per cubic yard placed). Golder developed production rates based on equipment capabilities (e.g., haul truck capacity, estimated load and unload times, estimates of average speed) and checked them against experience from similar projects. The hourly heavy equipment rates used in the cost estimates were from an internal database of heavy equipment ownership and operating costs by type and size (capacity) of equipment. The internal database reflects the estimated cost associated with owned heavy equipment in the central United States. The hourly labor rates used in the cost estimates were from an internal database of typical labor rates from similar projects in the north-central United States. Unit prices for some cost components (e.g., furnishing and installation of geosynthetics, seeding, and mulching) were estimated based on typical unit prices from similar recent projects. Material quantities correspond with the closure approaches shown in Exhibits 1 and 2 and were developed primarily in Autodesk Civil3D. At a conceptual level of cost estimating, project costs other than direct construction costs (e.g., mobilization and demobilization, miscellaneous construction items not captured elsewhere) were estimated as a proportion of the direct construction cost. Experience on similar projects was used as the basis for the proportions applied.

4.0 REFERENCES

Hanson (Hanson Professional Services Inc.). 2006. Geotechnical Investigation Results. Bottom Ash Basin. Duck Creek Power Station. February.

Sargent & Lundy. 2007a. Bottom Ash and Low Volume Sump Water Basin and Piping Drawings, Issued for Construction. Duck Creek Power Station. September.

Sargent & Lundy. 2007b. Bottom Ash and Low Volume Sump Water Basin and Piping Construction Specifications. Duck Creek Power Station. September.

Attachments: Attachment 1: Exhibits 1 and 2
- Exhibit 1: Closure-in-Place Figures
- Exhibit 2: Closure-by-Removal Figures

Attachment 2: Tables
- Table 1: Information Summary
- Table 2: Closure Estimates – Closure in Place
- Table 3: Closure Estimates – Closure by Removal with On-Site Disposal
- Table 4: Closure Estimates – Closure by Removal with Off-Site Disposal

Tables

Table 1: Information Summary

Background/Current Site Conditions	
Surface area of impoundment	2.2 acres total (includes all three cells and the concrete area around the cells). 0.9 acres maximum wetted area.
Volume of CCR in impoundment	No appreciable amount (CCR has already been removed and disposed).
Published or draft engineering evaluations undertaken at the site to date	
Conceptual site models	None.
Regional well (receptor) survey information	None.
History of construction report	See [1]
Dike stability report	Stability analysis was not completed for the CCR Rule (volume is less than 20 acre-feet and height is less than 20 feet), according to AECOM [2]. Based on site observations, there is no risk associated with dike stability.
Hydraulic evaluation of basins (evaluation of possibility of overtopping and/or emergency spillway releases during flood conditions)	Hydraulic and hydrologic analyses performed by AECOM [3] found that the Bottom Ash Basin adequately manages outflow during the 25-year IDF, as overtopping of the BAB is not expected.
Surface impoundment hazard assessment/hazard category determination	Hazard category determination not completed for the CCR Rule (not required for incised CCR surface impoundments).
Habitat survey	Not available.
Wetlands survey	Not available. Based on visual observation, wetlands do not appear to be present in the area to be disturbed for closure construction.

Table 1: Information Summary

Closure Design and Implementation	
Copy of draft of closure report, if available	Provided.
Engineering spreadsheet containing breakdown of labor, equipment/vehicle, and material requirements for each closure alternative, if available (expected on-site and off-site vehicle and equipment mileages, labor hours, etc.)	See Tables 2 through 4.
Overview of planned activities under each closure alternative	Closure by removal: Under this scenario, approximately 1950 cy of concrete, 1600 cy of compacted clay, and 1 acre of geomembrane that make up the BAB liner system, along with 3200 cy of overexcavated subsoil, will be removed and disposed in the on-site landfill or in an off-site landfill. Approximately 17500 cy of low-plasticity silts available on site will be used as fill to reach reclamation grades, and it will be compacted to at least 95% of the standard Proctor maximum dry density to prevent excessive settlement. The site will be graded to promote positive drainage and prevent significant ponding (2% grade to the edge of concrete, 4H:1V from edge of concrete to existing ground), and it will be seeded to promote long-term vegetation.
	Closure in place: Under this scenario, the concrete, compacted clay, and geomembrane that make up the BAB liner system will remain in place. Approximately 10750 cy of low-plasticity silt available on site will be used as fill to reach reclamation grades, and it will be compacted to at least 95% of the standard Proctor maximum dry density to prevent excessive settlement. The final cover system will be composed of (from top to bottom): 2 feet of locally available low-plasticity silt, compacted to between 80% and 95% of the standard Proctor maximum dry density; a drainage layer of approximately 87500 sq ft of geocomposite; and approximately 87500 sq ft of 40-mil LLDPE geomembrane. To promote drainage and prevent excessive ponding, the cover system will be sloped at a 2% grade to the edge of concrete, and compacted fill with a 4H:1V slope will extend from the edge of concrete to the existing grades. It will be seeded to promote long-term vegetation.
Expected duration of major construction activities under each closure activity	Closure by removal: 12 weeks.
	Closure in place: 6 weeks.
If an on-site landfill will be constructed on the site under a given closure alternative, please include the years required to construct and later close the on-site landfill	Not applicable. The existing permitted on-site landfill has sufficient capacity to accept waste generated from closure by removal without expansion of the existing landfill or construction of a new on-site landfill.
If an on-site landfill must first be constructed on the site, please estimate the anticipated delay in the commencement of excavation activities while the landfill is being sited, designed, and constructed; indicate whether dewatering/unwatering of the ponds will begin immediately, or after the landfill is constructed	Not applicable.
Proposed location of the on-site landfill if on-site disposal is being considered for CBR scenario	The existing on-site landfill is approximately 3.7 miles north of the Bottom Ash Basin via site roads.

Table 1: Information Summary

Closure Design and Implementation	
Surface area of the on-site landfill, if a new landfill must be constructed at the site	Not applicable.
Name and location of proposed off-site landfill	If an off-site landfill were to be used, the Peoria City-County Landfill is the nearest suitable facility (33 miles away). An alternate off-site landfill is the Envirofill of IL Landfill.
Location of borrow area, if a borrow area will be established (for either the impoundment or construction/closure of an on-site landfill); if location is unknown, please estimate a likely distance to the borrow area	The anticipated on-site borrow source location is approximately 3.4 miles north of the Bottom Ash Basin via site roads.
Estimated volume of soil to be hauled from the borrow area under each closure alternative	Closure by removal: 18,000 cy.
	Closure in place: 17,000 cy.
Difficulty associated with implementation of each closure alternative (e.g., do any alternatives pose particular engineering/implementation challenges?)	No major challenges are anticipated for any closure alternative.
Availability of necessary equipment and specialists for each closure alternative	Good availability of equipment and services is anticipated for all closure alternatives.
Available capacity and location of needed treatment, storage, and disposal services for each closure alternative	The distance to the nearest off-site landfill (approximately 33 miles) presents a significant challenge for the option that involves off-site disposal.
Estimated cost of each closure alternative	Closure by removal: $480,000 (on-site disposal); $1,360,000 (off-site disposal).
	Closure in place: $500,000.

Table 1: Information Summary

Post-Closure Plan/Long-Term Management Plan	
Planned duration of post-closure care activities	Closure by removal: An owner or operator of a CCR surface impoundment that elects to close a CCR surface impoundment by removing CCR as provided in Section 845.740 must continue groundwater monitoring for three years after the completion of closure or until concentrations have been reduced to the maximum extent feasible and they are protective of human health and the environment.
	Closure in place: The owner or operator of the CCR surface impoundment must conduct post-closure care for 30 years. The owner or operator must continue to conduct post-closure care beyond the 30-year post-closure care period until groundwater monitoring data shows the concentrations are (a) below groundwater protection standards given in Section 845.600 of Part 845 or (b) not increasing for those constiuents over background using the statistical procedures and performance standards in Section 845.640(f) and (g), provided that concentrations have been reduced to the maximum extent feasible and they are protective of human health and the environment.
Expected frequency of groundwater and surface water monitoring during post-closure period	Closure by removal: Quarterly.
	Closure in place: Quarterly for 5 years and semi-annually thereafter.
Summary of planned maintenance activities post-closure	Closure by removal: Groundwater monitoring will be conducted.
	Closure in place: Groundwater monitoring will be conducted. Site inspections will be conducted on a quarterly basis for a minimum of 5 years after closure. An annual site inspection will be performed until settlement has ceased and there are no eroded or scoured areas or until the end of the 30-year post-closure care period. Over these 30 years, repair and maintenance, including soil filling and reseeding, will be performed if ponding is observed, cracks greater than 1 inch wide or gullies 6 inches or deeper have formed, vegetative or vector problems arise, or leachate seeps are present. Areas susceptible to erosion will be recontoured and reseeded. Eroded and scoured drainage channels will be repaired and the liner material replaced if necessary. Vegetation will be mowed annually. Areas of failed or eroded vegetation in excess of 100 square feet will be revegetated. Minor repairs to ensure the integrity and proper function of fencing, surface water drainage features, monitoring points, and groundwater monitoring wells may be required.
Summary of planned post-closure care activities at the on-site landfill, if a new on-site landfill is going to be constructed	Not applicable.

Corrective Measures Assessment	
Corrective measures being considered post-closure	None anticipated.
Overview of planned activities for each corrective measure	None anticipated.

References

1) Golder (2021). History of Construction for the Bottom Ash Basin, Duck Creek Power Plant.

2) AECOM (2016). CCR Rule Report: Initial Structural Stability Assessment for Bottom Ash Basin at Duck Creek Power Station. Available online: https://www.luminant.com/ccr.

3) AECOM (2016). CCR Rule Report: Initial Inflow Design Flood Control System Plan for Bottom Ash Basin at Duck Creek Power Station. Available online:

Table 2: Closure Estimates - Closure in Place

Description	Unit	Quantity	Unit Price	Total	Labor	Equipment	Truck Trips
Mobilization/Demobilization	LS	1	10%	$ 34,950	1 superintendent	Pickup truck, flatbed truck	
Survey	LS	1	$ 20,000	$ 20,000	1 surveyor		
Borrow Area Preparation and Reclamation	LS	1	$ 15,000	$ 15,000	2 equipment operators	Dozer, seed drill or hydroseeder	
Pipe Removal/Abandonment	LS	1	$ 10,000	$ 10,000	1 equipment operator, 4 laborers	Excavator	
Embankment Fill	CY	10,750	$ 9.30	$ 99,975	8 equipment operators	Excavator, dozer, compactor, water truck, 4 haul trucks	372 (3.4 miles one way)
Geomembrane	SF	87,500	$ 0.75	$ 65,625	5 laborers, 1 equipment operator, 1 superintendent, 1 quality assurance technician	Telehandler	
Geocomposite	SF	87,500	$ 0.75	$ 65,625			
Final Protective Soil Layer	CY	6,500	$ 8.20	$ 53,300	7 equipment operators	Excavator, dozer, water truck, 4 haul trucks	225 (3.4 miles one way)
Fertilize, Seed, and Mulch	AC	3	$ 5,000	$ 15,000	2 equipment operators	Seed drill or hydroseeder	
Erosion Control	LS	1	$ 5,000	$ 5,000	1 equipment operator, 2 laborers	Excavator	
Construction Quality Assurance	LS	1	$ 75,000	$ 75,000	1 technician		
Miscellaneous Construction	LS	1	10%	$ 38,450	Miscellaneous	Miscellaneous	
			Total	**$ 497,925**			

Notes:

Miscellaneous Costruction includes other work not captured in the items shown.

Soil components were assumed to be taken from the stockpile north of the GMF (3.4-mile haul).

Table 3: Closure Estimates - Closure by Removal with On-Site Disposal

Description	Unit	Quantity	Unit Price	Total	Labor	Equipment	Truck Trips
Mobilization/Demobilization	LS	1	10%	$ 37,530	1 superintendent	Pickup truck, flatbed truck	
Survey	LS	1	$ 10,000	$ 10,000	1 surveyor		
Borrow Area Preparation and Reclamation	LS	1	$ 15,000	$ 15,000	2 equipment operators	Dozer, seed drill or hydroseeder	
Pipe Removal/Abandonment	LS	1	$ 10,000	$ 10,000	1 equipment operator, 4 laborers	Excavator	
Concrete Demolition and Disposal	CY	1,950	$ 57	$ 111,150	5 equipment operators, 4 laborers	2 breakers, dozer, loader, haul truck	67 (3.7 miles one way)
Geomembrane Removal and Disposal	AC	1	$ 8,000	$ 8,000	3 equipment operators, 4 laborers	Dozer, loader, haul truck	4 (3.7 miles one way)
Liner Soil Removal and Disposal	CY	1,600	$ 8.00	$ 12,800	6 equipment operators	Excavator, dozer, 4 haul trucks	55 (3.7 miles one way)
Subsoil Overexcavation and Disposal	CY	3,200	$ 8.00	$ 25,600	6 equipment operators	Excavator, dozer, 4 haul trucks	111 (3.7 miles one way)
Embankment Fill	CY	17,500	$ 9.30	$ 162,750	8 equipment operators	Excavator, dozer, compactor, water truck, 4 haul trucks	606 (3.4 miles one way)
Fertilize, Seed, and Mulch	AC	3	$ 5,000	$ 15,000	2 equipment operators	Seed drill or hydroseeder	
Erosion Control	LS	1	$ 5,000	$ 5,000	1 equipment operator, 2 laborers	Excavator	
Construction Quality Assurance	LS	1	$ 25,000	$ 25,000	1 technician		
Miscellaneous Construction	LS	1	10%	$ 41,280	Miscellaneous	Miscellaneous	
			Total	**$ 479,110**			

Notes:
Miscellaneous Construction includes other work not captured in the items shown.
Soil components were assumed to be taken from the stockpile north of the GMF (3.4-mile haul).
Disposal was assumed to occur in the on-site landfill (3.7-mile haul).

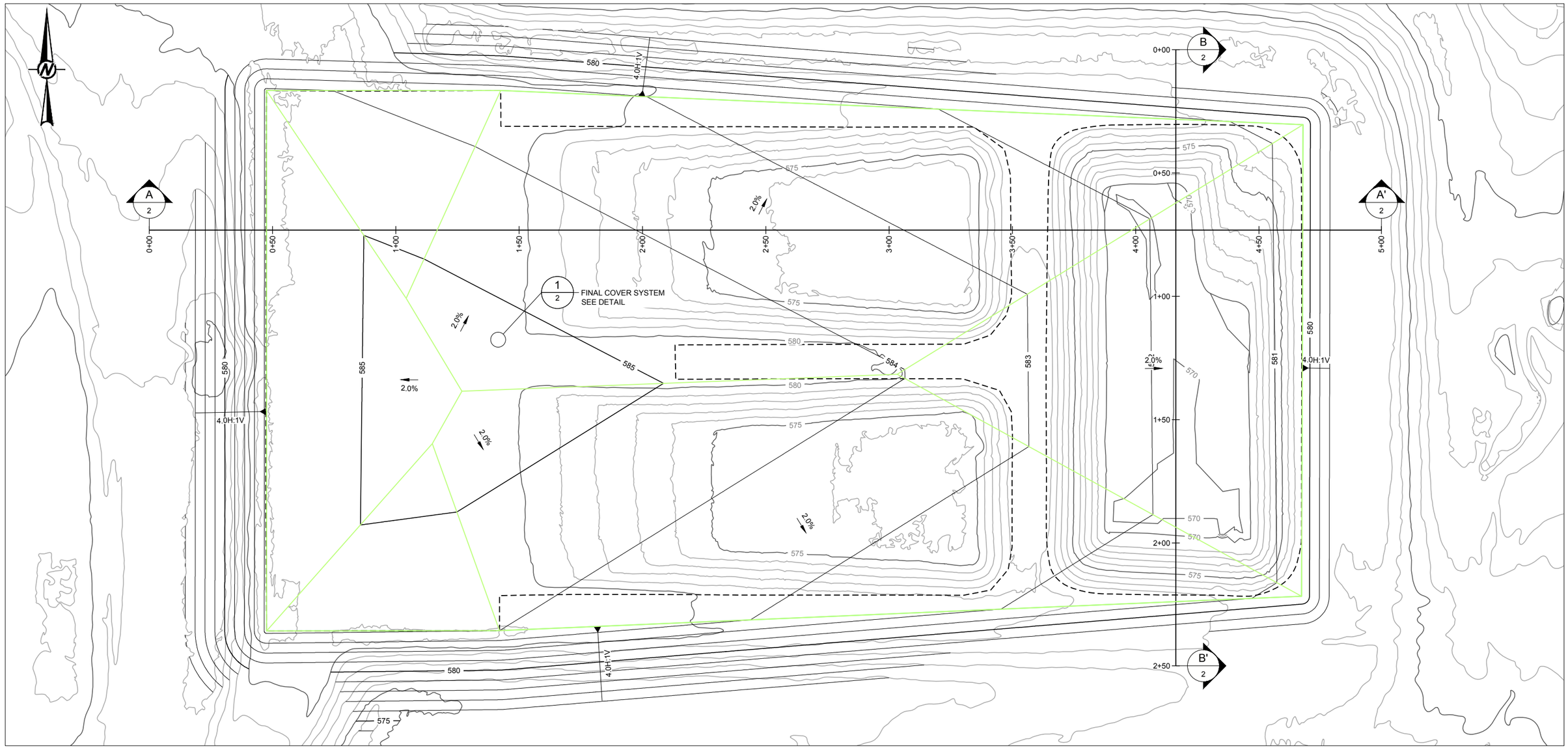
Table 4: Closure Estimates - Closure by Removal with Off-Site Disposal

Description	Unit	Quantity	Unit Price	Total	Labor	Equipment	Truck Trips
Mobilization/Demobilization	LS	1	10%	$ 110,440	1 superintendent	Pickup truck, flatbed truck	
Survey	LS	1	$ 10,000	$ 10,000	1 surveyor		
Borrow Area Preparation and Reclamation	LS	1	$ 15,000	$ 15,000	2 equipment operators	Dozer, seed drill or hydroseeder	
Pipe Removal/Abandonment	LS	1	$ 10,000	$ 10,000	1 equipment operator, 4 laborers	Excavator	
On-Site Concrete Demolition	CY	1,950	$ 182	$ 354,900	4 equipment operators, 4 laborers	2 breakers, dozer, loader	
Off-Site Concrete Hauling and Disposal					Equipment operator	On-highway truck	140 (32.6 miles one way)
On-Site Geomembrane Removal	AC	1	$ 8,500	$ 8,500	2 equipment operators, 4 laborers	Dozer, loader	
Off-Site Geomembrane Hauling and Disposal					Equipment operator	On-highway truck	6 (32.6 miles one way)
On-Site Liner Soil Removal	CY	1,600	$ 109	$ 174,400	2 equipment operators	Excavator, dozer	
Off-Site Liner Soil Hauling and Disposal					4 equipment operators	4 on-highway trucks	114 (32.6 miles one way)
On-Site Subsoil Overexcavation	CY	3,200	$ 109	$ 348,800	2 equipment operators	Excavator, dozer	
Off-Site Subsoil Hauling and Disposal					4 equipment operators	4 on-highway trucks	229 (32.6 miles one way)
Embankment Fill	CY	17,500	$ 9.30	$ 162,750	8 equipment operators	Excavator, dozer, compactor, water truck, 4 haul trucks	606 (3.4 miles one way)
Fertilize, Seed, and Mulch	AC	3	$ 5,000	$ 15,000	2 equipment operators	Seed drill or hydroseeder	
Erosion Control	LS	1	$ 5,000	$ 5,000	1 equipment operator, 2 laborers	Excavator	
Construction Quality Assurance	LS	1	$ 25,000	$ 25,000	1 technician		
Miscellaneous Construction	LS	1	10%	$ 121,480	Miscellaneous	Miscellaneous	
			Total	**$ 1,361,270**			

Notes:
Miscellaneous Construction includes other work not captured in the items shown.
Soil components were assumed to be taken from the stockpile north of the GMF (3.4-mile haul).
Disposal was assumed to occur in an off-site landfill (32.6-mile haul).

EXHIBIT 1

Closure-in-Place Figures



LEGEND

- 600 — PROPOSED CLOSURE GRADES
- 600 — EXISTING GROUND CONTOURS (SEE NOTE 1)
- EDGE OF CONCRETE (SEE NOTE 3)
- GRADING BREAKLINE

NOTE(S)

1. EXISTING CONTOURS SHOWN ARE FROM AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 11/17/2020 AND TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 11/4/2020 & 11/5/2020. NO UNDERGROUND OR OVERHEAD UTILITIES WERE LOCATED DURING THIS SURVEY.
2. ELEVATIONS ARE IN NAVD 88.
3. EDGE OF CONCRETE PROVIDED IN INGENAE SURVEY RECORD DRAWING DATED 2/9/2021.

0 20 40
SCALE FEET

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC
DUCK CREEK POWER PLANT

PROJECT
BOTTOM ASH BASIN
CLOSURE ALTERNATIVES ANALYSIS

CONSULTANT
GOLDER
MEMBER OF WSP

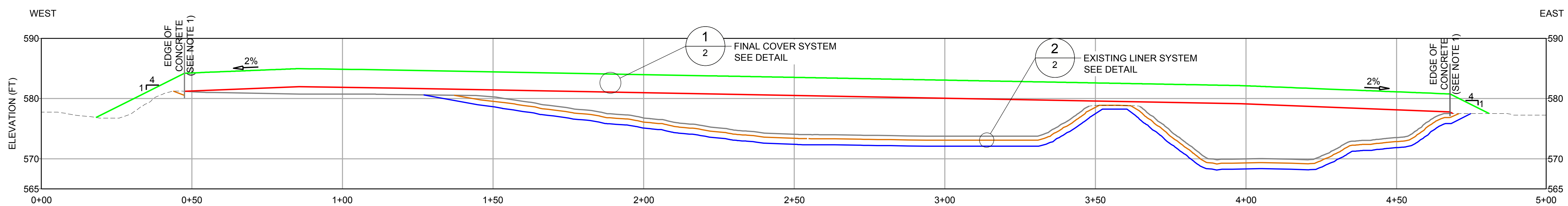
YYYY-MM-DD	2021-11-05
DESIGNED	JEO
PREPARED	KAC
REVIEWED	JJS
APPROVED	JEO

TITLE
CLOSURE IN PLACE
CONCEPTUAL DESIGN PLAN

PROJECT NO. 21454861 | REV. A | FIGURE 1

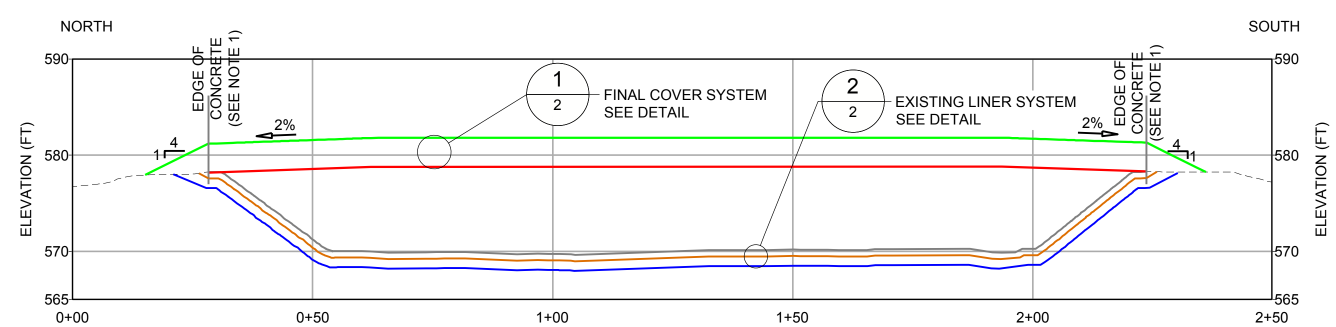
Path: \\golder.gds\complexdata\office\Denver\acad\V\STRA\Duck Creek\99_PROJECTS\21454861\Bottom Ash Basin Figures\ | File Name: Closure In Place.dwg | Last Edited By: jobermeyer Date: 2021-11-05 Time:12:50:00 PM | Printed By: JObermeyer Date: 2022-01-25 Time:5:26:17 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D
1 in
0



SCALE AS SHOWN
VERT. SCALE = 2X
A / 2 CROSS SECTION A

0 20 40
SCALE FEET



SCALE AS SHOWN
VERT. SCALE = 2X
B / 2 CROSS SECTION B

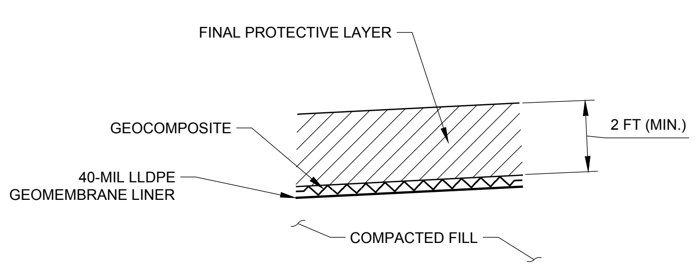
0 20 40
SCALE FEET

CROSS SECTION LEGEND

- PROPOSED TOP OF FINAL COVER SYSTEM
- PROPOSED TOP OF COMPACTED FILL
- EXISTING GROUND
- EXISTING LINER SYSTEM - TOP OF CONCRETE
- EXISTING LINER SYSTEM - TOP OF COMPACTED CLAY
- EXISTING LINER SYSTEM - GEOMEMBRANE

NOTE(S)

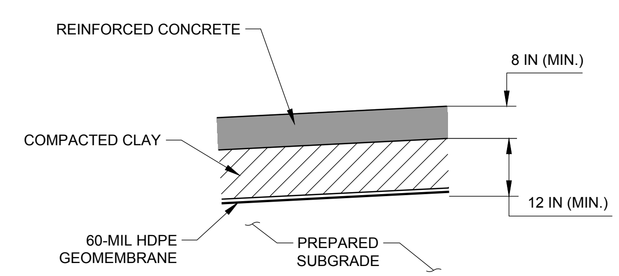
1. EDGE OF CONCRETE PROVIDED IN INGENAE SURVEY RECORD DRAWING DATED 2/9/2021.



SCALE N.T.S. 1 / 2 FINAL COVER SYSTEM

NOTE(S)

FINAL PROTECTIVE LAYER WILL BE COMPOSED OF LOCALLY AVAILABLE SOILS COMPACTED TO BETWEEN 80% AND 95% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY FOR ESTABLISHMENT OF VEGETATION AND PROTECTION OF THE GEOMEMBRANE.



SCALE N.T.S. 2 / 2 EXISTING LINER SYSTEM

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC
DUCK CREEK POWER PLANT

PROJECT
BOTTOM ASH BASIN
CLOSURE ALTERNATIVES ANALYSIS

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-11-05
DESIGNED	JEO
PREPARED	KAC
REVIEWED	JJS
APPROVED	JEO

TITLE
CLOSURE IN PLACE
SECTIONS AND DETAILS

PROJECT NO. 21454861
REV. A
FIGURE 2

Path: \\golder.gds\complexdata\office\Denver\acad\VISTRA\Duck Creek\99_PROJECTS\21454861\Bottom Ash Basin Figures\ | File Name: Closure In Place.dwg | Last Edited By: jobermeyer Date: 2021-11-05 Time:12:50:00 PM | Printed By: JObermeyer Date: 2022-01-25 Time:5:22:07 PM

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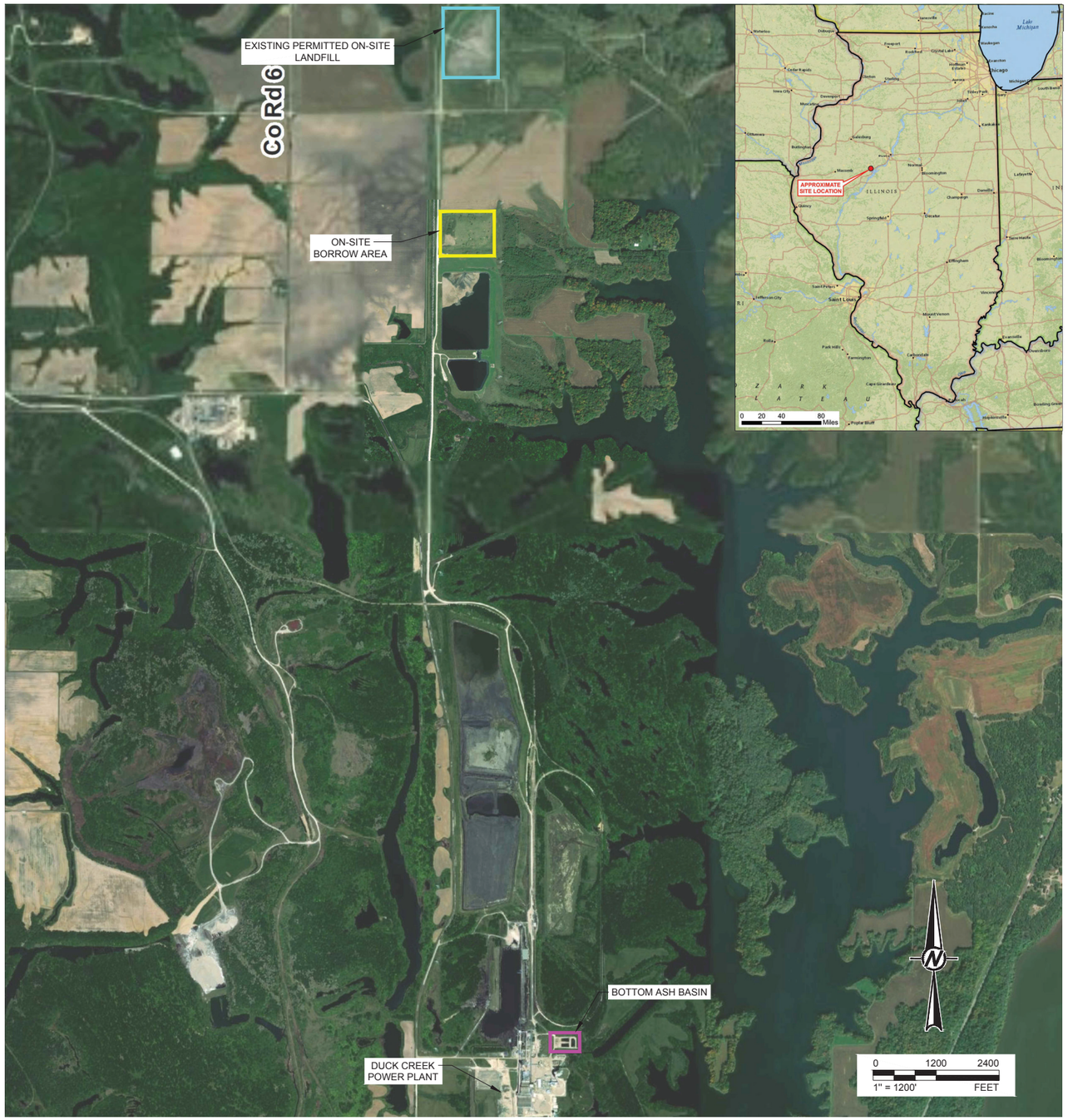
0 1 in

EXHIBIT 2

Closure-by-Removal Figures



ILLINOIS POWER RESOURCES GENERATING, LLC DUCK CREEK POWER PLANT BOTTOM ASH BASIN CONSTRUCTION PERMIT APPLICATION

PREPARED BY:

GOLDER ASSOCIATES INC.
13515 BARRETT PARKWAY DRIVE, SUITE 260
BALLWIN, MISSOURI 63021

PERMIT APPLICATION DRAWING LIST

NUMBER	TITLE	REVISION
1	TITLE SHEET	A
2	EXISTING CONDITIONS	A
3	EXCAVATION GRADES	A
4	FINAL GRADES	A
5	SECTIONS AND DETAILS	A

NOTE(S)

1. AERIAL IMAGERY OBTAINED FROM ESRI PROVIDED BASEMAP SURVEY. IMAGERY COLLECTED 5/14/2017, 10/21/2017, 8/22/2018, AND 4/1/2019.

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2022-01-25	ISSUED FOR PERMIT APPLICATION	AGD	BCB	JJS	JEO

SEAL

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC
DUCK CREEK POWER PLANT

CONSULTANT
GOLDER MEMBER OF WSP

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www.golder.com

PROJECT
BOTTOM ASH BASIN
CONSTRUCTION PERMIT APPLICATION

TITLE
TITLE SHEET

PROJECT NO. 21454861 | REV. A | DRAWING 1

Path: \\golder.gds\complexdata\office\Denver\acad\VISTRA\Duck Creek\09_PROJECTS\21454861\Bottom Ash\02_PRODUCTION\DWG\ | File Name: 1-TITLE SHEET.dwg | Last Edited By: jdbermeyer Date: 2021-11-04 Time:1:01:00 PM | Printed By: JDbermeyer Date: 2022-01-26 Time:4:03:12 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D
0 1 in

LEGEND

- 580 — EXISTING GROUND CONTOURS (SEE NOTE 1)
- EDGE OF EXISTING CONCRETE (SEE NOTE 3)
- LIMITS OF EXISTING GEOMEMBRANE AND COMPACTED CLAY LAYER
- EXISTING STORMWATER CHANNEL (SEE NOTE 4)
- EXISTING CULVERT (SEE NOTE 4)

NOTE(S)

1. EXISTING CONTOURS SHOWN ARE FROM TOPOGRAPHIC SURVEY COMPLETED BY INGENAE DATED 11/4/2020 & 11/5/2020. NO UNDERGROUND OR OVERHEAD UTILITIES WERE SURVEYED.
2. COORDINATE SYSTEM USED IS ILLINOIS STATE PLANE ZONE-WEST NORTH AMERICAN DATUM OF 1983. ELEVATIONS ARE RELATIVE TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.
3. EDGE OF CONCRETE PROVIDED IN INGENAE SURVEY RECORD DRAWING DATED 2/9/2021.
4. LOCATIONS OF STORMWATER CHANNELS AND LIMITS OF EXISTING GEOMEMBRANE AND COMPACTED CLAY LAYER BASED ON SEPTEMBER 2007 ISSUED FOR CONSTRUCTION DRAWINGS PREPARED BY SARGENT & LUNDY, LLC.
5. AERIAL IMAGERY FROM DRAGONFLY AEROSOLUTIONS DATED 11/17/2020, IN COMBINATION WITH TOPOGRAPHIC SURVEY (NOTE 1).

0 30 60
1" = 30' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2022-01-25	ISSUED FOR PERMIT APPLICATION	AGD	BCB	JJS	JEO

SEAL

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC
DUCK CREEK POWER PLANT

CONSULTANT
GOLDER MEMBER OF WSP

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www.golder.com

PROJECT
BOTTOM ASH BASIN
CONSTRUCTION PERMIT APPLICATION

TITLE
EXISTING CONDITIONS

PROJECT NO. 21454861 | REV. A | DRAWING 2

Path: \\golder.gds\complexdata\office\Denver\acad\VISTRA\Duck Creek\99_PROJECTS\21454861\Bottom Ash\02_PRODUCTION\DWG\ | File Name: 2-EXISTING CONDITIONS.dwg | Last Edited By: jobermeyer Date: 2021-11-04 Time:1:01:00 PM | Printed By: JObermeyer Date: 2022-01-26 Time:4:22:35 PM

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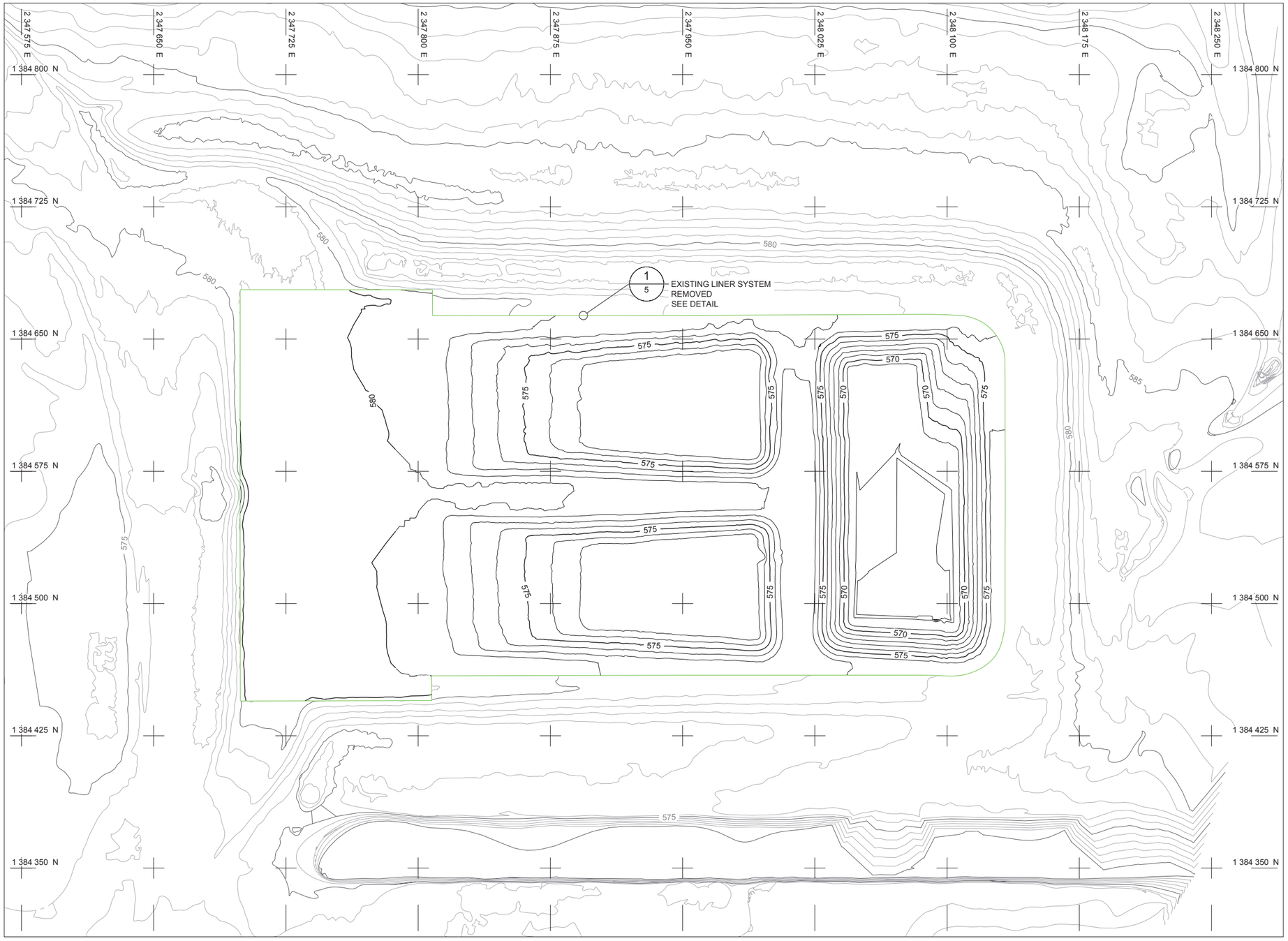

LEGEND

580	EXISTING GROUND CONTOURS (SEE NOTE 1)
575	EXCAVATION CONTOURS (SEE NOTE 3)
	EXTENTS OF EXCAVATION

NOTE(S)

1. EXISTING CONTOURS SHOWN ARE FROM TOPOGRAPHIC SURVEY COMPLETED BY INGENAE DATED 11/4/2020 & 11/5/2020. NO UNDERGROUND OR OVERHEAD UTILITIES WERE SURVEYED.
2. COORDINATE SYSTEM USED IS ILLINOIS STATE PLANE ZONE-WEST NORTH AMERICAN DATUM OF 1983. ELEVATIONS ARE RELATIVE TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.
3. EXCAVATION GRADES ARE SHOWN AS A 20-INCH OFFSET BELOW THE EXISTING GRADES TO ACCOUNT FOR THE REMOVAL OF THE LINER SYSTEM.

0 30 60
1" = 30' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2022-01-25	ISSUED FOR PERMIT APPLICATION	AGD	BCB	JJS	JEO

SEAL

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC
DUCK CREEK POWER PLANT

CONSULTANT
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PROJECT
BOTTOM ASH BASIN
CONSTRUCTION PERMIT APPLICATION

TITLE
EXCAVATION GRADES

PROJECT NO. 21454861 | REV. A | of | DRAWING 3

Path: \\golder.gds\comp\exdata\office\Denver\acad\VISTRA\Duck Creek\99_PROJECTS\21454861\Bottom Ash\02_PRODUCTION\DWG | File Name: 3-EXCAVATION PLAN.dwg | Last Edited By: adarr Date: 2021-10-18 Time:9:14:00 PM | Printed By: JOberrmeyer Date: 2022-01-25 Time:4:24:19 PM

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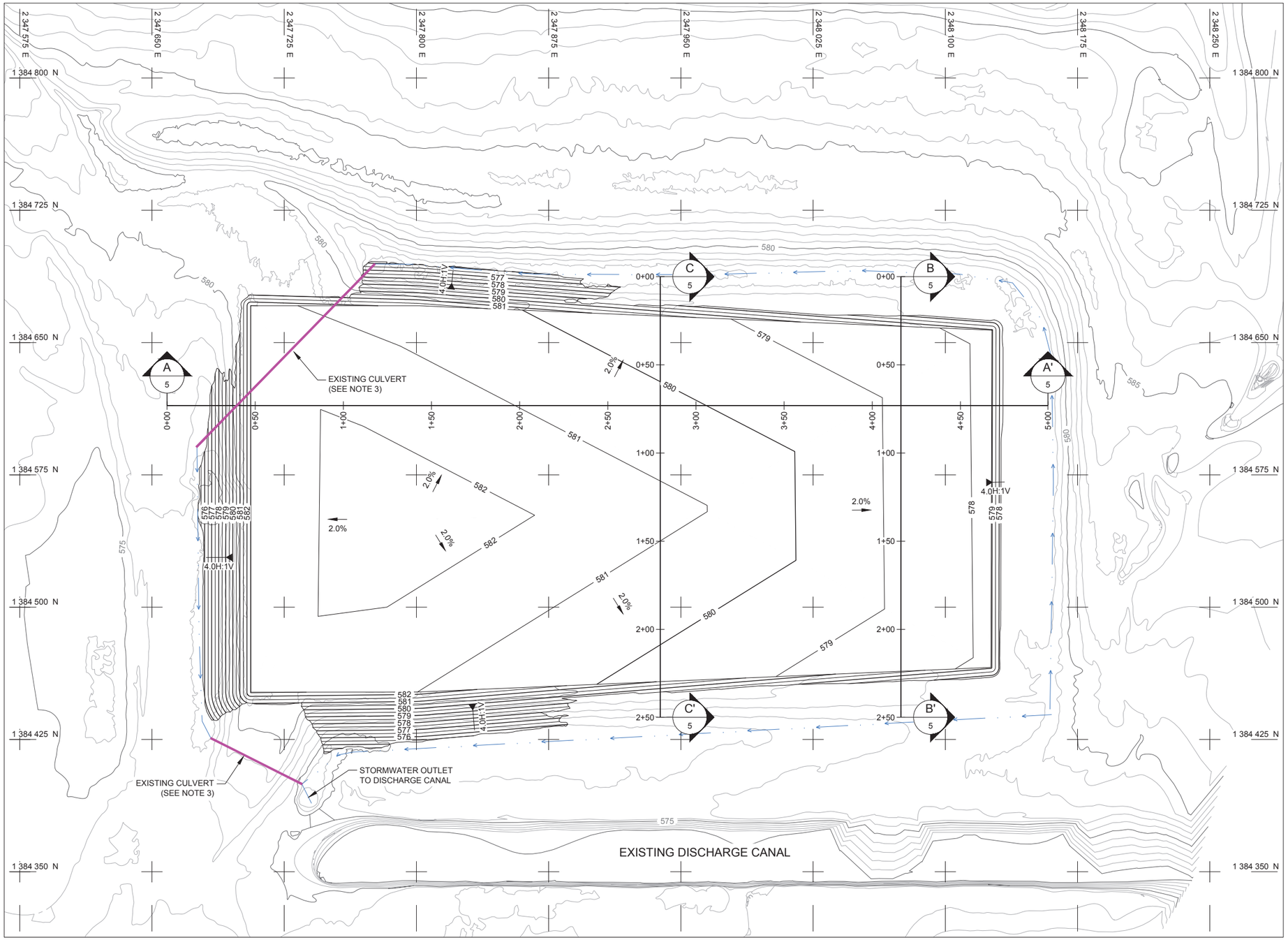

LEGEND

- 580 — PROPOSED TOP OF COMPACTED FILL ELEVATION CONTOURS
- 580 — EXISTING GROUND CONTOURS (SEE NOTE 1)
- EXISTING STORMWATER CHANNEL (SEE NOTE 3)
- EXISTING CULVERT (SEE NOTE 3)

NOTE(S)

1. EXISTING CONTOURS SHOWN ARE FROM TOPOGRAPHIC SURVEY COMPLETED BY INGENAE DATED 11/4/2020 & 11/5/2020. NO UNDERGROUND OR OVERHEAD UTILITIES WERE SURVEYED.
2. COORDINATE SYSTEM USED IS ILLINOIS STATE PLANE ZONE-WEST NORTH AMERICAN DATUM OF 1983. ELEVATIONS ARE RELATIVE TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.
3. LOCATIONS OF STORMWATER CHANNELS BASED ON SEPTEMBER 2007 ISSUED FOR CONSTRUCTION DRAWINGS PREPARED BY SARGENT & LUNDY, LLC.
4. COMPACTED FILL TO BE PLACED TO A MINIMUM OF 95 PERCENT OF STANDARD PROCTOR MAXIMUM DRY DENSITY TO LIMIT POTENTIAL FOR EXCESSIVE SETTLEMENT.
5. UPON COMPLETION OF COMPACTED FILL CONSTRUCTION, DISTURBED AREAS SHALL BE SEEDED AND MULCHED TO PROMOTE VEGETATIVE GROWTH AND LIMIT POTENTIAL FOR FUTURE EROSION.

0 30 60
1" = 30' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2022-01-25	ISSUED FOR PERMIT APPLICATION	AGD	BCB	JJS	JEO

SEAL

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC
DUCK CREEK POWER PLANT

CONSULTANT
GOLDER
MEMBER OF WSP

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PROJECT
BOTTOM ASH BASIN
CONSTRUCTION PERMIT APPLICATION

TITLE
FINAL GRADES

PROJECT NO. 21454861 | REV. A | DRAWING 4

Path: \\golder.gds\comp\exdata\office\Denver\acad\VISTRA\Duck Creek\99_PROJECTS\21454861\Bottom Ash\02_PRODUCTION\DWG\ | File Name: 4-FINAL GRADES.dwg | Last Edited By: adart Date: 2021-10-18 Time:6:18:00 PM | Printed By: JObermeyer Date: 2022-01-25 Time:4:28:22 PM

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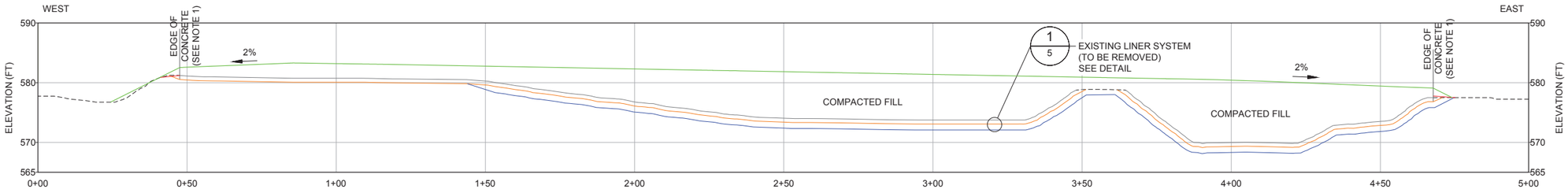
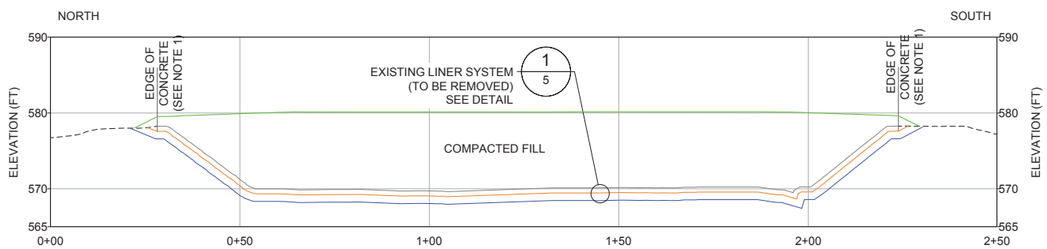


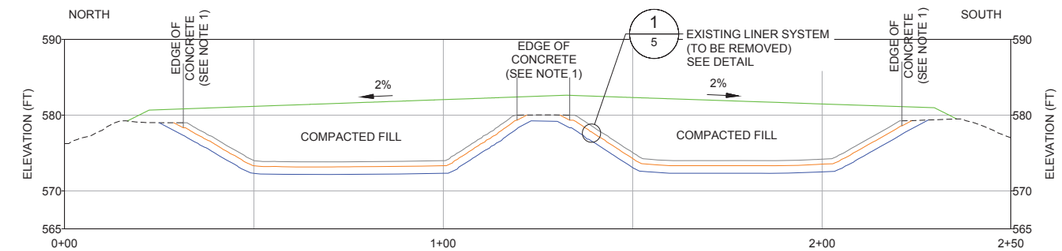
SCALE 1" = 20' / VERT. SCALE = 2X — A/4 CROSS SECTION A

0 20 40 — 1" = 20' FEET



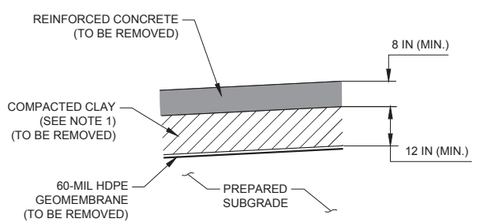
SCALE 1" = 20' / VERT. SCALE = 2X — B/4 CROSS SECTION B

0 20 40 — 1" = 20' FEET



SCALE 1" = 20' / VERT. SCALE = 2X — C/4 CROSS SECTION C

0 20 40 — 1" = 20' FEET



SCALE N.T.S. — 1/5 EXISTING LINER SYSTEM

CROSS SECTION LEGEND

- PROPOSED TOP OF COMPACTED FILL
- EXISTING GROUND
- EXISTING LINER SYSTEM - TOP OF CONCRETE (SEE NOTES 1 AND 2)
- EXISTING LINER SYSTEM - TOP OF COMPACTED CLAY (SEE NOTES 1 AND 2)
- EXISTING LINER SYSTEM - GEOMEMBRANE (SEE NOTES 1 AND 2)

NOTE(S)

1. EDGE OF CONCRETE PROVIDED IN INGENAE SURVEY RECORD DRAWING DATED 2/9/2021. LIMITS OF EXISTING GEOMEMBRANE AND COMPACTED CLAY LAYER BASED ON SEPTEMBER 2007 ISSUED FOR CONSTRUCTION DRAWINGS PREPARED BY SARGENT & LUNDY, LLC.
2. CONCRETE, COMPACTED CLAY, AND GEOMEMBRANE COMPONENTS OF THE BOTTOM ASH BASIN LINER SYSTEM TO BE REMOVED AND DISPOSED IN THE EXISTING PERMITTED ON-SITE LANDFILL OR TRANSPORTED FOR OFF-SITE DISPOSAL.
3. UP TO AN ADDITIONAL 12 INCHES OF SOIL MAY BE EXCAVATED FROM BENEATH THE LINER SYSTEM AND REPLACED WITH COMPACTED FILL.

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2022-01-25	ISSUED FOR PERMIT APPLICATION	AGD	BCB	JJS	JEO

SEAL

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC
DUCK CREEK POWER PLANT

CONSULTANT
GOLDER MEMBER OF WSP

GOLDER ASSOCIATES INC.
13515 BARRETT PARKWAY DRIVE, SUITE 260
BALLWIN, MISSOURI 63021
USA
[+1] (314) 984 8800
www.golder.com

PROJECT
BOTTOM ASH BASIN
CONSTRUCTION PERMIT APPLICATION

TITLE
SECTIONS AND DETAILS

PROJECT NO. 21454861 | REV. A | DRAWING 5

Path: \\golder.gds\complexdata\office\Denver\acad\VISTRA\Duck Creek\99_PROJECTS\21454861\bottom Ash\02_PRODUCTION\DWG\ | File Name: 5-SECTIONS AND DETAILS.dwg | Last Edited By: bbradley Date: 2021-11-04 Time:1:00:00 PM | Printed By: JObermeyer Date: 2022-01-25 Time:4:33:33 PM
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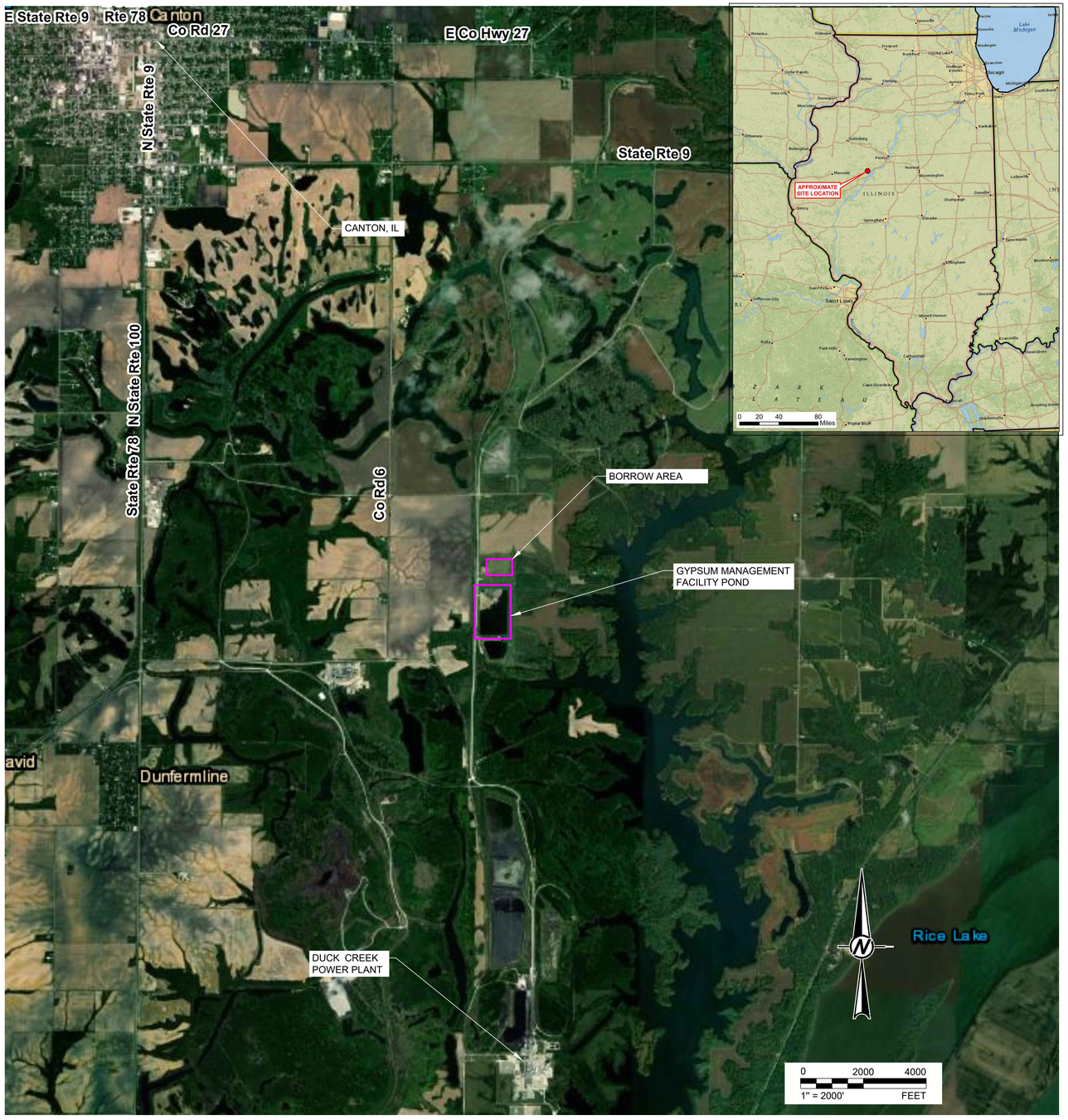
ATTACHMENT 2

Drawings



ILLINOIS POWER RESOURCES GENERATING, LLC DUCK CREEK POWER PLANT GYPSUM MANAGEMENT FACILITY POND CONSTRUCTION PERMIT APPLICATION

PREPARED BY:

GOLDER ASSOCIATES INC.
13515 BARRETT PARKWAY DRIVE, SUITE 260
BALLWIN, MISSOURI USA 63021

PERMIT APPLICATION DRAWING LIST

NUMBER	TITLE	REVISION
1	TITLE SHEET	A
2	EXISTING CONDITIONS	A
3	GYPSUM REGRADING AND CONTAINMENT PLAN	A
4	FINAL COVER AND STORMWATER PLAN	A
5	SECTIONS	A
6	DETAILS (1 OF 2)	A
7	DETAILS (2 OF 2)	A

NOTE(S)

1. AERIAL IMAGERY FROM ESRI-PROVIDED BASEMAP SERVICE. IMAGERY COLLECTED 5/14/2017, 10/21/2017, 8/22/2018, AND 4/1/2019.
2. INSET MAP BOUNDARIES FROM ESRI-PROVIDED FEATURE SERVICE. USA STATE BOUNDARIES. 2021
3. INSET MAP BACKGROUND FROM ESRI-PROVIDED BASEMAP SERVICE. NATIONAL GEOGRAPHIC BASEMAP. 2021.

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2022-01-25	ISSUED FOR PERMIT APPLICATION	DVS	DVS	JJS	JEO

SEAL

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC
DUCK CREEK POWER PLANT

CONSULTANT
GOLDER MEMBER OF WSP
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BALLWIN, MO 63021
UNITED STATES
(313) 984 8770
www.golder.com

PROJECT
GYPSUM MANAGEMENT FACILITY POND
CONSTRUCTION PERMIT APPLICATION

TITLE
TITLE SHEET

PROJECT NO. 21454861 | REV. A | 1 of 7 | DRAWING 1

Path: \\golder.gds\complexdata\office\Denver\acad\VISTRA\Duck Creek\99_PROJECTS\21454861\Gypsum Management Facility\02_PRODUCTION\DWG\A_CIP Permit DWGs_rev\B 2 ft cover\ | File Name: 21454861A001.dwg | Last Edited By: jsauer Date: 2022-01-25 Time:2:52:10 PM | Printed By: JSauer Date: 2022-01-25 Time:4:38:12 PM
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LEGEND

- 600 — EXISTING GROUND ELEVATION CONTOURS (NOTE 1)
- EXISTING ROAD
- LIMIT OF GMF POND LINER SYSTEM (NOTE 2)
- WATER LEVEL LINE (NOTE 3)
- EXISTING PIPING (NOTE 3)

NOTES

1. EXISTING CONTOURS ARE A COMPOSITE OF AN AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 11/17/2020, TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 11/4/2020 & 11/5/2020, AND U.S. GEOLOGICAL SURVEY LIDAR POINT CLOUD DATA DATED 2/12/2018.
2. LIMIT OF LINER SYSTEM ESTIMATED FROM CONSTRUCTION RECORD DRAWINGS PREPARED BY HANSON PROFESSIONAL SERVICES, DATED 03/05/2009.
3. WATER LEVEL LINE AND EXISTING PIPING FROM INGENAE SURVEY RECORD DRAWING DATED 3/19/2021.
4. AERIAL IMAGERY FROM DRAGONFLY AEROSOLUTIONS DATED 11/17/2020.

0 120 240
1" = 120' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2022-01-25	ISSUED FOR PERMIT APPLICATION	DVS	DVS	JJS	JEO

SEAL

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC
DUCK CREEK POWER PLANT

CONSULTANT
GOLDER MEMBER OF WSP
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BALLWIN, MO 63021
UNITED STATES
(313) 984 8770
www.golder.com

PROJECT
GYPSUM MANAGEMENT FACILITY POND
CONSTRUCTION PERMIT APPLICATION

TITLE
EXISTING CONDITIONS

PROJECT NO. 21454861 | REV. A | 2 of 7 | DRAWING 2

Path: \\golder.gds\complexdata\office\Denver\acad\VISTRA\Duck Creek\99_PROJECTS\21454861\Gypsum Management Facility\02_PRODUCTION\DWG\A_CIP Permit DWGs_rev\B 2 ft cover\ | File Name: 21454861A002.dwg | Last Edited By: jsauer Date: 2022-01-25 Time:3:30:59 PM | Printed By: JSauer Date: 2022-01-25 Time:4:39:20 PM
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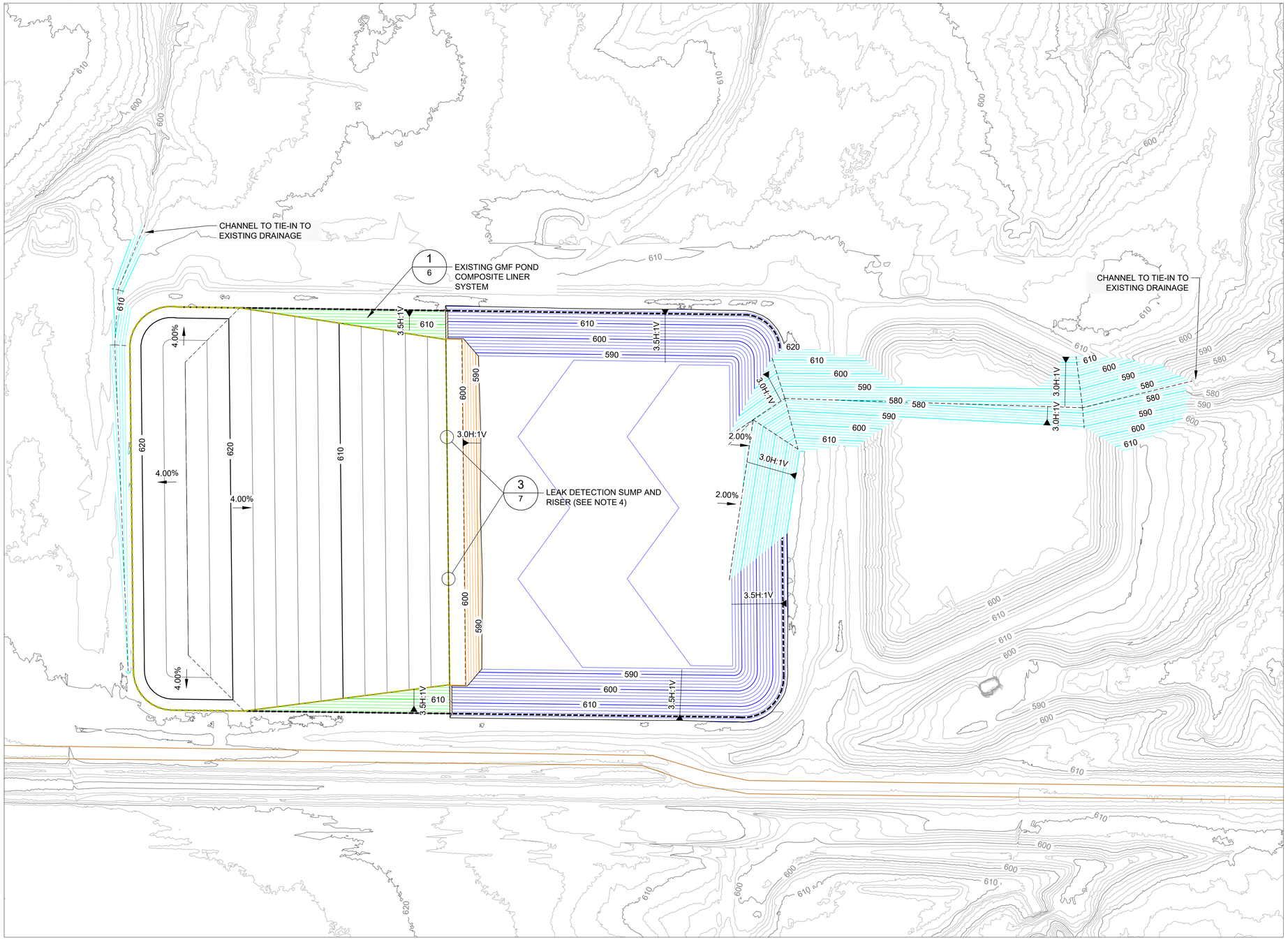

LEGEND

- 600 — TOP OF RELOCATED GYPSUM
- 600 — TOP OF EXISTING COMPOSITE LINER SYSTEM (SEE NOTE 1)
- 600 — TOP OF EXISTING CLAY LINER (SEE NOTE 1)
- 600 — DRAINAGE CHANNEL GRADES
- 600 — EARTHEN BERM GRADES
- 600 — EXISTING GROUND CONTOURS (SEE NOTE 2)
- EXISTING ROAD
- LIMIT OF EXISTING GMF POND LINER SYSTEM (NOTE 1)
- LIMIT OF WASTE

NOTES

1. GYPSUM MANAGEMENT FACILITY (GMF) POND BASE GRADES AND LIMIT OF LINER SYSTEM WERE DEVELOPED FROM CONSTRUCTION RECORD DRAWINGS PREPARED BY HANSON PROFESSIONAL SERVICES.
2. EXISTING CONTOURS ARE A COMPOSITE OF AN AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 11/17/2020, TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 11/4/2020 & 11/5/2020, AND U.S. GEOLOGICAL SURVEY LIDAR POINT CLOUD DATA DATED 2/12/2018.
3. CLOSURE WILL INVOLVE REMOVAL OF PONDED WATER AND LIQUID WASTE, CONSTRUCTION OF AN EARTHEN BERM WITH A LINER SYSTEM ON THE UPSTREAM SLOPE, REMOVAL AND RELOCATION OF GYPSUM SOUTH OF THE BERM TO WITHIN THE CLOSURE FOOTPRINT, AND FINAL COVER SYSTEM CONSTRUCTION.
4. THE EXISTING LEAK DETECTION SYSTEM WILL BE ADAPTED TO THE CLOSURE FOOTPRINT. EXISTING LEACHATE COLLECTION PIPING WILL BE TERMINATED IN NEW SUMPS (TWO LOCATIONS WITH NEW RISERS FOR CONTINUED LEAK DETECTION CAPABILITY.

0 120 240
1" = 120' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2022-01-25	ISSUED FOR PERMIT APPLICATION	DVS	DVS	JJS	JEO

SEAL

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC
DUCK CREEK POWER PLANT

CONSULTANT
GOLDER MEMBER OF WSP
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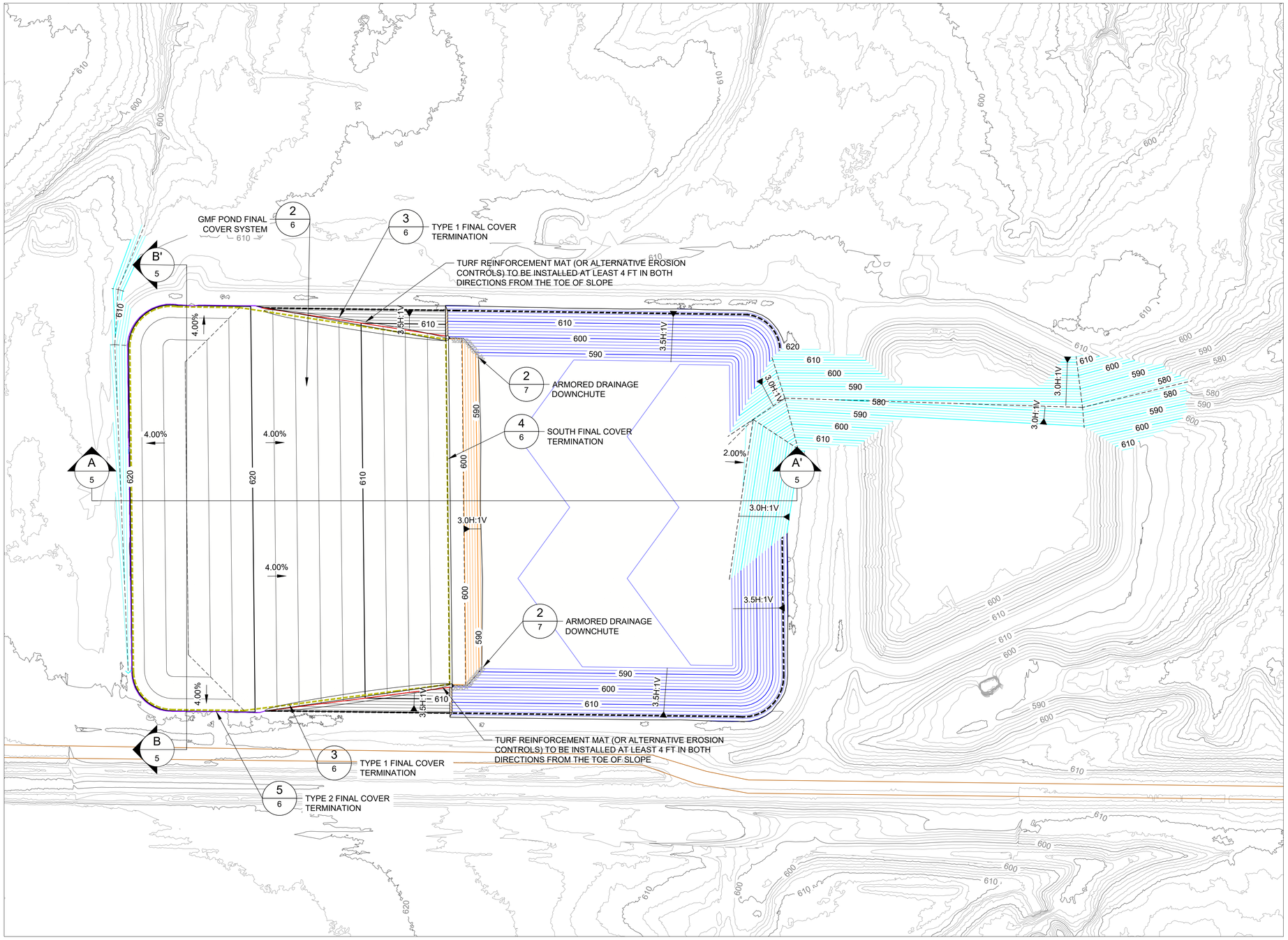
BALLWIN, MO 63021
UNITED STATES
(313) 984 8770
www.golder.com

PROJECT
GYPSUM MANAGEMENT FACILITY POND
CONSTRUCTION PERMIT APPLICATION

TITLE
GYPSUM REGRADING AND CONTAINMENT PLAN

PROJECT NO. 21454861 | REV. A | 3 of 7 | DRAWING 3

Path: \\golder.gds\complexdata\office\Denver\acad\VISTRA\Duck Creek\09_PROJECTS\21454861\Gypsum Management Facility\02_PRODUCTION\DWG\A_CIP Permit DWGs_revB 2 ft cover\ | File Name: 21454861A003.dwg | Last Edited By: jsauer Date: 2022-01-25 Time:3:30:45 PM | Printed By: JSauer Date: 2022-01-25 Time:4:40:12 PM
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D
1 in



LEGEND

- 600 — TOP OF FINAL COVER SYSTEM
- 600 — TOP OF EXISTING COMPOSITE LINER SYSTEM (SEE NOTE 1)
- 600 — TOP OF EXISTING CLAY LINER (SEE NOTE 1)
- 600 — EARTHEN BERM GRADES
- 600 — EXISTING GROUND CONTOURS (SEE NOTE 2)
- EXISTING ROAD
- LIMIT OF EXISTING GMF POND LINER SYSTEM (NOTE 1)
- LIMIT OF WASTE AT CLOSURE
- TYPE 1 FINAL COVER TERMINATION
- TYPE 2 FINAL COVER TERMINATION

NOTES

1. GYPSUM MANAGEMENT FACILITY (GMF) POND BASE GRADES AND LIMIT OF LINER SYSTEM WERE DEVELOPED FROM CONSTRUCTION RECORD DRAWINGS PREPARED BY HANSON PROFESSIONAL SERVICES.
2. EXISTING CONTOURS ARE A COMPOSITE OF AN AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 11/17/2020, TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 11/4/2020 & 11/5/2020, AND U.S. GEOLOGICAL SURVEY LIDAR POINT CLOUD DATA DATED 2/12/2018.
3. CLOSURE WILL INVOLVE REMOVAL OF PONDED WATER AND LIQUID WASTE, CONSTRUCTION OF AN EARTHEN BERM WITH A LINER SYSTEM ON THE UPSTREAM SLOPE, REMOVAL AND RELOCATION OF GYPSUM SOUTH OF THE BERM TO WITHIN THE CLOSURE FOOTPRINT, AND FINAL COVER SYSTEM CONSTRUCTION.

0 120 240
1" = 120' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2022-01-25	ISSUED FOR PERMIT APPLICATION	DVS	DVS	JJS	JEO

SEAL

CLIENT
ILLINOIS POWER RESOURCES GENERATING, LLC
DUCK CREEK POWER PLANT

CONSULTANT
GOLDER MEMBER OF WSP
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(313) 984 8770
www.golder.com

PROJECT
GYPSUM MANAGEMENT FACILITY POND
CONSTRUCTION PERMIT APPLICATION

TITLE
FINAL COVER AND STORMWATER PLAN

PROJECT NO. 21454861 | REV. A | 4 of 7 | DRAWING 4

Path: \\golder.gds\complexdata\office\Denver\lacaf\VISTRA\Duck Creek\99_PROJECTS\21454861\Gypsum Management Facility\02_PRODUCTION\DWGs_CIP Permit DWGs_rev8-2 ft cover\ | File Name: 21454861A004.dwg | Last Edited By: jsauer Date: 2022-01-25 Time:4:28:53 PM | Printed By: JSauer Date: 2022-01-25 Time:4:40:57 PM
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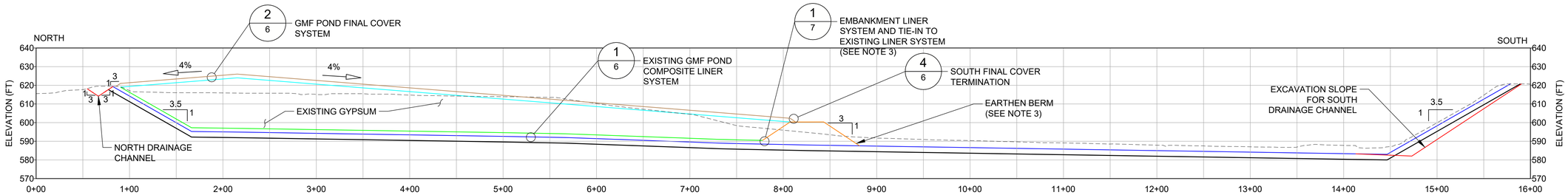

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VERT. SCALE X2

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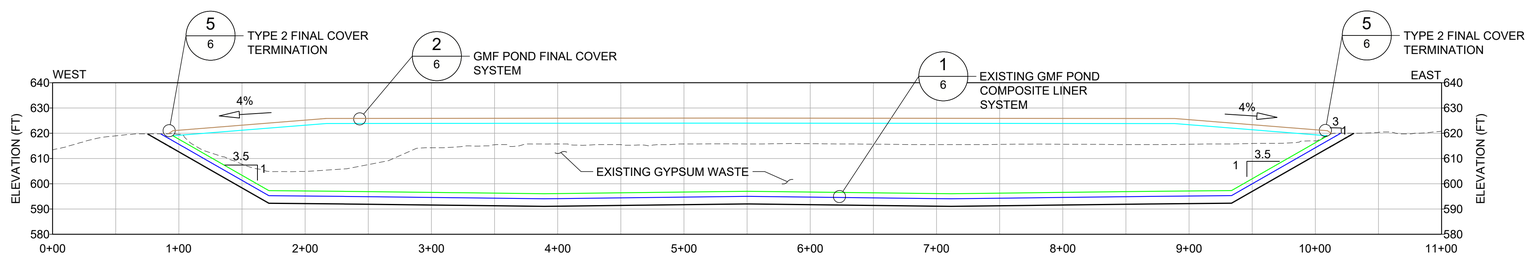

SCALE 1" = 60' B 5 SECTION B-B'
VERT. SCALE X2

0 60 120
1" = 60' FEET

LEGEND

- TOP OF FINAL COVER SYSTEM
- TOP OF RELOCATED GYPSUM
- TOP OF EXISTING COMPOSITE LINER SYSTEM (SEE NOTE 1)
- TOP OF EXISTING CLAY LINER (SEE NOTE 1)
- BOTTOM OF EXISTING COMPOSITE LINER SYSTEM (SEE NOTE 1)
- EXISTING GROUND CONTOURS (SEE NOTE 2)
- EARTHEN BERM (SEE NOTE 3)
- DRAINAGE CHANNEL GRADING

NOTES

1. GYPSUM MANAGEMENT FACILITY (GMF) POND BASE GRADES SHOWN WERE DEVELOPED FROM CONSTRUCTION RECORD DRAWINGS PREPARED BY HANSON PROFESSIONAL SERVICES.
2. EXISTING CONTOURS ARE A COMPOSITE OF AN AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 11/17/2020, TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 11/4/2020 & 11/5/2020, AND U.S. GEOLOGICAL SURVEY LIDAR POINT CLOUD DATA DATED 2/12/2018.
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PROJECT
GYPSUM MANAGEMENT FACILITY POND
CONSTRUCTION PERMIT APPLICATION

TITLE
SECTIONS

PROJECT NO. 21454861 | REV. A | 5 of 7 | DRAWING 5

Path: \\golder.gds\complexdata\office\Denver\acad\VISTRA\Duck Creek\99_PROJECTS\21454861\Gypsum Management Facility\02_PRODUCTION\DWG\A_CIP Permit DWGs_revB 2 ft cover\ | File Name: 21454861A005.dwg | Last Edited By: jsauer Date: 2022-01-25 Time:3:30:28 PM | Printed By: JSauer Date: 2022-01-25 Time:4:41:48 PM

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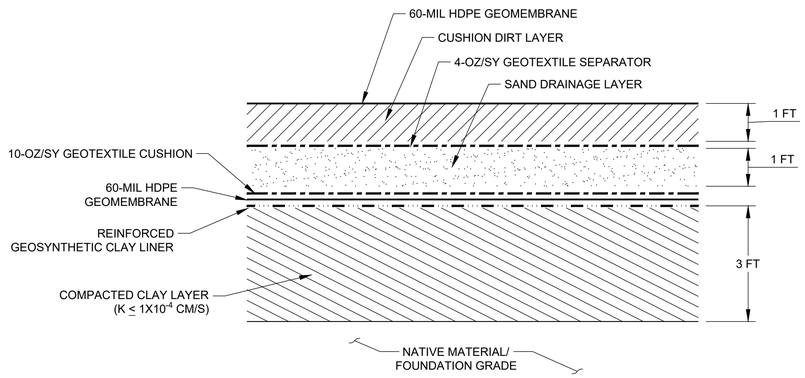
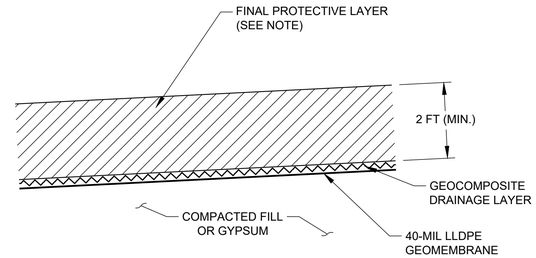


SCALE N.T.S. 1/6 EXISTING GMF POND COMPOSITE LINER SYSTEM



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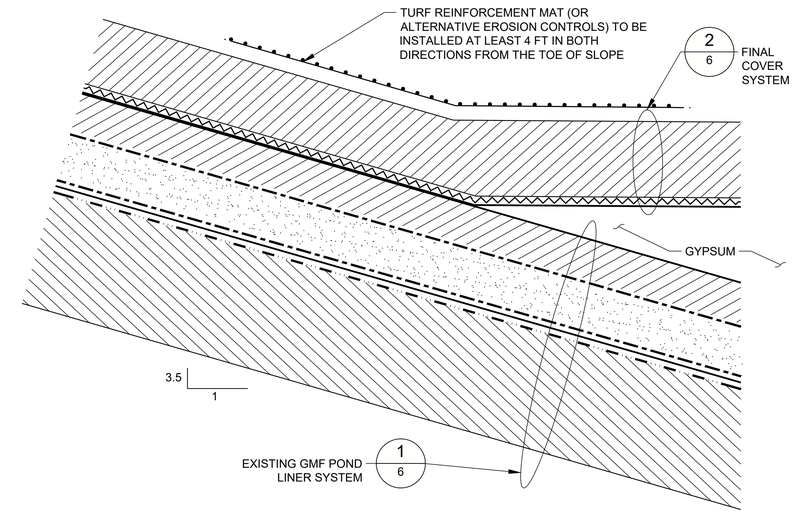

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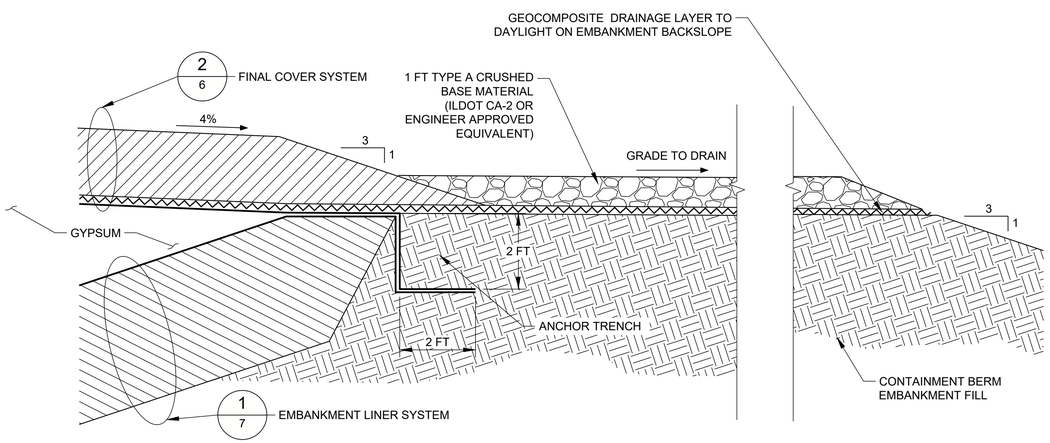
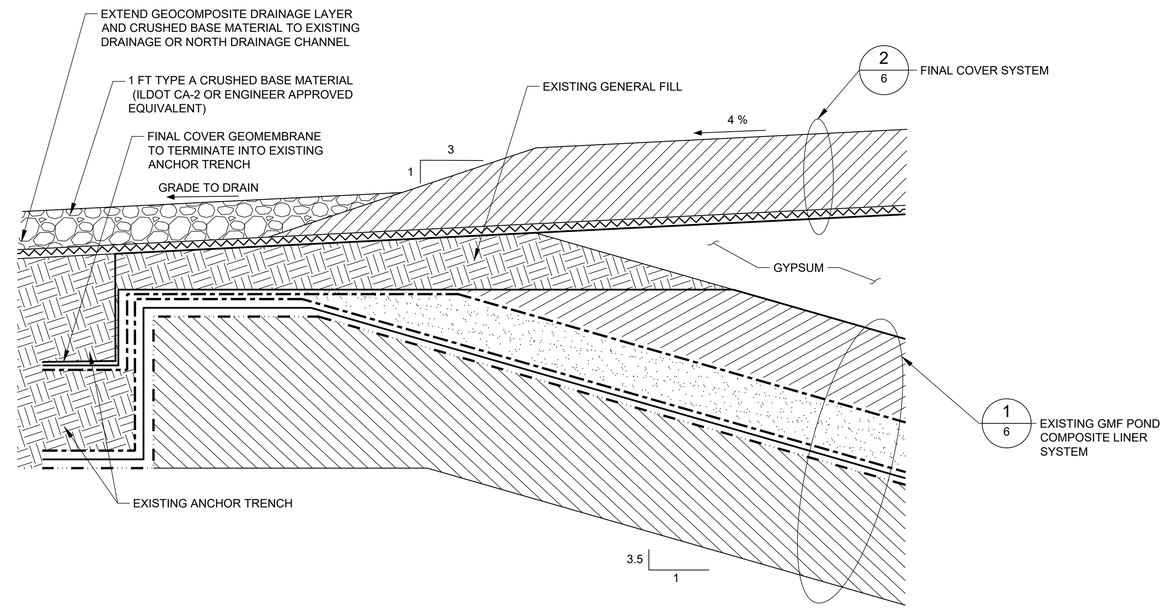


SCALE N.T.S. 4/6 SOUTH FINAL COVER TERMINATION



SCALE N.T.S. 5/6 TYPE 2 COVER TERMINATION

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
A	2022-01-25	ISSUED FOR PERMIT APPLICATION	DVS	DVS	JJS	JEO

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PROJECT
GYPSUM MANAGEMENT FACILITY POND
CONSTRUCTION PERMIT APPLICATION

TITLE
DETAILS (1 OF 2)

PROJECT NO. 21454861 | REV. A | 6 of 7 | DRAWING 6

Path: \\golder.gds\complexdata\office\Denver\acad\VISTRA\Duck Creek\09_PROJECTS\21454861\Gypsum Management Facility\02_PRODUCTION\DWG\A_CIP Permit DWGs_revB 2 ft cover\ | File Name: 21454861A006.dwg | Last Edited By: jsauer Date: 2022-01-25 Time:4:38:30 PM | Printed By: JSauer Date: 2022-01-25 Time:4:42:10 PM

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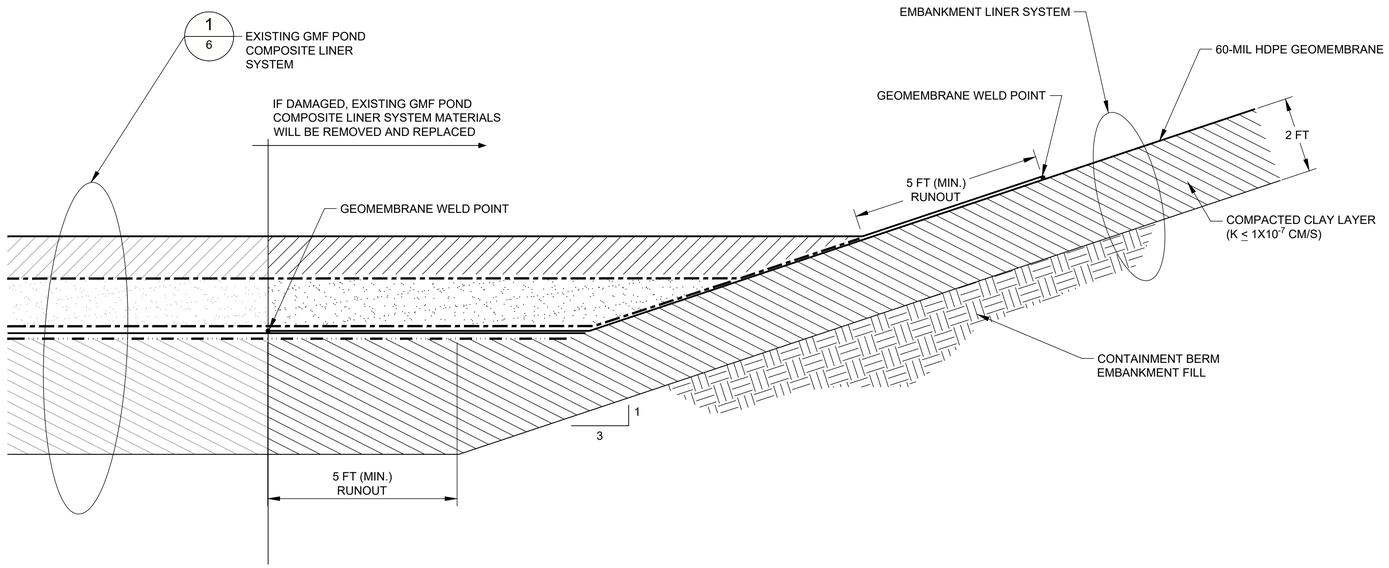
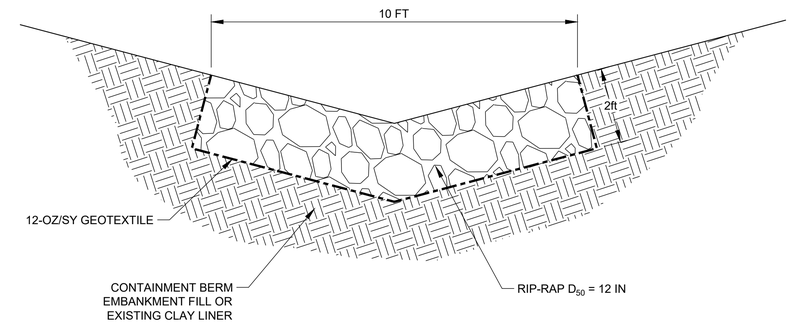


SCALE N.T.S. 1/7 EMBANKMENT LINER SYSTEM AND TIE-IN TO EXISTING COMPOSITE LINER SYSTEM



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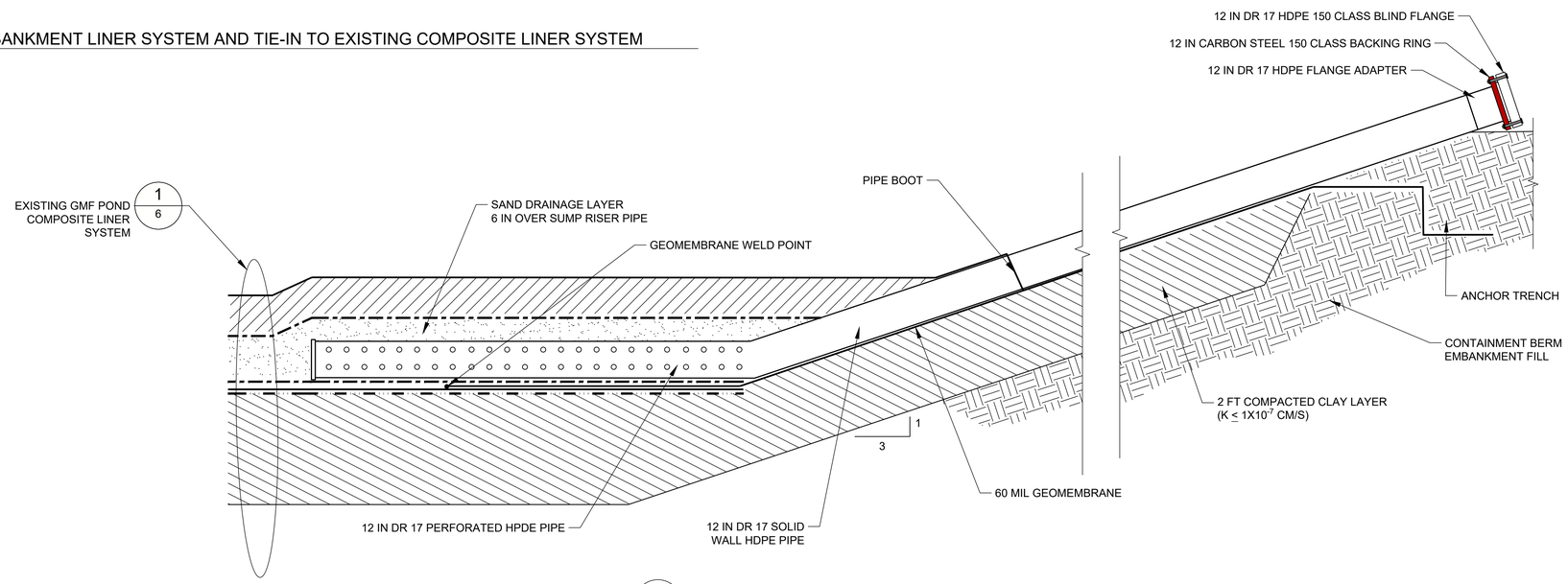

SCALE N.T.S. 3/7 LEAK DETECTION SYSTEM SUMP AND RISER

NOTE

EXISTING 6 INCH LEACHATE COLLECTION PIPE NOT SHOWN IN DETAIL. LEACHATE COLLECTION PIPE WILL TERMINATE AND BE CAPPED AT THE TOE OF THE CONTAINMENT BERM

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
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PROJECT
GYPSUM MANAGEMENT FACILITY POND
CONSTRUCTION PERMIT APPLICATION

TITLE
DETAILS (2 OF 2)

PROJECT NO. 21454861 | REV. A | 7 of 7 | DRAWING 7

Path: \\golder.gds\complexdata\office\Denver\acad\VISTRA\Duck Creek\09_PROJECTS\21454861\Gypsum Management Facility\02_PRODUCTION\DWGs_CIP Permit DWGs_rev\B 2 ft cover\ | File Name: 21454861A007.dwg | Last Edited By: jsauer Date: 2022-01-25 Time:3:50:26 PM | Printed By: JSauer Date: 2022-01-25 Time:4:42:31 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D
1 in

ATTACHMENT 3

Final Protective Layer Demonstration

Geosyntec consultants

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Technical Memorandum

Date:	January 25, 2022
To:	Victor Modeer, P.E., DGE
Copies to:	Phil Morris, Rhys Fuller
From:	John Seymour, P.E., Geosyntec Consultants (Geosyntec)
Subject:	Proposed Alternative Final Protective Layer Equivalency Demonstration Hennepin East Ash Pond and Duck Creek GMF Pond CCR Surface Impoundments Geosyntec Project: GLP8026

PROPOSAL

An alternative final protective layer is proposed by Dynegy Midwest Generation, LLC (DMG) for surface impoundments closed in place for the Hennepin Power Plant (HPP) East Ash Pond (EAP) and by Illinois Power Resources Generating, LLC (IPRG) for the Duck Creek Power Plant (DCPP) Gypsum Management Facility (GMF) Pond. The closure will be in accordance with IAC Part 845 Rule [1] (Part 845). Overall, the proposal will meet the requirements of Section 845.750 c) 2).

This Technical Memorandum presents a demonstration that a 2-foot-thick alternative final protective layer consisting of an 18-inch-thick soil layer and a 6-inch layer of topsoil provide equivalent or superior performance to the default protective layer set forth in Section 845.750 c) 2). The alternative final protective layer works in combination with an underlying low permeability (geomembrane) layer in place of the default three-foot thick, low permeability compacted earth layer. In addition, a cushion layer consisting of a geotextile (at HPP EAP) or a drainage layer consisting of a geocomposite (at DCPP GMF) are placed on top of the geomembrane prior to installation of the final protective layer. The combination of the above materials comprises the final "alternative final cover system".

A discussion of how the closure, including the proposed alternative final cover system discussed herein, meets the performance standards is contained in the Closure Plan, which includes the Closure Alternatives Assessment required by Section 845.710.

REQUIREMENTS OF SECTION 845

Section 845.750 provides requirements for both the final protective layer and underlying low permeability layer. They work in tandem to provide protection of groundwater and surface exposure conditions. A principal intention of the low permeability layer is to reduce the infiltration of liquid through the final cover system and into the CCR waste mass during post-closure conditions, in accordance with Section 845.720 (a), which states in part:

> *The owner or operator of a CCR surface impoundment must ensure that, at a minimum, the CCR surface impoundment is closed in a manner that will*:
>
> *1) Control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate or contaminated run-off to the ground or surface waters or to the atmosphere;*

Specific default requirements for the final cover system are included in Section 845.750(c), which requires the final cover system to have either: 1) a three-foot thick soil low permeability compacted earth layer overlain by a three-foot-thick final protective layer (final protective layer), or 2) a geomembrane low permeability layer with a three-foot-thick final protective layer.

The specific Section 845.750 (c) (2) design requirements for the final protective layer are as follows (emphasis added):

> *Standards for the Final Protective Layer: The final protective layer must meet the following requirements,* ***unless the owner or operator demonstrates that another final protective layer construction technique or material provides equivalent or superior performance to the requirements of this subsection (c)(2)*** *and is approved by the Agency.*

Therefore, Section 845.750 (c) (2) specifically allows the use of an alternate final protective layer as long as it provides an equivalent or superior performance to the default standards set forth in Section 845.750(c)(2), which are as follows:

> *A) Cover the entire low permeability layer;*
>
> *B) Be at least three feet thick, be sufficient to protect the low permeability layer from freezing, and minimize root penetration of the low permeability layer;*
>
> *C) Consist of soil material capable of supporting vegetation;*
>
> *D) Be placed as soon as possible after placement of the low permeability layer; and*

E) Be covered with vegetation to minimize wind and water erosion.

The alternate design is only requesting an alternate to Section 845.740(c)(2)(B) related to the thickness of the of the final protective layer.

PROPOSED FINAL COVER SYSTEM SUMMARY

The proposed final cover systems for each site will include:

- A low permeability layer consisting of a linear low-density polyethylene (LLDPE) geomembrane that is at least 40-mil in thickness, placed on a smooth CCR subgrade.
- A geosynthetic cushion layer, such as a needle-punched, nonwoven geotextile (HPP EAP), or a geocomposite drainage layer (DCPP GMF), on top of the geomembrane.
    - The geocomposite drainage layer is comprised of a high-density polyethylene (HDPE) geonet covered with a geotextile filter fabric (typically a needle-punched, non-woven geotextile fabric)
- A final protective layer consisting of 18 inches of protective cover soil with a 6-inch layer of topsoil capable of supporting vegetation.

The final protective layer will meet all Section 845.750(c)(2) criteria, will not need any supplemental engineering measures, and will be designed by a qualified professional engineer licensed in Illinois.

The concepts of the alternative cover system are illustrated on **Figure 1**.

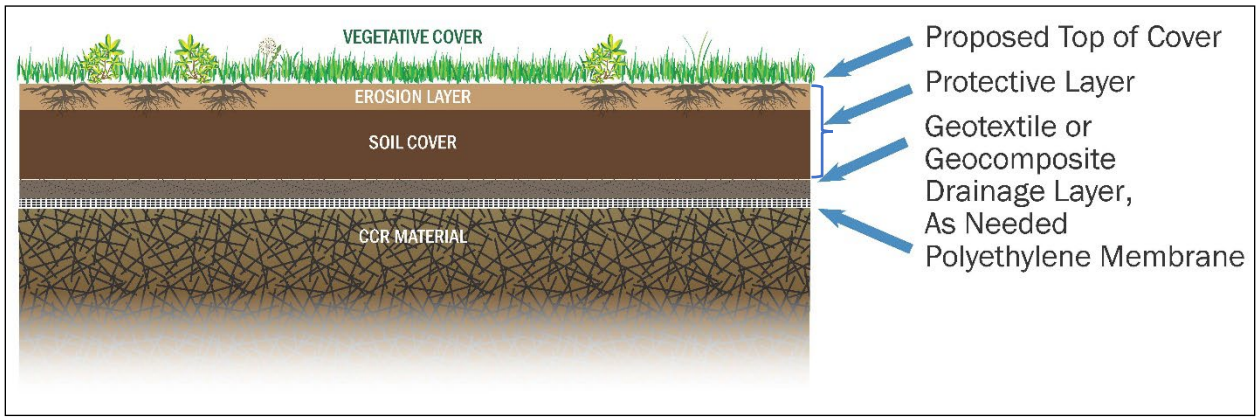

Figure 1: Proposed Alternative Final Cover System

DEMONSTRATION

The proposed alternate final protective layer will address the five requirements of Section 845.750 (c)(2)(A) to (E), as described in this section.

Section 845.750(c)(2)(A) Cover the entire low permeability layer

The final protective layer will horizontally cover the entire low-permeability layer, as indicated in the following drawings for each CCR surface impoundment:

- Duck Creek GMF Pond: Closure-in place drawings 4, 5, and 6 within Attachment 2 to the Closure Plan [2].
- Hennepin East Ash Pond: Drawings C-101, C-102, and C-103 within Attachment C to the Closure Plan [3].

Therefore, the use of the two-foot-thick final protective layer will meet the minimum requirements of Section 845 750(c)(2)(A) because it will completely cover the low-permeability layer.

Section 845.750(c)(2)(B) Be sufficient to protect the low permeability layer from freezing, and minimize root penetration of the low permeability layer

The existing Part 845, which has the same requirements as Part 814 (closure rule for landfills), requires a three-foot-thick final protective layer to protect the underlying low permeability layer from freeze-thaw effects and root penetration. However, when a geomembrane is used as the low permeability layer it does not need these protections since it is not subject to the same impacts (i.e., increase in hydraulic conductivity) as a compacted earth layer as discussed in more detail below.

Geomembrane low permeability layers will be used for both the HPP EAP and the DCPP GMF Pond. They have the following characteristics:

- Geomembranes do not have pores that can contain water and are therefore not susceptible to freeze-thaw damage that may reduce their performance as a low permeability layer and/or lead to degradation of the geomembrane.
    - In fact, geomembrane panel strength and stiffness both increase with decreasing temperatures ([4], [5]). In 1996, the United States Bureau of Reclamation [6] (USBR) performed testing of both geomembrane panels and seams subjected to up to 500 freeze-thaw cycles, in both constrained and unconstrained conditions, with temperature cycles as severe as +30º C to -20º C.

- The testing showed no changes in the strength of the geomembrane panels or seams. The USBR concluded that *"…there is simply "no change" in tensile behavior of geomembrane sheets or their seams after freeze-thaw cycling"*.
- In 2013, the Geosynthetic Institute, upon reviewing the results of the USBR and other studies, concluded that *"the essential question often raised in this regard, i.e., "will freeze-thaw conditions affect geomembrane sheets or their seam behavior," is answered with a resounding "NO""* [7].

- Geomembranes are not susceptible to grass plant root penetration because the geomembranes do not provide organic nutrients to plant roots and do not have pores or other areas where roots can enter the geomembrane.
  - Consequently, geomembranes are not a hospitable material that would either encourage root penetration or allow root penetration. Additionally, the geomembrane will be covered with a geotextile cushion or geocomposite drainage layer, which will provide an additional barrier to root penetration.

U.S. EPA research [8] states that "…a typical minimum thickness of the cover soil is 0.45 to 0.6 m…" (18 to 24 inches) thick "… for cover systems with hydraulic barriers" (low permeability layer). This is particularly appropriate when using a geomembrane low permeability which is not susceptible to any impact from freezing. U.S. EPA research also states that cover thickness design for root penetration into the low permeability layer is only a concern for compacted clay layers or geosynthetic clay barriers. This is when using an appropriate design of cover vegetation.

Therefore, the use of the two-foot-thick final protective layer will provide equivalent or superior performance to the requirements of Section 845.750 (c) (2) (B) when coupled with a geotextile cushion or geocomposite drainage layer, and a geomembrane low permeability layer, as geomembranes are not susceptible to freeze-thaw damage or root penetration as compared to a low permeability compacted earth layer.

Section 845.750(c)(2)(C) Consist of soil material capable of supporting vegetation.

The uppermost six inches of the final protective layer will consist of topsoil that is capable of supporting vegetation, which is the same requirement as the default (three-foot thick) final protective layer. This is also consistent with the Federal CCR Rule, which requires a six-inch-thick erosion (topsoil) layer. Research [8] and Geosyntec's experience indicate topsoil layers are designed to have shallow-rooted grasses and most shallow-rooted grasses do not typically penetrate more than six inches into the subsurface. Shallow-rooted grasses will be specified based

on recommendations from specialists at nurseries in the location of HPP and DCPP and Illinois Department of Transportation guidelines. The topsoil layer will be fertilized and/or amended, as necessary, on a site-specific basis based on agronomical soil testing, to provide a growing medium for the vegetation that provides the required levels of nutrients and water storage during drought conditions.

Grass species will also be selected on a site-specific basis to minimize long-term vegetation maintenance, based on the climatic conditions at each site and the soil types. Vegetation will be established by applying seed and mulch and watering to establish the vegetation. Temporary erosion control measures will also be used during vegetation establishment to protect the topsoil layer from erosion. These measures may include erosion control blankets (ECBs), silt fences, hydroseeding, and/or other methods. The Post-Closure Care Plan includes the commitment to maintain the vegetation of the surface for the closed DCPP GMF Pond in the Construction Permit Application, Attachment J [2] and the HPP EAP in the Construction Permit Application Attachment J [3].

The 18-inches of the protective layer below the topsoil will consist of a soil type suitable for retaining moisture to provide additional support for vegetation during times of drought, and to support any grass species with roots that exceed six inches. Such soil types may include silts, silty clays, lean clays, sandy clays, and/or sandy silts. A silty granular layer will be used at HPP EAP and a silty clay layer will be used at DCPP GMF.

Therefore, the use of the two-foot-thick protective layer will meet the requirements of Section 845.750(c)(2)(C), as the final protective layer will utilize soil capable of supporting vegetation.

Section 845.750(c)(2)(D) Be placed as soon as possible after placement of the low permeability layer

The HPP EAP Closure Plan (Section 4.7.2 [3]) states that the geotextile and cover soil "…will be placed as soon as practical after the geomembrane has been deployed and both quality assurance and quality control testing has been performed on the geomembrane seams." The DCPP GMF Closure Plan (Section 4.7.2 [2]) states the protective layer will be placed "…as soon as possible after placement of the low-permeability layer and will be covered with vegetation to limit wind and water erosion."

The use of a two-foot-thick protective layer will allow the final protective layer to be placed on top of the low permeability layer and vegetation to be established on top of the final protective

layer sooner than if a three-foot thick final protective layer is used. This is due to the 33% reduction in earthwork volumes associated with the thinner 2-ft-thick final protective layer.

Therefore, the use of the two-foot-thick final protective layer will exceed the minimum requirements of Section 845.750(c)(2)(D), by allowing the protective layer to be installed sooner than when using a three-foot-thick protective layer.

Section 845.750(c)(2)(E) Be covered with vegetation to minimize wind and water erosion.

Vegetation will be established to cover the final protective layer immediately after the protective layer is installed, as noted in the discussion regarding Section 845.750(c)(2)(C). Additionally, the following design and engineering features, construction techniques, and maintenance procedures will be used to reduce the potential for wind and water erosion under both long-term conditions and during vegetation establishment.

- Design and Engineering Features
    - Final cover system slopes will be installed at relatively flat grades (e.g., typically 2.5 to 4%, with steeper slopes used only in limited areas). The use of flat grades will reduce water runoff velocities and therefore reduce the potential for water erosion of the final cover soils.
    - The geotextile cushion and geocomposite drainage layer provide cushioning and help to facilitate lateral drainage of infiltration off the geomembrane, thereby reducing the amount of water available for infiltration through the geomembrane. This layer is not required by Section 845.750 but it enhances the final cover system performance.
    - A stormwater management system consisting of channels and letdown structures is included in each Construction Permit Application and will be designed to collect stormwater in a controlled manner and route it off the final cover system which will minimize infiltration into the CCR waste mass. The stormwater management system will minimize the overland flow distance between stormwater channels. Channels will be lined with an appropriate material, based on estimated stormwater velocities, to limit water erosion.
- Construction Techniques
    - The final protective layer is typically the most susceptible to wind and water erosion in the period between the placement of the protective layer and the establishment of vegetation. To reduce the potential for both wind and water

erosion during this time, the following approaches will be utilized:

- Temporary erosion and sediment controls (ESCs) will be installed to reduce the potential for erosion, such as erosion control blankets (ECBs), silt socks, silt fences, and other methods. These ECSs will be regularly inspected and maintained until vegetation is established.
- The entire surface of the final protective layer will be stabilized during seeding and until vegetation is established. Coverings may consist of straw mulch, hydroseeding binder, ECBs, or engineering growing media.
- The final protective layer will be regularly inspected and maintained during vegetation establishment. Any areas that become eroded by wind and water will be repaired until vegetation is established to a suitable level over the surface of the final cover.

- Maintenance Procedures
  - During the post-closure care period, vegetation established on the final protective cover layer will be regularly maintained using a written and IEPA-approved maintenance program. The program will consist of regular mowing and inspections. Any bare areas or areas of erosion will be repaired by seeding and stabilizing the area, and observing the area until vegetation becomes re-established.
  - The final cover slopes will be relatively flat (<5%); these slopes experience less erosion in general, especially less than typical landfill covers sloped at 25 to 33%. Typically, after three to five years, it is Geosyntec's experience that the cover vegetation becomes fully stabilized and experiences less erosion.

Therefore, the use of the two-foot-thick final protective layer will exceed the minimum requirements of Section 845 750 c) 2) E), using a robust program to support the establishment of protective vegetation, prevent and address any erosion that may occur during vegetation establishment, and monitor and maintain the vegetation during post-closure conditions.

ADDITIONAL CONSIDERATIONS

Infiltration Analysis

The use of the proposed two-foot-thick final protective layer, when coupled with a geomembrane low permeability layer, will also meet the criteria contained within Section 845.750 (a) (1). Section 845.750 (a) (1) provides the following requirement:

> *Section 845.750(a)(1) Control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere;*

Section 845.750(a)(1) is an important overall measure of the effectiveness of the final cover system because it requires control of post-closure infiltration of liquids through the final cover and into the waste and releases of CCR.

An infiltration analysis was performed to estimate post-closure liquid infiltration rates through both the default and the proposed alternate final cover systems. The following infiltration analysis discussion is provided for the proposed closure at the HPP EAP and DC GMF.

The cover systems for both the EAP and GMF have the same final cover system thickness configuration[1]. An infiltration analysis was performed by Ramboll in the HPP EAP Construction Permit Application [3] and in the DCPP GMF Construction Permit Application [2] using the Hydrologic Evaluation of Landfill Performance (HELP) software promulgated by the USEPA [9]. The HELP model estimates the infiltration rates from the top of the cover, through the final protective layer and through the low permeability layer (either a geomembrane or the three-foot thick compacted earth layer). The results are included in **Appendix A**. The resulting estimated infiltration rates are provided in **Table 1** for HPP EAP and in **Table 2** for DCPP GMF.

[1] The EAP has a 40 mil LLDPE with an overlying geotextile cushion, 18-inches of silty granular soil, and 6-inches of topsoil. The GMF has a 40 mil LLDPE with an overlying geocomposite drainage layer, 18-inches of silty clay soil, and 6-inches of topsoil.

Table 1 – HPP Final Cover Systems for Infiltration Analysis

Description	Low Permeability Layer[2]	Final Protective Layer	Infiltration Rate[3]
Proposed Alternative Final Cover System	40-mil Linear Low-Density Polyethylene (LLDPE) Geomembrane	2 ft of cover material, including, from bottom to top, a protective geotextile cushion[4], 1.5 ft of sandy soil and 0.5 ft of silty, sandy clay topsoil	0.53 in/yr
Default Cover with Geomembrane Barrier	40-mil LLDPE Geomembrane	3 ft of cover material, including, from bottom to top, a protective geotextile cushion, 2.5 ft of silty sandy soil and 0.5 ft of silty, sandy clay topsoil	0.88 in/yr
Default Cover with Compacted Earth Layer	3-ft thick compacted earth layer (1×10^{-7} cm/sec)	3 ft of cover material, including, from bottom to top, 2.5 ft of silty sandy soil and 0.5 ft of silty, sandy clay topsoil	2.26 in/yr

The HPP analysis indicated that the proposed alternative final cover system with a geomembrane and a two-foot-thick final protective layer exceeds the performance offered by the default final cover system utilizing a geomembrane with the default three-foot-thick protective layer, with the infiltration rate reduced by a factor of 1.66.

Furthermore, the proposed alternative final cover system performance exceeds the performance of a final cover system using a three-foot-thick compacted earthen low permeability layer and a three-foot-thick final protective layer (a total cover thickness of six feet) by reducing infiltration by a factor of 4.26.

[2] All HELP run versions used a pinhole density of 1 hole per acre, installation defects of 1 hole/acre, and construction quality as "good".
[3] Infiltration is out the bottom of the low permeability layer.
[4] The geotextile cushion was not included in the HELP run as HELP does not include a default drainage value for geotextiles. If the geotextile were included, infiltration may reduce even further than indicated in Table 1, relative to the default cover.

Table 2 – DCPP GMF Final Cover Systems for Infiltration Analysis

Description	Low Permeability Layer[5]	Protective Layer	Infiltration Rate
Proposed Alternative Final Cover System	40-mil Linear Low-Density Polyethylene (LLDPE) Geomembrane	2 ft of cover soil, including, from bottom to top, a geocomposite drainage layer[6], a 1.5 ft of silty clay soil, and 0.5 ft of silty clay topsoil	0.00025 in/yr
Default Cover with Geomembrane Barrier	40-mil LLDPE Geomembrane	3 ft of cover soil, including, from bottom to top, a geocomposite drainage layer, a 2.5 ft of silty clay soil, and 0.5 ft of silty clay topsoil	0.00026 in/yr
Default Cover with Compacted Clay Barrier	3-ft thick Clay Liner (1×10^{-7} cm/sec)	3 ft of cover soil, including, from bottom to top, 2.5 ft of silty clay soil and 0.5 ft of silty clay topsoil	2.1 in/yr

The DCPP GMF Pond analysis indicated that the proposed alternative final cover system with a geomembrane and a two-foot-thick final protective layer is essentially equivalent to the performance offered by the geomembrane with the default three-foot-thick final protective layer.

Furthermore, the proposed alternative final cover system performance exceeds the performance of a final cover system using a three-foot-thick compacted earth low permeability layer and a three-foot-thick soil protective layer (a total cover thickness of six feet) by reducing infiltration by a factor of nearly four orders of magnitude.

Environmental and Societal Benefits

The use of the proposed two-foot-thick final protective layer will provide the following additional environmental and societal benefits, relative to the default three-foot-thick final protective layer:

- The final cover system earthwork quantities will be reduced by 33% for each CCR surface impoundment. This will result in a corresponding 33% reduction in the amount of locally available soil fill that needs to be excavated, hauled to the construction location, and placed. This provides multiple benefits, such as:
    - Reduced disruption to offsite areas caused by the excavation of fill materials and corresponding disturbance to the natural environment.

[5] All HELP run versions used a pinhole density of 1 hole per acre, installation defects of 1 hole/acre, and construction quality as "good".

  - Reduced haul truck traffic on local roadways, thereby reducing traffic impacts, roadway damage, air pollution, and carbon emissions.
  - Reduced earthwork effort during installation of the final cover system, thereby reducing air pollution and carbon emissions.
- Construction of the alternate final cover system can be completed faster than the default final cover, providing multiple benefits, such as:
  - Initiation of the reduction of infiltration at a sooner date than with the default final cover system.
  - Ceasing construction-related impacts to offsite residents (e.g., haul truck traffic, congestion) at a sooner date than otherwise possible.

SUMMARY

The proposed alternate final protective layer will:

- Provide equivalent or superior performance to the requirements of Section 845.750 (c)(2).
- Have a geotextile cushion or a geocomposite drainage layer, which are not required by Section 845.750, over the geomembrane that add both physical protection and a lateral drainage layer to reduce the amount of water available for infiltration through the geomembrane.
- Have a lower infiltration rate than the infiltration through the default final cover system.
- Meet or exceed the same criteria for long term performance and all other requirements of Section 845.750(c)(2).
- Provide other benefits by reducing the amount of final cover earthwork by 33% at each site.

REFERENCES

[1] Illinois Environmental Protection Agency, "35 Ill. Adm. Code Part 845, Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments," Springfield, IL, 2021.

[2] Golder Associates, "Final Closure Plan for the Gypsum Management Facility Pond, Duck Creek Power Plant," Canton, Illinois, 2022.

[3] Geosyntec Consultants, "Construction Permit Application Hennepin Power Plant East Ash Pond," Geosyntec Consultants, St. Louis, 2022.

[4] A. L. Rollin, J. Lafleur, M. Marcotte, O. Dascal and Z. Akber, "Selection Criteria for the Use of Geomembranes in Dams and Dykes in Northern Climate," in *Proceedings of the International Conference on Geomembranes*, Denver, Colorado, 1945.

[5] D. E. Thorton and P. Blackall, "Report EPA-3-76-13: Field Evaluation of Plastic Film Liners for Petroleum Storage Areas in the Mackenzie Delta," Canadian Environmental Protection Service, 1976.

[6] A. I. Comer and Y. G. Hsuan, "Report R-96-03: Freeze-Thaw Cycling and Cold Temperature Effects on Geomembrane Sheets and Seams," U.S. Bureau of Reclamation, 1996.

[7] Y. G. Hsuan, R. M. Koerner and A. I. Comer, "GSI White Paper #28: Cold Temperature and Freeze-Thaw Cycling Behavior of Geomembranes and their Seams," Geosynthetic Institute, Folsom, Pennsylvania, 2013.

[8] United States Environmental Protection Agency, "(Draft) Technical Guidance For RCRA/CERCLA Final Covers," Office of Solid Waste and Emergency Response, Washington D.C., 2004.

[9] T. Tolaymat and M. Krause, "Hydrologic Evaluation of Landfill Performance: HELP 4.0 User Manual," United States Environmental Protection Agency, Washington, DC, 2020.

APPENDIX A: HELP MODEL OUTPUT

A-1: HPP EAP- 2-FT FINAL PROTECTIVE COVER SOIL

A-2: HPP EAP-3-FT FINAL PROTECTIVE COVER SOIL

A-3: HPP EAP-3-FT COMPACTED EARTH LAYER, 3-FT FINAL PROTECTIVE COVER SOIL

A-4: DCPP GMF Pond- 2-FT FINAL PROTECTIVE COVER SOIL

A-5: A-4: DCPP GMF Pond- 3-FT FINAL PROTECTIVE COVER SOIL

A-6: A-4: DCPP GMF Pond- 3-FT COMPACTED EARTH LAYER, 3-FT FINAL PROTECTIVE COVER SOIL

APPENDIX A-1
HENNEPIN POWER PLANT EAST ASH POND HELP RESULTS: 2-FT OF FINAL PROTECTIVE COVER SOIL

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: HEN EAP CIP (2 ft cover) **Simulated On:** 10/28/2021 14:14

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	6	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.3947	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 2
Type 1 - Vertical Percolation Layer
CoS - Coarse Sand
Material Texture Number 1

Thickness	=	18	inches
Porosity	=	0.417	vol/vol
Field Capacity	=	0.045	vol/vol
Wilting Point	=	0.018	vol/vol
Initial Soil Water Content	=	0.4166	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-02	cm/sec

Layer 3
Type 4 - Flexible Membrane Liner
LDPE Membrane
Material Texture Number 36

Thickness	=	0.04	inches
Effective Sat. Hyd. Conductivity	=	4.00E-13	cm/sec
FML Pinhole Density	=	1	Holes/Acre
FML Installation Defects	=	1	Holes/Acre
FML Placement Quality	=	3	Good

Layer 4

Type 1 - Vertical Percolation Layer (Waste)

High-Density Electric Plant Coal Fly Ash

Material Texture Number 30

Thickness	=	372	inches
Porosity	=	0.541	vol/vol
Field Capacity	=	0.187	vol/vol
Wilting Point	=	0.047	vol/vol
Initial Soil Water Content	=	0.1873	vol/vol
Effective Sat. Hyd. Conductivity	=	5.00E-05	cm/sec

Layer 5

Type 1 - Vertical Percolation Layer

Clay - moderate

Material Texture Number 43

Thickness	=	48	inches
Porosity	=	0.451	vol/vol
Field Capacity	=	0.419	vol/vol
Wilting Point	=	0.332	vol/vol
Initial Soil Water Content	=	0.4207	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Layer 6

Type 1 - Vertical Percolation Layer

S - Sand

Material Texture Number 2

Thickness	=	12	inches
Porosity	=	0.437	vol/vol
Field Capacity	=	0.062	vol/vol
Wilting Point	=	0.024	vol/vol
Initial Soil Water Content	=	0.0649	vol/vol
Effective Sat. Hyd. Conductivity	=	5.80E-03	cm/sec

Layer 7

Type 1 - Vertical Percolation Layer

Glacial Outwash

Material Texture Number 44

Thickness	=	156	inches
Porosity	=	0.417	vol/vol
Field Capacity	=	0.045	vol/vol
Wilting Point	=	0.018	vol/vol
Initial Soil Water Content	=	0.045	vol/vol
Effective Sat. Hyd. Conductivity	=	1.80E-01	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	80.6	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	510	acres
Evaporative Zone Depth	=	8	inches
Initial Water in Evaporative Zone	=	3.196	inches
Upper Limit of Evaporative Storage	=	3.222	inches
Lower Limit of Evaporative Storage	=	0.852	inches
Initial Snow Water	=	0.274951	inches
Initial Water in Layer Materials	=	107.552	inches
Total Initial Water	=	107.827	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	41.3	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	120	days
End of Growing Season (Julian Date)	=	300	days
Average Wind Speed	=	9	mph
Average 1st Quarter Relative Humidity	=	70	%
Average 2nd Quarter Relative Humidity	=	66	%
Average 3rd Quarter Relative Humidity	=	74	%
Average 4th Quarter Relative Humidity	=	77	%

Note: Evapotranspiration data was obtained for , Illinois

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
1.665246	1.874612	2.254818	3.099339	4.449317	4.12829
3.29051	4.017539	3.401471	3.029886	2.510213	1.863762

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 41.3/-89.31

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
27.4	35	40.3	50	69.5	78.4
83	79.7	71.5	56.9	46.3	33.6

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 41.3/-89.31
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 41.3/-89.31

Average Annual Totals Summary

Title: HEN EAP CIP (2 ft cover)
Simulated or 10/28/2021 14:16

	Average Annual Totals for Years 1 - 50*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	35.59	[5.14]	65,878,515.6	100.00
Runoff	8.075	[3.311]	14,948,903.1	22.69
Evapotranspiration	27.017	[3.834]	50,016,380.0	75.92
Subprofile1				
Percolation/leakage through Layer 3	**0.529518**	[0.021507]	980,296.3	1.49
Average Head on Top of Layer 3	18.5065	[0.739]	---	---
Subprofile2				
Percolation/leakage through Layer 7	**0.319267**	[0.207637]	591,059.7	0.90
Water storage				
Change in water storage	0.1740	[0.9142]	322,172.8	0.49

* Note: Average inches are converted to volume based on the user-specified area.

APPENDIX A-2
HENNEPIN POWER PLANT EAST ASH POND HELP RESULTS: 3-FT OF FINAL PROTECTIVE COVER SOIL

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: HEN EAP - Closure-in-Place **Simulated On:** 1/14/2022 8:20

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	6	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.2488	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 2
Type 1 - Vertical Percolation Layer
CoS - Coarse Sand
Material Texture Number 1

Thickness	=	30	inches
Porosity	=	0.417	vol/vol
Field Capacity	=	0.045	vol/vol
Wilting Point	=	0.018	vol/vol
Initial Soil Water Content	=	0.3063	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-02	cm/sec

Layer 3
Type 4 - Flexible Membrane Liner
LDPE Membrane
Material Texture Number 36

Thickness	=	0.04	inches
Effective Sat. Hyd. Conductivity	=	4.00E-13	cm/sec
FML Pinhole Density	=	1	Holes/Acre
FML Installation Defects	=	1	Holes/Acre
FML Placement Quality	=	3	Good

Layer 4

Type 1 - Vertical Percolation Layer (Waste)

High-Density Electric Plant Coal Fly Ash

Material Texture Number 30

Thickness	=	372	inches
Porosity	=	0.541	vol/vol
Field Capacity	=	0.187	vol/vol
Wilting Point	=	0.047	vol/vol
Initial Soil Water Content	=	0.1873	vol/vol
Effective Sat. Hyd. Conductivity	=	5.00E-05	cm/sec

Layer 5

Type 1 - Vertical Percolation Layer

Clay - moderate

Material Texture Number 43

Thickness	=	48	inches
Porosity	=	0.451	vol/vol
Field Capacity	=	0.419	vol/vol
Wilting Point	=	0.332	vol/vol
Initial Soil Water Content	=	0.4205	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Layer 6

Type 1 - Vertical Percolation Layer

S - Sand

Material Texture Number 2

Thickness	=	12	inches
Porosity	=	0.437	vol/vol
Field Capacity	=	0.062	vol/vol
Wilting Point	=	0.024	vol/vol
Initial Soil Water Content	=	0.0646	vol/vol
Effective Sat. Hyd. Conductivity	=	5.80E-03	cm/sec

Layer 7

Type 1 - Vertical Percolation Layer

Glacial Outwash

Material Texture Number 44

Thickness	=	156	inches
Porosity	=	0.417	vol/vol
Field Capacity	=	0.045	vol/vol
Wilting Point	=	0.018	vol/vol
Initial Soil Water Content	=	0.045	vol/vol
Effective Sat. Hyd. Conductivity	=	1.80E-01	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	80.6	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	510	acres
Evaporative Zone Depth	=	8	inches
Initial Water in Evaporative Zone	=	1.697	inches
Upper Limit of Evaporative Storage	=	3.222	inches
Lower Limit of Evaporative Storage	=	0.852	inches
Initial Snow Water	=	0.27495054	inches
Initial Water in Layer Materials	=	108.323	inches
Total Initial Water	=	108.598	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	41.3	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	120	days
End of Growing Season (Julian Date)	=	300	days
Average Wind Speed	=	9	mph
Average 1st Quarter Relative Humidity	=	70	%
Average 2nd Quarter Relative Humidity	=	66	%
Average 3rd Quarter Relative Humidity	=	74	%
Average 4th Quarter Relative Humidity	=	77	%

Note: Evapotranspiration data was obtained for , Illinois

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
1.665246	1.874612	2.254818	3.099339	4.449317	4.12829018
3.29051	4.017539	3.401471	3.029886	2.510213	1.86376189

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 41.30303/-89.31435

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
27.4	35	40.3	50	69.5	78.4
83	79.7	71.5	56.9	46.3	33.6

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 41.30303/-89.31435
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 41.30303/-89.31435

Average Annual Totals Summary

Title: HEN EAP - CURRENT CONDITIONS
Simulated on: 1/14/2022 8:23

	Average Annual Totals for Years 1 - 50*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	35.59	[5.14]	65,878,515.6	100.00
Runoff	7.713	[3.344]	14,279,113.1	21.67
Evapotranspiration	26.948	[3.837]	49,888,594.9	75.73
Subprofile1				
Percolation/leakage through Layer 3	**0.880978**	[0.027359]	1,630,955.3	2.48
Average Head on Top of Layer 3	30.2516	[0.8802]	---	---
Subprofile2				
Percolation/leakage through Layer 7	**0.544600**	[0.386956]	1,008,217.1	1.53
Water storage				
Change in water storage	0.3795	[1.1939]	702,590.4	1.07

* Note: Average inches are converted to volume based on the user-specified area.

APPENDIX A-3
HENNEPIN POWER PLANT EAST ASH POND HELP RESULTS: 3-FT OF COMPACTED EARTH LAYER, 3-FT OF FINAL PROTECTIVE COVER SOIL

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: HEN EAP - Closure-in-Place **Simulated On:** 10/13/2021 20:45

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
SCL - Sandy Clay Loam
Material Texture Number 10

Thickness	=	6	inches
Porosity	=	0.398	vol/vol
Field Capacity	=	0.244	vol/vol
Wilting Point	=	0.136	vol/vol
Initial Soil Water Content	=	0.2488	vol/vol
Effective Sat. Hyd. Conductivity	=	1.20E-04	cm/sec

Layer 2
Type 1 - Vertical Percolation Layer
CoS - Coarse Sand
Material Texture Number 1

Thickness	=	30	inches
Porosity	=	0.417	vol/vol
Field Capacity	=	0.045	vol/vol
Wilting Point	=	0.018	vol/vol
Initial Soil Water Content	=	0.275	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-02	cm/sec

Layer 3
Type 3 - Barrier Soil Liner
Liner Soil (High)
Material Texture Number 16

Thickness	=	36	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Layer 4

Type 1 - Vertical Percolation Layer (Waste)

High-Density Electric Plant Coal Fly Ash

Material Texture Number 30

Thickness	=	372	inches
Porosity	=	0.541	vol/vol
Field Capacity	=	0.187	vol/vol
Wilting Point	=	0.047	vol/vol
Initial Soil Water Content	=	0.19	vol/vol
Effective Sat. Hyd. Conductivity	=	5.00E-05	cm/sec

Layer 5

Type 1 - Vertical Percolation Layer

Clay - moderate

Material Texture Number 43

Thickness	=	48	inches
Porosity	=	0.451	vol/vol
Field Capacity	=	0.419	vol/vol
Wilting Point	=	0.332	vol/vol
Initial Soil Water Content	=	0.419	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Layer 6

Type 1 - Vertical Percolation Layer

S - Sand

Material Texture Number 2

Thickness	=	12	inches
Porosity	=	0.437	vol/vol
Field Capacity	=	0.062	vol/vol
Wilting Point	=	0.024	vol/vol
Initial Soil Water Content	=	0.0641	vol/vol
Effective Sat. Hyd. Conductivity	=	5.80E-03	cm/sec

Layer 7

Type 1 - Vertical Percolation Layer

Glacial Outwash

Material Texture Number 44

Thickness	=	156	inches
Porosity	=	0.417	vol/vol
Field Capacity	=	0.045	vol/vol
Wilting Point	=	0.018	vol/vol
Initial Soil Water Content	=	0.045	vol/vol
Effective Sat. Hyd. Conductivity	=	1.80E-01	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	80.6	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	510	acres
Evaporative Zone Depth	=	8	inches
Initial Water in Evaporative Zone	=	1.696	inches
Upper Limit of Evaporative Storage	=	3.222	inches
Lower Limit of Evaporative Storage	=	0.852	inches
Initial Snow Water	=	0.27495054	inches
Initial Water in Layer Materials	=	123.7	inches
Total Initial Water	=	123.975	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	41.3	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	120	days
End of Growing Season (Julian Date)	=	300	days
Average Wind Speed	=	9	mph
Average 1st Quarter Relative Humidity	=	70	%
Average 2nd Quarter Relative Humidity	=	66	%
Average 3rd Quarter Relative Humidity	=	74	%
Average 4th Quarter Relative Humidity	=	77	%

Note: Evapotranspiration data was obtained for , Illinois

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
1.665246	1.874612	2.254818	3.099339	4.449317	4.12829018
3.29051	4.017539	3.401471	3.029886	2.510213	1.86376189

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 41.3/-89.31

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
27.4	35	40.3	50	69.5	78.4
83	79.7	71.5	56.9	46.3	33.6

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 41.3/-89.31
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 41.3/-89.31

Average Annual Totals Summary

Title: HEN EAP - Closure-in-Place (CLAY)
Simulated on: 10/13/2021 20:48

	Average Annual Totals for Years 1 - 50*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	35.59	[5.14]	65,878,515.6	100.00
Runoff	6.701	[3.161]	12,404,742.9	18.83
Evapotranspiration	26.571	[4.002]	49,190,796.8	74.67
Subprofile1				
Percolation/leakage through Layer 3	**2.261741**	[0.038582]	4,187,161.3	6.36
Average Head on Top of Layer 3	29.5380	[1.1069]	---	---
Subprofile2				
Percolation/leakage through Layer 7	**1.697246**	[0.951224]	3,142,112.4	4.77
Water storage				
Change in water storage	0.6162	[1.663]	1,140,863.6	1.73

* Note: Average inches are converted to volume based on the user-specified area.

APPENDIX A-4
DUCK CREEK POWER PLANT GYPSUM MANAGEMET FACILITY POND
HELP RESULTS: 2-FT OF FINAL PROTECTIVE COVER SOIL

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: Duck Creek Coversystem CIP **Simulated On:** 1/12/2022 9:32

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
SiL - Silty Loam(Moderate)
Material Texture Number 23

Thickness	=	6	inches
Porosity	=	0.461	vol/vol
Field Capacity	=	0.36	vol/vol
Wilting Point	=	0.203	vol/vol
Initial Soil Water Content	=	0.4073	vol/vol
Effective Sat. Hyd. Conductivity	=	9.00E-06	cm/sec

Layer 2
Type 1 - Vertical Percolation Layer
SiL - Silty Loam(Moderate)
Material Texture Number 23

Thickness	=	18	inches
Porosity	=	0.461	vol/vol
Field Capacity	=	0.36	vol/vol
Wilting Point	=	0.203	vol/vol
Initial Soil Water Content	=	0.3829	vol/vol
Effective Sat. Hyd. Conductivity	=	9.00E-06	cm/sec

Layer 3
Type 2 - Lateral Drainage Layer
Drainage Net (0.5 cm)
Material Texture Number 20

Thickness	=	0.2	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.0338	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E+01	cm/sec
Slope	=	4	%
Drainage Length	=	450	ft

Layer 4

Type 4 - Flexible Membrane Liner
LDPE Membrane
Material Texture Number 36

Thickness	=	0.04	inches
Effective Sat. Hyd. Conductivity	=	4.00E-13	cm/sec
FML Pinhole Density	=	1	Holes/Acre
FML Installation Defects	=	1	Holes/Acre
FML Placement Quality	=	3	Good

Layer 5

Type 1 - Vertical Percolation Layer
Gypsum waste material (Sandy Loam)
Material Texture Number 43

Thickness	=	240	inches
Porosity	=	0.437	vol/vol
Field Capacity	=	0.105	vol/vol
Wilting Point	=	0.047	vol/vol
Initial Soil Water Content	=	0.105	vol/vol
Effective Sat. Hyd. Conductivity	=	6.70E-04	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	90.1	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	15	acres
Evaporative Zone Depth	=	8	inches
Initial Water in Evaporative Zone	=	3.294	inches
Upper Limit of Evaporative Storage	=	3.688	inches
Lower Limit of Evaporative Storage	=	1.624	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	34.543	inches
Total Initial Water	=	34.543	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	40.5	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	120	days

End of Growing Season (Julian Date)	=	300	days
Average Wind Speed	=	9	mph
Average 1st Quarter Relative Humidity	=	72	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	74	%
Average 4th Quarter Relative Humidity	=	75	%

Note: Evapotranspiration data was obtained for ,

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
2.01298	1.895696	2.373253	3.597322	4.095479	4.395065
3.769391	3.145982	3.272523	2.912689	2.788342	2.489949

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.5/-89.98

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
32.4	34.2	41.9	56.4	69.6	79
83.5	81	72.5	61.4	45.9	35.6

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.5/-89.98
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.5/-89.98

Average Annual Totals Summary

Title: Duck Creek Coversystem CIP
Simulated on: 1/12/2022 9:36

	Average Annual Totals for Years 1 - 100*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	36.75	[5.46]	2,000,965.1	100.00
Runoff	12.581	[3.246]	685,044.7	34.24
Evapotranspiration	23.227	[2.957]	1,264,727.0	63.21
Subprofile1				
Lateral drainage collected from Layer 3	0.9541	[0.7929]	51,952.6	2.60
Percolation/leakage through Layer 4	0.000247	[0.00019]	13.5	0.00
Average Head on Top of Layer 4	0.0005	[0.0004]	---	---
Subprofile2				
Percolation/leakage through Layer 5	0.000248	[0.00019]	13.5	0.00
Water storage				
Change in water storage	-0.0142	[1.0912]	-772.6	-0.04

* Note: Average inches are converted to volume based on the user-specified area.

APPENDIX A-5
DUCK CREEK POWER PLANT GYPSUM MANAGEMENT FACILITY POND
HELP RESULTS: 3-FT OF FINAL PROTECTIVE COVER SOIL

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: Duck Creek Coversystem CIP **Simulated On:** 1/13/2022 15:36

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
SiL - Silty Loam(Moderate)
Material Texture Number 23

Thickness	=	6	inches
Porosity	=	0.461	vol/vol
Field Capacity	=	0.36	vol/vol
Wilting Point	=	0.203	vol/vol
Initial Soil Water Content	=	0.4073	vol/vol
Effective Sat. Hyd. Conductivity	=	9.00E-06	cm/sec

Layer 2
Type 1 - Vertical Percolation Layer
SiL - Silty Loam(Moderate)
Material Texture Number 23

Thickness	=	30	inches
Porosity	=	0.461	vol/vol
Field Capacity	=	0.36	vol/vol
Wilting Point	=	0.203	vol/vol
Initial Soil Water Content	=	0.3834	vol/vol
Effective Sat. Hyd. Conductivity	=	9.00E-06	cm/sec

Layer 3
Type 2 - Lateral Drainage Layer
Drainage Net (0.5 cm)
Material Texture Number 20

Thickness	=	0.2	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.0156	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E+01	cm/sec
Slope	=	4	%
Drainage Length	=	450	ft

Layer 4

Type 4 - Flexible Membrane Liner
LDPE Membrane
Material Texture Number 36

Thickness	=	0.04	inches
Effective Sat. Hyd. Conductivity	=	4.00E-13	cm/sec
FML Pinhole Density	=	1	Holes/Acre
FML Installation Defects	=	1	Holes/Acre
FML Placement Quality	=	3	Good

Layer 5

Type 1 - Vertical Percolation Layer
Gypsum waste material (Sandy Loam)
Material Texture Number 43

Thickness	=	240	inches
Porosity	=	0.437	vol/vol
Field Capacity	=	0.105	vol/vol
Wilting Point	=	0.047	vol/vol
Initial Soil Water Content	=	0.105	vol/vol
Effective Sat. Hyd. Conductivity	=	6.70E-04	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	90.1	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	15	acres
Evaporative Zone Depth	=	8	inches
Initial Water in Evaporative Zone	=	3.294	inches
Upper Limit of Evaporative Storage	=	3.688	inches
Lower Limit of Evaporative Storage	=	1.624	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	39.149	inches
Total Initial Water	=	39.149	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	40.5	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	120	days

End of Growing Season (Julian Date)	=	300	days
Average Wind Speed	=	9	mph
Average 1st Quarter Relative Humidity	=	72	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	74	%
Average 4th Quarter Relative Humidity	=	75	%

Note: Evapotranspiration data was obtained for ,

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
2.01298	1.895696	2.373253	3.597322	4.095479	4.395065
3.769391	3.145982	3.272523	2.912689	2.788342	2.489949

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.5/-89.98

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
32.4	34.2	41.9	56.4	69.6	79
83.5	81	72.5	61.4	45.9	35.6

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.5/-89.98
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.5/-89.98

Average Annual Totals Summary

Title: Duck Creek Coversystem CIP
Simulated on: 1/13/2022 15:40

	Average Annual Totals for Years 1 - 100*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	36.75	[5.46]	2,000,965.1	100.00
Runoff	12.581	[3.246]	685,044.7	34.24
Evapotranspiration	23.227	[2.957]	1,264,727.0	63.21
Subprofile1				
Lateral drainage collected from Layer 3	0.9570	[0.8034]	52,108.0	2.60
Percolation/leakage through Layer 4	0.000258	[0.0002]	14.1	0.00
Average Head on Top of Layer 4	0.0005	[0.0004]	---	---
Subprofile2				
Percolation/leakage through Layer 5	0.000258	[0.0002]	14.1	0.00
Water storage				
Change in water storage	-0.0171	[1.1899]	-928.6	-0.05

* Note: Average inches are converted to volume based on the user-specified area.

APPENDIX A-6
DUCK CREEK POWER PLANT GYPSUM MANAGEMENT FACILITY POND HELP RESULTS: 3-FT OF COMPACTED EARTH LAYER, 3-FT OF FINAL PROTECTIVE COVER SOIL

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: Duck Creek Coversystem CIP **Simulated On:** 1/13/2022 15:07

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
SiL - Silty Loam(Moderate)
Material Texture Number 23

Thickness	=	6	inches
Porosity	=	0.461	vol/vol
Field Capacity	=	0.36	vol/vol
Wilting Point	=	0.203	vol/vol
Initial Soil Water Content	=	0.461	vol/vol
Effective Sat. Hyd. Conductivity	=	9.00E-06	cm/sec

Layer 2
Type 1 - Vertical Percolation Layer
SiL - Silty Loam(Moderate)
Material Texture Number 23

Thickness	=	30	inches
Porosity	=	0.461	vol/vol
Field Capacity	=	0.36	vol/vol
Wilting Point	=	0.203	vol/vol
Initial Soil Water Content	=	0.461	vol/vol
Effective Sat. Hyd. Conductivity	=	9.00E-06	cm/sec

Layer 3
Type 3 - Barrier Soil Liner
Liner Soil (High)
Material Texture Number 16

Thickness	=	36	inches
Porosity	=	0.427	vol/vol
Field Capacity	=	0.418	vol/vol
Wilting Point	=	0.367	vol/vol
Initial Soil Water Content	=	0.427	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07	cm/sec

Layer 4
Type 1 - Vertical Percolation Layer
Gypsum waste material (Sandy Loam)
Material Texture Number 43

Thickness	=	240	inches
Porosity	=	0.437	vol/vol
Field Capacity	=	0.105	vol/vol

Wilting Point	=	0.047	vol/vol
Initial Soil Water Content	=	0.1135	vol/vol
Effective Sat. Hyd. Conductivity	=	6.70E-04	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	90.1	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	15	acres
Evaporative Zone Depth	=	8	inches
Initial Water in Evaporative Zone	=	3.688	inches
Upper Limit of Evaporative Storage	=	3.688	inches
Lower Limit of Evaporative Storage	=	1.624	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	59.2	inches
Total Initial Water	=	59.2	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	40.5	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	120	days
End of Growing Season (Julian Date)	=	300	days
Average Wind Speed	=	9	mph
Average 1st Quarter Relative Humidity	=	72	%
Average 2nd Quarter Relative Humidity	=	67	%
Average 3rd Quarter Relative Humidity	=	74	%
Average 4th Quarter Relative Humidity	=	75	%

Note: Evapotranspiration data was obtained for ,

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
2.01298	1.895696	2.373253	3.597322	4.095479	4.395065
3.769391	3.145982	3.272523	2.912689	2.788342	2.489949

Note: Precipitation was simulated based on HELP V4 weather simulation for: Lat/Long: 40.5/-89.98

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
32.4	34.2	41.9	56.4	69.6	79
83.5	81	72.5	61.4	45.9	35.6

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.5/-89.98
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 40.5/-89.98

Average Annual Totals Summary

Title: Duck Creek Coversystem CIP
Simulated on: 1/13/2022 15:10

	Average Annual Totals for Years 1 - 100*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	36.75	[5.46]	2,000,965.1	100.00
Runoff	6.844	[2.987]	372,642.1	18.62
Evapotranspiration	27.772	[3.713]	1,512,183.1	75.57
Subprofile1				
Percolation/leakage through Layer 3	2.147626	[0.073824]	116,938.2	5.84
Average Head on Top of Layer 3	26.2293	[2.126]	---	---
Subprofile2				
Percolation/leakage through Layer 4	1.973425	[0.573329]	107,453.0	5.37
Water storage				
Change in water storage	0.1595	[1.2078]	8,686.9	0.43

* Note: Average inches are converted to volume based on the user-specified area.

ATTACHMENT 4

Slope Stability Calculations

GOLDER
MEMBER OF WSP

CALCULATION

DATE January 25, 2022 **Reference No.** 21454861-13-R-1

PREPARED BY: Jason Obermeyer

CHECKED BY: Jeff Rusch

REVIEWED BY: Mark Haddock, PE **CLIENT NAME: Illinois Power Resources Generating, LLC**

SLOPE STABILITY ANALYSIS – GYPSUM MANAGEMENT FACILITY POND CLOSURE

1.0 OBJECTIVE

Evaluate slope stability for the Gypsum Management Facility (GMF) Pond closure design in terms of global stability and veneer stability for the final cover system and containment berm.

2.0 METHODOLOGY

Limit-equilibrium slope stability analyses were performed using Spencer's method of slices (Spencer 1967) in Slide2, a two-dimensional slope stability modeling software platform (Rocscience Inc. 2020). Spencer's method of slices considers both moment and force equilibrium. It is common geotechnical practice to analyze the stability of embankment slopes using limit-equilibrium methods.

2.1 Target Factors of Safety

The following target factors of safety are based on the values presented in Illinois Administrative Code Title 35, Subsection 845.460(a), as pertinent to the GMF Pond following closure:

- target minimum factor of safety under static long-term conditions = 1.5
- target minimum factor of safety under seismic loading conditions = 1.0

The locally available soils that will be used for closure construction have relatively high silt and clay contents. Therefore, they are not expected to be susceptible to liquefaction.

3.0 SLOPE STABILITY ANALYSIS

3.1 Geometry

A typical cross section through the containment berm along the south end of the closure footprint was selected for the slope stability analysis. This is identified as the critical cross section for slope stability following closure of the GMF Pond, as the GMF Pond is mostly incised around the remainder of the closure footprint perimeter.

The existing liner system will remain in place beneath the closure footprint and consists of (from top to bottom):

- 60-mil textured high-density polyethylene (HDPE) geomembrane
- 1 foot of cushion soil (primarily silt and clay)

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- 4-ounce-per-square-yard (oz/yd^2) nonwoven needle-punched (NWNP) geotextile
- 1 foot of granular drainage aggregate
- 10-oz/yd^2 NWNP geotextile
- 60-mil textured HDPE geomembrane
- reinforced geosynthetic clay liner (GCL)
- 3 feet of compacted clay

The containment berm is designed with 3H:1V slopes and a crest width of 36 feet. The final cover system will be sloped at 4%. The base of the final cover system is designed to meet the upstream edge of the containment berm crest and terminate with a 3H:1V slope to the crest. The final cover system will consist of the following components (from top to bottom):

- 2 feet of protective cover, anticipated to consist primarily of locally available low-plasticity silt or clay
- double-sided geocomposite drainage layer
- 40-mil textured linear low-density (LLDPE) geomembrane

A liner system will be installed on the upstream containment berm slope and tied into the existing liner system at the toe of the slope. The liner system will consist of the following components (from top to bottom):

- 60-mil textured HDPE geomembrane
- 2 feet of compacted clay

Downstream of the containment berm, the closure grades represent the top of the compacted clay layer in the existing liner system, as the components of the existing liner system above this layer will be removed during closure of the GMF Pond.

For simplification of the model geometry, the liner systems are each represented as a layer having a thickness of 2 feet and the final cover system geosynthetics are represented as a layer having a thickness of 1 foot.

Groundwater levels in the vicinity of the GMF Pond are elevated above the existing liner system. For slope stability analysis, the phreatic surface is modeled along the top of the compacted clay layer in the existing liner system. Within the closure footprint, the liner system will prevent the phreatic surface from rising above this level. Downstream of the containment berm, elevated groundwater is expected to present as surface water that will be managed in a stormwater channel, resulting in phreatic levels near the ground surface.

3.2 Approach and Input Parameters

The slope stability analysis uses the following approach and input parameters:

- Circular and non-circular slip surfaces are evaluated. Analysis of non-circular slip surfaces enables evaluation of veneer stability for the final cover system.
- Earthquake (seismic) loading conditions are simulated using a pseudostatic approach. The United States Geological Survey (USGS) Unified Hazard Tool indicates a 2% probability of exceeding a peak ground

acceleration (PGA) of 0.06 g in 50 years at the site. In an actual seismic event, the peak acceleration would be sustained for only a fraction of a second. A pseudostatic analysis conservatively models seismic events as a force with constant acceleration and direction (i.e., an infinitely long seismic pulse). Consequently, it is common geotechnical practice to reduce the predicted PGA when performing pseudostatic analyses. For conservatism, however, the pseudostatic analysis for the GMF Pond is conducted for the long-term condition using a horizontal seismic coefficient of 0.06, corresponding to the PGA.

- Material unit weights were selected based on engineering judgment.
- Strength parameters for zones that may consist of cohesive soils (i.e., containment berm, protective soil cover, and subsoil) are selected based on engineering judgment. These zones are assigned a friction angle of 28 degrees. Cohesion is neglected for conservatism.
- For conservatism, undrained strengths are applied for gypsum. A vertical stress ratio (ratio of undrained strength to initial vertical effective stress) of 0.22 is used, consistent with the typical value for normally consolidated fine-grained material (Mesri 1989).
- Strength parameters for the geosynthetic interfaces included in the liner systems and final cover systems associated with the closed GMF Pond are evaluated from laboratory testing data published by Koerner and Narejo (2005) and summarized in Table 1.
- The lowest geosynthetic interface strength parameters in a given system (liner or final cover) from Table 1 are selected for analysis. Adhesion is conservatively neglected for all geosynthetic interfaces.

Table 1: Characteristic Geosynthetic Interface Strengths

Interface	Peak Friction Angle	Peak Adhesion
Textured HDPE geomembrane against cohesive soil	18 degrees	209 psf
NWNP geotextile against cohesive soil	30 degrees	104 psf
NWNP geotextile against granular soil	33 degrees	0 psf
NWNP geotextile against textured HDPE geomembrane	25 degrees	167 psf
Textured HDPE geomembrane against reinforced GCL	23 degrees	167 psf
Reinforced GCL against cohesive soil	Use NWNP geotextile against cohesive soil	
Geocomposite against cohesive soil	Use NWNP geotextile against cohesive soil	
Geocomposite against textured LLDPE geomembrane	26 degrees	121 psf
Textured LLDPE geomembrane against cohesive soil	21 degrees	169 psf

Source: Koerner and Narejo 2005.

A summary of material properties used in the slope stability analysis is presented in Table 2.

Table 2: Material Properties

Zone	Unit Weight	Friction Angle	Cohesion or Adhesion	Vertical Stress Ratio
Existing liner system	120 pcf	18 degrees	0 psf	–
New liner system	120 pcf	18 degrees	0 psf	–
Cover geosynthetics	120 pcf	21 degrees	0 psf	–
Protective cover	120 pcf	28 degrees	0 psf	–
Containment berm	120 pcf	28 degrees	0 psf	–
Gypsum	100 pcf	–	–	0.22
Subsoil	120 pcf	28 degrees	0 psf	–

3.3 Results and Conclusions

The factor of safety for slope stability under static loading conditions is calculated as 1.6, as shown in Figure 1. The critical slip surface is surficial on the downstream face of the containment berm. The factor of safety for global stability under seismic loading conditions is calculated as 1.3, as shown in Figure 2. As with the static analysis, the critical slip surface is surficial on the downstream face of the containment berm.

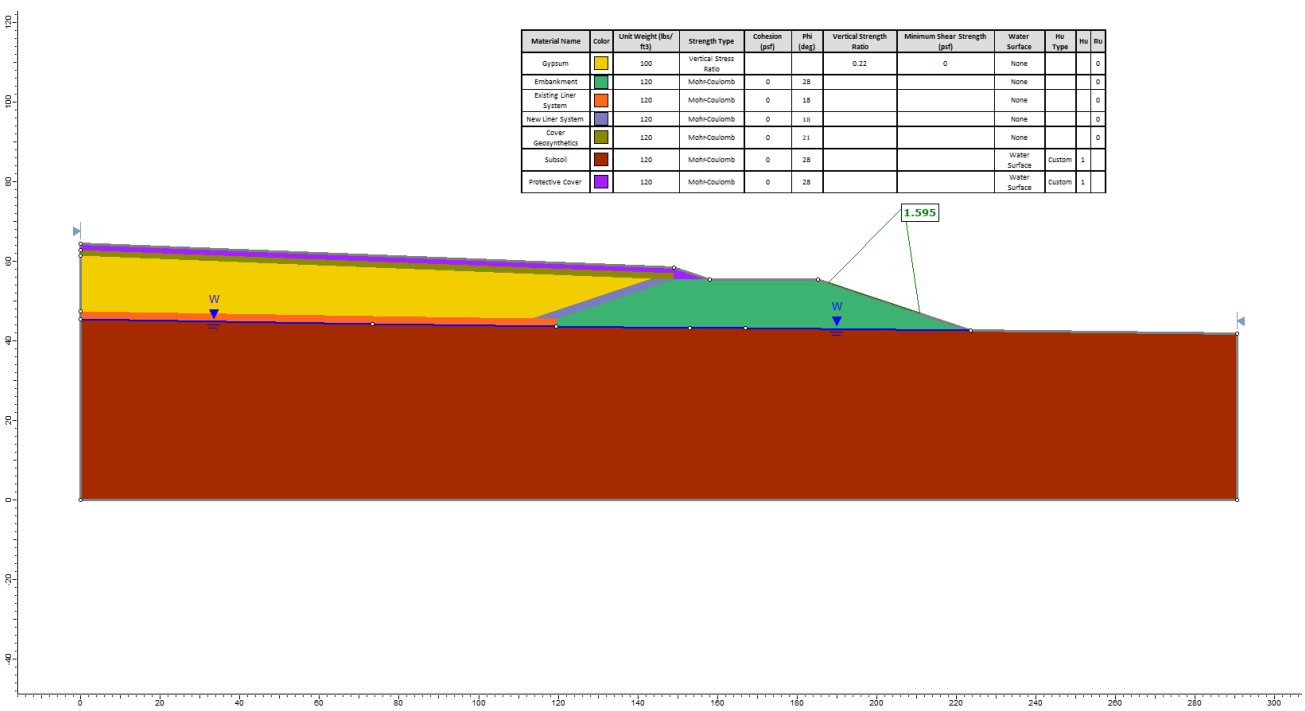

Figure 1: Analysis Result – Static Loading

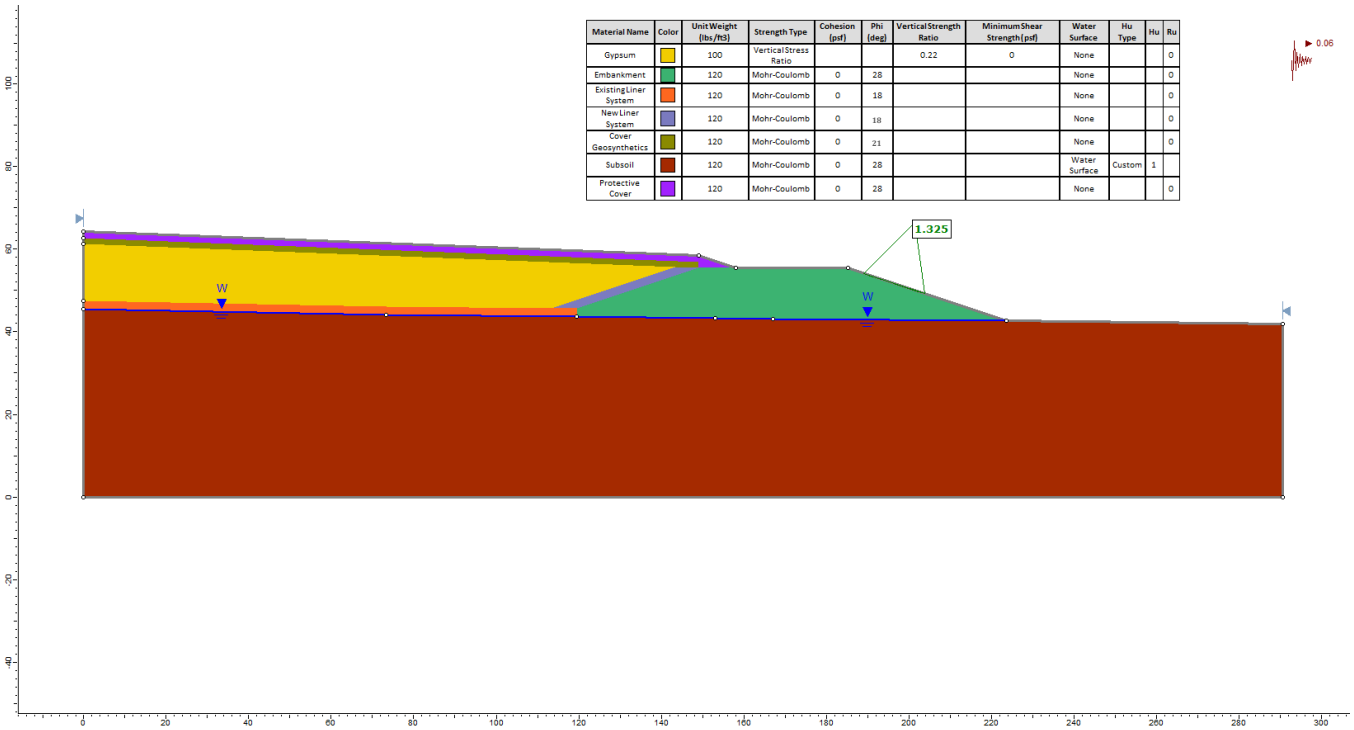

Figure 2: Analysis Result – Seismic Loading

Based on the factors of safety computed using the methods and assumptions described, the closed GMF Pond is expected to remain stable with an appropriate safety margin for global and veneer stability. A factor of safety greater that 1.5 was computed for static loading conditions. A factor of safety greater than 1.0 was computed for seismic loading conditions.

4.0 REFERENCES

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ATTACHMENT 5

Hydrologic Calculations

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CALCULATION

DATE January 25, 2022 **Reference No.** 21454861-13-R-1

PREPARED BY: Micah Richey

CHECKED BY: Brendan Purcell

REVIEWED BY: Jason Obermeyer **CLIENT NAME: Illinois Power Resources Generating, LLC**

HYDROLOGY CALCULATIONS FOR CLOSURE OF THE GYPSUM MANAGEMENT FACILITY POND AT THE DUCK CREEK POWER PLANT

1.0 OBJECTIVE

Evaluate the hydrology (routing of stormwater runoff) after closure of the Duck Creek Gypsum Management Facility (GMF) Pond. These calculations were done to support the closure plan by determining the minimum channel dimensions.

2.0 METHODOLOGY

The areas contributing to the GMF Pond were delineated in AutoCAD, as shown in Figure 1. The ground conditions were used to estimate a lag time using NRCS methodology (NRCS 1986). The calculations for the hydrologic parameters are included in Tables 1 and 2. The hydrologic parameters were used to model the stormwater runoff reporting to a proposed channel south of the closed GMF Pond and another proposed channel north of the closed GMF Pond during the 25-year, 24-hour design storm event using HEC-HMS software (USACE 2021). The channels were analyzed using Manning's equation to evaluate the steady-state hydraulics.

3.0 INPUTS AND ASSUMPTIONS

Information and assumptions regarding input parameters used in the analyses include the following:

- A curve number of 58 was used to be consistent with the closed condition of Meadow and hydrologic soil group B (NRCS 1986) based on a review of the Web Soil Survey in the vicinity of the GMF Pond (NRCS 2021).
- The design storm (25-year, 24-hour) depth from NOAA Atlas 14 (NOAA 2006) is 5.25 inches.
- Lag time was estimated using NRCS TR-55 methodology.
- Manning's number used for channel design was 0.030 for capacity and 0.035 for depth assuming a grass-lined channel.

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4.0 RESULTS AND CONCLUSIONS

The HEC-HMS model results provide the estimated peak flow from the 25-year, 24-hour design storm to discharge points of interest:

- The peak flow rate at the proposed stormwater channel south of the closed GMF Pond is estimated as 48.6 cubic feet per second (cfs).
- The peak flow rate at the proposed stormwater channel north of the closed GMF Pond is estimated as 12.6 cfs.

The output from the HEC-HMS model is shown in Table 3.

The channels were designed with dimensions as indicated in Table 4. Freeboard is shown to be at least 1 foot and at least one-half of the velocity head. The calculations indicate that the channel should function properly as designed.

5.0 REFERENCES

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Tables

TABLE 1
SUBBASIN SUMMARY TABLE

Illinois Power Resources Generating, LLC
Duck Creek Gypsum Management Facility Pond
Project Number: 21454861

Date:	1/25/22
By:	MBR
Chkd:	BJP
Apprvd:	JEO

Design Storm **25 -Year Recurrence Interval**

Storm Duration (hours)	2-Year Depth (inches)	25 -Year Depth (inches)	Storm Distribution
24	3.01	5.25	II

Subbasin ID	Subbasin Area (ft^2)	Subbasin Area (acres)	Subbasin Area (sq mile)	CN = 58 Meadow HSG B (acres)	CN = 99 Open Water or Impervious (acres)	Composite SCS Curve No.	$S = \frac{1000}{CN} - 10$	Unit Runoff Q (in)	Runoff Volume (ac-ft)	Runoff Volume (ft^3)
CIP	1,871,960	42.97	0.0671	42.97		CN = 58	7.24	1.31	4.69	204,167
CIP N	445,396	10.22	0.0160	10.22		CN = 58	7.24	1.31	1.12	48,577

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TABLE 2
BASIN TIME OF CONCENTRATION CALCULATIONS

Illinois Power Resources Generating, LLC
Duck Creek Gypsum Management Facility Pond
Project Number: 21454861

Date:	1/25/22
By:	MBR
Chkd:	BJP
Apprvd:	JEO

					Flow Segment 1							Flow Segment 2							Flow Segment 3						
Subbasin ID	Subbasin Area (sq mile)	Composite Curve Number	Total Lag (0.6*Tc) (min)	Total Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)
CIP	0.0671	58	15.9	26.5	Sheet	100	0.040	G	Bermuda Grass		17.1	Shallow	550	0.040	U	Unpaved		2.8	Channel	1,700	0.0094	G	Grass-lined	1.07	6.6
CIP N	0.0160	58	13.9	23.1	Sheet	100	0.040	G	Bermuda Grass		17.1	Shallow	100	0.050	U	Unpaved		0.5	Channel	950	0.0105	G	Grass-lined	0.53	5.6

TABLE 3
FLOW RESULTS FROM HEC-HMS

Illinois Power Resources Generating, LLC
Duck Creek Gypsum Management Facility Pond
Project Number: 21454861

Date:	1/25/22
By:	MBR
Chkd:	BJP
Apprvd:	JEO

HEC-HMS Basin Model:	GMF
HEC-HMS Met. Model:	25-yr, 24-hr
HEC-HMS Control Specs:	48-hr, 1-min

Hydrologic Element	Drainage Area (sq mile)	Peak Discharge (cfs)	Time of Peak	Total Volume (ac-ft)
CIP	0.067	48.6	02Jun2525, 01:10	4.7
CIP N	0.016	12.6	02Jun2525, 01:08	1.1

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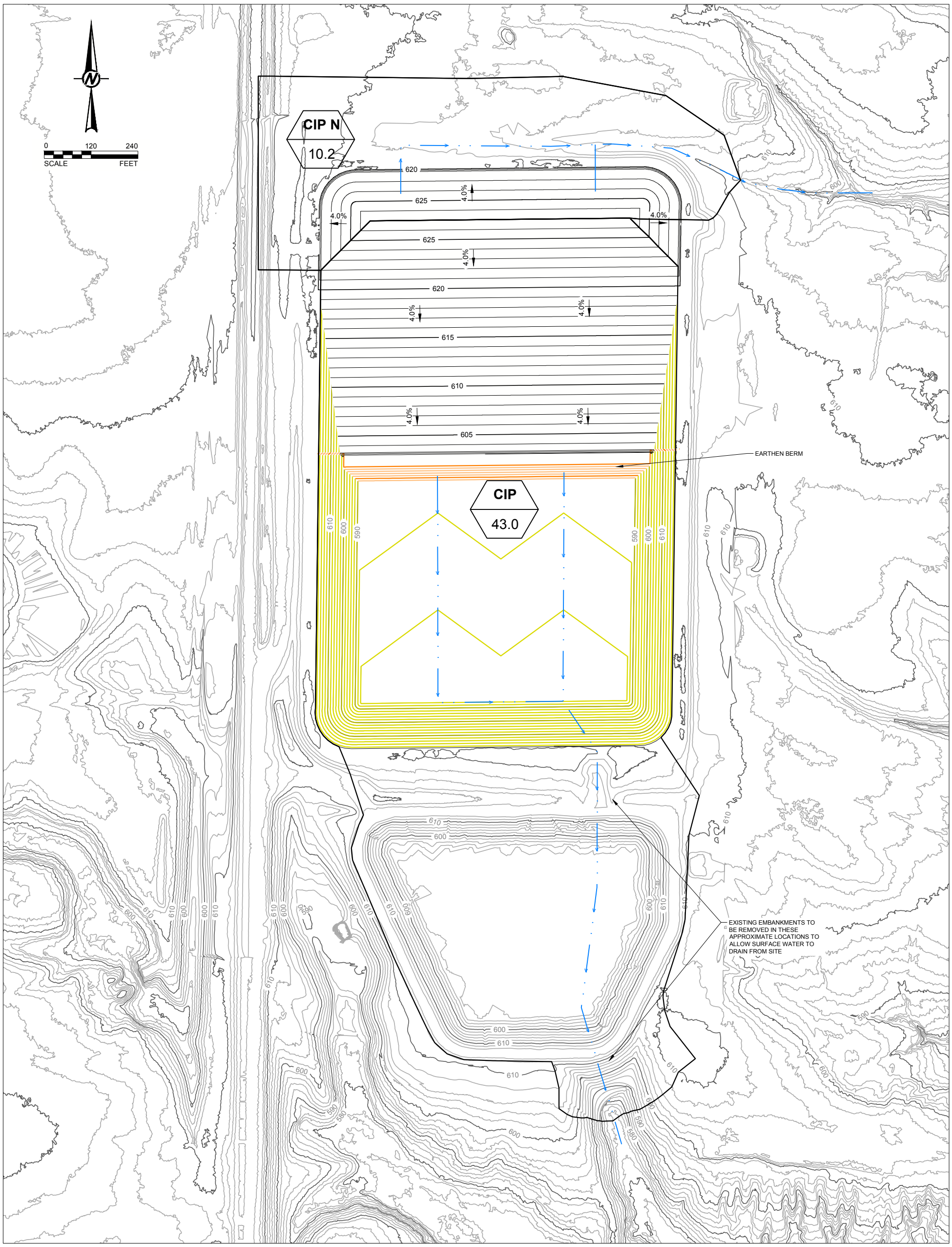
TABLE 4
CHANNEL HYDRAULIC CALCULATIONS

Illinois Power Resources Generating, LLC
Duck Creek Gypsum Management Facility Pond
Project Number: 21454861

Date:	1/25/22
By:	MBR
Chkd:	BJP
Apprvd:	JEO

			Channel Design Geometry						Channel Roughness Parameters				Hydraulic Calculations							Channel Evaluations	
Reach Designation	**Q25 from HEC-HMS (cfs)**	**HEC HMS Element ID for Q**	**Approximate Channel Length (ft)**	**Bed Slope (ft/ft)**	**Left Side Slope (H:1V)**	**Right Side Slope (H:1V)**	**Bottom Width (ft)**	**Minimum Channel Depth (ft)**	**Design Channel Lining**		**Mannings 'n' for Capacity (Depth Calculation)**	**Mannings 'n' for Stability (Velocity Calculation)**	**Maximum Velocity (ft/sec)**	**Maximum Normal Flow Depth (ft)**	**Froude Number**	**Normal Depth Shear Stress (lb/ft^2)**	**Stream Power (W/m^2)**	**Top Width of Flow (ft)**	**Top Width of Channel (ft)**	**Available Freeboard (ft)**	
CIP	48.6	CIP	1,770	0.0075	3.0	3.0	0	11.7	G	Grass-lined	0.035	0.030	4.1	2.10	0.73	0.98	58.81	12.6	70.2	9.6	Suitable
CIP N	12.6	CIP N	950	0.0110	3.0	3.0	0	2.2	G	Grass-lined	0.035	0.030	3.4	1.18	0.80	0.81	39.86	7.1	13.2	1.0	Suitable

Figures



NOTE(S)

1. GYPSUM MANAGEMENT FACILITY (GMF) POND BASE GRADES SHOWN ARE TOP OF CUSHION DIRT LAYER. ELEVATION CONTOURS WERE DEVELOPED FROM CONSTRUCTION RECORD DRAWINGS PREPARED BY HANSON PROFESSIONAL SERVICES INC.
2. EXISTING CONTOURS ARE A COMPOSITE OF AN AERIAL SURVEY COMPLETED BY DRAGONFLY AEROSOLUTIONS DATED 11/17/2020, TOPOGRAPHIC/BATHYMETRIC SURVEYS COMPLETED BY INGENAE DATED 11/4/2020 & 11/5/2020, AND U.S. GEOLOGICAL SURVEY LIDAR POINT CLOUD DATA DATED 2/12/2018.
3. THE PROPOSED STORMWATER DRAINAGE CONCEPT IS TO SHED WATER INTO EXISTING DRAINAGE CHANNELS NORTHEAST AND SOUTHEAST OF THE FACILITY. DRAINAGE TO THE SOUTHEAST WILL BE DIRECTED INTO AN OPEN CHANNEL CREATED BY REMOVING EXISTING EMBANKMENTS AND EXCAVATING BELOW EXISTING GRADES ALONG THE ROUTING SHOWN. THE OPEN CHANNEL WILL CONNECT INTO AN EXISTING DRAINAGE SOUTHEAST OF THE GMF POND.

LEGEND

- 600 — PROPOSED TOP OF COVER GRADES
- 600 — GMF POND BASE GRADES (SEE NOTE 1)
- 600 — EXISTING GROUND CONTOURS (SEE NOTE 2)
- 600 — EARTHEN BERM GRADES
- PROPOSED STORMWATER ROUTING (SEE NOTE 3)
- BASIN DELINEATION
- BASIN / ACRES

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GYPSUM MANAGEMENT FACILITY POND SURFACE WATER DRAINAGE BASINS

FIGURE 1

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APPENDIX I

Groundwater Monitoring Plan

Intended for
Illinois Power Resources Generating, LLC

Date
October 25, 2021

Project No.
1940100806-003

GROUNDWATER MONITORING PLAN

GYPSUM MANAGEMENT FACILITY POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

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GROUNDWATER MONITORING PLAN
DUCK CREEK POWER PLANT GYPSUM MANAGEMENT FACILITY POND

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Project Name	**Duck Creek Power Plant Gypsum Management Facility Pond**
Project No.	**1940100806-003**
Recipient	**Illinois Power Resources Generating, LLC**
Document Type	**Groundwater Monitoring Plan**
Revision	**FINAL**
Date	**October 25, 2021**

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Chase J. Christenson, PG
Hydrogeologist

LICENSED PROFESSIONAL CERTIFICATIONS

35 I.A.C. § 845.630 Groundwater Monitoring Systems (PE)

I, Eric J. Tlachac, a qualified professional engineer in good standing in the State of Illinois, certify that the groundwater monitoring system described in this document (Groundwater Monitoring Plan, Duck Creek Power Plant Gypsum Management Facility Pond), has been designed and constructed to meet the requirements of 35 I.A.C. § 845.630. The monitoring system was developed based on information included in the Hydrogeologic Site Characterization Report (Ramboll 2021; included in the Operating Permit to which this Groundwater Monitoring Plan is attached).

Eric J. Tlachac
Qualified Professional Engineer
062-063091
Illinois
Date: October 25, 2021

35 I.A.C. § 845.630 Groundwater Monitoring Systems (PG)

I, Brian G. Hennings, a qualified professional geologist in good standing in the State of Illinois, certify that the groundwater monitoring system described in this document (Groundwater Monitoring Plan, Duck Creek Power Plant Gypsum Management Facility Pond), has been designed and constructed to meet the requirements of 35 I.A.C. § 845.630. The monitoring system was developed based on information included in the Hydrogeologic Site Characterization Report (Ramboll 2021; included in the Operating Permit to which this Groundwater Monitoring Plan is attached).

Brian G. Hennings
Professional Geologist
196.001482
Illinois
Date: October 25, 2021

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Table 2-1 Monitoring Well Locations and Construction Details
Table 3-1 Background Groundwater Quality and Standards
Table 4-1 Sampling and Analysis Summary
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FIGURES (ATTACHED)

Figure 1-1 Site Location Map
Figure 1-2 Site Map
Figure 1-3 Uppermost Aquifer Groundwater Elevation Contours, April 14, 2021
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APPENDICES

Appendix A Statistical Analysis Plan

ACRONYMS AND ABBREVIATIONS

35 I.A.C.	Title 35 of the Illinois Administrative Code
40 C.F.R.	Title 40 of the Code of Federal Regulations
ASD	Alternate Source Demonstration
bgs	below ground surface
CCR	coal combustion residuals
cm/s	centimeters per second
CSM	conceptual site model
DCPP	Duck Creek Power Plant
GMF Pond	Gypsum Management Facility Pond
GMP	Groundwater Monitoring Plan
GWPS	groundwater protection standard
HCR	Hydrogeologic Site Characterization Report
HDPE	high-density polyethylene
ID	identification
IEPA	Illinois Environmental Protection Agency
IPRG	Illinois Power Resources Generating, LLC
mg/L	milligrams per liter
mil	millimeter
msl	mean sea level
NA	not applicable
NAVD88	North American Vertical Datum of 1988
NID	National Inventory of Dams
No.	number
NRT/OBG	Natural Resource Technology, an OBG Company
oz/yd^2	ounces per square yard
Part 845	Residuals in Surface Impoundments: Title 35 of the Illinois Administrative Code § 845
PMP	potential migration pathway
QA/QC	quality assurance/quality control
Ramboll	Ramboll Americas Engineering Solutions, Inc.
RL	reporting limit
SI	surface impoundment
TDS	total dissolved solids
UA	uppermost aquifer
USEPA	United States Environmental Protection Agency
WLO	water level only
WPCP	Water Pollution Control Permit

1. INTRODUCTION

1.1 Overview

In accordance with requirements of the Standards for the Disposal of Coal Combustion Residuals (CCR) in Surface Impoundments (SIs): Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845 (Part 845) (Illinois Environmental Protection Agency [IEPA], April 15, 2021), Ramboll Americas Engineering Solutions, Inc. (Ramboll) has prepared this Groundwater Monitoring Plan (GMP) on behalf of Duck Creek Power Plant (DCPP), operated by Illinois Power Resources Generating, LLC (IPRG). This report will apply specifically to the CCR Unit referred to as the Gypsum Management Facility Pond (GMF Pond) (Vistra identification [ID] number [No.] 203, IEPA ID No. W0578010001-04, and National Inventory of Dams [NID] No. IL50573). This GMP includes Part 845 content requirements specific to 35 I.A.C. § 845.630 (Groundwater Monitoring System), 35 I.A.C. § 845.640 (Groundwater Sampling and Analysis), and 35 I.A.C. § 845.650 (Groundwater Monitoring Program) for the GMF Pond at the DCPP.

A checklist which identifies the specific requirements of 35 I.A.C. § 845.630, 35 I.A.C. § 845.640, and 35 I.A.C. § 845.650 is included in **Table 1-1**. The table provides references to sections, tables, and figures included in this document to locate the information that meets specific requirements of 35 I.A.C. § 845.630, 35 I.A.C. § 845.640, and 35 I.A.C. § 845.650.

1.2 Site Location and Background

The DCPP is located in Fulton County, Illinois, approximately six miles southeast of the town of Canton, Illinois. The GMF Pond is located north of the DCPP within Section 18, Township 6 North, Range 5 East (**Figure 1-1**). Prior to construction of the DCPP and associated facilities, strip mining of coal took place within the current property boundary. Currently, land use adjacent to the DCPP is primarily agriculture, pasture, and forested land with minimal development.

The GMF Pond is a 1,500-foot by 900-foot earthen berm double-lined CCR SI located north of the former DCPP. The GMF Pond decant water discharges to the lined GMF Recycle Pond located to the south of the GMF Pond (**Figure 1-2**). In addition to the GMF Pond, several other CCR units are located on the DCPP property, including the Landfill located due north of the GMF Pond; the closed units Ash Pond No. 1 and Ash Pond No. 2 located south of the GMF Pond; and the Bottom Ash Basin located between the former DCPP and the closed Ash Pond No. 1 and Ash Pond No. 2.

The GMF Pond, also referred to as the gypsum stack/management system, operates under IEPA Water Pollution Control Permit (WPCP) No. 2017-E0-62640, issued in December 2017. It consists of 1,500-foot by 900-foot earthen berm with 3.5:1 side slopes, a maximum elevation of 620 feet above mean sea level, a double geomembrane liner consisting of a 60-millimeter (mil) high-density polyethylene (HPDE) geomembrane liner, 12 inches of clay cushion, 4 ounces per square yard (oz/yd^2) non-woven geotextile filter fabric, 12 inches highly permeable granular drainage (sand), 10 oz/yd^2 non-woven geotextile filter fabric, 60-mil HPDE geomembrane liner, reinforced bentonite mat, 36 inches compacted clay all installed over in-situ foundation soil, and all pipes, pumps, and appurtenances necessary for the storage of approximately 3.6 million tons of gypsum at a maximum elevation of 715 feet above mean sea level with discharge to the Recycle Pond. The GMF Recycle Pond is lined with a 60-mil HDPE geomembrane liner, reinforced bentonite mat, and 36 inches of compacted clay.

Strip mining has occurred in this area since the 1930s. Strip mining in the site vicinity extracted coal from the Springfield (No. 5) coal seam. Mining operations in the area have ceased. Strip mining has completely disrupted the natural stratigraphy down to the Springfield (No. 5) coal unit at some portions of the DCPP property. Previous investigations completed outside of the GMF Pond indicated that bedrock in the area is overlain by mine spoil ranging in thickness from approximately 10 to 75 feet. The mine spoil consists of excavated bedrock (weathered shale, shale fragments, and some coal fines) mixed with the sand, silts and silty clays of the unconsolidated glacial and aeolian deposits. The GMF Pond is located immediately adjacent to and downgradient of several former large surface mining areas.

1.3 Conceptual Model

Significant site investigation has been completed at the DCPP to characterize the geology, hydrogeology, and groundwater quality. Based on extensive investigation and monitoring, the GMF Pond has been well characterized and detailed in the Hydrogeologic Site Characterization Report (HCR; Ramboll, 2021); included in the Operating Permit to which this Plan is attached). A conceptual site model (CSM) has been developed and is discussed below.

The three distinct hydrostratigraphic units summarized below have been identified at the GMF Pond based on stratigraphic relationships and common hydrogeologic characteristics:

- **Uppermost Aquifer:** At the GMF Pond, this unit includes the Peoria/Roxana Loess, the upper Radnor Till, and the shallow sands. These units are hydraulically connected and underlain by a thick till sequence of the Radnor Till (Natural Resource Technology, an OBG Company [NRT/OBG], 2017a). The shallow sands are laterally extensive across the GMF Pond, vary in thickness from less than one to 18 feet, and are generally located at an elevation of 570 to 590 feet above mean sea level (msl). Sand was completely removed where it was encountered during construction of the GMF Pond, putting the base of liner in contact with clay of the lower Radnor Till. Sand outside the GMF Pond footprint remains in place. While the primary migration pathway is the shallow sand of the uppermost aquifer, the groundwater within the overlying Peoria/Roxanna Loess has the potential to be impacted and is considered a potential migration pathway (PMP).
- **Lower Radnor Till/Lower Confining Unit**: Underlying the uppermost aquifer, the lower Radnor Till is approximately 42 to 58 feet thick. Previous hydrogeologic studies indicate discontinuous sand lenses observed within the till are not hydraulically connected to the shallow sand unit (NRT/OBG, 2017a).
- **Bedrock Confining Unit**: The thick and low permeability shaley siltstone, silty shale, and coal beds of the Carbondale Formation, are estimated to have a thickness of approximately 300 to 400 feet.

Groundwater migrates downward through the loess and upper Radnor Till into the shallow sands of the uppermost aquifer. Groundwater flow in the sands is generally in a northwest to southeast direction (**Figure 1-3**). Seasonal variation of groundwater levels at the GMF Pond are present and may fluctuate approximately one to 10 feet. There is no observable seasonal variation of groundwater flow direction at the GMF Pond associated with the elevation changes. Groundwater flows toward the Duck Creek Cooling Pond located approximately 2,100 feet east of the GMF Pond. The surface water elevation of the Duck Creek Cooling Pond is estimated from 562.5 to 565 feet North American Vertical Datum of 1988 (NAVD88). Which is approximately 20 feet lower than downgradient groundwater at the GMF Pond.

Part 845 parameters were monitored in the uppermost aquifer and PMP monitoring wells at the GMF Pond as part of the Title 40 of the Code of Federal Regulations (40 C.F.R.) § 257 monitoring program beginning in 2015. These data were supplemented with sampling of additional locations in 2021. The results indicate that the following parameters were detected at concentrations or measurements greater than the applicable 35 I.A.C. § 845.600 groundwater protection standards (GWPSs) and are considered potential exceedances:

- Antimony, arsenic, cobalt, lead, pH, sulfate, and thallium were detected at least once at concentrations or measurements greater than the GWPS in downgradient uppermost aquifer wells (including PMP wells). Lead, mercury, pH, and thallium were detected at concentrations or measurements greater than the GWPS in upgradient uppermost aquifer wells. Radium 226 and 228 combined was detected once at concentrations greater than the GWPS in the bedrock confining unit well.

Concentration results for the above parameters were compared directly to 35 I.A.C. § 845.600 GWPS, without an evaluation of background concentrations. Evaluation of background groundwater quality has been completed as part of this GMP, and compliance with Part 845 will be determined following the first round of groundwater sampling. The first round of groundwater sampling for compliance will be completed the quarter following issuance of the Operating Permit and in accordance with this GMP.

2. GROUNDWATER MONITORING SYSTEMS

2.1 Existing Monitoring Well Network and Analysis

This GMP is being provided to propose a groundwater monitoring network and monitoring program specific to the GMF Pond that will comply with Part 845. Monitoring networks and programs that apply to other units are not discussed in this GMP. Those programs will continue to be performed as specified in IEPA approvals. Any future modifications will be proposed and submitted to IEPA for approval in a separate document. The remaining discussion in this document will include only these networks and monitoring programs that are applicable and specific to the GMF Pond, specifically the IEPA WPCP monitoring network, the 40 C.F.R. § 257 monitoring network and the proposed Part 845 monitoring network.

2.1.1 IEPA Monitoring Program

Routine quarterly groundwater monitoring is completed at GMF Pond wells G50L/S, G51L/S, G52L/S, G53L/S, G54L/S, G55L/S, G56L/S, G57L/S, G58L/S, G59L/S, G60L/S, R61L/G61S, G62L, G63L/S, and G64L/S in accordance with the IEPA WPCP No. 2017-E0-62640. This permit also requires sampling G65L/S, G66L/S, G67L/S, G70L, G71L/S, and G72L/R72S at the GMF Recycle Pond. The boring logs, well construction forms, and other related monitoring well forms for the GMF Pond well network are included in Appendix B of the HCR (included in the Operating Permit to which this Plan is attached). The location of all IEPA monitoring wells is illustrated in **Figure 2-1**. Groundwater samples are collected quarterly and annually and are analyzed for the laboratory and field parameters listed in **Table A** below.

Table A. IEPA Groundwater Monitoring Program Parameters

Field Parameters			
pH	Temperature	Specific Conductance	
Groundwater Elevation	Depth to Water (bmp)	Bottom of Well Elevation	
Quarterly Parameters (Dissolved)			
Arsenic	Cadmium	Lead	Sulfate
Boron	Chloride	Manganese	Total Dissolved Solids (TDS)
Annual Parameters (Dissolved)			
Alkalinity, bicarbonate	Chromium	Mercury	Selenium
Alkalinity, carbonate	Cobalt	Nickel	Sodium
Ammonia as Nitrogen	Iron	Nitrate nitrogen	Zinc
Calcium	Magnesium	Potassium	

2.1.2 40 C.F.R. § 257 Monitoring Program

The 40 C.F.R. § 257 well network for the GMF Pond consists of seven monitoring wells installed nearby or adjacent to the GMF Pond in the uppermost aquifer. The GMF Pond 40 C.F.R. § 257 well network consists of three background monitoring wells (G02S, G50S, and G51S) and four compliance monitoring wells (G54S, G57S, G60S, and G64S). The boring logs, well construction forms, and other related monitoring well forms are available in the Operating Records as required by 40 C.F.R. § 257.91 for each monitored CCR Unit or CCR Multi-Unit, and are included in Appendix B of the HCR (included in the Operating Permit to which this Plan is attached).

Groundwater is being monitored at the GMF Pond in accordance with the Detection Monitoring Program requirements specified in 40 C.F.R. § 257.94. Details on the procedures and techniques used to fulfill the groundwater sampling and analysis program requirements are found in the Sampling and Analysis Plan for the GMF Pond (NRT/OBG, 2017b).

Groundwater samples are collected semiannually and analyzed for the laboratory and field parameters from Appendix III of 40 C.F.R. § 257, summarized in **Table B** below.

Table B. 40 C.F.R. § 257 Groundwater Monitoring Program Parameters

Field Parameters[1]		
pH	Groundwater Elevation	
Appendix III Parameters (Total, except TDS)		
Boron	Chloride	Sulfate
Calcium	Fluoride	TDS

[1]Dissolved oxygen, temperature, specific conductance, oxidation/reduction potential, and turbidity were recorded during sample collection.

Results and analysis of groundwater sampling are reported annually by January 31 of the following year and made available on the CCR public website as required by 40 C.F.R. § 257.

2.1.3 Part 845 Well Installation and Monitoring

In 2021, one additional monitoring well (G54C) was installed between the GMF Pond and the GMF Recycle Pond to assess the vertical and horizontal lithology, stratigraphy, chemical properties, and physical properties of geologic layers to a minimum of 100 feet below ground surface (bgs) as specified in 35 I.A.C. § 845.620(b). Additionally, a porewater sample was collected from a temporary leachate monitoring location (XTPW02) installed within the GMF Pond to characterize the CCR materials.

Prospective Part 845 monitoring wells were sampled for eight rounds from February to August 2021 and the results were assessed for selection of the GMF Pond Part 845 monitoring well network. Groundwater samples were collected and analyzed for 35 I.A.C. § 845.600 parameters as summarized in **Table C** below.

Table C. Part 845 Groundwater Monitoring Program Parameters

Field Parameters[1]			
Groundwater Elevation	pH	Turbidity	
Metals (Total)			
Antimony	Boron	Cobalt	Molybdenum
Arsenic	Cadmium	Lead	Selenium
Barium	Calcium	Lithium	Thallium
Beryllium	Chromium	Mercury	
Inorganics (Total)			
Fluoride	Sulfate	Chloride	TDS
Other (Total)			
Radium 226 and 228 combined			

[1] Dissolved oxygen, temperature, specific conductance, and oxidation/reduction potential were recorded during sample collection.

Data and results from the Part 845 background monitoring were included in the water quality discussion included in the HCR (included in the Operating Permit to which this Plan is attached). The data collected from background locations during the Part 845 monitoring were used to evaluate and calculate background concentrations for the GMF Pond. The evaluation and discussion are included in **Section 3.2** of this report.

Data collected from the 40 C.F.R. § 257 monitoring network from 2015 to 2021, and from the Part 845 background monitoring were used for selection of the Part 845 monitoring well network proposed in **Section 2.2**.

2.2 Proposed Part 845 Monitoring Well Network

The groundwater monitoring network proposed in this plan will include seven wells screened in the uppermost aquifer (G02S, G50S, G51S, G54S, G57S, G60S, and G64S), three wells screened in the PMP (G54L, G60L, and G64L), and one temporary water level only monitoring point (X301) that is located in a riser along the south end of the pond for monitoring the phreatic surface within the GMF Pond. The proposed network is summarized in **Table D** below and displayed on **Figure 2-2**. Ten wells (three background and seven compliance) will be used to monitor groundwater concentrations within the hydrostratigraphic units.

The groundwater samples collected from the ten wells will be used to monitor and evaluate groundwater quality and demonstrate compliance with the groundwater quality standards listed in 35 I.A.C. § 845.600(a). The proposed monitoring wells will yield groundwater samples that represent the quality of downgradient groundwater at the CCR boundary (as required in 35 I.A.C. § 845.630(a)(2)). Monitoring well depths and construction details are listed in **Table 2-1** and summarized in **Table D** below.

Table D. Proposed Part 845 Monitoring Well Network

Well ID	Monitored Unit	Well Screen Interval (feet bgs)	Well Type[1]
G02S	UA	23.0 – 28.0	Background
G50S	UA	29.2 – 34.0	Background
G51S	UA	24.0 – 28.8	Background
G54L	PMP	27.3 – 36.8	Compliance
G54S	UA	43.5 – 48.0	Compliance
G57S	UA	29.7 – 34.2	Compliance
G60L	PMP	20.1 – 24.9	Compliance
G60S	UA	31.1 – 35.9	Compliance
G64L	PMP	18.1 – 27.5	Compliance
G64S	UA	34.5 – 39.0	Compliance
X301[2,3]	CCR	NA	WLO

[1] Well Type refers to the role of the well in the monitoring network.
[2] Well is to be used for water level data collection only.
[3] Location is temporary pending implementation of impoundment closure per an approved Construction Permit Application.
NA = not applicable
UA = uppermost aquifer
WLO = water level only

2.3 Well Abandonment

No wells are currently proposed for abandonment.

3. APPLICABLE GROUNDWATER QUALITY STANDARDS

3.1 Groundwater Classification

Groundwater at the GMF Pond meets the definition of Class I – Potable Resource Groundwater (35 I.A.C. § 620.210), based on the following criteria:

- Groundwater in the uppermost aquifer extends ten feet or more below the land surface.
- Field hydraulic conductivity tests performed in the unlithified geologic materials that include loess, shallow sand, and intermediate sand at the GMF Pond resulted in an overall (geometric mean) horizontal hydraulic conductivity exceeding the 1×10^{-4} centimeters per second (cm/s) criterion.

However, background (upgradient) groundwater originates from areas north and west of the GMF Pond that have been surface mined and present a significant alternative source for groundwater impacts.

3.2 Statistical Evaluation of Background Groundwater Data

A Statistical Analysis Plan (**Appendix A**) has been developed to describe procedures that will be used to establish background conditions and implement compliance monitoring as necessary and required by 35 I.A.C. § 845.640 and 35 I.A.C. § 845.650. The Statistical Analysis Plan was prepared in accordance with the requirements of 35 I.A.C. § 845.640(f), with reference to the acceptable statistical procedures provided in United States Environmental Protection Agency's (USEPA) *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (*Unified Guidance,* March 2009), and is intended to provide a logical process and framework for conducting the statistical analysis of the data obtained during groundwater monitoring.

In accordance with 35 I.A.C. § 845.640(f)(1), the statistical method chosen for analysis of background groundwater quality was either the tolerance interval or the prediction interval procedure for each constituent listed in 35 I.A.C. § 845.600(a)(1) at this CCR unit per 35 I.A.C. § 845.640(f)(1)(C). A comparison of the statistical background concentrations and groundwater quality standards listed in 35 I.A.C. § 845.600(a)(1) and the resulting GWPSs are summarized in **Table 3-1**.

3.3 Applicable Groundwater Protection Standards

The applicable GWPSs will be established in accordance with 35 I.A.C. § 845.600(a) (greater of the background concentration or numerical limit specified in 35 I.A.C. § 845.600(a)(1)). The results of the statistical analysis of background groundwater data (**Table 3-1**) indicate that most background concentrations in the uppermost aquifer are less than the groundwater quality standards listed in 35 I.A.C. § 845.600(a)(1). Therefore, for these parameters, the groundwater quality standards listed in 35 I.A.C. § 845.600(a)(1) will be applied to the results from the proposed groundwater monitoring network. The exception being lead, where the background concentration is greater than the 35 I.A.C. § 845.600(a)(1) standard (0.015 milligrams per liter [mg/L] versus 0.0075 mg/L). In this instance, the GWPS will be the background concentration.

Under most circumstances, the GWPS will be compared to the lower confidence limit for the observed concentrations for each constituent in each compliance well. Exceptions are when there are high percentages (greater than 50 percent) of non-detects in compliance well data, for which

a future mean (for 50 to 70 percent non-detects) or median (for greater than 70 percent non-detects) will be compared to the GWPS. Consistent with the *Unified Guidance*, the same general statistical method of confidence interval testing against a fixed GWPS is recommended in compliance and corrective action programs. Confidence intervals provide a flexible and statistically accurate method to test how a parameter estimated from a single sample compares to a fixed numerical limit. Confidence intervals explicitly account for variation and uncertainty in the sample data used to construct them.

Evaluation of the applicable standards will occur in conjunction with the analysis of groundwater quality results. Background calculations and the resulting concentrations may be updated as appropriate, in accordance with the Statistical Analysis Plan included in **Appendix A.**

4. GROUNDWATER MONITORING PLAN

The groundwater monitoring plan will monitor and evaluate groundwater quality to demonstrate compliance with the groundwater quality standards included in 40 C.F.R. § 257.94(e), 40 C.F.R. § 257.95(h), and 35 I.A.C. § 845.600(a). The groundwater monitoring program will include sampling and analysis procedures that are consistent and that provide an accurate representation of groundwater quality at the background and compliance wells as required by 35 I.A.C. § 845.630. As discussed in **Section 2**, three monitoring programs specific to the GMF Pond exist: IEPA WPCP monitoring program, the 40 C.F.R. § 257 monitoring program, and the proposed Part 845 monitoring program. These programs will continue to be monitored as specified in IEPA approvals or 40 C.F.R. § 257. Upon approval of the Operating Permit applications (and by extension the GMP) for the GMF Pond, the monitoring program required by IEPA WPCP will be discontinued following approval of a future permit modification submittal and will be replaced by the proposed Part 845 monitoring program. It is expected that upon USEPA approval of Part 845, the 40 C.F.R. § 257 monitoring program and reporting will be eliminated, and the proposed Part 845 monitoring and reporting included in this Plan will continue until requirements of Part 845 have been achieved.

4.1 Monitoring Networks and Parameters

4.1.1 IEPA Groundwater Monitoring

The existing IEPA monitoring program was discussed in detail in **Section 2.1.1**. Monitoring wells are sampled on a quarterly and yearly frequency for the parameters required under IEPA WPCP 2017-EO-62640. Well locations and parameters will continue to be monitored as required by the WPCP until IEPA approves the Operating Permit (and by extension the GMP) for the GMF Pond.

4.1.2 40 C.F.R. § 257 Groundwater Monitoring

The existing 40 C.F.R. § 257 monitoring program was discussed in detail in **Section 2.1.2**. Seven wells (three background and four compliance) are sampled for Appendix III parameters on a semi-annual frequency. No changes are proposed to this monitoring network. Well locations and parameters will continue to be monitored and reported as required by 40 C.F.R. § 257 until USEPA approves Part 845.

4.1.3 Part 845 Groundwater Monitoring

The proposed Part 845 monitoring network will consist of three background monitoring wells (G02S, G50S, and G51S), seven compliance monitoring wells (G54L, G54S, G57S, G60L, G60S, G64L, and G64S), and one temporary water level only monitoring point (X301) to monitor potential impacts from the GMF Pond (**Figure 2-2**). The monitoring wells are screened within the uppermost aquifer (G02S, G50S, G51S, G54S, G57S, G60S, and G64S) and PMP (G54L, G60L, and G64L) along the perimeter of the GMF Pond. Groundwater samples will be collected and analyzed for the laboratory and field parameters in **Table E** below.

Table E. Part 845 Groundwater Monitoring Program Parameters

Field Parameters[1]			
Groundwater Elevation	pH	Turbidity	
Metals (Total)			
Antimony	Boron	Cobalt	Molybdenum
Arsenic	Cadmium	Lead	Selenium
Barium	Calcium	Lithium	Thallium
Beryllium	Chromium	Mercury	
Inorganics (Total)			
Fluoride	Sulfate	Chloride	TDS
Other (Total)			
Radium 226 and 228 combined			

[1] Dissolved oxygen, temperature, specific conductance, and oxidation/reduction potential will be recorded during sample collection.

All parameters listed above were sampled a minimum of eight times by October 18, 2021 to establish background groundwater quality in accordance with 35 I.A.C. § 845.650 (b)(1)(A). Discussion of background groundwater quality is included in **Section 3.2**.

4.2 Sampling Schedule

Groundwater sampling for the Part 845 monitoring well network will initially be performed quarterly according to the following schedule:

Table F. Part 845 Sampling Schedule

Frequency	**Duration**
Monthly (groundwater elevations only)	Begins: the quarter following approval of this plan and issuance of the Operating Permit.
	Ends: Following the 30-year post closure care period and following IEPA approval of documentation that groundwater concentrations are below standards in 35 I.A.C. § 845.600 and concentrations exceeding background are not increasing and meet requirements in 35 I.A.C. § 845.780 (c)(2)(B)(i) and (ii).
Quarterly (groundwater quality)	Begins: the quarter following approval of this plan and issuance of the Operating Permit.
	Ends: Following the 30-year post closure care period and following IEPA approval of documentation that groundwater concentrations are below standards in 35 I.A.C. § 845.600 and concentrations exceeding background are not increasing and meet requirements in 35 I.A.C. § 845.780 (c)(2)(B)(i) and (ii), or upon IEPA approval of an alternate schedule as allowed by 35 I.A.C. § 845.650(b)(4).
Semi-annual (groundwater quality)	Begins: Following 5 years of quarterly groundwater monitoring and IEPA approval of a demonstration that groundwater concentrations are below standards in 35 I.A.C. § 845.600 and not exhibiting statistically-significant increasing trends, monitoring effectiveness is not compromised by a semi-annual schedule, and sufficient data has been collected to characterize groundwater.
	Ends: Following detection of a statistically-significant increasing trend in groundwater concentrations or an exceedance of the standards in 35 I.A.C. § 845.600 (quarterly

	monitoring shall be resumed in these circumstances), or following the 30-year post closure care period and following IEPA approval of documentation that groundwater concentrations are below standards in 35 I.A.C. § 845.600 and concentrations exceeding background are not increasing and meet requirements in 35 I.A.C. § 845.780 (c)(2)(B)(i) and (ii).

4.3 Groundwater Sample Collection

Groundwater sampling procedures have been developed and the collection of groundwater samples is being implemented to meet the requirements of 35 I.A.C. § 845.640. In addition to groundwater well samples, quality assurance samples will be collected as described in **Section 4.5** (**Table 4-1**).

4.4 Laboratory Analysis

Laboratory analysis will be performed consistent with the requirements of 35 I.A.C. § 845.640(j) by a state-certified laboratory using methods approved by IEPA and USEPA. Laboratory methods may be modified based on laboratory equipment availability or procedures, but the Reporting Limit (RL) for all parameters analyzed, regardless of method, will be lower than the applicable groundwater quality standard. RLs for the applicable parameters are summarized in **Table 4-2**. Concentrations lower than the RL will be reported as less than the RL.

4.5 Quality Assurance Program

Consistent with the requirements of 35 I.A.C. § 845.640(a)(5), the sampling and analysis program includes procedures and techniques for quality assurance/quality control (QA/QC). Additional quality assurance samples to be collected will include the following:

- Field duplicates will be collected at a frequency of one per group of ten or fewer investigative water samples.
- One equipment blank sample will be collected and analyzed for each day of sampling. If dedicated sampling equipment is used, then equipment blank samples will not be collected.
- The duplicate and equipment blank quality assurance samples will be supplemented by the laboratory QA/QC program, which typically includes:
  - Regular generation of instrument calibration curves to assure instrument reliability
  - Laboratory control samples and/or quality control check standards that have been spiked, and analyses to monitor the performance of the analytical method
  - Matrix spike/matrix spike duplicate analyses to determine percent recoveries and relative percent differences for each of the parameters detected
  - Analysis of replicate samples to check the precision of the instrumentation and/or methodology employed for all analytical methods
  - Analysis of method blanks to assure that the system is free of contamination

Water quality meters used to measure pH and turbidity will be calibrated according to manufacturer's specifications. At a minimum, it is recommended that calibration of pH occur daily prior to sampling and checked for accuracy at the end of each day. Unusual or suspect pH measurements during sampling events will be flagged, evaluated, and additional calibration may

be performed throughout the sampling events. Turbidity meters will be checked daily, prior to and following sampling. Unusual measurements or erratic meter performance will be flagged and evaluated for overall effects on the data prior to reporting.

4.6 Groundwater Monitoring System Maintenance Plan

Consistent with the requirements of 35 I.A.C. § 845.630(e)(2), maintenance will be performed as needed to assure that the monitoring wells provide representative groundwater samples. Monitoring wells will be inspected during each groundwater sampling event; inspections will consist of the following:

- Visual inspection, clearing of vegetation, replacement of markers, and painting of protective casings as needed to assure that monitoring wells are clearly marked and accessible
- Visual inspection and repair or replacement of well aprons as needed to assure that they are intact, drain water away from the well, and have not heaved
- Visual inspection and repair or replacement of protective casings as needed to assure that they are undamaged, and that locks are present and functional
- Checks to assure that well caps are intact and vented, unless in flood-prone areas in which case caps will not be vented
- Annual measurement of monitoring well depths to determine the degree of siltation within the wells. Wells will be redeveloped as needed to remove siltation from the screened interval if it impedes flow of water into the well
- Checks to assure that wells are clear of internal obstructions, and flow freely

If maintenance of a monitoring well cannot address an identified deficiency, a replacement well will be installed.

4.7 Statistical Analysis

Statistical analysis will be consistent with procedures listed in 35 I.A.C. § 845.640(f). A Statistical Analysis Plan, provided in **Appendix A**, has been developed to summarize the statistical procedures that will be used to evaluate the groundwater results.

4.8 Data Reporting

Data reporting for the 40 C.F.R. § 257 monitoring program will be consistent with recordkeeping, notification, and internet posting requirements described in 40 C.F.R. § 257.105 through 257.107.

Groundwater monitoring and analysis completed in accordance with the Part 845 monitoring under an approved monitoring program will be reported to IEPA within 60 days after completion of sampling and the data placed in the facility's operating record as required by 35 I.A.C. § 845.610(b)(3)(D). Within 14 days of posting to the operating record, information will be posted to the publicly accessible internet site "Illinois CCR Rule Compliance Data and Information" as required by 35 I.A.C. § 845.810(d). Information will also be submitted to IEPA annually by January 31 as required by 35 I.A.C. § 845.550, for data collected the preceding year. The report will include the status of the groundwater monitoring and any required corrective action plan for the GMF Pond in addition to other requirements detailed in 35 I.A.C. § 845.610(e).

4.9 Compliance with Applicable On-site Groundwater Protection Standards

In accordance with 35 I.A.C. § 845.600(a)(1), the groundwater protection standard at the waste boundary will be the higher of either the 35 I.A.C. § 845.600 standard or the concentration determined by background groundwater monitoring.

As provided in 35 I.A.C. § 845.780(c)(2), at the end of the 30-year post-closure care period, groundwater monitoring will continue to be conducted in post-closure care until the groundwater results show the concentrations are:

- Below the GWPS in 35 I.A.C. § 845.600; and
- Not increasing for those constituents over background, using the statistical procedures and performance standards in 35 I.A.C. § 845.640(f) and (g), provided that:
  - Concentrations have been reduced to the maximum extent feasible; and
  - Concentrations are protective of human health and the environment.

Following detection of an exceedance of the GWPS, an Alternate Source Demonstration (ASD) will be evaluated as described in **Section 4.10**.

4.10 Alternate Source Demonstrations

As allowed in 35 I.A.C. § 845.650(e), following detection of an exceedance of the GWPS, an ASD will be evaluated and, if completed, submitted to IEPA within 60 days. The ASD will provide lines of evidence that a source other than the GMF Pond caused the contamination and the GMF Pond did not contribute to the contamination, or that the exceedance of the GWPS resulted from error in sampling, analysis, statistical evaluation, natural variation in groundwater quality, or a change in the potentiometric surface and groundwater flow direction.

The ASD will include information and analysis that supports the conclusions and a certification of accuracy by a qualified professional engineer. Once the ASD is approved by IEPA, the Part 845 groundwater monitoring will continue as defined in **Section 4.1.3**.

If an ASD is not completed and submitted, or IEPA does not approve the ASD, a notification of the exceedance will be provided to IEPA and placed in the operating record. Additional actions will also be completed as required by 35 I.A.C § 845.650(d)(1) through (3), including initiation of an assessment of corrective measures under 35 I.A.C § 845.660. As allowed in 35 I.A.C § 845.650(e)(7) a petition for review of IEPA's non-concurrence under 35 I.A.C. § 105 may also be filed.

4.11 Assessment of Corrective Measures and Corrective Action

As described in 35 I.A.C. § 845.660, if the ASD summarized in **Section 4.10** has not been approved by IEPA, an assessment of corrective measures will be initiated within 90 days of the detection of a result exceeding 35 I.A.C. § 845.600 standards (*i.e.,* receipt of laboratory data). The assessment of corrective measures will include at least the following (35 I.A.C. § 845.660 (c)):

- The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to any residual contamination;
- The time required to begin and complete the corrective action plan; 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 corrective action plan.

Within one year of completing the assessment of corrective measures, a corrective action plan will be developed to identify the selected remedy in accordance with 35 I.A.C. § 845.670. If closure of the CCR Unit is required, a closure alternatives analysis will be completed as specified in 35 I.A.C. § 845.710. The analysis and selected alternative will be submitted to IEPA in a Closure Plan as specified by 35 I.A.C. § 845.720. Groundwater monitoring proposed in this Addendum will continue as specified until the post closure care period has expired and IEPA has approved termination of post-closure care.

5. REFERENCES

Illinois Environmental Protection Agency, 2021. *Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments: Title 35 of the Illinois Administrative Code § 845.* April 15, 2021.

Natural Resource Technology, an OBG Company (NRT/OBG), 2017a. *Hydrogeologic Monitoring Plan, Duck Creek GMF Pond – CCR Unit ID 203 and Duck Creek Landfill – CCR Unit ID 204.* October 17, 2017.

Natural Resource Technology, an OBG Company. (NRT/OBG), 2017b. *Sampling and Analysis Plan, Final, Duck Creek GMF Pond, Duck Creek Power Station, Canton, Illinois, Project No. 2285, Revision 0.* October 17, 2017.

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2021. *Hydrogeologic Site Characterization Report. Gypsum Management Facility Pond. Duck Creek Power Plant*. Canton, Illinois.

United States Environmental Protection Agency (USEPA), March 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance*. Office of Resource Conservation and Recovery, Program Implementation and Information Division, United States Environmental Protection Agency, Washington D.C. EPA/530/R-09/007.

TABLES

TABLE 1-1. PART 845 REQUIREMENTS CHECKLIST

GROUNDWATER MONITORING PLAN

DUCK CREEK POWER PLANT

GMF POND

CANTON, ILLINOIS

Part 845 Reference	Part 845 Components	Location of Information in GMP
845.630	**Groundwater Monitoring Systems**	
845.630(a)(2)	Potential contaminant pathways must be monitored.	Sections 2.2 & 4.1.3 Table 2-1
845.630(a) 845.630(b) 845.630(c)	At least two upgradient wells and four downgradient wells (min. 1 and 3, but requires additional documentation)	Sections 2.2 & 4.1.3 Table 2-1 Figure 2-2
845.630(a) 845.630(b) 845.630(c)	Downgradient Well Density	Figure 2-2
845.630(a)(2)	Downgradient wells at waste boundary	Figure 2-2
845.640	**Groundwater Sampling and Analysis Requirements**	
845.640(a)	Consistent sampling and analysis procedures	Section 4 Tables 4-1 & 4-2
845.640(b)	Methods are appropriate	Section 4 Tables 4-1 & 4-2
845.640(c)	Groundwater elevations must be measured in each well prior to purging, each time groundwater is sampled.	Section 4.3
845.640 (d)(e)(f)(g)(h)	Establishment of background and application of statistical methods	Sections 3 & 4.7 Appendix A
845.640(i)	Analyze total recoverable metals	Section 4.1.3
845.640(j)	Analyze groundwater samples using a certified laboratory	Section 4.4

TABLE 1-1. PART 845 REQUIREMENTS CHECKLIST

GROUNDWATER MONITORING PLAN

DUCK CREEK POWER PLANT

GMF POND

CANTON, ILLINOIS

Part 845 Reference	Part 845 Components	Location of Information in GMP
845.650	**Groundwater Monitoring Program**	
845.650(a)	Must include monitoring for all constituents with a groundwater protection standard in Section 845.600(a), calcium, and turbidity	Section 4.1.3
845.650(b)(c)	Groundwater Monitoring Frequency	Sections 4.1.3 & 4.2
845.650(d)(e)	Exceedances of the groundwater protection standard	Sections 4.9, 4.10, & 4.11
845.650(b)(2) and (3)	Staff gauge/ piezometer to monitor head in impoundment	Sections 2.2 & 4.1.3 Figure 2-1 (X301)
NA	Staff gauge/ piezometer to monitor head of neighboring surface water body	NA

[O: CJC 09/17/21; C: LDC 09/20/21]

Notes:

GMP = Groundwater Monitoring Plan

NA = Not Applicable

TABLE 2-1. MONITORING WELL LOCATIONS AND CONSTRUCTION DETAILS
GROUNDWATER MONITORING PLAN
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Well Number	Type	HSU	Date Constructed	Top of PVC Elevation (ft)	Measuring Point Elevation (ft)	Measuring Point Description	Ground Elevation (ft)	Screen Top Depth (ft BGS)	Screen Bottom Depth (ft BGS)	Screen Top Elevation (ft)	Screen Bottom Elevation (ft)	Well Depth (ft BGS)	Bottom of Boring Elevation (ft)	Screen Length (ft)	Screen Diameter (inches)	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
G02S	B	UA	09/29/2003	--	621.66	Top of Disk	619.18	23.00	28.00	596.18	591.18	28.00	589.20	5	2	40.512879	-89.991105
G50S	B	UA	03/13/2007	623.65	623.65	Top of Riser	620.83	29.17	33.98	591.66	586.85	34.30	586.50	4.8	2	40.508672	-89.990607
G51S	B	UA	01/28/2008	619.66	619.66	Top of Riser	616.83	24.01	28.79	592.82	588.04	29.16	587.70	4.8	2	40.50656	-89.990864
G54L	C	UA/PMP	02/12/2009	622.95	622.95	Top of Riser	620.18	27.32	36.75	592.86	583.43	37.22	583.00	9.4	2	40.504524	-89.988927
G54S	C	UA	02/12/2009	622.98	622.98	Top of Riser	620.25	43.50	47.97	576.75	572.28	48.41	571.80	4.5	2	40.504525	-89.98894
G57S	C	UA	01/30/2009	622.76	622.76	Top of Riser	620.20	29.65	34.18	590.55	586.02	34.62	582.20	4.5	2	40.505608	-89.987043
G60L	C	UA/PMP	01/17/2008	615.39	615.39	Top of Riser	612.69	20.12	24.91	592.57	587.78	25.28	587.40	4.8	2	40.506745	-89.986816
G60S	C	UA	01/16/2008	615.03	615.03	Top of Riser	612.33	31.12	35.91	581.21	576.42	36.29	574.30	4.8	2	40.506732	-89.986815
G64L	C	UA/PMP	01/22/2009	622.46	622.46	Top of Riser	620.24	18.12	27.48	602.12	592.76	27.95	592.30	9.4	2	40.508378	-89.987007
G64S	C	UA	01/22/2009	623.06	623.06	Top of Riser	620.25	34.50	38.99	585.75	581.26	39.48	580.30	4.5	2	40.508365	-89.987011
X301	WLO	S	--	--	--	--	--	--	--	--	--	--	--	--	--	40.504777	-89.990046

Notes:
All elevation data are presented relative to the North American Vertical Datum 1988 (NAVD88), GEOID 12A
Type refers to the role of the well in the monitoring network: background (B), compliance (C), or water level measurements only (WLO)
WLO wells are temporary pending implementation of impoundment closure per an approved Construction Permit application
-- = data not available
BGS = below ground surface
ft = foot or feet
HSU = Hydrostratigraphic Unit
PVC = polyvinyl chloride
S = source water
UA = uppermost aquifer
UA/PMP = uppermost aquifer/potential migration pathway

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RAMBOLL

TABLE 3-1. BACKGROUND GROUNDWATER QUALITY AND STANDARDS
GROUNDWATER MONITORING PLAN
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Parameter	Background Concentration	845 Limit	Groundwater Protection Standard	Unit
Antimony, total	0.003	0.006	0.006	mg/L
Arsenic, total	0.0092	0.010	0.010	mg/L
Barium, total	0.28	2.0	2.0	mg/L
Beryllium, total	0.001	0.004	0.004	mg/L
Boron, total	0.21	2	2	mg/L
Cadmium, total	0.001	0.005	0.005	mg/L
Chloride, total	17	200	200	mg/L
Chromium, total	0.0059	0.1	0.1	mg/L
Cobalt, total	0.002	0.006	0.006	mg/L
Fluoride, total	0.498	4.0	4.0	mg/L
Lead, total	0.015	0.0075	0.015	mg/L
Lithium, total	0.02	0.04	0.04	mg/L
Mercury, total	0.00098	0.002	0.002	mg/L
Molybdenum, total	0.0023	0.1	0.1	mg/L
pH (field)	7.4 / 6.6	9.0 / 6.5	9.0 / 6.5	SU
Radium 226 and 228 combined	2	5	5	pCi/L
Selenium, total	0.0012	0.05	0.05	mg/L
Sulfate, total	55	400	400	mg/L
Thallium, total	0.001	0.002	0.002	mg/L
Total Dissolved Solids	483	1200	1200	mg/L

Notes:
For pH, the values presented are the upper / lower limits
Groundwater protection standards for calcium and turbidity do not apply per 35 I.A.C. § 845.600(b)
mg/L = milligrams per liter
SU = standard units
pCi/L = picocuries per liter

generated 10/07/2021, 6:48:34 AM CDT

TABLE 4-1. SAMPLING AND ANALYSIS SUMMARY
GROUNDWATER MONITORING PLAN
DUCK CREEK POWER PLANT
GMF POND
CANTON, ILLINOIS

Parameter	Analytical Method [1]	Number of Samples	Field Duplicates [2]	Field Blanks [3]	Equipment Blanks [3]	MS/MSD [4]	Total	Container Type	Minimum Volume [5]	Preservation (Cool to 4 °C for all samples)	Sample Hold Time from Collection Date
Metals											
Metals [6]	6020, Li - EPA 200.7	10	1	0	0	1	12	plastic	600 mL	HNO_3 to pH<2	6 months
Mercury	7470A or 6020	10	1	0	0	1	12	plastic	400 mL	HNO_3 to pH<2	28 days
Inorganic Parameters											
Fluoride	9214 or EPA 300	10	1	0	0	1	12	plastic	300 mL	Cool to 4 °C	28 days
Chloride	9251 or EPA 300	10	1	0	0	1	12	plastic	100 mL	Cool to 4 °C	28 days
Sulfate	9036 or EPA 300	10	1	0	0	1	12	plastic	50 mL	Cool to 4 °C	28 days
Total Dissolved Solids	SM 2540 C	10	1	0	0	1	12	plastic	200 mL	Cool to 4 °C	7 days
Radium											
Radium 226	9315 or EPA 903	10	0	0	0	0	10	plastic	1000 mL	HNO_3 to pH<2	6 months
Radium 228	9320 or EPA 904	10	0	0	0	0	10	plastic	1000 mL	HNO_3 to pH<2	6 months
Field Parameters											
pH	SM 4500-H+ B	10	NA	NA	NA	NA	10	flow-through cell	NA	none	immediately
Dissolved Oxygen [8]	SM 4500-O/405.1	10	NA	NA	NA	NA	10	flow-through cell	NA	none	immediately
Temperature [8]	SM 2550	10	NA	NA	NA	NA	10	flow-through cell	NA	none	immediately
Oxidation/Reduction Potential [8]	SM 2580 B	10	NA	NA	NA	NA	10	flow-through cell	NA	none	immediately
Specific Conductance [8]	SM 2510 B	10	NA	NA	NA	NA	10	flow-through cell	NA	none	immediately
Turbidity [7]	SM 2130 B	10	NA	NA	NA	NA	10	flow-through cell or hand-held turbidity meter	NA	none	immediately

[O: CJC 09/17/21; C: LDC 09/20/21]

Notes:
[1] Analytical method numbers are from SW-846 unless otherwise indicated. Analytical methods may be updated with more recent versions as appropriate.
[2] Field duplicates will be collected at a frequency of one per group of 10 or fewer investigative water samples. Field duplicates will not be collected for radium analysis.
[3] Field blanks will be collected at the discretion of the project manager; Equipment blanks will be collected at a rate of 1 per sampling event if non-dedicated equipment is used.
[4] Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples will be collected at a frequency of one per group of 20 or fewer investigative water samples per CCR unit/multi-unit. Additional volume to be determined by laboratory.
[5] Sample volume is estimated and will be determined by the laboratory.
[6] Metals = antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, lead, lithium, molybdenum, selenium, thallium. Metals may be analyzed via ICP/ ICP-MS USEPA methods 6010 or 6020 depending on laboratory instrument availability
[7] If turbidity exceeds 10 NTUs, a duplicate sample filtered through a .45 micron filter may be collected for metals analysis in addition to the unfiltered sample. Both samples would be submitted for analysis.
[8] Parameter collected for quality assurance and quality control for field sampling purposes only; not required to be collected or reported under Part 845; collection of parameter may be discontinued without notification.
< = less than
°C = degrees Celsius
GMF = Gypsum Management Facility
HNO_3 = nitric acid
mL = milliliter
NA = not applicable
NTU = nephelometric turbidity unit

TABLE 4-2. DETECTION AND REPORTING LIMITS FOR PART 845 PARAMETERS

GROUNDWATER MONITORING PLAN

DUCK CREEK POWER PLANT

GMF POND

CANTON, ILLINOIS

Constituent	CAS	Unit	Analytical Methods [1]	USEPA MCL [2]	35 I.A.C. § 845.600	RL [4, 5]	MDL [5]
Metals							
Antimony	7440-36-0	mg/L	6020	0.006	0.006	0.003	0.00036
Arsenic	7440-38-2	mg/L	6020	0.01	0.01	0.001	0.00013
Barium	7440-39-3	mg/L	6020	2	2	0.001	0.00028
Beryllium	7440-41-7	mg/L	6020	0.004	0.004	0.001	0.000017
Boron	7440-42-8	mg/L	6020	NS	2	0.01	0.0023
Cadmium	7440-43-9	mg/L	6020	0.005	0.005	0.001	0.000042
Calcium	7440-70-2	mg/L	6020	NS	NS	0.15	0.15
Chromium	7440-47-3	mg/L	6020	0.1	0.1	0.004	0.00027
Cobalt	7440-48-4	mg/L	6020	0.006	0.006	0.002	0.000017
Lead	7439-92-1	mg/L	6020	0.015	0.0075	0.001	0.000025
Lithium	7439-93-2	mg/L	6020 or EPA 200.7	0.04	0.04	0.02	0.0001
Mercury	7439-97-6	mg/L	6020 or 7470A	0.002	0.002	0.0002	0.000078
Molybdenum	7439-98-7	mg/L	6020	0.1	0.1	0.001	0.000063
Selenium	7782-49-2	mg/L	6020	0.05	0.05	0.001	0.00032
Thallium	7440-28-0	mg/L	6020	0.002	0.002	0.001	0.000062
Inorganics							
Fluoride	7681	mg/L	9214 or EPA 300	4	4	0.25	0.065
Chloride	16887-00-6	mg/L	9251 or EPA 300	250 [3]	200	1	0.15
Sulfate	18785-72-3	mg/L	9036 or EPA 300	250 [3]	400	1	0.24
Total Dissolved Solids	10052	mg/L	SM 2540C	500 [3]	1200	17	--
Other							
Radium 226 and 228 combined	7440-14-4	pCi/L	9315/9320 or EPA 903/904	5	5	-- [6]	-- [7]

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TABLE 4-2. DETECTION AND REPORTING LIMITS FOR PART 845 PARAMETERS

GROUNDWATER MONITORING PLAN

DUCK CREEK POWER PLANT

GMF POND

CANTON, ILLINOIS

Constituent	CAS	Unit	Analytical Methods [1]	USEPA MCL [2]	35 I.A.C. § 845.600	RL [4, 5]	MDL [5]
Field							
pH	NA	SU	SM 4500-H+ B	NS	6.5-9.0	NA	NA
Oxidation/Reduction Potential	NA	mV	SM 2580 B	NS	NS	NA	NA
Dissolved Oxygen	NA	mg/L	SM 4500-O/405.1	NS	NS	NA	NA
Temperature	NA	°C	SM 2550	NS	NS	NA	NA
Specific Conductivity	NA	µS/cm	SM 2510 B	NS	NS	NA	NA
Turbidity	NA	NTU	SM 2130 B	NS	NS	NA	NA

[O: CJC 09/17/21; C: LDC 09/20/21]

Notes:

[1] Analytical method numbers are from SW-846 unless otherwise indicated. Metals will be analyzed via Method 6020 or 6010 depending on laboratory equipment availability. Selected method will ensure reporting limits (RL) are below Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845.600 groundwater protection standards.

[2] USEPA MCL = United States Environmental Protection Agency Maximum Contaminant Level.

[3] USEPA SMCL = United States Environmental Protection Agency Secondary Maximum Contaminant Level.

[4] RLs will be less than the 35 I.A.C. § 845.600 groundwater protection standards.

[5] RLs and method detection limits (MDL) will vary depending on the laboratory performing the work.

[6] All radium results will be reported (values may be positive or negative) and will include uncertainty and the calculated MDC.

[7] Laboratories calculate a minimum detectable concentration (MDC) based on the sample.

°C = degrees Celsius

µS/cm = microSiemens per centimeter

CAS = Chemical Abstract Number

MDL = Method detection limit as established by the laboratory

mg/L = milligrams per liter

mV = millivolts

NS = No standard

NTU = nephelometric turbidity unit

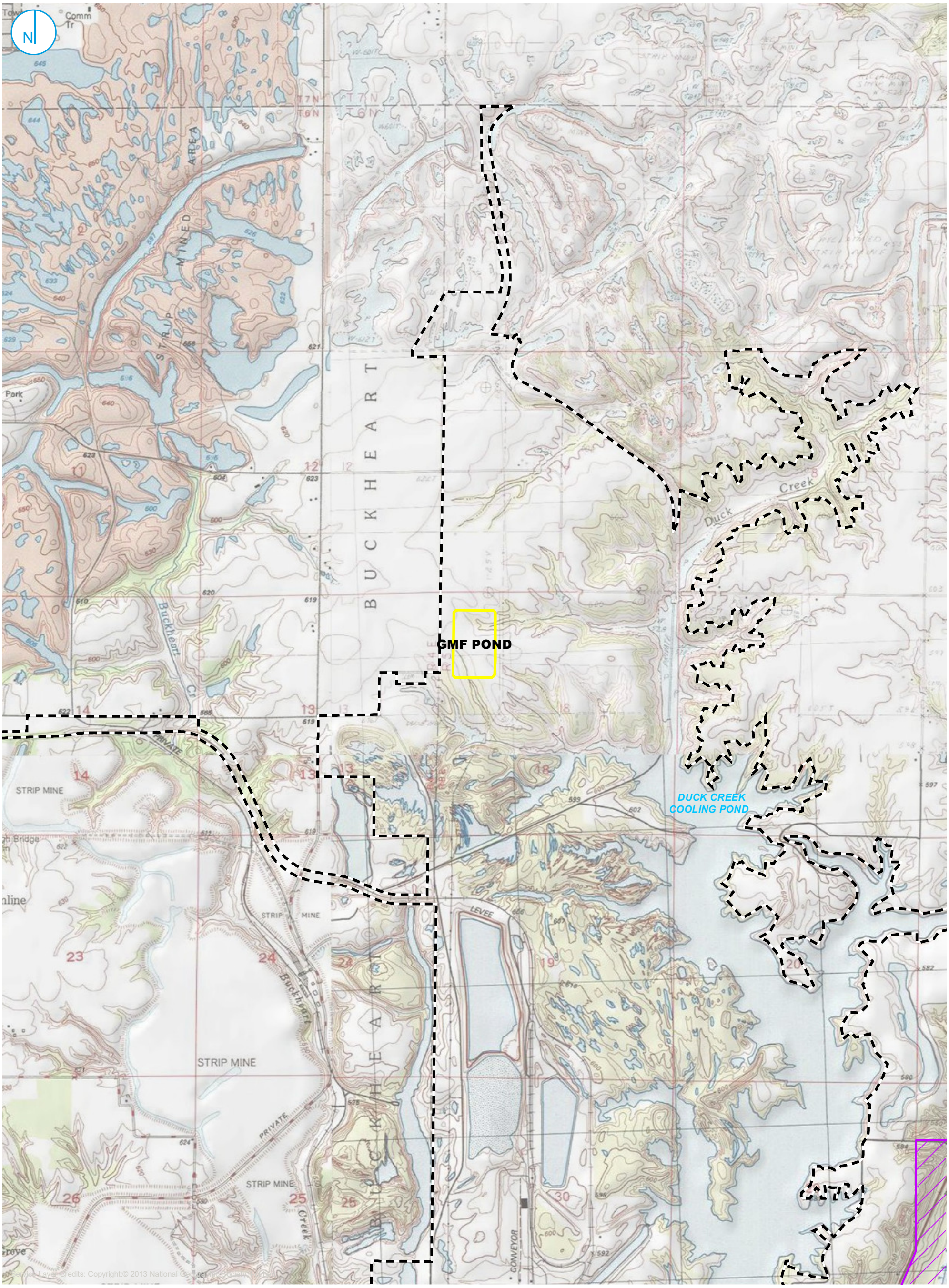
pCi/L = picoCuries per liter

RL = Reporting limit as established by the laboratory

SM = Standard Methods for the Examination of Water and Wastewater

SU = standard units

FIGURES



PART 845 REGULATED UNIT (SUBJECT UNIT)
PROPERTY BOUNDARY
RICE LAKE STATE RECREATION AREA

0 1,000 2,000 Feet

SITE LOCATION MAP

FIGURE 1-1

GROUNDWATER MONITORING PLAN
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

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ENGINEERING SOLUTIONS, INC.

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PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY

0 150 300 Feet

SITE MAP

FIGURE 1-2

GROUNDWATER MONITORING PLAN
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

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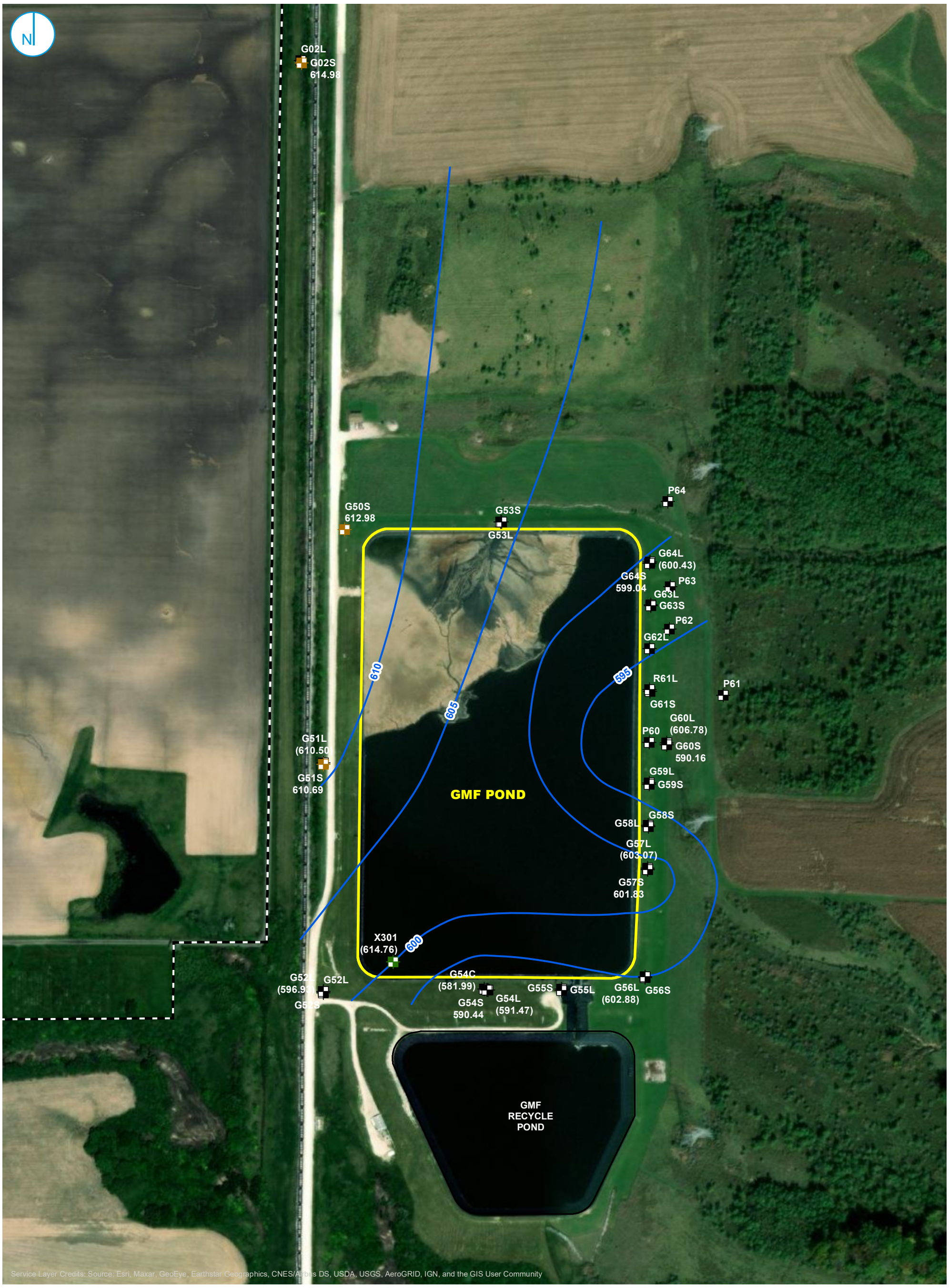

BACKGROUND WELL
MONITORING WELL
SOURCE SAMPLE LOCATION
GROUNDWATER ELEVATION CONTOUR (5-FT CONTOUR INTERVAL, NAVD88)
PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY

0 150 300 Feet

UPPERMOST AQUIFER GROUNDWATER ELEVATION CONTOURS APRIL 14, 2021

GROUNDWATER MONITORING PLAN
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

FIGURE 1-3

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MONITORING WELL
PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY

0 150 300 Feet

IEPA MONITORING PROGRAM WELL NETWORK

FIGURE 2-1

GROUNDWATER MONITORING PLAN
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

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BACKGROUND WELL
COMPLIANCE WELL
SOURCE SAMPLE LOCATION
PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY

0 150 300 Feet

PROPOSED PART 845 GROUNDWATER MONITORING WELL NETWORK

GROUNDWATER MONITORING PLAN
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

FIGURE 2-2

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APPENDIX A
STATISTICAL ANALYSIS PLAN

Prepared for
Illinois Power Resources Generating, LLC

Date
October 25, 2021

Project No.
1940100806-003

STATISTICAL ANALYSIS PLAN

GYPSUM MANAGEMENT FACILITY POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL Bright ideas. Sustainable change.

STATISTICAL ANALYSIS PLAN
DUCK CREEK POWER PLANT GYPSUM MANAGEMENT FACILITY POND

Project Name	**Duck Creek Power Plant Gypsum Management Facility Pond**
Project No.	**1940100806-003**
Recipient	**Illinois Power Resources Generating, LLC**
Document Type	**Statistical Analysis Plan**
Version	**FINAL**
Date	**October 25, 2021**

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Senior Managing Hydrogeologist

Eric J. Tlachac, PE
Senior Managing Engineer

Rachel A. Banoff, EIT
Project Statistician

LICENSED PROFESSIONAL CERTIFICATIONS

This certification is based on the description of the statistical methods selected to evaluate groundwater as presented in the following Statistical Analysis Plan; Duck Creek Power Plant Gypsum Management Facility Pond. The procedures described in the plan will be used to establish background conditions and implement compliance monitoring as necessary and required by 35 I.A.C. § 845.640 and 35 I.A.C. § 845.650. The Statistical Analysis Plan was prepared in accordance with the requirements of 35 I.A.C. § 845.640(f), with reference to the acceptable statistical procedures provided in the United States Environmental Protection Agency (USEPA)'s *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (*Unified Guidance,* March 2009), and is intended to provide a logical process and framework for conducting the statistical analysis of the data obtained during groundwater monitoring. In accordance with 35 I.A.C. § 845.640(f)(1), the statistical method chosen for analysis of background groundwater quality will be either the tolerance interval or the prediction interval procedure for each constituent listed in 35 I.A.C. § 845.600(a)(1) at this CCR unit per 35 I.A.C. § 845.640(f)(1)(C). Groundwater Protection Standards (GWPS) will be established in accordance with 35 I.A.C. § 845.600(a) (greater of the background concentration or numerical limit specified in 35 I.A.C. § 845.600(a)(1)). The GWPS will be compared to the lower confidence limit for the observed concentrations for each constituent in each compliance well. Consistent with the *Unified Guidance*, the same general statistical method of confidence interval testing against a fixed GWPS is recommended in compliance and corrective action programs. Confidence intervals provide a flexible and statistically accurate method to test how a parameter estimated from a single sample compares to a fixed numerical limit. Confidence intervals explicitly account for variation and uncertainty in the sample data used to construct them.

Description of the statistical methods chosen for analysis of groundwater monitoring data and application of these methods for determining exceedances of the GWPS identified in 35 I.A.C. § 845.600(a) is provided in this Statistical Analysis Plan.

35 I.A.C. § 845.640 Statistical Analysis (PE)

I, Eric J. Tlachac, a qualified professional engineer in good standing in the State of Illinois, certify that the statistical methods summarized above and described in this document (Statistical Analysis Plan; Duck Creek Power Plant Gypsum Management Facility Pond) are appropriate for evaluating the groundwater monitoring data collected as described in the attached document and are in substantial compliance with 35 I.A.C. § 845.640.

Eric J. Tlachac
Qualified Professional Engineer
062-063091
Illinois
Date: October 25, 2021

35 I.A.C. § 845.640 Statistical Analysis (PG)

I, Brian G. Hennings, a qualified professional geologist in good standing in the State of Illinois, certify that the statistical methods described in this document (Statistical Analysis Plan; Duck Creek Power Plant Gypsum Management Facility Pond) are appropriate for evaluating the groundwater monitoring data collected as described in the attached document and are in substantial compliance with 35 I.A.C. § 845.640.

Brian G. Hennings
Professional Geologist
196.001482
Illinois
Date: October 25, 2021

35 I.A.C. § 845.640 Statistical Analysis

I, Rachel A. Banoff, a qualified professional, certify that the statistical methods described in this document (Statistical Analysis Plan; Duck Creek Power Plant Gypsum Management Facility Pond), are appropriate for evaluating the groundwater monitoring data collected as described in the attached document and are in substantial compliance with 35 I.A.C. § 845.640.

Rachel A. Banoff, EIT
Project Statistician
Date: October 25, 2021

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Table A Statistical Calculations Used in Compliance Monitoring Procedures

ACRONYMS AND ABBREVIATIONS

§	Section
35 I.A.C.	Title 35 of the Illinois Administrative Code
ANOVA	analysis of variance
CCR	coal combustion residuals
COC	constituents of concern
GWPS	groundwater protection standard
IEPA	Illinois Environmental Protection Agency
LCL	lower confidence limit
LTL	lower tolerance limit
MSE	mean squared error
P	probability
Part 845	Residuals in Surface Impoundments: Title 35 of the Illinois Administrative Code § 845
RCRA	Resource Conservation and Recovery Act
RL	reporting limit
ROS	regression on order statistics
SI	surface impoundment
SSI	statistically significant increase
SWFPR	site-wide false positive rate
Unified Guidance	*Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (USEPA, 2009)
UPL	upper prediction limit
USEPA	United States Environmental Protection Agency
UTL	upper tolerance limit

1. INTRODUCTION

In April 2021, the Illinois Environmental Protection Agency (IEPA) issued a final rule for the regulation and management of Coal Combustion Residuals (CCR) in surface impoundments (SIs) under the Standards for the Disposal of CCR in Surface Impoundments: Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845 (Part 845). Facilities regulated under Part 845 are required to develop and sample a groundwater monitoring well network to evaluate whether impounded CCR materials are impacting downgradient groundwater quality. The groundwater quality evaluation must include selection and certification by a qualified professional engineer of the statistical procedures to be used. The procedures described in the evaluation will be used to establish background conditions and implement compliance and corrective action monitoring as necessary and required by 35 I.A.C. § 845.640 and 35 I.A.C. § 845.650. This Statistical Analysis Plan was prepared in accordance with the requirements of 35 I.A.C. § 845.640(f), with reference to the acceptable statistical procedures provided in United States Environmental Protection Agency's (USEPA's) *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (*Unified Guidance*) (March 2009).

This Statistical Analysis Plan does not include procedures for groundwater sample collection and analysis, as these activities are conducted in accordance with the Sampling and Analysis Plan prepared for each CCR unit in accordance with 35 I.A.C. § 845.640. This Statistical Analysis Plan will be used as the primary reference for evaluating groundwater quality during operation and post-closure care.

1.1 Statistical Analysis Objectives

This Statistical Analysis Plan is intended to provide a logical process and framework for conducting the statistical analyses of data obtained during groundwater monitoring conducted in accordance with the Sampling and Analysis Plan for each CCR unit. The Statistical Analysis Plan will enable a qualified professional engineer to certify that the selected statistical methods are appropriate for evaluating the groundwater monitoring data for the applicable CCR unit(s).

1.2 Statistical Analysis Plan Approach

The main sections of this Statistical Analysis Plan should be viewed as a "generic" outline of statistical methods utilized for each CCR unit and constituent required to be monitored. The statistical analysis of the groundwater monitoring data, however, will be conducted on an individual-constituent or well basis, and may involve the use of appropriate statistical procedures depending on multiple factors such as detection frequency and normality distributions.

The CCR Rule outlines two phases of groundwater monitoring:

- Background Monitoring in accordance with 35 I.A.C. § 845.650(b)(1)
- Compliance Monitoring in accordance with 35 I.A.C. § 845.650

Each phase of the groundwater monitoring program requires specific statistical procedures to accomplish the intended purpose. During the background monitoring phase, background groundwater quality will be established utilizing upgradient and background wells and downgradient groundwater quality data will be collected to facilitate statistics in subsequent phases. Compliance Monitoring is then initiated through the evaluation of the downgradient

groundwater monitoring data for exceedances of the groundwater protection standard (GWPS) established by Part 845 (concentration specified in 35 I.A.C. § 845.600 or an IEPA-approved background concentration). The developed statistical analysis plan will be implemented for each monitoring phase and in accordance with the statistical procedures.

2. BACKGROUND MONITORING AND DATA PREPARATION

The background and compliance monitoring wells were sampled and analyzed for constituents, as listed in Part 845 (antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chloride, chromium, cobalt, fluoride, lead, lithium, mercury, molybdenum, pH, radium 226 and 228 combined, selenium, sulfate, thallium, total dissolved solids, and turbidity), during the baseline phase of the groundwater monitoring program.

The background monitoring well(s) were placed upgradient of the CCR unit, or at an alternative background location, where they are not affected by potential leakage from the CCR unit. Compliance monitoring wells were placed at the waste boundary of the CCR unit, along the same groundwater flow path. As 35 I.A.C. § 845.630(a) specifies, the location of these wells ensures that background accurately represents the quality of unaffected groundwater, while compliance wells accurately represent groundwater quality at the waste boundary and monitor all potential contaminant pathways.

As required by 35 I.A.C. § 845.650(a)(1), eight sampling events were completed within 180 days of April 21, 2021. As outlined, groundwater sampling procedures included sampling of the background and compliance wells using low-flow sampling methods, collection of one field quality control sample per event, and groundwater samples were not field filtered before laboratory analysis of total recoverable metals.

Following completion of the eight sampling events, background groundwater quality was established for Part 845 constituents. Groundwater monitoring will be conducted quarterly for at least the first five years. In accordance with 35 I.A.C. § 845.650(b)(4), after the first five years, a request to reduce the monitoring frequency to semiannual may be submitted to IEPA if all of the following can be demonstrated:

- Groundwater monitoring effectiveness will not be compromised by the reduced frequency
- Sufficient data has been collected to characterize groundwater
- Monitoring to date does not show any statistically significant increasing trends
- The concentrations of monitored constituents at the compliance monitoring wells are below the applicable GWPSs established in 35 I.A.C. § 845.600

The following subsections outline the statistical tests and procedures (methods) that will be utilized to evaluate data collected for each constituent in both background and compliance wells for Background and Compliance Monitoring. When necessary and contingent upon equivalent statistical power, an alternative test not included in this Statistical Analysis Plan may be chosen due to site-specific data requirements.

2.1 Sample Independence

Independence of sample results is a major assumption for most statistical analyses. To ensure physical independence of groundwater sampling results, the minimum time between sampling events must be longer than the time required for groundwater to move through the monitoring well. The sampling schedules for both the baseline and compliance monitoring periods are specified in 35 I.A.C. § 845.650(b) and may conflict with the statistical assumption of independence of sample results.

2.2 Non-Detect Data Processing

The reporting limit (RL) will be used as the lower level for the reporting of non-detected groundwater quality data. For all summary statistics (box plots, timeseries, etc.), the RL will be substituted for concentrations reported below the RL, including non-detects. With professional judgement, analytical results between the RL and the method detection limit, *i.e.,* estimated values, typically identified with a "J" flag, may be utilized if provided by the laboratory.

For all statistical test procedures:

- If the frequency of non-detect data are less than or equal to 15 percent, half of the RL will be substituted for these data
- If the non-detect frequency is between 15 percent and 50 percent, either the Kaplan-Meier or robust regression on order statistics (ROS) will be used to estimate the mean and standard deviation adjusted for the presence of left-censored values
- If the non-detect frequency is greater than 50 percent, a non-parametric test will be used
- If only one background result is detected that value will be used as the non-parametric upper prediction limit (UPL)

2.3 Testing for Normality

Many statistical analyses assume that sample data are normally distributed (parametric). However, environmental data are frequently not normally distributed (nonparametric). 35 I.A.C. § 845.640(g) requires the knowledge of the background data distribution for comparison to compliance results. The *Unified Guidance* document recommends the Shapiro-Wilk normality test for sample sizes of 50 or less, and the Shapiro-Francia normality test for sample sizes greater than 50.

When possible, transformation of datasets to achieve normal distributions is preferred.

2.4 Testing for Outliers

Part 845 constituents will be screened for the existence of outliers using a method described by the *Unified Guidance*. Outliers are extreme data points that may represent an anomaly or erroneous data point. To test for outliers, one or more of the following outlier tests will be utilized:

- Dixon's test, for well-constituent pairs with less than 25 samples, assumes normally distributed data.
- Rosner's test, for well-constituent pairs with more than 20 samples, assumes normally distributed data.
- Grubb's test for well-constituent pairs with seven or more samples, assumes normally distributed data.
- Time series, box-whisker plots, and probability plots provide visual tools to identify potential outliers, and evaluation of seasonal, spatial, or temporal variability for both normally and non-normally distributed data.

Data quality control, groundwater geochemistry, and sampling procedures will be evaluated as potential sources of error leading to an outlier result. The outlier tests cannot be used alone to determine whether a value is a true outlier that should be excluded from future statistical

analysis. Corroborating evidence needed to exclude values includes a discrete data reporting or analytical error, or potential laboratory bias. Absent corroborating evidence, the flagged values are considered true, but extreme, values in the data set. Professional judgement will be used to exclude extreme outliers from further statistical analyses. Outliers will be retained in the database.

With professional judgement, a confirmatory sample may be collected to allow for the distinction between an outlier and a true representation of groundwater quality at the monitoring point. If re-sampling is conducted, this sample will be collected within 90 days following outlier identification. If the confirmatory sample indicates the original result as an outlier, it will be reported as such.

2.5 Trend Analysis

Statistical analyses supporting the lack of trend are a fundamental step to confirm the assumption that groundwater quality values are stationary or constant over time at a CCR unit. These analyses allow for evaluation of variation in the background and compliance data for each constituent over time. A statistically significant increasing trend in background data could indicate an existing release from the CCR unit or alternate source, requiring further investigation. In addition, statistically significant trending background data can result in increased standard deviation and, therefore, greater prediction or control limits. Consequently, the increased prediction or control limit will have less power or ability to identify a release from the CCR unit.

A linear regression, coupled with a t-test for slope significance at a 95 percent confidence level (0.05 significance level), may be used on datasets for each constituent with few non-detects and a normally distributed variance of the mean to evaluate time trends. The Theil-Sen trend line, coupled with the Mann-Kendall test for slope significance at a 95 percent confidence level (0.05 significance level), will be used for datasets with frequent non-detects or non-normal variance. Similarly, trend analyses could also be used on compliance data to evaluate a possible release from the CCR unit.

2.6 Spatial Variation

Spatial trends and/or variation between background wells could indicate an existing release from a CCR unit. If the spatial variability is not due to an existing release, intrawell comparisons in compliance wells may be used to account for spatial variability and monitor for a future release. However, the CCR unit being monitored was placed into service prior to the start of groundwater monitoring and it is unknown whether a previous release has occurred. Accordingly, intrawell comparisons in compliance wells cannot be used to determine the occurrence of a future release. Interwell comparisons between compliance wells and background wells will be used.

2.7 Temporal Variation

Time series plots can be used to identify temporal dependence. Potentially significant temporal components of variability can be identified by graphing single constituent data from multiple wells together on a time series plot. With temporal dependence, the time series plot as a pattern of parallel traces, in which the individual wells will tend to rise and fall together across the sequence of sampling dates. Time series plots can be helpful by plotting multiple constituents over time for the same well, or averaging values for each constituent across wells on each sampling event and then plotting the averages over time. In either case, the plots can signify whether the general concentration pattern over time is simultaneously observed for different

constituents. If so, it may indicate that a group of constituents is highly correlated in groundwater or that the same artifacts of sampling and/or lab analysis impacted the results of several monitoring parameters.

Hydrologic factors such as drought, recharge patterns or regular (*e.g.,* seasonal) water table fluctuations may be responsible for the temporal variation. In these cases, it may be useful to test for the presence of a significant temporal effect by first constructing a parallel time series plot and then running a formal one-way analysis of variance (ANOVA) ($\alpha = 0.05$) for temporal effects. A one-way ANOVA for temporal effects considers multiple well data sets for individual sampling events or seasons as the relevant statistical factor. If event-specific analytical differences or seasonality appear to be an important temporal factor, the one-way ANOVA for temporal effects can be used to formally identify seasonality, parallel trends, or changes in lab performance that affect other temporal effects. The one-way ANOVA for temporal effects assumes that the data groups are normally distributed with constant variance. It is also assumed that for each of a series of background wells, measurements are collected at each well on sampling events or dates common to all the wells. Results of the ANOVA can also be used to create temporally stationary residuals, where the temporal effect has been 'subtracted from' the original measurements. These stationary residuals may be used to replace the original data in subsequent statistical testing.

If the data cannot be normalized, a similar test for a temporal or seasonal effect can be performed using the Kruskal-Wallis test ($\alpha = 0.05$). Each sampling event should be treated as a separate 'well,' while each well is treated as a separate 'sampling event.' In this case, no residuals can be computed since the Kruskal-Wallis test employs ranks of the data rather than the measurements themselves.

Where both spatial and temporal variation occur, two-way ANOVA can be considered where both well location and sampling event/season are treated as statistical factors. This procedure is described in Davis (1994).

2.8 Updating Background

Updating the background dataset periodically by adding recent results to an existing background dataset can improve the statistical power and accuracy of the statistical analysis, especially for non-parametric prediction intervals. The *Unified Guidance* recommends updating statistical limits (background) when at least four to eight new measurements (every 1 to 2 years under a quarterly monitoring program), are available for comparison to historical data. Professional judgement will be used to evaluate whether any background data appear to be affected by a release and need to be excluded from a background update. A t-test for equal means (if normal data distribution) or appropriate non-parametric test (if non-normal data distribution) such as a Mann-Whitney (or Wilcoxon) rank-sum or box-whisker plots, will be conducted to evaluate whether the two groups of background sample populations are statistically different prior to updating any background datasets. A 0.05 significance level will be utilized when evaluating the two populations, with the null hypothesis that they are equivalent. In addition, time series graphs or other trend evaluation statistics will be conducted on the new background dataset to verify the absence of a release or changing groundwater quality. If the tests indicate that there are no statistical differences between the two background populations, the new data will be combined with the existing dataset. If the two populations are found to be different, the data will be reviewed to evaluate the cause of the difference. If the differences appear to be caused by a

release (if the new data are significantly higher, or lower for pH), then the previous background dataset may continue to be used. Furthermore, verified outliers will not be added to an existing background dataset. In accordance with the *Unified Guidance*, continual background updates will not be conducted due to the lack of sufficient samples for a statistical comparison.

3. COMPLIANCE MONITORING

Compliance monitoring is designed to monitor groundwater for evidence of a release by comparing Part 845 constituents in compliance wells to both background concentrations and the GWPS. Compliance Monitoring will begin the 1st quarter following approval of this Groundwater Monitoring Plan and issuance of the Operating Permit. The selected Compliance Monitoring statistical method used to compare compliance groundwater quality data for each constituent to the GWPS will provide for adequate statistical power, error levels and individual test false positive rates, and be appropriate for the distribution and detection frequency of the background dataset. Statistical power is the ability of a statistical test to detect a true exceedance.

In accordance with 35 I.A.C. § 845.610(b)(3)(D), compliance monitoring statistical analyses will be completed and submitted to IEPA within 60 days after completion of sampling.

3.1 GWPS Establishment and Exceedance Determination

In accordance with 35 I.A.C. § 845.600(a), the GWPS will be the constituent concentrations specified in 35 I.A.C. § 845.600(a)(1) except for when the background concentration is greater, or no concentration is specified (*i.e.,* for calcium and turbidity), in which case the GWPS will be the background concentration. The GWPS based on background concentration will be calculated using a parametric upper tolerance limit (UTL), a parametric UPL for a future mean, or a non-parametric UPL for a future median.

Statistical calculations that will be utilized in Compliance Monitoring procedures are summarized in **Table A** below and listed in **Sections 3.1.1** through **3.1.7**. Depending on the distribution of the data and the percentage of non-detects, it may be more appropriate to use a parametric model over a non-parametric model. As necessary, other techniques as mentioned in the *Unified Guidance* and/or new methods will be implemented.

Table A. Statistical Calculations Used in Compliance Monitoring Procedures

Compliance Monitoring						
Significant Trend?	Background Data			Compliance Data		
	Percent Non-Detects	Distribution	GWPS Determination	Percent Non-Detects	Distribution	Method to Determine Exceedance
No	0 ≤ 50	Normal	35 I.A.C § 845.600(a)(1) constituent concentration or The Upper Tolerance Limit	≤75	Normal	Parametric Lower Confidence Limit around a Normal Mean
				≤75	Log-Normal	Parametric Lower Confidence Limit around a Lognormal Geometric Mean
				NA	Non-Normal	Non-Parametric Lower Confidence Limit around a Median
				>75	Unknown/ Cannot be determined	
	50 ≤ 70	Normal	The Upper Prediction Limit for a Future Mean	NA	NA	Future mean
	>70	Non-Normal	Upper Prediction Limit for a Future Median	NA	NA	Future median
	100	Non-Normal	Double Quantification Rule	NA	NA	Individual Retesting Values
Yes	0 ≤ 50	Normal	UCL of Confidence Band around Linear Regression	≤75	Residuals after subtracting trend are normal, equal variance	Lower Limit from Confidence Band around Linear Regression
	50 ≤ 100	Non-Normal	UCL of Confidence Band around Thiel-Sen trend line	≤75	Residuals not normal	Lower Limit from Confidence Band around Thiel-Sen

3.1.1 The Upper Tolerance Limit

The UTL will be used to calculate the GWPS when pooled background data are normally distributed, with a non-detect frequency of 50 percent or less. When non-detect frequency is 15 percent or less, half the RL will be substituted for non-detects. The *Unified Guidance* recommends 95 percent confidence level and 95 percent coverage (95/95 tolerance interval).

- When non-detect frequency is 15 percent or less, half the RL will be substituted for non-detects (simple substitution), and the normal mean and standard deviation will be calculated.

- The Kaplan-Meier or the ROS method will be used when the detection frequency is between 15 percent and 50 percent. The Kaplan-Meier method assesses the linearity of a censored probability plot to determine whether the background sample can be approximately normalized. If so, then the Kaplan-Meier method will be used to compute estimates of the mean and standard deviation adjusted for the presence of left-censored values. The Kaplan-Meier or ROS estimate of the mean and standard deviation will be substituted for the sample mean and standard deviation.
- If background normality cannot be achieved, non-parametric UTLs will not be calculated until a minimum of 60 background samples have been collected (to achieve 95 percent coverage).

The parametric UTL on a future mean will be calculated from the background dataset as follows:

$$UTL = \overline{x} + \kappa\,(n, \gamma, \alpha - 1) \cdot s$$

$\overline{x}$ = background sample mean

s = background sample standard deviation

$\kappa\,(n, \gamma, \alpha - 1)$ = one-sided normal tolerance factor based on the chosen coverage (γ) and confidence level (α -1) and the size of the background dataset (n). Values are tabulated in Table 17-3 in Appendix D of the *Unified Guidance*. If exact values are not provided, then κ values can be estimated by linear interpolation.

If the UTL is constructed on the logarithms of original observations to achieve normality, where $\overline{y}$ and s_y are the log-mean and log-standard deviation, the limit will be exponentiated for back-transformation to the concentration scale as follows:

$$UTL = \exp\left[\overline{y} + \kappa\,(n, \gamma, \alpha - 1) \cdot s_y\right]$$

$\overline{y}$ = background sample log-mean

s_y = background sample log-standard deviation

When the GWPS is based on the 35 I.A.C. § 845.600(a)(1) constituent concentrations or a UTL derived from the background dataset, an exceedance in compliance wells relative to the GWPS will be evaluated using confidence intervals. A confidence interval defines the upper and lower bound of the true mean of a constituent concentration in groundwater within a specified confidence range.

- Non-detects in compliance data will be handled similarly to upgradient analyses, with half the RL substituted for non-detects when the frequency is 15 percent or less.
- The Kaplan-Meier, or the ROS method, will be used when the detection frequency is between 15 percent and 50 percent to compute estimates of the mean and standard deviation adjusted for the presence of left-censored values. These estimates will then be substituted for the sample mean and standard deviation.

Once the GWPS is established for background data using the UTL, either parametric or non-parametric confidence intervals will be computed for each constituent in compliance wells to identify GWPS exceedances.

3.1.2 Parametric Confidence Intervals around a Mean

If compliance data are approximately normal, one-sided parametric confidence intervals around a sample mean will be constructed for each constituent and well pair. The lower confidence limit (LCL) will be calculated as:

$$LCL_{1-\alpha} = \overline{x} - t_{1-\alpha,n-1} \cdot \frac{s}{\sqrt{n}}$$

$\overline{x}$ = compliance sample mean

s = compliance sample standard deviation

n = compliance sample size

$t_{1-\alpha,n-1}$ = obtained from a Student's t-table with (n–1) degrees of freedom (Table 16-1 in Appendix D of the *Unified Guidance*)

The chosen t value will aim to achieve both a low false-positive rate, and high statistical power. Minimum α values are tabulated in Table 22-2 of Appendix D of the *Unified Guidance*. The selected minimum α value, from which the t value will be derived, will have at least 80 percent power (1-β = 0.8) when the underlying mean concentration is twice the GWPS.

If compliance data are distributed lognormally, the LCL will be computed around the lognormal geometric mean as:

$$LCL_{1-\alpha} = \exp\left(\overline{y} - t_{1-\alpha,n-1} \cdot \frac{s_y}{\sqrt{n}}\right)$$

$\overline{y}$ = compliance sample log-mean

s_y = compliance sample log-standard deviation

3.1.3 Non-Parametric Confidence Intervals around a Median

Non-parametric confidence intervals around the median will be computed if the compliance data contain greater than 50 percent non-detects or are not normally distributed. The mathematical algorithm used to construct non-parametric confidence intervals is based on the probability (*P*) that any randomly selected measurement in a sample of n concentration measurements will be less than an unknown *P* x 100th percentile of interest (where *P* is between 0 and 1). Then the probability that the measurement will exceed the *P* x 100th percentile is (1–*P*). The number of sample values falling below the *P* x 100th percentile out of a set of n should follow a binomial distribution with parameters n and success probability *P*, where 'success' is defined as the event that a sample measurement is below the *P* x 100th percentile. The probability that the interval formed by a given pair of order statistics will contain the percentile of interest will then be determined by a cumulative binomial distribution *Bin(x;n,p)*, representing the probability of *x* or fewer successes occurring in *n* trials with success probability p. *P* will be set to 0.50 for an interval around the median.

The sample size n will be ordered from least to greatest. Given *P* = 0.50, candidate interval endpoints will be chosen by ordered data values with ranks close to the product of (n+1) x 0.50. If the result of (n+1) x 0.50 is a fraction (for even-numbered sample sizes), the rank values immediately above and below will be selected as possible candidate endpoints. If the result of (n+1) x 0.50 is an integer (for odd-numbered sample sizes), one will be added to and subtracted

from the result to get the upper and lower candidate endpoints. The ranks of the endpoints will be denoted L* and U*. For a one-sided LCL, the confidence level associated with endpoint L* will be computed as:

$$1 - \alpha = Bin(L^* - 1; n, 0.50) = \sum_{x=L^*}^{n} \binom{n}{x} \left(\frac{1}{2}\right)^n$$

If the candidate endpoint(s) do not achieve the desired confidence level, new candidate endpoints (L*−1) and (U*+1) and achieved confidence levels will be calculated. If one candidate endpoint equals the data minimum or maximum, only the rank of the other endpoint will be changed. Achievable confidence levels are tabulated using these equations in Table 21-11 in Appendix D of the *Unified Guidance*.

Both parametric and non-parametric confidence limits will then be compared to the GWPS. The CCR unit is considered to be in compliance if the LCL is equal to or lower than the GWPS for all detected constituents at all compliance monitoring wells. A GWPS exceedance is determined if the LCL exceeds the GWPS.

3.1.4 The Upper Prediction Limit for a Future Mean

The parametric UPL for a future mean will be used to calculate the GWPS if the pooled background data contain 50 to 70 percent non-detects and normality can be achieved. The Kaplan-Meier or ROS methods will be used to estimate the mean and standard deviation. The non-parametric UPL for a future median will be calculated as the GWPS if background samples cannot be normalized or contain greater than 70 percent non-detects. The parametric UPL for a future mean will be calculated from the background dataset at follows:

$$UPL_{1-\alpha} = \overline{x} + \kappa s$$

$\overline{x}$ = background sample mean

s = background standard deviation

κ = multiplier based on the order (p) of the future mean to be predicted, the number of compliance wells to be tested (w), the background sample size (n) the number (c) of constituents of concern (COCs), the "1-of-m" retesting scheme, and the evaluation schedule (annual, semi-annual, quarterly). Values are tabulated in 19-5 to 19-9 in Appendix D of the *Unified Guidance*.

The mean of order p will be computed for each well and compared against the UPL. For any compliance point mean that exceeds the limit, p additional resamples may be collected at that well for a 1-of-2 retesting scheme. Resample means will then be compared to the UPL. A GWPS exceedance has been deemed to occur at a compliance well when the initial mean and all resample means exceed the UPL.

3.1.5 The Non-Parametric Upper Prediction Limit for a Future Median

The non-parametric UPL for a future median will be used to calculate the GWPS if the pooled background data contain greater than 70 percent non-detects and normality cannot be achieved. Non-parametric methods assume that the data does not have an underlying distribution. To calculate the non-parametric UPL on a future value, the target per-constituent false positive rate (α_{const}) will be determined as follows:

$$\alpha_{const} = 1 - (1 - \alpha)^{1/c}$$

α = the site-wide false positive rate (SWFPR) of 0.10 recommended by the *Unified Guidance*

c = the number of monitoring constituents

The number of yearly statistical evaluation (nE) will be multiplied by the number of compliance wells (w) to determine the look-up table entry, w*. The background sample size (n) and w* will be used to select an achievable per-constituent false positive rate value in Table 19-24 of Appendix D in the *Unified Guidance*. The chosen achievable per-constituent false positive rate value will determine the type of non-parametric prediction limit (maximum or 2nd highest value in background) and a retesting scheme for a future median. The background data will be sorted in ascending order, and the upper prediction limit will be set to the appropriate order statistic previously determined by the achievable per-constituent false positive rate value in Table 19-24. If all constituent measurements in a background sample are non-detect, the Double Quantification rule will be used. The use of the Double Quantification rule in Compliance Monitoring will only be applicable if the RL is above the 35 I.A.C. § 845.600(a)(1) constituent concentration or a constituent concentration is not specified in § 845.600(a)(1). This scenario is highly unlikely. The constituent will also be removed from calculations identifying the target false positive rate.

Two initial measurements per compliance well will be collected. If both do not exceed the upper prediction limit, a third initial measurement will not be collected since the median of order 3 will also not exceed the limit. If both exceed the prediction limit, a third initial measurement will not be collected since the median will also exceed the limit. If one initial measurement is above and one below the limit, a third initial observation may be collected to determine the position of the median relative to the UPL. Up to three resamples will be collected in order to assess the resample median. In all cases, if two or more of the compliance point observations are non-detect, the median will be set equal to the RL. The median value for each compliance well will be compared to the UPL. For the 1-of-2 retesting scheme, if any compliance point median exceeds the limit, up to three additional resamples will may be collected from that well. The resample median will be computed and compared to the UPL. A GWPS exceedance has been deemed to occur at a compliance well when either the initial median, or both the initial median and resample median exceed the UPL.

If the concentrations of detected constituents are below the established GWPS, Compliance Monitoring will continue.

3.1.6 Parametric Linear Regression and Confidence Band

If the t-test detects a significant trend in the parametric linear regression line using either background or compliance data for a particular constituent, confidence bands accounting for trends will be constructed to account for the trend-induced variation. If this is not accounted for, a wider confidence interval will inevitably be calculated for a given confidence level and sample size (n). A wider confidence interval will result in less statistical power, or ability to demonstrate an exceedance or return to compliance. When a linear trend line has been estimated, a series of confidence intervals is estimated at each point along the trend. This creates a simultaneous confidence band that follows the trend line. As the underlying population mean increases or decreases, the confidence band does also to reflect this change at that point in time.

Linear regression will be used when background or compliance data are approximately normally distributed, with a constant sample variance around the mean, and the frequency of non-detects is low. The linear regression of concentration against sampling date (time) will be computed as follows:

$$\hat{b} = \sum_{i=1}^{n} (t_i - \bar{t}) \cdot x_i / (n-1) \cdot s_t^2$$

x_i = i^{th} concentration value and

t_i = i^{th} sampling date

$\bar{t}$ = sampling mean date

s_t^2 = variance of the sampling dates

This estimate leads to the following regression equation:

$$\hat{x} = \bar{x} + \hat{b} \cdot (\mathrm{t} - \bar{t})$$

$\bar{x}$ = mean concentration level

$\hat{x}$ = estimated mean concentration at time t

The regression residuals will also be computed at each sampling event to ensure uniformity and lack of significant skewness. Regression residuals will be computed at each sampling event as follows:

$$r_i = x_i - \hat{x}_i$$

The estimated variance around the regression line, or mean squared error (MSE) will be computed as follows:

$$s_e^2 = \frac{1}{n-2} \sum_{i=1}^{n} r_i^2$$

The confidence intervals around a linear regression trend line given confidence level (1-α) and a point in time (t_0), will be computed as follows:

$$LCL_{1-\alpha} = \hat{x}_0 - \sqrt{2s_e^2 \cdot F_{1-2\alpha,2,\mathrm{n}-1} \cdot \left[\frac{1}{n} + \frac{(t_0 - \bar{t})^2}{(n-1) \cdot s_t^2}\right]}$$

$$UCL_{1-\alpha} = \hat{x}_0 - \sqrt{2s_e^2 \cdot F_{1-2\alpha,2,\mathrm{n}-2} \cdot \left[\frac{1}{n} + \frac{(t_0 - \bar{t})^2}{(n-1) \cdot s_t^2}\right]}$$

$\hat{x}_0$ = estimated mean concentration from the regression equation at time t_0

$F_{1-2\alpha,2,\mathrm{n}-2}$ = upper $(1\text{-}2\alpha)^{th}$ percentage point from an F-distribution with 2 and (n-2) degrees of freedom

For background data, the UCL around the linear regression line will be used as the GWPS for the trending constituent. For compliance data, confidence bands around the linear regression line will be compared to the GWPS. The CCR unit is considered to be in compliance if the LCL is equal to or lower than the GWPS for all detected constituents at all compliance wells. A GWPS exceedance is determined when the LCL based on the trend line first exceeds the GWPS.

3.1.7 Non-Parametric Thiel-Sen Trend Line and Confidence Band

If the Mann-Kendall test detects a significant trend in the non-parametric Thiel-Sen line using either background or compliance data for a particular constituent, confidence bands accounting for trends will be constructed to account for the trend-induced variation. The Thiel-Sen trend line will be used as a non-parametric alternative to linear regression when trend residuals cannot be normalized or if there are a higher percentage of non-detects in either background or compliance data. The Thiel-Sen trend line estimates the median concentration over time by combining the median pairwise slope with the median concentration value and the median sample date. To compute the Thiel-Sen line, the data will first be ordered by sampling event x1, x2, xn. All possible distinct pairs of measurements (x_i, x_j) for j > i will be considered and the simple pairwise slope estimate will be computed for each pair as follows:

$$m_{ij} = (x_j - x_i)/(j - i)$$

With a sample size of n, there will be a total of N = n(n-1)/2 pairwise estimates (m_{ij}). If a given observation is a non-detect, half the RL will be substituted. The N pairwise slope estimates (m_{ij}) will be ordered from least to greatest (renamed m(1), m(2),..m(N)). The Thiel-Sen estimate of slope (Q) will be calculated as the median value of the list depending on whether N is even or odd as follows:

$$Q = \begin{cases} m_{([N+1]/2)} \; if \; N \; is \; odd \\ (m_{(N/2)} + m_{([N+2]/2)})/2 \; if \; N \; is \; even \end{cases}$$

The sample concentration magnitude will be ordered from least to greatest, x(1), x(2), to x(n) and the median concentration will be calculated as follows:

$$\tilde{x} = \begin{cases} x_{([n+1]/2)} \; if \; n \; is \; odd \\ (x_{(n/2)} + x_{([n+2]/2)})/2 \; if \; n \; is \; even \end{cases}$$

The median sampling date ($\tilde{t}$) with ordered times (t(1), t(2), to t(n)) will also be determined in this way. The Thiel-Sen trend line will then be computed for an estimate at any time (t) of the expected median concentration (x) as follows:

$$x = \tilde{x} + Q \cdot (\mathrm{t} - \tilde{t}) = (\tilde{x} - Q \cdot \tilde{t}) + Q \cdot \mathrm{t}$$

To construct a confidence band around the Thiel-Sen line, sample pairs (ti, xi) will be formed with a sample date (ti) and the concentration measurement from that date (xi). Bootstrap samples (B) will be formed by repeatedly sampling n pairs at random with replacement from the original sample pairs. This will be repeated 500 times. For each bootstrap sample, a Thiel-Sen trend line will be constructed using the equation above. A series of equally spaced time points (tj) will be identified along the range of sampling dates represented in the original sample, j =1 to m. The Thiel-Sen trend line associated with each bootstrap replicate will be used to compute an estimated concentration ($\hat{x}_j^B$). An LCL will be constructed for the lower α^{th} percentile $\hat{x}_j^{[\alpha]}$ from the distribution of estimated concentrations at each time point (tj). For a UCL, compute the upper (1-α)th percentile, $\hat{x}_j^{[1-\alpha]}$ at each time point (tj).

For background data, the UCL around the Thiel-Sen trend line will be used as the GWPS for the trending constituent. For compliance data, confidence bands around the Thiel-Sen trend line will be compared to the GWPS. The CCR unit is considered to be in compliance if the LCL is equal to or lower than the GWPS for all detected constituents at all compliance wells. A GWPS exceedance is confirmed when the LCL based on the trend line first exceeds the GWPS.

3.2 Determination of Statistically Significant Increases over Background

In accordance with 35 I.A.C. §§ 845.610(b)(3)(B) and 845.640(h), individual monitoring event concentrations for each constituent detected in the compliance monitoring wells during compliance monitoring sampling events will be compared to the background concentration as determined by the methods described above. An exceedance of the background concentration for any constituent measured at any compliance monitoring well, or constituent detection if not detected in the background samples, constitutes a Statistically Significant Increase (SSI). An exception to this method is pH, where two-sided (upper and lower) tolerance limits are established from the distribution of the background groundwater quality data. An exceedance of either the UTL or lower tolerance limit (LTL) would constitute an SSI for pH.

4. REFERENCES

Davis, C.B., 1994. *Environmental Regulatory Statistics.* In GP Patil & CR Rao (Eds.) *Handbook of Statistics, Volume 12: Environmental Statistics*, Chapter 26. New York: Elsevier Science B.V.

United States Environmental Protection Agency (USEPA), 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance*. EPA 530-R-09-007. March 2009.

APPENDIX J

Post-closure Care Plan

POST-CLOSURE PLAN FOR EXISTING CCR SURFACE IMPOUNDMENT
40 C.F.R. § 257.104 and 35 I.A.C. 845.780
REV 0 – 10/30/2021

SITE INFORMATION

Site Name / Address	Duck Creek Power Plant / 17751 North Cilco Road, Canton, IL 62234		
Owner Name / Address	Illinois Power Generating Company / 6555 Sierra Drive Irving, Texas 75039		
CCR Unit	GMF Pond	Closure Method and Final Cover Type	Close In-Place Geomembrane with Soil and Vegetation Cover

POST-CLOSURE PLAN DESCRIPTION

40 C.F.R. § 257.104(c)(1) and 35 I.A.C. 845.780(c)(1) – Length of post-closure care period.	Post-closure care will be conducted for a period of 30 years as required by 40 C.F.R. § 257.104(c)(1) and 35 I.A.C. 845.780(c)(1), except as provided by 40 C.F.R. § 257.104(c)(2) and 35 I.A.C. 845.780(c)(2).
40 C.F.R. § 257.104(c)(2) and 35 I.A.C. 845.780(c)(2) - Circumstances extending the post closure care period.	If at the end of the post-closure care period the CCR unit is operating under assessment monitoring in accordance with §257.95, the post-closure care as described in this plan will continue until returning to detection monitoring in accordance with §257.95. Under 35 I.A.C. 845.780(c)(2), the post-closure care period will be extended until groundwater monitoring data demonstrate that concentrations are below the groundwater protection standards in Section 845.600 and are not increasing for those constituents over background, using the statistical procedures and performance standards in Section 845.640(f) and (g), provided that concentrations have been reduced to the maximum extent feasible and concentrations are protective of human health and the environment.
40 C.F.R. § 257.104(d)(1)(i) and 35 I.A.C. 845.780(d)(1)(A) – A description of the monitoring and maintenance activities required in 40 C.F.R. § 257.104(b) and 845.780(b), and the frequency at which these activities will be performed, to maintain the integrity and effectiveness of the final cover system, maintain the groundwater monitoring system and monitor the groundwater.	Pursuant to § 257.104(b)(1) and 35 I.A.C. 845.780(b)(1), throughout the post-closure care period, periodic visual observations of the final cover system and stormwater management system will be performed at least annually for evidence of settlement, subsidence, erosion, or other damage that may adversely affect the integrity and effectiveness of the final cover system. When practical, visual observations of the final cover will be made concurrent with groundwater monitoring activities. Noted evidence of damage, such as damage to the geosynthetic components, rills, surface cracks and settlement, will be repaired to maintain the integrity and effectiveness of the final cover system. Vegetation will be established and maintained on the final cover system, including storm drainage areas, where appropriate, to provide long-term erosion control. Established vegetation and the slope design of the final cover system will prevent potential erosion and damage

	that may be caused by run-on and run-off. Repair activities may include, but are not limited to, repairing, or replacing damaged geosynthetic components, replacing and compacting soil cover, repairing drainage channels that have been eroded, filling in depressions with soil, regrading, and reseeding areas of failed vegetation, as necessary. Pursuant to § 257.104(b)(3) and 35 I.A.C. 845.780(b)(3), the groundwater monitoring system will be maintained, and groundwater will be monitored as required by 40 C.F.R. § 257.90 through 40 C.F.R. § 257.98 and 35 I.A.C. 845.600 through 35 I.A.C. 845.680. Monitoring wells will be inspected during each groundwater sampling event. Monitoring wells and associated instrumentation will be maintained so that they perform to the design specifications throughout the life of the monitoring program. Groundwater monitoring frequency will be at least quarterly, except as provided in 40 C.F.R. § 257.94(d), 257.94(c), and 35 I.A.C. 845.650(b)(4).
40 C.F.R. § 257.104(d)(1)(ii) and 35 I.A.C. 845.780(d)(1)(B) – The name, address, telephone number and email address of the person or office to contact about the facility during the post-closure care period.	Illinois Power Generating Company 6555 Sierra Drive Irving, Texas 75039 800.633.4704 ccr@dynegy.com
40 C.F.R. § 257.104(d)(1)(iii) and 35 I.A.C. 845.780(d)(1)(C) – A description of the planned uses of the property during the post-closure period.	The CCR unit is located at a retired electric generation facility. Planned uses of the property during the post-closure period are currently unknown, except for post-closure care of the CCR unit. Post-closure use of the property will not disturb the integrity of the final cover system or other components of the containment system, or the function of the monitoring systems unless necessary to comply with the requirements of 40 C.F.R. Part § 257, Subpart D and 35 I.A.C. Part 845. Any other disturbance will be conducted following a demonstration that it will not increase the potential threat to human health or the environment, as required by 40 C.F.R. § 257.104(d)(1)(iii) and 35 I.A.C. 845.780 (d)(1)(C). The demonstration will be certified by a qualified professional engineer and submitted to the Illinois Environmental Protection Agency (IEPA). Per 40 C.F.R. § 257.104(d)(1)(iii) notification shall be provided to the State Director that the demonstration has been placed in the operating record and on the owners or operator's publicly accessible internet site. Following closure of the CCR unit, a notation on the deed to the property, or some other instrument that is normally examined during title search, will be recorded in accordance with 40 C.F.R. § 257.102(i) and 35 I.A.C. 845.760(h). The notation will notify potential purchasers of the property that the land has been used as a CCR unit and its use is restricted under the post-closure care requirements in 40 C.F.R. 40 C.F.R. § 257.104(d)(1)(iii) and 35 I.A.C. 845.780(d)(1)(C) or groundwater monitoring requirements per 35 I.A.C. 845.740(b). Within 30 days of recording the deed notation, a notification stating that the notation has been recorded will be submitted to the IEPA and placed in the facility's operating record per 845.760(h)(3). The notification will be placed on

	the owner or operator's publicly accessible CCR Web site in accordance with 40 C.F.R. § 257.107(i)(9) and 35 I.A.C. 845.810(e) and placed in the facility's operating record as required by 35 I.A.C. 845.800(d)(26) and §257.105(i)(9).
40 C.F.R. § 257.104(d)(3) and 35 I.A.C. 845.780(d)(3)– Amendments to the initial or subsequent written post-closure plan.	Pursuant to 40 C.F.R. § 257.104(d), the initial post closure care plan for the Duck Creek GMF Pond was prepared on October 17, 2016. That plan is being amended pursuant to 40 C.F.R. § 257.104(d)(3)(i). This plan also serves as the initial post-closure care plan, prepared in accordance with 35 I.A.C. 845.780(d). Pursuant to § 257.104(d)(3) and 35 I.A.C. 845.780(d)(3), an operating permit modification application to amend the initial or any subsequent written post-closure care plan developed under 35 I.A.C. 845.780 (d)(1) and § 257.104(d)(1) will be submitted to IEPA. The written post-closure care plan will be amended whenever there is a change in the operation of the CCR surface impoundment that would substantially affect the written post-closure care plan in effect; or unanticipated events necessitate a revision of the written post-closure care plan, after post-closure activities have started. The written post-closure care plan will be amended at least 60 days before a planned change in the operation of the facility or CCR surface impoundment, or within 60 days after an unanticipated event requires the need to revise the existing plan. If the plan is revised after post-closure activities have started, a request to modify the operating permit, including an amended written post-closure care plan, will be submitted to the IEPA within 30 days following the triggering event.
40 C.F.R. § 257.104(d)(4) and 35 I.A.C. 845.780(d)(4) – Qualified professional engineering certification.	Certification by a qualified professional engineer will be appended to this plan and any amendment of this plan.
35 I.A.C. 845.780(e) – Termination of post-closure care.	Upon completion of the post-closure period, a request to terminate post-closure care will be submitted to the IEPA. The request will include a certification by a qualified professional engineer verifying that post-closure care has been completed in accordance with the post-closure care plan specified in 35 I.A.C. 845.780(d) and the requirements of 35 I.A.C. 845.780.
40 C.F.R. § 257.104(e) and 35 I.A.C. 845.780(f) – Notification of completion of the post-closure care period.	A notification of completion of post-closure care will be prepared and placed in the facility's operating record within 30 days after IEPA approval of the request to terminate post-closure care. The notification will be placed in the facility's operating record in accordance with 35 I.A.C. 845.800(d)(31) and § 257.105(i)(13). The notification will be placed on the owner or operator's publicly accessible CCR Internet site in accordance with the requirements of § 257.107(i)(13) and 35 I.A.C. 845.810(e). The IEPA will be notified when the notification has been placed in the operating record and on the owner or operator's publicly accessible Internet site in accordance with the requirements of § 257.106(i)(13).

Certification Statement 40 C.F.R. § 257.104 (d)(4) and 35 I.A.C. 845.780(d)(4) – Amended/Initial Written Post Closure Plan for a CCR Surface Impoundment

CCR Unit: Illinois Power Resources Generating, LLC; Duck Creek Power Plant; GMF Pond

I, John R. Hesemann, being a Registered Professional Engineer in good standing in the State of Illinois, do hereby certify, to the best of my knowledge, information, and belief, that the information contained in this certification has been prepared in accordance with the accepted practice of engineering. I certify, for the above referenced CCR Unit, that the information contained in the amended/initial written post closure plan, dated October 30, 2021, meets the requirements of 40 C.F.R. § 257.104 and 35 I.A.C. 845.780.

John R. Hesemann

Printed Name

9/28/2021

Date

JOHN ROBERT HESEMANN
062-058523
LICENSED PROFESSIONAL ENGINEER OF ILLINOIS

11/30/2021

APPENDIX K

Legal Description

Land Description of the Duck Creek Power Plant
GMF Pond Facility Boundary
39.42 Acres

Part of the Northwest Quarter of Section 18, Township 6 North, Range 5 East of the Fourth Principal Meridian, Fulton County, Illinois and being more particularly described as follows:

Commencing at the Four Way Township Corner Being the same as the Southeast corner of Section 36 T. 6 N., R. 4 E., also being the same as the Southwest corner of Section 31 T. 6 N., R. 5 E. of the Fourth Principal Meridian; thence North 0 degrees 46 minutes 44 seconds East along the Township line dividing T. 6 N., R 4 E. and T. 6 N., R. 5 E. a distance of 20,948.09 feet; thence South 88 degrees 30 minutes 55 seconds East a distance of 250.99 feet to the Point of Beginning of the Tract described herein; thence continuing South 88 degrees 30 minutes 55 seconds East a distance of 1023.8 feet; thence South 0 degrees 39 minutes 15 seconds west, a distance of 1660.38 feet; thence North 89 degrees 41 minutes 47 seconds West a distance of 808.81 feet; thence North 63 degrees 59 minutes 59 seconds West, a distance of 262.93 feet; thence North 01 degrees 29 minutes 05 seconds East a distance of 1567.77 feet to the Point of Beginning and containing 39.42 Acres.

FACILITY CORNER COORDINATES		
Point #	Northing	Easting
183	1399298.86	2345303.24
184	1399292.36	2345554.14
185	1399265.83	2346577.60
186	1397605.56	2346558.64
187	1397609.85	2345749.84
188	1397725.11	2345513.52

Luminant

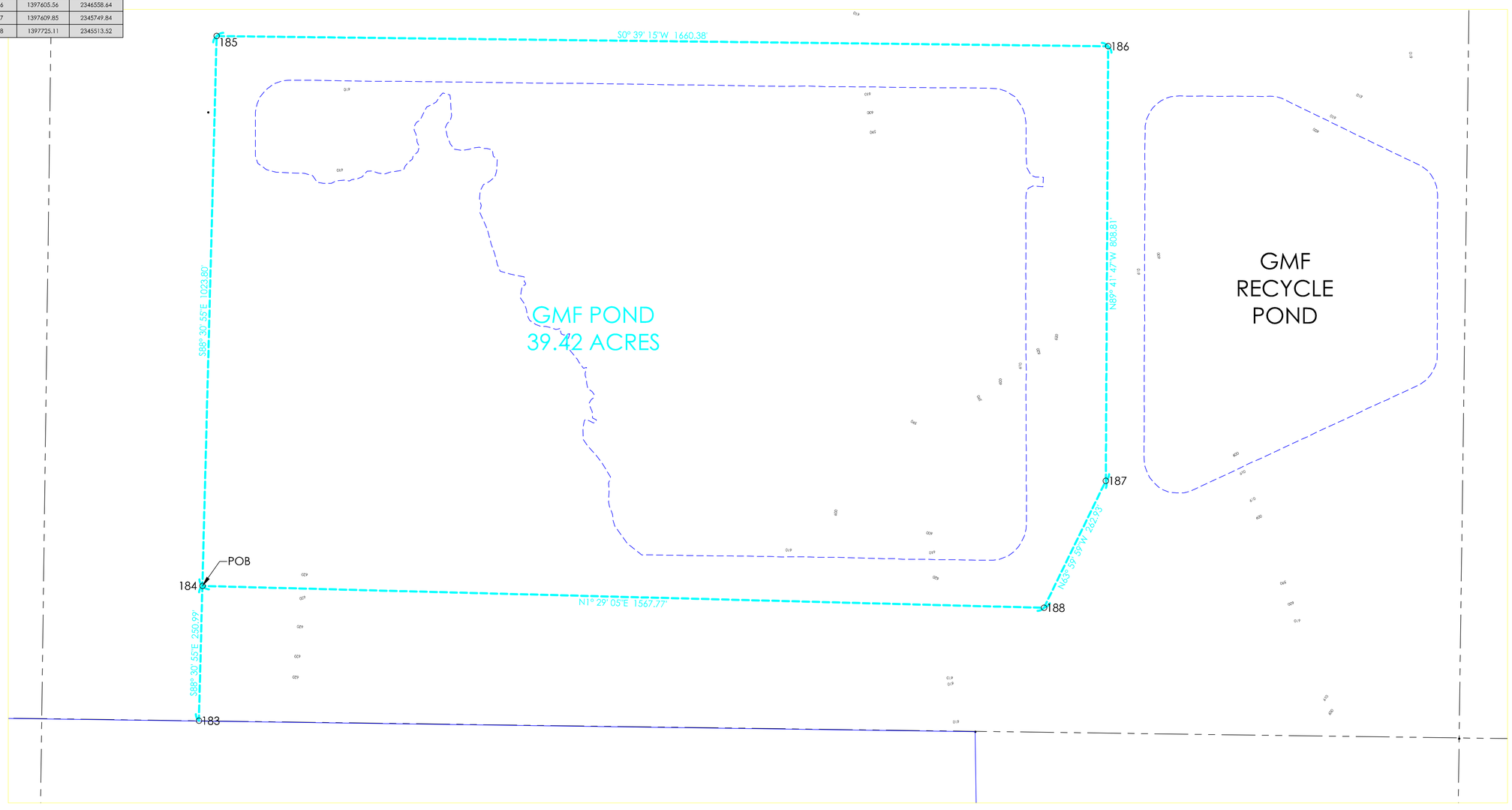
ILLINOIS POWER RESOURCES GENERATING L.L.C.
DUCK CREEK POWER PLANT

0' 100' 200'

LEGEND

- ***SECTION LINE***
- ***RESTRICTED USE BOUNDARY***
- ***APPROXIMATE DUCK CREEK POWER STATION PROPERTY BOUNDARY LINE***
- ***FACILITY BOUNDARY***
- N0° 47' 10"E 3100.48' ***RECORD BOUNDARY DIMENSIONS***
- ● ***FOUND SURVEY MARKER AS NOTED***
- ***M*** ***DENOTES MEASURED DIMENSION***

SURVEY NOTE:
THIS DRAWING AND THE INFORMATION SHOWN HERE ON WAS OBTAINED FROM DATA COLLECTED FROM A FIELD SURVEY MADE BY INGENAE, LLC BETWEEN MARCH 16 THROUGH JUNE 29, 2021. SURVEY COORDINATES, BEARINGS & DISTANCES ARE REFERENCED TO ILLINOIS WEST 1202 STATE PLANE COORDINATE SYSTEM NAD 1983. ELEVATIONS SHOWN HEREON ARE BASED ON NAVD 1988.



IngenAE
502 Earth City Plaza, Suite 120
Earth City, MO 63045
www.ingenae.com

Submissions / Revisions:		Date:
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Luminant

Project Name & Location:

DUCK CREEK
POWER PLANT
17751 N. CILCO RD.
CANTON, IL 61520

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Drawing Name:
GMF POND
BOUNDARY
EXHIBIT

Date: 9/21/2021	Project No.
Type: SITE	Drawing No. 3
Drawn By: CB	
Approved By: MG	
Scale: AS NOTED	

Land Description of the Duck Creek Power Plant
GMF Pond Facility Boundary
39.42 Acres

Part of the Northwest Quarter of Section 18, Township 6 North, Range 5 East of the Fourth Principal Meridian, Fulton County, Illinois and being more particularly described as follows:

Commencing at the Four Way Township Corner Being the same as the Southeast corner of Section 36 T. 6 N., R. 4 E., also being the same as the Southwest corner of Section 31 T. 6 N., R. 5 E. of the Fourth Principal Meridian; thence North 0 degrees 46 minutes 44 seconds East along the Township line dividing T. 6 N., R 4 E. and T. 6 N., R. 5 E. a distance of 20,948.09 feet; thence South 88 degrees 30 minutes 55 seconds East a distance of 250.99 feet to the Point of Beginning of the Tract described herein; thence continuing South 88 degrees 30 minutes 55 seconds East a distance of 1023.8 feet; thence South 0 degrees 39 minutes 15 seconds west, a distance of 1660.38 feet; thence North 89 degrees 41 minutes 47 seconds West a distance of 808.81 feet; thence North 63 degrees 59 minutes 59 seconds West, a distance of 262.93 feet; thence North 01 degrees 29 minutes 05 seconds East a distance of 1567.77 feet to the Point of Beginning and containing 39.42 Acres.

FACILITY CORNER COORDINATES		
Point #	Northing	Easting
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184	1399292.36	2345554.14
185	1399265.83	2346577.60
186	1397605.56	2346558.64
187	1397609.85	2345749.84
188	1397725.11	2345513.52

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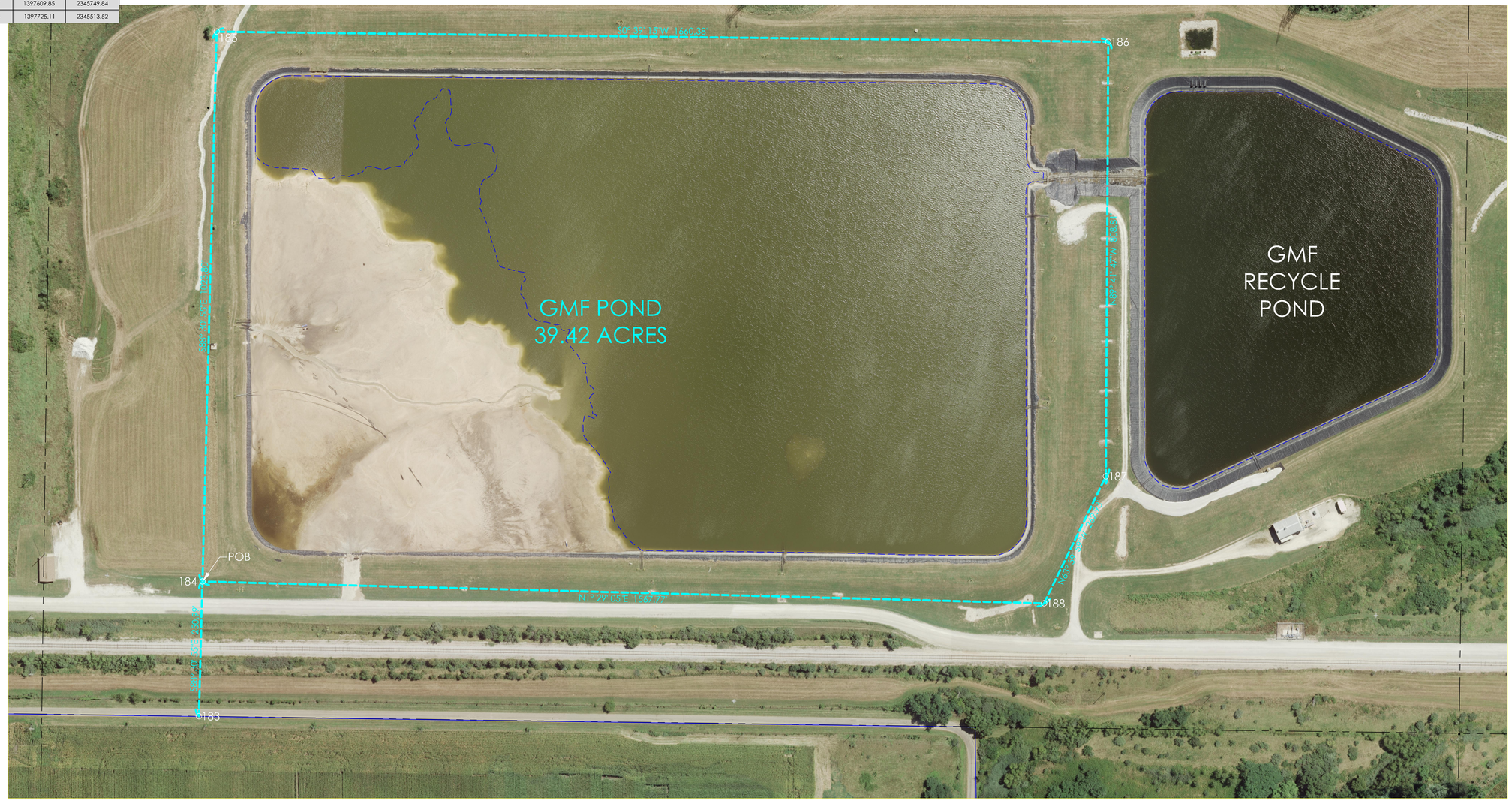
ILLINOIS POWER RESOURCES GENERATING L.L.C.
DUCK CREEK POWER PLANT

0' 100' 200'

LEGEND

- SECTION LINE
- RESTRICTED USE BOUNDARY
- APPROXIMATE DUCK CREEK POWER STATION PROPERTY BOUNDARY LINE
- FACILITY BOUNDARY
- N0° 47' 10"E 3100.48' RECORD BOUNDARY DIMENSIONS
- ● FOUND SURVEY MARKER AS NOTED
- M DENOTES MEASURED DIMENSION

SURVEY NOTE:
THIS DRAWING AND THE INFORMATION SHOWN HERE ON WAS OBTAINED FROM DATA COLLECTED FROM A FIELD SURVEY MADE BY INGENAE, LLC BETWEEN MARCH 16 THROUGH JUNE 29, 2021. SURVEY COORDINATES, BEARINGS & DISTANCES ARE REFERENCED TO ILLINOIS WEST 1202 STATE PLANE COORDINATE SYSTEM NAD 1983. ELEVATIONS SHOWN HEREON ARE BASED ON NAVD 1988.



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Submissions / Revisions:		Date:
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Luminant

Project Name & Location:

DUCK CREEK
POWER PLANT
17751 N. CILCO RD.
CANTON, IL 61520

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Drawing Name:
GMF POND BOUNDARY EXHIBIT

Date: 9/21/2021	Project No.
Type: SITE	Drawing No. 4
Drawn By: CB	
Approved By: MG	
Scale: AS NOTED	

APPENDIX L

Public Meetings Information

Dianna Tickner
Illinois Power Resources Generating, LLC
1500 Eastport Plaza Drive
Collinsville, IL 62234

January 28, 2022

Illinois Environmental Protection Agency
DWPC – Permits MC # 15
ATTN: Part 845 Coal Combustion Residual Rule Submittal
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

Re: 35 IAC 845.220(a)(9) Certification Statement
Duck Creek Power Plant GMF Pond (IEPA ID # W0578010001-04)

Dear Mr. Darin LeCrone:

For the above-refenced CCR surface impoundment and in accordance with 35 IAC 845.220(a)(9), Illinois Power Resources Generating, LLC certifies that the public notification and public meetings required under 35 IAC 845.240 were completed. Please find enclosed both the public meeting summary and listserv.

Sincerely,
Illinois Power Resources Generating, LLC

Dianna Tickner
Director, Decommissioning & Demolition

Duck Creek Public Meeting Issues Summary, December 7, 2021

On Sunday, November 7, 2021, Illinois Power Resource Generating, LLC made available to the public its plans to close the GMF Pond and Bottom Ash Basin (BAB) CCR surface impoundments located at Duck Creek Power Plant. On Tuesday, December 7, 2021, Illinois Power Resource Generating, LLC held in-person and virtual public meetings at 3:00 pm and 5:30 pm to present its decision-making process, a comparison of projected groundwater impacts for the alternatives presented, and an objective comparison of the pros and cons of each alternative presented. During the question-and-answer portion of the meeting, the public asked questions related to the closure and, the company-provided answers.

As required by Section 845.240(g), Illinois Power Resource Generating, LLC distributed to those public meeting attendees who requested a copy a general summary of the issues raised by the public, a response to those issues or comments raised by the public, and a summary of any revisions, changes, and considerations made to the closure plans, on December 21, 2021.

Issue/Topic		Summary of Response Provided at Meeting	Additional Written Response
1.	Engineered Final Cover System at the GMF Pond	The final cover system includes a 60-mil high-density polyethylene (HDPE) geomembrane and 2 feet of soil on top of the geomembrane to protect the geomembrane from damage. Vegetative grass with a shallow root system will be planted on the final cover system. The geomembrane will be rolled out in panels. The panels will be heat sealed to each other. In combination with the existing liner system, the final cover system will provide complete encapsulation of the material within the GMF Pond. The final cover system will be monitored for 30 years. If preferential pathways for water infiltration through the final cover system were to form, they would be detected during the monitoring and inspections and would be corrected. Groundwater data will continue to be collected to monitor system performance. Groundwater data will be publicly available.	The issue of geomembrane service life was raised. A significant amount of research has been conducted to evaluate the expected service life of geomembranes under different field conditions. The Geosynthetics Research Institute developed the foremost technical paper on this topic entitled "Geomembrane Lifetime Predictions: Unexposed and Exposed Conditions" (Koerner et al., 2011) to summarize the findings from a 12-year study on this topic and to provide guidance on the expected service life for geomembranes. The expected service life of a geomembrane is dependent on whether it is exposed or unexposed to ultraviolet radiation and other environmental factors, as well as the in-service temperature of the geomembrane. The geomembrane in the final cover system over the GMF Pond will be covered with soil, so it will be unexposed. Considering the soil cover thickness and the climate at the site, the highest expected in-service temperature at the depth of the geomembrane is about 20°C (68°F). According to Koerner et al. (2011), the expected service life of an HDPE geomembrane under these conditions is nearly 450 years.

Issue/Topic		Summary of Response Provided at Meeting	Additional Written Response
			In accordance with Section 845.780(c), the monitoring and inspection period for the GMF Pond is at least 30 years.
2.	GMF Pond Liner System	The GMF Pond was built and lined in or around 2010. The liner system beneath the GMF Pond is a very robust, state-of-the-art system. No exceedances of Groundwater Protection Standards (GWPS) related to the GMF Pond have been detected.	Based on information reviewed after the public meeting, the GMF Pond was constructed in 2008 and 2009. The GMF Pond liner system was designed and constructed to meet or exceed the criteria specified in 35 IAC 811 and 40 CFR 257 (Hanson Professional Services Inc., 2016). It has an upper geomembrane and a lower geomembrane with a leak detection system between them. The leak detection system has not detected any leakage. The lower geomembrane has two additional soil barrier layers below it for enhanced containment/redundancy. The issue of geomembrane service life was raised. A significant amount of research has been conducted to evaluate the expected service life of geomembranes under different field conditions. The Geosynthetics Research Institute developed the foremost technical paper on this topic entitled "Geomembrane Lifetime Predictions: Unexposed and Exposed Conditions" (Koerner et al., 2011) to summarize the findings from a 12-year study on this topic and to provide guidance on the expected service life for geomembranes. The expected service life of a geomembrane is dependent on whether it is exposed or unexposed to ultraviolet radiation and other environmental factors, as well as the in-service temperature of the geomembrane. The geomembranes in the liner system beneath the GMF Pond will be unexposed at closure. Considering the depth to the liner system and the measured temperatures of groundwater in the vicinity of the GMF Pond, the highest expected in-service temperature at the depths of the geomembranes is about 20°C (68°F).

Issue/Topic		Summary of Response Provided at Meeting	Additional Written Response
			According to Koerner et al. (2011), the expected service life of an HDPE geomembrane under these conditions is nearly 450 years. As a result of the issue raised by the public, the closure plan for the GMF Pond will be revised slightly to indicate that all areas of the liner system will be covered with soil to prevent geomembrane exposure.
3.	Groundwater Monitoring	At the GMF Pond, there are approximately 52 groundwater monitoring wells. At the BAB, there are approximately 10 groundwater monitoring wells. Maps and tables showing well locations and depths have been provided in the on-line, publicly available materials. Quarterly groundwater monitoring is required for at least 30 years after closure of the GMF Pond (closure in place). Groundwater monitoring is required for at least 3 years after closure of the BAB (closure by removal). Follow-up actions are required if GWPS exceedances are detected, as prescribed in Part 845, but there is no expectation of future impacts associated with the GMF Pond or BAB.	Based on information reviewed after the public meeting, we have confirmed there are 10 monitoring wells around the BAB. There are 36 monitoring wells around the GMF Pond, and 16 monitoring wells located around the GMF Recycle Pond. The proposed Part 845 monitoring well network for the BAB consists of 8 monitoring wells. The proposed Part 845 monitoring well network for the GMF Pond will consist of 10 wells and 1 unit water monitoring location.
4.	Water Handling	Ponded water in the GMF Pond will be removed to facilitate closure; interstitial water (water within pore spaces) will remain. Water will be discharged through an existing NPDES outfall, consistent with permit requirements. Treatment may be required prior to discharge.	No additional response is necessary.

Issue/Topic		Summary of Response Provided at Meeting	Additional Written Response
5.	Risk Assessment	We will provide a written response for this issue due to the level of technical detail involved.	The Duck Creek Power Plant Risk Assessment was conducted to identify potential hazards and evaluate potential risks to human and ecological receptors that may be exposed to CCR constituents in environmental media potentially impacted by the GMF Pond and BAB. The conceptual site model (CSM) provides a basis for understanding the site conditions and exposure pathways for receptors that may be exposed to site-related constituents. Exposure pathways refer to the way a person or animal could come in contact with a constituent. They are generally referred to as either complete or incomplete. The necessary components for a complete exposure pathway consist of: ▪ A source and mechanism of constituent release from the source; ▪ Retention or transport of the constituent through the environmental medium; ▪ A point of contact between the receptor and the environmental medium; and ▪ A route of exposure for the potential receptor at the contact point. Cancer risks are expressed as a unitless probability of an individual developing cancer over a lifetime, above background risk, as a result of site-related exposures. US EPA has established an acceptable target cancer risk range of 1×10^{-6} to 1×10^{-4} (US EPA, 1990, 1991). Non-cancer risks are expressed as a hazard index (HI) and US EPA has established an acceptable target HI of 1 (US EPA, 1997). An HI less than 1 suggests that exposures are not likely to cause an appreciable risk of non-cancer effects during a lifetime. Risks above these US EPA defined target levels are termed potentially "unacceptable risks".

Issue/Topic		Summary of Response Provided at Meeting	Additional Written Response
			For the Duck Creek Risk Assessment, we followed processes and protocols provided by US EPA comparing measured and modeled environmental concentrations to screening levels (*e.g.*, surface water quality standards) that have been determined by US EPA to be protective of human health and the environment. If the environmental concentrations were below the health protective screening levels, we concluded that there is no unacceptable risk. Based on the evaluation, no unacceptable risks to human and ecological receptors resulting from CCR exposures associated with either the GMF Pond or the BAB were identified.
6.	Closure Cost Estimation	For this current evaluation cost estimates were not considered. Cost estimates are being prepared and will be included in the construction permit application.	
7.	Financial Assurance/Future Assurances	Part 845 requires that the owner provide financial assurance instruments to cover the cost of closure and post-closure care in the event that the owner is unable to carry out these obligations.	Illinois Power Resources Generating, LLC (IPRG) has complied with the Part 845 financial assurance requirements for each of the CCR surface impoundments it is closing under Part 845. The financial assurance provisions in Part 845 are robust and were constructed based on other established financial assurance program regulations. Financial assurance has already been provided for closure activities, post-closure activities, and to address the need for potential remediation of releases and will be updated in the future as needed. The mechanisms for financial assurance provided for under Part 845 are all ones that have been successfully used in other regulatory contexts and that can be easily accessed by IEPA. For Duck Creek, IPRG is using surety bonds guaranteeing performance as its financial assurance mechanism. In the unlikely event of a default, this form of financial assurance allows the surety to step in to perform the closure, post-closure care, or corrective action or to pay a penal sum that will

Issue/Topic		Summary of Response Provided at Meeting	Additional Written Response
			be placed into the CCR Surface Impoundment Financial Assurance Fund within the State Treasury, assuring the work under Part 845 will be performed.
8.	Availability of Information Related to Public Meetings	Slides will not be posted on our publicly available website. Written responses will be provided to all issues raised in the public meetings.	
9.	On-Site Landfill	The landfill has been permitted with IEPA and permit conditions allow disposal of CCR. It has received CCR and will be closed in accordance with the permit after final receipt of waste.	The landfill remains open only for decommissioning activities. There is not capacity in the landfill for disposal of materials from the GMF Pond.
10.	GMF Recycle Pond	The GMF Recycle Pond is regulated under different regulatory provisions (*i.e.*, not Part 845) since it is not a CCR surface impoundment.	No further response is necessary since this question does not pertain to the GMF Pond or Bottom Ash Basin.
11.	Cooling Pond	The cooling pond is not subject to Part 845. Sampling is required for discharges from the cooling pond in accordance with the NPDES permit.	No further response is necessary since this question does not pertain to the GMF Pond or Bottom Ash Basin.
12.	NPDES Permitting	All surface water runoff from the closed GMF Pond and BAB will flow into the cooling pond. Discharges from the cooling pond are regulated by a NPDES permit. The NPDES permit is currently up for reauthorization. The NPDES permit reauthorization is a different issue from the CCR units and the Part 845 requirements.	The ammonia and other constituents are a byproduct of former used air pollution control devices.

In accordance with 845.240(f)(4), a list people who requested to be added to the IEPA Listserv for Duck Creek is as follows:

Duck Creek Listserv	
Name	email
Joseph Cooper	bgfarm47@gmail.com
Nancy Long	nclong405@yahoo.com
Joyce Blumanshire	joblumen@yahoo.com
Bob Jorgensen	jestpr@hotmail.com
Russell Shantz	icmfarm@yahoo.com
Bob Gilmore	robert.gilmore67@gmail.com
Andrew Rehn	arehn@prairierivers.org

APPENDIX M

Training Program Statement

Dianna Tickner
Dynegy Midwest Generation, LLC
Illinois Power Resources Generating, LLC
1500 Eastport Plaza Drive
Collinsville, IL 62234

January 14, 2022

Illinois Environmental Protection Agency
DWPC – Permits MC # 15
ATTN: Part 845 Coal Combustion Residual Rule Submittal
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

Re: 415 ILCS 5/22.59(b)(4) Certification Statement
Duck Power Plant GMF Pond (IEPA ID # W0578010001-04)
Duck Creek Power Plant Bottom Ash Basin (IEPA ID # W0578010001-03)
Hennepin Power Plant East Ash Pond (IEPA ID # W1550100002-05)
Vermilion Power Plant New East Ash Pond (IEPA ID # W1838000002-04)
Vermilion Power Plant North Ash Pond/Old East Ash Pond (IEPA ID # W1838000002- 01,03)

Dear Mr. Darin LeCrone:

For the above-refenced CCR surface impoundments and in accordance with 415 ILCS 5/22.59(b)(4), Dynegy Midwest Generation, LLC and Illinois Power Resources Generating, LLC certify that all contractors, subcontractors, and installers utilized to construct, install, modify, or close a CCR surface impoundment will be participants in a training program that is approved by and registered with the US Department of Labor's Employment and Training Administration and that includes instruction in the following: erosion control, environmental remediation, operation of heavy equipment and excavation.

Sincerely,
Dynegy Midwest Generation, LLC
Illinois Power Resources Generating, LLC

Dianna Tickner
Director, Decommissioning & Demolition

GOLDER
MEMBER OF WSP

golder.com