Luminant

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

October 25, 2021

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 Bottom Ash Basin; IEPA ID # W0578010001-03**

Dear Mr. LeCrone:

In accordance with 35 I.A.C. § 845.200, Illinois Power Resource Generating, LLC (IPRG) is submitting an operating permit application for the Duck Creek Power Plant Bottom Ash Basin (IEPA ID # W0578010001 03). One hardcopy and one digital copy are provided with this submittal.

The permit application was prepared in accordance with 35 I.A.C. § 845.230(d)(2) (Existing, Inactive and Inactive Closed CCR Surface Impoundment that have not completed an Agency approved closure before July 30, 2021). This submittal includes the completed permit forms as required by § 845.210.

Sincerely,

Cynthia E Vodopivec

Cynthia Vodopivec
SVP-Environmental Health and Safety

Enclosures

*Prepared for*

**Illinois Power Resources Generating, LLC**
1500 Eastport Plaza Drive, Collinsville, Illinois 62234

# INITIAL OPERATING PERMIT

## DUCK CREEK BOTTOM ASH BASIN

*Prepared by*

BURNS McDONNELL

425 South Woods Mill Road, Suite 300
St. Louis, MO 63017

October 25, 2021

## ATTACHMENTS

# 1. INTRODUCTION

Illinois Power Resources Generating, LLC (Dynegy) is operator of the  coal-fired Duck Creek Power Plant (Plant) located near Canton, Illinois.  The IEPA assigned identification numbers assigned to the Duck Creek Bottom Ash Basin is: W0578010001-03.  The National Inventory of Dams (NID) number assigned for the Duck Creek Bottom Ash Basin is IL50716.

This initial operating permit application was developed in accordance with 35 Ill. Admin. Code 845, Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments (Part 845).

This initial operating permit application is for the Duck Creek Bottom Ash Basin.

## 1.1. Facility Information

*Section 845.210(b)(1): All permit applications must contain the name, address, email address and telephone number of the operator, or duly authorized agent, and the property owner to whom all inquiries and correspondence shall be addressed.*

| | |
|---|---|
| Facility: | Duck Creek Bottom Ash<br>Basin Duck Creek Power<br>Plant 17751 North Cilco Road<br>Canton, IL 61520 |
| Owner/Operator: | 1500 Eastport Plaza Drive<br>Collinsville, Illinois 62234 |

## 1.2. <u>Owner Signatures</u>

> <u>*Section 845.210(b)(2):*</u> *All permit applications must be signed by the owner, operator or a duly authorized agent of the operator.*

The owner of the Duck Creek Power Plant is a corporation.

> <u>*Section 845.210(b)(3):*</u> *An application submitted by a corporation must be signed by a principal executive officer of at least the level of vice president, or his or her duly authorized representative, if that representative is responsible for the overall operation of the facility described in the application form..*

The signature of Cynthia Vodopivec on behalf of Illinois Power Resources Generating, LLC can be found in the cover letter as well as the permit applications located in Section 3.

## 1.3. Legal Description

> <u>*Section 845.210(c):*</u> *All permit applications must contain a legal description of the facility boundary and a description of the boundaries of all units included in the facility.*

A legal description has been developed in compliance with Section 845.210(c) and is included in Attachment A.

## 1.4. Previous Assessments

> <u>*Section 845.210(d):*</u> *Previous Assessments, Investigations Plans, and Programs*

Previous assessments were performed in accordance with 40 CFR § 257 and are referenced within the permit application and included in the appropriate Attachments.

> <u>*Section 845.210(d)(1):*</u> *The Agency may approve the use of any hydrogeologic site investigation or characterization, groundwater monitoring well or system, or groundwater monitoring plan, bearing the seal and signature of an Illinois Licensed Professional Geologist or Licensed Professional Engineer, completed before April 21, 2021 to satisfy the requirements of this Part.*

A previous hydrogeologic site investigation or characterization, groundwater monitoring well or system, or groundwater monitoring plan have been completed with a seal from an Illinois Licensed Professional Geologist or Licensed Professional Engineer. However, field investigations have been completed that supplement that work that will be utilized in the following sections of this report.

> <u>*Section 845.210(d)(2):*</u> *For existing CCR surface impoundments, the owner or operator of the CCR surface impoundment may use a previously completed location restriction demonstration required by Section 845.300 (Placement Above the Uppermost Aquifer), Section 845.310 (Wetlands), Section 845.320 (Fault Areas), Section 845.330 (Seismic Impact Zones), and Section 845.340 (Unstable Areas) provided that the previously completed assessments meet the applicable requirements of those Sections.*

Previous assessments are provided for Section 845.300 (Placement Above the Uppermost Aquifer), Section 845.310 (Wetlands), Section 845.320 (Fault Areas), Section 845.330 (Seismic Impact Zones), and Section 845.340 (Unstable Areas) in Attachment D.

> <u>*Section 845.210(d)(3):*</u> *For existing CCR surface impoundments, the owner or operator of the CCR surface impoundment may use a previously completed assessment to serve as the initial assessment required by Section 845.440 (Hazard Potential Classification Assessment), Section 845.450 (Structural Stability Assessment) and Section 845.460 (Safety Factor Assessment) provided that the previously completed assessment: A) Was not completed more than five years ago; and B) Meets the applicable requirements of those Sections.*

Previous assessments are provided for Section 845.440 (Hazard Potential Classification Assessment), Section 845.450 (Structural Stability Assessment) and Section 845.460 (Safety Factor Assessment) in Attachments O, P, and Q respectively. The addendum and certification for the Hazard Potential Classification Assessment, Structural Stability Assessment and Safety Factor Assessment are located in Attachment U.

> <u>*Section 845.210(d)(4):*</u> *For inactive closed CCR surface impoundments, the owner or operator of the CCR surface impoundment may use a post-closure care plan previously approved by the Agency.*

No post-closure care plan was previously approved by the Agency.

# 2. OPERATING PERMIT

## 2.1. Initial Operating Permit

*<u>Section 845.230(d):</u> Initial Operating Permit for Existing, Inactive and Inactive Closed CCR Surface Impoundments*

The Duck Creek Bottom Ash Basin is defined by the IEPA as an existing CCR surface impoundment that has not completed post-closure care. Per Part 845, Illinois Power Resources Generating, LLC is submitting an initial operating permit application to IEPA by October 31, 2021. The permit applications (CCR-1 and CCR-2E) are provided in Section 3.

The following sections contain information or references to documents required for the Operating Permit application (Section 845.230).

## 2.2. History of Construction

*<u>Section 845.230(d)(2)(A):</u> The history of construction specified in Section 845.220(a)(1);*

The history of construction has been prepared in compliance with Section 845.220(a)(1) and is provided in Attachment B.

## 2.3. Chemical Constituents

*<u>Section 845.230(d)(2)(B):</u> An analysis of the chemical constituents found within the CCR to be placed in the CCR surface impoundment;*

An analysis of the chemical constituents found within the CCR placed within the Duck Creek Bottom Ash Basin is provided in Attachment C.

*<u>Section 845.230(d)(2)(C):</u> An analysis of the chemical constituents of all waste streams, chemical additives and sorbent materials entering or contained in the CCR surface impoundment;*

An analysis of the chemical constituents of all waste streams, chemical additives and sorbent materials entering or contained within the Duck Creek Bottom Ash Basin is provided in Attachment C

## 2.4. Location Standards Demonstration

> *Section 845.230(d)(2)(D): A demonstration that the CCR surface impoundment, as built, meets, or an explanation of how the CCR surface impoundments fails to meet, the location standards in the following Sections:*

The Duck Creek Bottom Ash Basin location standards as specified in Section 845.230(d)(2)(D) are described in the following sections.

> *Section 845.230(d)(2)(D)(i): Placement Above the Uppermost Aquifer;*

The previous upper aquifer demonstration was certified by a qualified professional engineer stating that the demonstration meets the requirements of 40 C.F.R. § 257.60. The requirements described in 40 C.F.R. § 257.60 are identical to the requirements contained in Section 845.300. Pursuant to Section 845.210(d)(2), a certification is not required for this demonstration. The previously completed upper aquifer demonstration is included in Attachment D.

> *Section 845.230(d)(2)(D)(ii): Wetlands;*

The previous wetlands demonstration was certified by a qualified professional engineer stating that the demonstration meets the requirements of 40 C.F.R. § 257.61. The requirements described in 40 C.F.R. § 257.61 are identical to the requirements contained in Section 845.310. Pursuant to Section 845.210(d)(2), a certification is not required for this demonstration. The previously completed wetlands demonstration is included in Attachment D.

> *Section 845.230(d)(2)(D)(iii): Fault Areas;*

The previous fault area demonstration was certified by a qualified professional engineer stating that the demonstration meets the requirements of 40 C.F.R. § 257.62. The requirements described in 40 C.F.R. § 257.62 are identical to the requirements contained in Section 845.320. Pursuant to Section 845.210(d)(2), a certification is not required for this demonstration. The previously completed fault area demonstration is included in Attachment D.

> *Section 845.230(d)(2)(D)(iv): Seismic Impact Zone; and*

The previous seismic impact zone demonstration was certified by a qualified professional engineer stating that the demonstration meets the requirements of 40 C.F.R. § 257.63. The requirements described in 40 C.F.R. § 257.63 are identical to the requirements contained in Section 845.330. Pursuant to Section 845.210(d)(2), a certification is not required for this demonstration. The previously completed seismic impact zone demonstration is included in Attachment D.

*Section 845.230(d)(2)(D)(v): Unstable Areas and Floodplains;*

The previous unstable area demonstration was certified by a qualified professional engineer stating that the demonstration meets the requirements of 40 C.F.R. § 257.64. The requirements described in 40 C.F.R. § 257.64 are identical to the requirements contained in Section 845.340. Pursuant to Section 845.210(d)(2), a certification is not required for the unstable area demonstration. The previously completed unstable area demonstration is included in Attachment D.

The boundaries of the impoundment were determined by a survey conducted by a professional surveyor licensed in the State of Illinois. The boundaries of the Bottom Ash Pond were compared to the existing FEMA floodplain map, and it was determined that the Bottom Ash Basin is not located within the floodplain. A certification attesting to this is provided in Attachment D.

## 2.5. Permanent Markers

*Section 845.230(d)(2)(E): Evidence of permanent markers required by Section 845.130 have been installed;*

Evidence of permanent markers at the Duck Creek Bottom Ash Basin as required by Section 845.130 is provided in Attachment E.

## 2.6. Slope Maintenance

*Section 845.230(d)(2)(F): Documentation that the CCR surface impoundment, if not incised, will be operated and maintained with one of the forms of slope protection specified in Section 845.430;*

The Duck Creek Bottom Ash Basin is incised and therefore not subject to the requirements of slope protection described in Section 845.430.

## 2.7. Initial Emergency Action Plan

*Section 845.230(d)(2)(G): Initial Emergency Action Plan and accompanying certification (see Section 845.520(e));*

The initial emergency action plan and certification has been completed as specified by Section 845.520(e) and is provided in Attachment F.

### 2.8. Fugitive Dust Control Plan

*Section 845.230(d)(2)(H): Fugitive dust control plan and accompanying certification (see Section 845.500(b)(7));*

The fugitive dust control plan and certification has been completed as specified by Section 845.500(b)(7) and is provided in Attachment G.

### 2.9. Groundwater Monitoring

*Section 845.230(d)(2)(I): Groundwater monitoring information:*

The groundwater monitoring information for the Duck Creek Bottom Ash Basin are described in the following sections.

*Section 845.230(d)(2)(I)(i): Hydrogeologic site characterization (see Section 845.620);*

Hydrogeologic site characterization for the Duck Creek Bottom Ash Basin are provided in Attachment H.

*Section 845.230(d)(2)(I)(ii): Design and construction plans of a groundwater monitoring system (see Section 845.630);*

Design and construction plans of a groundwater monitoring system are provided in Attachment I.

*Section 845.230(d)(2)(I)(iii): A groundwater sampling and analysis program that includes selection of the statistical procedures to be used for evaluating groundwater monitoring data (see Section 845.640); and*

A groundwater sampling and analysis program that meets the requirements of Section 845.640 is provided in Attachment I.

*Section 845.230(d)(2)(I)(iv): Proposed groundwater monitoring program that includes a minimum of eight independent samples for each background and downgradient well (see Section 845.650(b));*

A proposed groundwater monitoring program that meets the requirements of Section 845.650(b) is provided in Attachment I.

## 2.10. Initial Post-Closure Care Plan

*<u>Section 845.230(d)(2)(K):</u> Initial written post-closure care plan, if applicable (see Section 845.780(d));*

The Duck Creek Bottom Ash Basin closure will be completed by removing CCR as specified in Section 845.740 and an initial written post-closure care plan is not required per Section 845.780(a)(2).

## 2.11. History of Groundwater Exceedances

> *<u>Section 845.230(d)(2)(M):</u> History of known exceedances of the groundwater protection standards in Section 845.600, and any corrective action taken to remediate the groundwater;*

A history of known exceedances and any corrective action taken is provided in Attachment M.

## 2.12. Financial Assurance Requirements

> *<u>Section 845.230(d)(2)(N):</u> A certification that the owner or operator meets the financial assurance requirements of Subpart I;*

A certification meeting the requirement of Section 845.230(d)(2)(N) stating that the Owner meets the financial assurance requirements of *Subpart I* is provided in Attachment N.

## 2.13. Hazard Potential Classification

> *<u>Section 845.230(d)(2)(O):</u> Hazard potential classification assessment and accompanying certification (see Section 845.440(a)(2));*

The Duck Creek Bottom Ash Pond is an incised pond per 40 CFR §257.53 and therefore not subject to the requirements of 40 CFR §257.73(a). In addition, Duck Creek Bottom Ash Pond is not subject to the requirements of Section 845.440 per Section 845.440(b).

## 2.14. Structural Stability Assessment

> *<u>Section 845.230(d)(2)(P):</u> Structural stability assessment and accompanying certification (see Section 845.450(c));*

The Duck Creek Bottom Ash Pond is an incised pond per 40 CFR §257.53 and therefore not subject to the requirements of 40 CFR §257.73(d). In addition, Duck Creek Bottom Ash Pond is not subject to the requirements of Section 845.450 per Section 845.450(e).

### 2.15. Safety Factor Assessment

*Section 845.230(d)(2)(Q):* *Safety factor assessment and accompanying certification (see Section 845.460(b));*

The Duck Creek Bottom Ash Pond is an incised pond per 40 CFR §257.53 and therefore not subject to the requirements of 40 CFR §257.73(a). In addition, Duck Creek Bottom Ash Pond is not subject to the requirements of Section 845.460 per Section 845.460(e).

### 2.16. Inflow Design Flood Control System Plan

*Section 845.230(d)(2)(R):* *Inflow design flood control system plan and accompanying certification (see Section 845.510(c)(3));*

The previous Inflow Design Flood Control System Plan Assessment completed in compliance with 40 CFR §257.82 is provided in Attachment R. The addendum to the Inflow Design Flood Control Plan Assessmentas required by Section 845.510(c)(3) is provided in Attachment U.

### 2.17. Safety and Health Plan

*Section 845.230(d)(2)(S):* *Safety and health plan (see Section 845.530); and*

The safety and health plan in accordance with Section 845.530 is included in Attachment S.

### 2.18. Proposed Closure Priority Categorization

*Section 845.230(d)(2)(T):* *For CCR surface impoundments required to close under 845.700, the proposed closure priority categorization required by Section 845.700(g).*

A CCR Surface Impoundment Category Designation and Justification letter was submitted to IEPA on May 19, 2021. The Duck Creek Bottom Ash Basin was designated as Category 3 Inactive CCR surface impoundment in compliance with groundwater protection standards in Section 845.600. This letter is provided in Attachment T.

## 3. PERMIT APPLICATION

All permit applications must be made on the forms prescribed by the Agency and must be mailed or delivered to the address designated by the Agency on the forms. The permit applications (CCR-1 and CCR-2E) are provided below.

| Form CCR 1 | Illinois Environmental Protection Agency<br>CCR Surface Impoundment Permit Application<br>Form CCR 1 – General Provisions |
|---|---|

| | |
|---|---|
| **Bureau of Water ID Number:**<br>W0578010001<br>**CCR Permit Number:**<br>Initial Permit<br>**Facility Name:**<br>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)<br>Phil Morris | Title<br>Senior Director - Environmental | Phone Number<br>618-343-7794 |
| | Email address<br>phil.morris@vistracorp.com | | |
| 1.4 | Facility Mailing Address | | |
| | Street or P.O. box<br>1500 Eastport Plaza Dr | | |
| | City or town<br>Collinsville | State<br>IL | Zip Code<br>62234 |
| 1.5 | Facility Location | | |
| | Street, route number, or other specific identifier<br>17751 North CILCO Road | | |
| | County name<br>Fulton | County code (if known) | |
| | City or town<br>Canton | State<br>IL | Zip Code<br>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)<br>Phil Morris | Title<br>Senior Director - Environmental | Phone Number<br>618-343-7794 |
| | | Email address<br>phil.morris@vistracorp.com | | |
| | 1.8 | Owner/Operator Mailing Address | | |
| | | Street or P.O. box<br>1500 Eastport Plaza Dr | | |
| | | City or town<br>Collinsville | State<br>IL | Zip Code<br>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. | | |
| | | W0578010001-03 (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** | **Date Signed** |
| | 10/25/2021 |

| Form CCR 2E | Illinois Environmental Protection Agency<br>CCR Surface Impoundment Permit Application<br>Form CCR 2E – Initial Operating Permit for Existing or Inactive CCR Surface Impoundments That Have Not Completed an Agency-approved Closure Before July 30, 2021 |
|---|---|

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

**SECTION 1: CONSTRUCTION HISTORY (35 Ill. Adm. Code 845.220 AND 35 Ill. Adm. Code 845.230)**

| Construction History | | |
|---|---|---|
| | 1.1 | CCR surface impoundment name. |
| | | Bottom Ash Basin |
| | 1.2 | Identification number of the CCR surface impoundment (if one has been assigned by the Agency). |
| | | W0578010001-03 |
| | 1.3 | Description of 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. |

| | | | | | |
|---|---|---|---|---|---|
| Construction History (Continued) | 1.7 | List name of the watershed within which the CCR surface impoundment is located. | | | |
| | | See Attachment B. | | | |
| | 1.8 | Size in acres of the watershed within which the CCR surface impoundment is located. | | | |
| | | See Attachment B. | | | |
| | 1.9 | Check the corresponding box to indicate that you have attached the following: | | | |
| | | ☑ | Description of the physical and engineering properties of the foundation and abutment materials on which the CCR surface impoundment is constructed. | | |
| | | ☑ | Description 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. | | |
| | | ☑ | Describe the method of site preparation and construction of each zone of the CCR surface impoundment. | | |
| | | ☑ | A listing of the approximate dates of construction of each successive stage of construction of the CCR surface impoundment. | | |
| | | ☑ | Drawing satisfying the requirements of 35 Ill. Adm. Code 845.220(a)(1)(F). | | |
| | | ☑ | Description of the type, purpose, and location of existing instrumentation. | | |
| | | ☑ | Area capacity curves for the CCR Impoundment. | | |
| | | ☑ | Description of each spillway and diversion design features and capacities and provide the calculations used in their determination. | | |
| | | ☑ | 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: ANALYSIS OF CHEMICAL CONSTITUENTS (35 Ill. Adm. Code 845.230(d)(2)(B))**

| | | | |
|---|---|---|---|
| Constituents | 2.1 | Check the corresponding boxes to indicate you have attached the following: | |
| | | ☑ | An analysis of the chemical constituents found within the CCR to be placed in the CCR surface impoundment. |
| | | ☑ | An analysis of the chemical constituents of all waste streams, chemical additives and sorbent materials entering or contained in the CCR surface impoundment. |

## SECTION 3: DEMONSTRATIONS AND CERTIFICATIONS (35 Ill. Adm. Code 845.230(d)(2)(D))

| | | | | | | |
|---|---|---|---|---|---|---|
| Demonstrations | 3.1 | Indicate whether you have attached a demonstration that the CCR surface impoundment, as built, meets, or an explanation of how the CCR surface impoundments fails to meet, the location standards in the following sections: | | | | |
| | | 35 Ill. Adm. Code 845.300 (Placement Above the Uppermost Aquifer) | ☑ | Demonstration | ☐ | Explanation |
| | | 35 Ill. Adm. Code 845.310 (Wetlands) | ☑ | Demonstration | ☐ | Explanation |
| | | 35 Ill. Adm. Code 845.320 (Fault Areas) | ☑ | Demonstration | ☐ | Explanation |
| | | 35 Ill. Adm. Code 845.330 (Seismic Impact Zones) | ☑ | Demonstration | ☐ | Explanation |
| | | 35 Ill. Adm. Code 845.340 (Unstable Areas and Floodplains) | ☑ | Demonstration | ☐ | Explanation |

## SECTION 4: ATTACHMENTS

| | | | |
|---|---|---|---|
| Attachments | 4.1 | Check the corresponding boxes to indicate that you have attached the following: | |
| | | ☑ | Evidence that the permanent markers required by 35 Ill. Adm. Code 845.130 have been installed. |
| | | ☑ | Documentation that the CCR surface impoundment, if not incised, will be operated and maintained with one of the forms of slope protection specified in 35 Ill. Adm. Code 845.430. |
| | | ☑ | Initial Emergency Action Plan and accompanying certification required by 35 Ill. Adm. Code 845.520(e). |
| | | ☑ | Fugitive dust control plan and accompanying certification required by 35 Ill. Adm. Code 845.500(b)(7). |
| | | ☐ | Preliminary written closure plan as specified in 35 Ill. Adm. Code 845.720(a). |
| | | ☑ | Initial written post-closure care plan as specified in 35 Ill. Adm. Code 845.780(d), if applicable. |
| | | ☐ | A certification as specified in 35 Ill. Adm. Code 845.400(h), or a statement that the CCR surface impoundment does not have a liner than meets the requirements of 35 Ill. Adm. Code 845.400(b) or (c). |
| | | ☑ | History of known exceedances of the groundwater protection standards in 35 Ill. Adm. Code 845.600, and any corrective action taken to remediate the groundwater. |
| | | ☑ | Safety and health plan, as required by 35 Ill. Adm. Code 845.530. |
| | | ☑ | For CCR surface impoundments required to close under 35 Ill. Adm. Code 845.700, the proposed closure priority categorization required by 35 Ill. Adm. Code 845.700(g). |

## SECTION 5: GROUNDWATER MONITORING

| | | | |
|---|---|---|---|
| Groundwater | 5.1 | Check the corresponding boxes to indicate you have attached the following groundwater monitoring information: | |
| | | ☑ | A hydrogeologic site characterization meeting the requirements of 35 Ill. Adm. Code 845.620. |
| | | ☑ | Design and construction plans of a groundwater monitoring system meeting the requirements of 35 Ill. Adm. Code 845.630. |

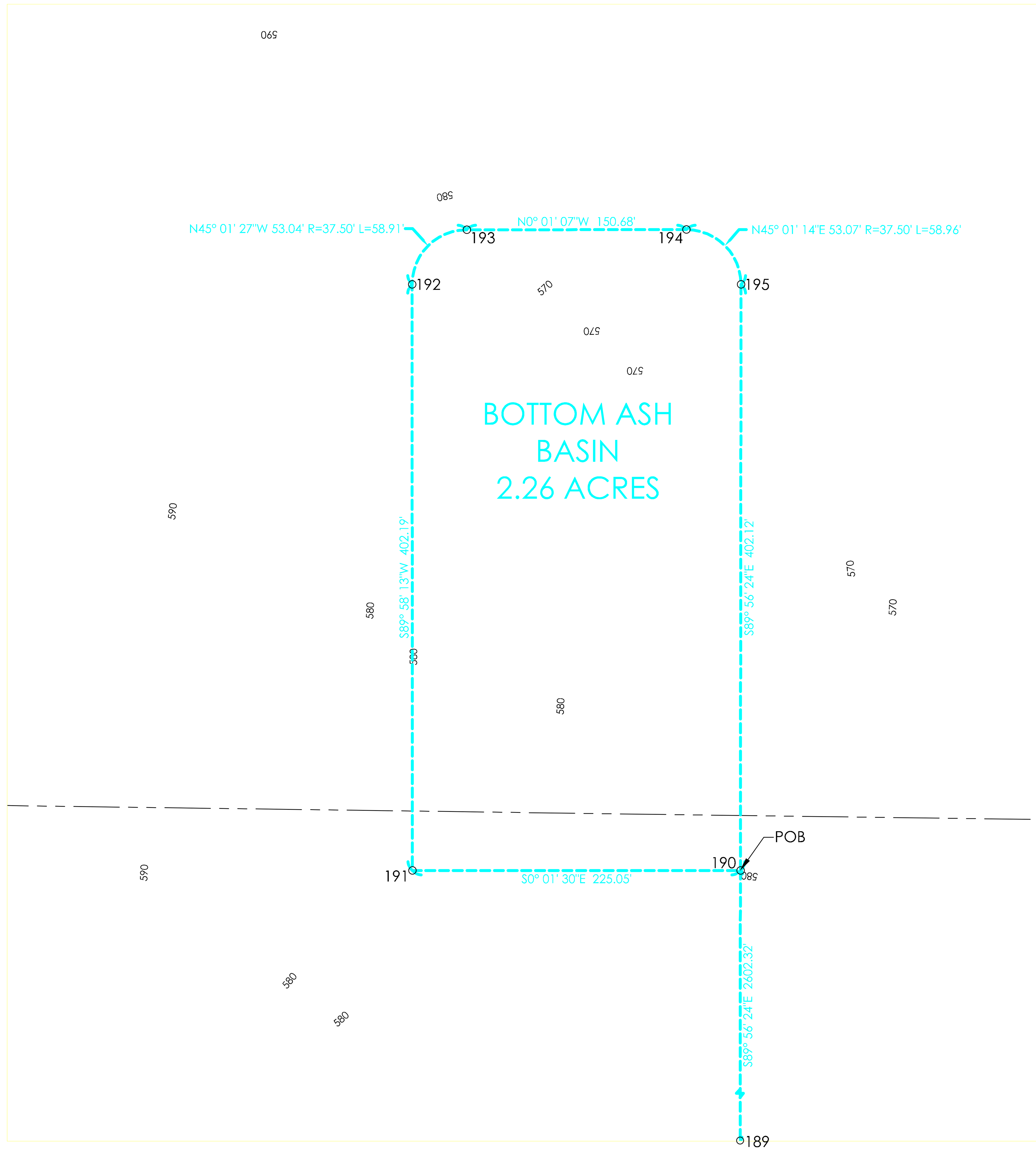
| | | | |
|---|---|---|---|
| | | ☑ | A groundwater sampling and analysis program that includes section of the statistical procedures to be used for evaluating groundwater monitoring data, required by 35 Ill. Adm. Code 845.640. |
| | | ☑ | Proposed groundwater monitoring program that includes a minimum of eight independent samples for each background and downgradient well, required by 35 Ill. Adm. Code 845.650(b). |
| **SECTION 6: CERTIFICATIONS** | | | |
| **Certifications** | 6.1 | Check the corresponding boxes to indicate you have attached the following certifications: | |
| | | ☑ | A certification that the owner or operator meets the financial assurance requirements of Subpart I, as required by 35 Ill. Adm. Code 845.230(d)(2)(N). |
| | | ☑ | Hazard potential classification assessment and accompanying certifications required by 35 Ill. Adm. Code 845.440(a)(2). |
| | | ☑ | Structural stability assessment and accompanying certification, required by 35 Ill. Adm. Code 845.450(c). |
| | | ☑ | Safety factor assessment and accompanying certification, as required by 35 Ill. Adm. Code 845.460(b). |
| | | ☑ | Inflow design flood control system plan and accompanying certification, as required by 35 Ill. Adm. Code 845.510(c)(3). |

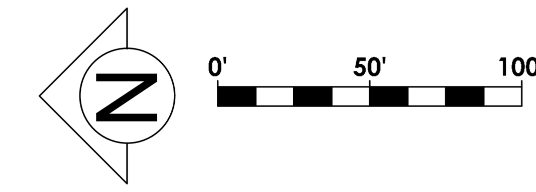
# ATTACHMENT A

| FACILITY CORNER COORDINATES | | |
|---|---|---|
| Point # | Northing | Easting |
| 189 | 1384451.47 | 2345101.36 |
| 190 | 1384448.75 | 2347703.68 |
| 191 | 1384673.80 | 2347703.58 |
| 192 | 1384674.01 | 2348105.77 |
| 193 | 1384636.52 | 2348143.29 |
| 194 | 1384485.84 | 2348143.34 |
| 195 | 1384448.33 | 2348105.80 |

Luminant

# ILLINOIS POWER RESOURCES GENERATING L.L.C.
# DUCK CREEK POWER PLANT




**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.**

**Land Description of the Duck Creek Power Plant**
**Bottom Ash Basin Facility Boundary**
**2.26 Acres**

Part of the South Half of Section 30, 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 6099.34 feet; thence South 89 degrees 56 minutes 24 seconds East a distance of 2602.32 feet to the Point of Beginning of the Tract described herein; thence continuing South 89 degrees 56 minutes 24 seconds East a distance of 402.12 feet; thence along a curve to the left having a radius of 37.50 feet, a curve length of 58.96 feet, a chord bearing North 45 degrees 01 minutes 14 seconds East, a chord distance of 53.07 feet; thence North 0 degrees 01 minutes 07 seconds West a distance of 150.68 feet; thence along a curve to the left having a radius of 37.50 feet a curve length of 58.91 feet, a chord bearing North 45 degrees 01 minutes 27 seconds West, a chord distance of 53.04 feet; thence South 89 degrees 58 minutes 13 seconds West a distance of 402.19 feet; thence South 0 degrees 01 minutes 30 seconds East a distance of 225.05 feet to the Point of Beginning and containing 2.26 Acres.


IngenAE
502 Earth City Plaza, Suite 120
Earth City, MO 63045
www.ingenae.com


| Submissions / Revisions: | Date: |
|---|---|
| 1 | |
| 2 | |
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| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| 11 | |
| 12 | |
| 13 | |

Luminant

Project Name & Location:

DUCK CREEK
POWER PLANT
17751 N. CILCO RD.
CANTON, IL 61520



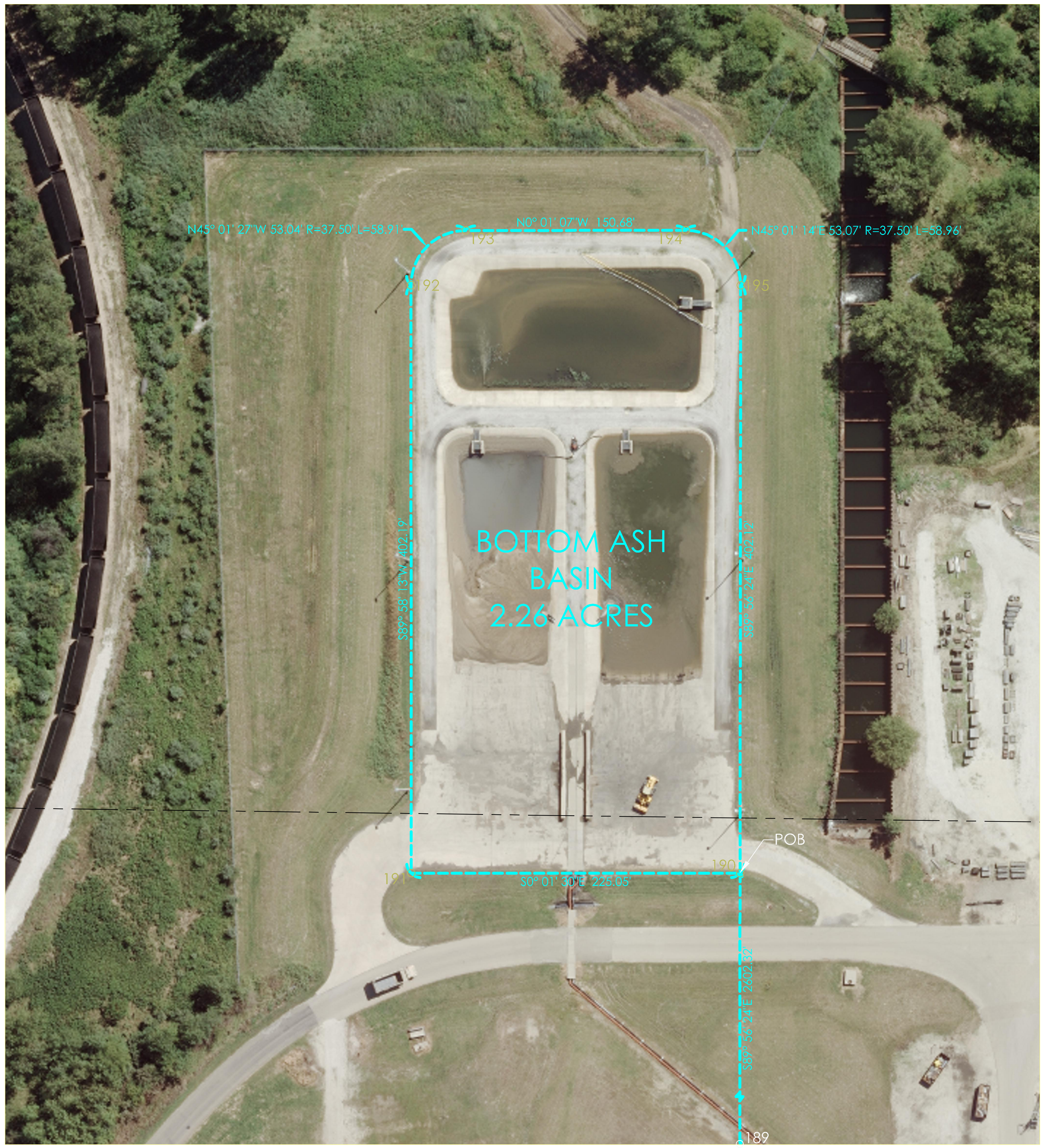
Drawing Name:
BOTTOM ASH BASIN BOUNDARY EXHIBIT

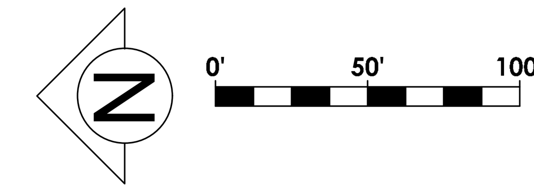
| | |
|---|---|
| Date: 9/21/2021 | Project No. |
| Type: SITE | Drawing No. 5 |
| Drawn By: CB | |
| Approved By: MG | |
| Scale: AS NOTED | |

| FACILITY CORNER COORDINATES | | |
|---|---|---|
| Point # | Northing | Easting |
| 189 | 1384451.47 | 2345101.36 |
| 190 | 1384448.75 | 2347703.68 |
| 191 | 1384673.80 | 2347703.58 |
| 192 | 1384674.01 | 2348105.77 |
| 193 | 1384636.52 | 2348143.29 |
| 194 | 1384485.84 | 2348143.34 |
| 195 | 1384448.33 | 2348105.80 |

Luminant

# ILLINOIS POWER RESOURCES GENERATING L.L.C.
# DUCK CREEK POWER PLANT




**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.**

**Land Description of the Duck Creek Power Plant**
**Bottom Ash Basin Facility Boundary**
**2.26 Acres**

Part of the South Half of Section 30, 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 6099.34 feet; thence South 89 degrees 56 minutes 24 seconds East a distance of 2602.32 feet to the Point of Beginning of the Tract described herein; thence continuing South 89 degrees 56 minutes 24 seconds East a distance of 402.12 feet; thence along a curve to the left having a radius of 37.50 feet, a curve length of 58.96 feet, a chord bearing North 45 degrees 01 minutes 14 seconds East, a chord distance of 53.07 feet; thence North 0 degrees 01 minutes 07 seconds West a distance of 150.68 feet; thence along a curve to the left having a radius of 37.50 feet a curve length of 58.91 feet, a chord bearing North 45 degrees 01 minutes 27 seconds West, a chord distance of 53.04 feet; thence South 89 degrees 58 minutes 13 seconds West a distance of 402.19 feet; thence South 0 degrees 01 minutes 30 seconds East a distance of 225.05 feet to the Point of Beginning and containing 2.26 Acres.


IngenAE
502 Earth City Plaza, Suite 120
Earth City, MO 63045
www.ingenae.com


| Submissions / Revisions: | Date: |
|---|---|
| 1 | |
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| 11 | |
| 12 | |
| 13 | |

Luminant

Project Name & Location:

DUCK CREEK
POWER PLANT
17751 N. CILCO RD.
CANTON, IL 61520



Drawing Name:
BOTTOM ASH BASIN BOUNDARY EXHIBIT

| | |
|---|---|
| Date: 9/21/2021 | Project No. |
| Type: SITE | Drawing No. 6 |
| Drawn By: CB | |
| Approved By: MG | |
| Scale: AS NOTED | |

# ATTACHMENT B

GOLDER
MEMBER OF WSP

**ATTACHMENT B**

# History of Construction for the Bottom Ash Basin

*Duck Creek Power Plant*

Submitted to:

**Illinois Environmental Protection Agency**

1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62234

Submitted by:

**Illinois Power Resource Generating, LLC**

1500 Eastport Plaza Drive
Collinsville, Illinois 62234

Compiled by:

**Golder Associates Inc.**

13515 Barrett Parkway Drive, Suite 260
Ballwin, Missouri 63021

21454861-9-R-0

October 22, 2021

# Table of Contents

**TABLES**



**FIGURES**



**APPENDICES**

# 1.0 INTRODUCTION

This History of Construction has been prepared to address certain requirements of 35 I.A.C. 845.230(d)(2)(A) for Illinois Power Resource Generating, LLC's (IPRG's) Bottom Ash Basin at the Duck Creek Power Plant near Canton, Illinois. Specifically, this document addresses requirements pertaining to the design and construction history of the Bottom Ash Basin.

## 1.1 Identifying Information

### 1.1.1 Ownership

Illinois Power Resource Generating, LLC owns the Duck Creek Power Plant. IPRG owns the entire site, including the Bottom Ash Basin. The Duck Creek Power Plant is located at:

17751 North Cilco Road
Canton, Illinois 61520

### 1.1.2 Facility Name and Identification Number

The CCR surface impoundment is named the Bottom Ash Basin. The identification numbers for the Bottom Ash Basin are provided in Table 1.

**Table 1: Identification Numbers**

| Agency | Identification Number |
|---|---|
| IPRG ID Number | CCR Unit ID 205 |
| IEPA ID Number | W0578010001-03 |
| IDNR Dam ID Number | IL50716 |

## 1.2 Facility Information

The Bottom Ash Basin is an incised surface impoundment with reinforced concrete slopes and floor. The Bottom Ash Basin is subdivided into Primary Pond 1, Primary Pond 2, and the Secondary Pond. Primary Ponds 1 and 2 temporarily stored sluiced bottom ash from the Duck Creek Power Plant. Primary Ponds 1 and 2 operated alternately so that while one pond was receiving sluiced bottom ash, the other pond could be drained and the accumulated bottom ash could be removed. Removed bottom ash was loaded into trucks and beneficially reused or permanently disposed in the permitted on-site landfill. Water decanted from Primary Ponds 1 and 2 was routed into the Secondary Pond. The Secondary Pond operated as a polishing pond for water clarification. Settled bottom ash particles were periodically removed from the Secondary Pond and disposed in the permitted on-site landfill. Clarified water decanted from the Secondary Pond was routed to the Discharge Canal, which flows into Duck Creek Reservoir, with discharge at a permitted outfall in accordance with the site's National Pollutant Discharge Elimination System (NPDES) permit. The Bottom Ash Basin has not been operated since the Duck Creek Power Plant was retired in December 2019, and appreciable amounts of CCR have been removed and beneficially reused or disposed in the permitted on-site landfill.

### 1.2.1 Statement of Purpose

The Bottom Ash Basin was historically used to temporarily store and dewater sluiced bottom ash.

### 1.2.2 Operational Time Period

The Bottom Ash Basin operated from 2009 until the Duck Creek Power Plant was retired in December 2019.

### 1.2.3 CCR Material Received

The only CCR historically received at the Bottom Ash Basin was bottom ash. The Bottom Ash Basin has not received bottom ash since 2019, and no appreciable amount of bottom ash is currently present in the facility.

### 1.2.4 Facility Capacity

The facility capacity was estimated by a stage-storage analysis using Autodesk Civil 3D. The cumulative capacity of all three cells of the Bottom Ash Basin is estimated at approximately 4.8 acre-feet or 1.55 million gallons. No appreciable CCR is currently contained in the Bottom Ash Basin.

### 1.2.5 Area–Capacity Curve Analysis

The facility capacity was estimated by a stage–storage analysis using Autodesk Civil 3D. The area–capacity curves for the three cells of the Bottom Ash Basin are presented in Figure 1, Figure 2, and Figure 3.

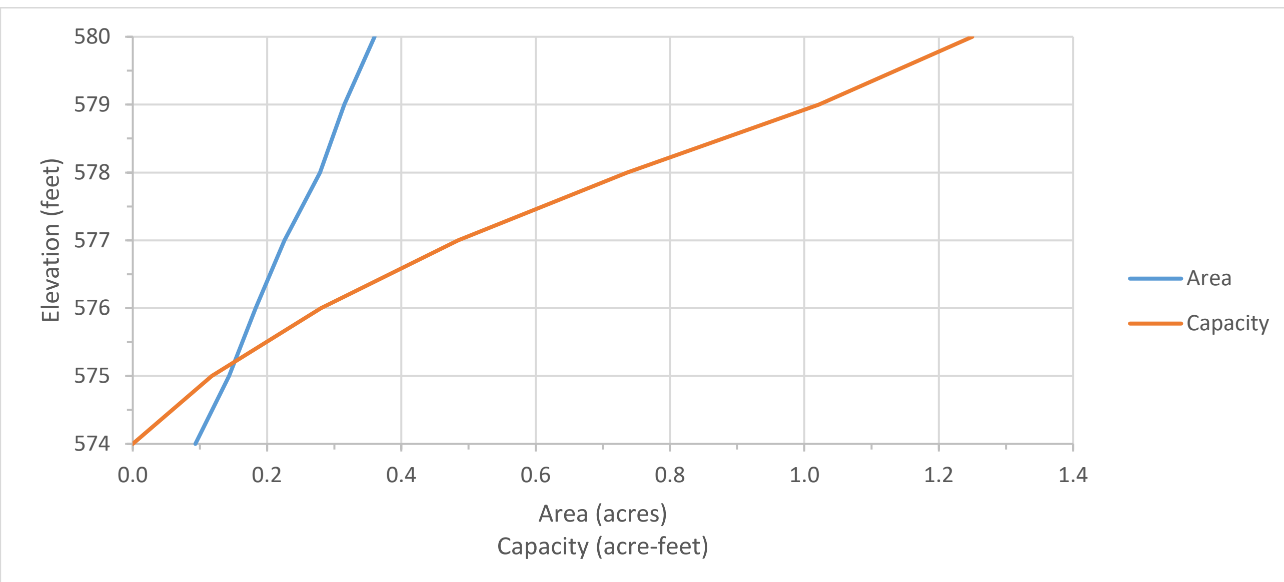



**Figure 1: Area–Capacity Curve for Primary Pond 1**

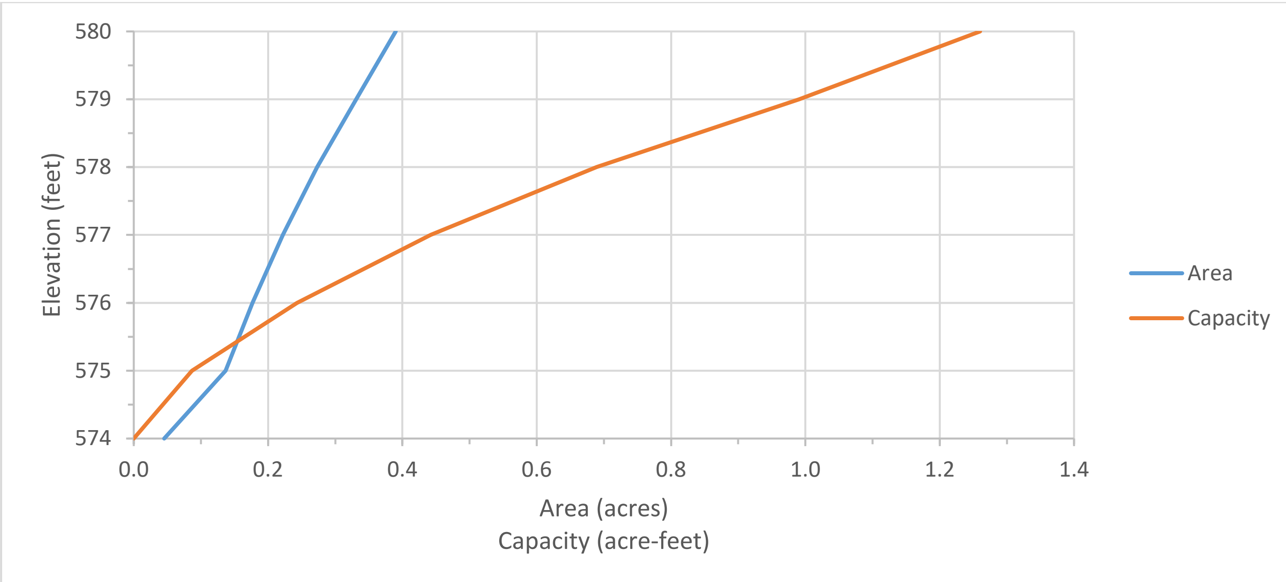



**Figure 2: Area–Capacity Curve for Primary Pond 2**

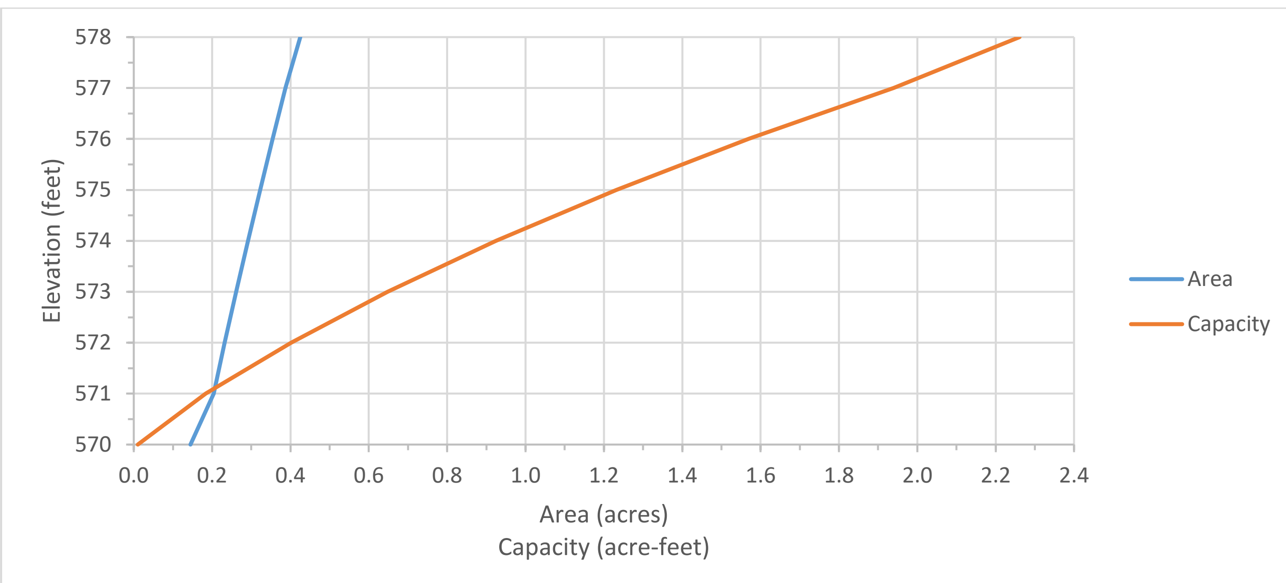



**Figure 3: Area–Capacity Curve for the Secondary Pond**

### 1.2.6 Rate of CCR Acceptance

The Bottom Ash Basin is no longer accepting CCR, and no appreciable CCR is currently contained in the Bottom Ash Basin.

## 1.3 Watershed

The Bottom Ash Basin is located in the Rice Lake-Illinois River Subwatershed with a Hydrologic Unit Code (HUC) of 071300030603. This watershed has a drainage area of 21,188 acres (USGS 2021).

## 1.4 Foundation and Abutment Materials

Results from the subsurface investigation conducted prior to construction of the Bottom Ash Basin, including the physical and engineering properties of the foundation materials and soils used for construction of the Bottom Ash Basin, are shown in Appendix A. Native soils in the area of the Bottom Ash Basin are generally low-plasticity silts. Additional information about the soils used to construct the Bottom Ash Basin and the associated construction requirements is provided in Section 3.0.

# 2.0 BOTTOM ASH BASIN DESIGN

The design of the Bottom Ash Basin was completed by Sargent & Lundy, LLC. The design drawings are provided in Appendix B. Based on Drawing No. C180-C1000-2, the existing liner system for the facility consists of (from top to bottom):

- eight inches of reinforced concrete
- one foot of compacted clay, placed in 6-inch-thick lifts to at least 95% of the standard Proctor maximum dry density
- sixty-mil high-density polyethylene (HDPE) geomembrane
- at least 6 inches of prepared subgrade (presumably native soils) compacted to at least 95% of the standard Proctor maximum dry density

## 2.1 Spillway and Diversion Design Features

During operation of the Bottom Ash Basin, bottom ash was hydraulically conveyed (sluiced) from the power plant in 10-inch-diameter, basalt-lined piping and deposited in Primary Pond 1 or 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 HDPE piping into the Secondary Pond. Further gravity settling occurred in the Secondary Pond before the sluice water was decanted via 12-inch-diameter corrugated HDPE piping into the Discharge Canal. Bottom ash particles gradually accumulated in Primary Pond 1 and Primary Pond 2, requiring periodic cleanout events. During cleanout events, heavy equipment was used to excavate bottom ash out of the cell, stage it on a concrete apron for dewatering as needed, and load it into trucks for beneficial reuse or permanent disposal in the permitted 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. After the Duck Creek Power Plant was retired, the remaining bottom ash was removed from the Bottom Ash Basin and beneficially reused or disposed in the permitted on-site landfill. A hydraulic analysis of the Bottom Ash Basin was conducted by AECOM (2016) and is provided in Appendix C. This analysis included an evaluation of the initial inflow design flood.

# 3.0 FACILITY CONSTRUCTION

The Bottom Ash Basin was constructed in 2009 in accordance with the Bottom Ash and Low Volume Sump Water Basin and Piping General Work Contract (Sargent & Lundy, LLC 2007). The contract included comprehensive construction specifications and a rigorous construction quality assurance (CQA) program.

## 3.1 Existing Instrumentation

The Bottom Ash Basin does not have instrumentation that is used for monitoring its operation.

## 3.2 Construction Specifications

Summaries of the key construction specification sections are provided in the following sections.

### 3.2.1 Concrete Specifications

The concrete specifications for construction of the Bottom Ash Basin are provided in Appendix D. According to the specifications for the reinforced concrete layer, the concrete 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). According to the design drawings (Appendix A), welded wire reinforcement (W5 wire, 12-inch mesh) was used.

### 3.2.2 Earthwork Specifications

The earthwork specifications for construction of the Bottom Ash Basin are provided in Appendix E. Key earthwork components of the Bottom Ash Basin construction included:

- compacted clay (one foot), placed in 6-inch-thick lifts to at least 95% of the standard Proctor maximum dry density
- prepared subgrade (minimum 6 inches) compacted to at least 95% of the standard Proctor maximum dry density

According to Appendix E, soil used for the compacted clay layer was required to classify as a low-plasticity clay (CL) under the Unified Soil Classification System. The minimum liquid limit was 30, and the plasticity index was required to be between 15 and 40. At least 50% of the material (by weight) needed to pass the No. 200 sieve, with at least 30% finer than 0.002 microns, no more than 10% retained on the ⅜-inch sieve, and no particles larger than ¾ inch. The construction specifications required a hydraulic conductivity of $1 \times 10^{-6}$ centimeters per second (cm/s) or less for the compacted clay layer.

### 3.2.3 Geomembrane Specifications

Geomembrane specifications used for the construction of the Bottom Ash Basin are provided in Appendix F. According to the design drawings, the geomembrane was composed of HDPE and had a thickness of 60 mils. According to the specifications, the geomembrane was generally intended to conform to GRI-GM13, which is a commonly used specification for geomembranes in waste containment application. The CQA program for the liner system included destructive and non-destructive testing of geomembrane seams to verify watertightness and strength.

## 3.3 Inspection, Maintenance, and Repairs

The Bottom Ash Basin is no longer in operation, so the requirement for an operation plan with procedures for inspection, maintenance, and repairs is not applicable.

## 3.4 Structural Instability Records

There is no record of structural instability associated with the Bottom Ash Basin.

# 4.0 REFERENCES

AECOM. 2016. CCR Certification Report: Initial Structural Stability Assessment, Initial Safety Factor Assessment, and Initial Inflow Design Flood Control System Plan for Bottom Ash Basin at Duck Creek Power Station. October.

Sargent & Lundy, LLC. 2007. Bottom Ash and Low Volume Sump Water Basin and Piping General Work Contract. September.

USGS (United States Geological Survey). 2021. The National Map Viewer. Available online: https://apps.nationalmap.gov/viewer/ (accessed October 19, 2021)

# Signature Page

**Golder Associates Inc.**



https://golderassociates.sharepoint.com/sites/141778/project files/6 deliverables/reports/9-r-bab_history_of_construction/9-r-0/21454861-9-r-0-bab_history_of_construction_22oct21.docx

**APPENDIX A**

# Soil Investigation Data

# FAX TRANSMISSION

TSC

**TESTING SERVICE CORPORATION**
1701 West Market Street, Suite B
Bloomington, IL 61701
309-821-0430
Fax: 309-821-1242

| Company | Hanson Professional Services | Date | February 28, 2006 |
|---|---|---|---|
| Attn: | Dan Whalen | From | Doug Ramsey |
| FAX: | 217-788-2503 | Pages | 11 (Including cover sheet) |

**COMMENTS:**

Following are the boring logs for the Bottom Ash Ponds at Duck Creek.

FEB-28-2006 13:36 HANSON 217 788 2503 P.02/11
02/28/2006 14:27 3098211242 TESTING SERVICE CORP PAGE 02/11

PROJECT Bottom Ash Ponds, Duck Creek Power Plant, Canton, IL

CLIENT Hanson Professional Services, Inc., 1525 S. Sixth St., Springfield, IL 62703

**TSC**

BORING **B-1** DATE STARTED **2-21-06** DATE COMPLETED **2-21-06** JOB **L-65,577**

| ELEVATIONS | |
|---|---|
| GROUND SURFACE | **579.6** |
| END OF BORING | **549.6** |

| WATER TABLE | |
|---|---|
| WHILE DRILLING | **19.5 '** |
| AT END OF BORING | **Caved @ 15'** |
| 24 HOURS | |

Offset 3' North

DISTANCE BELOW SURFACE IN FEET

| SAMPLE NO. | SAMPLE TYPE | N | WC | Qu | $\gamma_{DRY}$ | DEPTH | ELEV. | SOIL DESCRIPTIONS |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0.3 | 579.3 | Dark brown clayey TOPSOIL (OL) |
| 1 | SS | 2-4 5-11 | | | | | | Brown clayey SILT, trace sand and gravel (ML) |
| | | | | | | 2.0 | 577.6 | Brown-light brown clayey SILT, trace sand (ML) |
| 2 | ST | | | | | | | |
| 3 | SS | 1-4 5-7 | | | | | | |
| 4 A / 4 B | SS | 3-7 8-8 | | | | 7.5 | 572.1 | Brown clayey SILT, trace sand (ML) |
| 5 | ST | | | | | | | |
| 6 | SS | 1-2-3 | | | | | | |
| | | | | | | 18.0 | 561.6 | Light brown silty SAND, trace gravel (SM) |
| 7 A / 7 B | SS | 1-2-2 | | | | | | |
| 8 | ST | | | | | 24.0 | 555.6 | Brown sandy CLAY, trace gravel (CL) |
| | | | | | | 28.0 | 551.6 | Brown silty SAND, trace gravel (SM) |
| 9 A / 9 B | SS | 1-1-10 | | | | | | |
| | | | | | | | | End of Boring at 30' |

DRILL RIG NO. **242**

Division lines between deposits represent approximate boundaries between soil types; in-situ, the transition may be gradual.

PROJECT Bottom Ash Ponds, Duck Creek Power Plant, Canton, IL

CLIENT Hanson Professional Services, Inc., 1525 S. Sixth St., Springfield, IL 62703

TSC

BORING B-2 DATE STARTED 2-21-06 DATE COMPLETED 2-21-06 JOB L-65,577

| ELEVATIONS | | | WATER TABLE |
|---|---|---|---|
| GROUND SURFACE | 575.4 | WHILE DRILLING | DRY |
| END OF BORING | 545.4 | AT END OF BORING | DRY |
| | | 24 HOURS | |

Offset 4' South

DISTANCE BELOW SURFACE IN FEET

| Depth scale | LENGTH / RECOVERY | SAMPLE NO. | SAMPLE TYPE | N | WC | Qu | $\gamma_{DRY}$ | DEPTH | ELEV. | SOIL DESCRIPTIONS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | A | | | | | | 0.3 | 575.1 | Dark brown clayey TOPSOIL (OL) |
| | | 1 | SS | 2-4 6-5 | | | | | | Brown clayey SILT, trace sand (ML) |
| | | B | | | | | | | | |
| | | 2 | ST | | | | | | | |
| 5 | | 3 | SS | 3-5 6-6 | | | | | | |
| | | 4 | SS | 6-7 7-6 | | | | | | |
| | | 5 | ST | | | | | | | |
| 10 | | | | | | | | | | |
| | | 6 | SS | 2-1-2 | | | | | | |
| 15 | | | | | | | | | | |
| | | 7 | ST | | | | | 19.0 | 556.4 | Brown-light brown clayey SILT, little sand, trace gravel (ML) |
| 20 | | | | | | | | | | |
| | | | | | | | | 22.0 | 553.4 | Dark gray silty CLAY, trace sand and gravel (CL) |
| | | 8 | SS | 7-12-15 | | | | | | |
| 25 | | | | | | | | | | |
| | | 9 | ST | | | | | | | |
| | | 10 | SS | 8-13 | | | | | | |
| 30 | | | | | | | | | | End of Boring at 30' |
| 35 | | | | | | | | | | |

DRILL RIG NO. 242

Division lines between deposits represent approximate boundaries between soil types: in-situ, the transition may be gradual.

PROJECT Bottom Ash Ponds, Duck Creek Power Plant, Canton, IL

CLIENT **Hanson Professional Services, Inc., 1525 S. Sixth St., Springfield, IL 62703**

**TSC**

BORING **B-3** DATE STARTED **2-21-06** DATE COMPLETED **2-21-06** JOB **L-65,577**

ELEVATIONS

GROUND SURFACE **576.3**

END OF BORING **547.0**

WATER TABLE

WHILE DRILLING **28.0'**

AT END OF BORING **23.0'**

24 HOURS

| DISTANCE BELOW SURFACE IN FEET | SAMPLE NO. | SAMPLE TYPE | N | WC | Qu | $\gamma_{DRY}$ | DEPTH | ELEV. | SOIL DESCRIPTIONS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | 0.3 | 576.0 | Dark brown clayey TOPSOIL (OL) |
| | | | | | | | | | Brown clayey SILT, trace sand (ML) |
| | 1 | SS | 2-4 6-7 | | | | | | |
| | 2 | ST | | | | | | | |
| 5 | 3 | SS | 2-3 3-4 | | | | | | |
| | 4 A/B | SS | 5-5 4-4 | | | | | | |
| | 5 | SS | 0-2 4-5 | | | | | | |
| 10 | | | | | | | | | |
| | 6 | ST | | | | | | | |
| 15 | | | | | | | | | |
| | | | | | | | 18.0 | 558.3 | Brown silty CLAY, trace sand and gravel (CL) |
| | 7 | SS | 4-8-11 | | | | | | |
| 20 | | | | | | | | | |
| | | | | | | | 23.0 | 553.3 | Gray silty SAND, trace gravel (SM) |
| | 8 | ST | | | | | | | |
| | 9 | SS | 24-35 | | | | | | |
| 25 | | | | | | | | | |
| | 10 A/B | SS | 12-50/4" | | | | | | |
| | | | | | | | | | End of Boring at 29.3' |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

DRILL RIG NO. **242**

Division lines between deposits represent approximate boundaries between soil types; in-situ, the transition may be gradual.

PROJECT Bottom Ash Ponds, Duck Creek Power Plant, Canton, IL

CLIENT Hanson Professional Services, Inc., 1525 S. Sixth St., Springfield, IL 62703

TSC

BORING B-4 DATE STARTED 2-21-06 DATE COMPLETED 2-21-06 JOB L-65,577

| ELEVATIONS | |
|---|---|
| GROUND SURFACE | 575.7 |
| END OF BORING | 545.7 |

| WATER TABLE | |
|---|---|
| WHILE DRILLING | 23.0 ' |
| AT END OF BORING | 22.0 ' |
| 24 HOURS | |

DISTANCE BELOW SURFACE IN FEET

| SAMPLE NO. | TYPE | N | WC | Qu | γDRY | DEPTH | ELEV. | SOIL DESCRIPTIONS |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0.3 | 575.4 | Dark brown clayey TOPSOIL (OL) |
| 1 | SS | 2-3 4-5 | | | | | | Brown clayey SILT, trace sand (ML) |
| 2 | ST | | | | | | | |
| 3 | SS | 2-4 4-5 | | | | | | |
| 4 | SS | 4-5 6-6 | | | | | | |
| 5 | SS | 2-2 2-2 | | | | | | |
| 6 | ST | | | | | | | |
| | | | | | | 17.0 | 558.7 | Gray-brown silty CLAY, little sand, trace gravel (CL) |
| 7 | SS | 1-1-2 | | | | | | |
| 8 | ST | | | | | 23.0 | 552.7 | Brown silty SAND, trace gravel (SM) |
| 9 | SS | 7-34-44 | | | | 24.0 | 551.7 | Brown-gray sandy SILT, trace gravel (ML) |
| | | | | | | 28.0 | 547.7 | Gray silty CLAY, little sand, trace gravel (CL) 2' Blow-in at 28-1/2' |
| 10 | SS | 6-9-24 | | | | | | |
| | | | | | | | | End of Boring at 30' |

DRILL RIG NO. 242

Division lines between deposits represent approximate boundaries between soil types; in-situ, the transition may be gradual.

PROJECT Bottom Ash Ponds, Duck Creek Power Plant, Canton, IL

CLIENT Hanson Professional Services, Inc., 1525 S. Sixth St., Springfield, IL 62703

TSC

BORING B-5 DATE STARTED 2-22-06 DATE COMPLETED 2-22-06 JOB L-65,577

| ELEVATIONS | |
|---|---|
| GROUND SURFACE | 585.0 |
| END OF BORING | 555.0 |

| WATER TABLE | |
|---|---|
| ▼ WHILE DRILLING | 27.0 ' |
| ▽ AT END OF BORING | Caved @ 20' |
| ▼ 24 HOURS | |

DISTANCE BELOW SURFACE IN FEET

| SAMPLE NO. | SAMPLE TYPE | N | WC | Qu | $\gamma_{DRY}$ | DEPTH | ELEV. | SOIL DESCRIPTIONS |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0.4 | 584.6 | Dark brown clayey TOPSOIL (OL) |
| 1 | SS | 1-4 6-6 | | | | | | Brown clayey SILT, trace sand (ML) |
| 2 | ST | | | | | | | |
| 3 | SS | 2-4 4-6 | | | | | | |
| 4 | SS | 10-13 12-13 | | | | | | |
| 5 | SS | 12-10 9-8 | | | | | | |
| 6 | ST | | | | | 14.0 | 571.0 | Gray clayey SILT, trace sand (ML) |
| | | | | | | 18.0 | 567.0 | Brown clayey SILT, trace sand (ML) |
| 7 | SS | 2-2-3 | | | | | | |
| 8 | SS | 2-2-4 | | | | | | |
| | | | | | | | | ▼ |
| 9 | ST | | | | | 28.0 | 557.0 | Brown-gray clayey SILT, little sand, trace gravel (ML) |
| | | | | | | | | End of Boring at 30' |

DRILL RIG NO. 242

Division lines between deposits represent approximate boundaries between soil types; in-situ, the transition may be gradual.

PROJECT Bottom Ash Ponds, Duck Creek Power Plant, Canton, IL

CLIENT Hanson Professional Services, Inc., 1525 S. Sixth St., Springfield, IL 62703

TSC

BORING B-6 DATE STARTED 2-22-06 DATE COMPLETED 2-22-06 JOB L-65,577

ELEVATIONS

GROUND SURFACE 577.5

END OF BORING 547.5

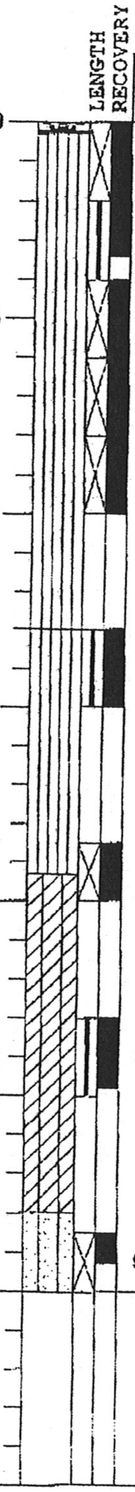
Offset 5' South

WATER TABLE

WHILE DRILLING 19.5 '

AT END OF BORING 20.0 '

24 HOURS



| SAMPLE NO. | SAMPLE TYPE | N | WC | Qu | $\gamma_{DRY}$ | DEPTH | ELEV. | SOIL DESCRIPTIONS |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0.3 | 577.2 | Dark brown clayey TOPSOIL (OL) |
| 1 | SS | 2-5 6-8 | | | | | | Brown clayey SILT, trace sand (ML) |
| 2 | ST | | | | | | | |
| 3 | SS | 1-3 3-4 | | | | | | |
| 4 | SS | 5-5 5-4 | | | | | | |
| 5 | SS | 1-2 2-2 | | | | | | |
| | | | | | | 13.0 | 564.5 | Gray clayey SILT, trace sand (ML) |
| 6 | ST | | | | | | | |
| 7 A / B | SS | 1-1-3 | | | | 19.3 | 558.2 | 1/2" Sand Seam at 19'-2" |
| | | | | | | | | Gray silty CLAY, trace sand and gravel (CL) |
| 8 | ST | | | | | | | |
| | | | | | | 28.0 | 549.5 | Gray silty SAND (ML) |
| 9 | SS | 3-3-5 | | | | | | |
| | | | | | | | | End of Boring at 30' |

DISTANCE BELOW SURFACE IN FEET: 0, 5, 10, 15, 20, 25, 30, 35

DRILL RIG NO. 242

Division lines between deposits represent approximate boundaries between soil types; in-situ, the transition may be gradual.

PROJECT Bottom Ash Ponds, Duck Creek Power Plant, Canton, IL

CLIENT Hanson Professional Services, Inc., 1525 S. Sixth St., Springfield, IL 62703

TSC

BORING B-7 DATE STARTED 2-22-06 DATE COMPLETED 2-22-06 JOB L-65,577

ELEVATIONS

GROUND SURFACE ______

END OF BORING ______

WATER TABLE

| | |
|---|---|
| WHILE DRILLING | DRY |
| AT END OF BORING | DRY |
| 24 HOURS | |

DISTANCE BELOW SURFACE IN FEET

| SAMPLE NO. | SAMPLE TYPE | N | WC | Qu | $\gamma_{DRY}$ | DEPTH | ELEV. | SOIL DESCRIPTIONS |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0.3 | | Dark brown clayey TOPSOIL (OL) |
| 1 | SS | 3-7-7 | | | | | | Brown clayey SILT, trace sand (ML) |
| 2 | SS | 3-2-2 | | | | 3.0 | | Gray clayey SILT, trace sand (ML) |
| 3 | SS | 1-3-3 | | | | 6.0 | | Brown sandy PEAT (PT) |
| 4 | SS | 0-2-2 | | | | 8.5 | | Brown-gray clayey SILT, little sand, trace gravel (ML) |
| 5 | SS | 0-2-2 | | | | 11.0 | | Brown clayey SILT, trace sand (ML) |
| 6 | SS | 1-2-4 | | | | 13.5 | | Gray silty SAND, trace gravel (SM) |
| 7 | SS | 2-3-4 | | | | 18.0 | | Brown clayey SILT, trace sand and gravel (ML) |
| A | | | | | | 23.0 | | Gray-brown silty CLAY, trace sand and gravel (CL) |
| 8 B | SS | 1-2-3 | | | | 24.5 | | Brown clayey SILT, trace sand and organics (ML) |
| | | | | | | 27.0 | | Gray clayey SILT, little sand, trace organics (ML) |
| 9 | SS | 1-3-4 | | | | | | |
| | | | | | | | | End of Boring at 30' |

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35

DRILL RIG NO. 242

Division lines between deposits represent approximate boundaries between soil types: in-situ, the transition may be gradual.

PROJECT Bottom Ash Ponds, Duck Creek Power Plant, Canton, IL

TSC

CLIENT Hanson Professional Services, Inc., 1525 S. Sixth St., Springfield, IL 62703

BORING B-8 DATE STARTED 2-22-06 DATE COMPLETED 2-22-06 JOB L-65,577

ELEVATIONS

GROUND SURFACE

END OF BORING

WATER TABLE

| | |
|---|---|
| WHILE DRILLING | DRY |
| AT END OF BORING | DRY |
| 24 HOURS | |

DISTANCE BELOW SURFACE IN FEET

| Sample No. | Sample Type | N | WC | Qu | $\gamma_{DRY}$ | DEPTH | ELEV. | SOIL DESCRIPTIONS |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 0.3 | | Dark brown clayey TOPSOIL (OL) |
| | | | | | | | | Brown clayey SILT, trace sand (ML) |
| 1 | SS | 2-4-5 | | | | | | |
| 2 | SS | 2-3-5 | | | | | | |
| 3 | SS | 2-4-6 | | | | | | |
| | | | | | | 8.0 | | Gray clayey SILT, trace sand (ML) |
| 4 | SS | 3-4-5 | | | | | | |
| | | | | | | 11.0 | | Brown clayey SILT, trace sand (ML) |
| 5 | SS | 3-4-4 | | | | | | |
| | | | | | | 13.0 | | Gray silty CLAY, trace sand (CL) |
| 6A / 6B | SS | 0-2-2 | | | | 14.5 | | Gray-brown clayey SILT, trace sand (ML) |
| | | | | | | 18.0 | | Gray clayey SILT, trace sand and gravel (ML) |
| 7 | SS | 0-2-2 | | | | | | |
| | | | | | | 23.0 | | Gray silty CLAY, little sand and gravel (CL) |
| 8 | SS | 0-1-3 | | | | | | |
| | | | | | | 25.0 | | Gray clayey SILT, trace sand (ML) |
| | | | | | | 28.0 | | Brown PEAT, trace clayey silt (PT) |
| 9 | SS | 2-2-4 | | | | | | |
| | | | | | | | | End of Boring at 30' |

DRILL RIG NO. 242

Division lines between deposits represent approximate boundaries between soil types; in-situ, the transition may be gradual.

PROJECT Bottom Ash Ponds, Duck Creek Power Plant, Canton, IL

CLIENT Hanson Professional Services, Inc., 1525 S. Sixth St., Springfield, IL 62703

TSC

BORING B-9 DATE STARTED 2-23-06 DATE COMPLETED 2-23-06 JOB L-65,577

ELEVATIONS

GROUND SURFACE ______

END OF BORING ______

WATER TABLE

WHILE DRILLING DRY

AT END OF BORING DRY

24 HOURS ______

| DISTANCE BELOW SURFACE IN FEET | SAMPLE NO. | TYPE | N | WC | Qu | γDRY | DEPTH | ELEV. | SOIL DESCRIPTIONS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | 0.6 | | Dark brown clayey TOPSOIL (OL) |
| | 1 | SS | 3-4-7 | | | | | | Brown clayey SILT, trace sand and gravel (ML) |
| 5 | 2 | SS | 5-10-12 | | | | | | |
| | 3 | SS | 4-7-7 | | | | | | |
| 10 | 4 | SS | 3-8-10 | | | | 11.0 | | |
| | 5 A | SS | 1-2-4 | | | | | | Brown-gray clayey SILT, trace sand and gravel (ML) |
| | 5 B | | | | | | 12.3 | | Black COAL |
| | | | | | | | 13.0 | | Brown clayey SILT, trace sand and gravel (ML) |
| 15 | 6 | SS | 2-3-2 | | | | 18.0 | | |
| | 7 A | SS | 2-3-2 | | | | 18.8 | | Gray clayey SILT, little sand, trace gravel (ML) |
| | | | | | | | 19.3 | | Gray silty SAND (SM) |
| 20 | 7 B | | | | | | 23.0 | | Brown-gray clayey SILT, trace sand and gravel (ML) |
| 25 | 8 | SS | 0-1-2 | | | | 28.0 | | Brown silty CLAY, trace sand and gravel (CL) |
| 30 | 9 | SS | 0-1-2 | | | | | | Brown clayey SILT, trace sand and gravel (ML) |
| 35 | | | | | | | | | End of Boring at 30' |

LENGTH RECOVERY

DRILL RIG NO. 242

Division lines between deposits represent approximate boundaries between soil types; in-situ, the transition may be gradual.

PROJECT Bottom Ash Ponds, Duck Creek Power Plant, Canton, IL

CLIENT Hanson Professional Services, Inc., 1525 S. Sixth St., Springfield, IL 62703

TSC

BORING B-10 DATE STARTED 2-23-06 DATE COMPLETED 2-23-06 JOB L-65,577

ELEVATIONS

GROUND SURFACE

END OF BORING

WATER TABLE

▼ WHILE DRILLING DRY

▽ AT END OF BORING DRY

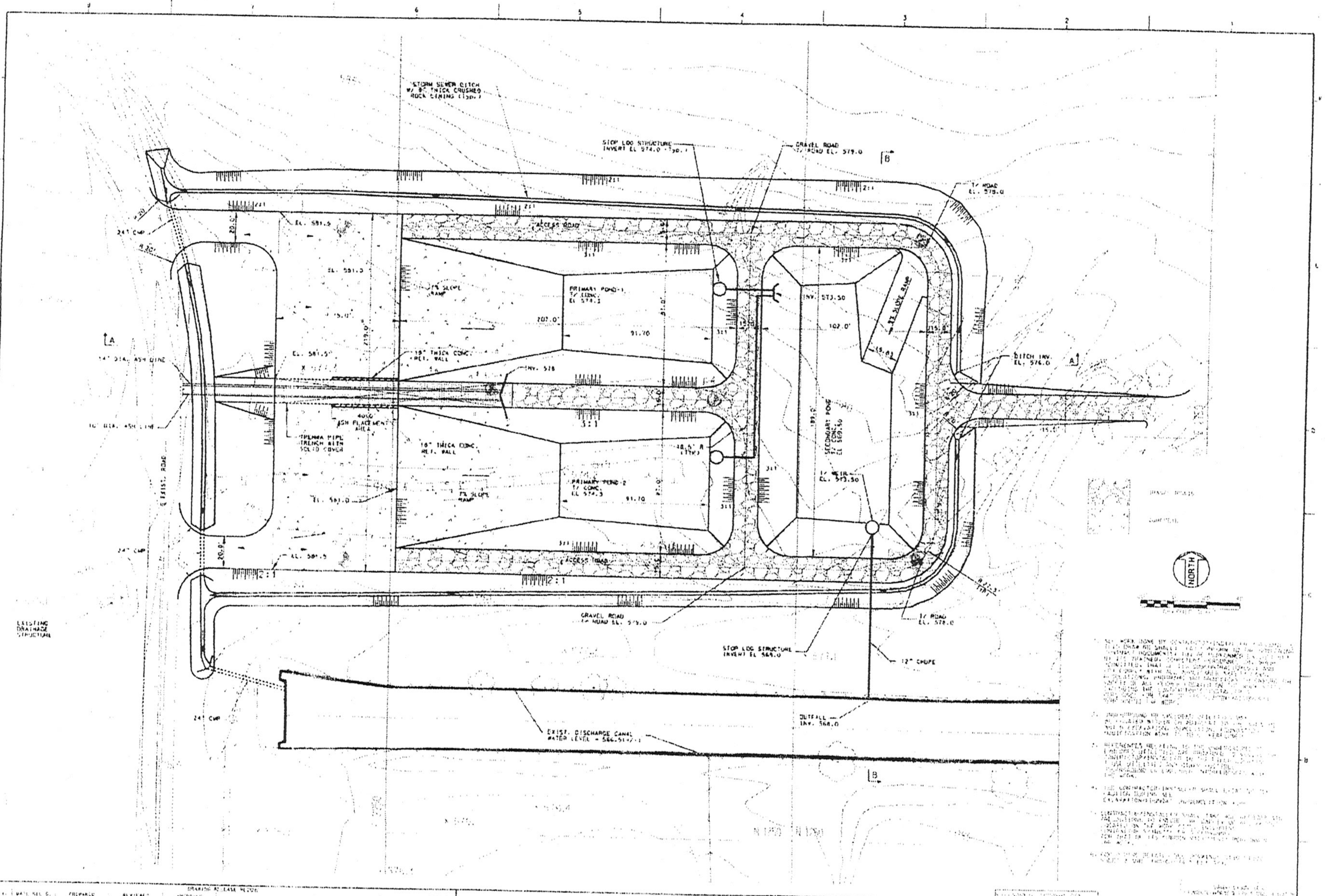
▼ 24 HOURS

DISTANCE BELOW SURFACE IN FEET

| SAMPLE NO. | SAMPLE TYPE | N | WC | Qu | γDRY | DEPTH | ELEV. | SOIL DESCRIPTIONS |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Dark brown clayey TOPSOIL (OL) |
| | | | | | | 0.6 | | Brown clayey SILT, trace sand and gravel (ML) |
| 1 | SS | 2-5-6 | | | | | | |
| 2 | SS | 4-8-10 | | | | | | |
| 3 | SS | 3-8-7 | | | | | | |
| 4 | SS | 2-4-5 | | | | | | |
| | | | | | | 11.0 | | Gray-brown clayey SILT, trace sand (ML) |
| 5 | SS | 2-4-5 | | | | | | |
| | | | | | | 13.0 | | Brown-gray silty CLAY, trace sand and gravel (CL) |
| 6 | SS | 1-1-2 | | | | | | |
| | | | | | | 18.0 | | Brown-gray clayey SILT, trace sand and organics (ML) |
| 7 | SS | 1-1-3 | | | | | | |
| | | | | | | 23.0 | | Brown clayey SILT, trace sand (ML) |
| 8 | SS | 0-2-2 | | | | | | |
| 9 | SS | 0-2-2 | | | | | | |
| | | | | | | | | End of Boring at 30' |

DRILL RIG NO. 242

Division lines between deposits represent approximate boundaries between soil types; in-situ, the transition may be gradual.



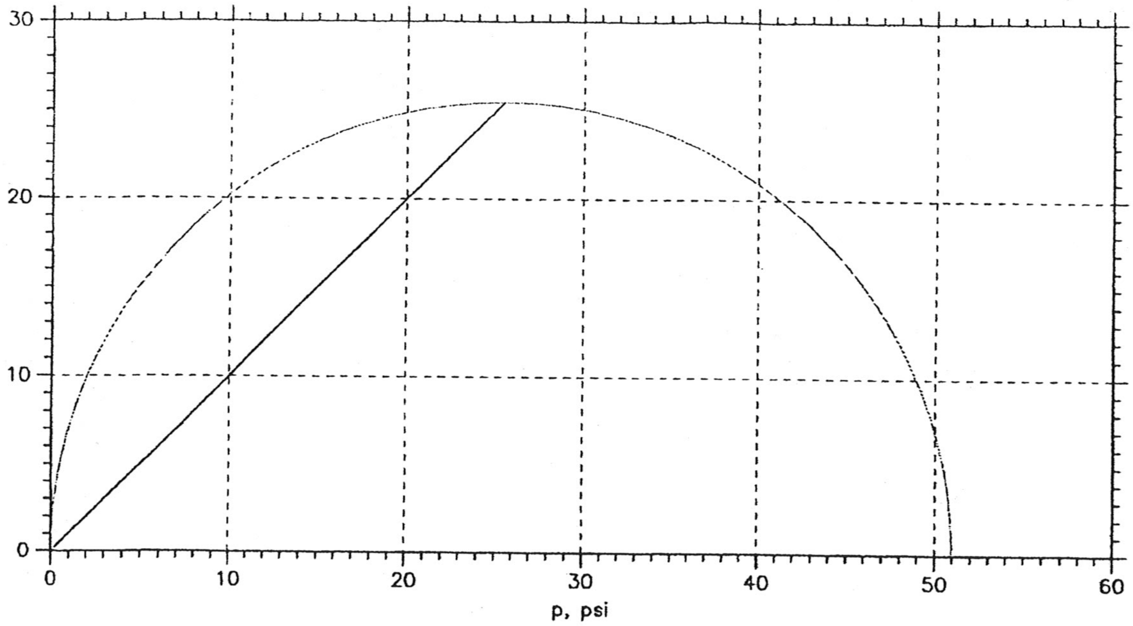

AMEREN ENERGY RESOURCES
GENERATING COMPANY
DUCK CREEK
GENERATING STATION

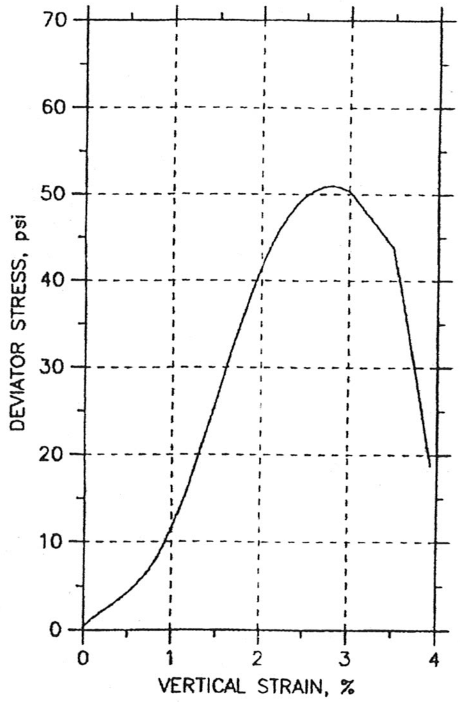
BOTTOM ASH AND LOW VOLUME
WASTE BASIN PLAN

DRAWING NO. C-1000

REV. 0

# TRIAXIAL COMPRESSION TEST REPORT




| | | | | | | |
|---|---|---|---|---|---|---|
| Symbol | | | | | | |
| Test No. | | 1 | | | | |
| Initial | Diameter, in | 2.875 | | | | |
| | Height, in | 5.743 | | | | |
| | Water Content, % | 16.07 | | | | |
| | Dry Density, pcf | 108.63 | | | | |
| | Saturation, % | 78.66 | | | | |
| | Void Ratio | 0.55171 | | | | |
| Before Shear | Water Content, % | 16.07 | | | | |
| | Dry Density, pcf | 117.55 | | | | |
| | Saturation, % | 100.00 | | | | |
| | Void Ratio | 0.43397 | | | | |
| | Back Press., psi | --- | | | | |
| Minor Prin. Stress, psi | | 0 | | | | |
| Max. Dev. Stress, psi | | 50.961 | | | | |
| Time to Failure, min | | 1.8216 | | | | |
| Strain Rate, %/min | | 1.5 | | | | |
| B-Value | | --- | | | | |
| Specific Gravity | | 2.70 | | | | |
| Liquid Limit | | 0 | | | | |
| Plastic Limit | | 0 | | | | |
| Plasticity Index | | 0 | | | | |
| Failure Sketch | | | | | | |

| |
|---|
| Project: Duck Creek Ash Pond |
| Location: Canton, Illinois |
| Project No.: 03S5010 |
| Boring No.: B-1 |
| Sample Type: Tube 2-3 |
| Description: Brn. & gray vf. sandy silt. |
| Remarks: |

Mon, 10-APR-2006 14:34:02

TRIAXIAL TEST

| | | |
|---|---|---|
| 'roject: Duck Creek Ash Pond | Location: Canton, Illinois | Project No.: 03S5010 |
| ;oring No.: B-1 | Tested By: Rin | Checked By: JPK |
| ;ample No.: 2-3 | Test Date: 03/06/06 | Depth: 2.8-3.3 |
| 'est No.: 1 | Sample Type: Tube 2-3 | Elevation: N/A |

;oil Description: Brn. & gray vf. sandy silt.
:emarks:

| | | |
|---|---|---|
| ;pecimen Height: 5.74 in | Piston Area: 0.20 in^2 | Filter Correction: 0.00 psi |
| ;pecimen Area: 6.49 in^2 | Piston Friction: 0.00 lb | Membrane Correction: 0.00 lb/in |
| ;pecimen Volume: 0.02 ft^3 | Piston Weight: 0.50 lb | Correction Type: Uniform |
| .iquid Limit: 0 | Plastic Limit: 0 | Specific Gravity: 2.70 |

| | Before Test Trimmings | Before Test Specimen+Ring | After Test Specimen+Ring | After Test Trimmings |
|---|---|---|---|---|
| :ontainer ID | 42 | --- | | |
| /t. Container + Wet Soil, gm | 64.31 | 1233.9 | 1233.9 | 0 |
| /t. Container + Dry Soil, gm | 55.92 | 1063.1 | 1063.1 | 0 |
| /t. Container, gm | 3.72 | --- | 0 | 0 |
| /t. Dry Soil, gm | 52.2 | 1063.1 | 1063.1 | 0 |
| /ater Content, % | 16.07 | 16.07 | 16.07 | 0.00 |
| /oid Ratio | --- | 0.55 | 0.43 | --- |
| )egree of Saturation, % | --- | 78.66 | 100.00 | --- |
| )ry Unit Weight, pcf | --- | 108.63 | 117.55 | --- |

:nitial

:nd of Initialization

:nd of Consolidation/A

:nd of Saturation

:nd of Consolidation/B

:nd of Shear

\t Failure

TRIAXIAL TEST

Project: Duck Creek Ash Pond
Boring No.: B-1
Sample No.: 2-3
Test No.: 1

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube 2-3

Project No.: 03S5010
Checked By: JPK
Depth: 2.8-3.3
Elevation: N/A

Soil Description: Brn. & gray vf. sandy silt.
Remarks:

Specimen Height: 5.74 in
Specimen Area: 6.49 in^2
Specimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

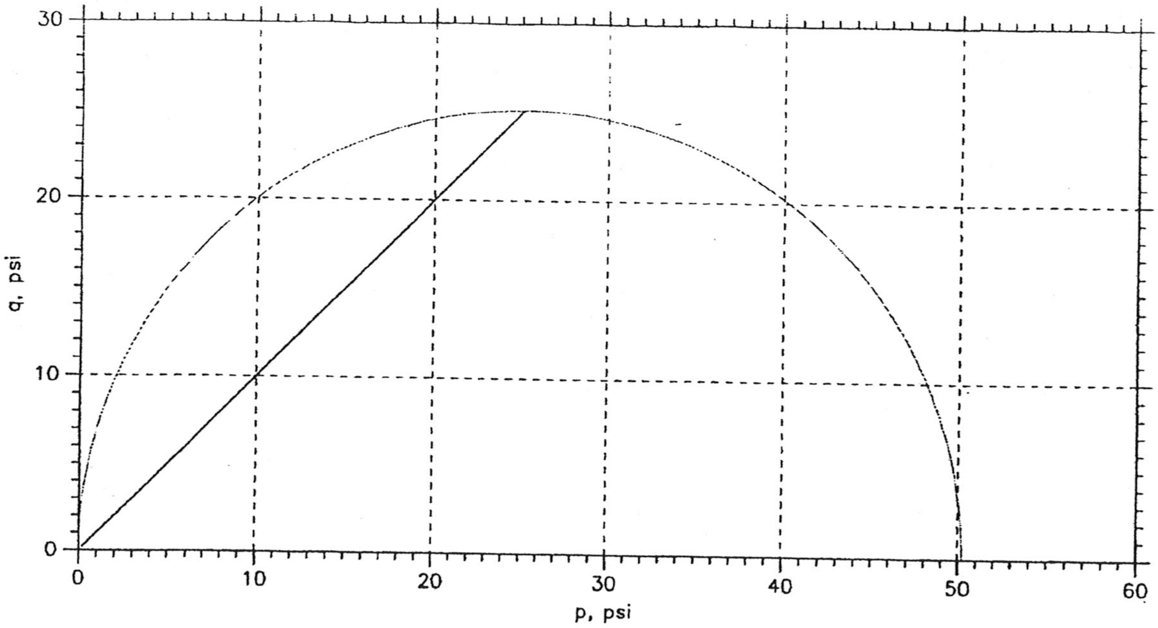
Liquid Limit: 0

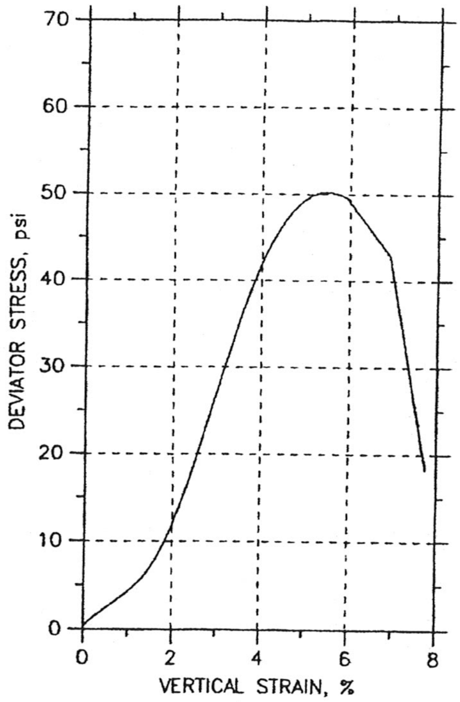
Plastic Limit: 0

Specific Gravity: 2.70

| | Time min | Vertical Strain % | Corrected Area in^2 | Deviator Load lb | Deviator Stress psi | Vertical Stress psi | p psi | q psi |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 6.4918 | 2.5658 | 0.39524 | 0.39524 | 0.19762 | 0.19762 |
| 2 | 0.0711 | 0.099749 | 6.4983 | 8.3699 | 1.288 | 1.288 | 0.64401 | 0.64401 |
| 3 | 0.13777 | 0.20145 | 6.5049 | 13.387 | 2.058 | 2.058 | 1.029 | 1.029 |
| 4 | 0.20027 | 0.30023 | 6.5114 | 17.814 | 2.7358 | 2.7358 | 1.3679 | 1.3679 |
| 5 | 0.2672 | 0.40487 | 6.5182 | 22.732 | 3.4875 | 3.4875 | 1.7438 | 1.7438 |
| 6 | 0.3297 | 0.50364 | 6.5247 | 27.848 | 4.2681 | 4.2681 | 2.134 | 2.134 |
| 7 | 0.3922 | 0.60143 | 6.5311 | 33.849 | 5.1827 | 5.1827 | 2.5913 | 2.5913 |
| 8 | 0.45887 | 0.70509 | 6.5379 | 41.227 | 6.3058 | 6.3058 | 3.1529 | 3.1529 |
| 9 | 0.52137 | 0.80191 | 6.5443 | 50.375 | 7.6976 | 7.6976 | 3.8488 | 3.8488 |
| 10 | 0.58803 | 0.90459 | 6.5511 | 62.672 | 9.5667 | 9.5667 | 4.7833 | 4.7833 |
| 11 | 0.65053 | 1.0004 | 6.5574 | 76.248 | 11.628 | 11.628 | 5.8139 | 5.8139 |
| 12 | 0.7172 | 1.1041 | 6.5643 | 92.971 | 14.163 | 14.163 | 7.0816 | 7.0816 |
| 13 | 0.78387 | 1.2048 | 6.571 | 112.15 | 17.068 | 17.068 | 8.534 | 8.534 |
| 14 | 0.84637 | 1.3007 | 6.5774 | 131.93 | 20.058 | 20.058 | 10.029 | 10.029 |
| 15 | 0.90887 | 1.4004 | 6.584 | 152.78 | 23.205 | 23.205 | 11.603 | 11.603 |
| 16 | 0.97553 | 1.5031 | 6.5909 | 175.31 | 26.599 | 26.599 | 13.299 | 13.299 |
| 17 | 1.038 | 1.6009 | 6.5974 | 196.85 | 29.838 | 29.838 | 14.919 | 14.919 |
| 18 | 1.1047 | 1.7036 | 6.6043 | 218.59 | 33.099 | 33.099 | 16.549 | 16.549 |
| 19 | 1.1672 | 1.8004 | 6.6108 | 238.37 | 36.057 | 36.057 | 18.029 | 18.029 |
| 20 | 1.238 | 1.9031 | 6.6177 | 258.14 | 39.007 | 39.007 | 19.504 | 19.504 |
| 21 | 1.3005 | 1.9999 | 6.6243 | 274.86 | 41.493 | 41.493 | 20.747 | 20.747 |
| 22 | 1.3672 | 2.1006 | 6.6311 | 290.6 | 43.824 | 43.824 | 21.912 | 21.912 |
| 23 | 1.4339 | 2.2043 | 6.6381 | 304.08 | 45.808 | 45.808 | 22.904 | 22.904 |
| 24 | 1.4964 | 2.3021 | 6.6448 | 314.8 | 47.376 | 47.376 | 23.688 | 23.688 |
| 25 | 1.563 | 2.4047 | 6.6518 | 324.05 | 48.716 | 48.716 | 24.358 | 24.358 |
| 26 | 1.6255 | 2.5025 | 6.6584 | 331.04 | 49.717 | 49.717 | 24.858 | 24.858 |
| 27 | 1.6922 | 2.6052 | 6.6655 | 336.35 | 50.461 | 50.461 | 25.231 | 25.231 |
| 28 | 1.755 | 2.702 | 6.6721 | 339.3 | 50.853 | 50.853 | 25.427 | 25.427 |
| 29 | 1.8216 | 2.8057 | 6.6792 | 340.38 | 50.961 | 50.961 | 25.481 | 25.481 |
| 30 | 1.8841 | 2.9015 | 6.6858 | 339.5 | 50.779 | 50.779 | 25.389 | 25.389 |
| 31 | 1.9508 | 3.0042 | 6.6929 | 337.04 | 50.357 | 50.357 | 25.179 | 25.179 |
| 32 | 2.2675 | 3.5 | 6.7273 | 294.83 | 43.827 | 43.827 | 21.913 | 21.913 |
| 33 | 2.5425 | 3.9264 | 6.7571 | 126.61 | 18.738 | 18.738 | 9.369 | 9.369 |

# TRIAXIAL COMPRESSION TEST REPORT




| | | | | | |
|---|---|---|---|---|---|
| Symbol | | | | | |
| Test No. | | 2 | | | |
| Initial | Diameter, in | 2.855 | | | |
| | Height, in | 2.909 | | | |
| | Water Content, % | 23.02 | | | |
| | Dry Density, pcf | 93.797 | | | |
| | Saturation, % | 77.97 | | | |
| | Void Ratio | 0.79702 | | | |
| Before Shear | Water Content, % | 23.02 | | | |
| | Dry Density, pcf | 103.96 | | | |
| | Saturation, % | 100.00 | | | |
| | Void Ratio | 0.62143 | | | |
| | Back Press., psi | --- | | | |
| Minor Prin. Stress, psi | | 0 | | | |
| Max. Dev. Stress, psi | | 50.224 | | | |
| Time to Failure, min | | 1.8216 | | | |
| Strain Rate, %/min | | 1.5 | | | |
| B-Value | | --- | | | |
| Specific Gravity | | 2.70 | | | |
| Liquid Limit | | 0 | | | |
| Plastic Limit | | 0 | | | |
| Plasticity Index | | 0 | | | |
| Failure Sketch | | | | | |

| |
|---|
| Project: Duck Creek Ash Pond |
| Location: Canton, Illinois |
| Project No.: 03S5010 |
| Boring No.: B-1 |
| Sample Type: Tube 5-1 |
| Description: Brn. vf. sandy silt. |
| Remarks: |

Mon, 10-APR-2006 14:34:41

TRIAXIAL TEST

rroject: Duck Creek Ash Pond
3oring No.: B-1
Sample No.: S-1
Test No.: 2

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube S-1

Project No.: 03S5010
Checked By: JPK
Depth: 8.0-8.5
Elevation: N/A

Soil Description: Brn. vf. sandy silt.
Remarks:

Specimen Height: 2.91 in
Specimen Area: 6.40 in^2
Specimen Volume: 0.01 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

Liquid Limit: 0

Plastic Limit: 0

Specific Gravity: 2.70

| | Before Test Trimmings | Before Test Specimen+Ring | After Test Specimen+Ring | After Test Trimmings |
|---|---|---|---|---|
| Container ID | 41 | --- | | |
| Wt. Container + Wet Soil, gm | 82.68 | 564.05 | 564.05 | 0 |
| Wt. Container + Dry Soil, gm | 67.92 | 458.52 | 458.52 | 0 |
| Wt. Container, gm | 3.79 | --- | 0 | 0 |
| Wt. Dry Soil, gm | 64.13 | 458.52 | 458.52 | 0 |
| Water Content, % | 23.02 | 23.02 | 23.02 | 0.00 |
| Void Ratio | --- | 0.80 | 0.62 | --- |
| Degree of Saturation, % | --- | 77.97 | 100.00 | --- |
| Dry Unit Weight, pcf | --- | 93.797 | 103.96 | --- |

Initial

End of Initialization

End of Consolidation/A

End of Saturation

End of Consolidation/B

End of Shear

At Failure

TRIAXIAL TEST

roject: Duck Creek Ash Pond
oring No.: B-1
ample No.: 5-1
est No.: 2

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube 5-1

Project No.: 0355010
Checked By: JPK
Depth: 8.0-8.5
Elevation: N/A

oil Description: Brn. vf. sandy silt.
emarks:

pecimen Height: 2.91 in
pecimen Area: 6.40 in^2
pecimen Volume: 0.01 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

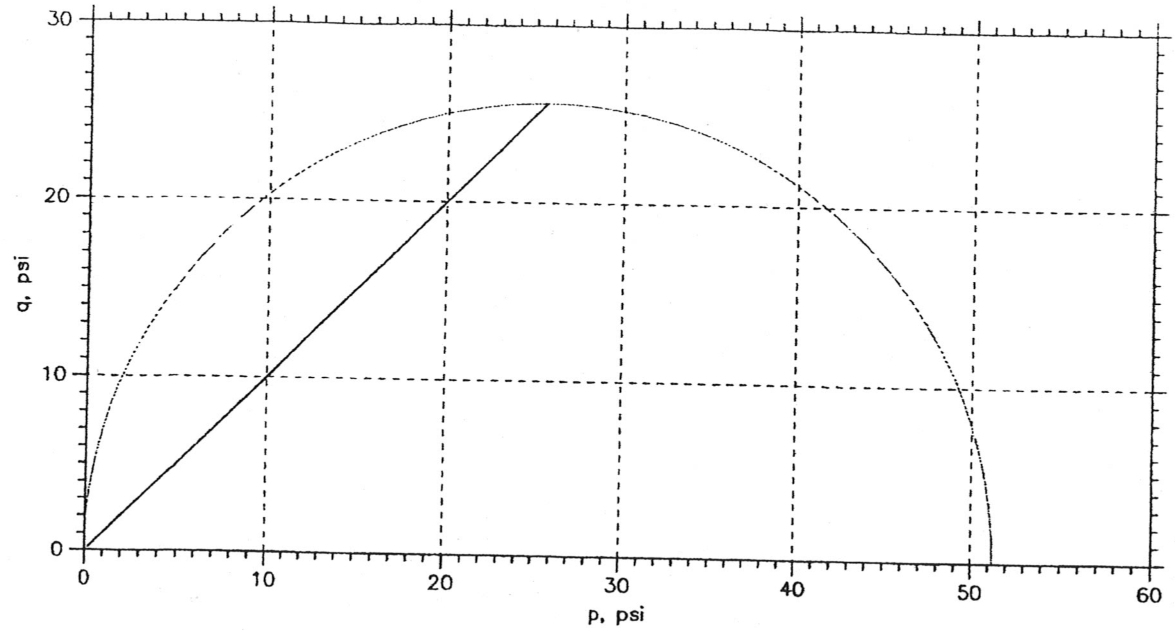
iquid Limit: 0

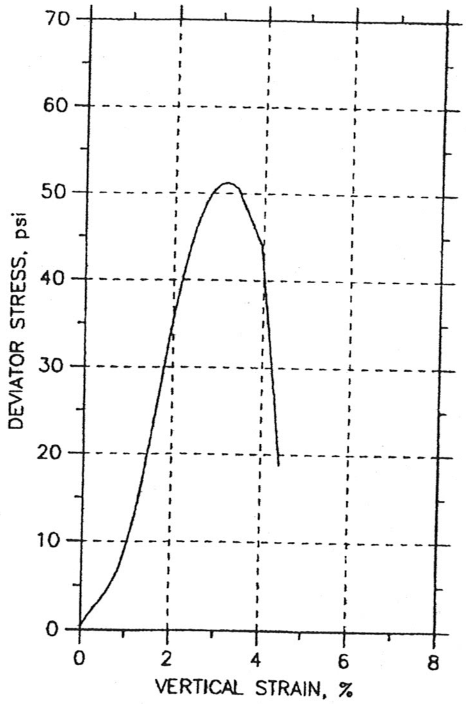
Plastic Limit: 0

Specific Gravity: 2.70

| | Time min | Vertical Strain % | Corrected Area in^2 | Deviator Load lb | Deviator Stress psi | Vertical Stress psi | p psi | q psi |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 6.4018 | 2.5658 | 0.4008 | 0.4008 | 0.2004 | 0.2004 |
| 2 | 0.0711 | 0.19693 | 6.4144 | 8.3699 | 1.3049 | 1.3049 | 0.65243 | 0.65243 |
| 3 | 0.13777 | 0.39772 | 6.4274 | 13.387 | 2.0828 | 2.0828 | 1.0414 | 1.0414 |
| 4 | 0.20027 | 0.59271 | 6.44 | 17.814 | 2.7661 | 2.7661 | 1.3831 | 1.3831 |
| 5 | 0.2672 | 0.79929 | 6.4534 | 22.732 | 3.5226 | 3.5226 | 1.7613 | 1.7613 |
| 6 | 0.3297 | 0.99429 | 6.4661 | 27.848 | 4.3068 | 4.3068 | 2.1534 | 2.1534 |
| 7 | 0.3922 | 1.1874 | 6.4787 | 33.849 | 5.2246 | 5.2246 | 2.6123 | 2.6123 |
| 8 | 0.45887 | 1.392 | 6.4922 | 41.227 | 6.3502 | 6.3502 | 3.1751 | 3.1751 |
| 9 | 0.52137 | 1.5831 | 6.5048 | 50.375 | 7.7444 | 7.7444 | 3.8722 | 3.8722 |
| 10 | 0.58803 | 1.7859 | 6.5182 | 62.672 | 9.6149 | 9.6149 | 4.8075 | 4.8075 |
| 11 | 0.65053 | 1.9751 | 6.5308 | 76.248 | 11.675 | 11.675 | 5.8376 | 5.8376 |
| 12 | 0.7172 | 2.1797 | 6.5445 | 92.971 | 14.206 | 14.206 | 7.1031 | 7.1031 |
| 13 | 0.78387 | 2.3786 | 6.5578 | 112.15 | 17.102 | 17.102 | 8.5512 | 8.5512 |
| 14 | 0.84637 | 2.5678 | 6.5705 | 131.93 | 20.079 | 20.079 | 10.039 | 10.039 |
| 15 | 0.90887 | 2.7647 | 6.5838 | 152.78 | 23.206 | 23.206 | 11.603 | 11.603 |
| 16 | 0.97553 | 2.9674 | 6.5976 | 175.31 | 26.572 | 26.572 | 13.286 | 13.286 |
| 17 | 1.038 | 3.1605 | 6.6107 | 196.85 | 29.778 | 29.778 | 14.889 | 14.889 |
| 18 | 1.1047 | 3.3632 | 6.6246 | 218.59 | 32.997 | 32.997 | 16.499 | 16.499 |
| 19 | 1.1672 | 3.5543 | 6.6377 | 238.37 | 35.911 | 35.911 | 17.955 | 17.955 |
| 20 | 1.238 | 3.7571 | 6.6517 | 258.14 | 38.808 | 38.808 | 19.404 | 19.404 |
| 21 | 1.3005 | 3.9482 | 6.6649 | 274.86 | 41.24 | 41.24 | 20.62 | 20.62 |
| 22 | 1.3672 | 4.1471 | 6.6788 | 290.6 | 43.512 | 43.512 | 21.756 | 21.756 |
| 23 | 1.4339 | 4.3517 | 6.6931 | 304.08 | 45.432 | 45.432 | 22.716 | 22.716 |
| 24 | 1.4964 | 4.5448 | 6.7066 | 314.8 | 46.939 | 46.939 | 23.47 | 23.47 |
| 25 | 1.563 | 4.7475 | 6.7209 | 324.05 | 48.216 | 48.216 | 24.108 | 24.108 |
| 26 | 1.6255 | 4.9406 | 6.7345 | 331.04 | 49.155 | 49.155 | 24.577 | 24.577 |
| 27 | 1.6922 | 5.1433 | 6.7489 | 336.35 | 49.837 | 49.837 | 24.919 | 24.919 |
| 28 | 1.755 | 5.3344 | 6.7625 | 339.3 | 50.173 | 50.173 | 25.087 | 25.087 |
| 29 | 1.8216 | 5.5391 | 6.7772 | 340.38 | 50.224 | 50.224 | 25.112 | 25.112 |
| 30 | 1.8841 | 5.7283 | 6.7908 | 339.5 | 49.993 | 49.993 | 24.997 | 24.997 |
| 31 | 1.9508 | 5.931 | 6.8054 | 337.04 | 49.525 | 49.525 | 24.762 | 24.762 |
| 32 | 2.2675 | 6.9098 | 6.877 | 294.83 | 42.872 | 42.872 | 21.436 | 21.436 |
| 33 | 2.5425 | 7.7516 | 6.9397 | 126.61 | 18.245 | 18.245 | 9.1225 | 9.1225 |

# TRIAXIAL COMPRESSION TEST REPORT




| | | | | | | |
|---|---|---|---|---|---|---|
| Symbol | | | | | | |
| Test No. | | 3 | | | | |
| Initial | Diameter, in | 2.862 | | | | |
| | Height, in | 5.091 | | | | |
| | Water Content, % | 18.82 | | | | |
| | Dry Density, pcf | 115.2 | | | | |
| | Saturation, % | 109.70 | | | | |
| | Void Ratio | 0.46321 | | | | |
| Before Shear | Water Content, % | 18.82 | | | | |
| | Dry Density, pcf | 111.76 | | | | |
| | Saturation, % | 100.00 | | | | |
| | Void Ratio | 0.50813 | | | | |
| | Back Press., psi | --- | | | | |
| Minor Prin. Stress, psi | | 0 | | | | |
| Max. Dev. Stress, psi | | 51.235 | | | | |
| Time to Failure, min | | 1.8216 | | | | |
| Strain Rate, %/min | | 1.5 | | | | |
| B-Value | | --- | | | | |
| Specific Gravity | | 2.70 | | | | |
| Liquid Limit | | 0 | | | | |
| Plastic Limit | | 0 | | | | |
| Plasticity Index | | 0 | | | | |
| Failure Sketch | | | | | | |

| |
|---|
| Project: Duck Creek Ash Pond |
| Location: Canton, Illinois |
| Project No.: 03S5010 |
| Boring No.: B-1 |
| Sample Type: Tube 8-3 |
| Description: Brn. vf.-f. sandy silt / so. clay (tr. c. sand & sm. gravel). |
| Remarks: |

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TRIAXIAL TEST

ʾroject: Duck Creek Ash Ponc
ɜoring No.: B-1
ʾample No.: 8-3
ʾest No.: 3

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube 8-3

Project No.: 03S5010
Checked By: JPK
Depth: 24.0-24.5
Elevation: N/A

ʾoil Description: Brn. vf.-f. sandy silt / so. clay (tr. c. sand & sm. gravel).
ʾemarks:

ʾpecimen Height: 5.09 in
ʾpecimen Area: 6.43 in^2
ʾpecimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

.iquid Limit: 0

Plastic Limit: 0

Specific Gravity: 2.70

| | Before Test Trimmings | Before Test Specimen+Ring | After Test Specimen+Ring | After Test Trimmings |
|---|---|---|---|---|
| :ontainer ID | 40 | --- | | |
| ıt. Container + Wet Soil, gm | 44.14 | 1176.7 | 1176.7 | 0 |
| ıt. Container + Dry Soil, gm | 37.73 | 990.36 | 990.36 | 0 |
| ıt. Container, gm | 3.67 | --- | 0 | 0 |
| ıt. Dry Soil, gm | 34.06 | 990.36 | 990.36 | 0 |
| ıater Content, % | 18.82 | 18.82 | 18.82 | 0.00 |
| /oid Ratio | --- | 0.46 | 0.51 | --- |
| )egree of Saturation, % | --- | 109.70 | 100.00 | --- |
| )ry Unit Weight, pcf | --- | 115.2 | 111.76 | --- |

ɪnitial

:nd of Initialization

:nd of Consolidation/A

:nd of Saturation

:nd of Consolidation/B

:nd of Shear

ʌt Failure

TRIAXIAL TEST

Project: Duck Creek Ash Pond
Boring No.: B-1
Sample No.: 8-3
Test No.: 3

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube 8-3

Project No.: 0355010
Checked By: JPK
Depth: 24.0-24.5
Elevation: N/A

Soil Description: Brn. vf.-f. sandy silt / so. clay (tr. c. sand & sm. gravel).
Remarks:

Specimen Height: 5.09 in
Specimen Area: 6.43 in^2
Specimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

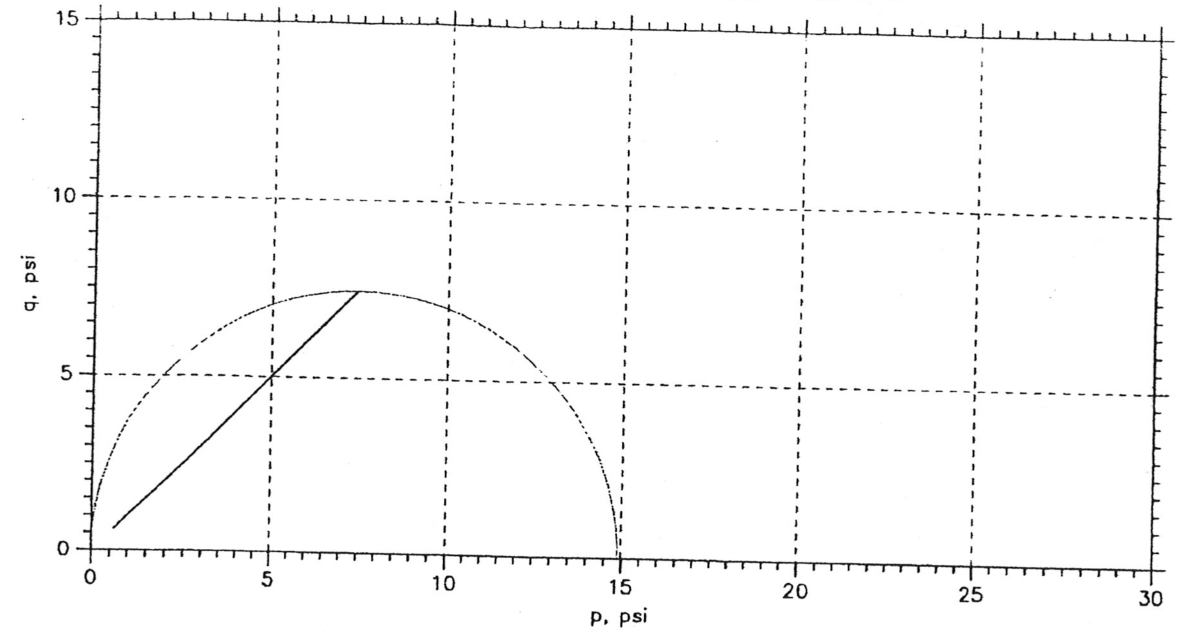
Liquid Limit: 0

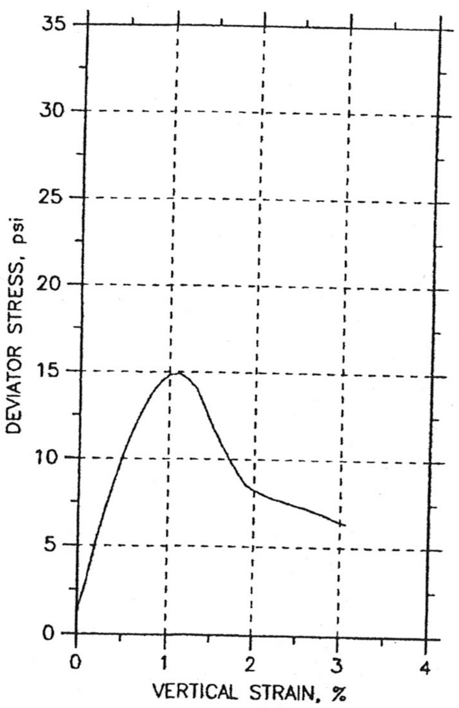
Plastic Limit: 0

Specific Gravity: 2.70

| | Time min | Vertical Strain % | Corrected Area in^2 | Deviator Load lb | Deviator Stress psi | Vertical Stress psi | p psi | q psi |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 6.4332 | 2.5658 | 0.39884 | 0.39884 | 0.19942 | 0.19942 |
| 2 | 0.0711 | 0.11252 | 6.4405 | 8.3699 | 1.2996 | 1.2996 | 0.64979 | 0.64979 |
| 3 | 0.13777 | 0.22725 | 6.4479 | 13.387 | 2.0762 | 2.0762 | 1.0381 | 1.0381 |
| 4 | 0.20027 | 0.33868 | 6.4551 | 17.814 | 2.7596 | 2.7596 | 1.3798 | 1.3798 |
| 5 | 0.2672 | 0.45672 | 6.4627 | 22.732 | 3.5175 | 3.5175 | 1.7587 | 1.7587 |
| 6 | 0.3297 | 0.56814 | 6.47 | 27.848 | 4.3042 | 4.3042 | 2.1521 | 2.1521 |
| 7 | 0.3922 | 0.67845 | 6.4772 | 33.849 | 5.2258 | 5.2258 | 2.6129 | 2.6129 |
| 8 | 0.45887 | 0.79539 | 6.4848 | 41.227 | 6.3574 | 6.3574 | 3.1787 | 3.1787 |
| 9 | 0.52137 | 0.90461 | 6.492 | 50.375 | 7.7597 | 7.7597 | 3.8798 | 3.8798 |
| 10 | 0.58803 | 1.0204 | 6.4996 | 62.672 | 9.6425 | 9.6425 | 4.8213 | 4.8213 |
| 11 | 0.65053 | 1.1286 | 6.5067 | 76.248 | 11.718 | 11.718 | 5.8592 | 5.8592 |
| 12 | 0.7172 | 1.2455 | 6.5144 | 92.971 | 14.272 | 14.272 | 7.1359 | 7.1359 |
| 13 | 0.78387 | 1.3591 | 6.5219 | 112.15 | 17.197 | 17.197 | 8.5983 | 8.5983 |
| 14 | 0.84637 | 1.4672 | 6.529 | 131.93 | 20.206 | 20.206 | 10.103 | 10.103 |
| 15 | 0.90887 | 1.5798 | 6.5365 | 152.78 | 23.374 | 23.374 | 11.687 | 11.687 |
| 16 | 0.97553 | 1.6956 | 6.5442 | 175.31 | 26.789 | 26.789 | 13.394 | 13.394 |
| 17 | 1.038 | 1.8059 | 6.5515 | 196.85 | 30.047 | 30.047 | 15.023 | 15.023 |
| 18 | 1.1047 | 1.9217 | 6.5593 | 218.59 | 33.326 | 33.326 | 16.663 | 16.663 |
| 19 | 1.1672 | 2.031 | 6.5666 | 238.37 | 36.3 | 36.3 | 18.15 | 18.15 |
| 20 | 1.238 | 2.1468 | 6.5744 | 258.14 | 39.265 | 39.265 | 19.632 | 19.632 |
| 21 | 1.3005 | 2.256 | 6.5817 | 274.86 | 41.762 | 41.762 | 20.881 | 20.881 |
| 22 | 1.3672 | 2.3696 | 6.5894 | 290.6 | 44.102 | 44.102 | 22.051 | 22.051 |
| 23 | 1.4339 | 2.4866 | 6.5973 | 304.08 | 46.092 | 46.092 | 23.046 | 23.046 |
| 24 | 1.4964 | 2.5969 | 6.6047 | 314.8 | 47.663 | 47.663 | 23.832 | 23.832 |
| 25 | 1.563 | 2.7127 | 6.6126 | 324.05 | 49.005 | 49.005 | 24.502 | 24.502 |
| 26 | 1.6255 | 2.823 | 6.6201 | 331.04 | 50.004 | 50.004 | 25.002 | 25.002 |
| 27 | 1.6922 | 2.9389 | 6.628 | 336.35 | 50.746 | 50.746 | 25.373 | 25.373 |
| 28 | 1.755 | 3.0481 | 6.6355 | 339.3 | 51.134 | 51.134 | 25.567 | 25.567 |
| 29 | 1.8216 | 3.165 | 6.6435 | 340.38 | 51.235 | 51.235 | 25.618 | 25.618 |
| 30 | 1.8841 | 3.2731 | 6.6509 | 339.5 | 51.045 | 51.045 | 25.522 | 25.522 |
| 31 | 1.9508 | 3.389 | 6.6589 | 337.04 | 50.614 | 50.614 | 25.307 | 25.307 |
| 32 | 2.2675 | 3.9483 | 6.6977 | 294.83 | 44.02 | 44.02 | 22.01 | 22.01 |
| 33 | 2.5425 | 4.4293 | 6.7314 | 126.61 | 18.81 | 18.81 | 9.4048 | 9.4048 |

# TRIAXIAL COMPRESSION TEST REPORT




| | | | | | |
|---|---|---|---|---|---|
| Symbol | | | | | |
| Test No. | | 1 | | | |
| Initial | Diameter, in | 2.798 | | | |
| | Height, in | 5.287 | | | |
| | Water Content, % | 18.06 | | | |
| | Dry Density, pcf | 92.303 | | | |
| | Saturation, % | 59.02 | | | |
| | Void Ratio | 0.82612 | | | |
| Before Shear | Water Content, % | 18.06 | | | |
| | Dry Density, pcf | 113.31 | | | |
| | Saturation, % | 100.00 | | | |
| | Void Ratio | 0.48757 | | | |
| | Back Press., psi | --- | | | |
| Minor Prin. Stress, psi | | 0 | | | |
| Max. Dev. Stress, psi | | 14.906 | | | |
| Time to Failure, min | | 0.7086 | | | |
| Strain Rate, %/min | | 1.5 | | | |
| B-Value | | --- | | | |
| Specific Gravity | | 2.70 | | | |
| Liquid Limit | | 0 | | | |
| Plastic Limit | | 0 | | | |
| Plasticity Index | | 0 | | | |
| Failure Sketch | | | | | |

| |
|---|
| Project: Duck Creek Ash Pond |
| Location: Canton, Illinois |
| Project No.: 03S5010 |
| Boring No.: B-2 |
| Sample Type: Tube 2-2 |
| Description: Brn. vf. sandy silt. |
| Remarks: |

Mon, 10-APR-2006 14:40:44

TRIAXIAL TEST

roject: Duck Creek Ash Pond
oring No.: B-2
ample No.: 2-2
est No.: 1

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube 2-2

Project No.: 03S5010
Checked By: JPK
Depth: 2.5-3.0
Elevation: N/A

oil Description: Brn. vf. sandy silt.
emarks:

pecimen Height: 5.29 in
pecimen Area: 6.15 in^2
pecimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

iquid Limit: 0

Plastic Limit: 0

Specific Gravity: 2.70

| | Before Test Trimmings | Before Test Specimen+Ring | After Test Specimen+Ring | After Test Trimmings |
|---|---|---|---|---|
| ontainer ID | 39 | --- | | |
| t. Container + Wet Soil, gm | 87.1 | 929.88 | 929.88 | 0 |
| t. Container + Dry Soil, gm | 74.34 | 787.64 | 787.64 | 0 |
| t. Container, gm | 3.68 | --- | 0 | 0 |
| t. Dry Soil, gm | 70.66 | 787.64 | 787.64 | 0 |
| ater Content, % | 18.06 | 18.06 | 18.06 | 0.00 |
| oid Ratio | --- | 0.83 | 0.49 | --- |
| egree of Saturation, % | --- | 59.02 | 100.00 | --- |
| ry Unit Weight, pcf | --- | 92.303 | 113.31 | --- |

nitial

nd of Initialization

nd of Consolidation/A

nd of Saturation

nd of Consolidation/B

nd of Shear

t Failure

TRIAXIAL TEST

roject: Duck Creek Ash Pond
oring No.: B-2
ample No.: 2-2
est No.: 1

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube 2-2

Project No.: 03S5010
Checked By: JPK
Depth: 2.5-3.0
Elevation: N/A

oil Description: Brn. vf. sandy silt.
emarks:

pecimen Height: 5.29 in
pecimen Area: 6.15 in^2
pecimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

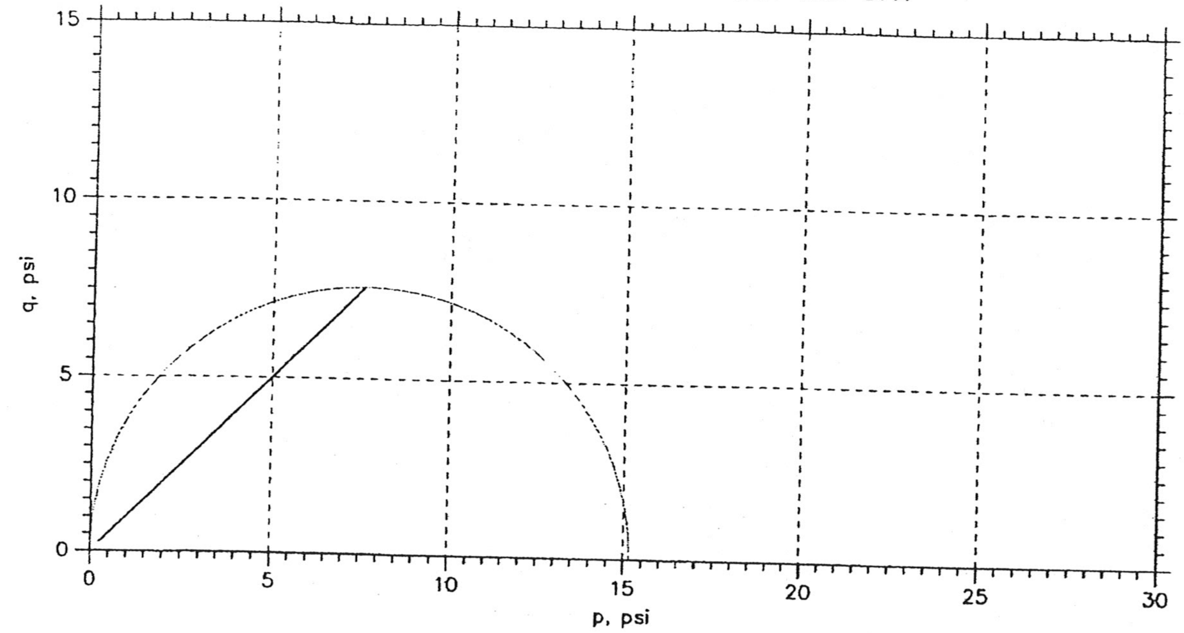
iquid Limit: 0

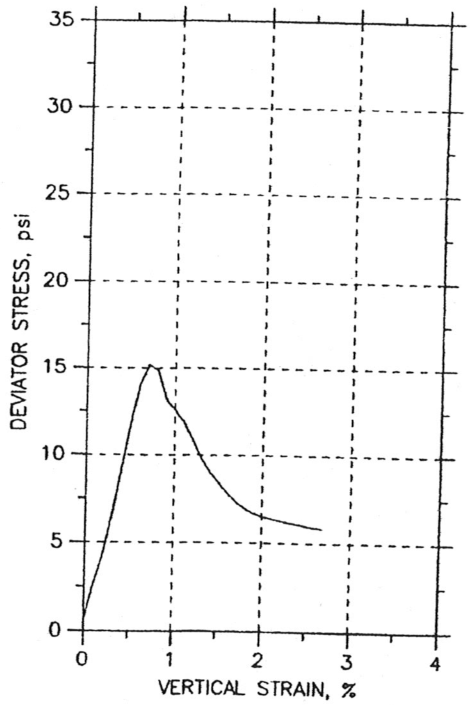
Plastic Limit: 0

Specific Gravity: 2.70

| | Time min | Vertical Strain % | Corrected Area in^2 | Deviator Load lb | Deviator Stress psi | Vertical Stress psi | p psi | q psi |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 6.1487 | 7.4845 | 1.2172 | 1.2172 | 0.60862 | 0.60862 |
| 2 | 0.0711 | 0.10198 | 6.155 | 18.502 | 3.0061 | 3.0061 | 1.503 | 1.503 |
| 3 | 0.13777 | 0.20502 | 6.1614 | 32.767 | 5.3181 | 5.3181 | 2.659 | 2.659 |
| 4 | 0.20027 | 0.30381 | 6.1675 | 44.276 | 7.179 | 7.179 | 3.5895 | 3.5895 |
| 5 | 0.26277 | 0.40154 | 6.1735 | 54.015 | 8.7495 | 8.7495 | 4.3748 | 4.3748 |
| 6 | 0.32943 | 0.50246 | 6.1798 | 63.656 | 10.301 | 10.301 | 5.1503 | 5.1503 |
| 7 | 0.39193 | 0.60338 | 6.1861 | 71.919 | 11.626 | 11.626 | 5.813 | 5.813 |
| 8 | 0.45443 | 0.70217 | 6.1922 | 79.297 | 12.806 | 12.806 | 6.403 | 6.403 |
| 9 | 0.51693 | 0.80096 | 6.1984 | 85.298 | 13.761 | 13.761 | 6.8807 | 6.8807 |
| 10 | 0.5836 | 0.90506 | 6.2049 | 89.823 | 14.476 | 14.476 | 7.2381 | 7.2381 |
| 11 | 0.6461 | 1.0039 | 6.2111 | 92.184 | 14.842 | 14.842 | 7.4209 | 7.4209 |
| 12 | 0.7086 | 1.1016 | 6.2172 | 92.676 | 14.906 | 14.906 | 7.4532 | 7.4532 |
| 13 | 0.77527 | 1.2046 | 6.2237 | 91.004 | 14.622 | 14.622 | 7.3111 | 7.3111 |
| 14 | 0.83777 | 1.3024 | 6.2299 | 88.052 | 14.134 | 14.134 | 7.067 | 7.067 |
| 15 | 0.90027 | 1.399 | 6.236 | 81.56 | 13.079 | 13.079 | 6.5395 | 6.5395 |
| 16 | 0.96693 | 1.5042 | 6.2426 | 73.887 | 11.836 | 11.836 | 5.9179 | 5.9179 |
| 17 | 1.0297 | 1.6019 | 6.2488 | 67.787 | 10.848 | 10.848 | 5.424 | 5.424 |
| 18 | 1.0922 | 1.6996 | 6.255 | 62.672 | 10.019 | 10.019 | 5.0097 | 5.0097 |
| 19 | 1.163 | 1.8038 | 6.2617 | 57.36 | 9.1605 | 9.1605 | 4.5802 | 4.5802 |
| 20 | 1.2255 | 1.9004 | 6.2678 | 53.425 | 8.5237 | 8.5237 | 4.2618 | 4.2618 |
| 21 | 1.2922 | 2.0045 | 6.2745 | 51.654 | 8.2324 | 8.2324 | 4.1162 | 4.1162 |
| 22 | 1.3547 | 2.0991 | 6.2806 | 50.277 | 8.0052 | 8.0052 | 4.0026 | 4.0026 |
| 23 | 1.4255 | 2.2053 | 6.2874 | 48.9 | 7.7774 | 7.7774 | 3.8887 | 3.8887 |
| 24 | 1.488 | 2.303 | 6.2937 | 48.113 | 7.6446 | 7.6446 | 3.8223 | 3.8223 |
| 25 | 1.5505 | 2.3997 | 6.2999 | 47.227 | 7.4965 | 7.4965 | 3.7483 | 3.7483 |
| 26 | 1.6172 | 2.5006 | 6.3064 | 46.342 | 7.3484 | 7.3484 | 3.6742 | 3.6742 |
| 27 | 1.6839 | 2.6015 | 6.313 | 45.555 | 7.2161 | 7.2161 | 3.6081 | 3.6081 |
| 28 | 1.7464 | 2.6993 | 6.3193 | 44.473 | 7.0376 | 7.0376 | 3.5188 | 3.5188 |
| 29 | 1.813 | 2.8012 | 6.3259 | 43.391 | 6.8592 | 6.8592 | 3.4296 | 3.4296 |
| 30 | 1.8797 | 2.9043 | 6.3326 | 42.014 | 6.6345 | 6.6345 | 3.3172 | 3.3172 |
| 31 | 1.9422 | 3.0009 | 6.339 | 40.735 | 6.4261 | 6.4261 | 3.2131 | 3.2131 |
| 32 | 1.9839 | 3.0636 | 6.3431 | 40.243 | 6.3444 | 6.3444 | 3.1722 | 3.1722 |

# TRIAXIAL COMPRESSION TEST REPORT




| | | | | | |
|---|---|---|---|---|---|
| Symbol | | | | | |
| Test No. | | 2 | | | |
| Initial | Diameter, in | 2.825 | | | |
| | Height, in | 5.581 | | | |
| | Water Content, % | 17.84 | | | |
| | Dry Density, pcf | 99.818 | | | |
| | Saturation, % | 69.96 | | | |
| | Void Ratio | 0.68862 | | | |
| Before Shear | Water Content, % | 17.84 | | | |
| | Dry Density, pcf | 113.75 | | | |
| | Saturation, % | 100.00 | | | |
| | Void Ratio | 0.48177 | | | |
| | Back Press., psi | --- | | | |
| Minor Prin. Stress, psi | | 0 | | | |
| Max. Dev. Stress, psi | | 15.18 | | | |
| Time to Failure, min | | 0.45417 | | | |
| Strain Rate, %/min | | 1.5 | | | |
| B-Value | | --- | | | |
| Specific Gravity | | 2.70 | | | |
| Liquid Limit | | 0 | | | |
| Plastic Limit | | 0 | | | |
| Plasticity Index | | 0 | | | |
| Failure Sketch | | | | | |

Project: Duck Creek Ash Pond

Location: Canton, Illinois

Project No.: 03S5010

Boring No.: B-2

Sample Type: Tube 5-2

Description: Red. brn. vf.-f. sandy silt / so. clay (tr. c. sand & sm. gravel).

Remarks:

Wed, 08-MAR-2006 09:33:01

TRIAXIAL TEST

Project: Duck Creek Ash Pond
Boring No.: B-2
Sample No.: S-2
Test No.: 2

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube S-2

Project No.: 03S5010
Checked By: JPK
Depth: 8.5-9.0
Elevation: N/A

Soil Description: Red. brn. vf.-f. sandy silt / so. clay (tr. c. sand & sm. gravel).
Remarks:

Specimen Height: 5.58 in
Specimen Area: 6.27 in^2
Specimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

Liquid Limit: 0

Plastic Limit: 0

Specific Gravity: 2.70

| | Before Test Trimmings | Before Test Specimen+Ring | After Test Specimen+Ring | After Test Trimmings |
|---|---|---|---|---|
| Container ID | 38 | --- | | |
| Wt. Container + Wet Soil, gm | 61.29 | 1080.1 | 1080.1 | 0 |
| Wt. Container + Dry Soil, gm | 52.57 | 916.58 | 916.58 | 0 |
| Wt. Container, gm | 3.7 | --- | 0 | 0 |
| Wt. Dry Soil, gm | 48.87 | 916.58 | 916.58 | 0 |
| Water Content, % | 17.84 | 17.84 | 17.84 | 0.00 |
| Void Ratio | --- | 0.69 | 0.48 | --- |
| Degree of Saturation, % | --- | 69.96 | 100.00 | --- |
| Dry Unit Weight, pcf | --- | 99.818 | 113.75 | --- |

Initial

End of Initialization

End of Consolidation/A

End of Saturation

End of Consolidation/B

End of Shear

At Failure

TRIAXIAL TEST

Project: Duck Creek Ash Pond
Boring No.: B-2
Sample No.: 5-2
Test No.: 2

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube 5-2

Project No.: 0355010
Checked By: JPK
Depth: 8.5-9.0
Elevation: N/A

Soil Description: Red. brn. vf.-f. sandy silt / so. clay (tr. c. sand & sm. gravel).
Remarks:

Specimen Height: 5.58 in
Specimen Area: 6.27 in^2
Specimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

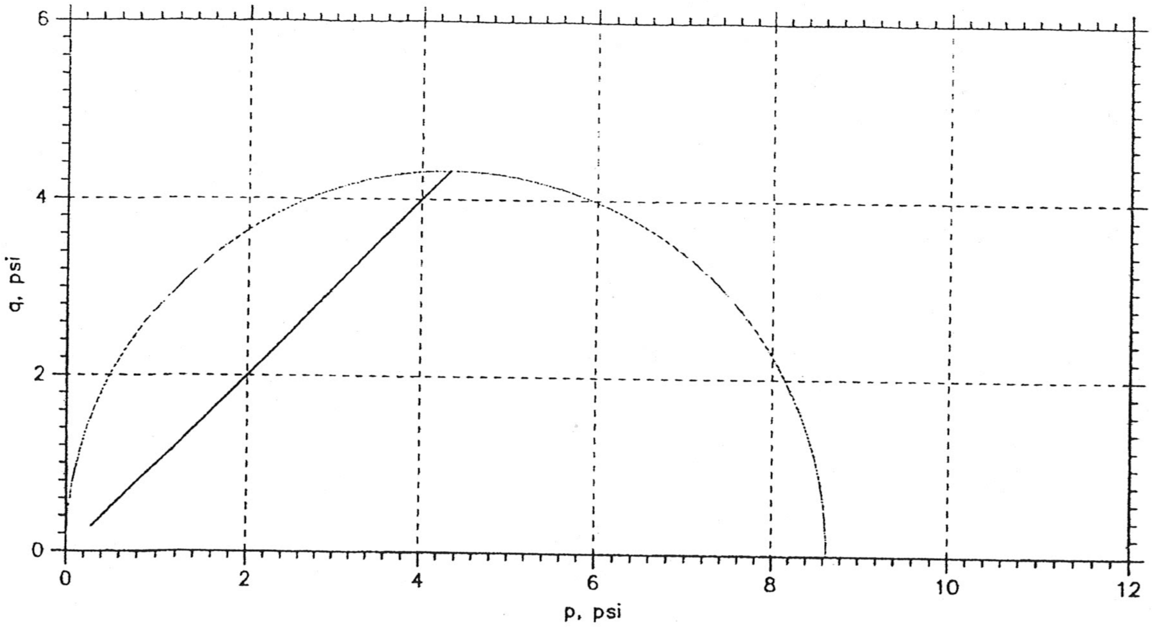
Liquid Limit: 0

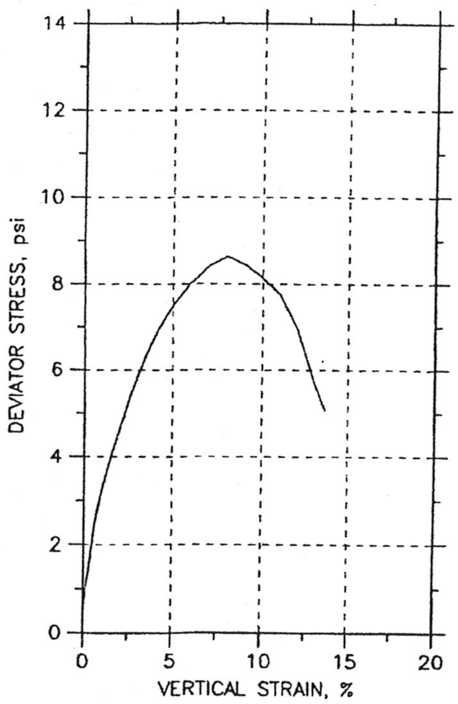
Plastic Limit: 0

Specific Gravity: 2.70

| | Time min | Vertical Strain % | Corrected Area in^2 | Deviator Load lb | Deviator Stress psi | Vertical Stress psi | p psi | q psi |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 6.268 | 3.2545 | 0.51922 | 0.51922 | 0.25961 | 0.25961 |
| 2 | 0.070833 | 0.10164 | 6.2743 | 15.945 | 2.5412 | 2.5412 | 1.2706 | 1.2706 |
| 3 | 0.13333 | 0.20026 | 6.2805 | 26.274 | 4.1834 | 4.1834 | 2.0917 | 2.0917 |
| 4 | 0.2 | 0.30391 | 6.2871 | 40.932 | 6.5104 | 6.5104 | 3.2552 | 3.2552 |
| 5 | 0.2625 | 0.40052 | 6.2932 | 57.852 | 9.1928 | 9.1928 | 4.5964 | 4.5964 |
| 6 | 0.325 | 0.49914 | 6.2994 | 73.887 | 11.729 | 11.729 | 5.8646 | 5.8646 |
| 7 | 0.39167 | 0.60379 | 6.306 | 88.348 | 14.01 | 14.01 | 7.005 | 7.005 |
| 8 | 0.45417 | 0.70241 | 6.3123 | 95.824 | 15.18 | 15.18 | 7.5902 | 7.5902 |
| 9 | 0.51667 | 0.80103 | 6.3186 | 93.856 | 14.854 | 14.854 | 7.427 | 7.427 |
| 10 | 0.58333 | 0.90368 | 6.3251 | 83.035 | 13.128 | 13.128 | 6.5639 | 6.5639 |
| 11 | 0.64583 | 1.0033 | 6.3315 | 79.396 | 12.54 | 12.54 | 6.2699 | 6.2699 |
| 12 | 0.70833 | 1.1009 | 6.3377 | 75.461 | 11.907 | 11.907 | 5.9533 | 5.9533 |
| 13 | 0.77083 | 1.2015 | 6.3442 | 69.165 | 10.902 | 10.902 | 5.451 | 5.451 |
| 14 | 0.83333 | 1.3002 | 6.3505 | 62.574 | 9.8533 | 9.8533 | 4.9266 | 4.9266 |
| 15 | 0.9 | 1.4048 | 6.3573 | 57.557 | 9.0537 | 9.0537 | 4.5268 | 4.5268 |
| 16 | 0.9625 | 1.5034 | 6.3636 | 53.72 | 8.4417 | 8.4417 | 4.2209 | 4.2209 |
| 17 | 1.025 | 1.6001 | 6.3699 | 49.982 | 7.8466 | 7.8466 | 3.9233 | 3.9233 |
| 18 | 1.0919 | 1.7037 | 6.3766 | 46.834 | 7.3446 | 7.3446 | 3.6723 | 3.6723 |
| 19 | 1.1586 | 1.8003 | 6.3829 | 44.571 | 6.983 | 6.983 | 3.4915 | 3.4915 |
| 20 | 1.2253 | 1.905 | 6.3897 | 42.702 | 6.683 | 6.683 | 3.3415 | 3.3415 |
| 21 | 1.2878 | 2.0026 | 6.3961 | 41.522 | 6.4918 | 6.4918 | 3.2459 | 3.2459 |
| 22 | 1.3503 | 2.1002 | 6.4024 | 40.932 | 6.3931 | 6.3931 | 3.1966 | 3.1966 |
| 23 | 1.4169 | 2.2028 | 6.4092 | 40.145 | 6.2636 | 6.2636 | 3.1318 | 3.1318 |
| 24 | 1.4794 | 2.2994 | 6.4155 | 39.456 | 6.1501 | 6.1501 | 3.0751 | 3.0751 |
| 25 | 1.5461 | 2.4021 | 6.4222 | 39.062 | 6.0824 | 6.0824 | 3.0412 | 3.0412 |
| 26 | 1.6128 | 2.5047 | 6.429 | 38.374 | 5.9689 | 5.9689 | 2.9844 | 2.9844 |
| 27 | 1.6753 | 2.6013 | 6.4354 | 37.882 | 5.8865 | 5.8865 | 2.9433 | 2.9433 |
| 28 | 1.7211 | 2.6708 | 6.44 | 37.587 | 5.8365 | 5.8365 | 2.9182 | 2.9182 |

# TRIAXIAL COMPRESSION TEST REPORT




| | | | | | | |
|---|---|---|---|---|---|---|
| Symbol | | | | | | |
| Test No. | | 1 | | | | |
| Initial | Diameter, in | 2.81 | | | | |
| | Height, in | 5.343 | | | | |
| | Water Content, % | 22.37 | | | | |
| | Dry Density, pcf | 97.962 | | | | |
| | Saturation, % | 83.81 | | | | |
| | Void Ratio | 0.72061 | | | | |
| Before Shear | Water Content, % | 22.37 | | | | |
| | Dry Density, pcf | 105.09 | | | | |
| | Saturation, % | 100.00 | | | | |
| | Void Ratio | 0.60392 | | | | |
| | Back Press., psi | --- | | | | |
| Minor Prin. Stress, psi | | 0 | | | | |
| Max. Dev. Stress, psi | | 8.6405 | | | | |
| Time to Failure, min | | 5.4688 | | | | |
| Strain Rate, %/min | | 1.5 | | | | |
| B-Value | | --- | | | | |
| Specific Gravity | | 2.70 | | | | |
| Liquid Limit | | 0 | | | | |
| Plastic Limit | | 0 | | | | |
| Plasticity Index | | 0 | | | | |
| Failure Sketch | | | | | | |

Project: Duck Creek Ash Pond
Location: Canton, Illinois
Project No.: 03S5010
Boring No.: B-3
Sample Type: Tube 6-1
Description: Brn. & gray vf. sandy silt (tr. clay).
Remarks:

Mon, 10-APR-2006 14:44:01

TRIAXIAL TEST

roject: Duck Creek Ash Pond
oring No.: B-3
ample No.: 6-1
est No.: 1

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube 6-1

Project No.: 03S5010
Checked By: JPK
Depth: 13.0-13.5
Elevation: N/A

oil Description: Brn. & gray vf. sandy silt (tr. clay).
emarks:

pecimen Height: 5.34 in
pecimen Area: 6.20 in^2
pecimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

iquid Limit: 0

Plastic Limit: 0

Specific Gravity: 2.70

| | Before Test Trimmings | Before Test Specimen+Ring | After Test Specimen+Ring | After Test Trimmings |
|---|---|---|---|---|
| ontainer ID | 37 | --- | | |
| t. Container + Wet Soil, gm | 118.95 | 1042.6 | 1042.6 | 0 |
| t. Container + Dry Soil, gm | 97.88 | 852.06 | 852.06 | 0 |
| t. Container, gm | 3.68 | --- | 0 | 0 |
| t. Dry Soil, gm | 94.2 | 852.06 | 852.06 | 0 |
| ater Content, % | 22.37 | 22.37 | 22.37 | 0.00 |
| oid Ratio | --- | 0.72 | 0.60 | --- |
| egree of Saturation, % | --- | 83.81 | 100.00 | --- |
| ry Unit Weight, pcf | --- | 97.962 | 105.09 | --- |

nitial

nd of Initialization

nd of Consolidation/A

nd of Saturation

nd of Consolidation/B

nd of Shear

t Failure

TRIAXIAL TEST

Project: Duck Creek Ash Pond
Boring No.: B-3
Sample No.: 6-1
Test No.: 1

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube 6-1

Project No.: 03S5010
Checked By: JPK
Depth: 13.0-13.5
Elevation: N/A

Soil Description: Brn. & gray vf. sandy silt (tr. clay).
Remarks:

Specimen Height: 5.34 in
Specimen Area: 6.20 in^2
Specimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

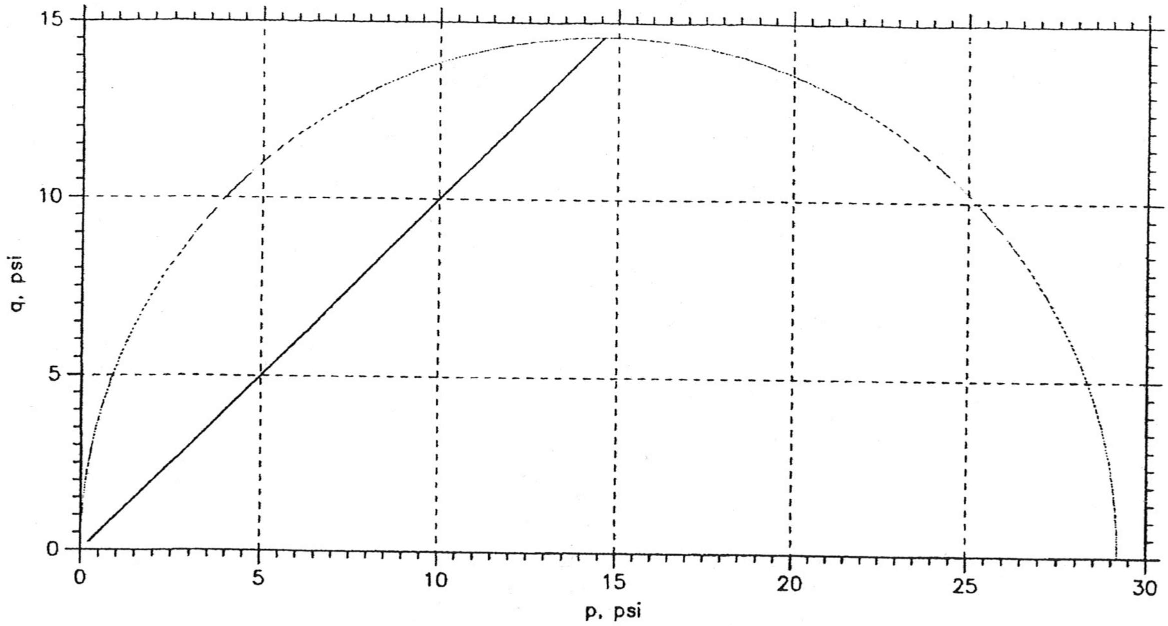
Liquid Limit: 0

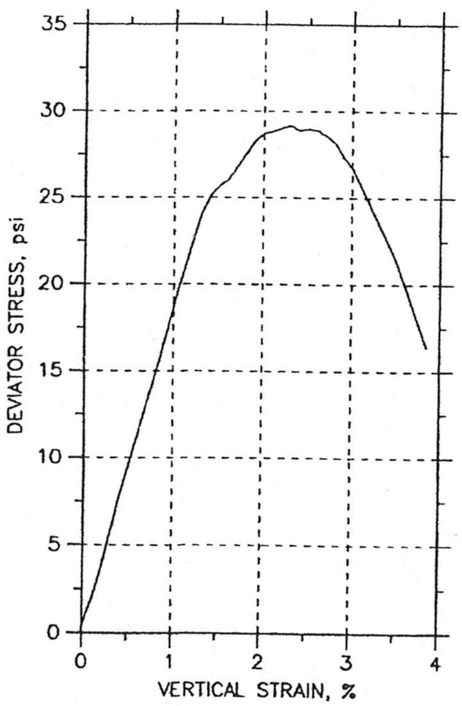
Plastic Limit: 0

Specific Gravity: 2.70

| | Time min | Vertical Strain % | Corrected Area in^2 | Deviator Load lb | Deviator Stress psi | Vertical Stress psi | p psi | q psi |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 6.2016 | 3.5496 | 0.57237 | 0.57237 | 0.28618 | 0.28618 |
| 2 | 0.075267 | 0.10511 | 6.2081 | 5.9105 | 0.95207 | 0.95207 | 0.47603 | 0.47603 |
| 3 | 0.13777 | 0.20182 | 6.2141 | 7.3861 | 1.1886 | 1.1886 | 0.5943 | 0.5943 |
| 4 | 0.20443 | 0.30273 | 6.2204 | 9.1569 | 1.4721 | 1.4721 | 0.73603 | 0.73603 |
| 5 | 0.2711 | 0.40469 | 6.2268 | 11.026 | 1.7707 | 1.7707 | 0.88537 | 0.88537 |
| 6 | 0.3336 | 0.49929 | 6.2327 | 12.993 | 2.0847 | 2.0847 | 1.0424 | 1.0424 |
| 7 | 0.40027 | 0.60231 | 6.2392 | 14.863 | 2.3821 | 2.3821 | 1.1911 | 1.1911 |
| 8 | 0.46693 | 0.70427 | 6.2456 | 16.535 | 2.6475 | 2.6475 | 1.3237 | 1.3237 |
| 9 | 0.53387 | 0.80518 | 6.2519 | 17.814 | 2.8493 | 2.8493 | 1.4247 | 1.4247 |
| 10 | 0.60053 | 0.90504 | 6.2582 | 18.994 | 3.0351 | 3.0351 | 1.5175 | 1.5175 |
| 11 | 0.6672 | 1.0059 | 6.2646 | 20.076 | 3.2047 | 3.2047 | 1.6024 | 1.6024 |
| 12 | 0.7297 | 1.1006 | 6.2706 | 21.06 | 3.3585 | 3.3585 | 1.6793 | 1.6793 |
| 13 | 0.79637 | 1.1994 | 6.2769 | 22.044 | 3.5119 | 3.5119 | 1.756 | 1.756 |
| 14 | 0.86303 | 1.3003 | 6.2833 | 22.929 | 3.6492 | 3.6492 | 1.8246 | 1.8246 |
| 15 | 0.9297 | 1.3991 | 6.2896 | 23.815 | 3.7863 | 3.7863 | 1.8932 | 1.8932 |
| 16 | 1.0005 | 1.5042 | 6.2963 | 24.798 | 3.9386 | 3.9386 | 1.9693 | 1.9693 |
| 17 | 1.0672 | 1.6041 | 6.3027 | 25.782 | 4.0906 | 4.0906 | 2.0453 | 2.0453 |
| 18 | 1.1341 | 1.705 | 6.3092 | 26.569 | 4.2112 | 4.2112 | 2.1056 | 2.1056 |
| 19 | 1.205 | 1.8048 | 6.3156 | 27.454 | 4.3471 | 4.3471 | 2.1735 | 2.1735 |
| 20 | 1.2716 | 1.9047 | 6.322 | 28.34 | 4.4827 | 4.4827 | 2.2414 | 2.2414 |
| 21 | 1.3383 | 2.0045 | 6.3284 | 29.127 | 4.6025 | 4.6025 | 2.3013 | 2.3013 |
| 22 | 1.405 | 2.1033 | 6.3348 | 30.012 | 4.7376 | 4.7376 | 2.3688 | 2.3688 |
| 23 | 1.4716 | 2.2022 | 6.3412 | 30.701 | 4.8414 | 4.8414 | 2.4207 | 2.4207 |
| 24 | 1.5383 | 2.2999 | 6.3476 | 31.586 | 4.9761 | 4.9761 | 2.488 | 2.488 |
| 25 | 1.6091 | 2.404 | 6.3543 | 32.471 | 5.1101 | 5.1101 | 2.5551 | 2.5551 |
| 26 | 1.6758 | 2.5007 | 6.3606 | 33.258 | 5.2288 | 5.2288 | 2.6144 | 2.6144 |
| 27 | 1.7466 | 2.6047 | 6.3674 | 34.144 | 5.3622 | 5.3622 | 2.6811 | 2.6811 |
| 28 | 1.8133 | 2.7036 | 6.3739 | 34.931 | 5.4803 | 5.4803 | 2.7401 | 2.7401 |
| 29 | 1.88 | 2.7992 | 6.3802 | 35.619 | 5.5828 | 5.5828 | 2.7914 | 2.7914 |
| 30 | 1.9508 | 2.9022 | 6.3869 | 36.406 | 5.7001 | 5.7001 | 2.8501 | 2.8501 |
| 31 | 2.0177 | 3.001 | 6.3935 | 37.292 | 5.8328 | 5.8328 | 2.9164 | 2.9164 |
| 32 | 2.3641 | 3.5045 | 6.4268 | 40.833 | 6.3536 | 6.3536 | 3.1768 | 3.1768 |
| 33 | 2.7057 | 4.0038 | 6.4602 | 43.883 | 6.7927 | 6.7927 | 3.3964 | 3.3964 |
| 34 | 3.0516 | 4.5031 | 6.494 | 46.539 | 7.1664 | 7.1664 | 3.5832 | 3.5832 |
| 35 | 3.3974 | 5.0024 | 6.5281 | 48.998 | 7.5057 | 7.5057 | 3.7528 | 3.7528 |
| 36 | 4.0977 | 6.0021 | 6.5976 | 53.031 | 8.038 | 8.038 | 4.019 | 4.019 |
| 37 | 4.7896 | 7.0017 | 6.6685 | 56.179 | 8.4246 | 8.4246 | 4.2123 | 4.2123 |
| 38 | 5.4688 | 8.0013 | 6.7409 | 58.245 | 8.6405 | 8.6405 | 4.3203 | 4.3203 |
| 39 | 6.1479 | 9.0052 | 6.8153 | 57.557 | 8.4452 | 8.4452 | 4.2226 | 4.2226 |
| 40 | 6.8274 | 10.003 | 6.8909 | 56.081 | 8.1385 | 8.1385 | 4.0692 | 4.0692 |
| 41 | 7.494 | 11 | 6.9681 | 54.015 | 7.7518 | 7.7518 | 3.8759 | 3.8759 |
| 42 | 8.1568 | 12.002 | 7.0474 | 48.998 | 6.9526 | 6.9526 | 3.4763 | 3.4763 |
| 43 | 8.8151 | 13.005 | 7.1286 | 40.636 | 5.7004 | 5.7004 | 2.8502 | 2.8502 |
| 44 | 9.2531 | 13.66 | 7.1827 | 36.308 | 5.0549 | 5.0549 | 2.5275 | 2.5275 |

# TRIAXIAL COMPRESSION TEST REPORT




| | | | | | | |
|---|---|---|---|---|---|---|
| Symbol | | | | | | |
| Test No. | | 1 | | | | |
| Initial | Diameter, in | 2.87 | | | | |
| | Height, in | 5.733 | | | | |
| | Water Content, % | 18.05 | | | | |
| | Dry Density, pcf | 111.29 | | | | |
| | Saturation, % | 94.70 | | | | |
| | Void Ratio | 0.51452 | | | | |
| Before Shear | Water Content, % | 18.05 | | | | |
| | Dry Density, pcf | 113.33 | | | | |
| | Saturation, % | 100.00 | | | | |
| | Void Ratio | 0.48724 | | | | |
| | Back Press., psi | --- | | | | |
| Minor Prin. Stress, psi | | 0 | | | | |
| Max. Dev. Stress, psi | | 29.193 | | | | |
| Time to Failure, min | | 1.6172 | | | | |
| Strain Rate, %/min | | 1.5 | | | | |
| B-Value | | --- | | | | |
| Specific Gravity | | 2.70 | | | | |
| Liquid Limit | | 0 | | | | |
| Plastic Limit | | 0 | | | | |
| Plasticity Index | | 0 | | | | |
| Failure Sketch | | | | | | |

| |
|---|
| Project: Duck Creek Ash Pond |
| Location: Canton, Illinois |
| Project No.: 03S5010 |
| Boring No.: B-4 |
| Sample Type: Tube 2-2 |
| Description: Brn. & gray vf. sandy silt / so. clay. |
| Remarks: |

Wed, 08-MAR-2006 09:27:55

TRIAXIAL TEST

roject: Duck Creek Ash Pond
oring No.: B-4
ample No.: 2-2
est No.: 1

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube 2-2

Project No.: 03S5010
Checked By: JPK
Depth: 2.5-3.0
Elevation: N/A

oil Description: Brn. & gray vf. sandy silt / so. clay.
emarks:

p[illegible]n Height: 5.73 in
p[illegible]n Area: 6.47 in^2
pe[illegible]en Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

iquid Limit: 0

Plastic Limit: 0

Specific Gravity: 2.70

| | Before Test Trimmings | Before Test Specimen+Ring | After Test Specimen+Ring | After Test Trimmings |
|---|---|---|---|---|
| ontainer ID | 33 | --- | | |
| t. Container + Wet Soil, gm | 77.14 | 1279 | 1279 | 0 |
| t. Container + Dry Soil, gm | 65.91 | 1083.5 | 1083.5 | 0 |
| t. Container, gm | 3.68 | --- | 0 | 0 |
| t. Dry Soil, gm | 62.23 | 1083.5 | 1083.5 | 0 |
| ater Content, % | 18.05 | 18.05 | 18.05 | 0.00 |
| oid Ratio | --- | 0.51 | 0.49 | --- |
| egree of Saturation, % | --- | 94.70 | 100.00 | --- |
| ry Unit Weight, pcf | --- | 111.29 | 113.33 | --- |

nitial

nd of Initialization

nd of Consolidation/A

nd of Saturation

nd of Consolidation/B

nd of Shear

t Failure

TRIAXIAL TEST

Project: Duck Creek Ash Pond
Boring No.: B-4
Sample No.: 2-2
Test No.: 1

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube 2-2

Project No.: 0355010
Checked By: JPK
Depth: 2.5-3.0
Elevation: N/A

Soil Description: Brn. & gray vf. sandy silt / so. clay.
Remarks:

Specimen Height: 5.73 in
Specimen Area: 6.47 in^2
Specimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

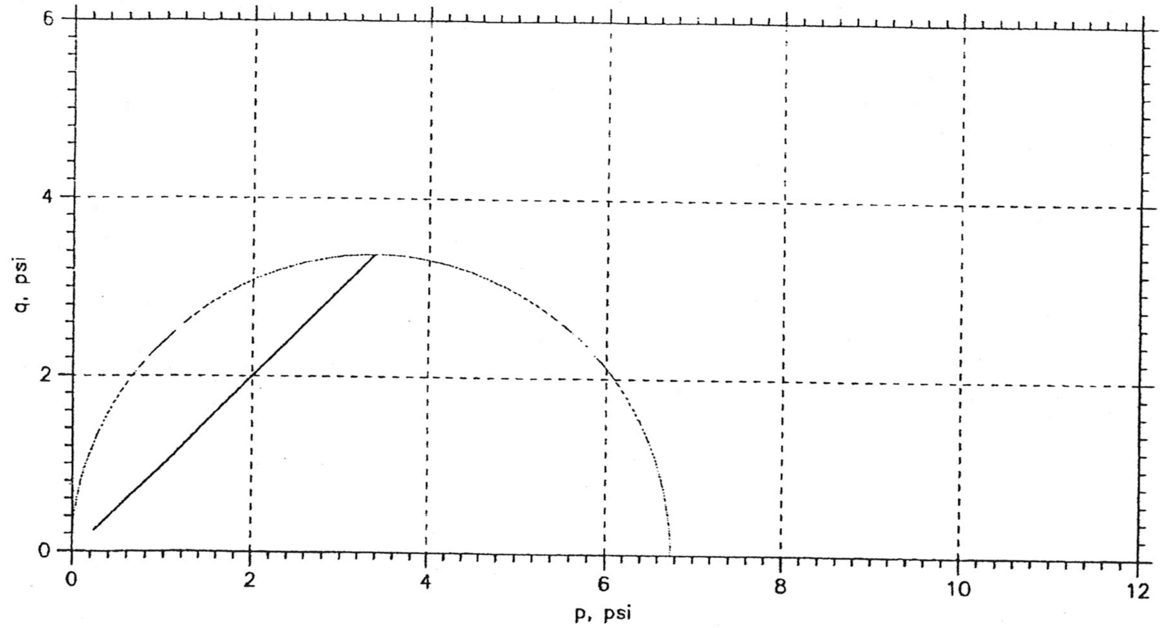
Liquid Limit: 0

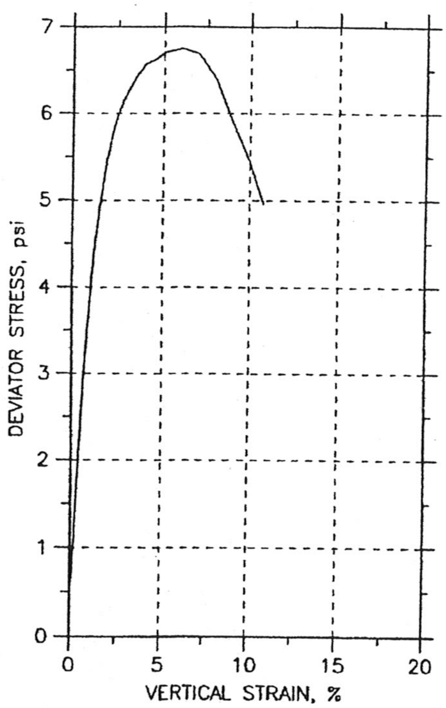
Plastic Limit: 0

Specific Gravity: 2.70

| | Time min | Vertical Strain % | Corrected Area in^2 | Deviator Load lb | Deviator Stress psi | Vertical Stress psi | p psi | q psi |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 6.4692 | 2.861 | 0.44224 | 0.44224 | 0.22112 | 0.22112 |
| 2 | 0.079433 | 0.10188 | 6.4758 | 12.403 | 1.9153 | 1.9153 | 0.95765 | 0.95765 |
| 3 | 0.15443 | 0.20474 | 6.4825 | 23.519 | 3.6281 | 3.6281 | 1.8141 | 1.8141 |
| 4 | 0.2211 | 0.29977 | 6.4887 | 36.406 | 5.6107 | 5.6107 | 2.8054 | 2.8054 |
| 5 | 0.29193 | 0.40067 | 6.4953 | 49.884 | 7.68 | 7.68 | 3.84 | 3.84 |
| 6 | 0.36277 | 0.50158 | 6.5019 | 61.983 | 9.5332 | 9.5332 | 4.7666 | 4.7666 |
| 7 | 0.4336 | 0.6015 | 6.5084 | 73.592 | 11.307 | 11.307 | 5.6536 | 5.6536 |
| 8 | 0.50443 | 0.69946 | 6.5148 | 85.2 | 13.078 | 13.078 | 6.5389 | 6.5389 |
| 9 | 0.57527 | 0.80037 | 6.5214 | 97.103 | 14.89 | 14.89 | 7.4449 | 7.4449 |
| 10 | 0.6461 | 0.90029 | 6.528 | 109.3 | 16.743 | 16.743 | 8.3717 | 8.3717 |
| 11 | 0.7211 | 1.0041 | 6.5349 | 122.38 | 18.728 | 18.728 | 9.364 | 9.364 |
| 12 | 0.78777 | 1.0992 | 6.5411 | 134.29 | 20.53 | 20.53 | 10.265 | 10.265 |
| 13 | 0.8586 | 1.201 | 6.5479 | 146.39 | 22.357 | 22.357 | 11.178 | 11.178 |
| 14 | 0.92943 | 1.3029 | 6.5546 | 157.41 | 24.014 | 24.014 | 12.007 | 12.007 |
| 15 | 1.0005 | 1.4058 | 6.5615 | 164.78 | 25.114 | 25.114 | 12.557 | 12.557 |
| 16 | 1.0672 | 1.5037 | 6.568 | 168.42 | 25.643 | 25.643 | 12.822 | 12.822 |
| 17 | 1.1339 | 1.6017 | 6.5746 | 171.08 | 26.022 | 26.022 | 13.011 | 13.011 |
| 18 | 1.2047 | 1.6997 | 6.5811 | 175.8 | 26.713 | 26.713 | 13.357 | 13.357 |
| 19 | 1.2755 | 1.8016 | 6.5879 | 181.31 | 27.522 | 27.522 | 13.761 | 13.761 |
| 20 | 1.3422 | 1.9005 | 6.5946 | 186.33 | 28.255 | 28.255 | 14.127 | 14.127 |
| 21 | 1.413 | 2.0053 | 6.6016 | 189.67 | 28.731 | 28.731 | 14.366 | 14.366 |
| 22 | 1.4797 | 2.1023 | 6.6082 | 190.66 | 28.852 | 28.852 | 14.426 | 14.426 |
| 23 | 1.5464 | 2.2003 | 6.6148 | 191.93 | 29.016 | 29.016 | 14.508 | 14.508 |
| 24 | 1.6172 | 2.3031 | 6.6218 | 193.31 | 29.193 | 29.193 | 14.597 | 14.597 |
| 25 | 1.6839 | 2.4021 | 6.6285 | 191.54 | 28.897 | 28.897 | 14.448 | 14.448 |
| 26 | 1.7505 | 2.501 | 6.6352 | 192.33 | 28.986 | 28.986 | 14.493 | 14.493 |
| 27 | 1.8214 | 2.6039 | 6.6422 | 191.93 | 28.896 | 28.896 | 14.448 | 14.448 |
| 28 | 1.888 | 2.7038 | 6.649 | 190.07 | 28.586 | 28.586 | 14.293 | 14.293 |
| 29 | 1.9547 | 2.8018 | 6.6557 | 187.51 | 28.172 | 28.172 | 14.086 | 14.086 |
| 30 | 2.0214 | 2.9007 | 6.6625 | 182.39 | 27.376 | 27.376 | 13.688 | 13.688 |
| 31 | 2.088 | 2.9997 | 6.6693 | 178.26 | 26.729 | 26.729 | 13.364 | 13.364 |
| 32 | 2.4302 | 3.4993 | 6.7038 | 143.93 | 21.47 | 21.47 | 10.735 | 10.735 |
| 33 | 2.6677 | 3.8529 | 6.7285 | 110.09 | 16.361 | 16.361 | 8.1807 | 8.1807 |

# TRIAXIAL COMPRESSION TEST REPORT




| | | | | | |
|---|---|---|---|---|---|
| Symbol | | | | | |
| Test No. | | 2 | | | |
| Initial | Diameter, in | 2.827 | | | |
| | Height, in | 5.231 | | | |
| | Water Content, % | 22.95 | | | |
| | Dry Density, pcf | 98.049 | | | |
| | Saturation, % | 86.18 | | | |
| | Void Ratio | 0.71909 | | | |
| Before Shear | Water Content, % | 22.95 | | | |
| | Dry Density, pcf | 104.07 | | | |
| | Saturation, % | 100.00 | | | |
| | Void Ratio | 0.6197 | | | |
| | Back Press., psi | --- | | | |
| Minor Prin. Stress, psi | | 0 | | | |
| Max. Dev. Stress, psi | | 6.7485 | | | |
| Time to Failure, min | | 3.9471 | | | |
| Strain Rate, %/min | | 1.5 | | | |
| B-Value | | --- | | | |
| Specific Gravity | | 2.70 | | | |
| Liquid Limit | | 0 | | | |
| Plastic Limit | | 0 | | | |
| Plasticity Index | | 0 | | | |
| Failure Sketch | | | | | |

Project: Duck Creek Ash Pond
Location: Canton, Illinois
Project No.: 03S5010
Boring No.: B-4
Sample Type: Tube 6-1
Description: Brn. & gray vf. sandy silt.
Remarks:

Wed, 08-MAR-2006 09:29:31

TRIAXIAL TEST

Project: Duck Creek Ash Pond
Boring No.: B-4
Sample No.: 6-1
Test No.: 2

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube 6-1

Project No.: 03S5010
Checked By: JPK
Depth: 13.0-13.5
Elevation:

Soil Description: Brn. & gray vf. sandy silt.
Remarks:

Specimen Height: 5.23 in
Specimen Area: 6.28 in^2
Specimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

Liquid Limit: 0

Plastic Limit: 0

Specific Gravity: 2.70

| | Before Test Trimmings | Before Test Specimen+Ring | After Test Specimen+Ring | After Test Trimmings |
|---|---|---|---|---|
| Container ID | 36 | --- | | |
| Wt. Container + Wet Soil, gm | 104.99 | 1039 | 1039 | 0 |
| Wt. Container + Dry Soil, gm | 86.08 | 845.07 | 845.07 | 0 |
| Wt. Container, gm | 3.69 | --- | 0 | 0 |
| Wt. Dry Soil, gm | 82.39 | 845.07 | 845.07 | 0 |
| Water Content, % | 22.95 | 22.95 | 22.95 | 0.00 |
| Void Ratio | --- | 0.72 | 0.62 | --- |
| Degree of Saturation, % | --- | 86.18 | 100.00 | --- |
| Dry Unit Weight, pcf | --- | 98.049 | 104.07 | --- |

Initial

End of Initialization

End of Consolidation/A

End of Saturation

End of Consolidation/B

End of Shear

At Failure

TRIAXIAL TEST

Project: Duck Creek Ash Pond
Boring No.: B-4
Sample No.: 6-1
Test No.: 2

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube 6-1

Project No.: 0355010
Checked By: JPK
Depth: 13.0-13.5
Elevation:

Soil Description: Brn. & gray vf. sandy silt.
Remarks:

Specimen Height: 5.23 in
Specimen Area: 6.28 in^2
Specimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

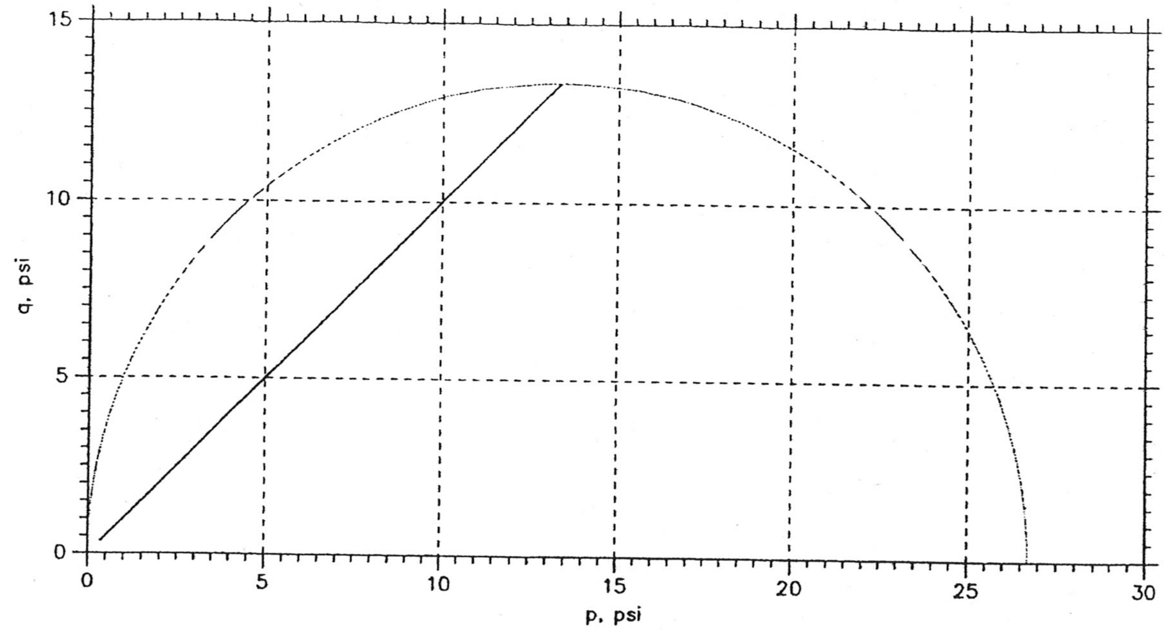
Liquid Limit: 0

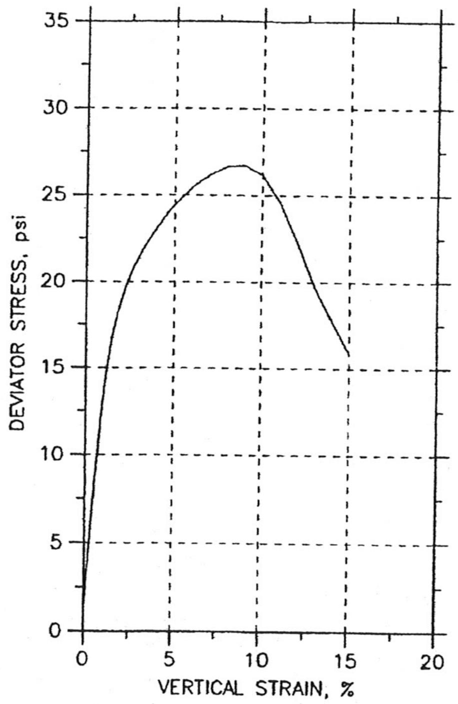
Plastic Limit: 0

Specific Gravity: 2.70

| | Time min | Vertical Strain % | Corrected Area in^2 | Deviator Load lb | Deviator Stress psi | Vertical Stress psi | p psi | q psi |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 6.2768 | 2.9593 | 0.47147 | 0.47147 | 0.23573 | 0.23573 |
| 2 | 0.07135 | 0.09985 | 6.2831 | 4.6317 | 0.73716 | 0.73716 | 0.36858 | 0.36858 |
| 3 | 0.14218 | 0.20614 | 6.2898 | 6.9927 | 1.1117 | 1.1117 | 0.55587 | 0.55587 |
| 4 | 0.20885 | 0.30492 | 6.296 | 9.452 | 1.5013 | 1.5013 | 0.75063 | 0.75063 |
| 5 | 0.27552 | 0.40477 | 6.3024 | 11.911 | 1.89 | 1.89 | 0.94499 | 0.94499 |
| 6 | 0.34218 | 0.50354 | 6.3086 | 14.272 | 2.2624 | 2.2624 | 1.1312 | 1.1312 |
| 7 | 0.40885 | 0.60339 | 6.315 | 16.732 | 2.6495 | 2.6495 | 1.3248 | 1.3248 |
| 8 | 0.47135 | 0.69895 | 6.321 | 18.994 | 3.0049 | 3.0049 | 1.5025 | 1.5025 |
| 9 | 0.54218 | 0.80524 | 6.3278 | 21.257 | 3.3593 | 3.3593 | 1.6796 | 1.6796 |
| 10 | 0.60468 | 0.90402 | 6.3341 | 23.028 | 3.6355 | 3.6355 | 1.8177 | 1.8177 |
| 11 | 0.66718 | 1.0006 | 6.3403 | 24.7 | 3.8957 | 3.8957 | 1.9479 | 1.9479 |
| 12 | 0.73385 | 1.1016 | 6.3468 | 26.372 | 4.1552 | 4.1552 | 2.0776 | 2.0776 |
| 13 | 0.80052 | 1.2046 | 6.3534 | 27.848 | 4.3832 | 4.3832 | 2.1916 | 2.1916 |
| 14 | 0.86718 | 1.3045 | 6.3598 | 29.127 | 4.5798 | 4.5798 | 2.2899 | 2.2899 |
| 15 | 0.92968 | 1.4 | 6.366 | 30.209 | 4.7454 | 4.7454 | 2.3727 | 2.3727 |
| 16 | 0.99635 | 1.5031 | 6.3726 | 31.389 | 4.9256 | 4.9256 | 2.4628 | 2.4628 |
| 17 | 1.063 | 1.6062 | 6.3793 | 32.373 | 5.0747 | 5.0747 | 2.5373 | 2.5373 |
| 18 | 1.1258 | 1.7017 | 6.3855 | 33.258 | 5.2084 | 5.2084 | 2.6042 | 2.6042 |
| 19 | 1.1966 | 1.8048 | 6.3922 | 34.144 | 5.3415 | 5.3415 | 2.6707 | 2.6707 |
| 20 | 1.2591 | 1.9004 | 6.3984 | 34.931 | 5.4593 | 5.4593 | 2.7296 | 2.7296 |
| 21 | 1.3258 | 2.0024 | 6.4051 | 35.619 | 5.5611 | 5.5611 | 2.7805 | 2.7805 |
| 22 | 1.3883 | 2.099 | 6.4114 | 36.308 | 5.663 | 5.663 | 2.8315 | 2.8315 |
| 23 | 1.455 | 2.201 | 6.4181 | 36.997 | 5.7644 | 5.7644 | 2.8822 | 2.8822 |
| 24 | 1.5216 | 2.3041 | 6.4249 | 37.587 | 5.8502 | 5.8502 | 2.9251 | 2.9251 |
| 25 | 1.5841 | 2.3996 | 6.4312 | 38.177 | 5.9363 | 5.9363 | 2.9681 | 2.9681 |
| 26 | 1.6508 | 2.5005 | 6.4378 | 38.669 | 6.0065 | 6.0065 | 3.0033 | 3.0033 |
| 27 | 1.7175 | 2.6025 | 6.4446 | 38.964 | 6.046 | 6.046 | 3.023 | 3.023 |
| 28 | 1.78 | 2.6992 | 6.451 | 39.259 | 6.0858 | 6.0858 | 3.0429 | 3.0429 |
| 29 | 1.8386 | 2.799 | 6.4576 | 39.751 | 6.1557 | 6.1557 | 3.0779 | 3.0779 |
| 30 | 1.9052 | 2.901 | 6.4644 | 40.046 | 6.1949 | 6.1949 | 3.0974 | 3.0974 |
| 31 | 1.9719 | 2.9998 | 6.471 | 40.341 | 6.2342 | 6.2342 | 3.1171 | 3.1171 |
| 32 | 2.3011 | 3.499 | 6.5044 | 41.817 | 6.429 | 6.429 | 3.2145 | 3.2145 |
| 33 | 2.6388 | 4.0015 | 6.5385 | 42.997 | 6.576 | 6.576 | 3.288 | 3.288 |
| 34 | 2.968 | 4.5061 | 6.573 | 43.489 | 6.6163 | 6.6163 | 3.3082 | 3.3082 |
| 35 | 3.293 | 5.0022 | 6.6074 | 44.276 | 6.701 | 6.701 | 3.3505 | 3.3505 |
| 36 | 3.9471 | 6.0006 | 6.6775 | 45.063 | 6.7485 | 6.7485 | 3.3742 | 3.3742 |
| 37 | 4.6099 | 7.0034 | 6.7495 | 45.162 | 6.6911 | 6.6911 | 3.3455 | 3.3455 |
| 38 | 5.2724 | 7.9998 | 6.8226 | 43.686 | 6.4031 | 6.4031 | 3.2015 | 3.2015 |
| 39 | 5.9354 | 9.0026 | 6.8978 | 40.636 | 5.8912 | 5.8912 | 2.9456 | 2.9456 |
| 40 | 6.5896 | 10.002 | 6.9744 | 37.882 | 5.4315 | 5.4315 | 2.7158 | 2.7158 |
| 41 | 7.1065 | 10.778 | 7.0351 | 34.832 | 4.9512 | 4.9512 | 2.4756 | 2.4756 |

# TRIAXIAL COMPRESSION TEST REPORT




| | | | | | |
|---|---|---|---|---|---|
| Symbol | | | | | |
| Test No. | | 1 | | | |
| Initial | Diameter, in | 2.858 | | | |
| | Height, in | 5.499 | | | |
| | Water Content, % | 23.50 | | | |
| | Dry Density, pcf | 100.49 | | | |
| | Saturation, % | 93.69 | | | |
| | Void Ratio | 0.67737 | | | |
| Before Shear | Water Content, % | 23.50 | | | |
| | Dry Density, pcf | 103.12 | | | |
| | Saturation, % | 100.00 | | | |
| | Void Ratio | 0.6346 | | | |
| | Back Press., psi | --- | | | |
| Minor Prin. Stress, psi | | 0 | | | |
| Max. Dev. Stress, psi | | 26.709 | | | |
| Time to Failure, min | | 6.1227 | | | |
| Strain Rate, %/min | | 1.5 | | | |
| B-Value | | --- | | | |
| Specific Gravity | | 2.70 | | | |
| Liquid Limit | | 0 | | | |
| Plastic Limit | | 0 | | | |
| Plasticity Index | | 0 | | | |
| Failure Sketch | | | | | |

| |
|---|
| Project: Duck Creek Ash Pond |
| Location: Canton, Illinois |
| Project No.: 03S5010 |
| Boring No.: B-5 |
| Sample Type: Tube 6-2 |
| Description: Brn. gray vf. sandy silty clay. |
| Remarks: |

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TRIAXIAL TEST

Project: Duck Creek Ash Pond
Boring No.: B-5
Sample No.: 6-2
Test No.: 1

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube 6-2

Project No.: 03S5010
Checked By: JPK
Depth: 13.5-14
Elevation:

Soil Description: Brn. gray vf. sandy silty clay.
Remarks:

Specimen Height: 5.50 in
Specimen Area: 6.42 in^2
Specimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

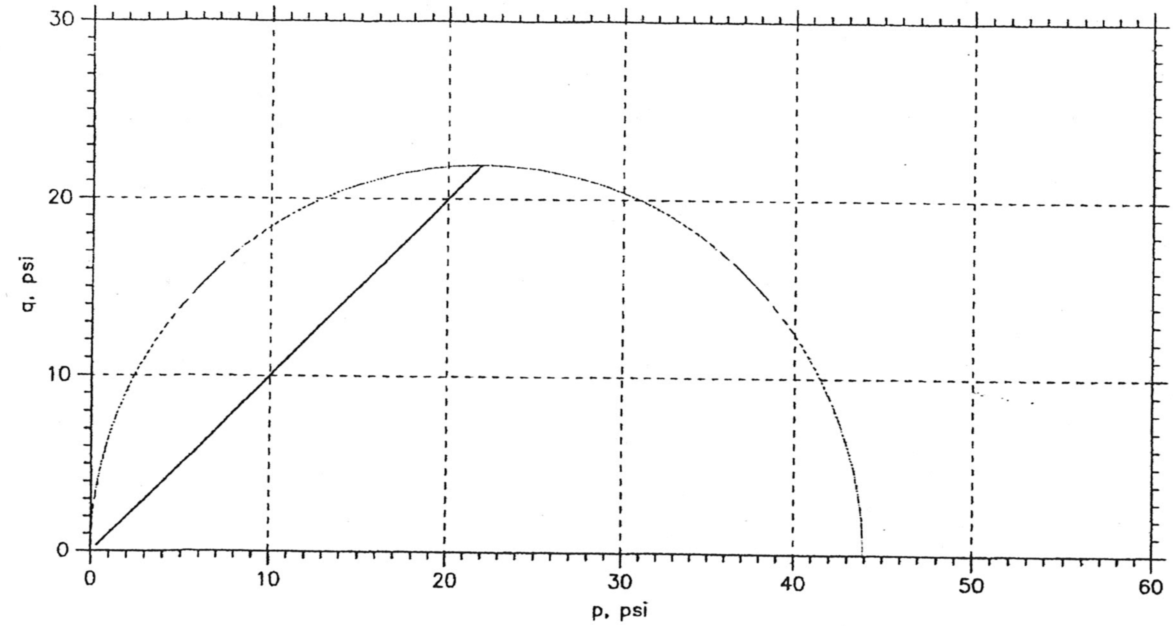
Liquid Limit: 0

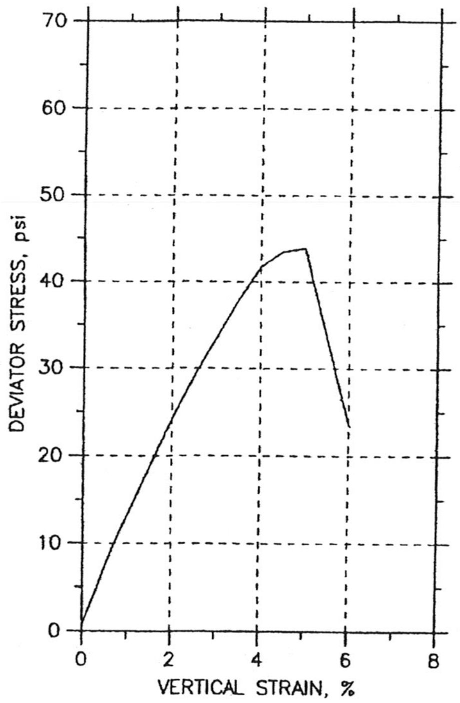
Plastic Limit: 0

Specific Gravity: 2.70

| | Time min | Vertical Strain % | Corrected Area in^2 | Deviator Load lb | Deviator Stress psi | Vertical Stress psi | p psi | q psi |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 6.4153 | 4.5333 | 0.70665 | 0.70665 | 0.35332 | 0.35332 |
| 2 | 0.079417 | 0.10111 | 6.4218 | 16.928 | 2.6361 | 2.6361 | 1.318 | 1.318 |
| 3 | 0.15025 | 0.20324 | 6.4283 | 24.798 | 3.8577 | 3.8577 | 1.9288 | 1.9288 |
| 4 | 0.21692 | 0.30027 | 6.4346 | 33.554 | 5.2146 | 5.2146 | 2.6073 | 2.6073 |
| 5 | 0.28775 | 0.40036 | 6.441 | 41.62 | 6.4617 | 6.4617 | 3.2309 | 3.2309 |
| 6 | 0.35858 | 0.50147 | 6.4476 | 49.49 | 7.6757 | 7.6757 | 3.8379 | 3.8379 |
| 7 | 0.42942 | 0.6036 | 6.4542 | 57.655 | 8.9329 | 8.9329 | 4.4665 | 4.4665 |
| 8 | 0.49608 | 0.69961 | 6.4605 | 65.328 | 10.112 | 10.112 | 5.056 | 5.056 |
| 9 | 0.56692 | 0.7997 | 6.467 | 72.706 | 11.243 | 11.243 | 5.6213 | 5.6213 |
| 10 | 0.63775 | 0.90081 | 6.4736 | 79.887 | 12.341 | 12.341 | 6.1703 | 6.1703 |
| 11 | 0.70858 | 1.0019 | 6.4802 | 86.282 | 13.315 | 13.315 | 6.6573 | 6.6573 |
| 12 | 0.77942 | 1.1041 | 6.4869 | 92.184 | 14.211 | 14.211 | 7.1054 | 7.1054 |
| 13 | 0.84608 | 1.2001 | 6.4932 | 97.201 | 14.97 | 14.97 | 7.4849 | 7.4849 |
| 14 | 0.91692 | 1.3012 | 6.4998 | 101.82 | 15.666 | 15.666 | 7.8329 | 7.8329 |
| 15 | 0.98775 | 1.4023 | 6.5065 | 106.05 | 16.3 | 16.3 | 8.1499 | 8.1499 |
| 16 | 1.0586 | 1.5024 | 6.5131 | 109.69 | 16.842 | 16.842 | 8.4211 | 8.4211 |
| 17 | 1.1336 | 1.6035 | 6.5198 | 113.14 | 17.353 | 17.353 | 8.6765 | 8.6765 |
| 18 | 1.2044 | 1.7026 | 6.5264 | 116.19 | 17.803 | 17.803 | 8.9014 | 8.9014 |
| 19 | 1.2755 | 1.8047 | 6.5332 | 119.14 | 18.236 | 18.236 | 9.118 | 9.118 |
| 20 | 1.3422 | 1.8997 | 6.5395 | 121.5 | 18.579 | 18.579 | 9.2897 | 9.2897 |
| 21 | 1.413 | 2.0028 | 6.5464 | 124.06 | 18.951 | 18.951 | 9.4753 | 9.4753 |
| 22 | 1.4839 | 2.1039 | 6.5531 | 126.32 | 19.276 | 19.276 | 9.6381 | 9.6381 |
| 23 | 1.5505 | 2.202 | 6.5597 | 128.48 | 19.587 | 19.587 | 9.7934 | 9.7934 |
| 24 | 1.6214 | 2.3051 | 6.5666 | 130.45 | 19.866 | 19.866 | 9.9329 | 9.9329 |
| 25 | 1.688 | 2.4022 | 6.5732 | 132.32 | 20.13 | 20.13 | 10.065 | 10.065 |
| 26 | 1.7547 | 2.5002 | 6.5798 | 134.19 | 20.394 | 20.394 | 10.197 | 10.197 |
| 27 | 1.8255 | 2.6034 | 6.5867 | 135.86 | 20.627 | 20.627 | 10.313 | 10.313 |
| 28 | 1.8922 | 2.7024 | 6.5934 | 137.53 | 20.859 | 20.859 | 10.43 | 10.43 |
| 29 | 1.9589 | 2.8005 | 6.6001 | 139.01 | 21.062 | 21.062 | 10.531 | 10.531 |
| 30 | 2.0297 | 2.9036 | 6.6071 | 140.49 | 21.263 | 21.263 | 10.631 | 10.631 |
| 31 | 2.0964 | 3.0007 | 6.6137 | 142.06 | 21.48 | 21.48 | 10.74 | 10.74 |
| 32 | 2.4385 | 3.4991 | 6.6479 | 148.75 | 22.375 | 22.375 | 11.188 | 11.188 |
| 33 | 2.7802 | 4.0046 | 6.6829 | 154.65 | 23.141 | 23.141 | 11.571 | 11.571 |
| 34 | 3.1177 | 4.503 | 6.7178 | 160.26 | 23.856 | 23.856 | 11.928 | 11.928 |
| 35 | 3.4552 | 5.0025 | 6.7531 | 165.08 | 24.445 | 24.445 | 12.222 | 12.222 |
| 36 | 4.1305 | 6.0003 | 6.8248 | 173.83 | 25.471 | 25.471 | 12.736 | 12.736 |
| 37 | 4.7974 | 7.0002 | 6.8981 | 180.52 | 26.17 | 26.17 | 13.085 | 13.085 |
| 38 | 5.4599 | 8.0041 | 6.9734 | 185.84 | 26.649 | 26.649 | 13.325 | 13.325 |
| 39 | 6.1227 | 9.002 | 7.0499 | 188.3 | 26.709 | 26.709 | 13.354 | 13.354 |
| 40 | 6.7768 | 10.001 | 7.1281 | 186.72 | 26.195 | 26.195 | 13.097 | 13.097 |
| 41 | 7.4354 | 11.003 | 7.2084 | 177.38 | 24.607 | 24.607 | 12.303 | 12.303 |
| 42 | 8.0815 | 12.001 | 7.2901 | 162.52 | 22.293 | 22.293 | 11.147 | 11.147 |
| 43 | 8.7398 | 13.003 | 7.3741 | 145.11 | 19.678 | 19.678 | 9.8391 | 9.8391 |
| 44 | 9.3987 | 14 | 7.4596 | 131.83 | 17.672 | 17.672 | 8.8361 | 8.8361 |
| 45 | 10.049 | 14.999 | 7.5473 | 119.43 | 15.825 | 15.825 | 7.9123 | 7.9123 |
| 46 | 10.053 | 15.006 | 7.5479 | 119.43 | 15.823 | 15.823 | 7.9117 | 7.9117 |

# TRIAXIAL COMPRESSION TEST REPORT




| | | | | | | |
|---|---|---|---|---|---|---|
| Symbol | | | | | | |
| Test No. | | 1 | | | | |
| Initial | Diameter, in | 2.809 | | | | |
| | Height, in | 5.319 | | | | |
| | Water Content, % | 15.68 | | | | |
| | Dry Density, pcf | 117.73 | | | | |
| | Saturation, % | 98.10 | | | | |
| | Void Ratio | 0.43165 | | | | |
| Before Shear | Water Content, % | 15.68 | | | | |
| | Dry Density, pcf | 118.41 | | | | |
| | Saturation, % | 100.00 | | | | |
| | Void Ratio | 0.42343 | | | | |
| | Back Press., psi | --- | | | | |
| Minor Prin. Stress, psi | | 0 | | | | |
| Max. Dev. Stress, psi | | 43.9 | | | | |
| Time to Failure, min | | 3.4594 | | | | |
| Strain Rate, %/min | | 1.5 | | | | |
| B-Value | | --- | | | | |
| Specific Gravity | | 2.70 | | | | |
| Liquid Limit | | 0 | | | | |
| Plastic Limit | | 0 | | | | |
| Plasticity Index | | 0 | | | | |
| Failure Sketch | | | | | | |

| | |
|---|---|
| Project: Duck Creek Ash Pond | |
| Location: Canton, Illinois | |
| Project No.: 03S5010 | |
| Boring No.: B-6 | |
| Sample Type: Tube 2-1 | |
| Description: Brn. & gray vf. sandy silt. | |
| Remarks: | |

Wed, 08-MAR-2006 09:34:31

TRIAXIAL TEST

Project: Duck Creek Ash Pond
Boring No.: B-6
Sample No.: 2-1
Test No.: 1

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube 2-1

Project No.: 03S5010
Checked By: JPK
Depth: 2.0-2.5
Elevation: N/A

Soil Description: Brn. & gray vf. sandy silt.
Remarks:

Specimen Height: 5.32 in
Specimen Area: 6.20 in^2
Specimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

Liquid Limit: 0

Plastic Limit: 0

Specific Gravity: 2.70

| | Before Test Trimmings | Before Test Specimen+Ring | After Test Specimen+Ring | After Test Trimmings |
|---|---|---|---|---|
| Container ID | 36 | --- | | |
| Wt. Container + Wet Soil, gm | 93.25 | 1178.5 | 1178.5 | 0 |
| Wt. Container + Dry Soil, gm | 81.11 | 1018.7 | 1018.7 | 0 |
| Wt. Container, gm | 3.7 | --- | 0 | 0 |
| Wt. Dry Soil, gm | 77.41 | 1018.7 | 1018.7 | 0 |
| Water Content, % | 15.68 | 15.68 | 15.68 | 0.00 |
| Void Ratio | --- | 0.43 | 0.42 | --- |
| Degree of Saturation, % | --- | 98.10 | 100.00 | --- |
| Dry Unit Weight, pcf | --- | 117.73 | 118.41 | --- |

Initial

End of Initialization

End of Consolidation/A

End of Saturation

End of Consolidation/B

End of Shear

At Failure

TRIAXIAL TEST

Project: Duck Creek Ash Pond
Boring No.: B-6
Sample No.: 2-1
Test No.: 1

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube 2-1

Project No.: 0355010
Checked By: JPK
Depth: 2.0-2.5
Elevation: N/A

Soil Description: Brn. & gray vf. sandy silt.
Remarks:

Specimen Height: 5.32 in
Specimen Area: 6.20 in^2
Specimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

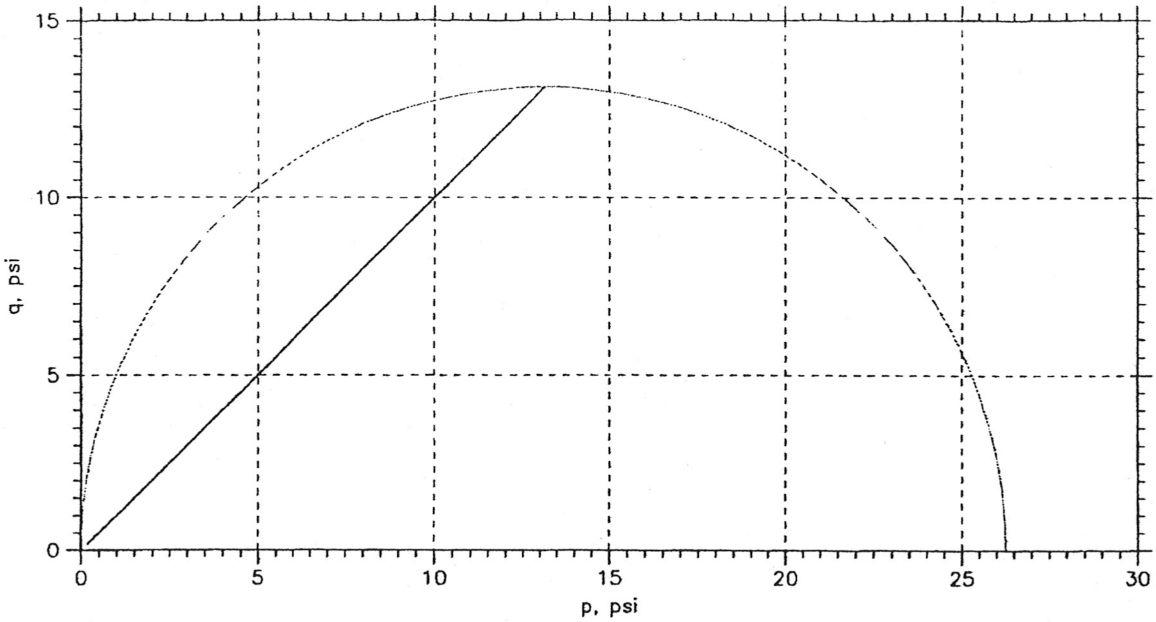
Liquid Limit: 0

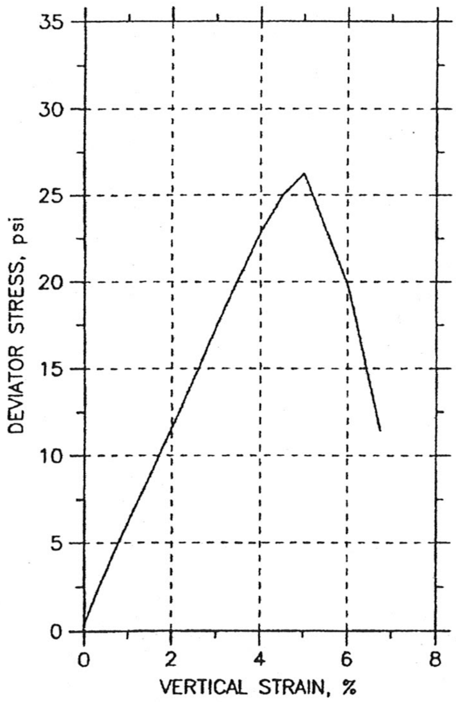
Plastic Limit: 0

Specific Gravity: 2.70

| | Time min | Vertical Strain % | Corrected Area in^2 | Deviator Load lb | Deviator Stress psi | Vertical Stress psi | p psi | q psi |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 6.1972 | 3.9431 | 0.63627 | 0.63627 | 0.31814 | 0.31814 |
| 2 | 0.075 | 0.10031 | 6.2034 | 12.108 | 1.9518 | 1.9518 | 0.97592 | 0.97592 |
| 3 | 0.14583 | 0.20379 | 6.2098 | 20.47 | 3.2964 | 3.2964 | 1.6482 | 1.6482 |
| 4 | 0.2125 | 0.3041 | 6.2161 | 28.635 | 4.6066 | 4.6066 | 2.3033 | 2.3033 |
| 5 | 0.27942 | 0.40229 | 6.2222 | 37.095 | 5.9617 | 5.9617 | 2.9809 | 2.9809 |
| 6 | 0.34608 | 0.50155 | 6.2284 | 45.752 | 7.3457 | 7.3457 | 3.6728 | 3.6728 |
| 7 | 0.41275 | 0.6008 | 6.2346 | 53.72 | 8.6164 | 8.6164 | 4.3082 | 4.3082 |
| 8 | 0.48358 | 0.70533 | 6.2412 | 61.885 | 9.9156 | 9.9156 | 4.9578 | 4.9578 |
| 9 | 0.55025 | 0.80459 | 6.2474 | 69.066 | 11.055 | 11.055 | 5.5276 | 5.5276 |
| 10 | 0.61692 | 0.90384 | 6.2537 | 76.051 | 12.161 | 12.161 | 6.0805 | 6.0805 |
| 11 | 0.68358 | 1.001 | 6.2598 | 82.839 | 13.233 | 13.233 | 6.6167 | 6.6167 |
| 12 | 0.75442 | 1.1045 | 6.2664 | 90.02 | 14.366 | 14.366 | 7.1828 | 7.1828 |
| 13 | 0.82108 | 1.2005 | 6.2725 | 96.906 | 15.449 | 15.449 | 7.7247 | 7.7247 |
| 14 | 0.89192 | 1.304 | 6.279 | 104.28 | 16.608 | 16.608 | 8.3041 | 8.3041 |
| 15 | 0.95858 | 1.4022 | 6.2853 | 111.27 | 17.703 | 17.703 | 8.8515 | 8.8515 |
| 16 | 1.0253 | 1.4994 | 6.2915 | 117.96 | 18.749 | 18.749 | 9.3744 | 9.3744 |
| 17 | 1.0961 | 1.6018 | 6.2981 | 125.34 | 19.901 | 19.901 | 9.9504 | 9.9504 |
| 18 | 1.1628 | 1.7 | 6.3043 | 132.22 | 20.973 | 20.973 | 10.487 | 10.487 |
| 19 | 1.2339 | 1.7992 | 6.3107 | 139.01 | 22.028 | 22.028 | 11.014 | 11.014 |
| 20 | 1.3047 | 1.9017 | 6.3173 | 145.99 | 23.11 | 23.11 | 11.555 | 11.555 |
| 21 | 1.3755 | 2.0062 | 6.324 | 153.08 | 24.206 | 24.206 | 12.103 | 12.103 |
| 22 | 1.4422 | 2.1033 | 6.3303 | 159.47 | 25.192 | 25.192 | 12.596 | 12.596 |
| 23 | 1.5089 | 2.2026 | 6.3367 | 166.06 | 26.206 | 26.206 | 13.103 | 13.103 |
| 24 | 1.5755 | 2.2997 | 6.343 | 172.06 | 27.126 | 27.126 | 13.563 | 13.563 |
| 25 | 1.6464 | 2.4022 | 6.3497 | 178.65 | 28.136 | 28.136 | 14.068 | 14.068 |
| 26 | 1.713 | 2.5003 | 6.3561 | 184.85 | 29.083 | 29.083 | 14.541 | 14.541 |
| 27 | 1.7839 | 2.6038 | 6.3628 | 191.44 | 30.088 | 30.088 | 15.044 | 15.044 |
| 28 | 1.8505 | 2.701 | 6.3692 | 197.25 | 30.969 | 30.969 | 15.484 | 15.484 |
| 29 | 1.9214 | 2.8034 | 6.3759 | 203.25 | 31.877 | 31.877 | 15.939 | 15.939 |
| 30 | 1.988 | 2.9016 | 6.3824 | 208.56 | 32.678 | 32.678 | 16.339 | 16.339 |
| 31 | 2.0589 | 3.004 | 6.3891 | 214.27 | 33.536 | 33.536 | 16.768 | 16.768 |
| 32 | 2.4091 | 3.5013 | 6.422 | 243.48 | 37.914 | 37.914 | 18.957 | 18.957 |
| 33 | 2.7591 | 4.0008 | 6.4554 | 269.55 | 41.756 | 41.756 | 20.878 | 20.878 |
| 34 | 3.1091 | 4.5044 | 6.4895 | 282.05 | 43.462 | 43.462 | 21.731 | 21.731 |
| 35 | 3.4594 | 5.0007 | 6.5234 | 286.37 | 43.9 | 43.9 | 21.95 | 21.95 |
| 36 | 4.1385 | 6.0006 | 6.5928 | 155.54 | 23.592 | 23.592 | 11.796 | 11.796 |
| 37 | 4.1635 | 6.0376 | 6.5954 | 153.96 | 23.344 | 23.344 | 11.672 | 11.672 |

# TRIAXIAL COMPRESSION TEST REPORT




| | | | | | |
|---|---|---|---|---|---|
| Symbol | | | | | |
| Test No. | | 2 | | | |
| Initial | Diameter, in | 2.82 | | | |
| | Height, in | 5.867 | | | |
| | Water Content, % | 48.72 | | | |
| | Dry Density, pcf | 72.273 | | | |
| | Saturation, % | 98.75 | | | |
| | Void Ratio | 1.3322 | | | |
| Before Shear | Water Content, % | 48.72 | | | |
| | Dry Density, pcf | 72.793 | | | |
| | Saturation, % | 100.00 | | | |
| | Void Ratio | 1.3156 | | | |
| | Back Press., psi | --- | | | |
| Minor Prin. Stress, psi | | 0 | | | |
| Max. Dev. Stress, psi | | 26.26 | | | |
| Time to Failure, min | | 3.4636 | | | |
| Strain Rate, %/min | | 1.5 | | | |
| B-Value | | --- | | | |
| Specific Gravity | | 2.70 | | | |
| Liquid Limit | | 0 | | | |
| Plastic Limit | | 0 | | | |
| Plasticity Index | | 0 | | | |
| Failure Sketch | | | | | |

Project: Duck Creek Ash Pond
Location: Canton, Illinois
Project No.: 03S5010
Boring No.: B-6
Sample Type: Tube 6-3
Description: Brn. & gray vf. sandy silt. (organic)
Remarks:

Wed, 08-MAR-2006 09:35:07

TRIAXIAL TEST

Project: Duck Creek Ash Pond
Boring No.: B-6
Sample No.: 6-3
Test No.: 2

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube 6-3

Project No.: 03S5010
Checked By: JPK
Depth: 14.0-14.5
Elevation: N/A

Soil Description: Brn. & gray vf. sandy silt. (organic)
Remarks:

Specimen Height: 5.87 in
Specimen Area: 6.25 in^2
Specimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

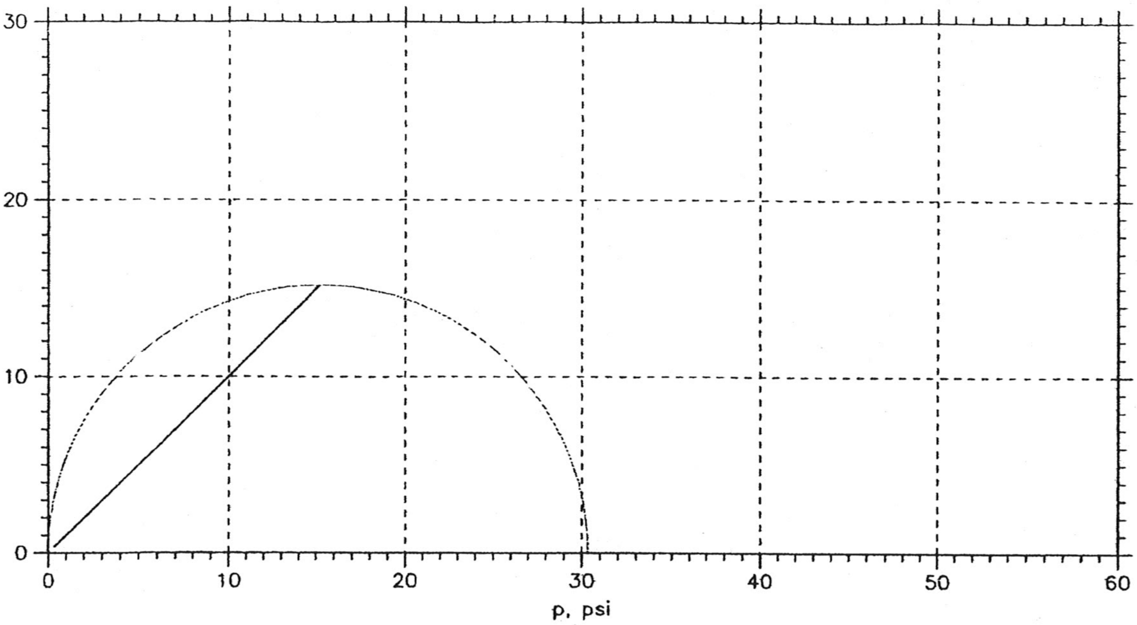
Liquid Limit: 0

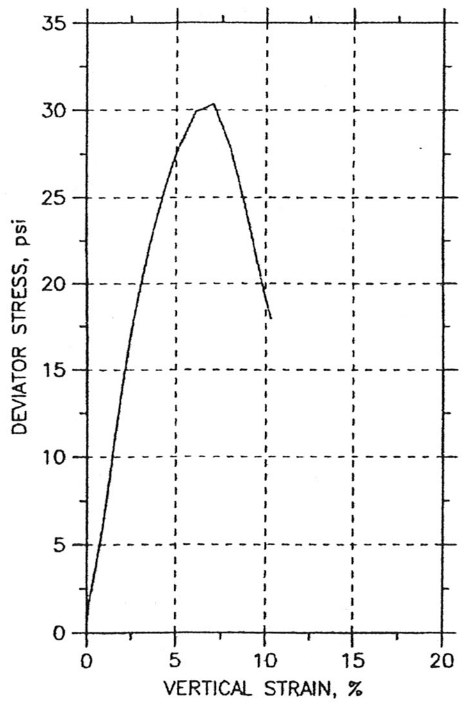
Plastic Limit: 0

Specific Gravity: 2.70

| | Time min | Vertical Strain % | Corrected Area in^2 | Deviator Load lb | Deviator Stress psi | Vertical Stress psi | p psi | q psi |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 6.2458 | 2.2707 | 0.36356 | 0.36356 | 0.18178 | 0.18178 |
| 2 | 0.075267 | 0.10051 | 6.2521 | 6.4024 | 1.024 | 1.024 | 0.51202 | 0.51202 |
| 3 | 0.1461 | 0.20294 | 6.2585 | 10.239 | 1.636 | 1.636 | 0.81801 | 0.81801 |
| 4 | 0.21277 | 0.30154 | 6.2647 | 13.977 | 2.2311 | 2.2311 | 1.1156 | 1.1156 |
| 5 | 0.2836 | 0.40492 | 6.2712 | 17.912 | 2.8563 | 2.8563 | 1.4281 | 1.4281 |
| 6 | 0.35027 | 0.50256 | 6.2773 | 21.552 | 3.4333 | 3.4333 | 1.7166 | 1.7166 |
| 7 | 0.41693 | 0.59925 | 6.2835 | 25.192 | 4.0092 | 4.0092 | 2.0046 | 2.0046 |
| 8 | 0.48777 | 0.70359 | 6.2901 | 28.733 | 4.568 | 4.568 | 2.284 | 2.284 |
| 9 | 0.5586 | 0.80506 | 6.2965 | 32.373 | 5.1414 | 5.1414 | 2.5707 | 2.5707 |
| 10 | 0.62527 | 0.9027 | 6.3027 | 35.718 | 5.6671 | 5.6671 | 2.8335 | 2.8335 |
| 11 | 0.69193 | 0.99939 | 6.3089 | 39.062 | 6.1917 | 6.1917 | 3.0958 | 3.0958 |
| 12 | 0.76277 | 1.1028 | 6.3154 | 42.604 | 6.746 | 6.746 | 3.373 | 3.373 |
| 13 | 0.82943 | 1.1995 | 6.3216 | 45.85 | 7.2529 | 7.2529 | 3.6265 | 3.6265 |
| 14 | 0.90027 | 1.3009 | 6.3281 | 49.293 | 7.7896 | 7.7896 | 3.8948 | 3.8948 |
| 15 | 0.9711 | 1.4034 | 6.3347 | 52.835 | 8.3405 | 8.3405 | 4.1703 | 4.1703 |
| 16 | 1.0378 | 1.4991 | 6.3409 | 56.179 | 8.8599 | 8.8599 | 4.43 | 4.43 |
| 17 | 1.1086 | 1.6005 | 6.3474 | 59.721 | 9.4087 | 9.4087 | 4.7044 | 4.7044 |
| 18 | 1.1839 | 1.7039 | 6.3541 | 63.262 | 9.9562 | 9.9562 | 4.9781 | 4.9781 |
| 19 | 1.2505 | 1.7997 | 6.3603 | 66.705 | 10.488 | 10.488 | 5.2439 | 5.2439 |
| 20 | 1.3214 | 1.9021 | 6.3669 | 70.345 | 11.049 | 11.049 | 5.5243 | 5.5243 |
| 21 | 1.3922 | 2.0045 | 6.3736 | 74.083 | 11.624 | 11.624 | 5.8118 | 5.8118 |
| 22 | 1.4589 | 2.1012 | 6.3799 | 77.625 | 12.167 | 12.167 | 6.0836 | 6.0836 |
| 23 | 1.5297 | 2.2036 | 6.3865 | 81.461 | 12.755 | 12.755 | 6.3776 | 6.3776 |
| 24 | 1.5964 | 2.2994 | 6.3928 | 85.003 | 13.297 | 13.297 | 6.6483 | 6.6483 |
| 25 | 1.6672 | 2.3999 | 6.3994 | 88.839 | 13.883 | 13.883 | 6.9413 | 6.9413 |
| 26 | 1.738 | 2.5004 | 6.406 | 92.676 | 14.467 | 14.467 | 7.2336 | 7.2336 |
| 27 | 1.8089 | 2.6038 | 6.4128 | 96.513 | 15.05 | 15.05 | 7.525 | 7.525 |
| 28 | 1.8797 | 2.7043 | 6.4194 | 100.45 | 15.647 | 15.647 | 7.8237 | 7.8237 |
| 29 | 1.9505 | 2.8038 | 6.426 | 104.28 | 16.229 | 16.229 | 8.1143 | 8.1143 |
| 30 | 2.0172 | 2.8996 | 6.4323 | 108.02 | 16.794 | 16.794 | 8.3969 | 8.3969 |
| 31 | 2.088 | 3.001 | 6.439 | 111.96 | 17.387 | 17.387 | 8.6936 | 8.6936 |
| 32 | 2.4383 | 3.4998 | 6.4723 | 130.94 | 20.231 | 20.231 | 10.116 | 10.116 |
| 33 | 2.78 | 4.0014 | 6.5061 | 148.55 | 22.833 | 22.833 | 11.416 | 11.416 |
| 34 | 3.1216 | 4.503 | 6.5403 | 163.6 | 25.015 | 25.015 | 12.507 | 12.507 |
| 35 | 3.4636 | 5.0027 | 6.5747 | 172.65 | 26.26 | 26.26 | 13.13 | 13.13 |
| 36 | 4.1386 | 6.004 | 6.6447 | 131.44 | 19.78 | 19.78 | 9.8902 | 9.8902 |
| 37 | 4.6471 | 6.7554 | 6.6983 | 76.444 | 11.413 | 11.413 | 5.7063 | 5.7063 |

# TRIAXIAL COMPRESSION TEST REPORT




| | | | | | |
|---|---|---|---|---|---|
| Symbol | | | | | |
| Test No. | | 3 | | | |
| Initial | Diameter, in | 2.867 | | | |
| | Height, in | 5.789 | | | |
| | Water Content, % | 14.41 | | | |
| | Dry Density, pcf | 124.58 | | | |
| | Saturation, % | 110.21 | | | |
| | Void Ratio | 0.35294 | | | |
| Before Shear | Water Content, % | 14.41 | | | |
| | Dry Density, pcf | 121.35 | | | |
| | Saturation, % | 100.00 | | | |
| | Void Ratio | 0.38899 | | | |
| | Back Press., psi | --- | | | |
| Minor Prin. Stress, psi | | 0 | | | |
| Max. Dev. Stress, psi | | 30.356 | | | |
| Time to Failure, min | | 4.793 | | | |
| Strain Rate, %/min | | 1.5 | | | |
| B-Value | | --- | | | |
| Specific Gravity | | 2.70 | | | |
| Liquid Limit | | 0 | | | |
| Plastic Limit | | 0 | | | |
| Plasticity Index | | 0 | | | |
| Failure Sketch | | | | | |

Project: Duck Creek Ash Pond
Location: Canton, Illinois
Project No.: 03S5010
Boring No.: B-6
Sample Type: Tube 8-3
Description: Gray f. sandy clayey silt (tr. c. sand & sm. gravel).
Remarks:

Wed, 08-MAR-2006 09:36:08

TRIAXIAL TEST

Project: Duck Creek Ash Pond
Boring No.: B-6
Sample No.: 8-3
Test No.: 3

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube 8-3

Project No.: 03S5010
Checked By: JPK
Depth: 24.0-24.5
Elevation: N/A

Soil Description: Gray f. sandy clayey silt (tr. c. sand & sm. gravel).
Remarks:

Specimen Height: 5.79 in
Specimen Area: 6.46 in^2
Specimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

Liquid Limit: 0

Plastic Limit: 0

Specific Gravity: 2.70

| | Before Test Trimmings | Before Test Specimen+Ring | After Test Specimen+Ring | After Test Trimmings |
|---|---|---|---|---|
| Container ID | 34 | --- | | |
| Wt. Container + Wet Soil, gm | 91.26 | 1398.3 | 1398.3 | 0 |
| Wt. Container + Dry Soil, gm | 80.23 | 1222.2 | 1222.2 | 0 |
| Wt. Container, gm | 3.67 | --- | 0 | 0 |
| Wt. Dry Soil, gm | 76.56 | 1222.2 | 1222.2 | 0 |
| Water Content, % | 14.41 | 14.41 | 14.41 | 0.00 |
| Void Ratio | --- | 0.35 | 0.39 | --- |
| Degree of Saturation, % | --- | 110.21 | 100.00 | --- |
| Dry Unit Weight, pcf | --- | 124.58 | 121.35 | --- |

Initial

End of Initialization

End of Consolidation/A

End of Saturation

End of Consolidation/B

End of Shear

At Failure

TRIAXIAL TEST

Project: Duck Creek Ash Pond
Boring No.: B-6
Sample No.: 8-3
Test No.: 3

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/06/06
Sample Type: Tube 8-3

Project No.: 03S5010
Checked By: JPK
Depth: 24.0-24.5
Elevation: N/A

Soil Description: Gray f. sandy clayey silt (tr. c. sand & sm. gravel).
Remarks:

Specimen Height: 5.79 in
Specimen Area: 6.46 in^2
Specimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

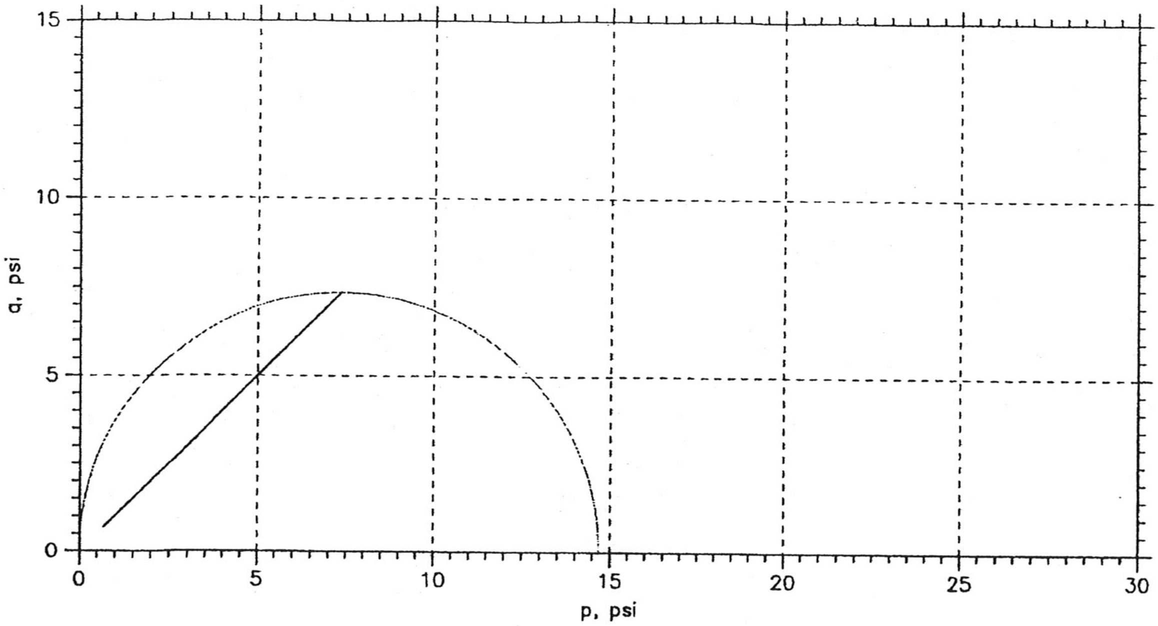
Liquid Limit: 0

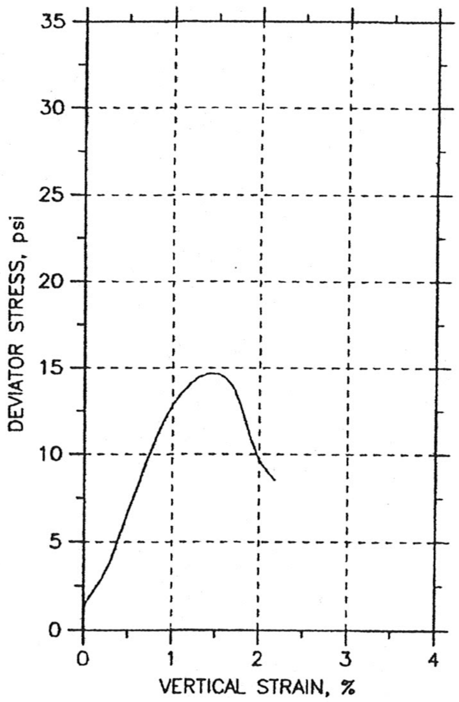
Plastic Limit: 0

Specific Gravity: 2.70

| | Time min | Vertical Strain % | Corrected Area in^2 | Deviator Load lb | Deviator Stress psi | Vertical Stress psi | p psi | q psi |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 6.4557 | 4.4349 | 0.68698 | 0.68698 | 0.34349 | 0.34349 |
| 2 | 0.079417 | 0.10478 | 6.4625 | 10.337 | 1.5996 | 1.5996 | 0.7998 | 0.7998 |
| 3 | 0.14608 | 0.20179 | 6.4688 | 13.682 | 2.1151 | 2.1151 | 1.0575 | 1.0575 |
| 4 | 0.21275 | 0.29978 | 6.4751 | 17.027 | 2.6296 | 2.6296 | 1.3148 | 1.3148 |
| 5 | 0.28358 | 0.40262 | 6.4818 | 20.568 | 3.1732 | 3.1732 | 1.5866 | 1.5866 |
| 6 | 0.35442 | 0.50352 | 6.4884 | 24.208 | 3.731 | 3.731 | 1.8655 | 1.8655 |
| 7 | 0.42108 | 0.60053 | 6.4947 | 27.749 | 4.2726 | 4.2726 | 2.1363 | 2.1363 |
| 8 | 0.49192 | 0.70434 | 6.5015 | 31.586 | 4.8583 | 4.8583 | 2.4291 | 2.4291 |
| 9 | 0.55885 | 0.80039 | 6.5078 | 35.029 | 5.3826 | 5.3826 | 2.6913 | 2.6913 |
| 10 | 0.62968 | 0.90128 | 6.5144 | 39.161 | 6.0114 | 6.0114 | 3.0057 | 3.0057 |
| 11 | 0.70052 | 1.0031 | 6.5211 | 43.784 | 6.7142 | 6.7142 | 3.3571 | 3.3571 |
| 12 | 0.76718 | 1.0992 | 6.5275 | 48.506 | 7.4311 | 7.4311 | 3.7155 | 3.7155 |
| 13 | 0.83802 | 1.2011 | 6.5342 | 53.425 | 8.1762 | 8.1762 | 4.0881 | 4.0881 |
| 14 | 0.90885 | 1.3029 | 6.541 | 58.54 | 8.9498 | 8.9498 | 4.4749 | 4.4749 |
| 15 | 0.97968 | 1.4038 | 6.5476 | 63.557 | 9.7069 | 9.7069 | 4.8535 | 4.8535 |
| 16 | 1.0505 | 1.5047 | 6.5544 | 68.476 | 10.447 | 10.447 | 5.2237 | 5.2237 |
| 17 | 1.1172 | 1.6008 | 6.5608 | 73.198 | 11.157 | 11.157 | 5.5785 | 5.5785 |
| 18 | 1.1925 | 1.6997 | 6.5674 | 77.92 | 11.865 | 11.865 | 5.9324 | 5.9324 |
| 19 | 1.2633 | 1.8016 | 6.5742 | 82.74 | 12.586 | 12.586 | 6.2928 | 6.2928 |
| 20 | 1.3341 | 1.9025 | 6.5809 | 87.462 | 13.29 | 13.29 | 6.6451 | 6.6451 |
| 21 | 1.405 | 2.0034 | 6.5877 | 92.086 | 13.978 | 13.978 | 6.9892 | 6.9892 |
| 22 | 1.4758 | 2.1043 | 6.5945 | 96.513 | 14.635 | 14.635 | 7.3177 | 7.3177 |
| 23 | 1.5425 | 2.2013 | 6.601 | 100.74 | 15.262 | 15.262 | 7.6308 | 7.6308 |
| 24 | 1.6133 | 2.3041 | 6.608 | 105.07 | 15.901 | 15.901 | 7.9503 | 7.9503 |
| 25 | 1.68 | 2.4012 | 6.6146 | 109.1 | 16.495 | 16.495 | 8.2473 | 8.2473 |
| 26 | 1.7508 | 2.504 | 6.6215 | 113.24 | 17.101 | 17.101 | 8.5506 | 8.5506 |
| 27 | 1.8175 | 2.602 | 6.6282 | 117.17 | 17.678 | 17.678 | 8.8388 | 8.8388 |
| 28 | 1.8841 | 2.7 | 6.6349 | 120.81 | 18.208 | 18.208 | 9.1042 | 9.1042 |
| 29 | 1.955 | 2.8028 | 6.6419 | 124.65 | 18.767 | 18.767 | 9.3834 | 9.3834 |
| 30 | 2.0216 | 2.9018 | 6.6487 | 128.29 | 19.295 | 19.295 | 9.6476 | 9.6476 |
| 31 | 2.0925 | 3.0036 | 6.6556 | 131.83 | 19.807 | 19.807 | 9.9035 | 9.9035 |
| 32 | 2.4344 | 3.5004 | 6.6899 | 147.96 | 22.117 | 22.117 | 11.059 | 11.059 |
| 33 | 2.7719 | 4 | 6.7247 | 162.52 | 24.168 | 24.168 | 12.084 | 12.084 |
| 34 | 3.1094 | 4.4996 | 6.7599 | 175.31 | 25.934 | 25.934 | 12.967 | 12.967 |
| 35 | 3.4555 | 5.0031 | 6.7957 | 187.02 | 27.52 | 27.52 | 13.76 | 13.76 |
| 36 | 4.1263 | 6.0024 | 6.868 | 205.22 | 29.88 | 29.88 | 14.94 | 14.94 |
| 37 | 4.793 | 7.0017 | 6.9418 | 210.72 | 30.356 | 30.356 | 15.178 | 15.178 |
| 38 | 5.4513 | 8.0009 | 7.0172 | 195.28 | 27.829 | 27.829 | 13.914 | 13.914 |
| 39 | 6.1143 | 9.0022 | 7.0944 | 168.52 | 23.754 | 23.754 | 11.877 | 11.877 |
| 40 | 6.7729 | 10.003 | 7.1733 | 136.45 | 19.022 | 19.022 | 9.5111 | 9.5111 |
| 41 | 6.9688 | 10.304 | 7.1974 | 129.07 | 17.934 | 17.934 | 8.9668 | 8.9668 |

# TRIAXIAL COMPRESSION TEST REPORT




| | | | | | | |
|---|---|---|---|---|---|---|
| Symbol | | | | | | |
| Test No. | | 1 | | | | |
| Initial | Diameter, in | 2.875 | | | | |
| | Height, in | 6 | | | | |
| | Water Content, % | 17.23 | | | | |
| | Dry Density, pcf | 102.94 | | | | |
| | Saturation, % | 72.95 | | | | |
| | Void Ratio | 0.63749 | | | | |
| Before Shear | Water Content, % | 17.23 | | | | |
| | Dry Density, pcf | 115.05 | | | | |
| | Saturation, % | 100.00 | | | | |
| | Void Ratio | 0.46508 | | | | |
| | Back Press., psi | --- | | | | |
| Minor Prin. Stress, psi | | 0 | | | | |
| Max. Dev. Stress, psi | | 14.688 | | | | |
| Time to Failure, min | | 1.0516 | | | | |
| Strain Rate, %/min | | 1.5 | | | | |
| B-Value | | --- | | | | |
| Specific Gravity | | 2.70 | | | | |
| Liquid Limit | | 0 | | | | |
| Plastic Limit | | 0 | | | | |
| Plasticity Index | | 0 | | | | |
| Failure Sketch | | | | | | |

Project: Duck Creek Ash Pond
Location: Canton, Illinois
Project No.: 03S5010
Boring No.: Bag B-3
Sample Type: Compacted
Description: Brn. vf. sandy silt.
Remarks:

Mon, 10-APR-2006 14:59:18

TRIAXIAL TEST

roject: Duck Creek Ash Pond
oring No.: Bag B-3
ample No.: 1
est No.: 1

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/16/06
Sample Type: Compacted

Project No.: 03S5010
Checked By: JCC
Depth: 1.0-10.0
Elevation: N/A

oil Description: Brn. vf. sandy silt.
emarks:

pecimen Height: 6.00 in
pecimen Area: 6.49 in^2
pecimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

iquid Limit: 0

Plastic Limit: 0

Specific Gravity: 2.70

| | Before Test Trimmings | Before Test Specimen+Ring | After Test Specimen+Ring | After Test Trimmings |
|---|---|---|---|---|
| ontainer ID | 36 | --- | | |
| t. Container + Wet Soil, gm | 111.08 | 1233.7 | 1233.7 | 0 |
| t. Container + Dry Soil, gm | 95.3 | 1052.5 | 1052.5 | 0 |
| t. Container, gm | 3.69 | --- | 0 | 0 |
| t. Dry Soil, gm | 91.61 | 1052.5 | 1052.5 | 0 |
| ater Content, % | 17.23 | 17.23 | 17.23 | 0.00 |
| oid Ratio | --- | 0.64 | 0.47 | --- |
| egree of Saturation, % | --- | 72.95 | 100.00 | --- |
| ry Unit Weight, pcf | --- | 102.94 | 115.05 | --- |

nitial

nd of Initialization

nd of Consolidation/A

nd of Saturation

nd of Consolidation/B

nd of Shear

t Failure

TRIAXIAL TEST

roject: Duck Creek Ash Pond
oring No.: Bag B-3
ample No.: 1
est No.: 1

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/16/06
Sample Type: Compacted

Project No.: 0355010
Checked By: JCC
Depth: 1.0-10.0
Elevation: N/A

oil Description: Brn. vf. sandy silt.
emarks:

pecimen Height: 6.00 in
pecimen Area: 6.49 in^2
pecimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

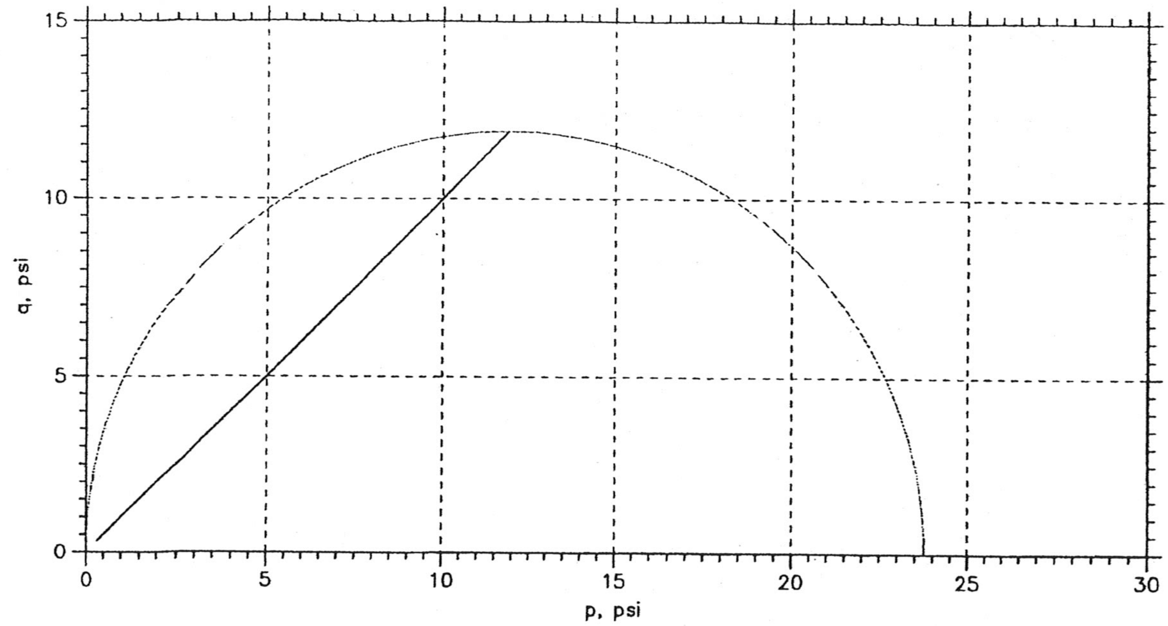
iquid Limit: 0

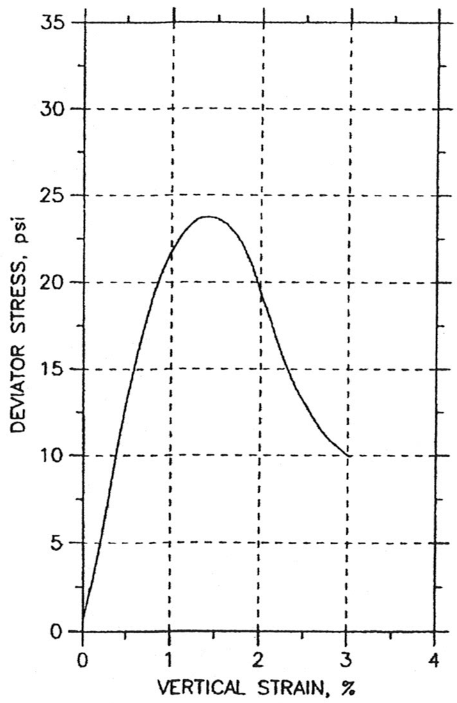
Plastic Limit: 0

Specific Gravity: 2.70

| | Time min | Vertical Strain % | Corrected Area in^2 | Deviator Load lb | Deviator Stress psi | Vertical Stress psi | p psi | q psi |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 6.4918 | 8.9601 | 1.3802 | 1.3802 | 0.69011 | 0.69011 |
| 2 | 0.071883 | 0.10016 | 6.4983 | 13.977 | 2.1509 | 2.1509 | 1.0754 | 1.0754 |
| 3 | 0.14297 | 0.20125 | 6.5049 | 18.797 | 2.8897 | 2.8897 | 1.4449 | 1.4449 |
| 4 | 0.2138 | 0.30515 | 6.5117 | 25.585 | 3.9291 | 3.9291 | 1.9646 | 1.9646 |
| 5 | 0.28073 | 0.40063 | 6.5179 | 34.537 | 5.2988 | 5.2988 | 2.6494 | 2.6494 |
| 6 | 0.35573 | 0.50172 | 6.5245 | 44.079 | 6.7559 | 6.7559 | 3.378 | 3.378 |
| 7 | 0.42657 | 0.60469 | 6.5313 | 53.031 | 8.1196 | 8.1196 | 4.0598 | 4.0598 |
| 8 | 0.49323 | 0.70016 | 6.5376 | 61.983 | 9.4811 | 9.4811 | 4.7406 | 4.7406 |
| 9 | 0.56407 | 0.80313 | 6.5444 | 70.837 | 10.824 | 10.824 | 5.4121 | 5.4121 |
| 10 | 0.6349 | 0.90422 | 6.551 | 78.412 | 11.969 | 11.969 | 5.9847 | 5.9847 |
| 11 | 0.70573 | 1.0034 | 6.5576 | 84.413 | 12.872 | 12.872 | 6.4362 | 6.4362 |
| 12 | 0.7724 | 1.1017 | 6.5641 | 89.036 | 13.564 | 13.564 | 6.782 | 6.782 |
| 13 | 0.84323 | 1.2028 | 6.5708 | 92.774 | 14.119 | 14.119 | 7.0596 | 7.0596 |
| 14 | 0.9099 | 1.2992 | 6.5773 | 95.234 | 14.479 | 14.479 | 7.2396 | 7.2396 |
| 15 | 0.98073 | 1.4022 | 6.5841 | 96.611 | 14.673 | 14.673 | 7.3367 | 7.3367 |
| 16 | 1.0516 | 1.5052 | 6.591 | 96.808 | 14.688 | 14.688 | 7.3439 | 7.3439 |
| 17 | 1.1182 | 1.6016 | 6.5975 | 95.135 | 14.42 | 14.42 | 7.21 | 7.21 |
| 18 | 1.1891 | 1.7008 | 6.6041 | 91.397 | 13.839 | 13.839 | 6.9197 | 6.9197 |
| 19 | 1.2602 | 1.8028 | 6.611 | 82.15 | 12.426 | 12.426 | 6.2131 | 6.2131 |
| 20 | 1.3268 | 1.8992 | 6.6175 | 71.919 | 10.868 | 10.868 | 5.434 | 5.434 |
| 21 | 1.3977 | 2.0013 | 6.6244 | 63.754 | 9.6242 | 9.6242 | 4.8121 | 4.8121 |
| 22 | 1.4727 | 2.1014 | 6.6312 | 59.426 | 8.9616 | 8.9616 | 4.4808 | 4.4808 |
| 23 | 1.5268 | 2.1791 | 6.6364 | 56.573 | 8.5246 | 8.5246 | 4.2623 | 4.2623 |

## TRIAXIAL COMPRESSION TEST REPORT




| | | | | | | |
|---|---|---|---|---|---|---|
| Symbol | | | | | | |
| Test No. | | 1 | | | | |
| Initial | Diameter, in | 2.875 | | | | |
| | Height, in | 6 | | | | |
| | Water Content, % | 16.74 | | | | |
| | Dry Density, pcf | 103.22 | | | | |
| | Saturation, % | 71.40 | | | | |
| | Void Ratio | 0.63303 | | | | |
| Before Shear | Water Content, % | 16.74 | | | | |
| | Dry Density, pcf | 116.09 | | | | |
| | Saturation, % | 100.00 | | | | |
| | Void Ratio | 0.45196 | | | | |
| | Back Press., psi | --- | | | | |
| Minor Prin. Stress, psi | | 0 | | | | |
| Max. Dev. Stress, psi | | 23.772 | | | | |
| Time to Failure, min | | 0.91772 | | | | |
| Strain Rate, %/min | | 1.5 | | | | |
| B-Value | | --- | | | | |
| Specific Gravity | | 2.70 | | | | |
| Liquid Limit | | 0 | | | | |
| Plastic Limit | | 0 | | | | |
| Plasticity Index | | 0 | | | | |
| Failure Sketch | | | | | | |

| |
|---|
| Project: Duck Creek Ash Pond |
| Location: Canton, Illinois |
| Project No.: 03S5010 |
| Boring No.: Bag B-4 |
| Sample Type: Compacted |
| Description: Yel. brn. vf. sandy silt. |
| Remarks: |

Mon, 10-APR-2006 15:03:21

TRIAXIAL TEST

Project: Duck Creek Ash Pond
Boring No.: Bag B-4
Sample No.: 1
Test No.: 1

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/16/06
Sample Type: Compacted

Project No.: 0355010
Checked By: JCC
Depth: 1.0-10.0
Elevation: N/A

Soil Description: Yel. brn. vf. sandy silt.
Remarks:

Specimen Height: 6.00 in
Specimen Area: 6.49 in^2
Specimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

Liquid Limit: 0

Plastic Limit: 0

Specific Gravity: 2.70

| | Before Test Trimmings | Before Test Specimen+Ring | After Test Specimen+Ring | After Test Trimmings |
|---|---|---|---|---|
| Container ID | 36 | --- | | |
| Wt. Container + Wet Soil, gm | 60.16 | 1232 | 1232 | 0 |
| Wt. Container + Dry Soil, gm | 52.07 | 1055.3 | 1055.3 | 0 |
| Wt. Container, gm | 3.74 | --- | 0 | 0 |
| Wt. Dry Soil, gm | 48.33 | 1055.3 | 1055.3 | 0 |
| Water Content, % | 16.74 | 16.74 | 16.74 | 0.00 |
| Void Ratio | --- | 0.63 | 0.45 | --- |
| Degree of Saturation, % | --- | 71.40 | 100.00 | --- |
| Dry Unit Weight, pcf | --- | 103.22 | 116.09 | --- |

Initial

End of Initialization

End of Consolidation/A

End of Saturation

End of Consolidation/B

End of Shear

At Failure

TRIAXIAL TEST

roject: Duck Creek Ash Pond
oring No.: Bag B-4
ample No.: 1
est No.: 1

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/16/06
Sample Type: Compacted

Project No.: 0355010
Checked By: JCC
Depth: 1.0-10.0
Elevation: N/A

oil Description: Yel. brn. vf. sandy silt.
emarks:

pecimen Height: 6.00 in
pecimen Area: 6.49 in^2
pecimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

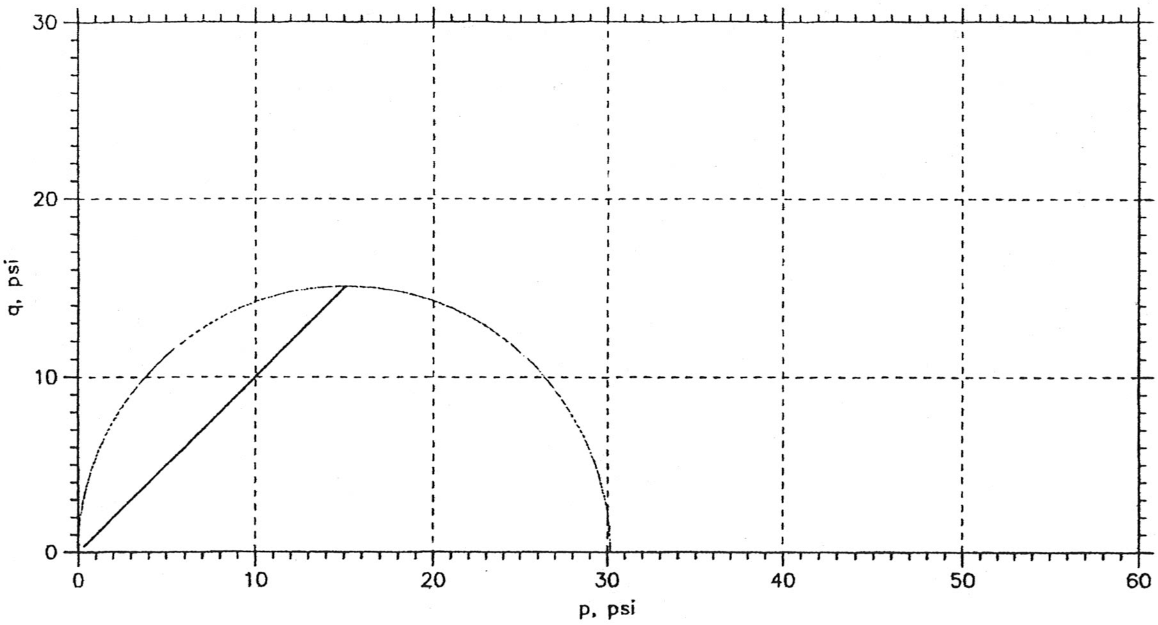
iquid Limit: 0

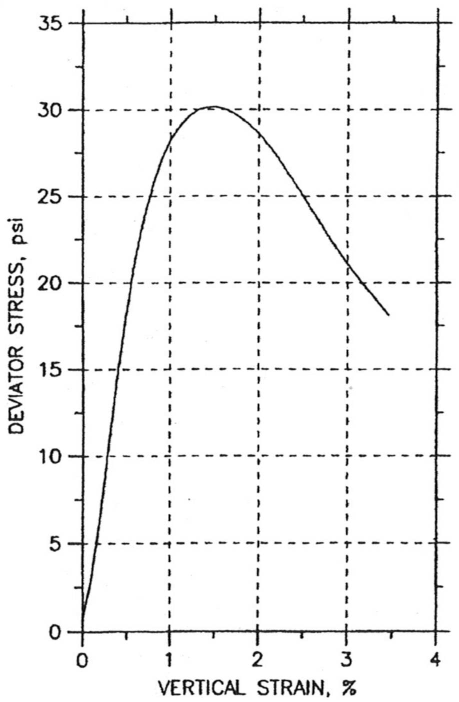
Plastic Limit: 0

Specific Gravity: 2.70

| | Time min | Vertical Strain % | Corrected Area in^2 | Deviator Load lb | Deviator Stress psi | Vertical Stress psi | p psi | q psi |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 6.4918 | 4.1398 | 0.6377 | 0.6377 | 0.31885 | 0.31885 |
| 2 | 0.075267 | 0.10203 | 6.4984 | 17.027 | 2.6201 | 2.6201 | 1.3101 | 1.3101 |
| 3 | 0.13828 | 0.20031 | 6.5048 | 31.783 | 4.886 | 4.886 | 2.443 | 2.443 |
| 4 | 0.20912 | 0.29953 | 6.5113 | 50.08 | 7.6913 | 7.6913 | 3.8456 | 3.8456 |
| 5 | 0.27995 | 0.40437 | 6.5182 | 69.46 | 10.656 | 10.656 | 5.3282 | 5.3282 |
| 6 | 0.34662 | 0.50734 | 6.5249 | 86.478 | 13.254 | 13.254 | 6.6268 | 6.6268 |
| 7 | 0.40912 | 0.60375 | 6.5312 | 101.04 | 15.47 | 15.47 | 7.735 | 7.735 |
| 8 | 0.47162 | 0.7011 | 6.5376 | 113.73 | 17.396 | 17.396 | 8.6979 | 8.6979 |
| 9 | 0.53412 | 0.80032 | 6.5442 | 125.24 | 19.137 | 19.137 | 9.5686 | 9.5686 |
| 10 | 0.60078 | 0.90516 | 6.5511 | 135.37 | 20.664 | 20.664 | 10.332 | 10.332 |
| 11 | 0.66328 | 1.0034 | 6.5576 | 142.75 | 21.768 | 21.768 | 10.884 | 10.884 |
| 12 | 0.72578 | 1.0999 | 6.564 | 148.65 | 22.646 | 22.646 | 11.323 | 11.323 |
| 13 | 0.79272 | 1.2038 | 6.5709 | 152.98 | 23.281 | 23.281 | 11.641 | 11.641 |
| 14 | 0.85522 | 1.3048 | 6.5776 | 155.64 | 23.661 | 23.661 | 11.831 | 11.831 |
| 15 | 0.91772 | 1.4022 | 6.5841 | 156.52 | 23.772 | 23.772 | 11.886 | 11.886 |
| 16 | 0.98022 | 1.5005 | 6.5907 | 156.13 | 23.689 | 23.689 | 11.844 | 11.844 |
| 17 | 1.0469 | 1.6053 | 6.5977 | 154.36 | 23.395 | 23.395 | 11.698 | 11.698 |
| 18 | 1.1094 | 1.7045 | 6.6044 | 151.01 | 22.865 | 22.865 | 11.433 | 11.433 |
| 19 | 1.1719 | 1.8028 | 6.611 | 145.99 | 22.084 | 22.084 | 11.042 | 11.042 |
| 20 | 1.2344 | 1.903 | 6.6177 | 138.42 | 20.916 | 20.916 | 10.458 | 10.458 |
| 21 | 1.3013 | 2.0013 | 6.6244 | 128.19 | 19.351 | 19.351 | 9.6755 | 9.6755 |
| 22 | 1.3638 | 2.1005 | 6.6311 | 118.84 | 17.922 | 17.922 | 8.9611 | 8.9611 |
| 23 | 1.4305 | 2.2035 | 6.6381 | 108.32 | 16.318 | 16.318 | 8.1588 | 8.1588 |
| 24 | 1.493 | 2.3055 | 6.645 | 99.759 | 15.013 | 15.013 | 7.5063 | 7.5063 |
| 25 | 1.5555 | 2.4047 | 6.6518 | 92.381 | 13.888 | 13.888 | 6.9441 | 6.9441 |
| 26 | 1.618 | 2.5021 | 6.6584 | 86.675 | 13.017 | 13.017 | 6.5087 | 6.5087 |
| 27 | 1.6805 | 2.5994 | 6.6651 | 81.068 | 12.163 | 12.163 | 6.0816 | 6.0816 |
| 28 | 1.7472 | 2.7042 | 6.6722 | 75.657 | 11.339 | 11.339 | 5.6696 | 5.6696 |
| 29 | 1.8097 | 2.8016 | 6.6789 | 72.411 | 10.842 | 10.842 | 5.4209 | 5.4209 |
| 30 | 1.8763 | 2.9064 | 6.6861 | 69.361 | 10.374 | 10.374 | 5.187 | 5.187 |
| 31 | 1.9388 | 3.0019 | 6.6927 | 67.001 | 10.011 | 10.011 | 5.0055 | 5.0055 |
| 32 | 1.9555 | 3.0281 | 6.6945 | 66.41 | 9.9201 | 9.9201 | 4.96 | 4.96 |

# TRIAXIAL COMPRESSION TEST REPORT




| | | | | | | |
|---|---|---|---|---|---|---|
| Symbol | | | | | | |
| Test No. | | 1 | | | | |
| Initial | Diameter, in | 2.875 | | | | |
| | Height, in | 6 | | | | |
| | Water Content, % | 15.54 | | | | |
| | Dry Density, pcf | 106.33 | | | | |
| | Saturation, % | 71.68 | | | | |
| | Void Ratio | 0.58524 | | | | |
| Before Shear | Water Content, % | 15.54 | | | | |
| | Dry Density, pcf | 118.74 | | | | |
| | Saturation, % | 100.00 | | | | |
| | Void Ratio | 0.4195 | | | | |
| | Back Press., psi | --- | | | | |
| Minor Prin. Stress, psi | | 0 | | | | |
| Max. Dev. Stress, psi | | 30.167 | | | | |
| Time to Failure, min | | 0.97578 | | | | |
| Strain Rate, %/min | | 1.5 | | | | |
| B-Value | | --- | | | | |
| Specific Gravity | | 2.70 | | | | |
| Liquid Limit | | 0 | | | | |
| Plastic Limit | | 0 | | | | |
| Plasticity Index | | 0 | | | | |
| Failure Sketch | | | | | | |

| | |
|---|---|
| Project: Duck Creek Ash Pond | |
| Location: Canton, Illinois | |
| Project No.: 03S5010 | |
| Boring No.: Bag B-5 | |
| Sample Type: Compacted | |
| Description: Yel. brn. vf. sandy silt / so. clay. | |
| Remarks: | |

Mon, 10-APR-2006 15:00:37

TRIAXIAL TEST

Project: Duck Creek Ash Pond
Boring No.: Bag B-5
Sample No.: 1
Test No.: 1

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/16/06
Sample Type: Compacted

Project No.: 03S5010
Checked By: JCC
Depth: 1.0-10.0
Elevation: N/A

Soil Description: Yel. brn. vf. sandy silt / so. clay.
Remarks:

Specimen Height: 6.00 in
Specimen Area: 6.49 in^2
Specimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

Liquid Limit: 0

Plastic Limit: 0

Specific Gravity: 2.70

| | Before Test Trimmings | Before Test Specimen+Ring | After Test Specimen+Ring | After Test Trimmings |
|---|---|---|---|---|
| Container ID | 31 | --- | | |
| Wt. Container + Wet Soil, gm | 114.96 | 1256.1 | 1256.1 | 0 |
| Wt. Container + Dry Soil, gm | 99.99 | 1087.1 | 1087.1 | 0 |
| Wt. Container, gm | 3.64 | --- | 0 | 0 |
| Wt. Dry Soil, gm | 96.35 | 1087.1 | 1087.1 | 0 |
| Water Content, % | 15.54 | 15.54 | 15.54 | 0.00 |
| Void Ratio | --- | 0.59 | 0.42 | --- |
| Degree of Saturation, % | --- | 71.68 | 100.00 | --- |
| Dry Unit Weight, pcf | --- | 106.33 | 118.74 | --- |

Initial

End of Initialization

End of Consolidation/A

End of Saturation

End of Consolidation/B

End of Shear

At Failure

TRIAXIAL TEST

Project: Duck Creek Ash Pond
Boring No.: Bag B-5
Sample No.: 1
Test No.: 1

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/16/06
Sample Type: Compacted

Project No.: 03S5010
Checked By: JCC
Depth: 1.0-10.0
Elevation: N/A

Soil Description: Yel. brn. vf. sandy silt / so. clay.
Remarks:

Specimen Height: 6.00 in
Specimen Area: 6.49 in^2
Specimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

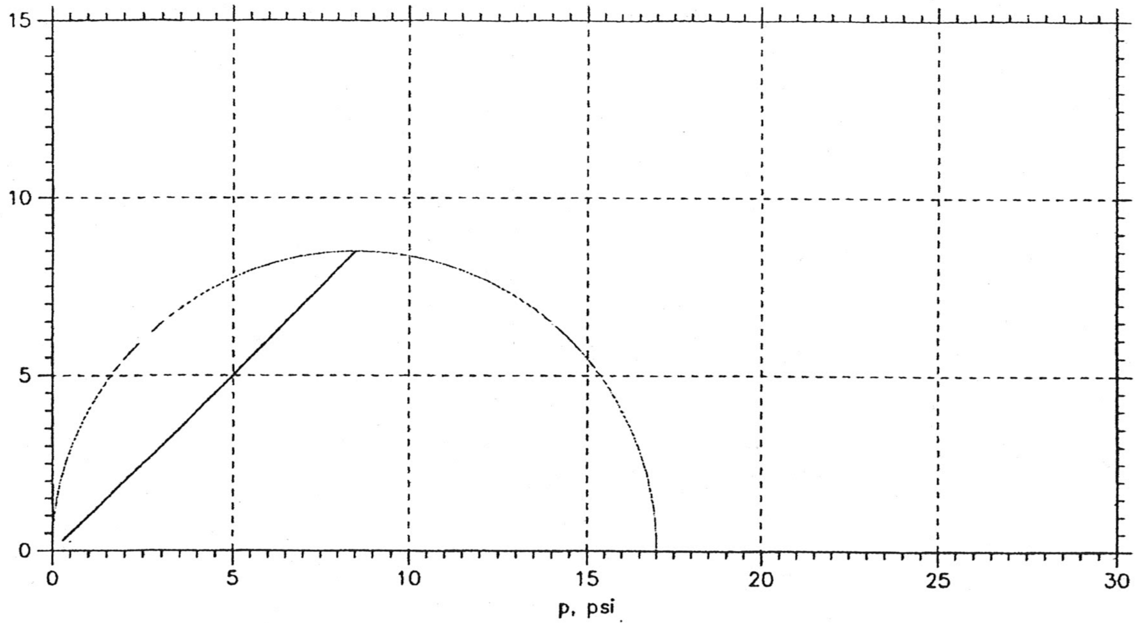
Liquid Limit: 0

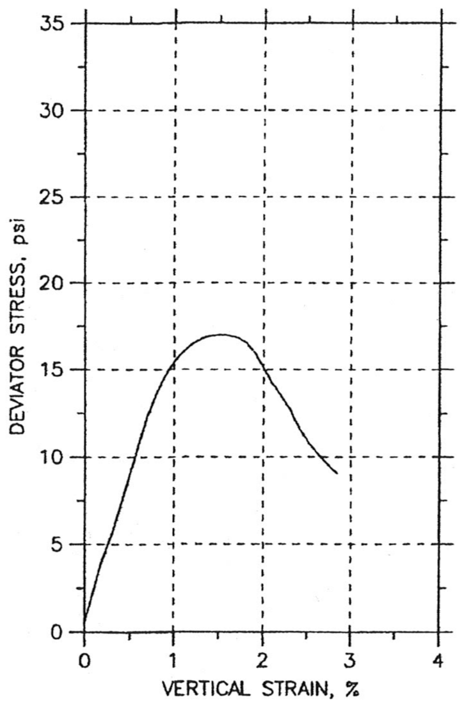
Plastic Limit: 0

Specific Gravity: 2.70

| | Time min | Vertical Strain % | Corrected Area in^2 | Deviator Load lb | Deviator Stress psi | Vertical Stress psi | p psi | q psi |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 6.4918 | 4.5333 | 0.69831 | 0.69831 | 0.34916 | 0.34916 |
| 2 | 0.075517 | 0.10016 | 6.4983 | 19.388 | 2.9835 | 2.9835 | 1.4917 | 1.4917 |
| 3 | 0.14218 | 0.20031 | 6.5048 | 42.407 | 6.5193 | 6.5193 | 3.2597 | 3.2597 |
| 4 | 0.20885 | 0.30047 | 6.5114 | 69.165 | 10.622 | 10.622 | 5.3111 | 5.3111 |
| 5 | 0.27552 | 0.4025 | 6.518 | 96.414 | 14.792 | 14.792 | 7.3959 | 7.3959 |
| 6 | 0.33802 | 0.50172 | 6.5245 | 120.02 | 18.396 | 18.396 | 9.1979 | 9.1979 |
| 7 | 0.40052 | 0.59907 | 6.5309 | 139.21 | 21.315 | 21.315 | 10.657 | 10.657 |
| 8 | 0.46718 | 0.70578 | 6.538 | 155.93 | 23.85 | 23.85 | 11.925 | 11.925 |
| 9 | 0.52968 | 0.80219 | 6.5443 | 168.03 | 25.676 | 25.676 | 12.838 | 12.838 |
| 10 | 0.59218 | 0.90141 | 6.5509 | 177.67 | 27.122 | 27.122 | 13.561 | 13.561 |
| 11 | 0.65885 | 1.0053 | 6.5577 | 185.34 | 28.263 | 28.263 | 14.132 | 14.132 |
| 12 | 0.72135 | 1.1027 | 6.5642 | 190.75 | 29.06 | 29.06 | 14.53 | 14.53 |
| 13 | 0.78385 | 1.2 | 6.5707 | 194.59 | 29.615 | 29.615 | 14.808 | 14.808 |
| 14 | 0.85052 | 1.303 | 6.5775 | 197.15 | 29.973 | 29.973 | 14.987 | 14.987 |
| 15 | 0.91328 | 1.4003 | 6.584 | 198.33 | 30.123 | 30.123 | 15.061 | 15.061 |
| 16 | 0.97578 | 1.4995 | 6.5906 | 198.82 | 30.167 | 30.167 | 15.084 | 15.084 |
| 17 | 1.0425 | 1.6044 | 6.5977 | 198.23 | 30.046 | 30.046 | 15.023 | 15.023 |
| 18 | 1.105 | 1.7036 | 6.6043 | 196.85 | 29.807 | 29.807 | 14.903 | 14.903 |
| 19 | 1.1719 | 1.8019 | 6.6109 | 194.89 | 29.479 | 29.479 | 14.74 | 14.74 |
| 20 | 1.2344 | 1.9002 | 6.6176 | 192.43 | 29.078 | 29.078 | 14.539 | 14.539 |
| 21 | 1.301 | 2.0041 | 6.6246 | 189.18 | 28.557 | 28.557 | 14.279 | 14.279 |
| 22 | 1.3635 | 2.1024 | 6.6312 | 185.34 | 27.95 | 27.95 | 13.975 | 13.975 |
| 23 | 1.4302 | 2.2053 | 6.6382 | 181.02 | 27.269 | 27.269 | 13.634 | 13.634 |
| 24 | 1.4927 | 2.3027 | 6.6448 | 176.39 | 26.546 | 26.546 | 13.273 | 13.273 |
| 25 | 1.5552 | 2.4028 | 6.6516 | 171.37 | 25.764 | 25.764 | 12.882 | 12.882 |
| 26 | 1.6177 | 2.5002 | 6.6583 | 166.55 | 25.015 | 25.015 | 12.507 | 12.507 |
| 27 | 1.6844 | 2.6041 | 6.6654 | 160.95 | 24.147 | 24.147 | 12.073 | 12.073 |
| 28 | 1.7469 | 2.7024 | 6.6721 | 155.73 | 23.341 | 23.341 | 11.67 | 11.67 |
| 29 | 1.8094 | 2.7997 | 6.6788 | 150.52 | 22.537 | 22.537 | 11.268 | 11.268 |
| 30 | 1.876 | 2.9036 | 6.6859 | 145.5 | 21.762 | 21.762 | 10.881 | 10.881 |
| 31 | 1.9385 | 3 | 6.6926 | 140.98 | 21.065 | 21.065 | 10.532 | 10.532 |
| 32 | 2.2385 | 3.4615 | 6.7246 | 121.6 | 18.083 | 18.083 | 9.0413 | 9.0413 |

# TRIAXIAL COMPRESSION TEST REPORT




| | | | | | | |
|---|---|---|---|---|---|---|
| Symbol | | | | | | |
| Test No. | | 1 | | | | |
| Initial | Diameter, in | 2.875 | | | | |
| | Height, in | 6 | | | | |
| | Water Content, % | 16.47 | | | | |
| | Dry Density, pcf | 103.32 | | | | |
| | Saturation, % | 70.46 | | | | |
| | Void Ratio | 0.63133 | | | | |
| Before Shear | Water Content, % | 16.47 | | | | |
| | Dry Density, pcf | 116.66 | | | | |
| | Saturation, % | 100.00 | | | | |
| | Void Ratio | 0.44482 | | | | |
| | Back Press., psi | --- | | | | |
| Minor Prin. Stress, psi | | 0 | | | | |
| Max. Dev. Stress, psi | | 17.001 | | | | |
| Time to Failure, min | | 0.9802 | | | | |
| Strain Rate, %/min | | 1.5 | | | | |
| B-Value | | --- | | | | |
| Specific Gravity | | 2.70 | | | | |
| Liquid Limit | | 0 | | | | |
| Plastic Limit | | 0 | | | | |
| Plasticity Index | | 0 | | | | |
| Failure Sketch | | | | | | |

| |
|---|
| Project: Duck Creek Ash Pond |
| Location: Canton, Illinois |
| Project No.: 03S5010 |
| Boring No.: Bag B-6 |
| Sample Type: Compacted |
| Description: Yel. brn. vf. sandy silt (tr. clay). |
| Remarks: |

Mon, 10-APR-2006 15:01:39

IRIAXIAL TEST

'roject: Duck Creek Ash Pond
;oring No.: Bag B-6
;ample No.: 1
'est No.: 1

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/16/06
Sample Type: Compacted

Project No.: 03S5010
Checked By: JCC
Depth: 1.0-10.0
Elevation: N/A

;oil Description: Yel. brn. vf. sandy silt (tr. clay).
:emarks:

;pecimen Height: 6.00 in
;pecimen Area: 6.49 in^2
;pecimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

.iquid Limit: 0

Plastic Limit: 0

Specific Gravity: 2.70

| | Before Test Trimmings | Before Test Specimen+Ring | After Test Specimen+Ring | After Test Trimmings |
|---|---|---|---|---|
| :ontainer ID | 30 | --- | | |
| /t. Container + Wet Soil, gm | 118.06 | 1230.5 | 1230.5 | 0 |
| /t. Container + Dry Soil, gm | 101.88 | 1056.4 | 1056.4 | 0 |
| /t. Container, gm | 3.67 | --- | 0 | 0 |
| /t. Dry Soil, gm | 98.21 | 1056.4 | 1056.4 | 0 |
| /ater Content, % | 16.47 | 16.47 | 16.47 | 0.00 |
| /oid Ratio | --- | 0.63 | 0.44 | --- |
| )egree of Saturation, % | --- | 70.46 | 100.00 | --- |
| )ry Unit Weight, pcf | --- | 103.32 | 116.66 | --- |

[nitial

:nd of Initialization

:nd of Consolidation/A

:nd of Saturation

:nd of Consolidation/B

:nd of Shear

\t Failure

TRIAXIAL TEST

Project: Duck Creek Ash Pond
Boring No.: Bag B-6
Sample No.: 1
Test No.: 1

Location: Canton, Illinois
Tested By: Rin
Test Date: 03/16/06
Sample Type: Compacted

Project No.: 0355010
Checked By: JCC
Depth: 1.0-10.0
Elevation: N/A

Soil Description: Yel. brn. vf. sandy silt (tr. clay).
Remarks:

Specimen Height: 6.00 in
Specimen Area: 6.49 in^2
Specimen Volume: 0.02 ft^3

Piston Area: 0.20 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.50 lb

Filter Correction: 0.00 psi
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

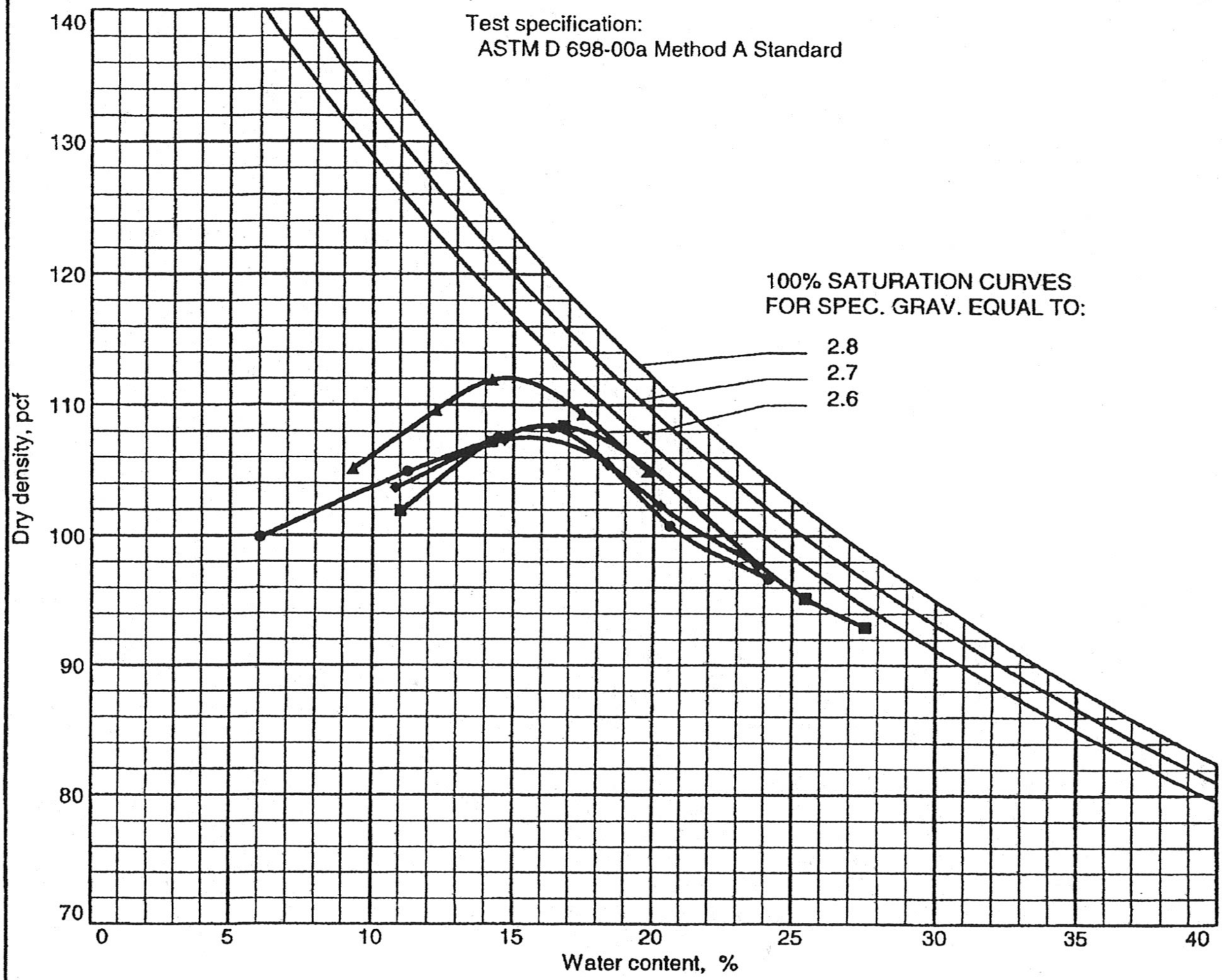
Liquid Limit: 0

Plastic Limit: 0

Specific Gravity: 2.70

| | Time min | Vertical Strain % | Corrected Area in^2 | Deviator Load lb | Deviator Stress psi | Vertical Stress psi | p psi | q psi |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 6.4918 | 3.8447 | 0.59224 | 0.59224 | 0.29612 | 0.29612 |
| 2 | 0.071617 | 0.10109 | 6.4984 | 15.256 | 2.3477 | 2.3477 | 1.1738 | 1.1738 |
| 3 | 0.13828 | 0.20125 | 6.5049 | 27.159 | 4.1752 | 4.1752 | 2.0876 | 2.0876 |
| 4 | 0.20495 | 0.30234 | 6.5115 | 36.308 | 5.576 | 5.576 | 2.788 | 2.788 |
| 5 | 0.27603 | 0.41092 | 6.5186 | 48.506 | 7.4412 | 7.4412 | 3.7206 | 3.7206 |
| 6 | 0.33853 | 0.50078 | 6.5245 | 58.54 | 8.9724 | 8.9724 | 4.4862 | 4.4862 |
| 7 | 0.4052 | 0.60375 | 6.5312 | 70.148 | 10.74 | 10.74 | 5.3702 | 5.3702 |
| 8 | 0.47187 | 0.70484 | 6.5379 | 81.068 | 12.4 | 12.4 | 6.1999 | 6.1999 |
| 9 | 0.53437 | 0.80313 | 6.5444 | 89.528 | 13.68 | 13.68 | 6.8401 | 6.8401 |
| 10 | 0.59687 | 0.90235 | 6.5509 | 96.217 | 14.688 | 14.688 | 7.3438 | 7.3438 |
| 11 | 0.65937 | 1.0006 | 6.5574 | 101.33 | 15.453 | 15.453 | 7.7266 | 7.7266 |
| 12 | 0.72603 | 1.1045 | 6.5643 | 105.46 | 16.066 | 16.066 | 8.0332 | 8.0332 |
| 13 | 0.78853 | 1.2038 | 6.5709 | 108.32 | 16.484 | 16.484 | 8.2422 | 8.2422 |
| 14 | 0.85103 | 1.302 | 6.5774 | 110.28 | 16.767 | 16.767 | 8.3836 | 8.3836 |
| 15 | 0.91353 | 1.3994 | 6.5839 | 111.47 | 16.93 | 16.93 | 8.4649 | 8.4649 |
| 16 | 0.9802 | 1.5042 | 6.5909 | 112.06 | 17.001 | 17.001 | 8.5007 | 8.5007 |
| 17 | 1.0427 | 1.6016 | 6.5975 | 111.96 | 16.97 | 16.97 | 8.4849 | 8.4849 |
| 18 | 1.1052 | 1.6999 | 6.6041 | 111.37 | 16.863 | 16.863 | 8.4317 | 8.4317 |
| 19 | 1.1719 | 1.8019 | 6.6109 | 109.5 | 16.563 | 16.563 | 8.2816 | 8.2816 |
| 20 | 1.2344 | 1.902 | 6.6177 | 105.56 | 15.952 | 15.952 | 7.9758 | 7.9758 |
| 21 | 1.2971 | 2.0022 | 6.6244 | 99.562 | 15.03 | 15.03 | 7.5148 | 7.5148 |
| 22 | 1.3596 | 2.1005 | 6.6311 | 94.053 | 14.184 | 14.184 | 7.0918 | 7.0918 |
| 23 | 1.4263 | 2.1997 | 6.6378 | 89.528 | 13.488 | 13.488 | 6.7438 | 6.7438 |
| 24 | 1.493 | 2.3045 | 6.6449 | 84.314 | 12.688 | 12.688 | 6.3442 | 6.3442 |
| 25 | 1.5555 | 2.4028 | 6.6516 | 77.723 | 11.685 | 11.685 | 5.8424 | 5.8424 |
| 26 | 1.618 | 2.5011 | 6.6583 | 72.608 | 10.905 | 10.905 | 5.4524 | 5.4524 |
| 27 | 1.6846 | 2.605 | 6.6654 | 68.574 | 10.288 | 10.288 | 5.144 | 5.144 |
| 28 | 1.7471 | 2.7005 | 6.672 | 65.131 | 9.7619 | 9.7619 | 4.881 | 4.881 |
| 29 | 1.8096 | 2.7997 | 6.6788 | 61.885 | 9.2659 | 9.2659 | 4.633 | 4.633 |
| 30 | 1.843 | 2.8512 | 6.6823 | 60.508 | 9.0549 | 9.0549 | 4.5274 | 4.5274 |

# COMPACTION TEST REPORT




| | SOIL DATA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | SOURCE | SAMPLE NO. | ELEV./ DEPTH (ft.) | USCS | NATURAL WATER CONTENT (%) | PLASTIC LIMIT (%) | LIQUID LIMIT (%) | MAXIMUM DRY DENSITY pcf | OPTIMUM MOISTURE CONTENT (%) |
| ● | | Bag B-3 | 1.0-10.0 | | 15 | 21.5 | 28.2 | 108.3 | 16.0 |
| ■ | | Bag B-4 | 1.0-10.0 | | 18.4 | 22.4 | 30.6 | 108.5 | 16.3 |
| ▲ | | Bag B-5 | 1.0-10.0 | | 13.7 | 20.5 | 30.1 | 112.0 | 14.7 |
| ◆ | | Bag B-6 | 1.0-10.0 | | 18.8 | 22.3 | 29.2 | 107.5 | 15.6 |

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Hanson Professional Services Inc.

**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project No.:** 03S5010 5000 **Plate**

## MOISTURE DENSITY TEST DATA

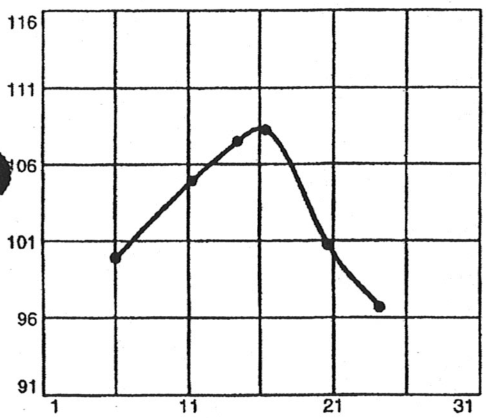
**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000

## Specimen Data

**Source:**
**Sample No.:** Bag B-3
**Elev. or Depth:** 1.0-10.0 **Sample Length (in./cm.):**
**Location:**
**Description:** Yel. brn. vf. sandy silt.
**USCS Classification:**
**Natural Moisture:** 15 **Liquid Limit:** 28.2 **Plastic Limit:** 21.5
**Percent retained on No.4 sieve:** 0.0
**Percent passing No. 200 sieve:** 99.7 **Specific gravity:**

## Test Data And Results For Curve 1

**Type of test:** ASTM D 698-00a Method A Standard
**Mold Dia.:** 4.00 in. **Hammer Wt.:** 5.5 lb. **Drop:** 12 in.
**Layers:** three **Blows per Layer:** 25




| POINT NO. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| WM + WS | 12.72 | 13.08 | 13.29 | 13.39 | 13.24 | 13.19 |
| WM | 9.19 | 9.19 | 9.19 | 9.19 | 9.19 | 9.19 |
| WW+T | 91.40 | 84.60 | 100.30 | 95.10 | 92.60 | 96.20 |
| WD+T | 86.40 | 76.40 | 88.10 | 82.20 | 77.40 | 78.20 |
| TARE | 3.80 | 3.70 | 3.70 | 3.70 | 3.70 | 3.70 |
| MOIST | 6.1 | 11.3 | 14.5 | 16.4 | 20.6 | 24.2 |
| MOISTURE | 6.1 | 11.3 | 14.5 | 16.4 | 20.6 | 24.2 |
| DRY DEN | 99.9 | 104.9 | 107.5 | 108.3 | 100.8 | 96.7 |

**Max dry den=** 108.3 pcf **Opt moisture=** 16.0 %

**Oversize Correction Not Applied**

## MOISTURE DENSITY TEST DATA

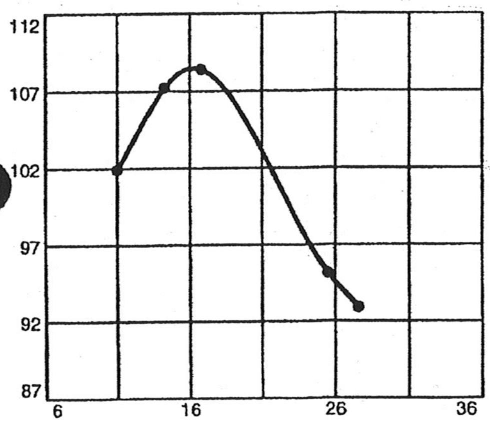
**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000

### Specimen Data

**Source:**
**Sample No.:** Bag B-4
**Elev. or Depth:** 1.0-10.0 **Sample Length (in./cm.):**
**Location:**
**Description:** Yel. brn. vf. sandy silt.
**USCS Classification:**
**Natural Moisture:** 18.4 **Liquid Limit:** 30.6 **Plastic Limit:** 22.4
**Percent retained on No.4 sieve:** 0.0
**Percent passing No. 200 sieve:** 98.9 **Specific gravity:**

### Test Data And Results For Curve 2

**Type of test:** ASTM D 698-00a Method A Standard
**Mold Dia.:** 4.00 in. **Hammer Wt.:** 5.5 lb. **Drop:** 12 in.
**Layers:** three **Blows per Layer:** 25




| POINT NO. | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| WM + WS | 12.96 | 13.27 | 13.41 | 13.17 | 13.14 |
| WM | 9.19 | 9.19 | 9.19 | 9.19 | 9.19 |
| WW+T | 97.30 | 99.30 | 95.30 | 100.70 | 94.50 |
| WD+T | 88.00 | 87.40 | 82.10 | 81.00 | 74.90 |
| TARE | 3.60 | 3.70 | 3.70 | 3.70 | 3.80 |
| MOIST | 11.0 | 14.2 | 16.8 | 25.5 | 27.6 |
| MOISTURE | 11.0 | 14.2 | 16.8 | 25.5 | 27.6 |
| DRY DEN | 101.9 | 107.2 | 108.4 | 95.2 | 92.9 |

**Max dry den=** 108.5 pcf **Opt moisture=** 16.3 %

**Oversize Correction Not Applied**

## MOISTURE DENSITY TEST DATA

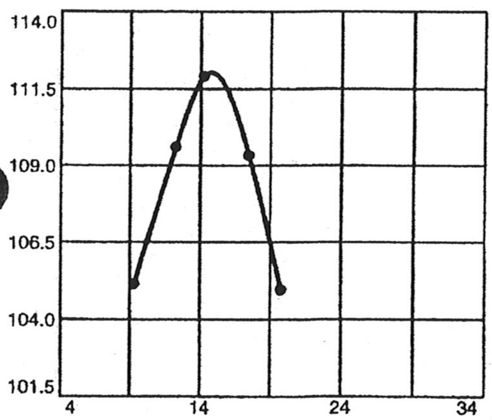
**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000

### Specimen Data

**Source:**
**Sample No.:** Bag B-5
**Elev. or Depth:** 1.0-10.0 **Sample Length (in./cm.):**
**Location:**
**Description:** Yel. brn. vf. sandy silt / so. clay.
**USCS Classification:**
**Natural Moisture:** 13.7 **Liquid Limit:** 30.1 **Plastic Limit:** 20.5
**Percent retained on No.4 sieve:** 0.1
**Percent passing No. 200 sieve:** 93.1 **Specific gravity:**

### Test Data And Results For Curve 3

**Type of test:** ASTM D 698-00a Method A Standard
**Mold Dia.:** 4.00 in. **Hammer Wt.:** 5.5 lb. **Drop:** 12 in.
**Layers:** three **Blows per Layer:** 25




| POINT NO. | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| WM + WS | 13.02 | 13.29 | 13.45 | 13.47 | 13.38 |
| WM | 9.19 | 9.19 | 9.19 | 9.19 | 9.19 |
| WW+T | 95.20 | 99.80 | 98.40 | 97.80 | 99.30 |
| WD+T | 87.40 | 89.30 | 86.60 | 83.80 | 83.50 |
| TARE | 3.70 | 3.70 | 3.70 | 3.70 | 3.70 |
| MOIST | 9.3 | 12.3 | 14.2 | 17.5 | 19.8 |
| MOISTURE | 9.3 | 12.3 | 14.2 | 17.5 | 19.8 |
| DRY DEN | 105.1 | 109.6 | 111.9 | 109.3 | 105.0 |

**Max dry den=** 112.0 pcf **Opt moisture=** 14.7 %

**Oversize Correction Not Applied**

## MOISTURE DENSITY TEST DATA

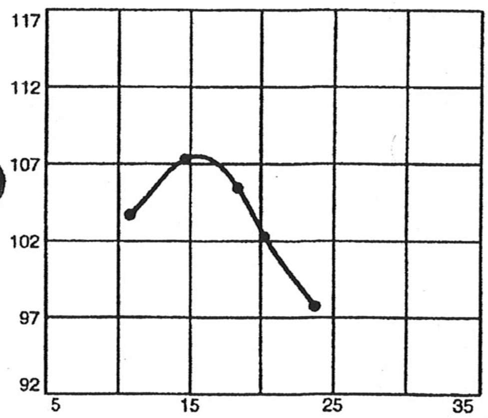
**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000

## Specimen Data

**Source:**
**Sample No.:** Bag B-6
**Elev. or Depth:** 1.0-10.0 **Sample Length (in./cm.):**
**Location:**
**Description:** Yel. brn. vf. sandy silt (tr. clay).
**USCS Classification:**
**Natural Moisture:** 18.8 **Liquid Limit:** 29.2 **Plastic Limit:** 22.3
**Percent retained on No.4 sieve:** 0.0
**Percent passing No. 200 sieve:** 99.0 **Specific gravity:**

## Test Data And Results For Curve 4

**Type of test:** ASTM D 698-00a Method A Standard
**Mold Dia.:** 4.00 in. **Hammer Wt.:** 5.5 lb. **Drop:** 12 in.
**Layers:** three **Blows per Layer:** 25




| POINT NO. | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| WM + WS | 13.02 | 13.29 | 13.35 | 13.29 | 13.22 |
| WM | 9.19 | 9.19 | 9.19 | 9.19 | 9.19 |
| WW+T | 98.70 | 99.90 | 99.60 | 99.80 | 97.60 |
| WD+T | 89.40 | 87.60 | 84.70 | 83.60 | 79.60 |
| TARE | 3.70 | 3.70 | 3.70 | 3.70 | 3.80 |
| MOIST | 10.9 | 14.7 | 18.4 | 20.3 | 23.7 |
| MOISTURE | 10.9 | 14.7 | 18.4 | 20.3 | 23.7 |
| DRY DEN | 103.7 | 107.3 | 105.4 | 102.3 | 97.7 |

**Max dry den=** 107.5 pcf **Opt moisture=** 15.6 %

**Oversize Correction Not Applied**

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Hanson Professional Services Inc.

# CONSTANT HEAD PERMEABILITY TEST

ASTM D5084

JOB NUMBER: 05S3010 TEST DATE: 3/13/2006

CLIENT: Sgt. & Lundy BORING #: B-3

JOB DESCRIPTION: Ash Pond SAMPLE #: 2

SAMPLE DESCRIPTION: Yel. Brn. Vf. Sandy silt DEPTH (FT): 1.0-10.0

FILE NAME: Duck Creek Ash Pond

| | |
|---|---|
| SPECIMEN WEIGHT (G) | 941.98 |
| SPECIMEN HEIGHT (IN) | 4.629 |
| DIAMETER (IN) | 2.865 |
| AREA (SQ IN) | 6.447 |
| VOLUME (CU IN) | 29.842 |
| WET DENSITY (PCF) | 120.25 |
| DRY DENSITY (PCF) | 103.02 |
| WT. DRY SOIL (G) | 807.01 |
| VOLUME DRY SOIL (CU IN | 18.240 |
| SP.GR. ASSUMED | 2.70 |
| POROSITY (%) | 38.88 |
| HEIGHT OF HEAD (PSI) | 5.00 |
| HYDRAULIC GRADIANT | 29.9 |
| 1/4 PORE VOLUME | 47.53 |

WATER CONTENT OF TRIMMINGS

| | BEFORI TEST | AFTER TEST |
|---|---|---|
| TARE + WET SOIL (G) | 253.75 | 1044.89 |
| TARE + DRY SOIL (G) | 217.92 | 854.45 |
| TARE (G) | 3.68 | 50.12 |
| WATER (G) | 35.83 | 190.44 |
| DRY SOIL (G) | 214.24 | 804.33 |
| WATER CONTENT (%) | 16.72 | 23.68 |

| | |
|---|---|
| STD. MAX. DEN.(LBS/CU.FT.) | 108.40 |
| OPTIMUM MOISTURE (%) | 16.10 |
| % COMPACTION | 95.04 |
| PRESSURE HEAD (CM H2O) | 189.86 |
| PANEL NUMBER | 5 |

TEST METHOD USED: IEPA ASTM D5084

PERMEANT USED: TAP WATER

HANSON.

Hanson Professional Services Inc.

# CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER: 05S3010
CLIENT: Sgt. & Lundy
JOB DESCRIPTION: Ash Pond

TEST DATE: 1/27/2006
BORING #: B-3
SAMPLE #: 2
DEPTH (FT): 1.0-10.0

SPECIMEN HEIGHT (IN) 4.629
DIAMETER (IN) 2.865
AREA (SQ IN) 6.447

HEIGHT OF HEAD (PSI) 5.00
PRESSURE HEAD (CM H2O) 351.59
PANEL NUMBER 5
FILE NAME: uck Creek Ash Pond

| START DATE | START TIME | STOP DATE | STOP TIME | INCREMENT. FLOW (CC) | TOTAL FLOW (CC) | INCREMENT. TIME (MIN) | TOTAL TIME (MIN) | INCREMENTAL PERMEABILITY (CM/SEC) | AVERAGE PERMEABILITY (CM/SEC) |
|---|---|---|---|---|---|---|---|---|---|
| 3/22/2006 | 11:31:10 | 3/22/2006 | 11:38:30 | 13.60 | 13.6000 | 7.33 | 7.33 | 2.49E-05 | 2.49E-05 |
| 3/22/2006 | 12:47:40 | 3/22/2006 | 13:01:00 | 23.60 | 37.2000 | 13.33 | 20.67 | 2.37E-05 | 2.43E-05 |
| 3/22/2006 | 13:04:00 | 3/22/2006 | 13:17:06 | 23.10 | 60.3000 | 13.10 | 33.77 | 2.36E-05 | 2.37E-05 |
| 3/22/2006 | 13:20:30 | 3/22/2006 | 13:34:50 | 25.10 | 85.4000 | 14.33 | 48.10 | 2.35E-05 | 2.35E-05 |
| 3/22/2006 | 13:40:00 | 3/22/2006 | 13:53:10 | 23.50 | 108.9000 | 13.17 | 61.27 | 2.39E-05 | 2.37E-05 |
| 3/22/2006 | 13:55:30 | 3/22/2006 | 14:09:00 | 24.30 | 133.2000 | 13.50 | 74.77 | 2.41E-05 | 2.40E-05 |
| 3/22/2006 | 14:11:00 | 3/22/2006 | 14:24:30 | 24.50 | 157.7000 | 13.50 | 88.27 | 2.43E-05 | 2.42E-05 |
| 3/22/2006 | 14:32:30 | 3/22/2006 | 14:46:00 | 24.50 | 182.2000 | 13.50 | 101.77 | 2.43E-05 | 2.43E-05 |
| 3/22/2006 | 14:47:30 | 3/22/2006 | 15:01:00 | 24.50 | 206.7000 | 13.50 | 115.27 | 2.43E-05 | 2.43E-05 |
| 3/22/2006 | 15:04:00 | 3/22/2006 | 15:17:30 | 24.60 | 231.3000 | 13.50 | 128.77 | 2.44E-05 | 2.44E-05 |
| 3/22/2006 | 15:20:00 | 3/22/2006 | 15:33:38 | 24.50 | 255.8000 | 13.63 | 142.40 | 2.41E-05 | 2.43E-05 |
| 3/22/2006 | 15:36:30 | 3/22/2006 | 15:50:00 | 24.50 | 280.3000 | 13.50 | 155.90 | 2.43E-05 | 2.42E-05 |

Hanson Professional Services Inc.

# CONSTANT HEAD PERMEABILITY TEST

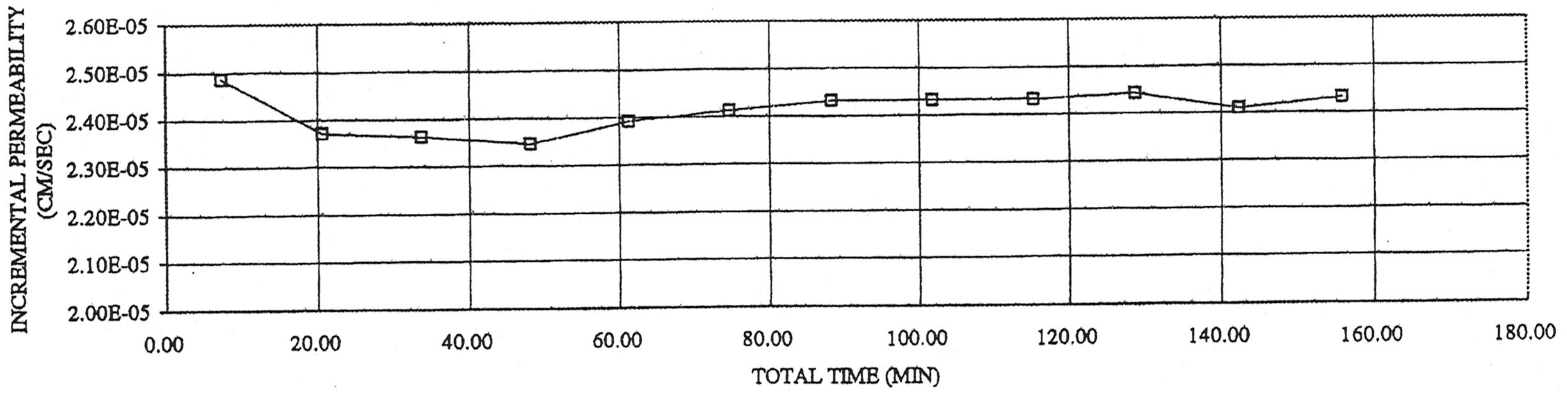
JOB NUMBER: 05S3010
CLIENT: Sgt. & Lundy
JOB DESCRIPTION: Ash Pond

TEST DATE: 1/27/2006
BORING #: B-3
SAMPLE #: 2
DEPTH (FT): 1.0-10.0

SPECIMEN HEIGHT (IN) 4.629
DIAMETER (IN) 2.865
AREA (SQ IN) 6.447

HEIGHT OF HEAD (PSI) 5.00
PRESSURE HEAD (CM H2O) 351.59
PANEL NUMBER 5
FILE NAME: uck Creek Ash Pond

| START DATE | START TIME | STOP DATE | STOP TIME | INCREMENT. FLOW (CC) | TOTAL FLOW (CC) | INCREMENT. TIME (MIN) | TOTAL TIME (MIN) | INCREMENTAL PERMEABILITY (CM/SEC) | AVERAGE PERMEABILITY (CM/SEC) |
|---|---|---|---|---|---|---|---|---|---|



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Hanson Professional Services Inc.

# CONSTANT HEAD PERMEABILITY TEST

ASTM D5084

| | | | |
|---|---|---|---|
| JOB NUMBER: | 05S5010 | TEST DATE: | 1/27/2006 |
| CLIENT: | Sgt. & Lundy | BORING #: | B-4 |
| JOB DESCRIPTION: | Ash Pond | SAMPLE #: | 2 |
| SAMPLE DESCRIPTION: | Yel. Brn. Vf. Sandy silt.. | DEPTH (FT): | 1.0-10 |
| | | FILE NAME: | : Creek Ash Pond |

WATER CONTENT OF TRIMMINGS

| | | | BEFORI TEST | AFTER TEST |
|---|---|---|---|---|
| SPECIMEN WEIGHT (G) | 978.64 | | | |
| SPECIMEN HEIGHT (IN) | 4.776 | | | |
| DIAMETER (IN) | 2.874 | TARE + WET SOIL (G) | 250.70 | 1080.75 |
| AREA (SQ IN) | 6.487 | TARE + DRY SOIL (G) | 216.37 | 888.44 |
| VOLUME (CU IN) | 30.983 | TARE (G) | 3.71 | 50.09 |
| WET DENSITY (PCF) | 120.33 | WATER (G) | 34.33 | 192.31 |
| DRY DENSITY (PCF) | 103.37 | DRY SOIL (G) | 212.66 | 838.35 |
| WT. DRY SOIL (G) | 840.76 | WATER CONTENT (%) | 16.40 | 22.94 |
| VOLUME DRY SOIL (CU IN | 19.002 | | | |
| SP.GR. ASSUMED | 2.70 | | | |
| POROSITY (%) | 38.67 | STD. MAX. DEN.(LBS/CU.FT.) | 108.50 | |
| HEIGHT OF HEAD (PSI) | 5.10 | OPTIMUM MOISTURE (%) | 16.40 | |
| HYDRAULIC GRADIANT | 29.6 | % COMPACTION | 95.28 | |
| 1/4 PORE VOLUME | 49.08 | PRESSURE HEAD (CM H2O) | 189.86 | |
| | | PANEL NUMBER | 3 | |

TEST METHOD USED: IEPA ASTM D5084 PERMEANT USED: Tap Water

HANSON.
Hanson Professional Services Inc.

# CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER: 05S5010
CLIENT: Sgt. & Lundy
JOB DESCRIPTION: Ash Pond

TEST DATE: 1/27/2006
BORING #: B-4
SAMPLE #: 2
DEPTH (FT): 1.0-10.0

SPECIMEN HEIGHT (IN) 4.776
DIAMETER (IN) 2.874
AREA (SQ IN) 6.487

HEIGHT OF HEAD (PSI) 5.10
PRESSURE HEAD (CM H2O) 358.62
PANEL NUMBER 3
FILE NAME: uck Creek Ash Pond

| START DATE | START TIME | STOP DATE | STOP TIME | INCREMENT. FLOW (CC) | TOTAL FLOW (CC) | INCREMENT. TIME (MIN) | TOTAL TIME (MIN) | INCREMENTAL PERMEABILITY (CM/SEC) | AVERAGE PERMEABILITY (CM/SEC) |
|---|---|---|---|---|---|---|---|---|---|
| 3/22/2006 | 11:35:10 | 3/22/2006 | 11:40:00 | 4.10 | 4.1000 | 4.83 | 4.83 | 1.14E-05 | 1.14E-05 |
| 3/22/2006 | 12:49:10 | 3/22/2006 | 13:21:00 | 23.90 | 28.0000 | 31.83 | 36.67 | 1.01E-05 | 1.08E-05 |
| 3/22/2006 | 13:24:00 | 3/22/2006 | 13:58:00 | 24.20 | 52.2000 | 34.00 | 70.67 | 9.59E-06 | 9.85E-06 |
| 3/22/2006 | 14:00:25 | 3/22/2006 | 14:34:30 | 23.80 | 76.0000 | 34.08 | 104.75 | 9.41E-06 | 9.50E-06 |
| 3/22/2006 | 14:37:00 | 3/22/2006 | 15:10:00 | 23.50 | 99.5000 | 33.00 | 137.75 | 9.59E-06 | 9.50E-06 |
| 3/22/2006 | 15:12:30 | 3/22/2006 | 15:45:00 | 23.80 | 123.3000 | 32.50 | 170.25 | 9.86E-06 | 9.73E-06 |
| 3/22/2006 | 15:47:01 | 3/22/2006 | 16:19:00 | 23.90 | 147.2000 | 31.98 | 202.23 | 1.01E-05 | 9.97E-06 |
| 3/23/2006 | 8:15:00 | 3/23/2006 | 8:47:30 | 24.30 | 171.5000 | 32.50 | 234.73 | 1.01E-05 | 1.01E-05 |
| 3/23/2006 | 8:49:00 | 3/23/2006 | 9:21:00 | 24.10 | 195.6000 | 32.00 | 266.73 | 1.01E-05 | 1.01E-05 |
| 3/23/2006 | 9:23:00 | 3/23/2006 | 9:55:00 | 24.30 | 219.9000 | 32.00 | 298.73 | 1.02E-05 | 1.02E-05 |
| 3/23/2006 | 9:58:00 | 3/23/2006 | 10:29:30 | 24.00 | 243.9000 | 31.50 | 330.23 | 1.03E-05 | 1.02E-05 |
| 3/23/2006 | 10:32:00 | 3/23/2006 | 11:04:00 | 24.90 | 268.8000 | 32.00 | 362.23 | 1.05E-05 | 1.04E-05 |
| 3/23/2006 | 11:13:00 | 3/23/2006 | 11:38:00 | 19.50 | 288.3000 | 25.00 | 387.23 | 1.05E-05 | 1.05E-05 |
| 3/23/2006 | 13:03:00 | 3/23/2006 | 13:34:00 | 23.80 | 312.1000 | 31.00 | 418.23 | 1.03E-05 | 1.04E-05 |
| 3/23/2006 | 13:36:30 | 3/23/2006 | 14:08:00 | 24.20 | 336.3000 | 31.50 | 449.73 | 1.03E-05 | 1.03E-05 |

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# CONSTANT HEAD PERMEABILITY TEST

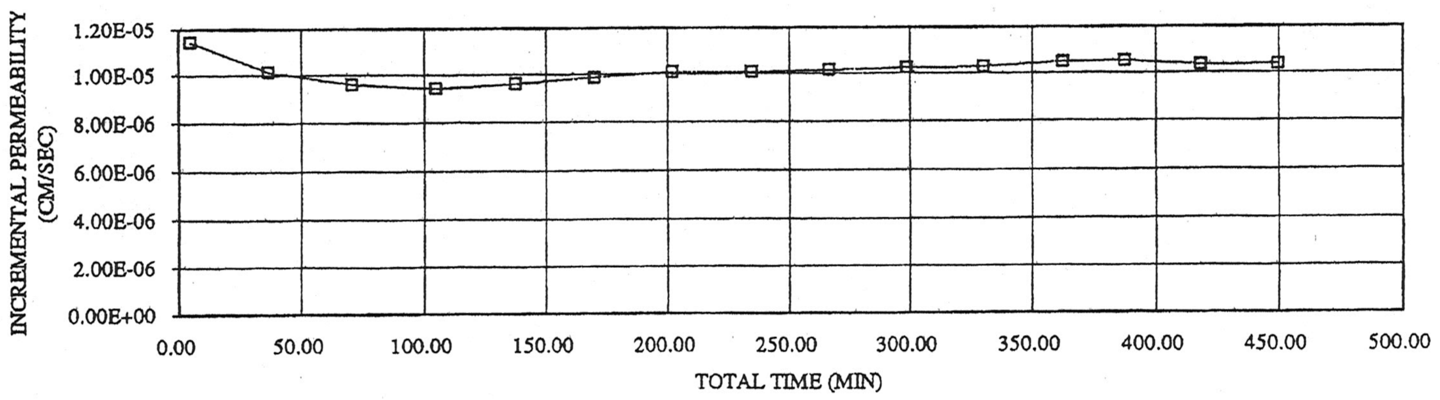
JOB NUMBER: 05S5010
CLIENT: Sgt. & Lundy
JOB DESCRIPTION: Ash Pond

TEST DATE: 1/27/2006
BORING #: B-4
SAMPLE #: 2
DEPTH (FT): 1.0-10.0

SPECIMEN HEIGHT (IN) 4.776
DIAMETER (IN) 2.874
AREA (SQ IN) 6.487

HEIGHT OF HEAD (PSI) 5.10
PRESSURE HEAD (CM H2O) 358.62
PANEL NUMBER 3
FILE NAME: 'uck Creek Ash Pond

| START DATE | START TIME | STOP DATE | STOP TIME | INCREMENT. FLOW (CC) | TOTAL FLOW (CC) | INCREMENT. TIME (MIN) | TOTAL TIME (MIN) | INCREMENTAL PERMEABILITY (CM/SEC) | AVERAGE PERMEABILITY (CM/SEC) |
|---|---|---|---|---|---|---|---|---|---|



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Hanson Professional Services Inc.

# CONSTANT HEAD PERMEABILITY TEST

ASTM D5084

| | | | |
|---|---|---|---|
| JOB NUMBER: | 05S5010 | TEST DATE: | 1/27/2006 |
| CLIENT: | Sgt. & Lundy | BORING #: | B-5 |
| JOB DESCRIPTION: | Ash Pond | SAMPLE #: | 2 |
| SAMPLE DESCRIPTION: | Yel. Brn. Vf. Sandy silt / so. Clay. | DEPTH (FT): | 1.0-10.0 |
| | | FILE NAME: : | Creek Ash Pond |

| | |
|---|---|
| SPECIMEN WEIGHT (G) | 944.87 |
| SPECIMEN HEIGHT (IN) | 4.474 |
| DIAMETER (IN) | 2.877 |
| AREA (SQ IN) | 6.501 |
| VOLUME (CU IN) | 29.085 |
| WET DENSITY (PCF) | 123.76 |
| DRY DENSITY (PCF) | 106.05 |
| WT. DRY SOIL (G) | 809.66 |
| VOLUME DRY SOIL (CU IN | 18.299 |
| SP.GR. ASSUMED | 2.70 |
| POROSITY (%) | 37.08 |
| HEIGHT OF HEAD (PSI) | 4.80 |
| HYDRAULIC GRADIANT | 29.7 |
| 1/4 PORE VOLUME | 44.18 |

WATER CONTENT OF TRIMMINGS

| | BEFORI TEST | AFTER TEST |
|---|---|---|
| TARE + WET SOIL (G) | 251.34 | 1036.52 |
| TARE + DRY SOIL (G) | 218.71 | 872.26 |
| TARE (G) | 15.17 | 50.11 |
| WATER (G) | 32.63 | 164.26 |
| DRY SOIL (G) | 203.54 | 822.15 |
| WATER CONTENT (%) | 16.70 | 19.98 |

| | |
|---|---|
| STD. MAX. DEN.(LBS/CU.FT.) | 112.00 |
| OPTIMUM MOISTURE (%) | 14.70 |
| % COMPACTION | 94.69 |
| PRESSURE HEAD (CM H2O) | 189.86 |
| PANEL NUMBER | 4 |

TEST METHOD USED: IEPA ASTM D5084

PERMEANT USED: TAP WATER

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# CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER: 05S5010
CLIENT: Sgt. & Lundy
JOB DESCRIPTION: Ash Pond

TEST DATE: 1/27/2006
BORING #: B-5
SAMPLE #: 2
DEPTH (FT): 1.0-10.0

SPECIMEN HEIGHT (IN) 4.474
DIAMETER (IN) 2.877
AREA (SQ IN) 6.501

HEIGHT OF HEAD (PSI) 4.80
PRESSURE HEAD (CM H2O) 337.52
PANEL NUMBER 4
FILE NAME: Duck Creek Ash Pond

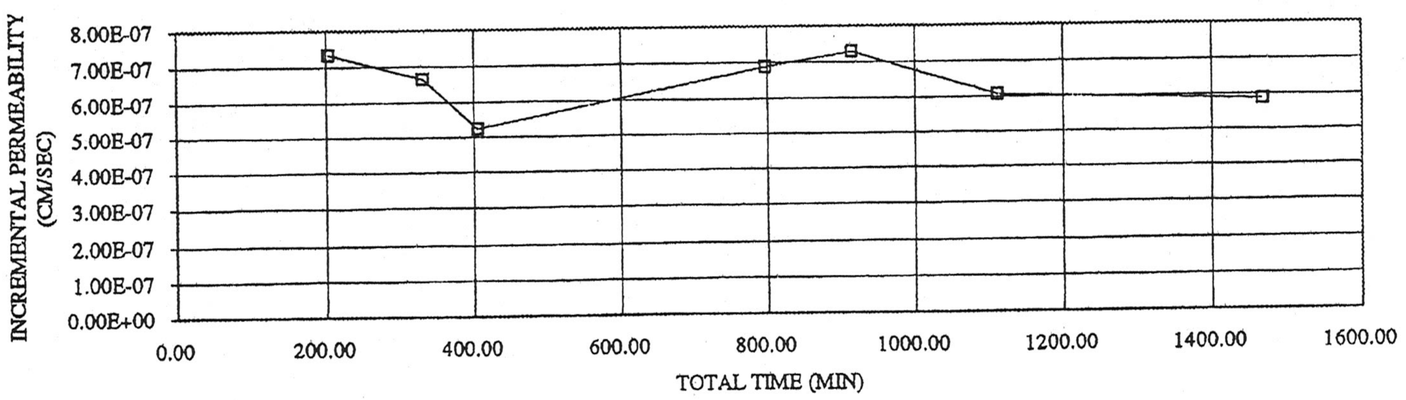
| START DATE | START TIME | STOP DATE | STOP TIME | INCREMENT. FLOW (CC) | TOTAL FLOW (CC) | INCREMENT. TIME (MIN) | TOTAL TIME (MIN) | INCREMENTAL PERMEABILITY (CM/SEC) | AVERAGE PERMEABILITY (CM/SEC) |
|---|---|---|---|---|---|---|---|---|---|
| 3/22/2006 | 13:08:00 | 3/22/2006 | 16:32:15 | 11.20 | 11.2000 | 204.25 | 204.25 | 7.34E-07 | 7.34E-07 |
| 3/23/2006 | 8:17:00 | 3/23/2006 | 10:23:45 | 6.30 | 17.5000 | 126.75 | 331.00 | 6.65E-07 | 6.99E-07 |
| 3/23/2006 | 10:23:45 | 3/23/2006 | 11:38 | 2.90 | 20.4000 | 74.25 | 405.25 | 5.23E-07 | 5.94E-07 |
| 3/24/2006 | 8:59:00 | 3/24/2006 | 15:31:25 | 20.20 | 40.6000 | 392.42 | 797.67 | 6.89E-07 | 6.06E-07 |
| 3/24/2006 | 15:52:40 | 3/24/2006 | 17:50:15 | 6.40 | 47.0000 | 117.58 | 915.25 | 7.28E-07 | 7.08E-07 |
| 3/27/2006 | 8:08:00 | 3/27/2006 | 11:24:50 | 8.90 | 55.9000 | 196.83 | 1112.08 | 6.05E-07 | 6.67E-07 |
| 3/27/2006 | 11:24:50 | 3/27/2006 | 17:21:10 | 15.60 | 71.5000 | 356.33 | 1468.42 | 5.86E-07 | 5.95E-07 |

Hanson Professional Services Inc.

# CONSTANT HEAD PERMEABILITY TEST

| | | | |
|---|---|---|---|
| JOB NUMBER: | 05S5010 | TEST DATE: | 1/27/2006 |
| CLIENT: | Sgt. & Lundy | BORING #: | B-5 |
| JOB DESCRIPTION: | Ash Pond | SAMPLE #: | 2 |
| | | DEPTH (FT): | 1.0-10.0 |
| SPECIMEN HEIGHT (IN) | 4.474 | HEIGHT OF HEAD (PSI) | 4.80 |
| DIAMETER (IN) | 2.877 | PRESSURE HEAD (CM H2O) | 337.52 |
| AREA (SQ IN) | 6.501 | PANEL NUMBER | 4 |
| | | FILE NAME: | Duck Creek Ash Pond |

| START DATE | START TIME | STOP DATE | STOP TIME | INCREMENT. FLOW (CC) | TOTAL FLOW (CC) | INCREMENT. TIME (MIN) | TOTAL TIME (MIN) | INCREMENTAL PERMEABILITY (CM/SEC) | AVERAGE PERMEABILITY (CM/SEC) |
|---|---|---|---|---|---|---|---|---|---|



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Hanson Professional Services Inc.

# CONSTANT HEAD PERMEABILITY TEST

ASTM D5084

| | | | |
|---|---|---|---|
| JOB NUMBER: | 05S5010 | TEST DATE: | 3/22/2006 |
| CLIENT: | Sgt. & Lundy | BORING #: | B-6 |
| JOB DESCRIPTION: | Ash Pond | SAMPLE #: | 2 |
| SAMPLE DESCRIPTION: | Yel. Brn. Vf. Sandy silt (tr. Clay). | DEPTH (FT): | 1.0-10.0 |
| | | FILE NAME: | :k Creek Ash Pond |

| | | WATER CONTENT OF TRIMMINGS | BEFORJ TEST | AFTER TEST |
|---|---|---|---|---|
| SPECIMEN WEIGHT (G) | 726.71 | | | |
| SPECIMEN HEIGHT (IN) | 3.576 | | | |
| DIAMETER (IN) | 2.859 | TARE + WET SOIL (G) | 256.28 | 818.17 |
| AREA (SQ IN) | 6.420 | TARE + DRY SOIL (G) | 221.19 | 673.54 |
| VOLUME (CU IN) | 22.957 | TARE (G) | 16.03 | 50.11 |
| WET DENSITY (PCF) | 120.59 | WATER (G) | 35.09 | 144.63 |
| DRY DENSITY (PCF) | 102.98 | DRY SOIL (G) | 205.16 | 623.43 |
| WT. DRY SOIL (G) | 620.57 | WATER CONTENT (%) | 17.10 | 23.20 |
| VOLUME DRY SOIL (CU IN | 14.026 | | | |
| SP.GR. ASSUMED | 2.70 | | | |
| POROSITY (%) | 38.90 | STD. MAX. DEN.(LBS/CU.FT.) | 107.50 | |
| HEIGHT OF HEAD (PSI) | 3.80 | OPTIMUM MOISTURE (%) | 15.70 | |
| HYDRAULIC GRADIANT | 29.4 | % COMPACTION | 95.79 | |
| 1/4 PORE VOLUME | 36.59 | PRESSURE HEAD (CM H2O) | 189.86 | |
| | | PANEL NUMBER | 8 | |

TEST METHOD USED: IEPA ASTM D5084 PERMEANT USED: TAP WATER

HANSON.
Hanson Professional Services Inc.

# CONSTANT HEAD PERMEABILITY TEST

JOB NUMBER: 05S5010
CLIENT: Sgt. & Lundy
JOB DESCRIPTION: Ash Pond

TEST DATE: 1/27/2006
BORING #: B-6
SAMPLE #: 2
DEPTH (FT): 1.0-10.0

SPECIMEN HEIGHT (IN) 3.576
DIAMETER (IN) 2.859
AREA (SQ IN) 6.420

HEIGHT OF HEAD (PSI) 3.80
PRESSURE HEAD (CM H2O) 267.21
PANEL NUMBER 8
FILE NAME: uck Creek Ash Pond

| START DATE | START TIME | STOP DATE | STOP TIME | INCREMENT. FLOW (CC) | TOTAL FLOW (CC) | INCREMENT. TIME (MIN) | TOTAL TIME (MIN) | INCREMENTAL PERMEABILITY (CM/SEC) | AVERAGE PERMEABILITY (CM/SEC) |
|---|---|---|---|---|---|---|---|---|---|
| 3/22/2006 | 13:10:00 | 3/22/2006 | 13:32:00 | 23.50 | 23.5000 | 22.00 | 22.00 | 1.46E-05 | 1.46E-05 |
| 3/22/2006 | 13:34:00 | 3/22/2006 | 14:03:30 | 23.70 | 47.2000 | 29.50 | 51.50 | 1.10E-05 | 1.28E-05 |
| 3/22/2006 | 14:05:00 | 3/22/2006 | 14:38:30 | 24.20 | 71.4000 | 33.50 | 85.00 | 9.88E-06 | 1.04E-05 |
| 3/22/2006 | 14:40:30 | 3/22/2006 | 15:15:00 | 24.00 | 95.4000 | 34.50 | 119.50 | 9.52E-06 | 9.70E-06 |
| 3/22/2006 | 15:16:40 | 3/22/2006 | 15:51:00 | 23.80 | 119.2000 | 34.33 | 153.83 | 9.48E-06 | 9.50E-06 |
| 3/22/2006 | 15:56:45 | 3/22/2006 | 16:31:00 | 23.80 | 143.0000 | 34.25 | 188.08 | 9.51E-06 | 9.49E-06 |
| 3/23/2006 | 8:19:00 | 3/23/2006 | 8:54:00 | 23.70 | 166.7000 | 35.00 | 223.08 | 9.26E-06 | 9.38E-06 |
| 3/23/2006 | 8:57:00 | 3/23/2006 | 9:32:00 | 24.10 | 190.8000 | 35.00 | 258.08 | 9.42E-06 | 9.34E-06 |
| 3/23/2006 | 9:34:30 | 3/23/2006 | 10:09:00 | 24.10 | 214.9000 | 34.50 | 292.58 | 9.56E-06 | 9.49E-06 |
| 3/23/2006 | 10:12:00 | 3/23/2006 | 10:46:00 | 23.70 | 238.6000 | 34.00 | 326.58 | 9.53E-06 | 9.55E-06 |
| 3/23/2006 | 10:48:00 | 3/23/2006 | 11:22:00 | 23.80 | 262.4000 | 34.00 | 360.58 | 9.58E-06 | 9.56E-06 |
| 3/23/2006 | 11:24:00 | 3/23/2006 | 11:38:04 | 10.50 | 272.9000 | 14.07 | 374.65 | 1.02E-05 | 9.89E-06 |
| 3/23/2006 | 13:07:00 | 3/23/2006 | 13:42:00 | 24.30 | 297.2000 | 35.00 | 409.65 | 9.50E-06 | 9.85E-06 |
| 3/23/2006 | 13:45:00 | 3/23/2006 | 14:20:00 | 24.50 | 321.7000 | 35.00 | 444.65 | 9.58E-06 | 9.54E-06 |
| | | | | | | | | | |

Hanson Professional Services Inc.

# CONSTANT HEAD PERMEABILITY TEST

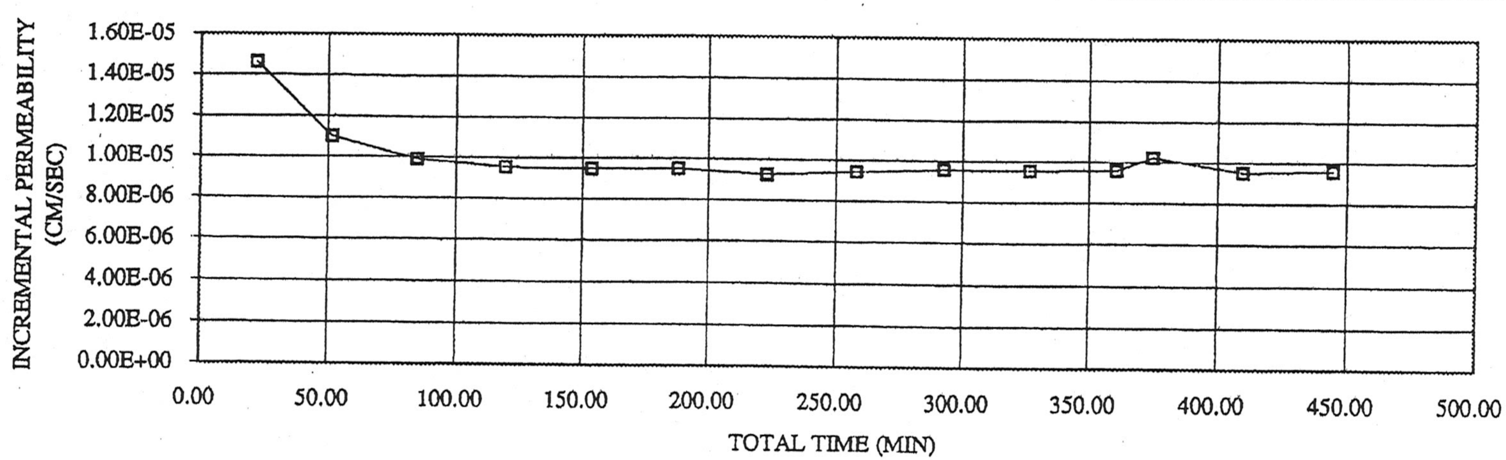
JOB NUMBER: 05S5010
CLIENT: Sgt. & Lundy
JOB DESCRIPTION: Ash Pond

TEST DATE: 1/27/2006
BORING #: B-6
SAMPLE #: 2
DEPTH (FT): 1.0-10.0

SPECIMEN HEIGHT (IN) 3.576
DIAMETER (IN) 2.859
AREA (SQ IN) 6.420

HEIGHT OF HEAD (PSI) 3.80
PRESSURE HEAD (CM H2O) 267.21
PANEL NUMBER 8
FILE NAME: uck Creek Ash Pond

| START DATE | START TIME | STOP DATE | STOP TIME | INCREMENT. FLOW (CC) | TOTAL FLOW (CC) | INCREMENT. TIME (MIN) | TOTAL TIME (MIN) | INCREMENTAL PERMEABILITY (CM/SEC) | AVERAGE PERMEABILITY (CM/SEC) |
|---|---|---|---|---|---|---|---|---|---|



Geotechnical Requirements for Soil Borings

1, Drill six (6) boreholes B-1 through B-6 at the locations shown on the plan and having following coordinates:

| | |
|---|---|
| B-1 | N-1617.9, E-2220.9 |
| B-2 | N-1415.7, E-2224.8 |
| B-3 | N-1521.0, E-2307.5 |
| B-4 | N-1517.4, E-2443.2 |
| B-5 | N-1615.5, E-2572.8 |
| B-6 | N-1422.1, E-2573.8 |

2, Holes shall be drilled to a depth of 30 feet. If rock is encountered at a depth of less than 30 feet, the boring shall be terminated when auger refusal is attained.

3, Perform continuous split spoon sampling in all borings to a depth of 10ft., then perform SPT's at 5 ft. intervals.

4, Obtain 50-lb bag samples in each cohesive soil layer in each boring for laboratory testing in the upper 10 ft. for remainder of depth.

5, Obtain undisturbed soil samples using a Shelby tube, per ASTM D 1587, when cohesive soils are encountered.

6, Laboratory Testing shall consist of:
A) Natural water content - ASTM D2216
B) Percent passing the #200 sieve - D1140
C) Atterberg limits - D4318
D) Standard Proctor tests - D698
E) Permeability tests on samples compacted to 95% per ASTM D698 at a moisture content of +1% of optimum (D5084).
F) Unconfined compression tests on samples compacted to 95% per ASTM D698 at a moisture content of +1% of optimum (D2166).
G) Dry density per EM-1110-2-1906.
Unconfined compressive strength on undisturbed samples per ASTM D2166.

**HANSON**

Hanson Professional Services Inc.
Springfield, Illinois

OPERATOR: JPK
TEST DATE: 2/27/06
JOB NO.: 03S5010ap

# LABORATORY SOIL TEST DATA

PROJECT NAME: Duck Creek Ash Pond
LOCATION: Canton, Illinois
CLIENT: AmerenCilco

| SAMP. | DEPTH (ft) | ELEV. (ft) | N (blows/ft) | STRENGTH TESTS Qu (tsf) | STRENGTH TESTS Failure | STRENGTH TESTS P (tsf) | WATER (%) | WET DENSITY (pcf) | DRY DENSITY (pcf) | Special Tests | SAMPLE DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BORING: B-01 | | | Ground Surface Elevation (ft): 579.6 | | | | | Balance: G09745 | | | |
| SS-1 | 2.0 | 577.6 | 16 | | | 2.75 | 12 | | | | Brn. - gray clayey silt w/some crs sand & sm. gravel |
| SS-3 | 6.0 | 573.6 | 12 | | | 0.70 | 17 | | | | Gray silt w/some vf. sand |
| SS-4A | 8.0 | 571.6 | 16 | | | 0.75 | 20 | | | | Gray - some brn. silt w/some vf. sand |
| SS-4B | 8.0 | 571.6 | 16 | | | | 21 | | | | Brn. silt/some vf. sand |
| SS-6 | 15.0 | 564.6 | 5 | 1.63 | B | 1.75 | 28 | | | | Brn. - yel. silt w/some clay & vf. sand |
| SS-7A | 20.0 | 559.6 | 4 | 0.47 | B | 1.00 | 21 | | | | Brn. - yel. silt w/some f. - med. sand, tr. clay |
| SS-7B | 20.0 | 559.6 | 4 | | | | 20 | | | | Brn. - yel. silty f. - med. sand w/tr. clay |
| SS-9A | 30.0 | 549.6 | 11 | 0.47 | BSh | 0.30 | 18 | | | | Brn. - yel. silty f. - med. sand w/tr. sm. gravel & clay |
| SS-9B | 30.0 | 549.6 | 11 | | | | 13 | | | | Brn. - yel. silty f. - med. sand w/tr. sm. gravel & clay |

LABORATORY SOIL TEST DATA 03S5010AP.GPJ HANSON ENG.GDT 3/16/06

Reviewed by: VLM Date: 02/28/06

P = Penetrometer Reading
Water % - ASTM 2216-98

Hanson Professional Services Inc.
Springfield, Illinois

OPERATOR: JPK

TEST DATE: 2/27/06

JOB NO.: 03S5010ap

# LABORATORY SOIL TEST DATA

PROJECT NAME: Duck Creek Ash Pond

LOCATION: Canton, Illinois

CLIENT: AmerenCilco

| SAMP. | DEPTH (ft) | ELEV. (ft) | N (blows/ft) | STRENGTH TESTS Qu (tsf) | Failure | P (tsf) | WATER (%) | WET DENSITY (pcf) | DRY DENSITY (pcf) | Special Tests | SAMPLE DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BORING: B-02 | | | Ground Surface Elevation (ft): 575.4 | | | | | Balance: G09745 | | | |
| SS-1A | 2.0 | 573.4 | 11 | | | | 18 | | | | Brn. silt w/some vf. sand |
| SS-1B | 2.0 | 573.4 | 11 | 1.55 | Sh | 1.25 | 21 | | | | Brn. silt w/some vf. sand |
| SS-3 | 6.0 | 569.4 | 12 | | | | 16 | | | | Brn. & gray silt w/some vf. sand |
| SS-4 | 8.0 | 567.4 | 13 | | | 2.75 | 19 | | | | Brn. vf. sandy silt w/tr. clay |
| SS-6 | 15.0 | 560.4 | 3 | 0.23 | B | 0.20 | 32 | | | | Brn. & gray silt |
| SS-8 | 25.0 | 550.4 | 27 | 6.55 | Sh | 4.50 | 17 | | | | Dk. gray-blk. clayey silt, shale, & coal |
| SS-9 | 30.0 | 545.4 | 21 | | | | 15 | | | | Gray - dk. gray shaley clay w/some coal |

LABORATORY SOIL TEST DATA 03S5010AP.GPJ HANSON ENG.GDT 3/16/06

Reviewed by: VLM Date: 02/28/06

P = Penetrometer Reading
Water % - ASTM 2216-98

Hanson Professional Services Inc.
Springfield, Illinois

OPERATOR: JPK
TEST DATE: 2/27/06
JOB NO.: 03S5010ap

# LABORATORY SOIL TEST DATA

PROJECT NAME: Duck Creek Ash Pond
LOCATION: Canton, Illinois
CLIENT: AmerenCilco

| SAMP. | DEPTH (ft) | ELEV. (ft) | N (blows/ft) | STRENGTH TESTS Qu (tsf) | STRENGTH TESTS Failure | STRENGTH TESTS P (tsf) | WATER (%) | WET DENSITY (pcf) | DRY DENSITY (pcf) | Special Tests | SAMPLE DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BORING: B-03 | | | Ground Surface Elevation (ft): 576.3 | | | | | Balance: G09745 | | | |
| SS-1 | 2.0 | 574.3 | 13 | 2.76 | Sh | 1.85 | 19 | | | | Brn. & gray silt w/some vf. sand |
| SS-3 | 6.0 | 570.3 | 7 | 1.38 | Sh | 1.25 | 25 | | | | Brn. & gray silt w/some vf. sand |
| SS-4A | 8.0 | 568.3 | 8 | 0.92 | Sh | 0.08 | 24 | | | | Brn. & gray silt w/some vf. sand |
| SS-4B | 8.0 | 568.3 | 8 | 1.75 | Sh | 1.25 | 26 | | | | Brn. silt w/some vf. sand |
| SS-5 | 10.0 | 566.3 | 9 | 1.92 | Sh | 1.25 | 24 | | | | Brn. silt w/some vf. sand |
| SS-7 | 20.0 | 556.3 | 19 | 5.43 | B | 4.50 | 11 | | | | Brn. silty f. - med sand w/tr. clay |
| SS-8 | 25.0 | 551.3 | 59 | | | | 11 | | | | Gray silty f. - crs. sand w/some gravel |
| SS-9A | 30.0 | 546.3 | 50/4" | | | | 12 | | | | Gray silty f. - crs. sand w/some gravel |
| SS-9B | 30.0 | 546.3 | 50/4" | | | | 9 | | | | Gray silty f. - crs. sand w/some gravel |

LABORATORY SOIL TEST DATA 03S5010AP.GPJ HANSON ENG.GDT 3/16/06

Reviewed by: VLM  Date: 02/28/06

P = Penetrometer Reading
Water % - ASTM 2216-98

HANSON

Hanson Professional Services Inc.
Springfield, Illinois

OPERATOR: JPK
TEST DATE: 2/28/06
JOB NO.: 03S5010ap

# LABORATORY SOIL TEST DATA

PROJECT NAME: Duck Creek Ash Pond
LOCATION: Canton, Illinois
CLIENT: AmerenCilco

| SAMP. | DEPTH (ft) | ELEV. (ft) | N (blows/ft) | STRENGTH TESTS | | | WATER (%) | WET DENSITY (pcf) | DRY DENSITY (pcf) | Special Tests | SAMPLE DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Qu (tsf) | Failure | P (tsf) | | | | | |
| BORING: B-04 | | | Ground Surface Elevation (ft): 575.7 | | | | | Balance: G09745 | | | |
| SS-1 | 2.0 | 573.7 | 9 | 1.84 | Sh | 1.50 | 20 | | | | Brn. silt w/some vf. sand |
| SS-3 | 6.0 | 569.7 | 9 | 1.61 | Sh | 1.00 | 21 | | | | Brn. silt w/some vf. sand |
| SS-4 | 8.0 | 567.7 | 12 | 1.38 | Sh | 1.75 | 27 | | | | Brn. & gray silt w/some vf. sand |
| SS-5 | 10.0 | 565.7 | 4 | 0.92 | Sh | 2.25 | 28 | | | | Gray & brn. silt w/some vf. sand |
| SS-7 | 20.0 | 555.7 | 3 | 0.55 | B | 0.25 | 20 | | | | Gray & brn. silt w/some vf. sand & tr. clay |
| SS-8A | 25.0 | 550.7 | 78 | 6.33 | Sh | | 16 | | | | Brn. silty f. - crs sand w/tr. sm. gravel |
| SS-8B | 25.0 | 550.7 | 78 | | | | 10 | | | | Gray silty f. - crs sand w/tr. sm. gravel & clay |
| SS-9 | 30.0 | 545.7 | 43 | 5.36 | B | 4.50 | 11 | | | | Gray clayey shaley silt w/some crs. sand |

Reviewed by: VLM Date: 02/28/06

P = Penetrometer Reading
Water % - ASTM 2216-98

Hanson Professional Services Inc.
Springfield, Illinois

# LABORATORY SOIL TEST DATA

OPERATOR: JPK
TEST DATE: 2/28/06
JOB NO.: 03S5010ap

PROJECT NAME: Duck Creek Ash Pond
LOCATION: Canton, Illinois
CLIENT: AmerenCilco

| SAMP. | DEPTH (ft) | ELEV. (ft) | N (blows/ft) | STRENGTH TESTS | | | WATER (%) | WET DENSITY (pcf) | DRY DENSITY (pcf) | Special Tests | SAMPLE DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Qu (tsf) | Failure | P (tsf) | | | | | |
| BORING: B-05 | | | Ground Surface Elevation (ft): 585.0 | | | | | Balance: G09745 | | | |
| SS-1 | 2.0 | 583.0 | 12 | 1.84 | Sh | | 15 | | | | Brn. silt w/some vf. sand |
| SS-3 | 6.0 | 579.0 | 10 | 2.18 | Sh | 2.50 | 18 | | | | Brn. silt w/some vf. sand |
| SS-4 | 8.0 | 577.0 | 25 | | | 1.25 | 17 | | | | Brn. silt w/some vf. sand |
| SS-5 | 10.0 | 575.0 | 17 | | | | 19 | | | | Brn. silt w/some vf. sand - cuttings |
| SS-7 | 20.0 | 565.0 | 5 | 2.62 | Sh | 2.00 | 27 | | | | Brn. silt w/some vf. sand |
| SS-8 | 25.0 | 560.0 | 6 | 2.62 | Sh | 2.00 | 24 | | | | Gray silt w/some vf. sand |

LABORATORY SOIL TEST DATA 03S5010AP.GPJ HANSON ENG.GDT 3/16/06

Reviewed by: VLM Date: 02/28/06

P = Penetrometer Reading
Water % - ASTM 2216-98

HANSON

Hanson Professional Services Inc.
Springfield, Illinois

OPERATOR: JPK
TEST DATE: 2/28/06
JOB NO.: 03S5010ap

# LABORATORY SOIL TEST DATA

PROJECT NAME: Duck Creek Ash Pond
LOCATION: Canton, Illinois
CLIENT: AmerenCilco

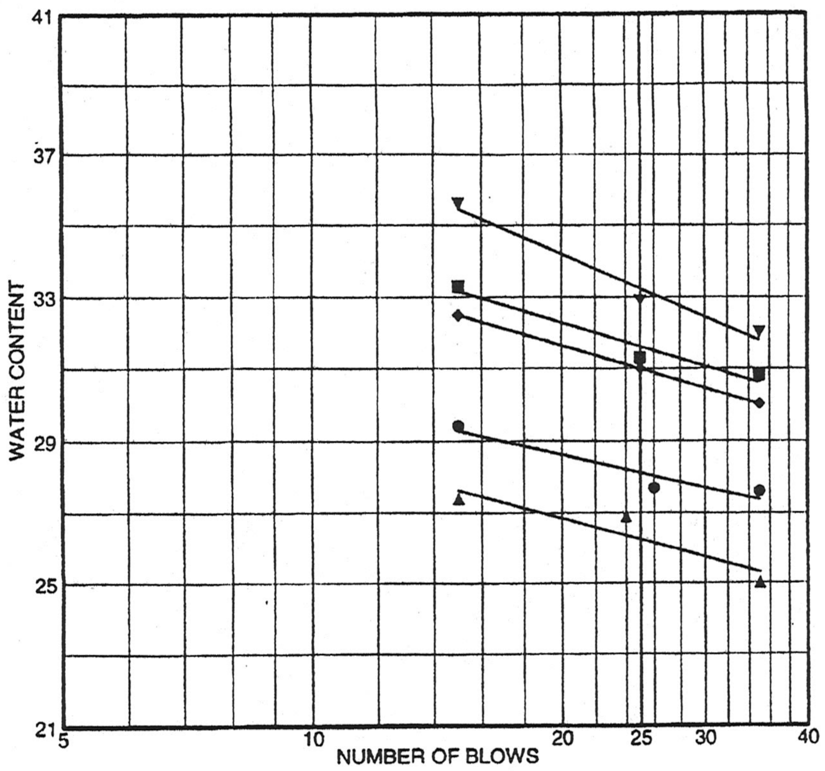
| SAMP. | DEPTH (ft) | ELEV. (ft) | N (blows/ft) | STRENGTH TESTS Qu (tsf) | STRENGTH TESTS Failure | STRENGTH TESTS P (tsf) | WATER (%) | WET DENSITY (pcf) | DRY DENSITY (pcf) | Special Tests | SAMPLE DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BORING: B-06 | | | Ground Surface Elevation (ft): 577.5 | | | | | Balance: G09745 | | | |
| SS-1 | 2.0 | 575.5 | 14 | | | 4.25 | 16 | | | | Brn. silt w/some vf. sand |
| SS-3 | 6.0 | 571.5 | 7 | 1.20 | Sh | 1.00 | 24 | | | | Brn. silt w/some vf. sand |
| SS-4 | 8.0 | 569.5 | 9 | 1.18 | Sh | 1.00 | 23 | | | | Gray - some brn. silt w/some vf. sand |
| SS-5 | 10.0 | 567.5 | 4 | 1.24 | Sh | 0.75 | 26 | | | | Gray - some brn. silt w/some vf. sand |
| SS-7A | 20.0 | 557.5 | 4 | 1.18 | B | 0.75 | 23 | | | | Gray silt w/some vf. - med. sand |
| SS-7B | 20.0 | 557.5 | 4 | 1.81 | B | 1.40 | 26 | | | | Gray sandy silt w/some clay |
| SS-8 | 30.0 | 547.5 | 8 | | | | 23 | | | | Gray silty f. - med. sand w/tr. crs. sand |

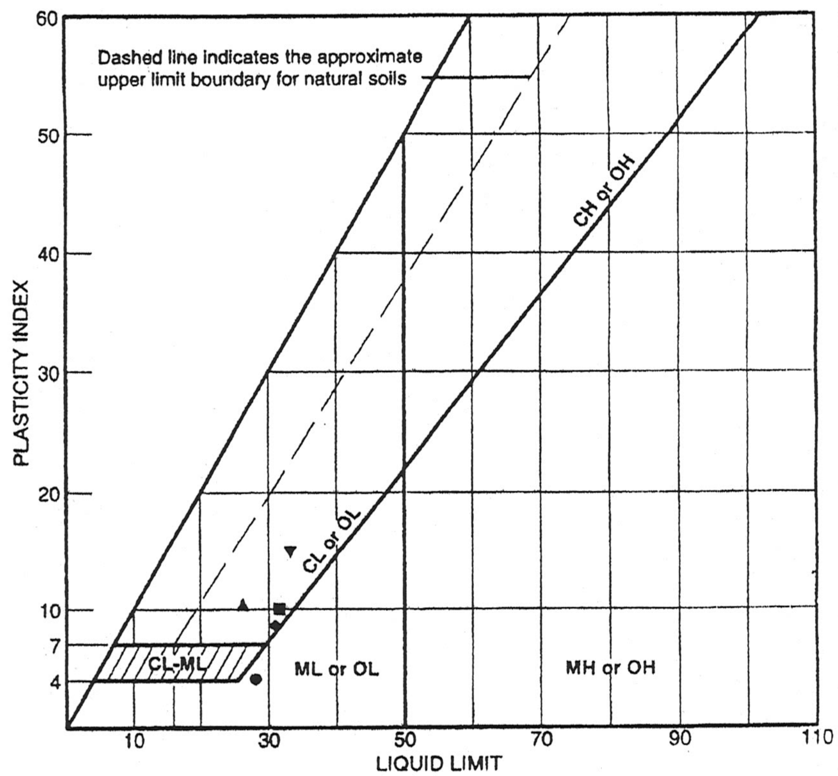
LABORATORY SOIL TEST DATA 03S5010AP.GPJ HANSON ENG.GDT 3/16/06

Reviewed by: VLM Date: 02/28/06

P = Penetrometer Reading
Water % - ASTM 2216-98

# LIQUID AND PLASTIC LIMITS TEST REPORT ASTM D 4318 / USCS SOIL




| | SOURCE | SAMPLE # | DEPTH/ELEV. | DATE SAMPLED | USCS | MATERIAL DESCRIPTION | NM % | LL | PI |
|---|---|---|---|---|---|---|---|---|---|
| ● | | B-1 ST-2 | 2.0-4.0 | 3/10-06 | | Brn. & gray vf. sandy silt. | 16.1 | 28.1 | 4.1 |
| ■ | | B-1 ST-5 | 8.0-10.0 | 3/10/06 | | Brn. vf. sandy silt. | 23.0 | 31.6 | 10.0 |
| ▲ | | B-1 ST-8 | 23.0-25 | 3/10/06 | | Brn. vf.-f. sandy silt / so. clay (tr. c. sand & sm. gravel). | 18.8 | 26.2 | 10.4 |
| ◆ | | B-2 SS-6 | 13.5-15.0 | 03-14-06 | | Brn. & gray silt. | 22.4 | 31.0 | 8.6 |
| ▼ | | B-4 ST-6 | 13.0-15.0 | 3/10/06 | | Brn. & gray vf. sandy silt. | 23 | 33.2 | 14.8 |

Client Sargent & Lundy

Project Duck Creek Ash Pond

Duck Creek Ash Pond

Project No. 03S5010 5000

Plate

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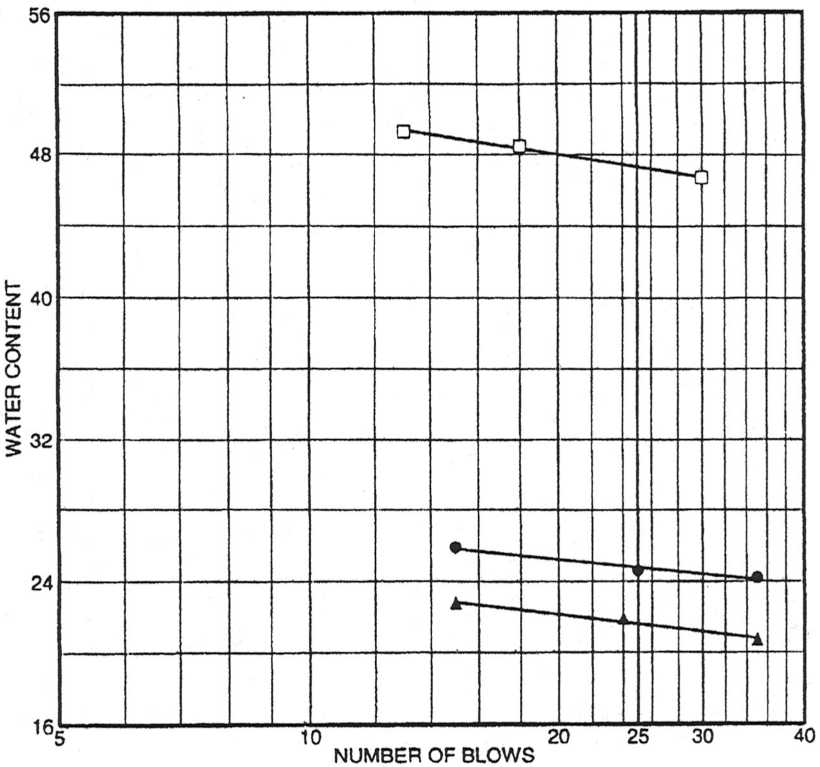
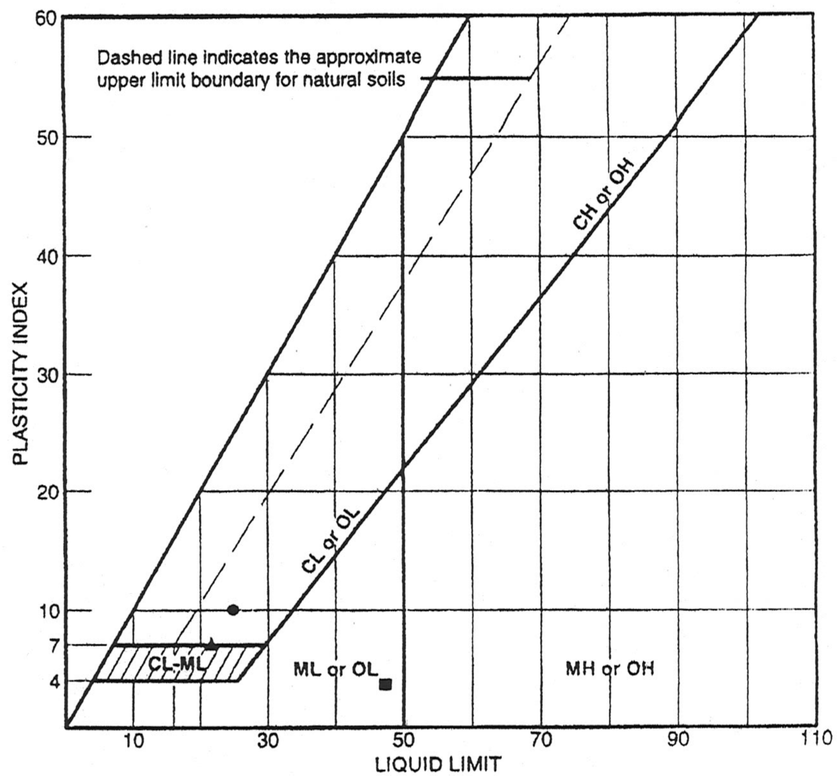
# LIQUID AND PLASTIC LIMITS TEST REPORT ASTM D 4318 / USCS SOIL




| | SOURCE | SAMPLE # | DEPTH/ELEV. | DATE SAMPLED | USCS | MATERIAL DESCRIPTION | NM % | LL | PI |
|---|---|---|---|---|---|---|---|---|---|
| ● | | B-4 SS-7 | 18.5-20.0 | 3/10/06 | | Gray & brn. silt / so. vf. sand & (tr. clay). | 20 | 24.8 | 10.0 |
| ■ | | B-6 ST-6 | 13.0-15.0 | 3/10/06 | | Brn. & gray vf. sandy silt - organic. | 48.7 | 47.3 | 3.6 |
| ▲ | | B-6 ST-8 | 23.0-25.0 | 3/10/06 | | Gray silty f.-m. sand / (tr. c. sand). | 14.4 | 21.6 | 7.1 |

Client Sargent & Lundy

Project Duck Creek Ash Pond

Duck Creek Ash Pond

Project No. 03S5010 5000 Plate

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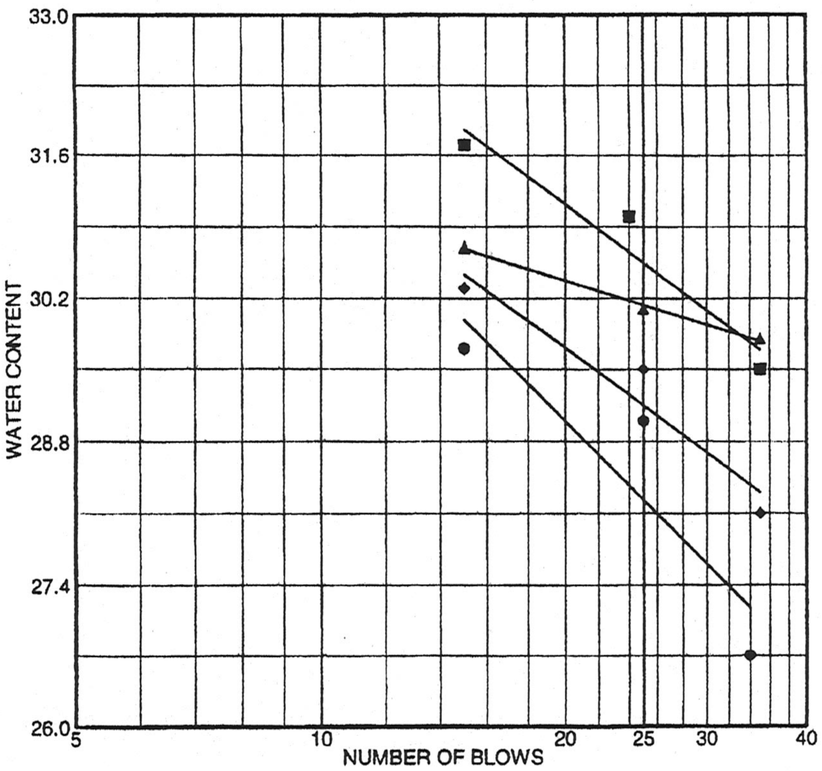
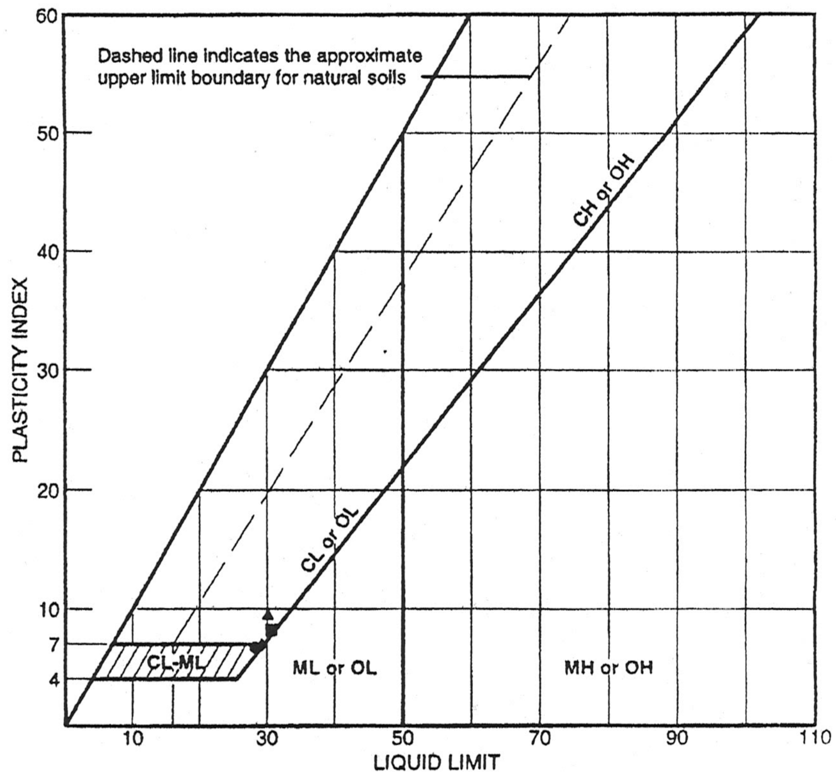
# LIQUID AND PLASTIC LIMITS TEST REPORT ASTM D 4318 / USCS SOIL




| | SOURCE | SAMPLE # | DEPTH/ELEV. | DATE SAMPLED | USCS | MATERIAL DESCRIPTION | NM % | LL | PI |
|---|---|---|---|---|---|---|---|---|---|
| ● | | Bag B-3 | 1.0-10.0 | 3/14/06 | | Yel. brn. vf. sandy silt. | 15 | 28.2 | 6.7 |
| ■ | | Bag B-4 | 1.0-10.0 | 03/10/06 | | Yel. brn. vf. sandy silt. | 18.4 | 30.6 | 8.2 |
| ▲ | | Bag B-5 | 1.0-10.0 | 03/14/06 | | Yel. brn. vf. sandy silt / so. clay. | 13.7 | 30.1 | 9.6 |
| ◆ | | Bag B-6 | 1.0-10.0 | 3/10/06 | | Yel. brn. vf. sandy silt (tr. clay). | 18.8 | 29.2 | 6.9 |

Client Sargent & Lundy

Project Duck Creek Ash Pond

Duck Creek Ash Pond

Project No. 03S5010 5000 | Plate

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## LIQUID AND PLASTIC LIMIT TEST DATA

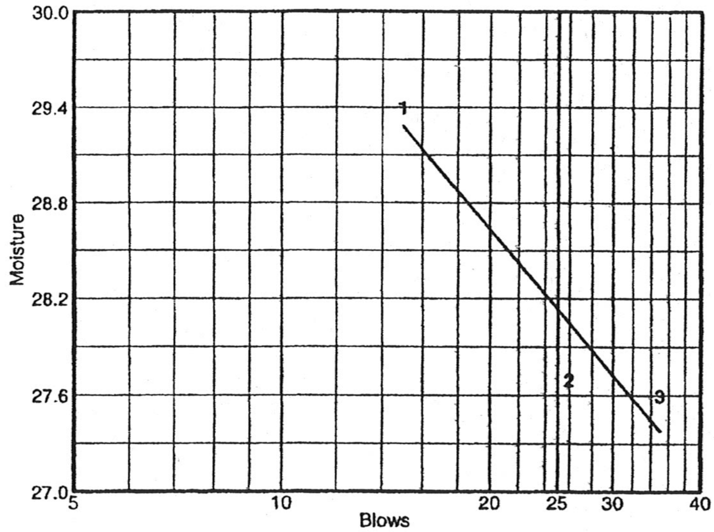
**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000

### Sample Data

**Source:**
**Sample No.:** B-1 ST-2
**Elev. or Depth:** 2.0-4.0 **Sample Length (in./cm.):**
**Location:**
**Description:** Brn. & gray vf. sandy silt.
**Date:** 3/10-06 **Natural Moisture:** 16.1
**USCS Class.:** **AASHTO Class.:**
**Testing Remarks:**

### Liquid Limit Data

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| | | | | | | |
| Wet+Tare | 27.63 | 29.83 | 28.92 | | | |
| Dry+Tare | 25.01 | 26.81 | 26.07 | | | |
| Tare | 16.11 | 15.92 | 15.75 | | | |
| # Blows | 15 | 26 | 35 | | | |
| Moisture | 29.4 | 27.7 | 27.6 | | | |




**Liquid Limit=** 28.1
**Plastic Limit=** 24.0
**Plasticity Index=** 4.1

### Plastic Limit Data

| Run No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| | | | | |
| Wet+Tare | 25.16 | 26.28 | | |
| Dry+Tare | 23.26 | 24.31 | | |
| Tare | 15.39 | 16.10 | | |
| Moisture | 24.1 | 24.0 | | |

# LIQUID AND PLASTIC LIMIT TEST DATA

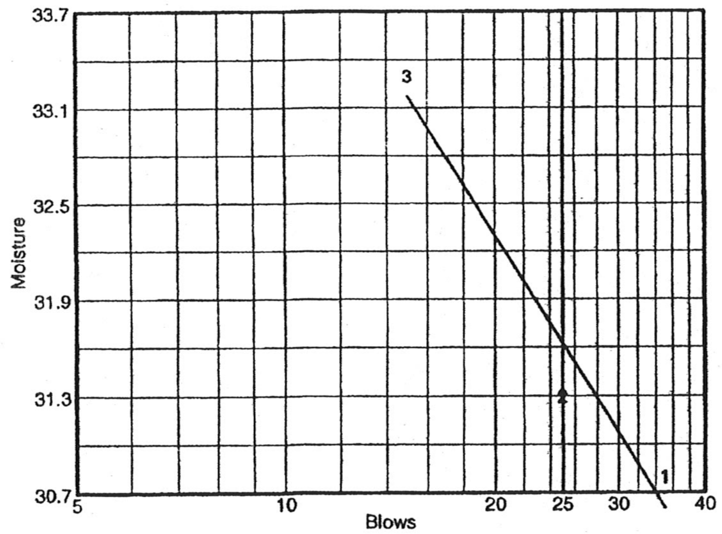
**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000

## Sample Data

**Source:**
**Sample No.:** B-1 ST-5
**Elev. or Depth:** 8.0-10.0 **Sample Length (in./cm.):**
**Location:**
**Description:** Brn. vf. sandy silt.
**Date:** 3/10/06 **Natural Moisture:** 23.0
**USCS Class.:** **AASHTO Class.:**
**Testing Remarks:**

## Liquid Limit Data

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Wet+Tare | 26.50 | 26.32 | 25.97 | | | |
| Dry+Tare | 24.04 | 23.81 | 23.38 | | | |
| Tare | 16.06 | 15.80 | 15.61 | | | |
| # Blows | 35 | 25 | 15 | | | |
| Moisture | 30.8 | 31.3 | 33.3 | | | |




**Liquid Limit=** 31.6
**Plastic Limit=** 21.6
**Plasticity Index=** 10.0

## Plastic Limit Data

| Run No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Wet+Tare | 24.50 | 25.88 | | |
| Dry+Tare | 22.97 | 24.07 | | |
| Tare | 15.80 | 15.81 | | |
| Moisture | 21.3 | 21.9 | | |

LIQUID AND PLASTIC LIMIT TEST DATA

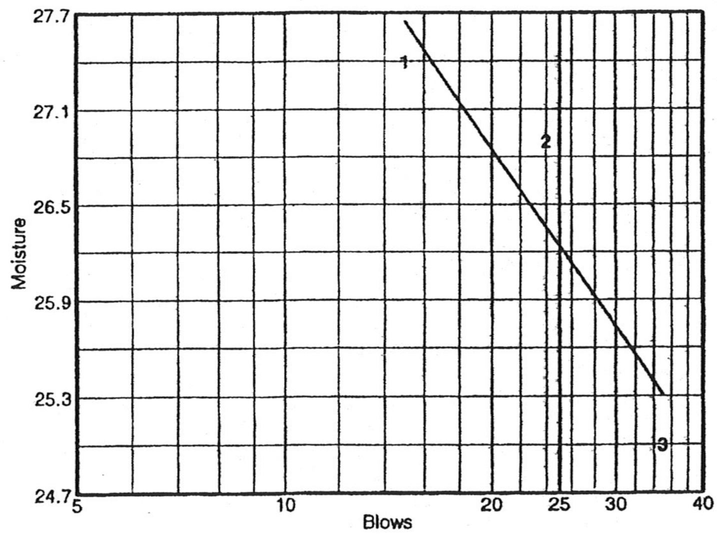
**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000

## Sample Data

**Source:**
**Sample No.:** B-1 ST-8
**Elev. or Depth:** 23.0-25 **Sample Length (in./cm.):**
**Location:**
**Description:** Brn. vf.-f. sandy silt / so. clay (tr. c. sand & sm. gravel).
**Date:** 3/10/06 **Natural Moisture:** 18.8
**USCS Class.:** **AASHTO Class.:**
**Testing Remarks:**

## Liquid Limit Data

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| | | | | | | |
| Wet+Tare | 27.83 | 28.21 | 27.39 | | | |
| Dry+Tare | 25.35 | 25.58 | 25.05 | | | |
| Tare | 16.31 | 15.82 | 15.68 | | | |
| # Blows | 15 | 24 | 35 | | | |
| Moisture | 27.4 | 26.9 | 25.0 | | | |




**Liquid Limit=** 26.2
**Plastic Limit=** 15.8
**Plasticity Index=** 10.4

## Plastic Limit Data

| Run No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| | | | | |
| Wet+Tare | 24.84 | 27.38 | | |
| Dry+Tare | 23.64 | 25.88 | | |
| Tare | 16.14 | 16.25 | | |
| Moisture | 16.0 | 15.6 | | |

## LIQUID AND PLASTIC LIMIT TEST DATA

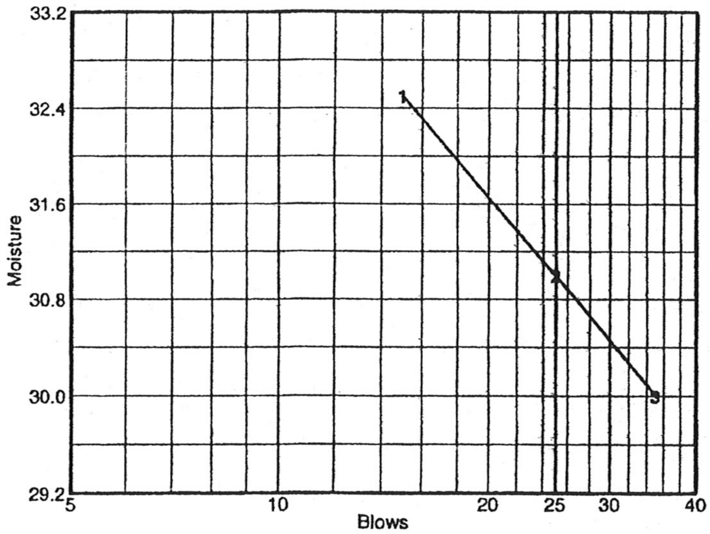
**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000

### Sample Data

**Source:**
**Sample No.:** B-2 SS-6
**Elev. or Depth:** 13.5-15.0 **Sample Length (in./cm.):**
**Location:**
**Description:** Brn. & gray silt.
**Date:** 03-14-06 **Natural Moisture:** 22.4
**USCS Class.:** **AASHTO Class.:**
**Testing Remarks:**

### Liquid Limit Data

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| | | | | | | |
| Wet+Tare | 25.81 | 26.66 | 26.94 | | | |
| Dry+Tare | 23.40 | 24.03 | 24.48 | | | |
| Tare | 15.99 | 15.54 | 16.29 | | | |
| # Blows | 15 | 25 | 35 | | | |
| Moisture | 32.5 | 31.0 | 30.0 | | | |




**Liquid Limit=** 31.0
**Plastic Limit=** 22.4
**Plasticity Index=** 8.6

### Plastic Limit Data

| Run No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| | | | | |
| Wet+Tare | 25.08 | 23.45 | | |
| Dry+Tare | 23.37 | 22.00 | | |
| Tare | 15.76 | 15.46 | | |
| Moisture | 22.5 | 22.2 | | |

**Hanson Professional Services, Inc.**

## LIQUID AND PLASTIC LIMIT TEST DATA

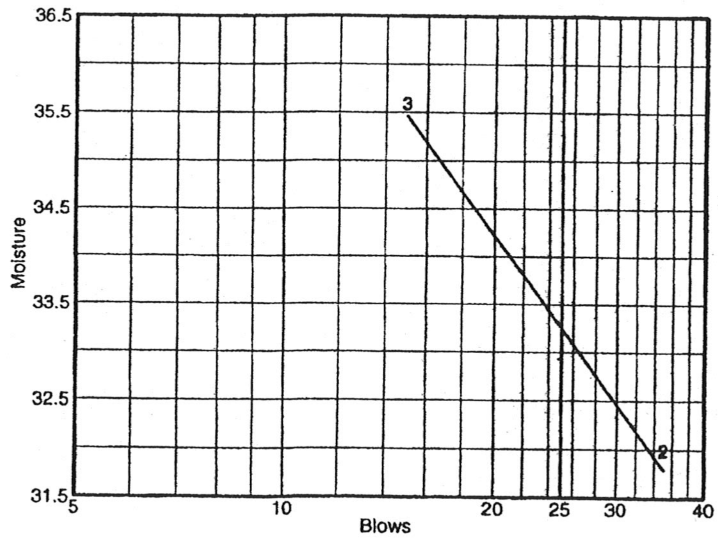
**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000

### Sample Data

**Source:**
**Sample No.:** B-4 ST-6
**Elev. or Depth:** 13.0-15.0 **Sample Length (in./cm.):**
**Location:**
**Description:** Brn. & gray vf. sandy silt.
**Date:** 3/10/06 **Natural Moisture:** 23
**USCS Class.:** **AASHTO Class.:**
**Testing Remarks:**

### Liquid Limit Data

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Wet+Tare | 27.60 | 30.62 | 27.64 | | | |
| Dry+Tare | 24.73 | 27.09 | 24.65 | | | |
| Tare | 16.01 | 16.06 | 16.26 | | | |
| # Blows | 25 | 35 | 15 | | | |
| Moisture | 32.9 | 32.0 | 35.6 | | | |




**Liquid Limit=** 33.2
**Plastic Limit=** 18.4
**Plasticity Index=** 14.8

### Plastic Limit Data

| Run No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Wet+Tare | 22.71 | 24.25 | | |
| Dry+Tare | 21.59 | 22.94 | | |
| Tare | 15.58 | 15.76 | | |
| Moisture | 18.6 | 18.2 | | |

# LIQUID AND PLASTIC LIMIT TEST DATA

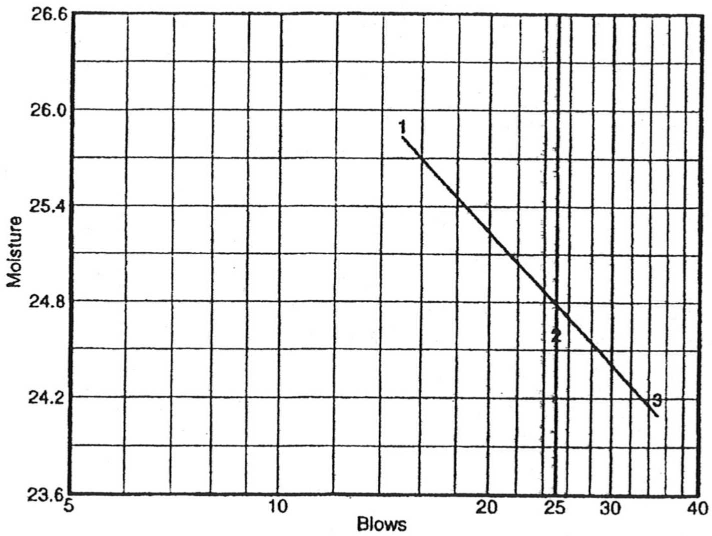
**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000

## Sample Data

**Source:**
**Sample No.:** B-4 SS-7
**Elev. or Depth:** 18.5-20.0 **Sample Length (in./cm.):**
**Location:**
**Description:** Gray & brn. silt / so. vf. sand & (tr. clay).
**Date:** 3/10/06 **Natural Moisture:** 20
**USCS Class.:** **AASHTO Class.:**
**Testing Remarks:**

## Liquid Limit Data

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Wet+Tare | 28.16 | 27.11 | 28.35 | | | |
| Dry+Tare | 25.74 | 24.89 | 25.85 | | | |
| Tare | 16.41 | 15.87 | 15.54 | | | |
| # Blows | 15 | 25 | 35 | | | |
| Moisture | 25.9 | 24.6 | 24.2 | | | |




**Liquid Limit=** 24.8
**Plastic Limit=** 14.8
**Plasticity Index=** 10.0

## Plastic Limit Data

| Run No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Wet+Tare | 22.99 | 24.55 | | |
| Dry+Tare | 22.10 | 23.44 | | |
| Tare | 16.09 | 15.95 | | |
| Moisture | 14.8 | 14.8 | | |

LIQUID AND PLASTIC LIMIT TEST DATA

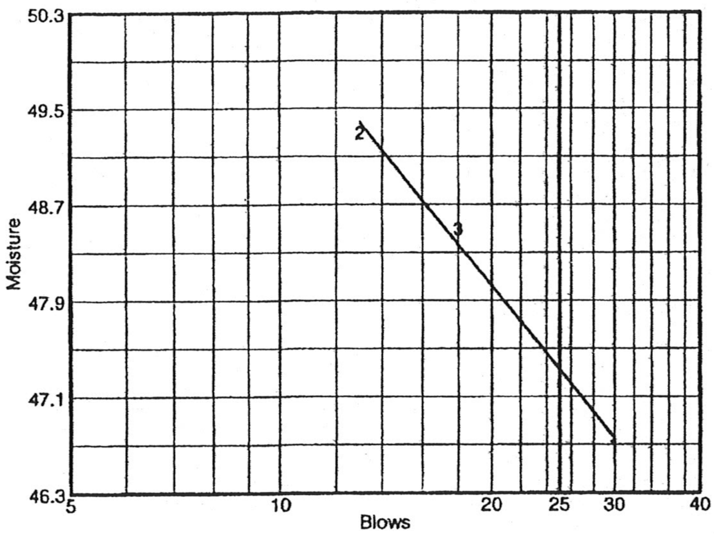
**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000

**Sample Data**

**Source:**
**Sample No.:** B-6 ST-6
**Elev. or Depth:** 13.0-15.0 **Sample Length (in./cm.):**
**Location:**
**Description:** Brn. & gray vf. sandy silt - organic.
**Date:** 3/10/06 **Natural Moisture:** 48.7
**USCS Class.:** **AASHTO Class.:**
**Testing Remarks:**

**Liquid Limit Data**

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Wet+Tare | 29.24 | 26.73 | 26.49 | | | |
| Dry+Tare | 24.84 | 23.03 | 22.72 | | | |
| Tare | 15.42 | 15.53 | 14.95 | | | |
| # Blows | 30 | 13 | 18 | | | |
| Moisture | 46.7 | 49.3 | 48.5 | | | |




**Liquid Limit=** 47.3
**Plastic Limit=** 43.7
**Plasticity Index=** 3.6

**Plastic Limit Data**

| Run No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Wet+Tare | 22.68 | 21.52 | | |
| Dry+Tare | 20.75 | 19.65 | | |
| Tare | 16.34. | 15.35 | | |
| Moisture | 43.8 | 43.5 | | |

## LIQUID AND PLASTIC LIMIT TEST DATA

**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000

### Sample Data

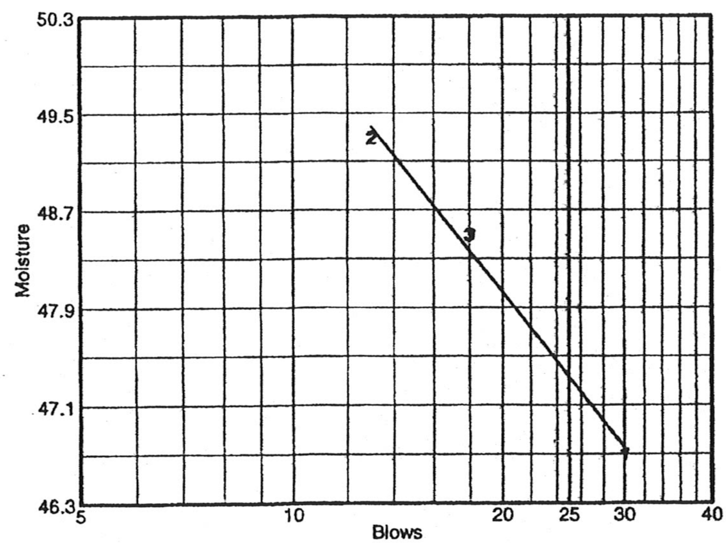
**Source:**
**Sample No.:** B-6 ST-6
**Elev. or Depth:** 13.0-15.0 **Sample Length (in./cm.):**
**Location:**
**Description:** Brn. & gray vf. sandy silt - organic.
**Date:** 3/10/06 **Natural Moisture:** 48.7
**USCS Class.:** **AASHTO Class.:**
**Testing Remarks:**

### Liquid Limit Data

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Wet+Tare | 29.24 | 26.73 | 26.49 | | | |
| Dry+Tare | 24.84 | 23.03 | 22.72 | | | |
| Tare | 15.42 | 15.53 | 14.95 | | | |
| # Blows | 30 | 13 | 18 | | | |
| Moisture | 46.7 | 49.3 | 48.5 | | | |

### Organics Liquid Limit Data

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Wet+Tare | 29.24 | 26.73 | 26.49 | | | |
| Dry+Tare | 24.84 | 23.03 | 22.72 | | | |
| Tare | 15.42 | 15.53 | 14.95 | | | |
| # Blows | 30 | 13 | 18 | | | |
| Moisture | 46.7 | 49.3 | 48.5 | | | |




**Liquid Limit=** 47.3
**Liquid Limit (organics)=** 47.3
**Plastic Limit=** 43.7
**Plasticity Index=** 3.6

## LIQUID AND PLASTIC LIMIT TEST DATA

### Plastic Limit Data

| Run No. | 1 | 2 | 3 | 4 | |
|---|---|---|---|---|---|
| | | | | | |
| Wet+Tare | 22.68 | 21.52 | | | |
| Dry+Tare | 20.75 | 19.65 | | | |
| Tare | 16.34. | 15.35 | | | |
| Moisture | 43.8 | 43.5 | | | |

## LIQUID AND PLASTIC LIMIT TEST DATA

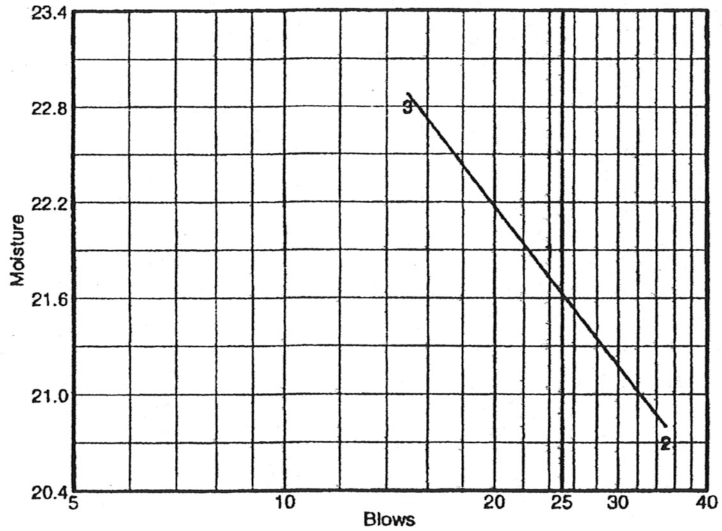
**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000

### Sample Data

**Source:**
**Sample No.:** B-6 ST-8
**Elev. or Depth:** 23.0-25.0 **Sample Length (in./cm.):**
**Location:**
**Description:** Gray silty f.-m. sand / (tr. c. sand).
**Date:** 3/10/06 **Natural Moisture:** 14.4
**USCS Class.:** **AASHTO Class.:**
**Testing Remarks:**

### Liquid Limit Data

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| | | | | | | |
| Wet+Tare | 26.76 | 30.04 | 28.76 | | | |
| Dry+Tare | 24.80 | 27.64 | 26.43 | | | |
| Tare | 15.86 | 16.02 | 16.20 | | | |
| # Blows | 24 | 35 | 15 | | | |
| Moisture | 21.9 | 20.7 | 22.8 | | | |




**Liquid Limit=** 21.6
**Plastic Limit=** 14.5
**Plasticity Index=** 7.1

### Plastic Limit Data

| Run No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| | | | | |
| Wet+Tare | 23.90 | 23.53 | | |
| Dry+Tare | 22.93 | 22.55 | | |
| Tare | 16.09 | 15.91 | | |
| Moisture | 14.2 | 14.8 | | |

LIQUID AND PLASTIC LIMIT TEST DATA

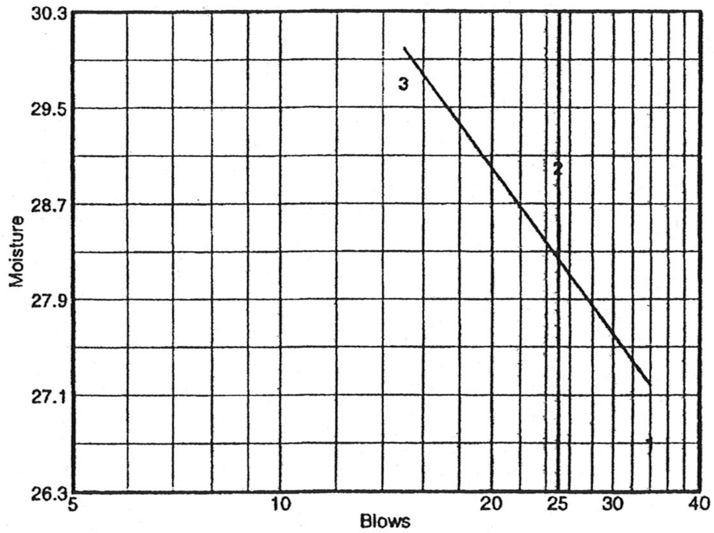
**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000

## Sample Data

**Source:**
**Sample No.:** Bag B-3
**Elev. or Depth:** 1.0-10.0 **Sample Length (in./cm.):**
**Location:**
**Description:** Yel. brn. vf. sandy silt.
**Date:** 3/14/06 **Natural Moisture:** 15
**USCS Class.:** **AASHTO Class.:**
**Testing Remarks:**

## Liquid Limit Data

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| | | | | | | |
| Wet+Tare | 31.48 | 25.33 | 26.79 | | | |
| Dry+Tare | 28.27 | 23.23 | 24.29 | | | |
| Tare | 16.25 | 16.00 | 15.87 | | | |
| # Blows | 34 | 25 | 15 | | | |
| Moisture | 26.7 | 29.0 | 29.7 | | | |




**Liquid Limit=** 28.2
**Plastic Limit=** 21.5
**Plasticity Index=** 6.7

## Plastic Limit Data

| Run No. | 1 | 2 | 3 | 4 | |
|---|---|---|---|---|---|
| | | | | | |
| Wet+Tare | 22.41 | 23.75 | | | |
| Dry+Tare | 21.24 | 22.32 | | | |
| Tare | 15.79 | 15.68 | | | |
| Moisture | 21.5 | 21.5 | | | |

## LIQUID AND PLASTIC LIMIT TEST DATA

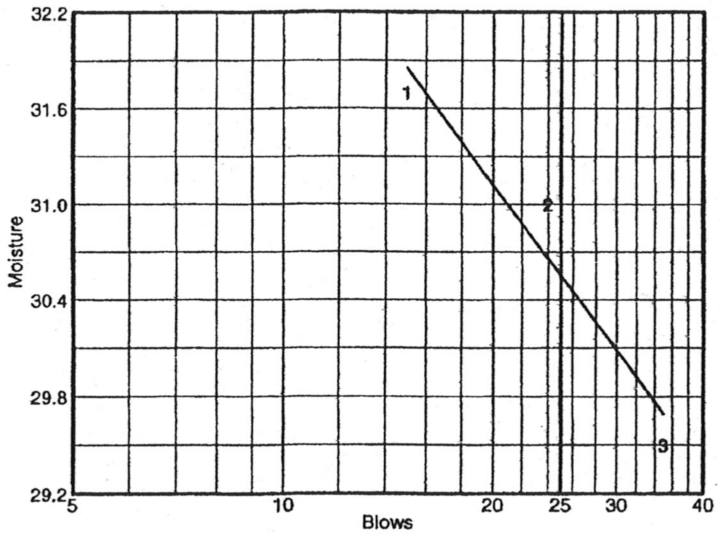
**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000

### Sample Data

**Source:**
**Sample No.:** Bag B-4
**Elev. or Depth:** 1.0-10.0 **Sample Length (in./cm.):**
**Location:**
**Description:** Yel. brn. vf. sandy silt.
**Date:** 03/10/06 **Natural Moisture:** 18.4
**USCS Class.:** **AASHTO Class.:**
**Testing Remarks:**

### Liquid Limit Data

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Wet+Tare | 24.77 | 24.20 | 24.13 | | | |
| Dry+Tare | 22.60 | 22.22 | 22.25 | | | |
| Tare | 15.76 | 15.84 | 15.87 | | | |
| # Blows | 15 | 24 | 35 | | | |
| Moisture | 31.7 | 31.0 | 29.5 | | | |




**Liquid Limit=** 30.6
**Plastic Limit=** 22.4
**Plasticity Index=** 8.2

### Plastic Limit Data

| Run No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Wet+Tare | 24.62 | 25.95 | | |
| Dry+Tare | 23.0 | 24.13 | | |
| Tare | 15.8 | 15.98 | | |
| Moisture | 22.5 | 22.3 | | |

LIQUID AND PLASTIC LIMIT TEST DATA

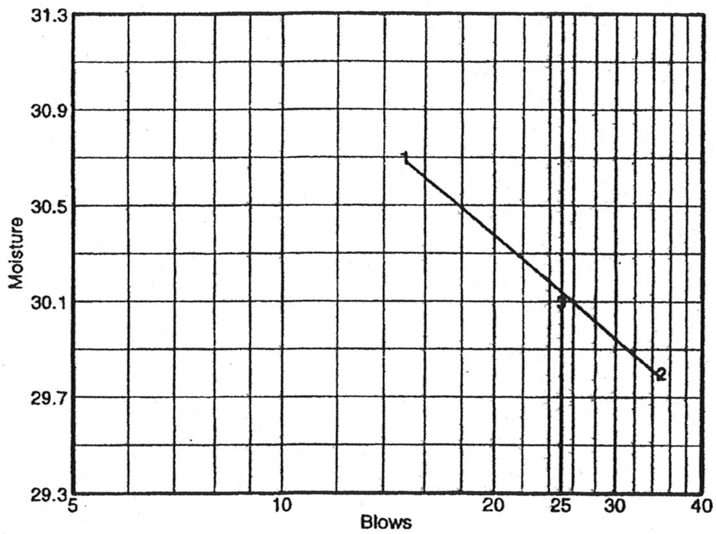
**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000

## Sample Data

**Source:**
**Sample No.:** Bag B-5
**Elev. or Depth:** 1.0-10.0 **Sample Length (in./cm.):**
**Location:**
**Description:** Yel. brn. vf. sandy silt / so. clay.
**Date:** 03/14/06 **Natural Moisture:** 13.7
**USCS Class.:** **AASHTO Class.:**
**Testing Remarks:**

## Liquid Limit Data

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| | | | | | | |
| Wet+Tare | 26.52 | 24.16 | 26.63 | | | |
| Dry+Tare | 24.11 | 22.24 | 24.11 | | | |
| Tare | 16.25 | 15.8 | 15.75 | | | |
| # Blows | 15 | 35 | 25 | | | |
| Moisture | 30.7 | 29.8 | 30.1 | | | |




**Liquid Limit=** 30.1
**Plastic Limit=** 20.5
**Plasticity Index=** 9.6

## Plastic Limit Data

| Run No. | 1 | 2 | 3 | 4 | |
|---|---|---|---|---|---|
| | | | | | |
| Wet+Tare | 23.30 | 23.53 | | | |
| Dry+Tare | 22.09 | 22.18 | | | |
| Tare | 16.28 | 15.52 | | | |
| Moisture | 20.8 | 20.3 | | | |

# LIQUID AND PLASTIC LIMIT TEST DATA

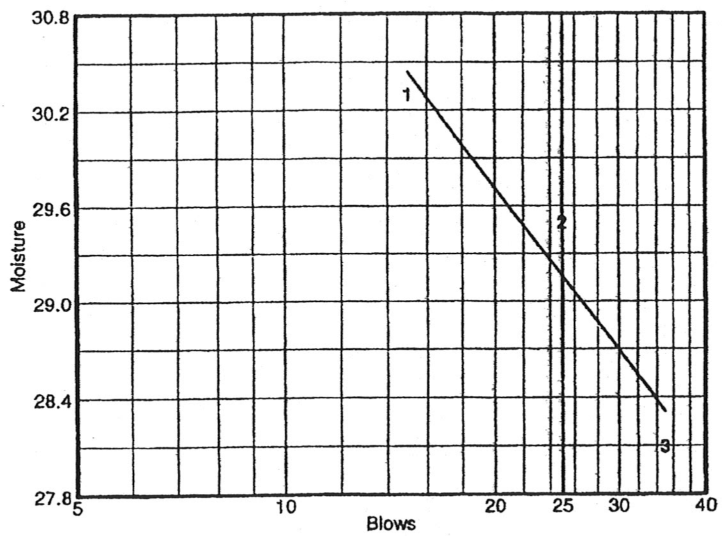
**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000

## Sample Data

**Source:**
**Sample No.:** Bag B-6
**Elev. or Depth:** 1.0-10.0 **Sample Length (in./cm.):**
**Location:**
**Description:** Yel. brn. vf. sandy silt (tr. clay).
**Date:** 3/10/06 **Natural Moisture:** 18.8
**USCS Class.:** **AASHTO Class.:**
**Testing Remarks:**

## Liquid Limit Data

| Run No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| | | | | | | |
| Wet+Tare | 24.12 | 24.63 | 25.01 | | | |
| Dry+Tare | 22.17 | 22.58 | 22.95 | | | |
| Tare | 15.74 | 15.62 | 15.61 | | | |
| # Blows | 15 | 25 | 35 | | | |
| Moisture | 30.3 | 29.5 | 28.1 | | | |

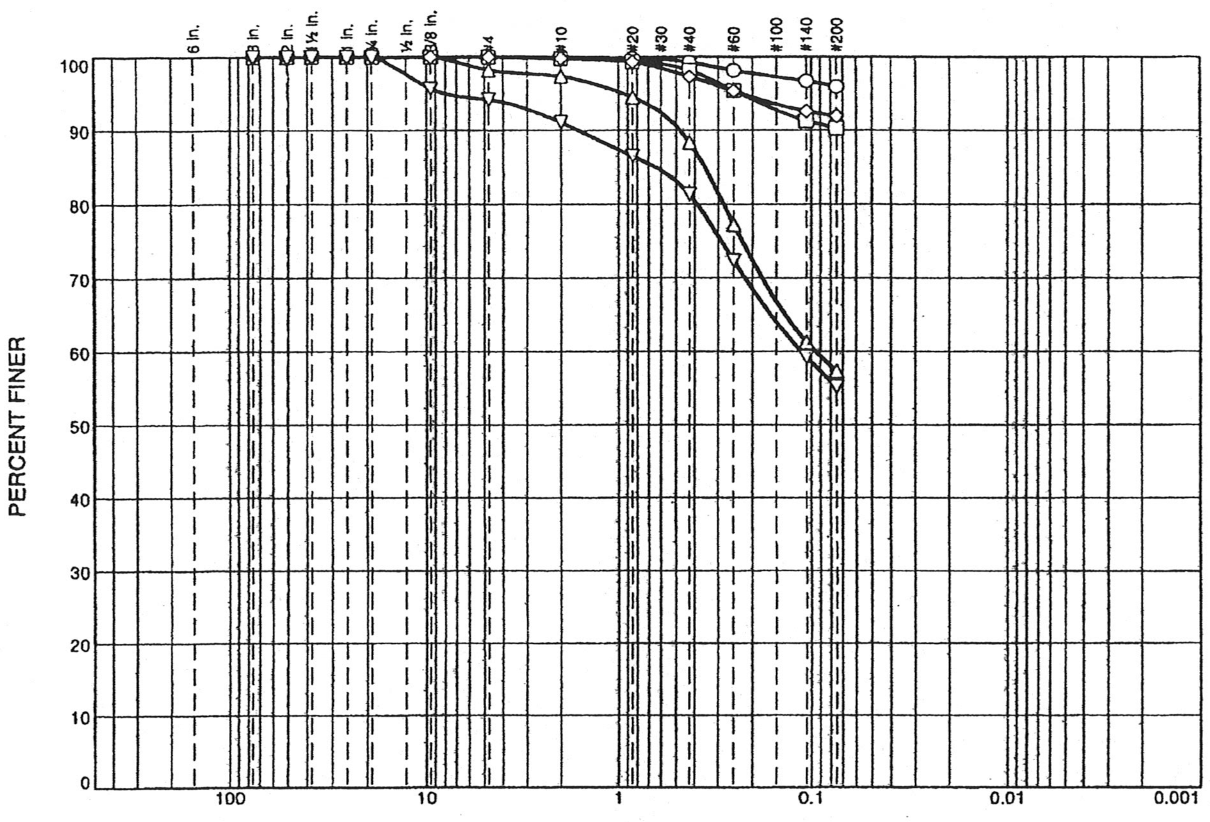



**Liquid Limit=** 29.2
**Plastic Limit=** 22.3
**Plasticity Index=** 6.9

## Plastic Limit Data

| Run No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| | | | | |
| Wet+Tare | 22.43 | 22.01 | | |
| Dry+Tare | 21.25 | 20.90 | | |
| Tare | 15.98 | 15.88 | | |
| Moisture | 22.4 | 22.1 | | |

# Particle Size Distribution Report




| | % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|---|
| | | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| ○ | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 3.3 | 96.0 | |
| □ | 0.0 | 0.0 | 0.0 | 0.2 | 1.6 | 7.9 | 90.3 | |
| △ | 0.0 | 0.0 | 1.8 | 0.8 | 9.0 | 31.1 | 57.3 | |
| ◇ | 0.0 | 0.0 | 0.0 | 0.2 | 2.5 | 5.4 | 91.9 | |
| ▽ | 0.0 | 0.0 | 5.8 | 3.1 | 9.8 | 26.1 | 55.2 | |

## SOIL DATA

| SYMBOL | SOURCE | SAMPLE NO. | DEPTH (ft.) | Material Description | USCS |
|---|---|---|---|---|---|
| ○ | | B-2 SS-6 | 13.5-15.0 | Brn. & gray silt. | |
| □ | | B-4 ST-6 | 13.0-15.0 | Brn. & gray vf. sandy silt. | |
| △ | | B-4 SS-7 | 18.5-20.0 | Gray & brn. silt / so. vf. sand & (tr. clay). | |
| ◇ | | B-6 ST-6 | 13.0-15.0 | Brn. & gray vf. sandy silt - organic. | |
| ▽ | | B-6 ST-8 | 23.0-25.0 | Gray silty f.-m. sand / (tr. c. sand). | |

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**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project No.:** 03S5010 5000 **Plate**

**Tested By:** Rin **Checked By:** JCC

# GRAIN SIZE DISTRIBUTION TEST DATA

3/16/2006

**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000
**Depth:** 13.5-15.0
**Sample Number:** B-2 SS-6
**Material Description:** Brn. & gray silt.
**Tested by:** Rin
**Checked by:** JCC

## Sieve Test Data

| Dry Sample and Tare (grams) | Tare (grams) | Cumulative Pan Tare Weight (grams) | Sieve Opening Size | Cumulative Weight Retained (grams) | Percent Finer |
|---|---|---|---|---|---|
| 37.95 | 0.00 | 0.00 | 3 | 0.00 | 100.0 |
| | | | 2 | 0.00 | 100.0 |
| | | | 1.5 | 0.00 | 100.0 |
| | | | 1 | 0.00 | 100.0 |
| | | | .75 | 0.00 | 100.0 |
| | | | .375 | 0.00 | 100.0 |
| | | | #4 | 0.00 | 100.0 |
| | | | #10 | 0.00 | 100.0 |
| | | | #20 | 0.07 | 99.8 |
| | | | #40 | 0.28 | 99.3 |
| | | | #60 | 0.68 | 98.2 |
| | | | #140 | 1.25 | 96.7 |
| | | | #200 | 1.53 | 96.0 |

## Fractional Components

| Cobbles | Gravel | | | Sand | | | | Fines | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Total | Coarse | Medium | Fine | Total | Silt | Clay | Total |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 3.3 | 4.0 | | | 96.0 |

| $D_{10}$ | $D_{15}$ | $D_{20}$ | $D_{30}$ | $D_{50}$ | $D_{60}$ | $D_{80}$ | $D_{85}$ | $D_{90}$ | $D_{95}$ |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

| Fineness Modulus |
|---|
| 0.05 |

# GRAIN SIZE DISTRIBUTION TEST DATA

3/16/2006

**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000
**Depth:** 13.0-15.0 **Sample Number:** B-4 ST-6
**Material Description:** Brn. & gray vf. sandy silt.
**Tested by:** Rin **Checked by:** JCC

## Sieve Test Data

| Dry Sample and Tare (grams) | Tare (grams) | Cumulative Pan Tare Weight (grams) | Sieve Opening Size | Cumulative Weight Retained (grams) | Percent Finer |
|---|---|---|---|---|---|
| 343.54 | 0.00 | 0.00 | 3 | 0.00 | 100.0 |
| | | | 2 | 0.00 | 100.0 |
| | | | 1.5 | 0.00 | 100.0 |
| | | | 1 | 0.00 | 100.0 |
| | | | .75 | 0.00 | 100.0 |
| | | | .375 | 0.00 | 100.0 |
| | | | #4 | 0.00 | 100.0 |
| | | | #10 | 0.72 | 99.8 |
| | | | #20 | 2.21 | 99.4 |
| | | | #40 | 6.22 | 98.2 |
| | | | #60 | 15.73 | 95.4 |
| | | | #140 | 29.78 | 91.3 |
| | | | #200 | 33.29 | 90.3 |

## Fractional Components

| Cobbles | Gravel | | | Sand | | | | Fines | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Total | Coarse | Medium | Fine | Total | Silt | Clay | Total |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 1.6 | 7.9 | 9.7 | | | 90.3 |

| $D_{10}$ | $D_{15}$ | $D_{20}$ | $D_{30}$ | $D_{50}$ | $D_{60}$ | $D_{80}$ | $D_{85}$ | $D_{90}$ | $D_{95}$ |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 0.2322 |

| Fineness Modulus |
|---|
| 0.12 |

## GRAIN SIZE DISTRIBUTION TEST DATA

3/16/2006

**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000
**Depth:** 18.5-20.0 **Sample Number:** B-4 SS-7
**Material Description:** Gray & brn. silt / so. vf. sand & (tr. clay).
**Tested by:** Rin **Checked by:** JCC

### Sieve Test Data

| Dry Sample and Tare (grams) | Tare (grams) | Cumulative Pan Tare Weight (grams) | Sieve Opening Size | Cumulative Weight Retained (grams) | Percent Finer |
|---|---|---|---|---|---|
| 54.13 | 0.00 | 0.00 | 3 | 0.00 | 100.0 |
| | | | 2 | 0.00 | 100.0 |
| | | | 1.5 | 0.00 | 100.0 |
| | | | 1 | 0.00 | 100.0 |
| | | | .75 | 0.00 | 100.0 |
| | | | .375 | 0.00 | 100.0 |
| | | | #4 | 0.95 | 98.2 |
| | | | #10 | 1.42 | 97.4 |
| | | | #20 | 2.99 | 94.5 |
| | | | #40 | 6.28 | 88.4 |
| | | | #60 | 12.31 | 77.3 |
| | | | #140 | 20.96 | 61.3 |
| | | | #200 | 23.09 | 57.3 |

### Fractional Components

| Cobbles | Gravel | | | Sand | | | | Fines | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Total | Coarse | Medium | Fine | Total | Silt | Clay | Total |
| 0.0 | 0.0 | 1.8 | 1.8 | 0.8 | 9.0 | 31.1 | 40.9 | | | 57.3 |

| $D_{10}$ | $D_{15}$ | $D_{20}$ | $D_{30}$ | $D_{50}$ | $D_{60}$ | $D_{80}$ | $D_{85}$ | $D_{90}$ | $D_{95}$ |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0.0957 | 0.2819 | 0.3538 | 0.4747 | 0.9524 |

| Fineness Modulus |
|---|
| 0.68 |

## GRAIN SIZE DISTRIBUTION TEST DATA

3/16/2006

**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000
**Depth:** 13.0-15.0 **Sample Number:** B-6 ST-6
**Material Description:** Brn. & gray vf. sandy silt - organic.
**Tested by:** Rin **Checked by:** JCC

### Sieve Test Data

| Dry Sample and Tare (grams) | Tare (grams) | Cumulative Pan Tare Weight (grams) | Sieve Opening Size | Cumulative Weight Retained (grams) | Percent Finer |
|---|---|---|---|---|---|
| 269.36 | 0.00 | 0.00 | 3 | 0.00 | 100.0 |
| | | | 2 | 0.00 | 100.0 |
| | | | 1.5 | 0.00 | 100.0 |
| | | | 1 | 0.00 | 100.0 |
| | | | .75 | 0.00 | 100.0 |
| | | | .375 | 0.00 | 100.0 |
| | | | #4 | 0.00 | 100.0 |
| | | | #10 | 0.49 | 99.8 |
| | | | #20 | 1.90 | 99.3 |
| | | | #40 | 7.26 | 97.3 |
| | | | #60 | 12.53 | 95.3 |
| | | | #140 | 19.98 | 92.6 |
| | | | #200 | 21.74 | 91.9 |

### Fractional Components

| Cobbles | Gravel | | | Sand | | | | Fines | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Total | Coarse | Medium | Fine | Total | Silt | Clay | Total |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 2.5 | 5.4 | 8.1 | | | 91.9 |

| $D_{10}$ | $D_{15}$ | $D_{20}$ | $D_{30}$ | $D_{50}$ | $D_{60}$ | $D_{80}$ | $D_{85}$ | $D_{90}$ | $D_{95}$ |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 0.2277 |

| Fineness Modulus |
|---|
| 0.12 |

# GRAIN SIZE DISTRIBUTION TEST DATA

3/16/2006

**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000
**Depth:** 23.0-25.0 **Sample Number:** B-6 ST-8
**Material Description:** Gray silty f.-m. sand / (tr. c. sand).
**Tested by:** Rin **Checked by:** JCC

## Sieve Test Data

| Dry Sample and Tare (grams) | Tare (grams) | Cumulative Pan Tare Weight (grams) | Sieve Opening Size | Cumulative Weight Retained (grams) | Percent Finer |
|---|---|---|---|---|---|
| 478.86 | 0.00 | 0.00 | 3 | 0.00 | 100.0 |
| | | | 2 | 0.00 | 100.0 |
| | | | 1.5 | 0.00 | 100.0 |
| | | | 1 | 0.00 | 100.0 |
| | | | .75 | 0.00 | 100.0 |
| | | | .375 | 20.86 | 95.6 |
| | | | #4 | 27.94 | 94.2 |
| | | | #10 | 42.57 | 91.1 |
| | | | #20 | 64.61 | 86.5 |
| | | | #40 | 89.54 | 81.3 |
| | | | #60 | 132.38 | 72.4 |
| | | | #140 | 195.21 | 59.2 |
| | | | #200 | 214.64 | 55.2 |

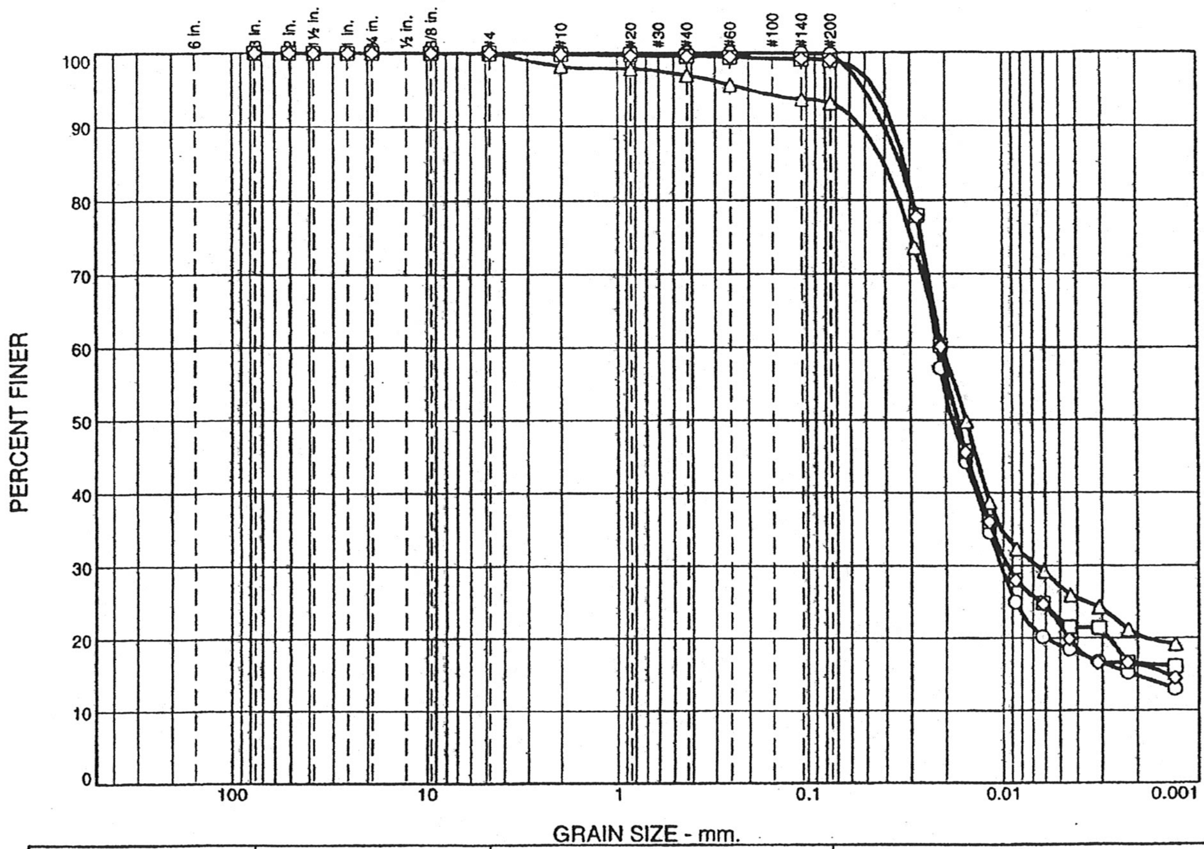
## Fractional Components

| Cobbles | Gravel | | | Sand | | | | Fines | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Total | Coarse | Medium | Fine | Total | Silt | Clay | Total |
| 0.0 | 0.0 | 5.8 | 5.8 | 3.1 | 9.8 | 26.1 | 39.0 | | | 55.2 |

| $D_{10}$ | $D_{15}$ | $D_{20}$ | $D_{30}$ | $D_{50}$ | $D_{60}$ | $D_{80}$ | $D_{85}$ | $D_{90}$ | $D_{95}$ |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0.1126 | 0.3875 | 0.6410 | 1.6174 | 8.1744 |

| Fineness Modulus |
|---|
| 1.06 |

# Particle Size Distribution Report




| | % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|---|
| | | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| O | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.2 | 80.8 | 18.9 |
| □ | 0.0 | 0.0 | 0.0 | 0.2 | 0.3 | 0.6 | 76.5 | 22.4 |
| Δ | 0.0 | 0.0 | 0.1 | 1.8 | 1.2 | 3.8 | 66.0 | 27.1 |
| ◇ | 0.0 | 0.0 | 0.0 | 0.2 | 0.3 | 0.5 | 77.3 | 21.7 |
| | | | | | | | | |

## SOIL DATA

| SYMBOL | SOURCE | SAMPLE NO. | DEPTH (ft.) | Material Description | USCS |
|---|---|---|---|---|---|
| O | | Bag B-3 | 1.0-10.0 | Yel. brn. vf. sandy silt. | |
| □ | | Bag B-4 | 1.0-10.0 | Yel. brn. vf. sandy silt. | |
| Δ | | Bag B-5 | 1.0-10.0 | Yel. brn. vf. sandy silt / so. clay. | |
| ◇ | | Bag B-6 | 1.0-10.0 | Yel. brn. vf. sandy silt (tr. clay). | |
| | | | | | |

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Hanson Professional Services Inc.

**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond

**Project No.:** 03S5010 5000 **Plate**

**Tested By:** Rin **Checked By:** JCC

## GRAIN SIZE DISTRIBUTION TEST DATA

3/16/2006

**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000
**Depth:** 1.0-10.0 **Sample Number:** Bag B-3
**Material Description:** Yel. brn. vf. sandy silt.
**Tested by:** Rin **Checked by:** JCC

### Sieve Test Data

| Dry Sample and Tare (grams) | Tare (grams) | Cumulative Pan Tare Weight (grams) | Sieve Opening Size | Cumulative Weight Retained (grams) | Percent Finer |
|---|---|---|---|---|---|
| 491.25 | 0.00 | 0.00 | 3 | 0.00 | 100.0 |
| | | | 2 | 0.00 | 100.0 |
| | | | 1.5 | 0.00 | 100.0 |
| | | | 1 | 0.00 | 100.0 |
| | | | .75 | 0.00 | 100.0 |
| | | | .375 | 0.00 | 100.0 |
| | | | #4 | 0.00 | 100.0 |
| | | | #10 | 0.17 | 100.0 |
| 49.42 | 0.00 | 0.00 | #20 | 0.01 | 99.9 |
| | | | #40 | 0.02 | 99.9 |
| | | | #60 | 0.03 | 99.9 |
| | | | #140 | 0.07 | 99.8 |
| | | | #200 | 0.11 | 99.7 |

### Hydrometer Test Data

**Hydrometer test uses material passing #10**
**Percent passing #10 based upon complete sample =** 100.0
**Weight of hydrometer sample =**50
**Hygroscopic moisture correction:**
**Moist weight and tare =** 50.58
**Dry weight and tare =** 50.18
**Tare weight =** 15.80
**Hygroscopic moisture =** 1.2%
**Table of composite correction values:**

| | | |
|---|---|---|
| **Temp., deg. C:** | 18.0 | 28.0 |
| **Comp. corr.:** | -3.7 | -1.8 |

**Meniscus correction only =** 0.0
**Specific gravity of solids =** 2.7
**Hydrometer type =** 151H
**Hydrometer effective depth equation: L =** 16.294964 - 0.2645 x Rm

| Elapsed Time (min.) | Temp. (deg. C.) | Actual Reading | Corrected Reading | K | Rm | Eff. Depth | Diameter (mm.) | Percent Finer |
|---|---|---|---|---|---|---|---|---|
| 2.00 | 23.2 | 1.0270 | 1.0243 | 0.0129 | 27.0 | 9.2 | 0.0277 | 78.0 |
| 4.00 | 23.2 | 1.0205 | 1.0178 | 0.0129 | 20.5 | 10.9 | 0.0213 | 57.1 |
| 8.00 | 23.2 | 1.0165 | 1.0138 | 0.0129 | 16.5 | 11.9 | 0.0158 | 44.3 |
| 15.00 | 23.2 | 1.0135 | 1.0108 | 0.0129 | 13.5 | 12.7 | 0.0119 | 34.7 |
| 30.00 | 23.1 | 1.0105 | 1.0078 | 0.0129 | 10.5 | 13.5 | 0.0087 | 25.0 |
| 60.00 | 23.1 | 1.0090 | 1.0063 | 0.0129 | 9.0 | 13.9 | 0.0062 | 20.1 |
| 120.00 | 22.9 | 1.0085 | 1.0057 | 0.0130 | 8.5 | 14.0 | 0.0044 | 18.4 |
| 240.00 | 22.7 | 1.0080 | 1.0052 | 0.0130 | 8.0 | 14.2 | 0.0032 | 16.7 |
| 480.00 | 22.9 | 1.0075 | 1.0047 | 0.0130 | 7.5 | 14.3 | 0.0022 | 15.2 |
| 1440.00 | 21.8 | 1.0070 | 1.0040 | 0.0131 | 7.0 | 14.4 | 0.0013 | 12.9 |

## Fractional Components

| Cobbles | Gravel | | | Sand | | | | Fines | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Total | Coarse | Medium | Fine | Total | Silt | Clay | Total |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.2 | 0.3 | 80.8 | 18.9 | 99.7 |

| $D_{10}$ | $D_{15}$ | $D_{20}$ | $D_{30}$ | $D_{50}$ | $D_{60}$ | $D_{80}$ | $D_{85}$ | $D_{90}$ | $D_{95}$ |
|---|---|---|---|---|---|---|---|---|---|
| | 0.0021 | 0.0061 | 0.0104 | 0.0186 | 0.0222 | 0.0292 | 0.0339 | 0.0404 | 0.0506 |

| Fineness Modulus |
|---|
| 0.00 |

## GRAIN SIZE DISTRIBUTION TEST DATA

3/16/2006

**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000
**Depth:** 1.0-10.0 **Sample Number:** Bag B-4
**Material Description:** Yel. brn. vf. sandy silt.
**Tested by:** Rin **Checked by:** JCC

### Sieve Test Data

| Dry Sample and Tare (grams) | Tare (grams) | Cumulative Pan Tare Weight (grams) | Sieve Opening Size | Cumulative Weight Retained (grams) | Percent Finer |
|---|---|---|---|---|---|
| 425.15 | 0.00 | 0.00 | 3 | 0.00 | 100.0 |
| | | | 2 | 0.00 | 100.0 |
| | | | 1.5 | 0.00 | 100.0 |
| | | | 1 | 0.00 | 100.0 |
| | | | .75 | 0.00 | 100.0 |
| | | | .375 | 0.00 | 100.0 |
| | | | #4 | 0.00 | 100.0 |
| | | | #10 | 0.91 | 99.8 |
| 49.31 | 0.00 | 0.00 | #20 | 0.03 | 99.7 |
| | | | #40 | 0.14 | 99.5 |
| | | | #60 | 0.23 | 99.3 |
| | | | #140 | 0.37 | 99.0 |
| | | | #200 | 0.42 | 98.9 |

### Hydrometer Test Data

**Hydrometer test uses material passing #10**
**Percent passing #10 based upon complete sample =** 99.8
**Weight of hydrometer sample =**50
**Hygroscopic moisture correction:**
**Moist weight and tare =** 45.90
**Dry weight and tare =** 45.48
**Tare weight =** 15.69
**Hygroscopic moisture =** 1.4%
**Table of composite correction values:**
**Temp., deg. C:** 18.0 28.0
**Comp. corr.:** -3.2 -1.4
**Meniscus correction only =** 0.0
**Specific gravity of solids =** 2.7
**Hydrometer type =** 151H
**Hydrometer effective depth equation: L =** 16.294964 **- 0.2645 x Rm**

| Elapsed Time (min.) | Temp. (deg. C.) | Actual Reading | Corrected Reading | K | Rm | Eff. Depth | Diameter (mm.) | Percent Finer |
|---|---|---|---|---|---|---|---|---|
| 2.00 | 23.2 | 1.0265 | 1.0242 | 0.0129 | 26.5 | 9.3 | 0.0279 | 77.9 |
| 4.00 | 23.2 | 1.0210 | 1.0187 | 0.0129 | 21.0 | 10.7 | 0.0212 | 60.2 |
| 8.00 | 23.2 | 1.0165 | 1.0142 | 0.0129 | 16.5 | 11.9 | 0.0158 | 45.8 |
| 15.00 | 23.1 | 1.0135 | 1.0112 | 0.0129 | 13.5 | 12.7 | 0.0119 | 36.1 |
| 30.00 | 23.1 | 1.0110 | 1.0087 | 0.0129 | 11.0 | 13.4 | 0.0086 | 28.0 |
| 60.00 | 23.1 | 1.0100 | 1.0077 | 0.0129 | 10.0 | 13.6 | 0.0062 | 24.8 |
| 120.00 | 22.9 | 1.0090 | 1.0067 | 0.0130 | 9.0 | 13.9 | 0.0044 | 21.5 |
| 240.00 | 22.7 | 1.0090 | 1.0066 | 0.0130 | 9.0 | 13.9 | 0.0031 | 21.4 |
| 480.00 | 22.8 | 1.0075 | 1.0052 | 0.0130 | 7.5 | 14.3 | 0.0022 | 16.6 |
| 1440.00 | 21.8 | 1.0075 | 1.0050 | 0.0131 | 7.5 | 14.3 | 0.0013 | 16.0 |

## Fractional Components

| Cobbles | Gravel | | | Sand | | | | Fines | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Total | Coarse | Medium | Fine | Total | Silt | Clay | Total |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.3 | 0.6 | 1.1 | 76.5 | 22.4 | 98.9 |

| $D_{10}$ | $D_{15}$ | $D_{20}$ | $D_{30}$ | $D_{50}$ | $D_{60}$ | $D_{80}$ | $D_{85}$ | $D_{90}$ | $D_{95}$ |
|---|---|---|---|---|---|---|---|---|---|
| | | 0.0028 | 0.0096 | 0.0174 | 0.0211 | 0.0289 | 0.0320 | 0.0364 | 0.0442 |

| Fineness Modulus |
|---|
| 0.02 |

# GRAIN SIZE DISTRIBUTION TEST DATA

3/16/2006

**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000
**Depth:** 1.0-10.0 **Sample Number:** Bag B-5
**Material Description:** Yel. brn. vf. sandy silt / so. clay.
**Tested by:** Rin **Checked by:** JCC

## Sieve Test Data

| Dry Sample and Tare (grams) | Tare (grams) | Cumulative Pan Tare Weight (grams) | Sieve Opening Size | Cumulative Weight Retained (grams) | Percent Finer |
|---|---|---|---|---|---|
| 455.56 | 0.00 | 0.00 | 3 | 0.00 | 100.0 |
| | | | 2 | 0.00 | 100.0 |
| | | | 1.5 | 0.00 | 100.0 |
| | | | 1 | 0.00 | 100.0 |
| | | | .75 | 0.00 | 100.0 |
| | | | .375 | 0.00 | 100.0 |
| | | | #4 | 0.63 | 99.9 |
| | | | #10 | 8.44 | 98.1 |
| 49.21 | 0.00 | 0.00 | #20 | 0.17 | 97.8 |
| | | | #40 | 0.63 | 96.9 |
| | | | #60 | 1.31 | 95.5 |
| | | | #140 | 2.28 | 93.6 |
| | | | #200 | 2.51 | 93.1 |

## Hydrometer Test Data

**Hydrometer test uses material passing #10**
**Percent passing #10 based upon complete sample =** 98.1
**Weight of hydrometer sample =**50
**Hygroscopic moisture correction:**
**Moist weight and tare =** 38.95
**Dry weight and tare =** 38.59
**Tare weight =** 16.29
**Hygroscopic moisture =** 1.6%
**Table of composite correction values:**

| | | |
|---|---|---|
| Temp., deg. C: | 18.0 | 28.0 |
| Comp. corr.: | -2.5 | -1.1 |

**Meniscus correction only =** 0.0
**Specific gravity of solids =** 2.7
**Hydrometer type =** 151H
**Hydrometer effective depth equation:** L = 16.294964 - 0.2645 x Rm

| Elapsed Time (min.) | Temp. (deg. C.) | Actual Reading | Corrected Reading | K | Rm | Eff. Depth | Diameter (mm.) | Percent Finer |
|---|---|---|---|---|---|---|---|---|
| 2.00 | 23.2 | 1.0250 | 1.0232 | 0.0129 | 25.0 | 9.7 | 0.0284 | 73.6 |
| 4.00 | 23.2 | 1.0210 | 1.0192 | 0.0129 | 21.0 | 10.7 | 0.0212 | 60.9 |
| 8.00 | 23.2 | 1.0175 | 1.0157 | 0.0129 | 17.5 | 11.7 | 0.0156 | 49.8 |
| 15.00 | 23.1 | 1.0140 | 1.0122 | 0.0129 | 14.0 | 12.6 | 0.0119 | 38.7 |
| 30.00 | 23.1 | 1.0120 | 1.0102 | 0.0129 | 12.0 | 13.1 | 0.0086 | 32.4 |
| 60.00 | 23.1 | 1.0110 | 1.0092 | 0.0129 | 11.0 | 13.4 | 0.0061 | 29.2 |
| 120.00 | 22.9 | 1.0100 | 1.0082 | 0.0130 | 10.0 | 13.6 | 0.0044 | 25.9 |
| 240.00 | 22.7 | 1.0095 | 1.0077 | 0.0130 | 9.5 | 13.8 | 0.0031 | 24.3 |
| 480.00 | 22.8 | 1.0085 | 1.0067 | 0.0130 | 8.5 | 14.0 | 0.0022 | 21.1 |
| 1440.00 | 21.8 | 1.0080 | 1.0060 | 0.0131 | 8.0 | 14.2 | 0.0013 | 19.1 |

## Fractional Components

| Cobbles | Gravel | | | Sand | | | | Fines | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Total | Coarse | Medium | Fine | Total | Silt | Clay | Total |
| 0.0 | 0.0 | 0.1 | 0.1 | 1.8 | 1.2 | 3.8 | 6.8 | 66.0 | 27.1 | 93.1 |

| $D_{10}$ | $D_{15}$ | $D_{20}$ | $D_{30}$ | $D_{50}$ | $D_{60}$ | $D_{80}$ | $D_{85}$ | $D_{90}$ | $D_{95}$ |
|---|---|---|---|---|---|---|---|---|---|
| | | 0.0019 | 0.0067 | 0.0157 | 0.0207 | 0.0339 | 0.0405 | 0.0525 | 0.2082 |

| Fineness Modulus |
|---|
| 0.16 |

# GRAIN SIZE DISTRIBUTION TEST DATA

3/16/2006

**Client:** Sargent & Lundy
**Project:** Duck Creek Ash Pond
**Project Number:** 03S5010 5000
**Depth:** 1.0-10.0 **Sample Number:** Bag B-6
**Material Description:** Yel. brn. vf. sandy silt (tr. clay).
**Tested by:** Rin **Checked by:** JCC

## Sieve Test Data

| Dry Sample and Tare (grams) | Tare (grams) | Cumulative Pan Tare Weight (grams) | Sieve Opening Size | Cumulative Weight Retained (grams) | Percent Finer |
|---|---|---|---|---|---|
| 427.84 | 0.00 | 0.00 | 3 | 0.00 | 100.0 |
| | | | 2 | 0.00 | 100.0 |
| | | | 1.5 | 0.00 | 100.0 |
| | | | 1 | 0.00 | 100.0 |
| | | | .75 | 0.00 | 100.0 |
| | | | .375 | 0.00 | 100.0 |
| | | | #4 | 0.00 | 100.0 |
| | | | #10 | 0.84 | 99.8 |
| 49.41 | 0.00 | 0.00 | #20 | 0.11 | 99.6 |
| | | | #40 | 0.17 | 99.5 |
| | | | #60 | 0.23 | 99.3 |
| | | | #140 | 0.36 | 99.1 |
| | | | #200 | 0.42 | 99.0 |

## Hydrometer Test Data

**Hydrometer test uses material passing #10**
**Percent passing #10 based upon complete sample** = 99.8
**Weight of hydrometer sample** =50
**Hygroscopic moisture correction:**
**Moist weight and tare** = 50.77
**Dry weight and tare** = 50.36
**Tare weight** = 15.54
**Hygroscopic moisture** = 1.2%
**Table of composite correction values:**

| | | |
|---|---|---|
| **Temp., deg. C:** | 18.0 | 28.0 |
| **Comp. corr.:** | -3.2 | -1.4 |

**Meniscus correction only** = 0.0
**Specific gravity of solids** = 2.7
**Hydrometer type** = 151H
**Hydrometer effective depth equation:** L = 16.294964 - 0.2645 x Rm

| Elapsed Time (min.) | Temp. (deg. C.) | Actual Reading | Corrected Reading | K | Rm | Eff. Depth | Diameter (mm.) | Percent Finer |
|---|---|---|---|---|---|---|---|---|
| 2.00 | 23.2 | 1.0265 | 1.0242 | 0.0129 | 26.5 | 9.3 | 0.0279 | 77.7 |
| 4.00 | 23.2 | 1.0210 | 1.0187 | 0.0129 | 21.0 | 10.7 | 0.0212 | 60.1 |
| 8.00 | 23.1 | 1.0165 | 1.0142 | 0.0129 | 16.5 | 11.9 | 0.0158 | 45.6 |
| 15.00 | 23.2 | 1.0135 | 1.0112 | 0.0129 | 13.5 | 12.7 | 0.0119 | 36.0 |
| 30.00 | 23.1 | 1.0110 | 1.0087 | 0.0129 | 11.0 | 13.4 | 0.0086 | 28.0 |
| 60.00 | 23.0 | 1.0100 | 1.0077 | 0.0130 | 10.0 | 13.6 | 0.0062 | 24.7 |
| 120.00 | 22.9 | 1.0085 | 1.0062 | 0.0130 | 8.5 | 14.0 | 0.0044 | 19.8 |
| 240.00 | 22.7 | 1.0075 | 1.0051 | 0.0130 | 7.5 | 14.3 | 0.0032 | 16.5 |
| 480.00 | 22.8 | 1.0075 | 1.0052 | 0.0130 | 7.5 | 14.3 | 0.0022 | 16.6 |
| 1440.00 | 21.8 | 1.0070 | 1.0045 | 0.0131 | 7.0 | 14.4 | 0.0013 | 14.4 |

## Fractional Components

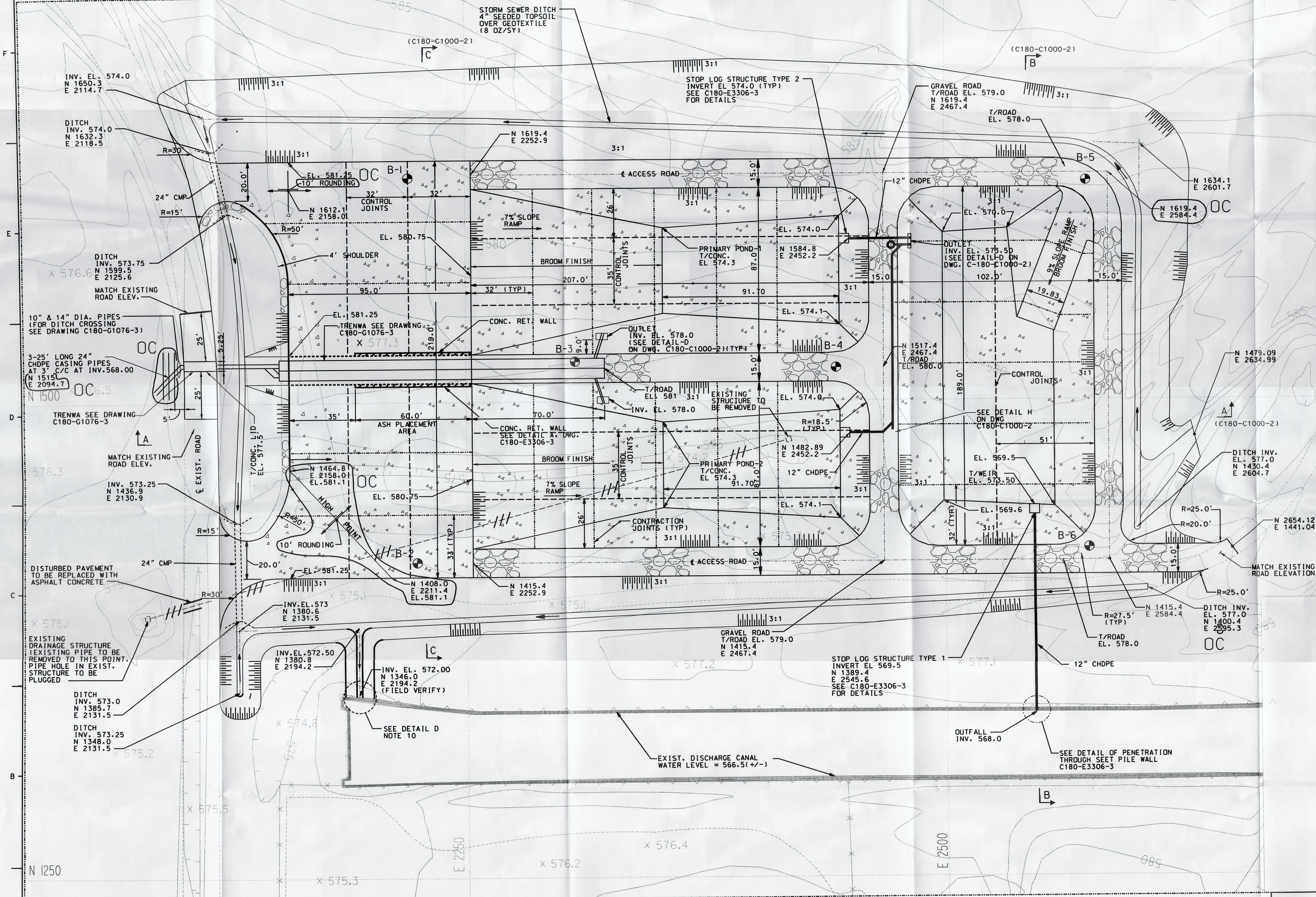
| Cobbles | Gravel | | | Sand | | | | Fines | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Total | Coarse | Medium | Fine | Total | Silt | Clay | Total |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.3 | 0.5 | 1.0 | 77.3 | 21.7 | 99.0 |

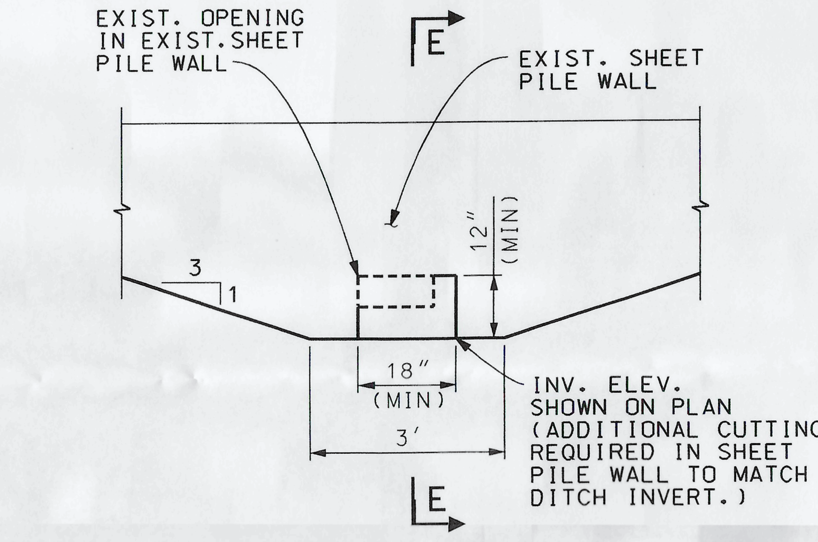
| $D_{10}$ | $D_{15}$ | $D_{20}$ | $D_{30}$ | $D_{50}$ | $D_{60}$ | $D_{80}$ | $D_{85}$ | $D_{90}$ | $D_{95}$ |
|---|---|---|---|---|---|---|---|---|---|
| | 0.0015 | 0.0045 | 0.0096 | 0.0175 | 0.0212 | 0.0290 | 0.0321 | 0.0366 | 0.0445 |

| Fineness Modulus |
|---|
| 0.02 |

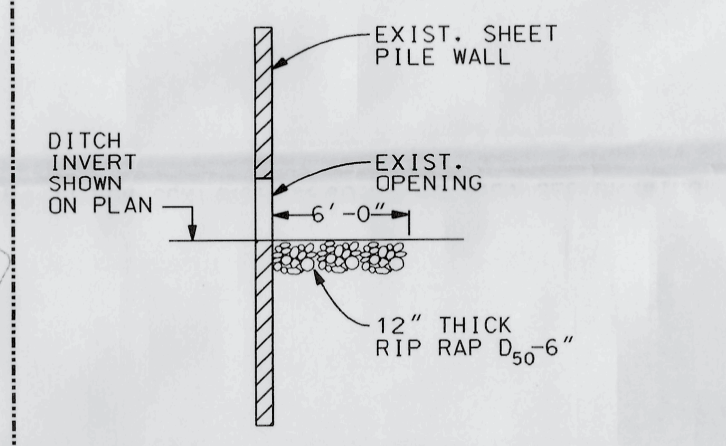
**APPENDIX B**

# Bottom Ash Basin Design Drawings




DETAIL D
N.T.S.




SECTION E
N.T.S.

| Symbol | Legend |
|---|---|
| | GRAVEL ROADS |
| | CONCRETE |
| | BORE HOLE |
| | CONTRACTION JOINT |
| | CONTROL JOINT |

1. ALL WORK DONE BY CONTRACTOR/INSTALLER PURSUANT TO THIS DRAWING SHALL: (A) CONFORM TO THE GOVERNING CONTRACT DOCUMENTS; (B) BE PERFORMED EXCLUSIVELY BY ITS TRAINED, COMPETENT PERSONNEL OR, WHERE PERMITTED, THAT OF ITS SUBCONTRACTOR(S); AND (C) COMPLY WITH ALL APPLICABLE SAFETY LAWS, REGULATIONS, PROGRAMS AND PRACTICES TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING THE CONTRACTOR'S/INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S)) PERFORMING THE WORK.
2. UNDERGROUND OR EMBEDDED UTILITIES MAY BE LOCATED WITHIN OR ADJACENT TO THE AREA IN WHICH EXCAVATION, DEMOLITION, FOUNDATION, OR MODIFICATION WORK IS TO BE PERFORMED.
3. REFERENCES RELATING TO THE UNDERGROUND OR EMBEDDED UTILITIES ARE PROVIDED TO ASSIST THE CONTRACTOR/INSTALLER IN THE FIELD LOCATING THOSE UTILITIES AND OTHER POSSIBLE UNDERGROUND OR EMBEDDED INTERFERENCES WITH THE WORK.
4. THE CONTRACTOR/INSTALLER SHALL EXERCISE DUE CAUTION DURING ALL EXCAVATION/FOUNDATION/DEMOLITION WORK.
5. CONTRACTOR/INSTALLER SHALL TAKE ALL APPROPRIATE PRECAUTIONS TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING CONTRACTOR'S/INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S)) PERFORMING THE WORK.
6. FOR PIPING DETAILS SEE DRAWINGS C180-G1902 SHEET 2 AND C180-G1076 SHEET 3/4.
7. FOR CONTRACTION JOINT DETAIL. SEE DRAWING C180-E3306-3.
8. FOR BORING LOGS. SEE SPEC. D-1007.
9. FOR CONCRETE NOTES SEE DRAWINGS C180-E3306-2.
10. NEW DRAINAGE DITCH WILL BE DISCHARGING THROUGH THE EXISTING OPENING IN THE SHEET PILE WALL.
11. THE LOCATION OF CONSTRUCTION JOINTS SHALL BE APPROVED BY OWNER BEFORE START OF CONSTRUCTION

FILE NO. C-1000SH1.DGN

20' 0 20' 40'
GRAPHIC SCALE

NORTH

AEC CAD GENERATED
DO NOT REVISE MANUALLY

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

DRAWING RECORD

| REV. | DATE | PREPARED | REVIEWED | APPROVED | DESCRIPTION |
|---|---|---|---|---|---|
| 0A | 04-21-06 | A.S. | S. AHMED | GPW | FOR CLIENT COMMENTS. SPECIFICATION D-1007 |
| 0B | 07-02-07 | A.S. | S. AHMED | GPW | FOR BID. SPEC. D-1007 |
| 0C | 09-21-07 | A.S. | S. AHMED | —— | FOR CONSTRUCTION. SPEC. D-1007 |

SARGENT & LUNDY LLC's
ILLINOIS DEPARTMENT OF PROFESSIONAL REGULATION
REGISTRATION NUMBER IS 184-000106

STATE OF ILLINOIS
GARY WILLIAMS
81-4140
LICENSED STRUCTURAL ENGINEER

SCALE: AS NOTED
PROJECT: 1478-034
DRAFTER: C.FLAMINI
DATE: —

DRAWING TITLE

# BOTTOM ASH AND LOW VOLUME SUMP WATER BASIN AND PIPING BOTTOM ASH BASIN SECTION DUCK CREEK POWER STATION UNIT 1 CANTON, ILLINOIS

DUCK CREEK POWER STATION UNIT NO. —

Ameren Energy
Resources Generating

DRAWING NUMBER: C180-C1000-1
REV.: 0C
SHEET NO. 1


1. ALL WORK DONE BY CONTRACTOR/INSTALLER PURSUANT TO THIS DRAWING SHALL: (A) CONFORM TO THE GOVERNING CONTRACT DOCUMENTS; (B) BE PERFORMED EXCLUSIVELY BY ITS TRAINED, COMPETENT PERSONNEL OR, WHERE PERMITTED, THAT OF ITS SUBCONTRACTOR(S); AND (C) COMPLY WITH ALL APPLICABLE SAFETY LAWS, REGULATIONS, PROGRAMS AND PRACTICES TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING THE CONTRACTOR'S/INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S)) PERFORMING THE WORK.
2. UNDERGROUND OR EMBEDDED UTILITIES MAY BE LOCATED WITHIN OR ADJACENT TO THE AREA IN WHICH EXCAVATION, DEMOLITION, FOUNDATION, OR MODIFICATION WORK IS TO BE PERFORMED.
3. REFERENCES RELATING TO THE UNDERGROUND OR EMBEDDED UTILITIES ARE PROVIDED TO ASSIST THE CONTRACTOR/INSTALLER IN THE FIELD LOCATING THOSE UTILITIES AND OTHER POSSIBLE UNDERGROUND OR EMBEDDED INTERFERENCES WITH THE WORK.
4. THE CONTRACTOR/INSTALLER SHALL EXERCISE DUE CAUTION DURING ALL EXCAVATION/FOUNDATION/DEMOLITION WORK.
5. CONTRACTOR/INSTALLER SHALL TAKE ALL APPROPRIATE PRECAUTIONS TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING CONTRACTOR'S/INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S)) PERFORMING THE WORK.

FILE NO. C-1000SH2.DGN

AEG CAD GENERATED DO NOT REVISE MANUALLY

DRAWING RECORD

| REV. | DATE | PREPARED | REVIEWED | APPROVED | DESCRIPTION |
|---|---|---|---|---|---|
| OA | 04-21-06 | A.S. | S. AHMED | GPW | FOR CLIENT COMMENTS. SPECIFICATION D-1007 |
| OB | 07-02-07 | A.S. | S. AHMED | GPW | FOR BID. SPEC. D-1007 |
| OC | 09-21-07 | RST/ALS | S. AHMED | — | FOR CONSTRUCTION. SPEC. D-1007 |

SARGENT & LUNDY LLC's ILLINOIS DEPARTMENT OF PROFESSIONAL REGULATION REGISTRATION NUMBER IS 184-000106

STATE OF ILLINOIS GARY WILLIAM 81-4140 LICENSED STRUCTURAL ENGINEER

SCALE NONE
PROJECT 1478-034
DRAFTER CF
DATE

DRAWING TITLE

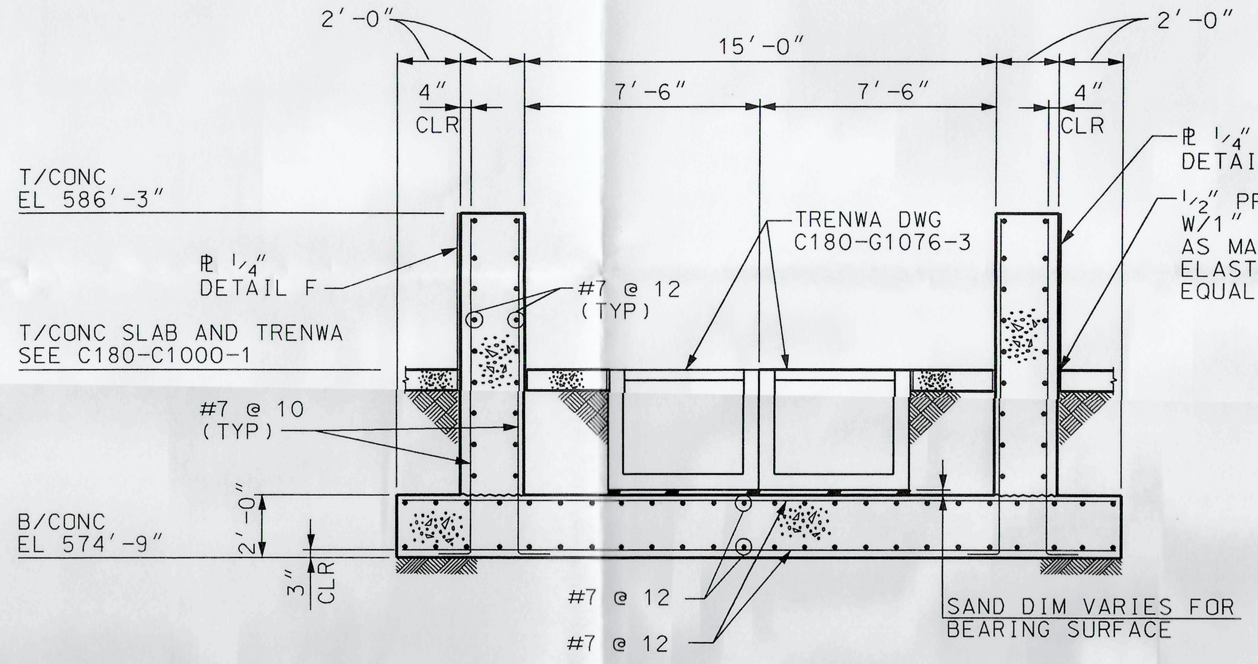
BOTTOM ASH AND LOW VOLUME SUMP WATER BASIN AND PIPING BOTTOM ASH BASIN SECTIONS DUCK CREEK POWER STATION UNIT 1 CANTON, ILLINOIS

DUCK CREEK POWER STATION UNIT NO. –

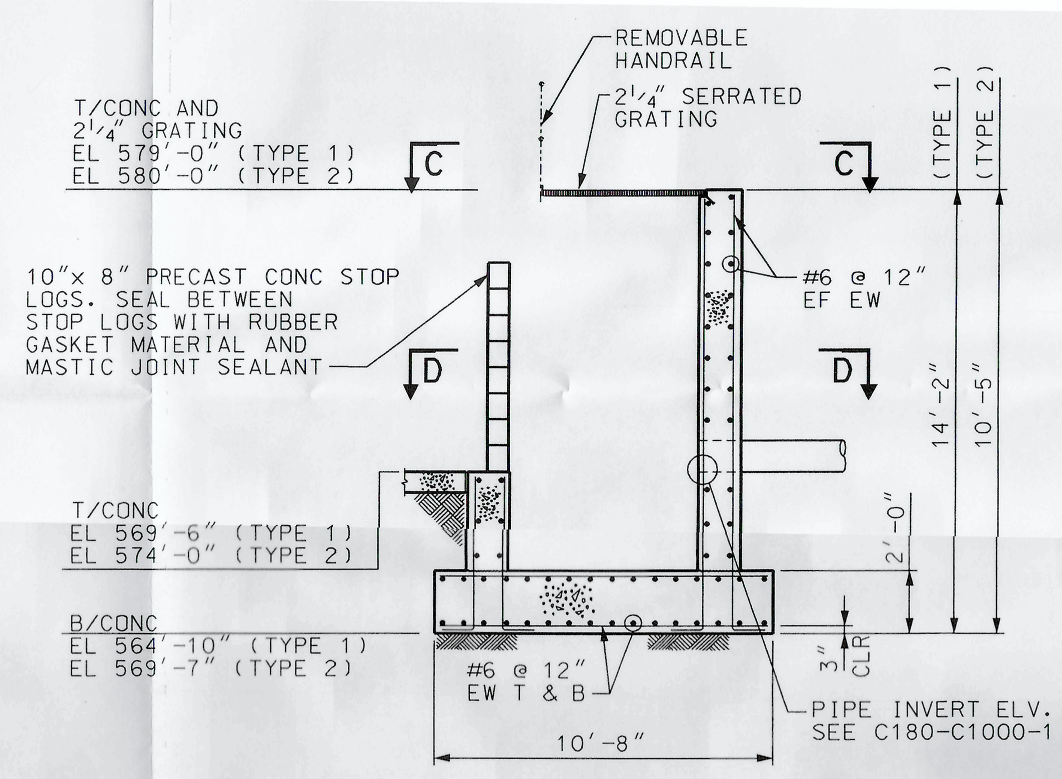
Ameren Energy Resources Generating

DRAWING NUMBER C180-C1000-2 REV. OC
SHEET NO. 2

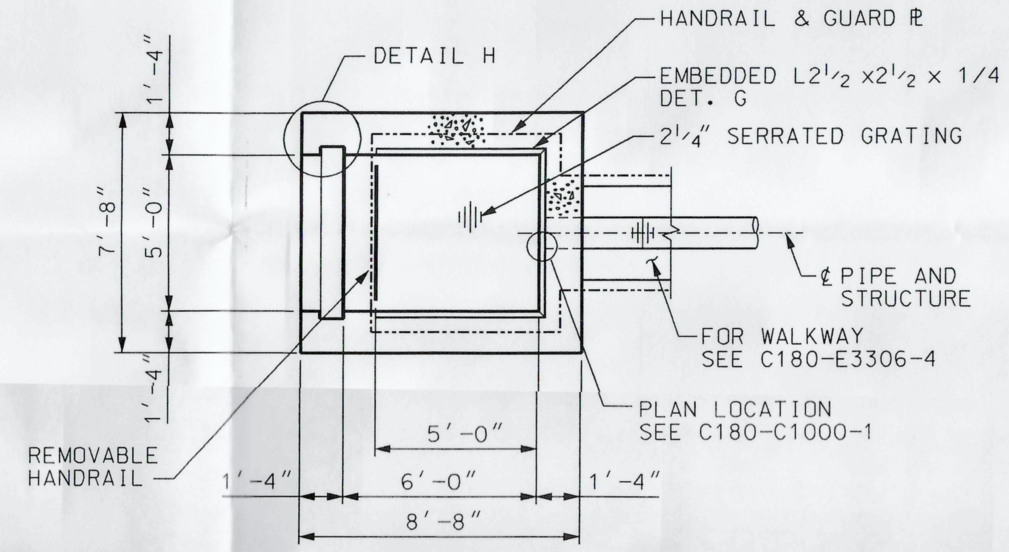
PAGE NO.
E3306-3



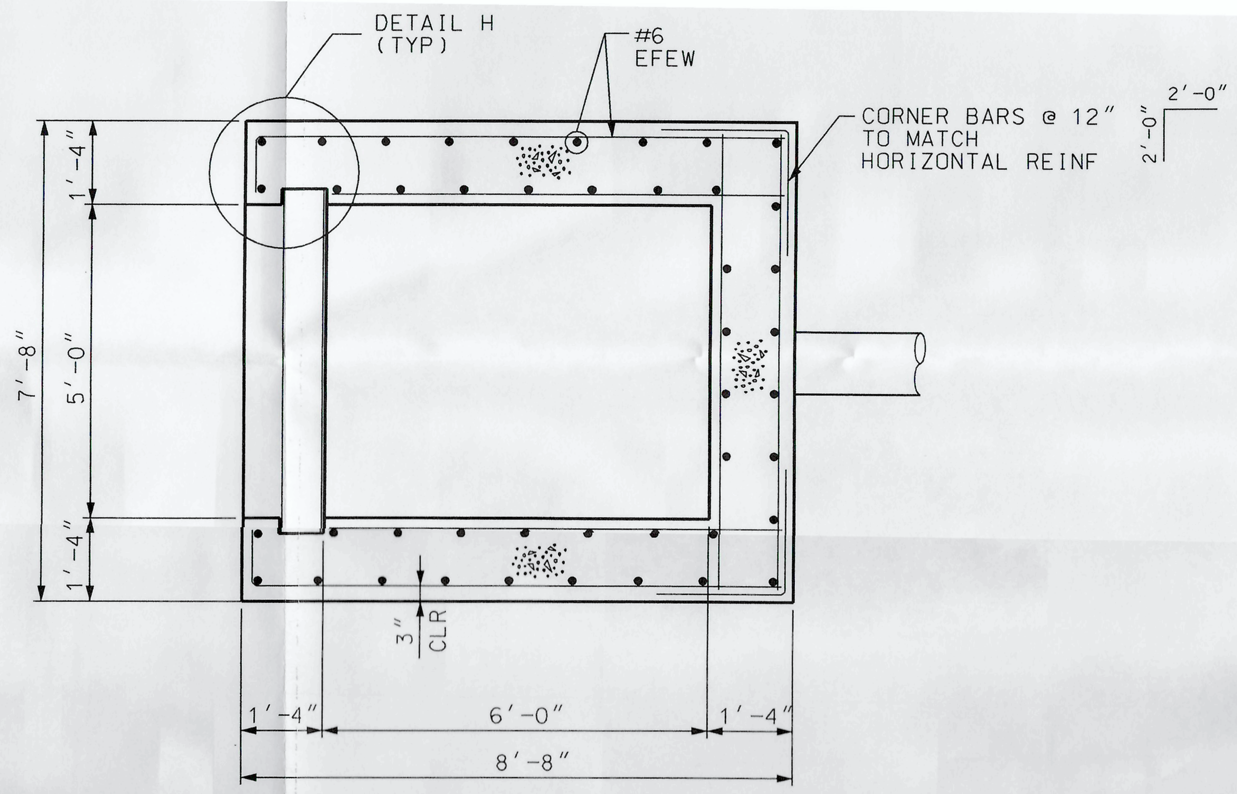

## DETAIL A
(SEE DWG C180-C1000-1)




## STOP LOG STRUCTURE TYPE 1 & TYPE 2
(SEE DWG C180-C1000-1 )




## SECTION C




## SECTION D
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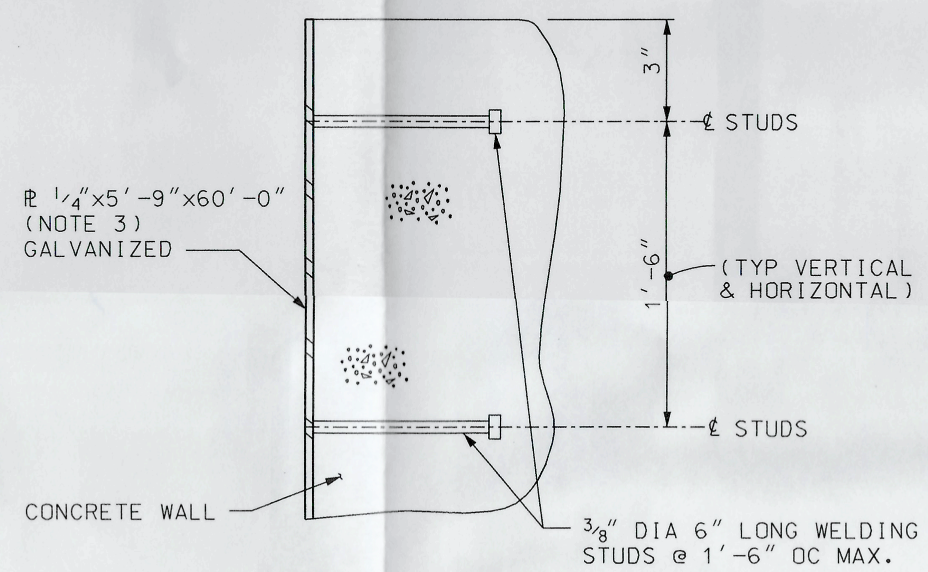


## DETAIL F
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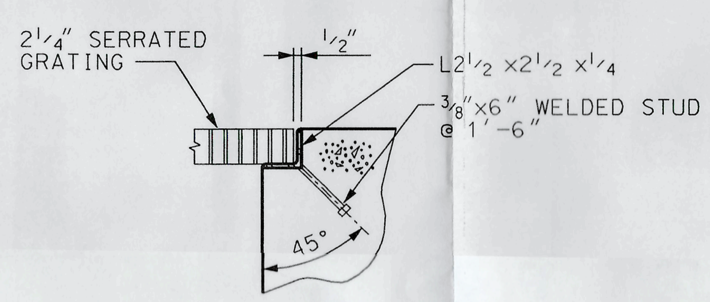
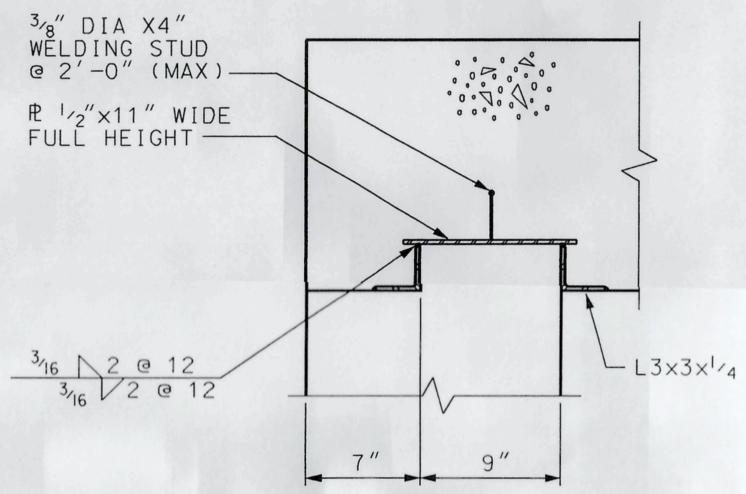
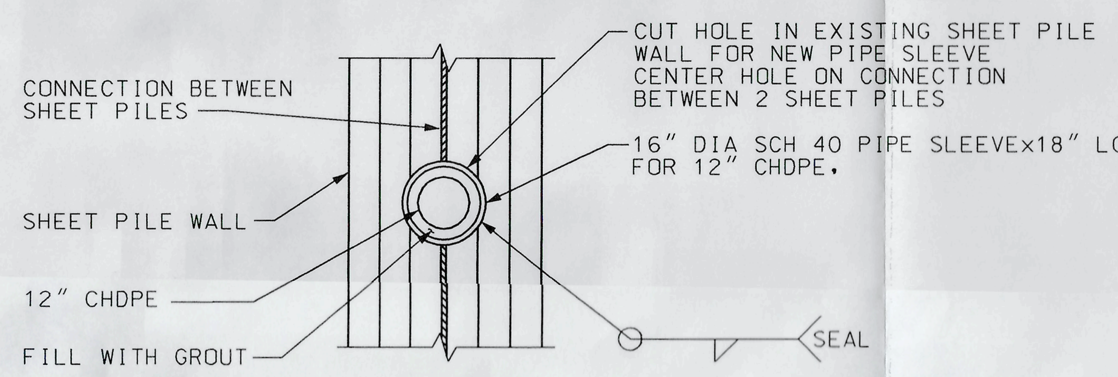


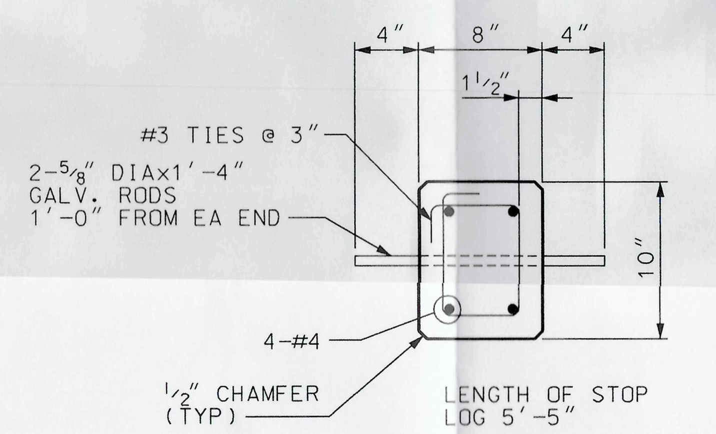

## DETAIL G
SCALE: 1 1/2"=1'-0"



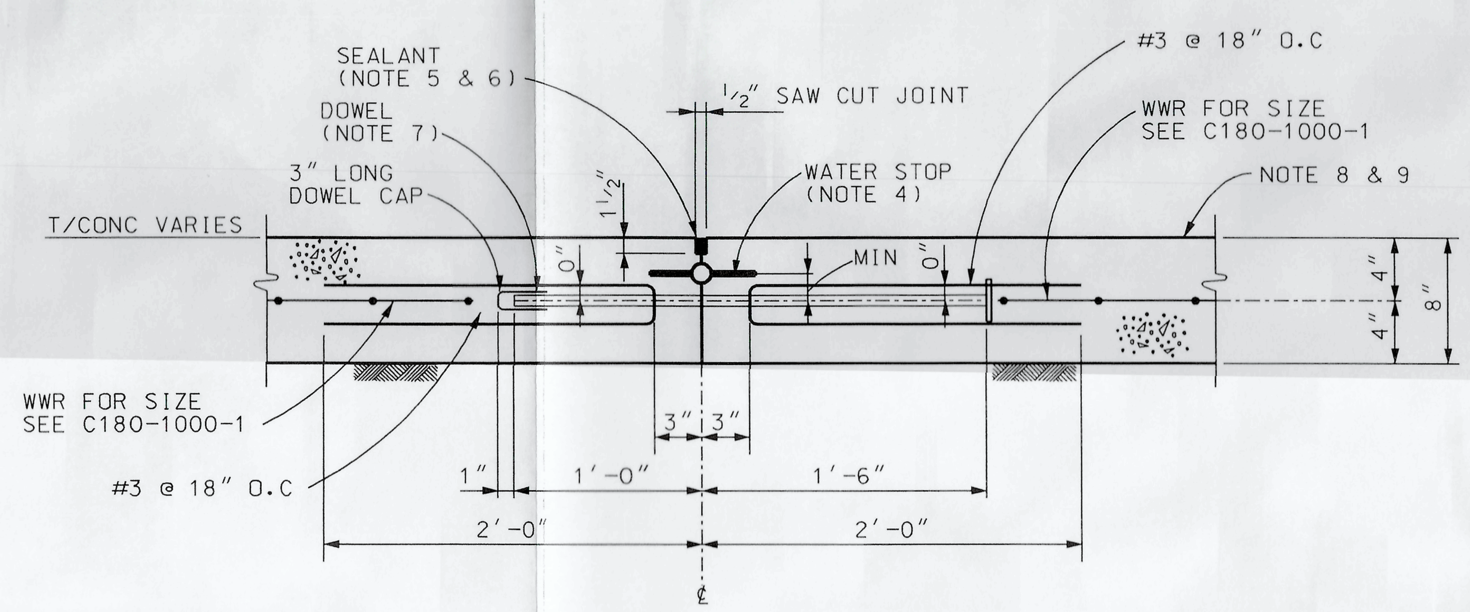

## DETAIL H
SCALE: 1 1/2"=1'-0"



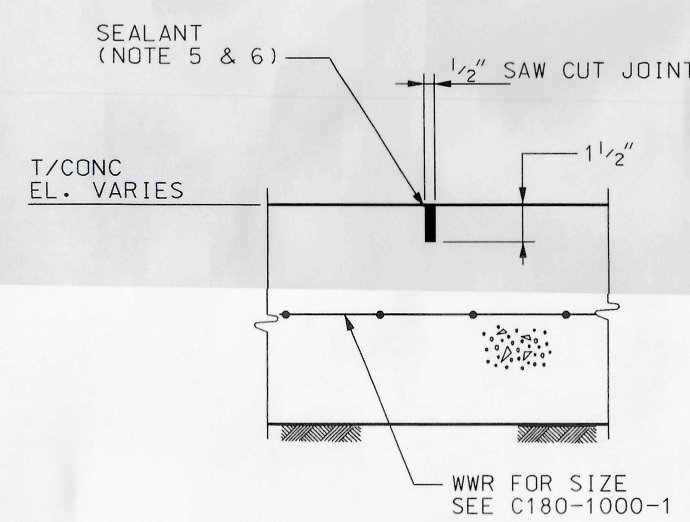

## DETAIL PENETRATION THROUGH SHEET PILE WALL
SCALE: NONE




## STOP LOG DETAIL
SCALE: 1 1/2"=1'-0"




## DETAIL L
(TYPICAL SLAB CONTRACTION AND CONSTRUCTION JOINT)
FOR LOCATION OF CONTRACTION JOINTS SEE DWG C180-C1000-1
CONTRACTOR TO SUBMIT LOCATION OF CONSTRUCTION JOINTS
TO AMEREN FOR APPROVAL PRIOR TO REBAR PURCHASE
SCALE: 1 1/2"=1'-0"




## DETAIL M
(TYPICAL SLAB CONTROL JOINT AT MAX. SPACING 20'-0" EACH WAY)
SCALE: NONE

## NOTES

1. FOR CONCRETE GENERAL NOTES SEE DWG E3306-2.
2. ALL WORK ON THIS DRAWING SHALL BE FURNISHED AND INSTALLED IN ACCORDANCE WITH SPECIFICATION D-1007.
3. PLATE TO BE FABRICATED WITHOUT ANY HORIZONTAL FIELD JOINTS. THE NUMBER OF VERTICAL FIELD JOINTS SHALL BE MINIMIZED
4. WATERSTOPS SHALL BE PVC RIBBED TYPE, 9" WIDE BY 1/4" THICK WITH 1 1/4" O.D. CENTER BULB, AND SHALL CONFORM TO THE REQUIREMENTS OF THE ARMY CORPS OF ENGINEERS CRD-C 572.
5. JOINT SEALANT SHALL BE PREFORMED ELASTOMERIC JOINT SEALER CONFORMING TO ASTM-D2628. TOP OF SEAL TO BE 1/4" INCH BELOW SLAB SURFACE.
6. APPLY SEALANT IN STRICT ADHERENCE TO MANUFACTURER'S REQUIREMENTS.
7. DOWEL SLEEVES SHALL BE PLASTIC SPEED DOWELS WITH REMOVABLE CAPS OR APPROVED EQUAL. ALL DOWELS SHALL BE 3/4" DIA., ASTM A36 PLAIN BAR, @1'-6" O.C. AND 3"SQ.x1/2" THICK PLATE WELDED TO BAR WITH A 1/4" FILLET.
8. CONCRETE SLAB SHALL HAVE HEAVY-DUTY FINISH PROVIDED IN ACCORDANCE WITH ACI 301.
9. THE 8 INCH THICK CONCRETE SLAB IS ADEQUATE FOR 32 KIP AXIAL LOADING AND LIGHT DUTY FRONT END LOADERS.
10. PROVIDE 9 STOP LOGS FOR TYPE-1 STRUCTURE PROVIDE 4 STOP LOGS FOR EACH TYPE-2 STRUCTURE.

## REFERENCE DRAWINGS

UNDERGROUND OR EMBEDDED UTILITIES MAY BE LOCATED WITHIN OR ADJACENT TO THE AREA IN WHICH EXCAVATION, DEMOLITION, FOUNDATION, OR MODIFICATION WORK IS TO BE PERFORMED.

REFERENCES RELATING TO THE UNDERGROUND OR EMBEDDED UTILITIES ARE PROVIDED TO ASSIST THE CONTRACTOR/INSTALLER IN THE FIELD LOCATING THOSE UTILITIES AND OTHER POSSIBLE UNDERGROUND OR EMBEDDED INTERFERENCES WITH THE WORK.

THE CONTRACTOR/INSTALLER SHALL EXERCISE DUE CAUTION DURING ALL EXCAVATION/FOUNDATION/DEMOLITION WORK.

FILE NO. C180-E3306-3.DGN

CONSTRUCTION NOTE: CONTRACTOR/INSTALLER SHALL TAKE ALL APPROPRIATE PRECAUTIONS TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR (S)) PERFORMING THE WORK.

NOTICE OF LIMITED RESPONSIBILITY

AEG CAD GENERATED
DO NOT REVISE MANUALLY

DRAWING RECORD

| REV. | DATE | PREPARED | REVIEWED | APPROVED | DESCRIPTION |
|---|---|---|---|---|---|
| OA | 04/21/06 | GT | AN | | FOR CLIENT COMMENTS |
| OB | 07-02-07 | S.R / A.C | GW | | FOR BIDS SPECIFICATION D-1007 |
| OC | 09/21/07 | D.ZIMA | GW | | FOR CONSTRUCTION SPECIFICATION D-1007 |

Sargent & Lundy LLC
SARGENT & LUNDY LLC's ILLINOIS DEPARTMENT OF PROFESSIONAL REGULATION REGISTRATION NUMBER IS 184-000106

STATE OF ILLINOIS — GARY WILLMAN — 81-4140 — LICENSED STRUCTURAL ENGINEER

SCALE 1/4"=1'-0"
PROJECT 11478-034
140M052
DRAFTER GT
DATE

Ameren Energy
Resources Generating

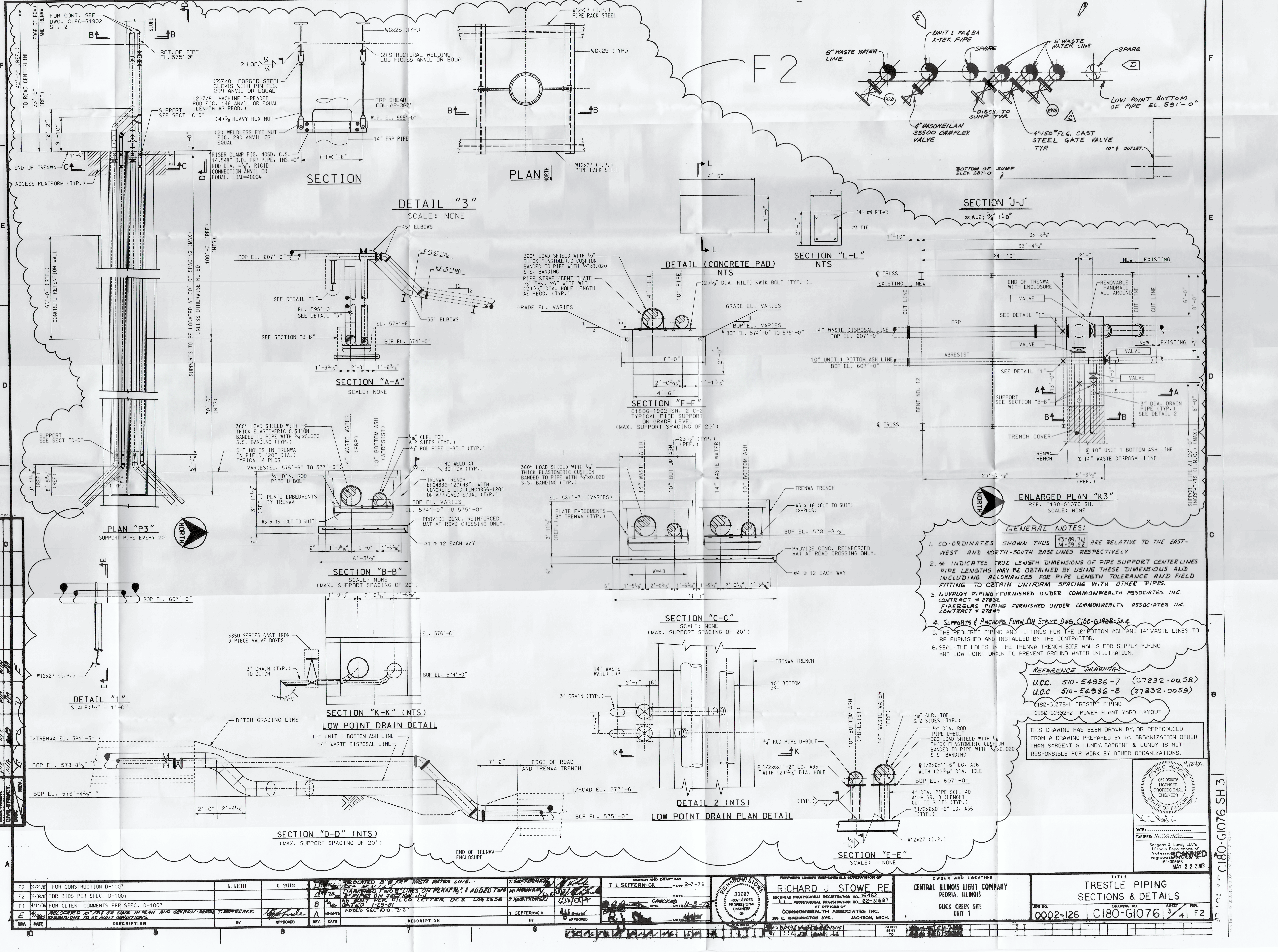
DRAWING TITLE

# FOUNDATION SECTION AND DETAILS

BOTTOM ASH AND LOW VOLUME SUMP WATER BASIN AND PIPING PROJECT
CANTON, ILLINOIS

DUCK CREEK POWER STATION UNIT NO. 1

DRAWING NUMBER: C180-E3306-3 REV. 0C
SHEET NO. 1



F2
FOR CONT. SEE DWG. C180-G1902 SH. 2
EDGE OF ROAD AND TRENWA
TO ROAD CENTERLINE
BOT. OF PIPE EL. 575'-0"
SUPPORT SEE SECT "C-C"
END OF TRENWA
ACCESS PLATFORM (TYP.)
CONCRETE RETENTION WALL
SUPPORTS TO BE LOCATED AT 20'-0" SPACING (MAX) UNLESS OTHERWISE NOTED
PLAN "P3"
SUPPORT PIPE EVERY 20'
NORTH
W6x25 (TYP.)
(2) STRUCTURAL WELDING LUG FIG.55 ANVIL OR EQUAL
(2)7/8 FORGED STEEL CLEVIS WITH PIN FIG. 299 ANVIL OR EQUAL
(2)7/8 MACHINE THREADED ROD FIG. 146 ANVIL OR EQUAL (LENGTH AS REQD.)
(4)7/8 HEAVY HEX NUT
(2) WELDLESS EYE NUT FIG. 290 ANVIL OR EQUAL
FRP SHEAR COLLAR-360°
W.P. EL. 595'-0"
14" FRP PIPE
RISER CLAMP FIG. 40SD, C.S. 14.548" O.D. FRP PIPE, INS.=0" ROD DIA. =7/8", RIGID CONNECTION ANVIL OR EQUAL. LOAD=4000#
SECTION
W12x27 (I.P.) PIPE RACK STEEL
W6x25 (TYP.)
PLAN
DETAIL "3"
SCALE: NONE
45° ELBOWS
BOP EL. 607'-0"
EXISTING
SEE DETAIL "1"
EL. 595'-0" SEE DETAIL "3"
35° ELBOWS
EL. 576'-6"
SEE SECTION "B-B"
BOP EL. 574'-0"
SECTION "A-A"
SCALE: NONE
360° LOAD SHIELD WITH 1/8" THICK ELASTOMERIC CUSHION BANDED TO PIPE WITH 3/4"x0.020 S.S. BANDING
PIPE STRAP (BENT PLATE 1/2" THK. x6" WIDE WITH (2) 13/16" DIA. HOLE LENGTH AS REQD. (TYP.)
GRADE EL. VARIES
14" PIPE
10" PIPE
(2) 3/8" DIA. HILTI KWIK BOLT (TYP.)
BOP EL. VARIES
BOP EL. 574'-0" TO 575'-0"
SECTION "F-F"
C180G-1902-SH. 2 C-2
TYPICAL PIPE SUPPORT ON GRADE LEVEL
(MAX. SUPPORT SPACING OF 20')
DETAIL (CONCRETE PAD)
NTS
(4) #4 REBAR
#3 TIE
SECTION "L-L"
NTS
SECTION "B-B"
SCALE: NONE
(MAX. SUPPORT SPACING OF 20')
CUT HOLES IN TRENWA IN FIELD (20" DIA.) TYPICAL 4 PLCS
PLATE EMBEDMENTS BY TRENWA
W5 x 16 (CUT TO SUIT)
1/16" CLR. TOP & 2 SIDES (TYP.)
3/4" ROD PIPE U-BOLT (TYP.)
NO WELD AT BOTTOM (TYP.)
TRENWA TRENCH BHC4836-120(48") WITH CONCRETE LID (LHC4836-120) OR APPROVED EQUAL (TYP.)
PROVIDE CONC. REINFORCED MAT AT ROAD CROSSING ONLY.
#4 @ 12 EACH WAY
SECTION "C-C"
SCALE: NONE
(MAX. SUPPORT SPACING OF 20')
EL. 581'-3" (VARIES)
BOP EL. 578'-8 1/2"
TRENWA TRENCH
W5 x 16 (CUT TO SUIT) (2-PLCS)
DETAIL "1"
SCALE: 1/2" = 1'-0"
W12x27 (I.P.)
BOP EL. 607'-0"
6860 SERIES CAST IRON 3 PIECE VALVE BOXES
3" DRAIN (TYP.) TO DITCH
EL. 576'-6"
BOP EL. 574'-0"
SECTION "K-K" (NTS)
LOW POINT DRAIN DETAIL
DITCH GRADING LINE
T/TRENWA EL. 581'-3"
10" UNIT 1 BOTTOM ASH LINE
14" WASTE DISPOSAL LINE
BOP EL. 578'-8 1/2"
BOP EL. 576'-4 3/8"
T/ROAD EL. 577'-6"
EDGE OF ROAD AND TRENWA TRENCH
BOP EL. 575'-0"
END OF TRENWA ENCLOSURE
SECTION "D-D" (NTS)
(MAX. SUPPORT SPACING OF 20')
14" WASTE WATER FRP
10" BOTTOM ASH
3" DRAIN (TYP.)
DETAIL 2 (NTS)
LOW POINT DRAIN PLAN DETAIL
SECTION "E-E"
SCALE: = NONE
R 1/2x6x1'-2" LG. A36 WITH (2) 13/16" DIA. HOLE
4" DIA. PIPE SCH. 40 A106 GR. B (LENGHT CUT TO SUIT) (TYP.)
R 1/2x6x0'-6" LG. A36 (TYP.)
UNIT 1 FA & BA X-TEK PIPE
8" WASTE WATER LINE
SPARE
LOW POINT BOTTOM OF PIPE EL. 591'-0"
DISCH. TO SUMP TYP.
4" MASONEILAN 35500 CAMFLEX VALVE
4"-150# FLG. CAST STEEL GATE VALVE TYP.
10" Ø OUTLET
BOTTOM OF SUMP ELEV. 587'-0"
SECTION "J-J"
SCALE: 3/4" 1'-0"
END OF TRENWA WITH ENCLOSURE
REMOVABLE HANDRAIL ALL AROUND
VALVE
14" WASTE DISPOSAL LINE BOP EL. 607'-0"
10" UNIT 1 BOTTOM ASH LINE BOP EL. 607'-0"
FRP
ABRESIST
NEW
EXISTING
CUT LINE
BENT NO. 12
TRUSS
TRENCH COVER
TRENWA TRENCH
3" DIA. DRAIN PIPE (TYP.) SEE DETAIL 2
10" UNIT 1 BOTTOM ASH LINE
14" WASTE DISPOSAL LINE
SUPPORT PIPE AT 20'-0" INCREMENTS (L.N.O.) (MAX)
ENLARGED PLAN "K3"
REF. C180-G1076 SH. 1
SCALE: NONE
GENERAL NOTES:
1. CO-ORDINATES SHOWN THUS 13+89.74 / 14+59.5E ARE RELATIVE TO THE EAST-WEST AND NORTH-SOUTH BASE LINES RESPECTIVELY
2. * INDICATES TRUE LENGTH DIMENSIONS OF PIPE SUPPORT CENTERLINES PIPE LENGTHS MAY BE OBTAINED BY USING THESE DIMENSIONS AND INCLUDING ALLOWANCES FOR PIPE LENGTH TOLERANCE AND FIELD FITTING TO OBTAIN UNIFORM SPACING WITH OTHER PIPES.
3. NUVALOY PIPING FURNISHED UNDER COMMONWEALTH ASSOCIATES INC CONTRACT # 27832 FIBERGLAS PIPING FURNISHED UNDER COMMONWEALTH ASSOCIATES INC. CONTRACT # 27849
4. SUPPORTS & ANCHORS FURN. ON STRUCT. DWG. C180-G1928-SH 4
5. THE REQUIRED PIPING AND FITTINGS FOR THE 10" BOTTOM ASH AND 14" WASTE LINES TO BE FURNISHED AND INSTALLED BY THE CONTRACTOR.
6. SEAL THE HOLES IN THE TRENWA TRENCH SIDE WALLS FOR SUPPLY PIPING AND LOW POINT DRAIN TO PREVENT GROUND WATER INFILTRATION.
REFERENCE DRAWINGS
U.C.C. 510-54936-7 (27832-0058)
U.C.C. 510-54936-8 (27832-0059)
C180-G1076-1 TRESTLE PIPING
C180-G1902-2 POWER PLANT YARD LAYOUT
THIS DRAWING HAS BEEN DRAWN BY, OR REPRODUCED FROM A DRAWING PREPARED BY AN ORGANIZATION OTHER THAN SARGENT & LUNDY. SARGENT & LUNDY IS NOT RESPONSIBLE FOR WORK BY OTHER ORGANIZATIONS.
KEVIN C. HOPKINS 062-056676 LICENSED PROFESSIONAL ENGINEER STATE OF ILLINOIS
Sargent & Lundy LLC's Illinois Department of Professional Regulation registration No. 184-000186
SCANNED MAY 22 2003
F2 09/21/07 FOR CONSTRUCTION D-1007 M. MIOTTI G. SWITAK
F2 06/08/07 FOR BIDS PER SPEC. D-1007
F1 4/14/06 FOR CLIENT COMMENTS PER SPEC. D-1007
E RELOCATED 10" FA & BA LINE IN PLAN AND SECTION - REVISED DIMENSIONS TO AS BUILT CONDITIONS. T. SEFFERNICK
D RELOCATED 8" Ø FRP WASTE WATER LINE
B ADDED SECTION "3-3"
REV. DATE DESCRIPTION BY APPROVED
DESIGN AND DRAFTING T L SEFFERNICK DATE 2-7-75
RICHARD J. STOWE 31687 REGISTERED PROFESSIONAL ENGINEER
PREPARED UNDER RESPONSIBLE SUPERVISION OF RICHARD J STOWE P.E.
MICHIGAN PROFESSIONAL REGISTRATION NO. 16462
ILL. PROFESSIONAL REGISTRATION NO. 62-31687
AT OFFICES OF COMMONWEALTH ASSOCIATES INC.
209 E. WASHINGTON AVE., JACKSON, MICH.
OWNER AND LOCATION
CENTRAL ILLINOIS LIGHT COMPANY
PEORIA, ILLINOIS
DUCK CREEK SITE UNIT 1
TITLE
TRESTLE PIPING SECTIONS & DETAILS
JOB NO. 0002-126
DRAWING NO. C180-G1076
SHEET 3/4
REV. F2
C180-G1076 SH 3


BASALT PIPE
X-TEK PIPE
FIBER GLASS PIPE REQUISITION 27889
BOTTOM OF $SO_2$ SLURRY PIPE ELEV. 607'-6"
18" STACK DRAIN
16" DEMIST TANK DRAIN
BOTTOM OF 10" ASH PIPE ELEV. 627'-6½
FOR DETAIL THIS AREA SEE ENLARGED PLAN "$B_2$"
BOTTOM OF 14" WASTE WATER COLLECTION LINE EL 627'-3"
340'-0" TO COL. ROW A
BENT 12
TIE-IN POINT NORTH OF BENT 12
SEE ENLARGED PLAN "K-3" C180-G1076-3
FOR DETAIL OF PIPING IN THIS AREA SEE DWG. G1146 SH.1
BOTTOM OF PIPES ELEV. 597'-1"
FOR DETAIL OF PIPING IN THIS AREA SEE DWG. C180-G1146 SH.3
WASTE WATER COLLECTION TANK
BOTTOM OF PIPES ELEV. 597'-1"
1211'-0"
610'-0" TO EAST-WEST BASE LINE
PLAN
SCALE: 1"=40'-0"
NORTH
TIE-IN POINT
SEE ENLARGED PLAN "K-3" C180-G1076-3
BOTTOM OF ASH PIPE ELEV. 627'-0½
T/S ELEV. 627'-0"
T/S ELEV. 617'-2½
T/S ELEV. 607'-5"
BOTTOM OF PIPE ELEV. 607'-5½
T/S ELEV. 607'-3⅜
T/S ELEV. 607'-0"
BOTTOM OF PIPES ELEV. 607'-0½
BOTTOM OF PIPE ELEV. 597'-5½
T/S ELEV. 597'-0"
BOTTOM OF PIPES ELEV. 597'-0½
TRENWA
BENT NO. 1
BENT NO. 3
BENT NO. 12
BENT NO. 13
BENT NO. 28
MATCH LINE
PROFILE
SCALE: 1"=40'
PIPE SUPPORT
44+25.13 N 14+18.21 E
7° 50'
WASTE DISPOSAL PIPE SUPPORTS
ROAD CROSSING
1436'-6⅞"
405'-4"
228'-4⅜"
37+47.56 N 17+20.00 E
40+15.96 N 16+44.50 E
FOR NEW CONSTRUCTION SEE DETAIL $E_4$
ROAD
R.R. TRACKS
SEE ENLARGED PLAN "$H_2$"
PLAN
SCALE: 1"=100'-0"
BOTTOM OF PIPE LOW POINT ELEV. 591'-0"
BOTTOM OF PIPE W.P. ELEV. 596'-0"
GRADE ELEV. 594'-0"
BOTTOM OF PIPE ELEV. 626'-0"
TOP OF ASH POND DIKE ELEV. 626'-0"
SLOPE
GRADE ELEV. 590'-0"
1721'-0"
PROFILE
VERT SCALE 1"=10'-0"
HORZ SCALE 1"=100'-0"
REFERENCE DRAWINGS:
C180-G1902-2 POWER PLANT YARD LAYOUT
C180-G1076-3 TRESTLE PIPING SECTIONS AND DETAILS
THIS DRAWING HAS BEEN DRAWN BY, OR REPRODUCED FROM A DRAWING PREPARED BY AN ORGANIZATION OTHER THAN SARGENT & LUNDY. SARGENT & LUNDY IS NOT RESPONSIBLE FOR WORK BY OTHER ORGANIZATIONS.
FOR GENERAL NOTES SEE SH. 3.
SCANNED
KEVIN C. HOPKINS 062-056678 LICENSED PROFESSIONAL ENGINEER STATE OF ILLINOIS
EXPIRES: 11-30-07
Sargent & Lundy LLC's Illinois Department of Professional Regulation registration number is 184-000108
H2 9/21/07 FOR CONSTRUCTION D-1007 M. MIOTTI G. SWITAK
H2 6/29/07 FOR BIDS SPEC. D-1007 M. VILLANUEVA R. KRONE
H1 4/14/06 FOR CLIENT COMMENTS PER SPEC. D-1007.
G REV. LOCATION OF FAB&A LINE. ADDED 18 STACK DRAIN & 16" DEMIST TANK DRAIN PER AS BUILT. T. SEFFERNICK
F REVISED PIPING TO PUMP HOUSE ADDITION REF. R.N. 12 J T. SEFFERNICK
E ADDED RETURN WATER PUMPHOUSE ADDITION PIPING. ADDED NOTE ZONE C-8 K. NEUKAM
D AS BUILT PER CILCO LETTER DCZ LOG 2558 DATED 1-23-81 J. KWIATKOWSKI
C 3-8-76 DIMENSION 170'-9" WAS 177'-6 (DIM. ERROR) T. SEFFERNICK
B 10-31-75 REVISED TRESTLE PIPING ELEV. T. SEFFERNICK
A 3-10-75 REV. 8" INLETS INTO 18" WASTE WATER HEADER. ADDED SO. LIMESTONE DISPOSAL LINES T. SEFFERNICK
REV. DATE DESCRIPTION BY APPROVED
DESIGN AND DRAFTING T. L. SEFFERNICK DATE 1-27-75
CHECKED DATE 11-3-75
APPROVED DATE 11-4-75
PREPARED UNDER RESPONSIBLE SUPERVISION OF RICHARD J STOWE P.E.
MICHIGAN PROFESSIONAL REGISTRATION NO. 16462
ILL PROFESSIONAL REGISTRATION NO. 62 31687
AT OFFICES OF COMMONWEALTH ASSOCIATES INC.
209 E. WASHINGTON AVE., JACKSON, MICH.
OWNER AND LOCATION
CENTRAL ILLINOIS LIGHT COMPANY PEORIA, ILLINOIS
DUCK CREEK SITE UNIT 1
TITLE
TRESTLE PIPING
JOB NO. 0002-126
DRAWING NO. C180-G1076
SHEET 1/4
REV. H2
TRESTLE PIPING SH 1
PRINTS SENT TO
C180-G1076 SH1

SHEET NO. 1
E3306-2

# 1.0 GENERAL

1.1 ABBREVIATIONS AND DEFINITIONS

| | |
|---|---|
| AB | = ANCHOR BOLT |
| AR | = ANCHOR ROD |
| B℗ | = BASE PLATE |
| BM | = BEAM |
| BOTT | = BOTTOM |
| B/ | = BOTTOM OF |
| ℄ | = CENTERLINE |
| C TO C | = CENTER TO CENTER |
| CHKD ℗ | = CHECKERED PLATE |
| CEA | = CONCRETE EXPANSION ANCHOR |
| CJ | = CONSTRUCTION JOINT |
| CLR | = CLEAR |
| COL | = COLUMN |
| CONC | = CONCRETE |
| CONT | = CONTINUOUS |
| DET | = DETAIL |
| DIA | = DIAMETER |
| Ø | = DIAMETER |
| DWLS | = DOWELS |
| DWG | = DRAWING |
| E | = ANCHOR BOLT EMBEDMENT LENGTH |
| EF | = EACH FACE |
| EL | = ELEVATION |
| EQ | = EQUAL |
| EW | = EACH WAY |
| FD | = FLOOR DRAIN |
| FDN | = FOUNDATION |
| FL | = FLOOR |
| FS | = FAR SIDE |
| Fy | = YIELD STRESS |
| GALV | = GALVANIZED |
| GL | = GIRT LINE |
| G℗ | = GUARD PLATE |
| GR | = GRADE |
| GRTG | = GRATING |
| GWC | = GENERAL WORK CONTRACTOR |
| HP | = HIGH POINT |
| HR | = HANDRAIL |
| ID | = INSIDE DIAMETER |
| INV | = INVERT |
| IP | = IN PLACE |
| KSF | = KIPS PER SQUARE FOOT |
| KSI | = KIPS PER SQUARE INCH |
| LG | = LENGTH, LONG |
| LP | = LOW POINT |
| MAX | = MAXIMUM |
| MIN | = MINIMUM |
| NS | = NEAR SIDE |
| NTS | = NOT TO SCALE |
| OC | = ON CENTER |
| OD | = OUTSIDE DIAMETER |
| P | = ANCHOR BOLT PROJECTION ABOVE ROUGH CONCRETE |
| PL | = PLATE |
| ℗ | = PLATE |
| PSI | = POUNDS PER SQUARE INCH |
| PT | = POINT OF TANGENCY |
| R | = RADIUS |
| REF | = REFERENCE |
| REINF | = REINFORCEMENT |
| REM | = REMOVABLE |
| REQD | = REQUIRED |
| SECT | = SECTION |
| SIM | = SIMILAR |
| SPA | = SPACES |
| SS | = STAINLESS STEEL |
| STL | = STEEL |
| SYMM | = SYMMETRICAL |
| T & B | = TOP & BOTTOM |
| T/ | = TOP OF |
| T/C | = TOP OF CONCRETE |
| T/G | = TOP OF GRATING |
| T/S | = TOP OF STEEL |
| TYP | = TYPICAL |
| UN | = UNLESS NOTED |
| VB | = VERTICAL BRACING |
| WP | = WORK POINT |
| WS | = WATER STOP |
| WWF | = WELDED WIRE FABRIC |
| WWR | = WELDED WIRE REINFORCMENT |

1.2 SYMBOLS

12″ = ONE-WAY SLAB SPAN WITHOUT DECKING (NOTE 1.3.1)

8″+2″ / D-2 = INDICATES A NOMINAL 8″ CONCRETE SLAB AND 2″ OF SEPARATE FINISH WITH TOP OF CONCRETE ELEVATION AS NOTED ON PLAN. THE DIRECTION OF MAIN REINFORCING AND SPAN OF METAL DECK IS INDICATED BY THE DIRECTION OF THE ARROW. DEPTH OF DECKING FLUTE IS INDICATED BY D-2 (SEE NOTE 1.3.2).

72″+8″ = INDICATES 72″ THICK ROUGH CONCRETE SLAB AND 8″ OF SEPARATE FINISH WITH TOP OF CONCRETE ELEVATION AS NOTED ON PLAN AND THE DIRECTIONS OF THE MAIN REINFORCING.

P = PRECAST CONCRETE SLAB SPAN

SLOPE = DIRECTION OF DOWNWARD SLOPE

F = CONSTRUCTION OPENINGS TO BE FILLED WITH CONCRETE LATER WITH PRIOR APPROVAL OF THE ENGINEER.

1.3 DESIGNATIONS

1.3.1

## GENERAL (CONTINUED)

1.3.2 METAL DECKING FLUTE DEPTHS
D = ROOF METAL DECKING
D-1 = 1½″
D-2 = 2″
D-3 = 3″

1.3.3 CONCRETE BEAM DESIGNATIONS INDICATE A BEAM NUMBER, WHEN APPLICABLE, AND THE BEAM SIZE IN INCHES (WIDTH X DEPTH)

EXAMPLE: B-310
36″X54″

1.4 STRUCTURAL DESIGN DATA

1.4.1 STRUCTURAL DESIGN IS BASED ON THE APPLICABLE REQUIREMENTS OF THE UNIFORM BUILDING CODE (UBC 1997).

1.4.2 WIND LOAD:
1. BASIC WIND SPEED: 70 MPH
2. IMPORTANCE FACTOR, $I_w$ = 1.0
3. EXPOSURE CATERGORY C

1.4.3 SEISMIC LOAD:
1. SEISMIC ZONE 1
2. IMPORTANCE FACTOR, I = 1.0
3. OCCUPANCY CATEGORY 3
4. SOIL PROFILE TYPE $S_E$

1.4.4 SNOW LOAD:
1. GROUND SNOW LOAD = 20 PSF
2. IMPORTANCE FACTOR, I = 1.0

1.4.5 FLOOR LIVE LOAD AT GRADE IS 350 PSF, UNLESS NOTED

# 2.0 CONCRETE WORK

2.1 TYPICAL DETAIL DRAWINGS

2.1.1 FOR STANDARD PILE DETAILS SEE DRAWING S-10001.

2.1.2 FOR MAT FOUNDATION DETAILS SEE DRAWINGS S-10002 AND S-10003.

2.1.3 FOR EQUIPMENT ANCHOR ROD DETAILS SEE DRAWING S-10004.

2.1.4 FOR CONCRETE WALL DETAILS SEE DRAWINGS S-10005.

2.1.5 FOR CONCRETE EDGE DETAILS SEE DRAWING S-10007.

2.1.6 FOR SLAB SUPPORTED BY METAL DECK DETAILS SEE DRAWING S-10008.

2.1.7 FOR REMOVABLE SLAB DETAILS SEE DRAWING S-10009.

2.1.8 FOR CONCRETE REINFORCED DUCT BANK DETAILS SEE DRAWING S-10010.

2.2 CONCRETE COVER REQUIREMENTS

REINFORCING BARS ADJACENT TO THE FACE OF CONCRETE SHALL HAVE THE FOLLOWING MINIMUM CONCRETE COVER UNLESS NOTED ON DESIGN DRAWINGS:

2.2.1 CONCRETE CAST AGAINST EARTH OR OTHER SURFACE NOT FORMED .............. 3″

2.2.2 FORMED CONCRETE SURFACES PERMANENTLY IN CONTACT WITH SOIL OR EXPOSED TO WEATHER: ......................... 2″

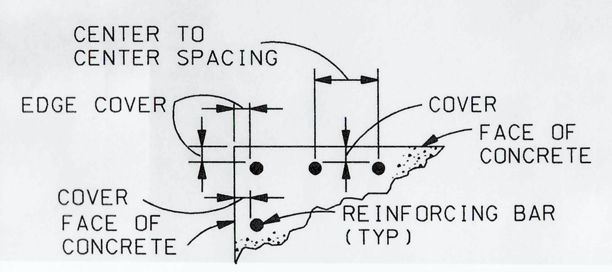
2.2.3 TOP BARS OF CONCRETE MATS AT GRADE. ............................ 2″

2.2.4 CONCRETE SURFACES NOT PERMANENTLY EXPOSED TO WEATHER:
a. SLABS, WALLS, JOIST #3 THROUGH #11 .......... ¾″
b. BEAMS AND COLUMNS ........ 1½″

2.2.5 ALL OTHER CONDITIONS ........... 1½″

2.3 REINFORCING LAP SPLICE, DEVELOPMENT LENGTH AND STANDARD HOOK REQUIREMENTS

FOR STANDARD HOOKS SEE NOTE 2.3.5. FOR STRAIGHT BARS, LAP SPLICE AND DEVELOPMENT LENGTH REQUIREMENTS, GIVEN IN THE TABLES FOR NOTES 2.3.1, ARE BASED ON THE FOLLOWING PARAMETERS:
- REINFORCING STEEL STRENGTH Fy=60,000 PSI
- BARS NOT BUNDLED
- BARS UNCOATED (β =1.0)
- NORMAL WEIGHT AGGREGATE ( λ =1.0)
- CLASS B SPLICES (LST=1.3xELT AND LSO=1.3xELO)
- CONCRETE STRENGTH, f′c, AS NOTED IN THE TABLES
- REINFORCING CLEAR COVER AND CENTER TO CENTER SPACING EQUAL TO, OR GREATER THAN, MINIMUM VALUES IN TABLES. THE CLEAR COVER SHALL BE THE SMALLER OF THE COVER TO THE FACE OR EDGE OF THE CONCRETE AS SHOWN IN THE SKETCH.




WHERE CONDITIONS LISTED ABOVE ARE NOT MET, LENGTHS IN THE TABLES SHALL BE ADJUSTED WITH THE APPROVAL OF THE ENGINEER.

## CONCRETE WORK (CONTINUED)

2.3.1 LAP AND DEVELOPMENT LENGTHS FOR CONCRETE STRENGTH f′c = 4,000 PSI OR f′c = 4,500 PSI

CONCRETE STRENGTH:
f′c = 4,000 PSI OR 4,500 PSI
REINFORCING STEEL CLEAR COVER: ¾″ MINIMUM
REINFORCING STEEL STRENGTH: Fy = 60,000 PSI
LENGTHS GIVEN IN INCHES

| BAR SIZE | LAP SPLICE LENGTH | | | DEVELOPMENT LENGTH | | |
|---|---|---|---|---|---|---|
| | TOP BARS LST | OTHER BARS LSO | MIN. BAR SPAC | TOP BARS ELT | OTHER BARS ELO | MIN. BAR SPAC |
| 3 | 16 | 16 | 2.3 | 12 | 12 | 1.9 |
| 4 | 24 | 19 | 2.5 | 19 | 15 | 2.0 |
| 5 | 36 | 28 | 2.8 | 28 | 21 | 2.2 |
| 6 | 48 | 37 | 3.0 | 37 | 29 | 2.3 |
| 7 | 78 | 60 | 3.3 | 60 | 46 | 2.4 |
| 8 | 96 | 74 | 3.5 | 74 | 57 | 2.5 |
| 9 | 117 | 90 | 3.8 | 90 | 69 | 2.7 |
| 10 | 140 | 108 | 4.1 | 108 | 83 | 2.8 |
| 11 | 165 | 127 | 4.4 | 127 | 98 | 3.0 |

CONCRETE STRENGTH:
f′c = 4,000 PSI OR 4,500 PSI
REINFORCING STEEL CLEAR COVER: 1½″ MINIMUM
REINFORCING STEEL STRENGTH: Fy = 60,000 PSI
LENGTHS GIVEN IN INCHES

| BAR SIZE | LAP SPLICE LENGTH | | | DEVELOPMENT LENGTH | | |
|---|---|---|---|---|---|---|
| | TOP BARS LST | OTHER BARS LSO | MIN. BAR SPAC | TOP BARS ELT | OTHER BARS ELO | MIN. BAR SPAC |
| 3 | 16 | 16 | 2.3 | 12 | 12 | 1.9 |
| 4 | 20 | 16 | 3.0 | 15 | 12 | 2.5 |
| 5 | 24 | 19 | 3.8 | 19 | 15 | 3.2 |
| 6 | 29 | 22 | 4.5 | 22 | 17 | 3.8 |
| 7 | 48 | 37 | 4.8 | 37 | 28 | 3.9 |
| 8 | 60 | 47 | 5.0 | 47 | 36 | 4.0 |
| 9 | 74 | 57 | 5.3 | 57 | 44 | 4.2 |
| 10 | 91 | 70 | 5.6 | 70 | 54 | 4.3 |
| 11 | 109 | 84 | 5.9 | 84 | 64 | 4.5 |

CONCRETE STRENGTH:
f′c = 4,000 PSI OR 4,500 PSI
REINFORCING STEEL CLEAR COVER: 2″ MINIMUM
REINFORCING STEEL STRENGTH: Fy = 60,000 PSI
LENGTHS GIVEN IN INCHES

| BAR SIZE | LAP SPLICE LENGTH | | | DEVELOPMENT LENGTH | | |
|---|---|---|---|---|---|---|
| | TOP BARS LST | OTHER BARS LSO | MIN. BAR SPAC | TOP BARS ELT | OTHER BARS ELO | MIN. BAR SPAC |
| 3 | 16 | 16 | 2.3 | 12 | 12 | 1.9 |
| 4 | 20 | 16 | 3.0 | 15 | 12 | 2.5 |
| 5 | 24 | 19 | 3.8 | 19 | 15 | 3.2 |
| 6 | 29 | 22 | 4.5 | 22 | 17 | 3.8 |
| 7 | 42 | 33 | 5.3 | 33 | 25 | 4.4 |
| 8 | 48 | 37 | 6.0 | 37 | 29 | 5.0 |
| 9 | 60 | 46 | 6.3 | 46 | 36 | 5.2 |
| 10 | 74 | 57 | 6.6 | 57 | 44 | 5.3 |
| 11 | 89 | 68 | 6.9 | 68 | 53 | 5.5 |

CONCRETE STRENGTH:
f′c = 4,000 PSI OR 4,500 PSI
REINFORCING STEEL CLEAR COVER: 3″ MINIMUM
REINFORCING STEEL STRENGTH: Fy = 60,000 PSI
LENGTHS GIVEN IN INCHES

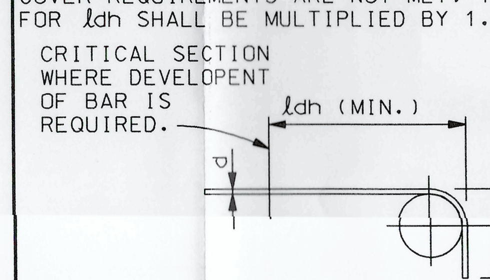
| BAR SIZE | LAP SPLICE LENGTH | | | DEVELOPMENT LENGTH | | |
|---|---|---|---|---|---|---|
| | TOP BARS LST | OTHER BARS LSO | MIN. BAR SPAC | TOP BARS ELT | OTHER BARS ELO | MIN. BAR SPAC |
| 3 | 16 | 16 | 2.3 | 12 | 12 | 1.9 |
| 4 | 20 | 16 | 3.0 | 15 | 12 | 2.5 |
| 5 | 24 | 19 | 3.8 | 19 | 15 | 3.2 |
| 6 | 29 | 22 | 4.5 | 22 | 17 | 3.8 |
| 7 | 42 | 33 | 5.3 | 33 | 25 | 4.4 |
| 8 | 48 | 37 | 6.0 | 37 | 29 | 5.0 |
| 9 | 55 | 42 | 6.8 | 42 | 32 | 5.7 |
| 10 | 61 | 47 | 7.7 | 47 | 36 | 6.4 |
| 11 | 68 | 52 | 8.5 | 52 | 40 | 7.1 |

2.3.2 - NOT USED -

2.3.3 WHERE REINFORCING BARS OF THE DIFFERENT SIZES ARE SPLICED, THE SPLICE LENGTH SHALL BE THE REQUIRED LAP SPLICE LENGTH FOR THE SMALLER BAR, BUT NOT LESS THAN THE DEVELOPMENT LENGTH FOR THE LARGER BAR.

2.3.4 ANY HORIZONTAL REINFORCING BAR, OR BAR BENT LESS THAN 45° FROM HORIZONTAL REGARDLESS OF LOCATION, WITH MORE THAN 12″ OF CONCRETE CAST BELOW THE BAR SHALL BE CONSIDERED AS A "TOP BAR" VERTICAL BAR AND HORIZONTAL REINFORCING BAR WITH LESS THAN 12″ OF CONCRETE CAST BELOW THE BAR SHALL BE CONSIDERED AS AN "OTHER BAR"

2.3.5 FOR A STANDARD HOOK, THE SCHEDULE BELOW IS BASED ON A SIDE COVER OF NOT LESS THAN 2½″ AND THE COVER OVER THE BAR EXTENSION BEYOND THE HOOK OF NOT LESS THAN 2″. IF THESE COVER REQUIREMENTS ARE NOT MET, THE VALUES FOR $\ell dh$ SHALL BE MULTIPLIED BY 1.43.




## CONCRETE WORK (CONTINUED)

STANDARD HOOK LENGTHS
REINFORCING STEEL Fy=60,000 PSI
LENGTHS GIVEN IN INCHES

| BAR SIZE | CONCRETE STRENGTH f′c = 4000 PSI f′c = 4500 PSI | |
|---|---|---|
| | H | $\ell dh$ |
| 3 | 6 | 6 |
| 4 | 8 | 7 |
| 5 | 10 | 9 |
| 6 | 12 | 10 |
| 7 | 14 | 12 |
| 8 | 16 | 14 |
| 9 | 20 | 15 |
| 10 | 22 | 17 |
| 11 | 24 | 19 |

2.4 DETAILING, FABRICATION & CONSTRUCTION REQUIREMENTS

2.4.1 ALL CONCRETE WORK, REINFORCING BAR, EMBEDMENTS IN CONCRETE AND GROUT WORK SHALL BE INSTALLED BY THE GENERAL WORK CONTRACTOR IN ACCORDANCE WITH THE APPLICABLE CONSTRUCTION SPECIFICATION.

2.4.2 THE MINIMUM SPECIFIED COMPRESSIVE STRENGTH OF CONCRETE FOR EACH PORTION OF THE STRUCTURE SHALL BE AS FOLLOWS UNLESS NOTED.

COMPRESSIVE STRENGTH — AREA/BUILDING
2000psi...........MUD MATS AND LEAN CONCRETE BACKFILL
4000psi...........ALL BUILDINGS AND STRUCTURES UNLESS NOTED
4500psi...........BUILDINGS AND STRUCTURES DESIGNATED AS USING CONCRETE CATEGORY E

2.4.3 - NOT USED -

2.4.4 ALL WELDING STUD ANCHORS SHALL BE COLD DRAWN STEEL CONFORMING TO ASTM A108 WITH A MINIMUM YIELD STRENGTH OF 50 ksi AND SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S GUIDELINES.

2.4.5 ALL LAP SPLICES FOR REINFORCING BARS #11 AND SMALLER SHALL BE AS INDICATED IN NOTE 2.3.5 AND SHALL BE STAGGERED AS INDICATED IN DETAIL 6.1.2 UNLESS OTHERWISE APPROVED BY THE ENGINEER.

2.4.6 MECHANICAL SPLICES SHALL BE USED FOR SPLICES OF REINFORCING BARS #14 TO #18 IN ACCORDANCE WITH THE APPLICABLE CONSTRUCTION SPECIFICATIONS. MECHANICAL SPLICES ON ADJACENT BARS OF THE SAME LAYER OR ADJACENT BARS OF PARALLEL LAYERS SHALL HAVE A MINIMUM STAGGER OF 2′-0″ UNLESS NOTED OTHERWISE ON DESIGN DRAWINGS.

2.4.7 LAP SPLICES SHALL BE USED ONLY WHERE IT IS NOT PRACTICAL TO USE CONTINUOUS BARS.

2.4.8 PROVIDE A STANDARD 90° HOOK LENGTH AS INDICATED IN NOTE 2.3.5 WHEN STRAIGHT BAR DEVELOPMENT LENGTH IS NOT OBTAINABLE. THE $\ell dh$ DIMENSION SHALL BE ADJUSTED AS SHOWN ON DESIGN DRAWINGS SO THAT THE HOOK CAN BE TIED TO THE FAR FACE BARS UNLESS NOTED OTHERWISE.

2.4.9 THE MINIMUM CLEAR DISTANCE BETWEEN TWO PARALLEL BARS (EXCEPT IN COLUMNS AND BETWEEN MULTIPLE LAYERS OF BARS IN BEAMS) OR BETWEEN A PARALLEL BAR AND AN EMBEDDED CONDUIT OR PIPE SHALL NOT BE LESS THAN ONE BAR DIAMETER OR 1 1/3 TIMES THE MAXIMUM SIZE OF COARSE AGGREGATE OR 1″WHICHEVER IS THE GREATER.

2.4.10 UNLESS NOTED OTHERWISE, THE MINIMUM CLEAR DISTANCE BETWEEN PARALLEL BARS IN COLUMNS SHALL NOT BE LESS THAN 1.5BAR DIAMETERS OR 1 1/3 TIMES THE MAXIMUM SIZE OF COARSE AGGREGATE OR 1½″, WHICHEVER IS THE GREATER. FOR BUNDLED BARS, THE DIAMETER SHALL BE THE DIAMETER OF A SINGLE BAR WITH THE EQUIVALENT CROSS-SECTION AREA.

2.4.11 WHERE PARALLEL REINFORCING BAR IS PLACED IN TWO OR MORE LAYERS, THE BARS IN THE UPPER LAYERS SHALL BE PLACED DIRECTLY ABOVE THOSE IN THE BOTTOM LAYER WITH CLEAR DISTANCE BETWEEN BARS NOT LESS THAN 1″.

2.4.12 FOR MULTIPLE LAYERS OF PARALLEL REINFORCING BARS, THE CONTRACTOR SHALL FURNISH SPACER BARS AS REQUIRED TO SATISFY THE REQUIREMENTS OF NOTES 2.4.9, 2.4.10 AND 2.4.11. REINFORCING BARS SHALL NOT BE BUNDLED UNLESS SPECIFICALLY NOTED ON THE DESIGN DRAWINGS.

2.4.13 - NOT USED -

2.4.14 OPENINGS IN METAL DECKING SHALL BE CUT AFTER THE CONCRETE IS PLACED AND SET. THE CUT EDGES OF METAL DECK SHALL BE GROUND SMOOTH ON A 45° BEVEL AND COATED PER THE APPLICABLE CONSTRUCTION SPECIFICATION.

2.4.15 ALL EXPOSED PROJECTING CORNERS OF CONCRETE WORK SHALL BE BEVELED 1″ UNLESS NOTED. CONCRETE WALL OPENINGS FOR HVAC FIRE DAMPERS SHALL NOT HAVE BEVELED EDGES UNLESS APPROVED ON A PROJECT UNIQUE BASIS.

## CONCRETE WORK (CONTINUED)

2.4.16 DRAWINGS INDICATING LOCATION OF CONSTRUCTION JOINTS REQUIRED IN ADDITION TO OR DIFFERENT FROM THOSE INDICATED ON THE DESIGN DRAWINGS SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW. THESE DRAWINGS SHALL BE SUBMITTED AND ACCEPTED BY THE ENGINEER BEFORE REBAR DETAILS ARE SUBMITTED FOR REVIEW. ALL CHANGES INCLUDING REQUIRED WATERSTOP, IF ANY, SHALL BE AT CONTRACTOR'S EXPENSE. FOR TYPICAL CONSTRUCTION JOINT DETAILS SEE DRAWING S-10002.

2.4.17 ALL CONSTRUCTION JOINTS SHALL BE ROUGHENED TO A MINIMUM AMPLITUDE OF ¼″ UNLESS NOTED OTHERWISE. ALL CONSTRUCTION JOINTS SHALL BE THOROUGHLY CLEANED AND MOISTENED BEFORE PLACING FRESH CONCRETE.

2.4.18 AT ALL HORIZONTAL CONSTRUCTION JOINTS A 1″ MINIMUM TO 3″ MAXIMUM LAYER OF MORTAR OF THE SAME STRENGTH OR GREATER AS THAT OF THE ADJACENT CONCRETE SHALL BE PLACED ON THE JOINT SURFACE IMMEDIATELY PRIOR TO PLACEMENT OF FRESH CONCRETE.

2.4.19 VERTICAL CONSTRUCTION JOINTS IN SHEAR WALLS SHALL BE STAGGERED BETWEEN FLOOR LEVELS AND LOCATED SIX TIMES THE WALL THICKNESS FROM THE CORNERS OF WALLS UNLESS NOTED.

2.4.20 - NOT USED -

2.4.21 IT IS NOT A REQUIREMENT THAT THE WATERSTOP BE PLACED AT THE CENTERLINE OF THE STRUCTURAL ELEMENT. AT THE CONTRACTOR'S OPTION THE WATERSTOP MAY BE PLACED ANYWHERE BETWEEN THE CENTERLINE OF THE STRUCTURAL ELEMENT AND A POINT LOCATED A MINIMUM OF 2″ FROM THE FACE OF THE REINFORCING BARS ON THE WATER SIDE OF THE JOINT.

2.4.22 - NOT USED -

2.4.23 NONSHRINK GROUT SHALL BE USED UNDER EQUIPMENT BASES, UNDER COLUMN BASE PLATES AND WHERE SPECIFICALLY INDICATED IN THE EQUIPMENT MANUFACTURER'S INSTRUCTION MANUAL. ANY DEVIATION FROM THIS REQUIREMENT SHALL BE APPROVED BY THE OWNER.

2.4.24 BEFORE APPLYING NONSHRINK GROUT, ALL SURFACES SHALL BE ROUGHENED TO A MINIMUM AMPLITUDE OF ⅛″ TO EXPOSE THE AGGREGATE, THOROUGHLY CLEANED AND MOISTENED.

2.4.25 ALL GROUT SHALL ATTAIN A MINIMUM COMPRESSIVE STRENGTH OF 5000 PSI AT 28 DAYS AND SHALL ATTAIN A MINIMUM COMPRESSIVE STRENGTH OF 3500 PSI AFTER 1 DAY.

2.4.26 THE FOLLOWING TYPES OF CONCRETE FINISH SHALL BE PROVIDED FOR THE SURFACES INDICATED UNLESS NOTED OTHERWISE. SEE ACI-301 AND THE APPLICABLE CONSTRUCTION SPECIFICATIONS FOR A DESCRIPTION OF THE SURFACE FINISH TYPES.

A. SCRATCHED FINISH
- TOP OF ROUGH CONCRETE SURFACES THAT WILL BE COVERED WITH SEPARATE CONCRETE FLOOR FINISH.
- TOP OF CONCRETE DUCT RUNS

B. SCRATCHED FINISH - INTENTIONALLY ROUGHENED TO A FULL AMPLITUDE OF ¼″
- TOP OF AN INTERMEDIATE LIFT IN MULTILIFT POURS OF SLABS, WALLS, OR MATS(E.G., CONSTRUCTION JOINTS).

C. FLOATED FINISH
- TOP OF WALLS, FLOORS OF TUNNELS, INTAKE STRUCTURES, MANHOLES, SUMP PITS, VALVE PITS AND MISCELLANEOUS PITS.
- FOR SURFACES RECEIVING ROOFING OR WATER PROOFING MEMBRANES.

D. TROWELLED FINISH
- FOR FLOORS AND THE TOP SURFACES OF CURBS, PIERS, PADS AND PEDESTALS.
- SWITCHYARD AND OTHER EQUIPMENT FOUNDATIONS WHERE THE TOP SURFACES WILL BE EXPOSED AFTER COMPLETION OF THE WORK.

E. BROOM OR BELT FINISH
- FOR EXTERIOR FLATWORK INCLUDING DRIVEWAYS AND SIDEWALKS.

F. NONSLIP FINISH
- FOR EXTERIOR AND INTERIOR PLATFORMS STEPS AND LANDINGS OF BOTH FORMED CONCRETE AND METAL PAN STAIRS.
- FOR EXTERIOR AND INTERIOR RAMPS.

2.4.27 SPECIAL CONCRETE FINISHES OTHER THAN THOSE SPECIFIED IN NOTE 2.4.26 ARE SPECIFIED ON THE DESIGN DRAWINGS.

2.4.28 WATERPROOFING SHALL BE APPLIED IN ACCORDANCE WITH THE APPLICABLE CONSTRUCTION SPECIFICATION AND AS INDICATED BELOW:

A. EXTERIOR SURFACES OF ALL WALLS BELOW FINISH GRADE UNLESS NOTED OTHERWISE. SEE DRAWING "LATER" FOR SITE PLAN OF PLANT GRADING.

B. SIDE SURFACES OF BASE MATS UNLESS NOTED.

C. ALL SURFACES OF TUNNELS AND OTHER MISCELLANEOUS STRUCTURES UNLESS NOTED.

2.4.29 SLEEVE PENETRATIONS OR EMBEDDED PIPES SHALL BE ROTATED TO PROVIDE MAXIMUM SPACE BETWEEN THE FIN LUGS OF ADJACENT SLEEVES.

## CONCRETE WORK (CONTINUED)

2.4.30 IN CASES WHERE EMBEDMENT PLATES ARE PROVIDED IN ROUGH CONCRETE AND THE FINISH CONCRETE IS POURED PRIOR TO INSTALLING ANY ATTACHMENTS TO THE PLATE, A BLOCK OUT SHALL BE PROVIDED IN THE FINISH CONCRETE AS PER DETAIL 6.1.11 ON DRAWING S-10002.

2.4.31 IF CONCRETE PLACEMENT MUST BE STOPPED RESULTING IN A COLD JOINT,PROVIDE A CONSTRUCTION JOINT AS FOLLOWS:

A. NO.8 SHEAR DOWELS SHALL BE PROVIDED PERPENDICULAR TO THE CONSTRUCTION JOINT AND SPACED AS SHOWN ON DETAIL 6.1.19 ON DRAWING S-10002.

B. THE CONSTRUCTION JOINT SHALL BE PREPARED BY THE METHODS DESCRIBED IN THE APPLICABLE CONSTRUCTION SPECIFICATION.

2.4.32 ALL REINFORCING BARS SHALL BE CONTINUOUS ON OUTSIDE CORNERS OF WALLS OR CORNER BARS SHALL BE PROVIDED.

2.4.33 - NOT USED -

2.4.34 FOR TYPICAL REINFORCING AROUND OPENINGS SEE DRAWING S-10003

2.4.35 ALL WATERSTOPS SHALL BE SPLICED TO FORM A CONTINUOUS WATERTIGHT SEAL. ALL WATERSTOPS SHALL BE 6″x⅜″ PVC OR STEEL AS INDICATED IN THE PROJECT SPECIFICATION, UNLESS NOTED. WATERSTOPS USED FOR CONTAINMENT AT ALL TRANSFORMERS SHALL BE PVC (DUMBBELL TYPE) OR APPROVED EQUAL.

2.4.36 FOR REINFORCING BARS AT COLUMN POCKETS, SEE TYPICAL COLUMN POCKET REINFORCEMENT DETAIL ON DRAWING S-10002.

2.4.37 NAIL HOLES SHALL BE PROVIDED FOR ALL EMBEDDED PLATES TO SECURE THEM TO FORMWORK. ALL NAIL HOLES SHALL BE INDICATED ON SHOP DRAWINGS.

2.4.38 - NOT USED -

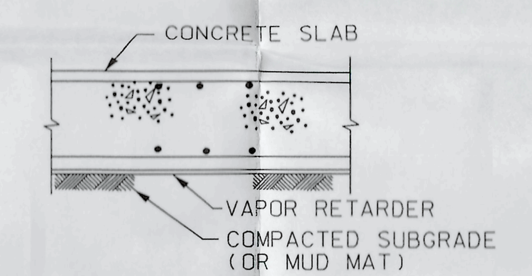
2.4.39 ALL ALUMINUM SURFACES EMBEDDED IN OR IN CONTACT WITH CONCRETE SHALL BE COATED IN ACCORDANCE WITH THE PROJECT SPECIFICATION.

2.4.40 - NOT USED -

2.4.41 WHERE CONCRETE SLAB IS INDICATED AS SLOPED (TO DRAIN) SPECIFIED CONCRETE THICKNESS SHALL BE MEASURED AT THE HIGH POINT. REINFORCING COVER REQUIREMENTS SHALL BE MAINTAINED AT THE LOW POINT OF CONCRETE.

2.4.42 PROVIDE SADDLES ON SLOPED FLOORS AT ALL EQUIPMENT PADS TO PREVENT WATER ACCUMULATON.

2.4.43 ALL FLOOR SLABS IN CONTACT WITH GROUND IN INHABITED BUILDINGS OR THAT RECEIVE ANY FORM OF FLOOR COVERING OR COATING SHALL BE INSTALLED WITH A VAPOR RETARDER BELOW THE SLAB IN ACCORDANCE WITH THE REQUIREMENTS THE SPECIFICATION.




TYPICAL VAPOR RETARDER DETAIL

2.4.44 DOWELS AND POST-INSTALLED ANCHOR RODS SHALL BE INSTALLED USING HILTI HIT HY-150 INJECTION ADHESIVE OR APPROVED EQUAL UNLESS NOTED. THE HOLE SIZE AND DRILLING REQUIREMENTS SHALL BE PER THE MANUFACTURER'S RECOMMENDATIONS UNLESS NOTED.

2.4.45 WHEN DRILLING INTO EXISTING CONCRETE, CUTTING OF EXISTING REBAR IS NOT ALLOWED. CONTRACTOR SHALL DRILL PILOT HOLES AND/OR MAP EXISTING REBAR AS REQUIRED. CONTRACTOR MAY RELOCATE NEW DOWELS ±2″ IN ANY DIRECTION TO AVOID HITTING ANY EXISTING REBAR.

2.4.46 ALL EXPANSION ANCHORS SHALL BE WEDGE TYPE, HILTI-KWIK BOLT 3 OR EQUAL. INSTALLATION SHALL BE PER MANUFACTURER'S RECOMMENDATION.

2.5 MATERIALS

2.5.1 REINFORCING STEEL

A. WELDED WIRE REINFORCEMENT SHALL BE PLAIN TYPE, ASTM A185; IN FLAT SHEETS AND UNCOATED.

B. REINFORCING STEEL SHALL BE ASTM A615, GRADE 60 BILLET STEEL DEFORMED BARS AND UNCOATED.

2.5.2 CONCRETE

CONCRETE SHALL BE IN ACCORDANCE WITH THE SPECIFICATION D-1060

NOTE:
THIS ELECTRONIC FILE CONTAINS INFORMATION WHICH MAY BE COPIED IN WHOLE OR IN PART FOR PREPARATION OF PROJECT DELIVERABLES. PROJECT PERSONNEL ARE RESPONSIBLE FOR REVIEW AND APPROVAL OF RESULTANT DELIVERABLES IN ACCORDANCE WITH S&L STANDARD OPERATING PROCEDURES (SOP).

## CONCRETE WORK (CONTINUED)

UNDERGROUND OR EMBEDDED UTILITIES MAY EXIST WITHIN THE AREA OF AND ADJACENT TO THE LIMITS OF THE WORK. THE LOCATION OR IDENTIFICATION OF SUCH UTILITIES HAS NOT BEEN VERIFIED BY OWNER OR BY S&L. CONTRACTOR/INSTALLER IS RESPONSIBLE FOR FIELD LOCATING AND IDENTIFYING UNDERGROUND OR EMBEDDED UTILITIES AND ANY OTHER UNDERGROUND OR EMBEDDED UTILITY DIMENSIONS.

REFERENCES USED HAVE BEEN IDENTIFIED ON EXCAVATION/FOUNDATION/DEMOLITION DRAWINGS AND HAVE BEEN PROVIDED TO ASSIST THE CONTRACTOR/INSTALLER IN THE FIELD LOCATING EXISTING UTILITIES AND OTHER POTENTIAL UNDERGROUND OR EMBEDDED INTERFERENCES. THESE REFERENCES ONLY SHOW THE APPROXIMATE LOCATION OF POTENTIAL UNDERGROUND OR EMBEDDED UTILITIES AND MAY NOT INDICATE OR REFLECT ALL EXISTING UNDERGROUND OR EMBEDDED UTILITIES OR THEIR ACTUAL LOCATIONS.

REFERENCES IDENTIFIED SHALL NOT SUBSTITUTE FOR THE CONTRACTOR'S/INSTALLER'S OBLIGATION TO FIELD LOCATE ANY UNDERGROUND OR EMBEDDED UTILITIES OR INTERFERENCES THAT MAY AFFECT THE WORK.

DUE CAUTION SHALL BE TAKEN DURING ANY EXCAVATION/FOUNDATION/DEMOLITION WORK WITHIN THE AREA OF AND ADJACENT TO THE LIMITS OF THE WORK DUE TO POSSIBLE INTERFERENCES THAT MAY NOT BE REFLECTED ON THE REFERENCES IDENTIFIED.

ALL WORK DONE BY CONTRACTOR/INSTALLER PURSUANT TO THIS DRAWING SHALL: (A) CONFORM TO THE GOVERNING CONTRACT DOCUMENTS; (B) BE PERFORMED EXCLUSIVELY BY ITS TRAINED, COMPETENT PERSONNEL OR, WHERE PERMITTED, THAT OF ITS SUBCONTRACTOR(S); AND (C) COMPLY WITH ALL APPLICABLE SAFETY LAWS, REGULATIONS, PROGRAMS AND PRACTICES TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING THE CONTRACTOR'S/INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S)) PERFORMING THE WORK.

FILE NO. C180-E3306-2.DGN



SARGENT & LUNDY LLC's
ILLINOIS DEPARTMENT OF PROFESSIONAL REGULATION
REGISTRATION NUMBER IS 184-000106

AEG CAD GENERATED
DO NOT REVISE MANUALLY

DRAWING RECORD

| REV. | DATE | PREPARED | REVIEWED | APPROVED | DESCRIPTION |
|---|---|---|---|---|---|
| 0A | 04/21/06 | GT | AN | —— | FOR CLIENT COMMENTS |
| 0B | 07-02-07 | S.R. / A. | GW | —— | FOR BIDS SPECIFICATION D-1007 |
| 0C | 09/21/07 | D.ZIMA | GW | —— | FOR CONSTRUCTION SPECIFICATION D-1007 |

STATE OF ILLINOIS — GARY WILLIAMS — 81-4140 — EXP. 11-30-2008 — LICENSED STRUCTURAL ENGINEER

SCALE 1/4″=1-0″
PROJECT 11478-034
140M052
DRAFTER
DDC
DATE
-

DRAWING TITLE

CONCRETE GENERAL NOTES

BOTTOM ASH AND LOW VOLUME SUMP WATER BASIN AND PIPING PROJECT
CANTON, ILLINOIS
DUCK CREEK POWER STATION UNIT NO. 1

Ameren Energy Resources Generating

| DRAWING NUMBER | REV. |
|---|---|
| C180-E3306-2 | 0C |

SHEET NO. 1

**APPENDIX C**

# Hydrologic and Hydraulic Assessments

AECOM

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

Submitted by
AECOM
1001 Highlands Plaza Drive West,
Suite 300
St. Louis, MO 63110

October 2016

# CCR Certification Report: Initial Structural Stability Assessment, Initial Safety Factor Assessment, and Initial Inflow Design Flood Control System Plan

For

Bottom Ash Basin

At Duck Creek Power Station

# Table of Contents

# Executive Summary

The initial structural stability assessment, initial safety factor assessment, and initial inflow design flood control system plan for the Bottom Ash Basin at the Duck Creek Power Station have been prepared in accordance with the United States Environmental Protection Agency (USEPA) Coal Combustion Residual (CCR) Rule 40 Code of Federal Regulations (CFR) §257.73(d), §257.73(e), and §257.82, respectively. These regulations require that the specified structural stability, safety factor, and hydrologic and hydraulic (supporting the inflow design flood control system plan) assessments for an existing CCR surface impoundment be completed by October 17, 2016. The Bottom Ash Basin is an incised CCR surface impoundment, as defined by 40 CFR §257.53. Per §257.73(b), the requirements of §257.73(d) (structural stability assessment) and §257.73(e) (safety factor assessment) are not applicable to incised CCR surface impoundments.

The engineering investigations, analyses, and evaluations determined that the Bottom Ash Basin meets all requirements for hydrologic and hydraulic analysis, as summarized in Table ES-1.

**Table ES-1 – Certification Summary**

<table>
<tr><th>Report Section</th><th>CCR Rule Reference</th><th>Requirement Summary</th><th>Requirement Met?</th><th>Comments</th></tr>
<tr><td colspan="5">Initial Structural Stability Assessment</td></tr>
<tr><td rowspan="7">3</td><td>§257.73(d)(1)(i)</td><td>Stable foundations and abutments</td><td rowspan="7">Not Applicable</td><td rowspan="7">The Bottom Ash Basin is an incised CCR surface impoundment and does not meet the criteria in §257.73(b); thus, the requirement to perform a structural stability assessment does not apply.</td></tr>
<tr><td>§257.73(d)(1)(ii)</td><td>Adequate slope protection</td></tr>
<tr><td>§257.73(d)(1)(iii)</td><td>Sufficiency of dike compaction</td></tr>
<tr><td>§257.73(d)(1)(iv)</td><td>Presence and condition of slope vegetation</td></tr>
<tr><td>§257.73(d)(1)(v)(A) and (B)</td><td>Adequacy of spillway design and management</td></tr>
<tr><td>§257.73(d)(1)(vi)</td><td>Structural integrity of hydraulic structures</td></tr>
<tr><td>§257.73(d)(1)(vii)</td><td>Stability of downstream slopes inundated by water body</td></tr>
<tr><td colspan="5">Initial Safety Factor Assessment</td></tr>
<tr><td rowspan="4">4</td><td>§257.73(e)(1)(i)</td><td>Maximum storage pool safety factor must be at least 1.50</td><td rowspan="4">Not Applicable</td><td rowspan="4">The Bottom Ash Basin is an incised CCR surface impoundment and does not meet the criteria in §257.73(b); thus, the requirement to perform a safety factor assessment does not apply.</td></tr>
<tr><td>§257.73(e)(1)(ii)</td><td>Maximum surcharge pool safety factor must be at least 1.40</td></tr>
<tr><td>§257.73(e)(1)(iii)</td><td>Seismic safety factor must be at least 1.00</td></tr>
<tr><td>§257.73(e)(1)(iv)</td><td>For dikes constructed of soils that have susceptibility to liquefaction safety factor must be at least 1.20</td></tr>
<tr><td colspan="5">Initial Inflow Design Flood Control System Plan</td></tr>
<tr><td>5.1</td><td>§257.82(a)(1), (2), (3)</td><td>Adequacy of inflow design flood control system</td><td>Yes</td><td>Flood control system adequately manages inflow and peak discharge during the 25-year, 24-hour Inflow Design Flood.</td></tr>
<tr><td>5.2</td><td>§257.82(b)</td><td>Discharge from the CCR Unit</td><td>Yes</td><td>Discharge from CCR Unit is routed through a NPDES-permitted outfall during both normal and 25-year, 24-hour Inflow Design Flood conditions.</td></tr>
</table>

# 1 Introduction

This report documents that the inflow design flood control system plan meets the requirements specified in 40 CFR §257.82 to support the certification required under the regulatory provision for the Duck Creek Power Station Bottom Ash Basin. The Bottom Ash Basin is an existing CCR surface impoundment as defined by 40 CFR §257.53. The CCR Rule requires that the specified initial structural stability assessment, initial safety factor assessment, and initial inflow design flood control system plan (i.e., hydrologic and hydraulic analysis) for an existing CCR surface impoundment be completed by October 17, 2016.

The Bottom Ash Basin is an incised CCR surface impoundment, as defined by 40 CFR §257.53, that is used to manage sluiced bottom ash. Under 40 CFR §257.73(b), structural stability assessments (§257.73(d)) and safety factor assessments (§257.73(e)) must be performed for an existing CCR surface impoundment that:

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.*

The Bottom Ash Basin does not satisfy the criteria because the incised basin does not have dikes. Therefore, the Bottom Ash Basin is not subject to the structural stability assessment (§257.73(d)) and safety factor assessment (§257.73(e)) requirements.

The requirements for hydrologic and hydraulic assessments specified in §257.82 are applicable to the incised Bottom Ash Basin and are addressed herein.

The Bottom Ash Basin has been evaluated to determine whether the inflow design flood control system plan requirements are met. The following sections describe the evaluations performed and the results from the analyses, as supported by the underlying data and analyses included in the appendix.

# 2 Facility Description and Location Map

## 2.1 Overview of Existing Surface Impoundments

The Duck Creek Power Station is a coal-fired power plant located near Canton, Illinois in Fulton County. The station is located west of the Illinois River and Duck Creek Reservoir, and the Bottom Ash Basin is located approximately 0.1 miles northeast of the station. A site location map showing the Duck Creek Power Station is in **Figure 1. Figure 2A** presents the Duck Creek Power Station site plan, and **Figure 2B** presents the site plan in the vicinity of the Bottom Ash Basin.

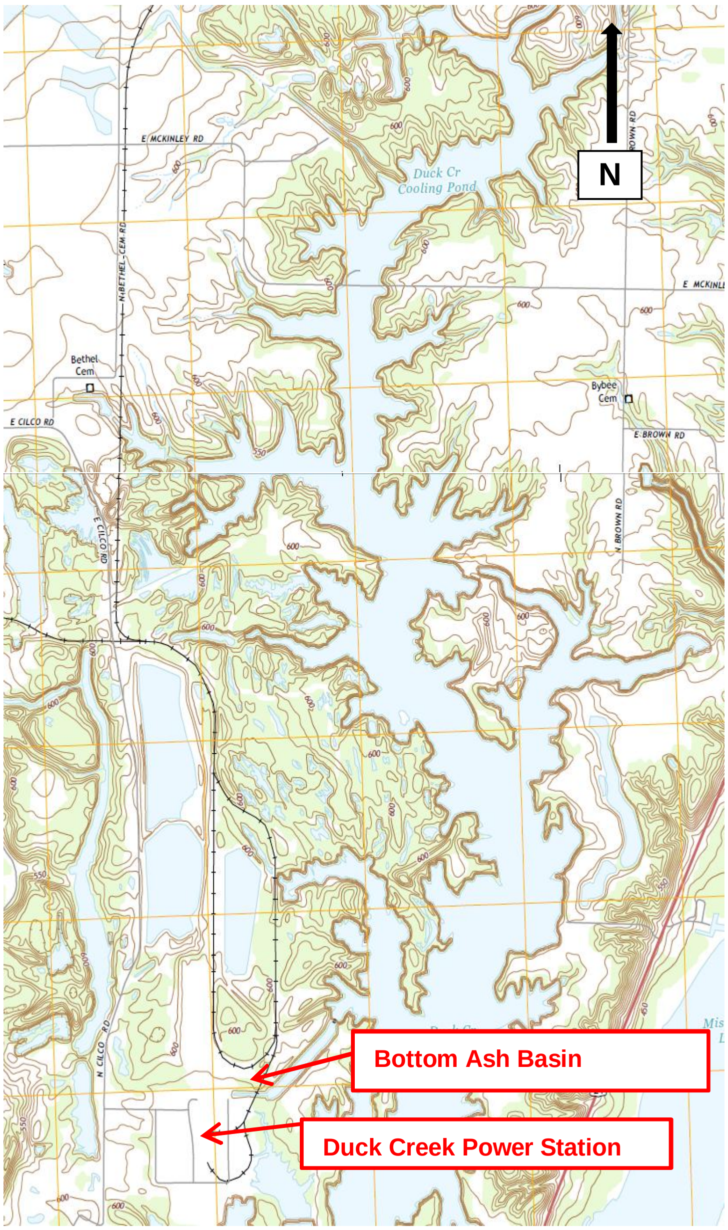



**Figure 1 – Duck Creek Power Station Location Map**

*(from United States Geological Survey Banner and Duck Island 7.5' Topographic Maps, 2015)*

Two active CCR surface impoundments – the GMF Pond and the Bottom Ash Basin – are utilized for managing CCRs generated by the Duck Creek Power Station. This certification report only pertains to the Bottom Ash Basin. Per §257.73, a hazard potential classification assessment is not required for incised CCR surface impoundments.

The Bottom Ash Basin, which is sub-divided into Primary Pond 1, Primary Pond 2 and the Secondary Settlement Pond, serves as the wet bottom ash impoundment basin. Within the Bottom Ash Basin, Primary Ponds 1 and 2 are essentially identical in design and construction and receive sluiced bottom ash from the Duck Creek Power Station. The Secondary Settlement Pond sub-basin operates as a polishing pond before discharging water into the station's discharge channel, which leads to the Duck Creek Reservoir and a NPDES-permitted outfall. The Bottom Ash Basin consists of incised trapezoidal basins that were constructed in 2009. Primary Pond 1 and Primary Pond 2 operate alternately with each sub-basin operating for approximately one week at a time. While one sub-basin is receiving bottom ash, the other sub-basin is dewatered and the ash is removed.

Sluiced bottom ash enters the Bottom Ash Basin through Trenwa precast modular trenches. Overflow water from the Primary Pond sub-basins flows into the Secondary Settlement Pond sub-basin through a stop-log weir. Outflow from the Bottom Ash Basin is transmitted from the Secondary Settlement Pond through a stop-log structure into a 12-inch diameter corrugated high-density polyethylene (HDPE) pipe which flows by gravity into the discharge channel.


**Figure 2A – Duck Creek Power Station Site Plan**
*(Imagery from Google Earth Pro, 2016)*

The Bottom Ash Basin is lined with, from bottom to top, a 60-mil geomembrane, 12-inches of compacted clay, and an 8-inch reinforced concrete slab. The interior side slopes of the Bottom Ash Basin are graded at a 7% slope and were constructed to a sidewall heights ranging from 5.7 to 9 feet (basin sidewalls below current existing grade).

As currently operated, the maximum operating pool of Bottom Ash Basin Primary Ponds 1 and 2 is El. 577.3 feet (all elevations listed in this report are in the NAVD88 datum, unless stated otherwise), and the normal pool elevation of the Secondary Settlement Pond is 573.5 feet. The pool elevation in each sub-basin is controlled by the stop log overflow weirs. The Bottom Ash Basin is approximately 1.9 acres in size and the perimeter (crest length) is approximately 1,100 feet. The minimum crest elevation of the Bottom Ash Basin is 579.0 feet for Primary Pond 1 and Primary Pond 2 and 578.0 feet for the Secondary Settlement Pond. Additional details about the geometry and configuration of the Bottom Ash Basin and each sub-basin is provided in the Hydrologic and Hydraulic Report in **Appendix A**.

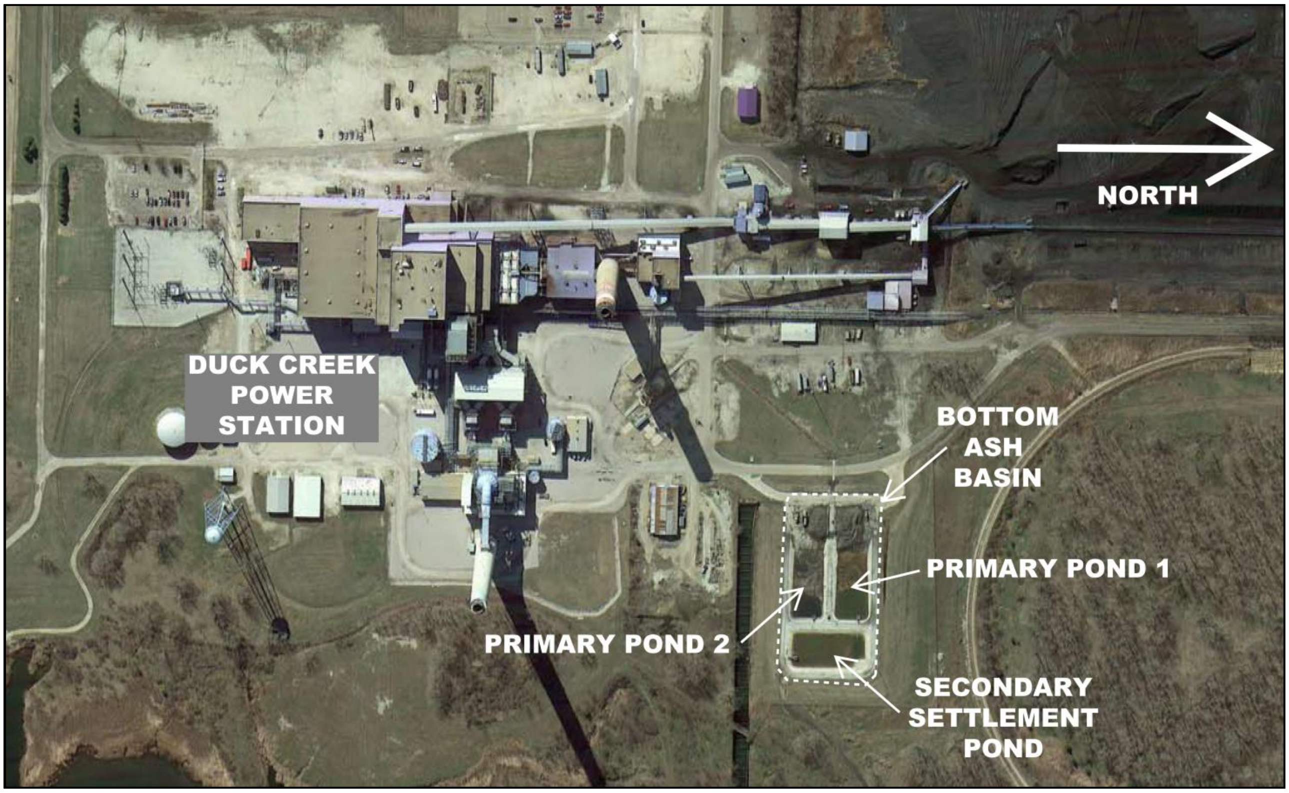



**Figure 2B – Duck Creek Power Station Bottom Ash Basin Area Plan**
*(Imagery from Google Earth Pro, 2016)*

# 3 Initial Structural Stability Assessment

*40 CFR §257.73(d)(1)*
*The owner or operator of the CCR unit must conduct initial and periodic structural stability assessments and document whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein. The assessment must, at a minimum, document whether the CCR unit has been designed, constructed, operated, and maintained with [the standards in (d)(1)(i)-(vii)].*

According to §257.73(b), structural stability assessments are required for existing CCR surface impoundments that have a height of five feet or more. The requirements of §257.73(d) are not applicable to the incised Bottom Ash Basin at the Duck Creek Power Station because dikes are not present.

# 4 Initial Safety Factor Assessment

*40 CFR §257.73(e)(1)*
*The owner or operator must conduct initial and periodic safety factor assessments for each CCR unit and document whether the calculated factors of safety for each CCR unit achieve the minimum safety factors specified in (e)(1)(i) through (iv) of this section for the critical cross section of the embankment. The critical cross section is the cross section anticipated to be the most susceptible of all cross sections to structural failure based on appropriate engineering considerations, including loading conditions. The safety factor assessments must be supported by appropriate engineering calculations.*

According to §257.73(b), safety factor assessments are required for existing CCR surface impoundments that have a height of five feet or more. The requirements of §257.73(e) are not applicable to the incised Bottom Ash Basin at the Duck Creek Power Station because dikes are not present.

# 5 Initial Inflow Design Flood Control System Plan

*40 CFR §257.82*

*(a) The owner or operator of an existing … CCR surface impoundment … must design, construct, operate, and maintain an inflow design flood control system as specified in paragraphs (a)(1) and (2) of this section.*

*(1) The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood specified in paragraph (a)(3) of this section.*

*(2) The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood specified in paragraph (a)(3) of this section.*

*(3) The inflow design flood is:*

*(i) For a high hazard potential CCR surface impoundment, …, the probable maximum flood;*

*(ii) For a significant hazard potential CCR surface impoundment, …, the 1,000-year flood;*

*(iii) For a low hazard potential CCR surface impoundment, …, the 100-year flood; or*

*(iv) For an incised CCR surface impoundment, the 25-year flood.*

*(b) Discharge from the CCR unit must be handled in accordance with the surface water requirements under §257.3-3.*

Analyses completed for the initial inflow design flood control system plan of the Bottom Ash Basin are described in the following subsections. Data and analysis results in the following subsection are based on spillway design information shown on design drawings, construction information, topographic surveys, information about operational and maintenance procedures provided by IPRG and field measurements collected by AECOM. The analysis approach and results of the hydrologic and hydraulic analyses are presented in the following subsections. A detailed presentation of the analyses performed can be found in **Appendix A**.

The Bottom Ash Basin is an “incised CCR surface impoundment” as defined by 40 CFR *§*257.53. Therefore, the inflow design flood (IDF) is the 25-year flood per *§*257.82(a)(3)(iv).

## 5.1 Initial Inflow Design Flood Control Systems (§257.82(a))

An initial inflow design flood control system plan, supported by a hydraulic and hydrologic analysis, was developed for the Bottom Ash Basin by evaluating the effects of a 24-hour duration design storm for the 25-year IDF using a hydraulic HydroCAD (Version 10) computer model and a starting water surface elevation of 577.3 feet in the Primary Pond 1 and 2 sub-basins and 573.5 feet in the Secondary Settlement Pond sub-basin. These starting water surface elevations are based on the characteristics of the outfall structures for each sub-basin, which, in their current configuration, would allow for normal pool elevations up to 577.3 feet in Primary Ponds 1 and 2 and 573.5 feet in the Secondary Settlement Pond when all stop logs are in place. The computer model evaluated the Bottom Ash Basin’s ability to collect and control the 25-year IDF under existing operational and maintenance procedures. Rainfall data for the 25-year IDF was obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14. The NOAA Atlas 14 rainfall depth is 5.25 inches.

The HydroCAD model results for the Bottom Ash Basin indicate that the CCR unit has sufficient storage capacity and spillway structures to adequately manage (1) flow into the CCR unit during and following the peak discharge of the 25-year IDF and (2) flow from the CCR unit to collect and control the peak discharge resulting from the 25-year IDF. The peak water surface elevation is 577.8 feet during the IDF in Primary Pond 1, 577.7 feet in Primary Pond 2, and 574.2 feet in the Secondary Settlement Pond. The minimum crest elevation is 579.0 feet for Primary Ponds 1 and 2 and 578.0 feet for the Secondary Settlement Pond. Therefore, overtopping is not expected.

Based on this evaluation, the Bottom Ash Basin meets the requirements in §257.82(a), and the hydrologic and hydraulic analysis is presented in **Appendix A**.

## 5.2 Discharge from the CCR Unit (§257.82(b))

40 CFR §257.82(b) provides that the discharge from the CCR unit must be handled in accordance with the surface water requirements under 40 CFR §257.3-3, which states the following:

> *(a) For purposes of section 4004(a) of the Act, a facility shall not cause a discharge of pollutants into waters of the United States that is in violation of the requirements of the National Pollutant Discharge Elimination System (NPDES) under section 402 of the Clean Water Act, as amended.*
>
> *(b) For purposes of section 4004(a) of the Act, a facility shall not cause a discharge of dredged material or fill material to waters of the United States that is in violation of the requirements under section 404 of the Clean Water Act, as amended.*
>
> *(c) A facility or practice shall not cause non-point source pollution of waters of the United States that violates applicable legal requirements implementing an areawide or Statewide water quality management plan that has been approved by the Administrator under section 208 of the Clean Water Act, as amended.*
>
> *(d) Definitions of the terms Discharge of dredged material, Point source, Pollutant, Waters of the United States, and Wetlands can be found in the Clean Water Act, as amended, 33 U.S.C. 1251 et seq., and implementing regulations, specifically 33 CFR part 323 (42 FR 37122, July 19, 1977).*

The handling of discharge was evaluated by reviewing design drawings, operational and maintenance procedures, conditions observed in the field by AECOM, and the inflow design flood control system plan developed per §257.82(a).

Based on this evaluation, outflow from the Bottom Ash Basin is ultimately routed through a NPDES-permitted outfall into the Duck Creek Reservoir, via the discharge channel. Hydraulic and hydrologic analyses performed as part of the initial inflow design flood control system plan found the Bottom Ash Basin adequately manages outflow during the 25-year IDF, as overtopping of the Bottom Ash Basin is not expected.

Therefore, discharge in pollutants in violation of the NPDES permit is not expected as discharge s routed and controlled through the existing spillway system and NPDES permitted outfall during both normal and IDF conditions. Based on this evaluation, the Bottom Ash Basin meets the requirements in §257.82(b).

# 6 Conclusions

The Bottom Ash Basin at the Duck Creek Power Station is an incised CCR surface impoundment; therefore, it is not required to meet the structural stability assessment (§257.73(d)) and safety factor assessment (§257.73(e)) requirements of the CCR Rule. The Bottom Ash Basin was evaluated relative to the CCR Rule requirements for the initial inflow design flood control system plan (§257.82). Based on the evaluations presented herein, the initial inflow design flood control system plan requirements are satisfied.

# 7 References

AECOM (2016). *Hydrologic and Hydraulic Summary Report-Duck Creek Power Station, Bottom Ash Basin.* Canton, Illinois.

National Oceanic and Atmospheric Administration (NOAA) (2013) Atlas 14, Precipitation-Frequency Atlas of the United States, Volume 2, Version 13, http://hdsc.nws.noaa.gov/hdsc/pfds/index.html.

Sargent & Lundy (2009). *Bottom Ash and Low Volume Sump Water Basin* design drawings. May 8, 2009.

U.S. Environmental Protection Agency [USEPA]. (2015). *Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments.* 40 CFR Part 257, Subpart D. 80 Fed. Reg. 21468 April 17, 2015.

# 8 Appendix

A. Hydrologic and Hydraulic Report

# Appendix A. Hydrologic and Hydraulic Report

AECOM
1001 Highlands Plaza Drive West
Suite 300
St. Louis, MO 63110-1337
www.aecom.com

314.429.0100 tel
314.429.0462 fax

October 7, 2016

Mr. Matt Ballance, PE
Senior Project Engineer
Dynegy Inc.
1500 Eastport Plaza Drive
Collinsville, IL 62234

**RE: Hydrologic and Hydraulic Summary Report**
**Duck Creek Station**
**Bottom Ash Basin**

Dear Mr. Ballance:

AECOM is pleased to provide this Summary Report of Hydrologic and Hydraulic Modeling for the Illinois Power Resources Generating, LLC (IPRG) Duck Creek Bottom Ash Basin Coal Combustion Residual (CCR) Unit. This analysis was performed to document that the facility meets the requirements of 40 CFR § 257.82(a) with regard to the Inflow Design Flood Control Plan. Based on AECOM's analysis, the Bottom Ash Basin meets all hydraulic requirements for certification per 40 CFR § 257.82(a).

AECOM looks forward to providing continued support to IPRG and working together on this important program. Please do not hesitate to call Ron Hager at 314-429-0100 (office) / 440-591-7868 (mobile), if you have any questions.

Sincerely,
AECOM

Brian Linnan, PE
Site Manager
brian.linnan@aecom.com

Ron Hager
Program Manager
ronald.hager@aecom.com

cc: Mark Rokoff, PE – AECOM

**Attachments:**

**A.** Location Plan
**B.** Hydrologic and Hydraulic Analysis

# 1. INTRODUCTION

## 1.1. *Purpose of this Memorandum*

This report presents the results of the hydrologic and hydraulic analysis prepared by AECOM for the Illinois Power Resources Generating, LLC (IPRG)[1] Bottom Ash Basin Coal Combustion Residual (CCR) unit at the Duck Creek Power Station, located southeast of Canton, Illinois in Fulton County (see Attachment A, Location Plan). This analysis was completed in accordance with the Environmental Protection Agency (EPA) 40 CFR Part §257, Subpart D, regulations for the disposal of CCR. As required by §257.82(a), by October 17, 2016 owners and operators of existing CCR surface impoundments must develop an Inflow Design Flood Control Plan that documents how the inflow design flood control system had been designed and constructed to meet the following requirements:

- *40 CFR 257.82 (a)(1)* - The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood.

- *40 CFR 257.82 (a)(2)* - The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood.

The Duck Creek Station Bottom Ash Basin is an "incised CCR surface impoundment" as defined in 40 CFR §257.53. In accordance with §257.82(a)(3)(iv), the inflow design flood for an incised CCR surface impoundment is the 25-year storm event. This event is the basis for AECOM certification.

## 1.2. *Brief Description of Impoundments*

The Duck Creek Power Station is located southeast of Canton in Fulton County, Illinois (see Attachment A, Location Plan). The Bottom Ash Basin is located directly northeast of the generating station, as shown on the Location Plan. Design drawings for the Bottom Ash Basin were prepared by Sargent and Lundy and are dated 2009. The Bottom Ash Basin is comprised of several internal sub-basins, which are Primary Pond 1, Primary Pond 2, and Secondary Settlement Pond. The two Primary Ponds are essentially identical. They are each approximately 0.73 acres in size and each discharges outflow over a weir into a stop-log structure and through a 12-inch corrugated high-density polyethylene (HDPE) transfer pipe into the approximately 0.48-acre Secondary Settlement Pond.

The Secondary Settlement Pond discharges through a stop-log structure to the discharge channel through a 105-foot long, 12-inch diameter HDPE pipe. The top of the stop-log weir is at elevation 573.5 feet (all elevations in this report are listed in the NAVD 88 datum unless otherwise noted). The 12-inch HDPE pipe has an invert elevation of 569.5 feet at the upstream end and an invert elevation of 568.0 feet at the outfall. The discharge channel also collects stormwater runoff from a stormwater

[1] Although the Duck Creek Power Station and Bottom Ash Basin are owned and operated by IPRG, Dynegy Administrative Services Company (*Dynegy*) contracted AECOM to develop this Hydrologic and Hydraulic Summary Report on behalf of IPRG). Therefore, "Dynegy" is referenced in materials attached to this hydraulic and hydrologic report.

channel that discharges into storm sewer pipe system that runs along the north and east side of the Bottom Ash Basin. The stormwater channel is incised below natural ground elevation.

The Primary Ponds are each operated for a week at a time, with ash being deposited and dewatered in one pond while in the other pond the dewatered ash is being removed. The normal water elevation in the discharge channel is 1.5 feet lower than the Secondary Settlement Pond outfall. AECOM assumed the water level in the discharge channel stays below the Secondary Settlement Pond outfall invert elevation during and after the design storm and that the discharge channel has free discharge to Duck Creek Reservoir.

## 2. POND CAPACITY / IMPOUNDMENT COMPUTATIONS

The elevation/areas for the hydraulic modeling of the Bottom Ash Basin Primary Ponds 1 and 2 and Secondary Settlement Pond were evaluated using the design documents provided by IPRG including plans and details (Sargent and Lundy, 2009). Detailed pond storage and discharge infrastructure data are provided in Attachment B. The normal operational pool water surface elevation at the beginning of the design storm was determined for the Bottom Ash Basin based on running a “sunny day” analysis, assuming plant process flow into the Bottom Ash Basin and assuming that all stop logs are in place on the outfall structures. This is intended to represent conditions where Primary Ponds 1 and 2 are filled to the maximum operating level with either CCR material or free water. Aerial photography was also examined for the site to estimate approximate volumes of CCR placed above the maximum operating level, and these volumes were accounted for in the capacity calculations for the Bottom Ash Basin.

The Bottom Ash Basin was analyzed to determine whether the sub-basins overtop and run into the run-on diversion channel during operations and the design storm.

The stormwater channel and storm sewer pipe system north and east of the Bottom Ash Basin was analyzed to evaluate the potential for run-on into the Bottom Ash Basin from this system and surrounding areas during the Inflow Design Flood.

## 3. HYDROLOGIC AND HYDRAULIC ANALYSIS

### 3.1. *Rainfall Data*

The rainfall information used in the HydroCAD modeling was based on the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 2, Version 3 (Reference 2) which provides rainfall data for storm events with average recurrence intervals ranging from 1 to 1,000 years and durations ranging from 5 minutes to 60 days. The design storm rainfall depth, obtained from the NOAA website, is 5.25 in for the 24-hour, 25-year storm. The Soil Conservation Service (SCS) Type II storm used by AECOM is appropriate to use for storms up to the 1,000-year flood at the project site.

### 3.2. *Runoff Computations*

The HydroCAD Version 10.0 computer model, by HydroCAD Software Solutions, LLC, was used to model the Duck Creek Bottom Ash Basin collection and control system, for the runoff calculations, and storage and discharge structure evaluations. The model evaluated pond capacities, hydraulics of the sub-basins considering details of the between-pond discharge structures, and the final outlet structure during peak discharges.

During normal operations, the water level in each of the sub-basins is controlled by the stop-log outlet structure in each sub-basin. The beginning water elevations in each pond would be at the lowest elevation if no stop-logs are in place and the highest elevations if all of the stop-logs are in place. The starting water surface elevation (WSE) in Primary Ponds 1 and 2 is based on the top of stop-logs elevation of 577.3 feet and the starting WSE in the Secondary Settlement Pond is based on the top of stop-log structure elevation of 573.5 feet. The flow from the plant, as provided by IPRG, was assumed to be approximately 1.37 cubic feet per second discharging to one of the Primary Ponds at a time. After setting the starting WSE for each sub-basin, the model determines the final WSE in all of the sub-basins based on the constant base flow and the 25-year, 24-hour design flood event.

Please refer to Attachment B.2 for further details and modeling results.

### 3.3. ***Hydraulics***

HydroCAD does not calculate the minor losses through a pipe network, so in order to determine the capacity of the storm sewer pipe system that collects flow from the stormwater channel and runs along the north and east side of the Bottom Ash Basin, it was modeled with AutoCAD Civil 3D Hydraflow Storm Sewers extension (Hydraflow). AECOM used Hydraflow to model the pipe system based on design drawings provided by IPRG. Hydraflow takes into account all of the minor head losses throughout the system due to friction, junctions, and angle changes. A rating curve was developed for the pipe system by inputting known inflows for several different storms ranging from the 1-year recurrence interval to the 50-year recurrence interval. For each known inflow, Hydraflow would calculate the necessary headwater elevation at the inlet. Using this information, a rating curve was constructed and input into the HydroCAD model to accurately account for minor losses throughout the system.

Please refer to Attachment B.3 for Run-on Drainage Basins and Attachment B.4 for Civil 3D Hydraflow Storm Sewers Output.

## 4. CONCLUSIONS

The inflow design flood control system of the Duck Creek Bottom Ash Basin adequately manages flow into and out of the unit during and following the peak discharge of the 25-year storm event inflow design flood while flow from the plant is discharging 1.37 cfs into Primary Pond 1. Results of the model are summarized in Table 4.1.

**Table 4.1**
**Duck Creek Summary of Hydrologic and Hydraulic Analysis, 25-Year, 24-Hour Storm**

| CCR Unit Sub-basin | Beginning WSE[1] (ft) | Peak WSE (ft) | Crest Elevation (ft) |
|---|---|---|---|
| Primary Pond 1 | 577.3 | 577.8 | 579.0 |
| Primary Pond 2 | 577.3 | 577.7 | 579.0 |
| Secondary Settlement Pond | 573.5 | 574.2 | 578.0 |

- There is no anticipated overtopping of the Bottom Ash Basin crest during the inflow design flood.
- Run-on from the surrounding areas does not flow into the Bottom Ash Basin during the inflow design flood.
- The Bottom Ash Basin meets the hydraulic requirements for certification.

## 5. LIMITATIONS

Background information, design basis, and other data, which AECOM has used in preparing this report, have been furnished to AECOM by IPRG. AECOM has relied on this information as furnished, and is not responsible for the accuracy of this information. Our recommendations are based on available information from previous and current investigations. These recommendations may be updated as future investigations are performed.

The conclusions presented in this report are intended only for the purpose, site location, and project indicated. The recommendations presented in this report should not be used for other projects or purposes. Conclusions or recommendations made from these data by others are their responsibility. The conclusions and recommendations are based on AECOM's understanding of current plant operations, maintenance, stormwater handling, and ash handling procedures at the station, as provided by IPRG. Changes in any of these operations or procedures may invalidate the findings in this report until AECOM has had the opportunity to review the changes, and revise the report if necessary.

This hydrologic and hydraulic analysis was performed in accordance with the standard of care commonly used as state-of-practice in our profession. Specifically, our services have been performed in accordance with accepted principles and practices of the engineering profession. The conclusions presented in this report are professional opinions based on the indicated project criteria and data available at the time this report was prepared. Our services were provided in a manner consistent with the level of care and skill ordinarily exercised by other professional consultants under similar circumstances. No other representation is intended.

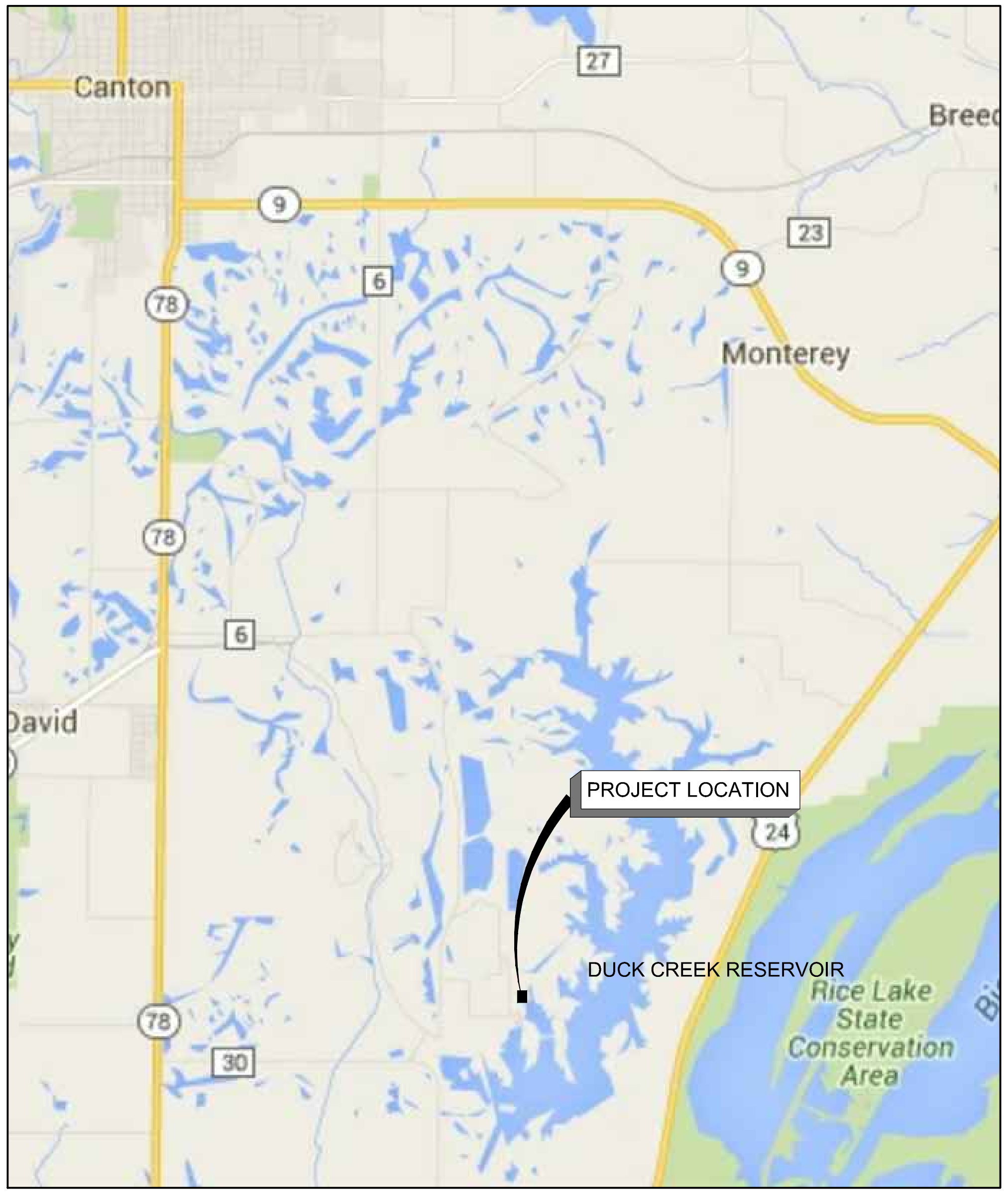
## 6. REFERENCES

Design Drawings, Sargent & Lundy, Inc. (May 8, 2009) – "Bottom Ash and Low Volume Sump Water Basin."

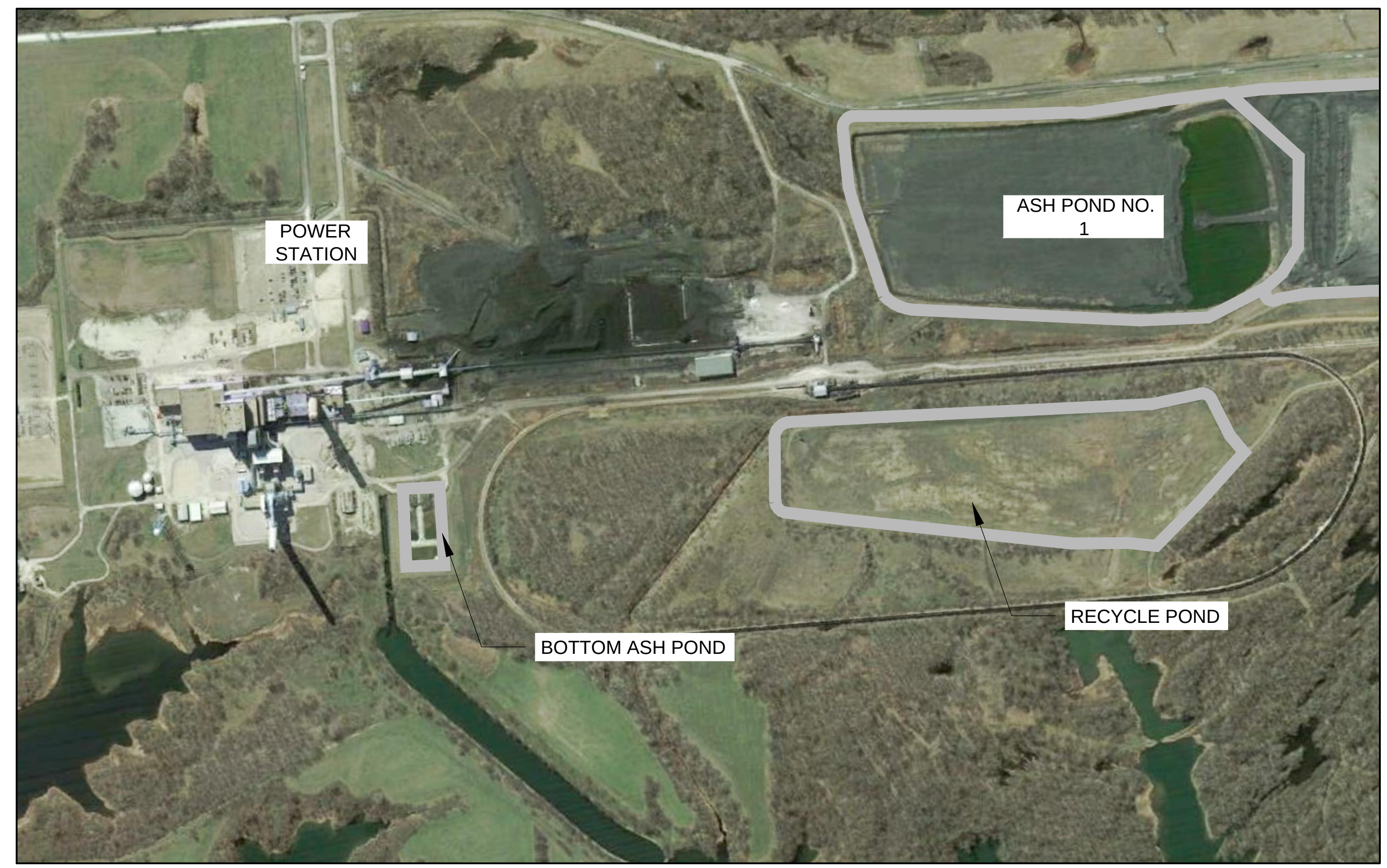
National Oceanic and Atmospheric Administration (NOAA) (2013) Atlas 14, Precipitation-Frequency Atlas of the United States, Volume 2, Version 13, http://hdsc.nws.noaa.gov/hdsc/pfds/index.html.

# Attachment A

# Location Plan




**LOCATION MAP**
NOT TO SCALE




**VICINITY MAP**
1" = 1000'


AECOM
8300 College Boulevard, Suite 200
Overland Park, Kansas 66210
913-344-1000 (phone)
913-344-1011 (fax)

DYNEGY
Dynegy Inc.
1500 East Port Plaza Drive
Collinsville, IL 62234


CCR RULE ASSESSMENT OF PLANTS

DUCK CREEK POWER PLANT
FULTON COUNTY, IL

GEOTECHNICAL REPORT

ISSUED FOR BIDDING DATE BY

ISSUED FOR CONSTRUCTION DATE BY

REVISIONS

| NO. | DESCRIPTION | DATE |
|---|---|---|
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| AECOM PROJECT NO: | 60439301 |
| DRAWN BY: | SMS |
| DESIGNED BY: | WDS |
| CHECKED BY: | BDL |
| DATE CREATED: | 2016-02-22 |
| PLOT DATE: | 2016-02-22 |
| SCALE: | |
| ACAD VER: | 2014 |

SHEET TITLE

LOCATION MAP & SITE VICINITY MAP

**FIGURE 1**

# Attachment B

# Hydrologic and Hydraulic Analysis

**Objective:** **This analysis describes the independent investigation and design calculations and considerations of the on-site hydrology and hydraulics for certification of the Bottom Ash Basin CCR Unit, as required by the Environmental Protection Agency's (EPA's) Final Coal Combustion Residuals (CCR) Rule. In particular, the analysis investigates the performance of the existing impoundments, spillways, and outlet structures for the Bottom Ash Basin during the 25-Yr, 24- hr storm event, as required by the aforementioned CCR rule. AECOM investigated the Bottom Ash Basin CCR Unit as it relates to concerns about stormwater overtopping the perimeter berm during the design storm event while the Duck Creek Plant is discharging to the Bottom Ash Basin.**

## I. Overview

The Bottom Ash Basin is an incised CCR surface impoundment as defined by 40 CFR §257.53. Per 40 CFR §257.82(a)(3)(iv), the inflow design flood is the 25-year flood. The rainfall depth for the 25-yr, 24-hr storm event for the site is 5.25 in as determined from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 2, Version 3. (See Point Precipitation Frequency Estimates for Canton, Illinois in Attachment B.1.) The SCS Type II storm distribution was used. Maximum plant inflow of 1.37 cfs was used, as determined from the Site Water Balance Diagram, provided by Dynegy. The HydroCAD model was used to simulate the pond system.

## II. Selected Methods:

- HydroCAD 10.0-12 was used to model the routing, storage, and conveyance of stormwater and process water through the impoundments and discharge structures and into the discharge channel.
- Within the HydroCAD program, runoff was calculated using the SCS TR-20 method and the routing was completed using the Dynamic Simultaneous Reach Routing method, where the stage-discharge and storage-indication curves are re-evaluated at each time step, based on the current elevation of any downstream nodes. This allows the routing to respond to ongoing tailwater changes, rather than assuming static tailwater conditions. This results in a more accurate representation of controls on the system throughout a flood event.
- AutoCAD Civil 3D Hydraflow Storm Sewers Extension was used to construct a rating curve for the storm sewer pipe system north and east of the Bottom Ash Basin, as this system is used to collect stormwater adjacent to the Bottom Ash Basin, and therefore the capacity of this system needs to considered for evaluating potential run-on into the Bottom Ash Basin. This rating curve was then input into AECOM's HydroCAD model to accurately account for minor head losses throughout the system.

## III. Design Criteria:

- Certification criteria are based on whether the Bottom Ash Basin CCR Unit can pass the 24-hour, 25-year storm event without overtopping the impoundment crest.

## IV. Data & Assumptions:

The following is a list of assumptions and determining factors used for the HydroCAD modeling effort:

- The two Primary Ponds receive the bottom ash (alternately) and act to settle the bottom ash. One pond is cleaned out while the other is operated.
- The Secondary Settlement Pond (Secondary Pond) accepts outflow from the Primary Ponds. The water discharges from the Secondary Pond after passing over the weir in the stop-log structure. It flows to the discharge channel through a 12-inch HDPE pipe.
- The configurations of the three sub-basins that make up the Duck Creek Bottom Ash Basin CCR Unit, such as crest elevations, control structure dimensions and inverts, and other relevant hydraulic controls were obtained from historic documents including design drawings.
- Perimeter channels run along the east and north sides of the Bottom Ash Basin and into an underground storm sewer pipe system. Both the channels and pipe system were assumed to be constructed as shown in the design drawings provided by Dynegy.
- The maximum base flow of 1.37 cfs of bottom ash/slurry water was provided by Dynegy and input into the model for flow into the Primary Ponds (one at a time, per the operating plan).

## V. Hydrology

The following chart shows the rainfall depth and duration for the storm modeled, in addition to the rainfall intensity distribution applied to the storm event. The source of the design storm data is included in Attachment B.1.

| Storm Event | Rainfall Depth (Inches) | Duration (Hours) | Rainfall Distribution |
|---|---|---|---|
| 25-Year | 5.25 | 24 | SCS Type II |

## VI. Hydraulics Calculations

All hydraulic modeling was done using HydroCAD hydraulic Modeling Software and AutoCAD Civil 3D Hydraflow Storm Sewers Extension. The information included in the model was provided by Dynegy. Storage areas were based on the plan drawing of the ponds. Inverts, widths, heights, and other details for inlet and outlet structures were taken from design drawings. The following information formed the basis for the HydroCAD calculations:

**Primary Pond 1 and Primary Pond 2**

- The Primary Ponds are identical
- The Primary Ponds discharge water over stop-log structures into transfer pipes which flow into the Secondary Pond.
- The only inflow into the Primary Ponds is the rainfall that falls directly into them and the maximum plant flow, which is assumed to be entering Primary Pond 1.
- The Primary Ponds were modeled to account for approximate limits of ash shown in aerial photography.
- Each Primary Pond has an area of approximately 0.73 acres.
- The two Primary Ponds discharge through stop-log structures with the top weir assumed to be at elevation 577.33. The width of the weirs is 5 ft according to the detail drawing provided by

Dynegy. The water flows into the Secondary Pond through 12-in CHDPE pipes which leave the stop-log structures at elevation 574.0 and discharge into the Secondary Pond at elevation 573.5. The discharge pipes are defined as "CHDPE." We assume they are corrugated on the inside. The length and slope of the discharge pipes varies, depending on which Primary Pond they exit from. During the design storm event, there may be tailwater at the outfalls of the discharge pipes.

**Secondary Settlement Pond**

- The only inflow into the Secondary Pond comes from the Primary Ponds and the rainfall that falls directly into it. It has an area of 0.48 acres.
- The Secondary Pond was modeled as though no bottom ash is in the pond above the permanent pool elevation which appears to be accurate, based on review of a site aerial photo.
- Discharge from the Secondary Pond is through the stop-log structure.
- The top weir is assumed to be at elevation 573.5. The weir is 5 ft wide. The discharge pipe is a 105-ft long CHDPE pipe sloped at 1.43%.
- Normal water elevation in the discharge channel is 566.5 via a 12-inch HDPE pipe. It was assumed that the discharge channel has free discharge to Duck Creek Reservoir and that this water elevation does not rise as much as 1.5 ft during the design storm. Therefore, there is no tailwater on the outfall pipe coming from the Secondary Pond.

**Off-Site Flow to Perimeter Channels and Storm Sewer Pipes**

- Perimeter channels constructed per design drawings with 3 ft bottom width and 3:1 (H:V) sideslopes.
- Storm sewer pipe system consists of a 24-in CMP and an 18-in CMP discharging into a 24-in CMP pipe system that outlets into the discharge channel.
- Minor head losses due to friction, junctions, and angle changes were modeled in AutoCAD Civil 3D Hydraflow Storm Sewers Extension.

**VII. <u>Results</u>**

**HydroCAD H&H Model Output**

Table 2 below summarizes the results of the AECOM HydroCAD model for the Bottom Ash Basin CCR Unit. The associated detailed HydroCAD output reports are included in Attachment B.2.

**Table 2 – 25-Year, 24-Hour Design Flood Pond Responses**

| Storage Area | $Q_{peak}$ in (cfs) | Qpeak out (cfs) | Max WSE[2] (ft) | Primary Spillway Elevation (ft) | Top of Crest Elevation (ft) |
|---|---|---|---|---|---|
| Primary Pond 1 | 6.95 | 4.72 | 577.8 | 577.3 | 579.0 |
| Primary Pond 2 | 5.58 | 2.93 | 577.7 | 577.3 | 579.0 |
| Secondary Pond | 10.43 | 4.73 | 574.2 | 573.5 | 578.0 |

[1]The storage is the volume of water stored in the area upstream of the outlet structure.
[2]WSE = Water Surface Elevation.

## Conclusions

The following conclusions are based on the HydroCAD model of the Bottom Ash Basin CCR Unit.

- Run-on does not cause backup of the storm sewer piping system or overtopping of the run-on channels into the Bottom Ash Basin.
- There is no anticipated overtopping of the CCR Unit Bottom Ash Basin during the design flood.
- The Bottom Ash Basin meets the hydraulic requirements for certification.

# Attachment B.1

# NOAA – Canton, Illinois
# Point Precipitation Frequency Estimates

**NOAA Atlas 14, Volume 2, Version 3**
**Location name: Canton, Illinois, US***
**Latitude: 40.5044°, Longitude: -89.9888°**
**Elevation: 619 ft***
* source: Google Maps

## POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

# PF tabular

**PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]**

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | **0.413** (0.378–0.453) | **0.493** (0.451–0.541) | **0.588** (0.537–0.645) | **0.662** (0.603–0.725) | **0.756** (0.686–0.827) | **0.828** (0.749–0.906) | **0.899** (0.809–0.984) | **0.973** (0.870–1.07) | **1.07** (0.950–1.18) | **1.15** (1.01–1.2 |
| 10-min | **0.642** (0.587–0.704) | **0.770** (0.704–0.845) | **0.914** (0.835–1.00) | **1.02** (0.932–1.12) | **1.16** (1.05–1.26) | **1.26** (1.14–1.37) | **1.35** (1.22–1.48) | **1.45** (1.30–1.59) | **1.58** (1.40–1.73) | **1.67** (1.47–1.8 |
| 15-min | **0.787** (0.720–0.863) | **0.942** (0.861–1.03) | **1.12** (1.03–1.23) | **1.26** (1.15–1.38) | **1.43** (1.30–1.56) | **1.55** (1.41–1.70) | **1.68** (1.51–1.84) | **1.81** (1.62–1.98) | **1.97** (1.74–2.16) | **2.09** (1.84–2.3 |
| 30-min | **1.04** (0.952–1.14) | **1.26** (1.15–1.38) | **1.54** (1.40–1.69) | **1.75** (1.59–1.91) | **2.02** (1.83–2.21) | **2.22** (2.01–2.43) | **2.43** (2.18–2.66) | **2.64** (2.36–2.89) | **2.91** (2.58–3.20) | **3.13** (2.75–3.4 |
| 60-min | **1.27** (1.16–1.39) | **1.55** (1.41–1.70) | **1.93** (1.76–2.11) | **2.22** (2.03–2.43) | **2.62** (2.37–2.86) | **2.93** (2.65–3.20) | **3.25** (2.92–3.55) | **3.58** (3.20–3.92) | **4.03** (3.57–4.42) | **4.39** (3.87–4.8 |
| 2-hr | **1.48** (1.35–1.62) | **1.80** (1.65–1.98) | **2.26** (2.07–2.48) | **2.63** (2.39–2.88) | **3.13** (2.83–3.42) | **3.52** (3.18–3.85) | **3.93** (3.53–4.30) | **4.37** (3.90–4.78) | **4.97** (4.39–5.44) | **5.46** (4.78–5.9 |
| 3-hr | **1.59** (1.46–1.74) | **1.93** (1.77–2.12) | **2.44** (2.24–2.68) | **2.84** (2.59–3.11) | **3.40** (3.08–3.71) | **3.85** (3.48–4.20) | **4.32** (3.88–4.71) | **4.82** (4.30–5.26) | **5.53** (4.87–6.03) | **6.11** (5.34–6.6 |
| 6-hr | **1.88** (1.73–2.06) | **2.29** (2.10–2.50) | **2.88** (2.65–3.15) | **3.36** (3.07–3.67) | **4.02** (3.66–4.38) | **4.55** (4.12–4.95) | **5.12** (4.61–5.57) | **5.72** (5.10–6.22) | **6.57** (5.79–7.16) | **7.27** (6.34–7.9 |
| 12-hr | **2.18** (2.01–2.37) | **2.64** (2.43–2.88) | **3.31** (3.05–3.60) | **3.84** (3.52–4.17) | **4.56** (4.17–4.95) | **5.15** (4.68–5.59) | **5.77** (5.21–6.25) | **6.42** (5.75–6.96) | **7.33** (6.50–7.96) | **8.08** (7.10–8.8 |
| 24-hr | **2.49** (2.31–2.69) | **3.01** (2.79–3.26) | **3.78** (3.51–4.10) | **4.40** (4.07–4.76) | **5.25** (4.84–5.69) | **5.94** (5.47–6.43) | **6.67** (6.10–7.21) | **7.43** (6.76–8.04) | **8.50** (7.68–9.20) | **9.37** (8.42–10 |
| 2-day | **2.91** (2.71–3.12) | **3.51** (3.27–3.77) | **4.38** (4.08–4.70) | **5.06** (4.70–5.43) | **5.99** (5.55–6.43) | **6.74** (6.22–7.23) | **7.51** (6.90–8.07) | **8.31** (7.61–8.95) | **9.43** (8.57–10.2) | **10.3** (9.33–11 |
| 3-day | **3.09** (2.88–3.31) | **3.72** (3.48–4.00) | **4.63** (4.32–4.97) | **5.34** (4.97–5.73) | **6.30** (5.85–6.76) | **7.06** (6.54–7.58) | **7.85** (7.23–8.43) | **8.66** (7.95–9.31) | **9.77** (8.91–10.5) | **10.7** (9.67–11 |
| 4-day | **3.27** (3.05–3.50) | **3.94** (3.68–4.23) | **4.89** (4.56–5.25) | **5.62** (5.24–6.03) | **6.61** (6.14–7.09) | **7.39** (6.85–7.93) | **8.19** (7.56–8.79) | **9.00** (8.29–9.67) | **10.1** (9.26–10.9) | **11.0** (10.0–11 |
| 7-day | **3.82** (3.58–4.07) | **4.58** (4.30–4.90) | **5.62** (5.27–6.00) | **6.40** (6.00–6.84) | **7.44** (6.95–7.95) | **8.24** (7.68–8.81) | **9.05** (8.41–9.69) | **9.87** (9.14–10.6) | **11.0** (10.1–11.8) | **11.8** (10.8–12 |
| 10-day | **4.35** (4.08–4.63) | **5.21** (4.89–5.56) | **6.34** (5.95–6.76) | **7.18** (6.72–7.65) | **8.28** (7.74–8.84) | **9.13** (8.52–9.75) | **9.98** (9.28–10.7) | **10.8** (10.0–11.6) | **11.9** (11.0–12.8) | **12.8** (11.8–13 |
| 20-day | **5.94** (5.57–6.34) | **7.11** (6.68–7.59) | **8.57** (8.05–9.15) | **9.64** (9.04–10.3) | **11.0** (10.3–11.8) | **12.1** (11.3–12.9) | **13.1** (12.2–14.0) | **14.1** (13.1–15.1) | **15.4** (14.3–16.5) | **16.4** (15.2–17 |
| 30-day | **7.36** (6.92–7.82) | **8.78** (8.27–9.33) | **10.5** (9.87–11.1) | **11.7** (11.0–12.4) | **13.3** (12.4–14.1) | **14.4** (13.5–15.3) | **15.5** (14.5–16.5) | **16.6** (15.5–17.7) | **18.0** (16.8–19.3) | **19.1** (17.7–20 |
| 45-day | **9.27** (8.74–9.82) | **11.0** (10.4–11.7) | **13.1** (12.3–13.8) | **14.5** (13.7–15.3) | **16.3** (15.3–17.2) | **17.6** (16.5–18.6) | **18.9** (17.7–20.0) | **20.1** (18.8–21.3) | **21.6** (20.2–23.0) | **22.8** (21.3–24 |
| 60-day | **11.1** (10.5–11.8) | **13.2** (12.5–14.0) | **15.5** (14.6–16.4) | **17.2** (16.2–18.2) | **19.2** (18.1–20.3) | **20.7** (19.4–21.9) | **22.1** (20.7–23.4) | **23.4** (22.0–24.9) | **25.1** (23.5–26.7) | **26.4** (24.7–28 |

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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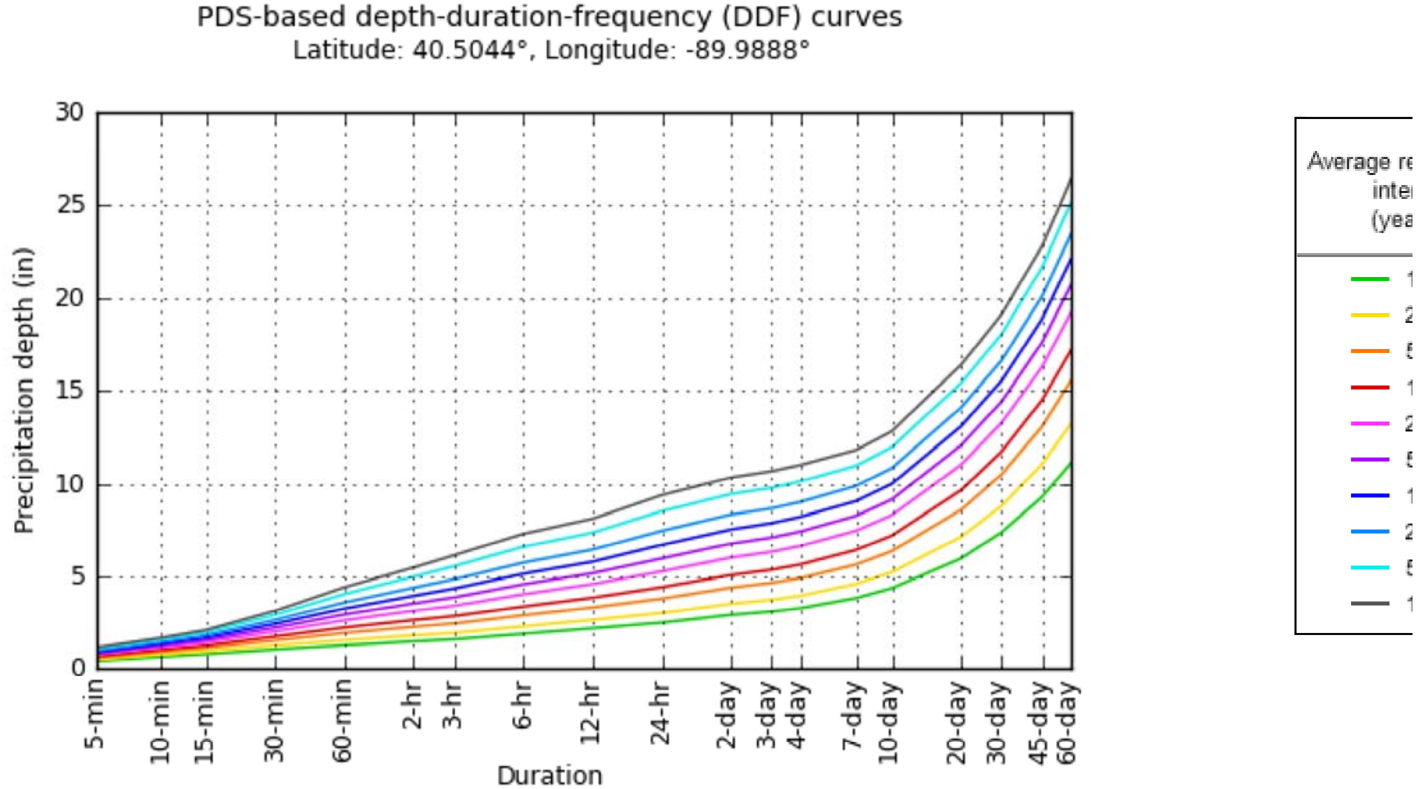
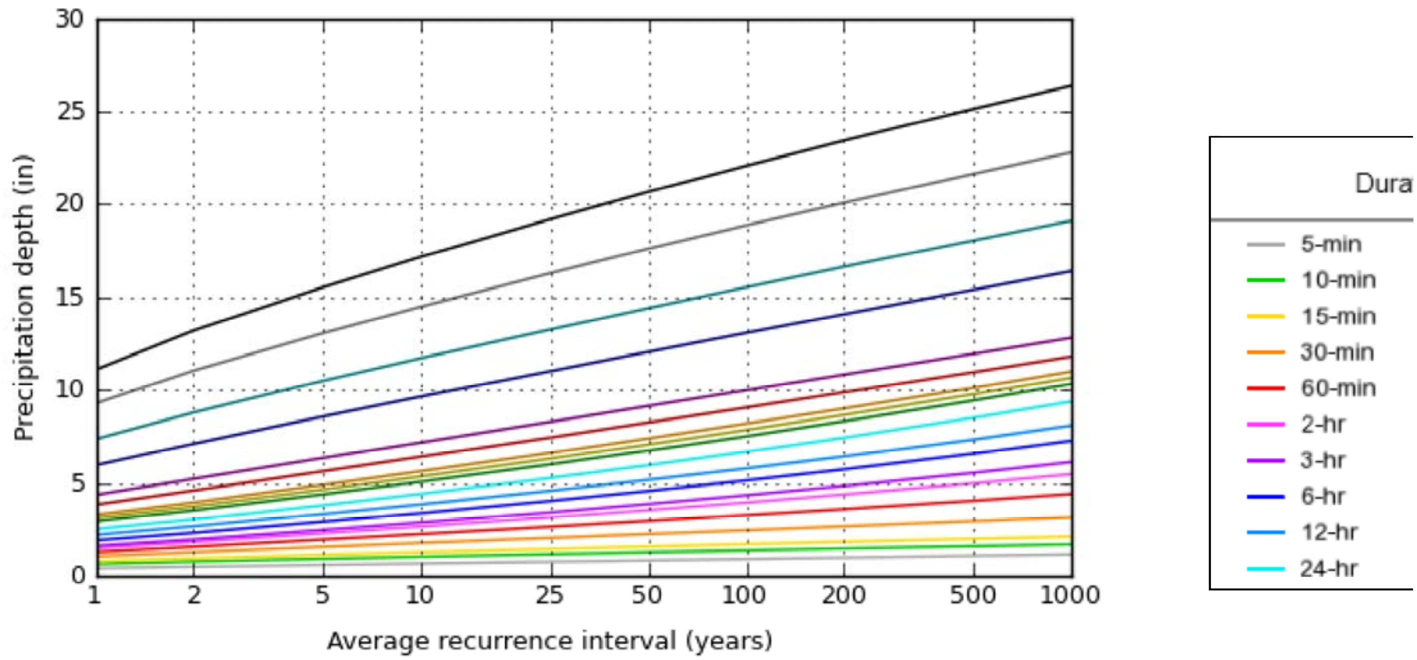
## PF graphical

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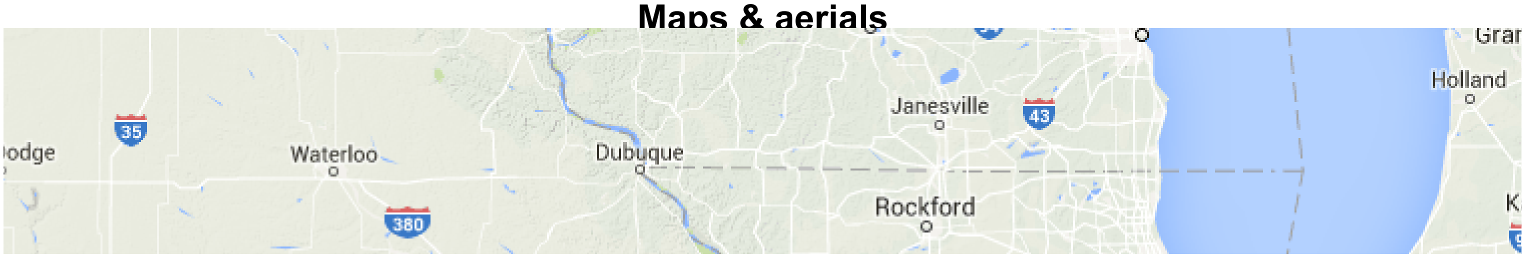
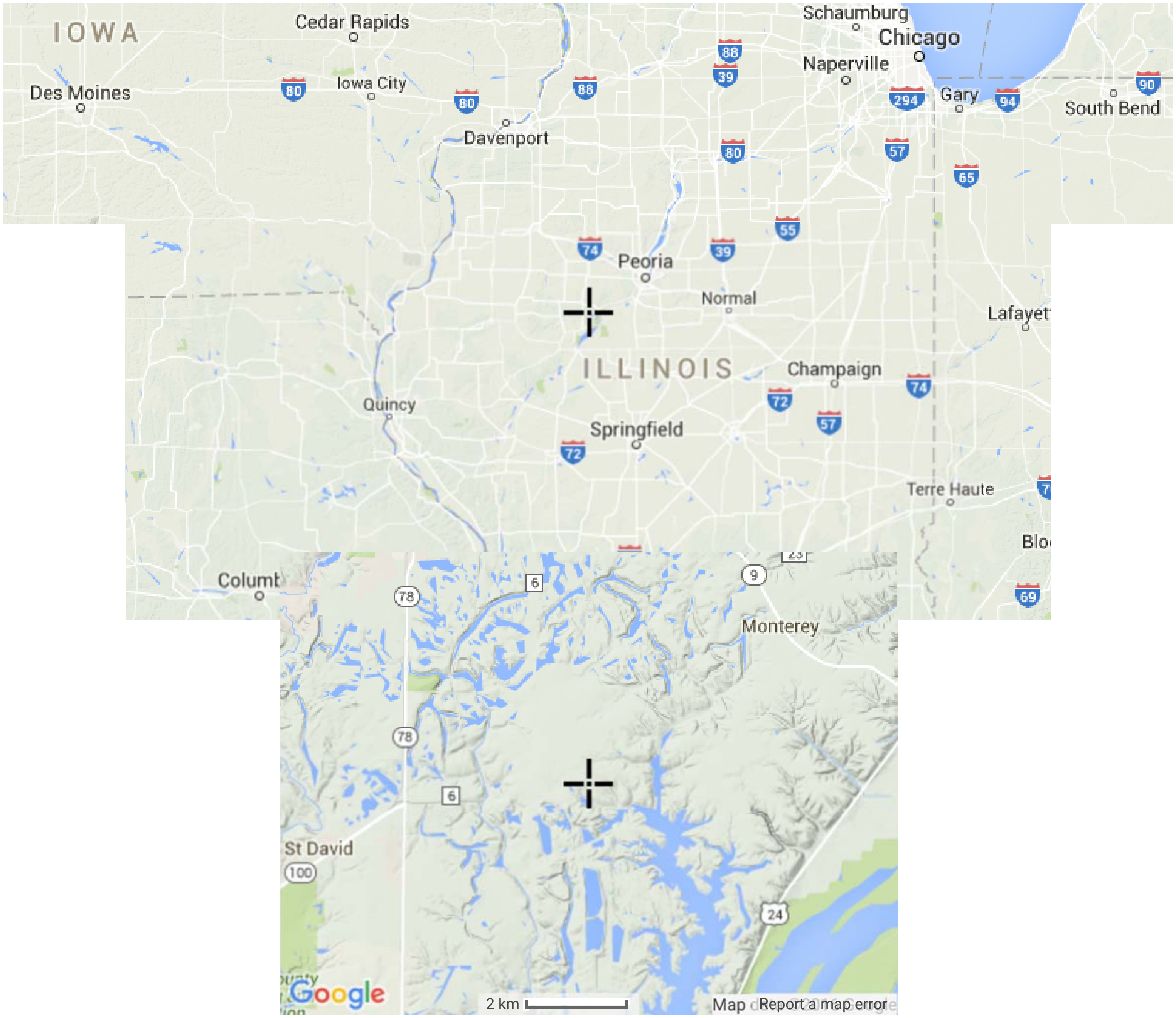
## Maps & aerials






Large scale map

**Large scale aerial**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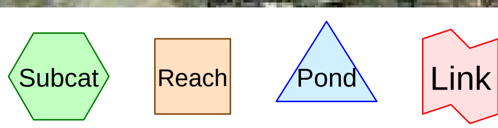
US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

# Attachment B.2

# HydroCAD Model Output


**Drainage Diagram for Dynegy Duck Creek Bottom Ash CCR Ponds2B**
Prepared by AECOM, Printed 3/30/2016
HydroCAD® 8.50 s/n 000800 © 2007 HydroCAD Software Solutions LLC

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 6.600 | 65 | Woods/grass comb., Fair, HSG B (7S) |
| 3.200 | 69 | Pasture/grassland/range, Fair, HSG B (8S) |
| 0.725 | 98 | Top of Berm Primary Pond 1 (4S) |
| 0.725 | 98 | Top of Berm Primary Pond 2 (5S) |
| 0.482 | 98 | Top of Berm Secondary Pond (6S) |
| **11.732** | | **TOTAL AREA** |

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment 4S: Primary Pond 1** Runoff Area=0.725 ac 100.00% Impervious Runoff Depth=5.01"
Tc=5.0 min CN=98 Runoff=5.59 cfs 0.303 af

**Subcatchment 5S: Primary Pond 2** Runoff Area=0.725 ac 100.00% Impervious Runoff Depth=5.01"
Tc=5.0 min CN=98 Runoff=5.59 cfs 0.303 af

**Subcatchment 6S: Secondary Pond** Runoff Area=0.482 ac 100.00% Impervious Runoff Depth=5.01"
Tc=5.0 min CN=98 Runoff=3.72 cfs 0.201 af

**Subcatchment 7S: 24" CMP Catchment** Runoff Area=6.600 ac 0.00% Impervious Runoff Depth=1.82"
Flow Length=1,100' Slope=0.0100 '/' Tc=28.4 min CN=65 Runoff=10.24 cfs 1.002 af

**Subcatchment 8S: 18" CMP Catchment** Runoff Area=3.200 ac 0.00% Impervious Runoff Depth=2.14"
Flow Length=1,000' Slope=0.0100 '/' Tc=34.8 min CN=69 Runoff=5.22 cfs 0.571 af

**Reach 6R: South ditch** Avg. Depth=0.98' Max Vel=2.63 fps Inflow=15.26 cfs 1.573 af
n=0.022 L=50.0' S=0.0028 '/' Capacity=70.63 cfs Outflow=15.25 cfs 1.573 af

**Pond 1P: Primary Pond 1** Peak Elev=577.76' Storage=0.112 af Inflow=6.96 cfs 3.701 af
Outflow=4.65 cfs 3.701 af

**Pond 2P: Primary Pond 2** Peak Elev=577.65' Storage=0.081 af Inflow=5.59 cfs 0.303 af
Outflow=2.93 cfs 0.302 af

**Pond 3P: Secondary Ash Settlement Pond** Peak Elev=574.22' Storage=0.222 af Inflow=10.50 cfs 4.205 af
Outflow=4.72 cfs 4.148 af

**Pond 4P: North perimeter stormwater pond** Peak Elev=575.43' Storage=881 cf Inflow=10.24 cfs 1.002 af
Outflow=10.09 cfs 1.002 af

**Pond 5P: Discharge Channel** Peak Elev=566.84' Storage=0.143 af Inflow=19.97 cfs 5.721 af
Outflow=19.14 cfs 5.712 af

**Pond 6P: 18" CMP** Peak Elev=580.32' Inflow=5.22 cfs 0.571 af
Outflow=5.22 cfs 0.571 af

**Total Runoff Area = 11.732 ac Runoff Volume = 2.380 af Average Runoff Depth = 2.43"**
**83.53% Pervious = 9.800 ac 16.47% Impervious = 1.932 ac**

## Summary for Subcatchment 4S: Primary Pond 1 Catchment

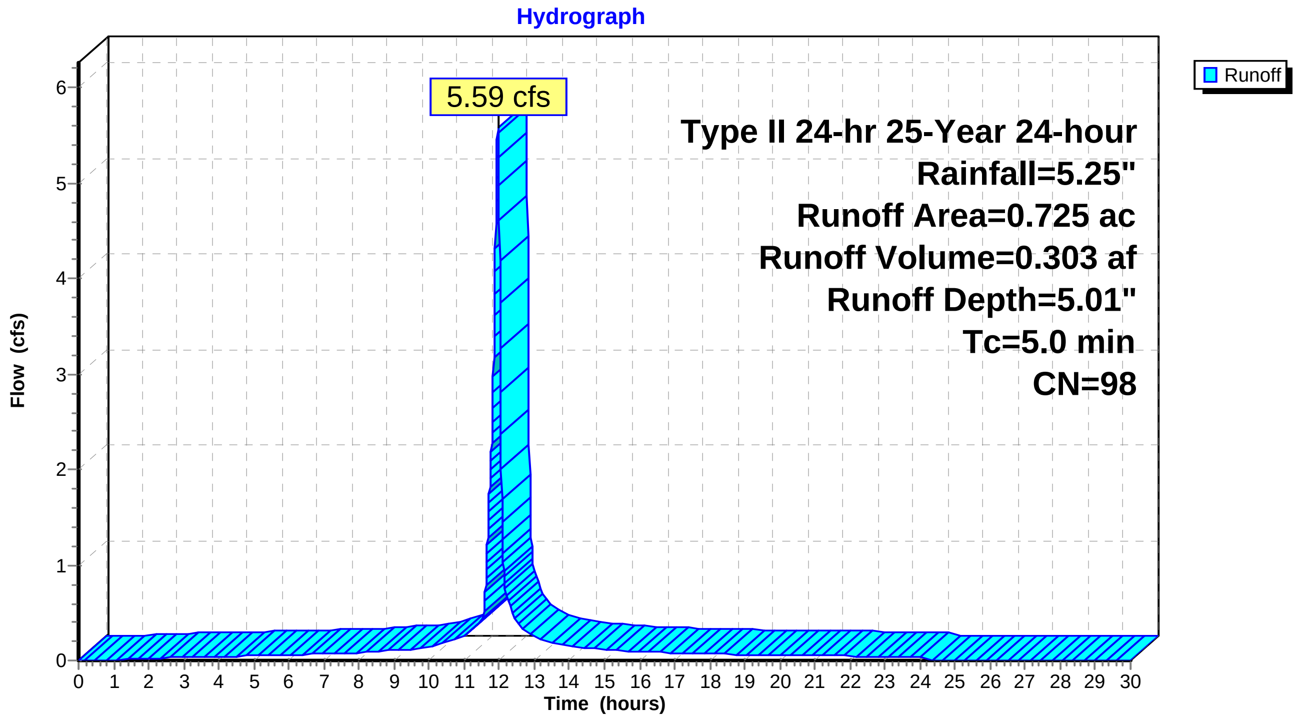
Runoff = 5.59 cfs @ 11.96 hrs, Volume= 0.303 af, Depth= 5.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year 24-hour Rainfall=5.25"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.725 | 98 | Top of Berm Primary Pond 1 |
| | 0.725 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry, Rainfall onto Primary Pond 1** |

## Subcatchment 4S: Primary Pond 1 Catchment



## Summary for Subcatchment 5S: Primary Pond 2 Catchment

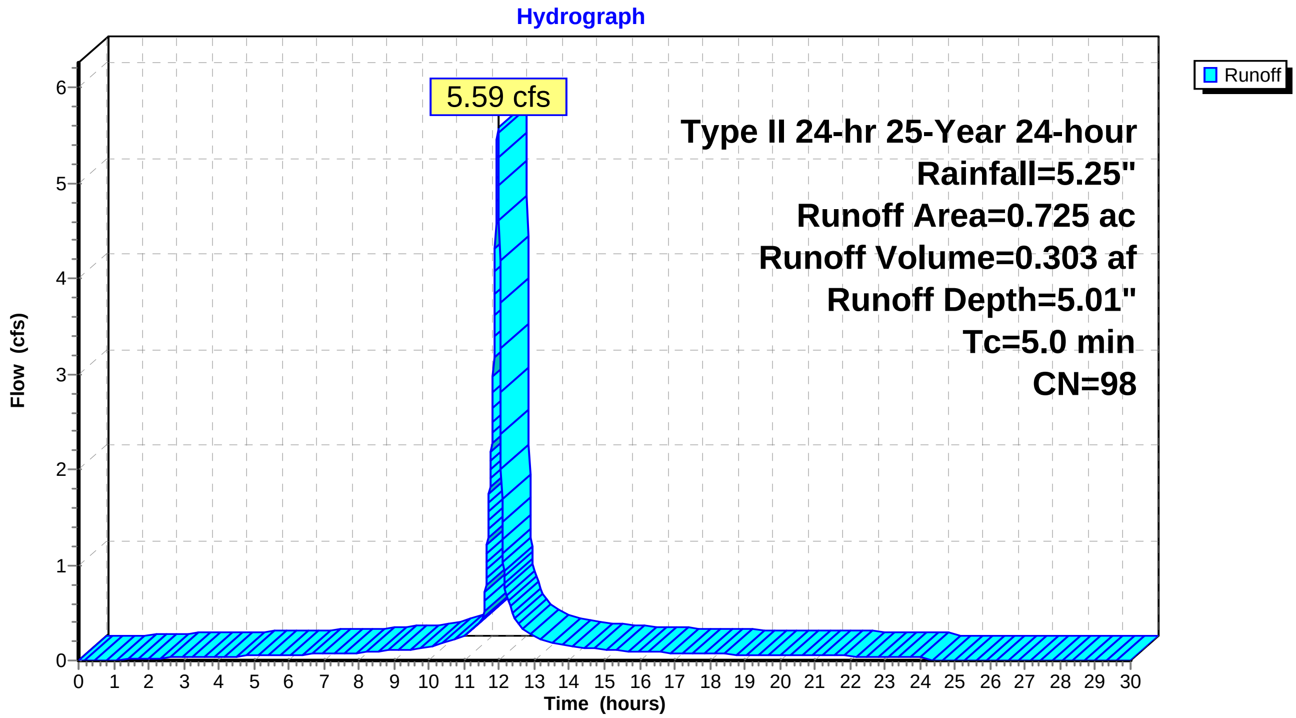
Runoff = 5.59 cfs @ 11.96 hrs, Volume= 0.303 af, Depth= 5.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year 24-hour Rainfall=5.25"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.725 | 98 | Top of Berm Primary Pond 2 |
| | 0.725 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry, Rainfall Falling in Primary Pond 2** |

### Subcatchment 5S: Primary Pond 2 Catchment



## Summary for Subcatchment 6S: Secondary Pond Catchment

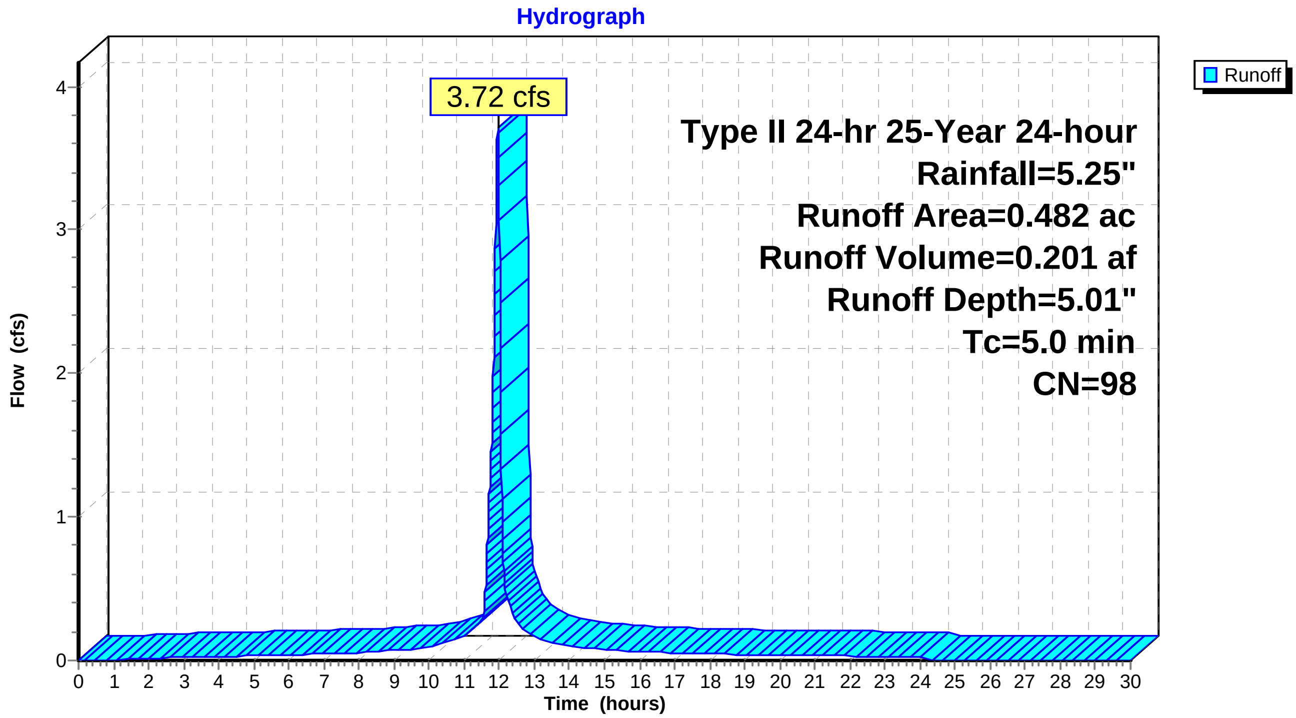
Runoff = 3.72 cfs @ 11.96 hrs, Volume= 0.201 af, Depth= 5.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year 24-hour Rainfall=5.25"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.482 | 98 | Top of Berm Secondary Pond |
| | 0.482 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry, Rainfall on Secondary Pond** |

## Subcatchment 6S: Secondary Pond Catchment



## Summary for Subcatchment 7S: 24" CMP Catchment

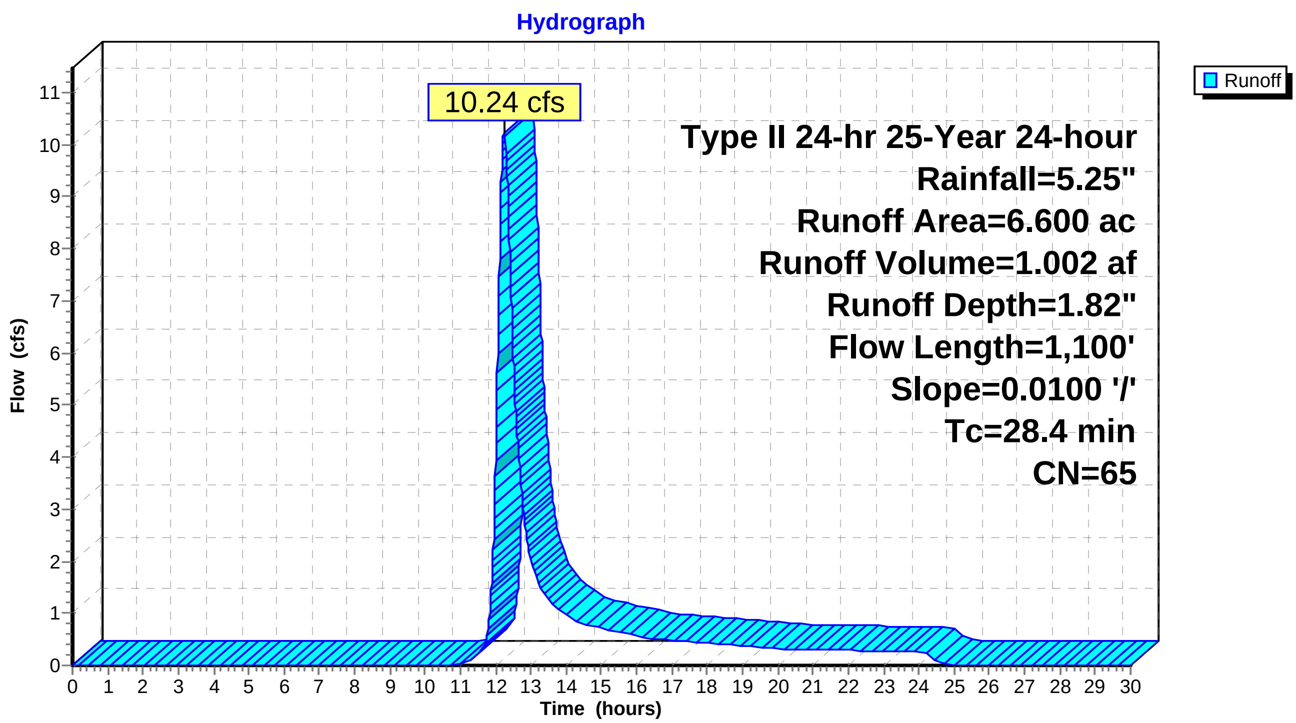
Runoff = 10.24 cfs @ 12.24 hrs, Volume= 1.002 af, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year 24-hour Rainfall=5.25"

| Area (ac) | CN | Description |
|---|---|---|
| 6.600 | 65 | Woods/grass comb., Fair, HSG B |
| 6.600 | | Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 13.4 | 100 | 0.0100 | 0.12 | | **Sheet Flow, shallow**<br>Grass: Short n= 0.150 P2= 3.00" |
| 14.3 | 600 | 0.0100 | 0.70 | | **Shallow Concentrated Flow, shallow conc**<br>Short Grass Pasture Kv= 7.0 fps |
| 0.7 | 400 | 0.0100 | 10.01 | 640.45 | **Trap/Vee/Rect Channel Flow, channel**<br>Bot.W=4.00' D=4.00' Z= 3.0 '/' Top.W=28.00'<br>n= 0.025 Earth, grassed & winding |
| 28.4 | 1,100 | Total | | | |

## Subcatchment 7S: 24" CMP Catchment



## Summary for Subcatchment 8S: 18" CMP Catchment

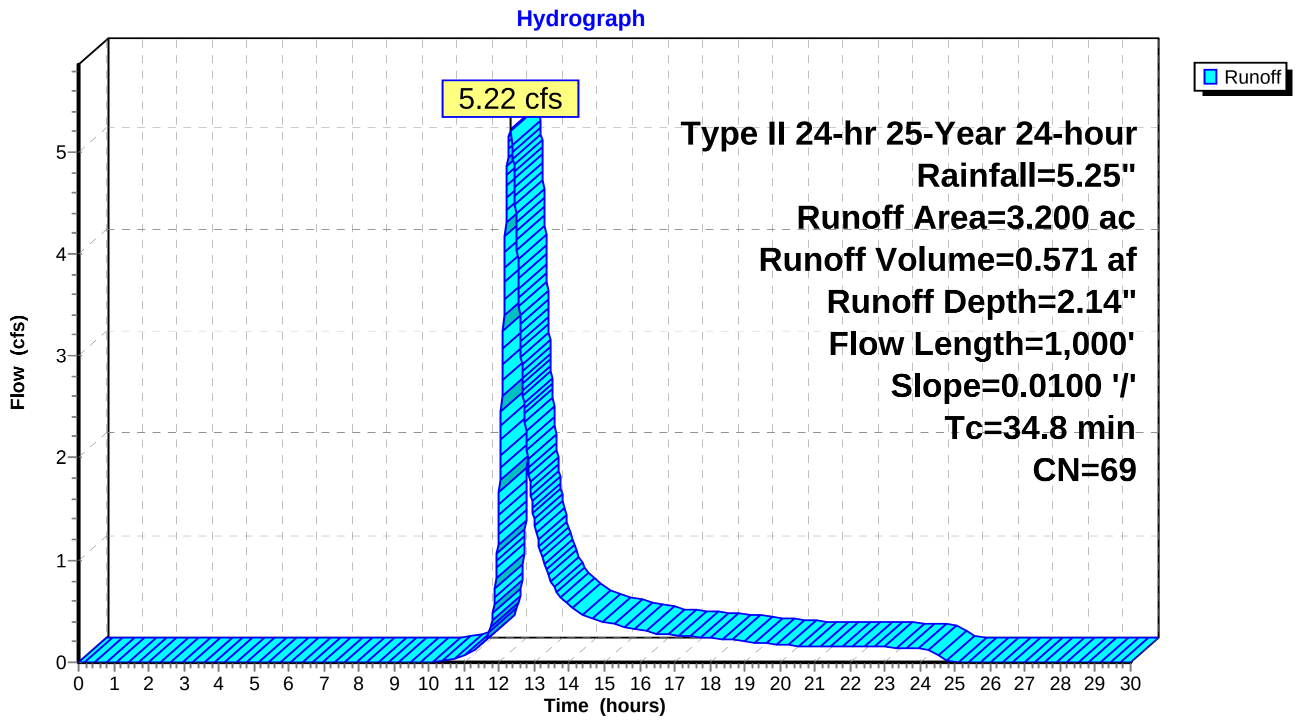
Runoff = 5.22 cfs @ 12.33 hrs, Volume= 0.571 af, Depth= 2.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-Year 24-hour  Rainfall=5.25"

| Area (ac) | CN | Description |
|---|---|---|
| 3.200 | 69 | Pasture/grassland/range, Fair, HSG B |
| 3.200 | | Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 13.4 | 100 | 0.0100 | 0.12 | | **Sheet Flow, sheet**<br>Grass: Short   n= 0.150   P2= 3.00" |
| 21.4 | 900 | 0.0100 | 0.70 | | **Shallow Concentrated Flow, shallow conc**<br>Short Grass Pasture   Kv= 7.0 fps |
| 34.8 | 1,000 | Total | | | |

## Subcatchment 8S: 18" CMP Catchment



## Summary for Reach 6R: South ditch

[78] Warning: Submerged Pond 4P Primary device # 1 by 0.98'
[78] Warning: Submerged Pond 6P Primary device # 1 by 0.98'

Inflow Area = 9.800 ac, 0.00% Impervious, Inflow Depth = 1.93" for 25-Year 24-hour event
Inflow = 15.26 cfs @ 12.29 hrs, Volume= 1.573 af
Outflow = 15.25 cfs @ 12.29 hrs, Volume= 1.573 af, Atten= 0%, Lag= 0.2 min

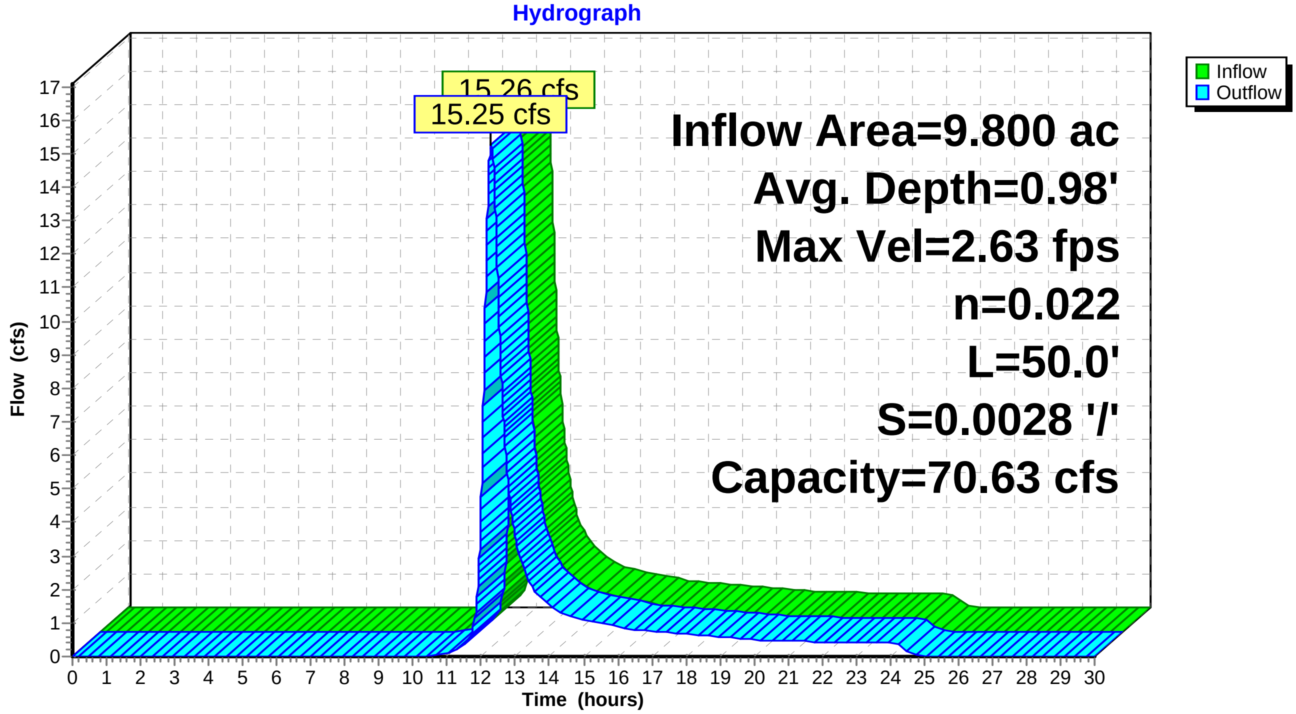
Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 3
Max. Velocity= 2.63 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.00 fps, Avg. Travel Time= 0.8 min

Peak Storage= 290 cf @ 12.29 hrs, Average Depth at Peak Storage= 0.98'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 70.63 cfs

3.00' x 2.00' deep channel, n= 0.022
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 50.0' Slope= 0.0028 '/'
Inlet Invert= 572.14', Outlet Invert= 572.00'

‡

## Reach 6R: South ditch



## Summary for Pond 1P: Primary Pond 1

Inflow Area = 0.725 ac,100.00% Impervious, Inflow Depth > 61.25" for 25-Year 24-hour event
Inflow = 6.96 cfs @ 11.96 hrs, Volume= 3.701 af, Incl. 1.37 cfs Base Flow
Outflow = 4.65 cfs @ 12.03 hrs, Volume= 3.701 af, Atten= 33%, Lag= 4.4 min
Primary = 4.65 cfs @ 12.03 hrs, Volume= 3.701 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 3
Starting Elev= 577.52' Surf.Area= 0.257 ac Storage= 0.048 af
Peak Elev= 577.76' @ 12.03 hrs Surf.Area= 0.271 ac Storage= 0.112 af (0.064 af above start)

Plug-Flow detention time= 24.7 min calculated for 3.651 af (99% of inflow)
Center-of-Mass det. time= 1.3 min ( 888.4 - 887.1 )

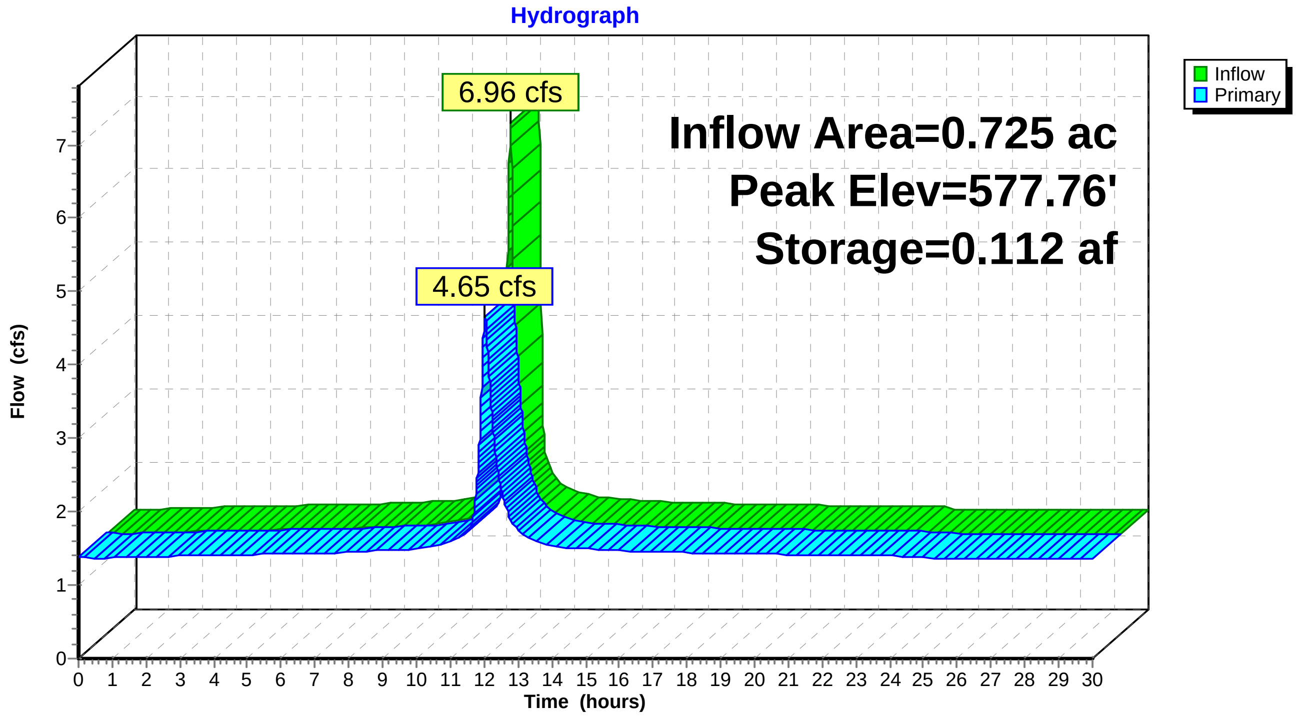
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 577.33' | 0.494 af | **Pimary Pond 1 Storage (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (acres) | Inc.Store (acre-feet) | Cum.Store (acre-feet) |
|---|---|---|---|
| 577.33 | 0.245 | 0.000 | 0.000 |
| 579.00 | 0.347 | 0.494 | 0.494 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 574.00' | **12.0" x 44.0' long Culvert** CPP, square edge headwall, Ke= 0.500<br>Outlet Invert= 573.50' S= 0.0114 '/' Cc= 0.900<br>n= 0.020 Corrugated PE, corrugated interior |
| #2 | Device 1 | 577.33' | **5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)<br>3.3' Crest Height |

**Primary OutFlow** Max=4.65 cfs @ 12.03 hrs HW=577.76' TW=574.08' (Dynamic Tailwater)
└─**1=Culvert** (Passes 4.65 cfs of 5.21 cfs potential flow)
  └─**2=Sharp-Crested Rectangular Weir** (Weir Controls 4.65 cfs @ 2.19 fps)

## Pond 1P: Primary Pond 1



## Summary for Pond 2P: Primary Pond 2

Inflow Area = 0.725 ac,100.00% Impervious, Inflow Depth = 5.01" for 25-Year 24-hour event
Inflow = 5.59 cfs @ 11.96 hrs, Volume= 0.303 af
Outflow = 2.93 cfs @ 12.04 hrs, Volume= 0.302 af, Atten= 48%, Lag= 4.9 min
Primary = 2.93 cfs @ 12.04 hrs, Volume= 0.302 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 577.65' @ 12.04 hrs Surf.Area= 0.265 ac Storage= 0.081 af

Plug-Flow detention time= 42.9 min calculated for 0.302 af (100% of inflow)
Center-of-Mass det. time= 41.8 min ( 784.0 - 742.2 )

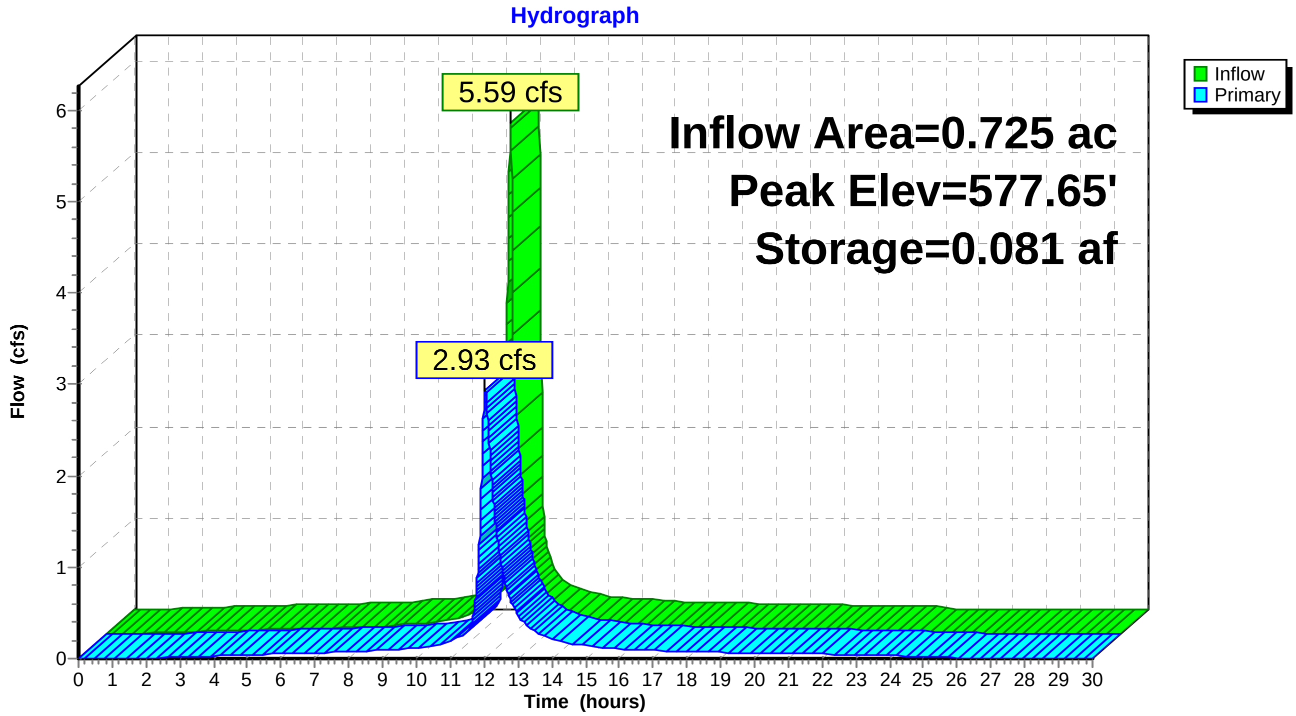
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 577.33' | 0.494 af | **Primary Pond 2 Storage (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (acres) | Inc.Store (acre-feet) | Cum.Store (acre-feet) |
|---|---|---|---|
| 577.33 | 0.245 | 0.000 | 0.000 |
| 579.00 | 0.347 | 0.494 | 0.494 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 574.00' | **12.0" x 176.0' long Culvert** CPP, square edge headwall, Ke= 0.500<br>Outlet Invert= 573.50' S= 0.0028 '/' Cc= 0.900<br>n= 0.020 Corrugated PE, corrugated interior |
| #2 | Device 1 | 577.33' | **5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)<br>3.3' Crest Height |

**Primary OutFlow** Max=2.93 cfs @ 12.04 hrs HW=577.65' TW=574.09' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 2.93 cfs @ 3.73 fps)
  └─**2=Sharp-Crested Rectangular Weir** (Passes 2.93 cfs of 2.95 cfs potential flow)

## Pond 2P: Primary Pond 2



## Summary for Pond 3P: Secondary Ash Settlement Pond

Inflow Area = 1.932 ac,100.00% Impervious, Inflow Depth > 26.12" for 25-Year 24-hour event
Inflow = 10.50 cfs @ 11.99 hrs, Volume= 4.205 af
Outflow = 4.72 cfs @ 12.33 hrs, Volume= 4.148 af, Atten= 55%, Lag= 20.4 min
Primary = 4.72 cfs @ 12.33 hrs, Volume= 4.148 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 574.22' @ 12.33 hrs Surf.Area= 0.322 ac Storage= 0.222 af

Plug-Flow detention time= 28.9 min calculated for 4.147 af (99% of inflow)
Center-of-Mass det. time= 16.1 min ( 890.0 - 873.9 )

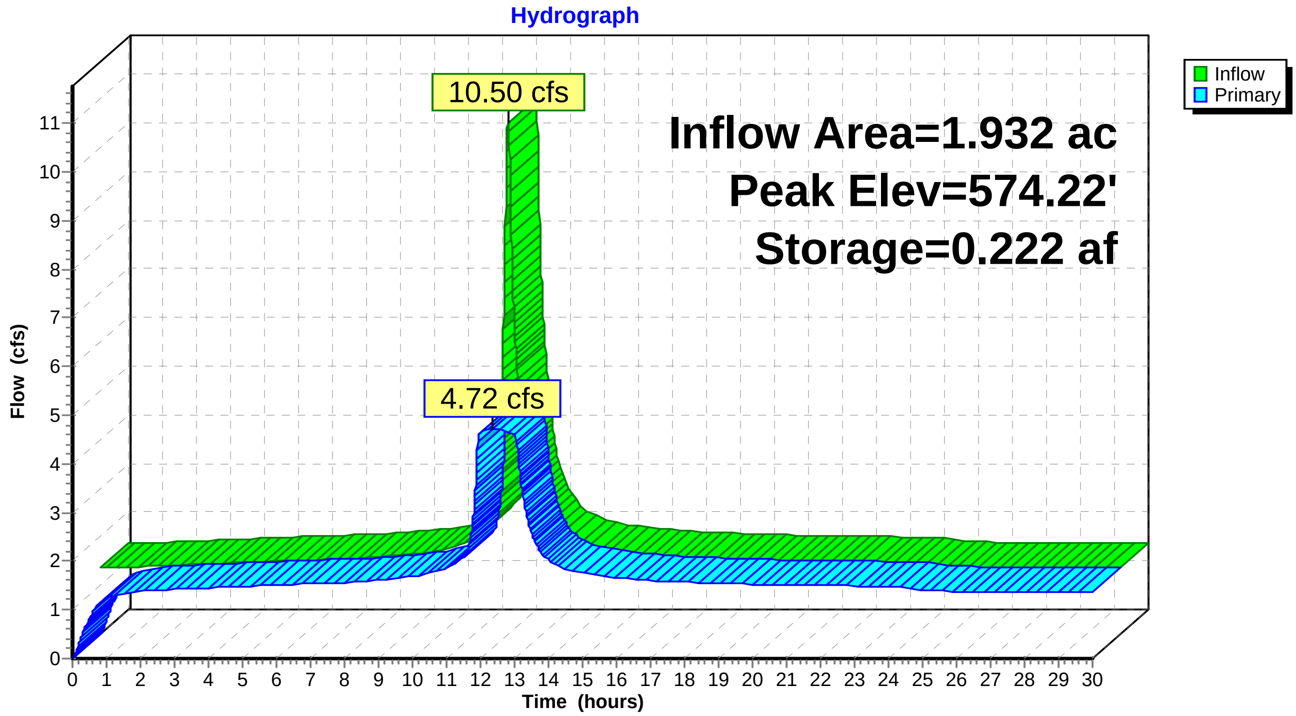
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 573.50' | 1.728 af | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (acres) | Inc.Store (acre-feet) | Cum.Store (acre-feet) |
|---|---|---|---|
| 573.50 | 0.293 | 0.000 | 0.000 |
| 577.00 | 0.433 | 1.270 | 1.270 |
| 578.00 | 0.482 | 0.457 | 1.728 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 569.50' | **12.0" x 105.0' long Culvert** CPP, square edge headwall, Ke= 0.500<br>Outlet Invert= 568.00' S= 0.0143 '/' Cc= 0.900<br>n= 0.020 Corrugated PE, corrugated interior |
| #2 | Device 1 | 573.50' | **5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)<br>4.0' Crest Height |

**Primary OutFlow** Max=4.72 cfs @ 12.33 hrs HW=574.22' TW=566.83' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 4.72 cfs @ 6.01 fps)
  └─**2=Sharp-Crested Rectangular Weir** (Passes 4.72 cfs of 9.98 cfs potential flow)

## Pond 3P: Secondary Ash Settlement Pond



## Summary for Pond 4P: North perimeter stormwater pond w/ 24" CMP

Inflow Area = 6.600 ac, 0.00% Impervious, Inflow Depth = 1.82" for 25-Year 24-hour event
Inflow = 10.24 cfs @ 12.24 hrs, Volume= 1.002 af
Outflow = 10.09 cfs @ 12.28 hrs, Volume= 1.002 af, Atten= 1%, Lag= 2.2 min
Primary = 10.09 cfs @ 12.28 hrs, Volume= 1.002 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 575.43' @ 12.28 hrs Surf.Area= 1,791 sf Storage= 881 cf

Plug-Flow detention time= 0.7 min calculated for 1.002 af (100% of inflow)
Center-of-Mass det. time= 0.7 min ( 876.0 - 875.3 )

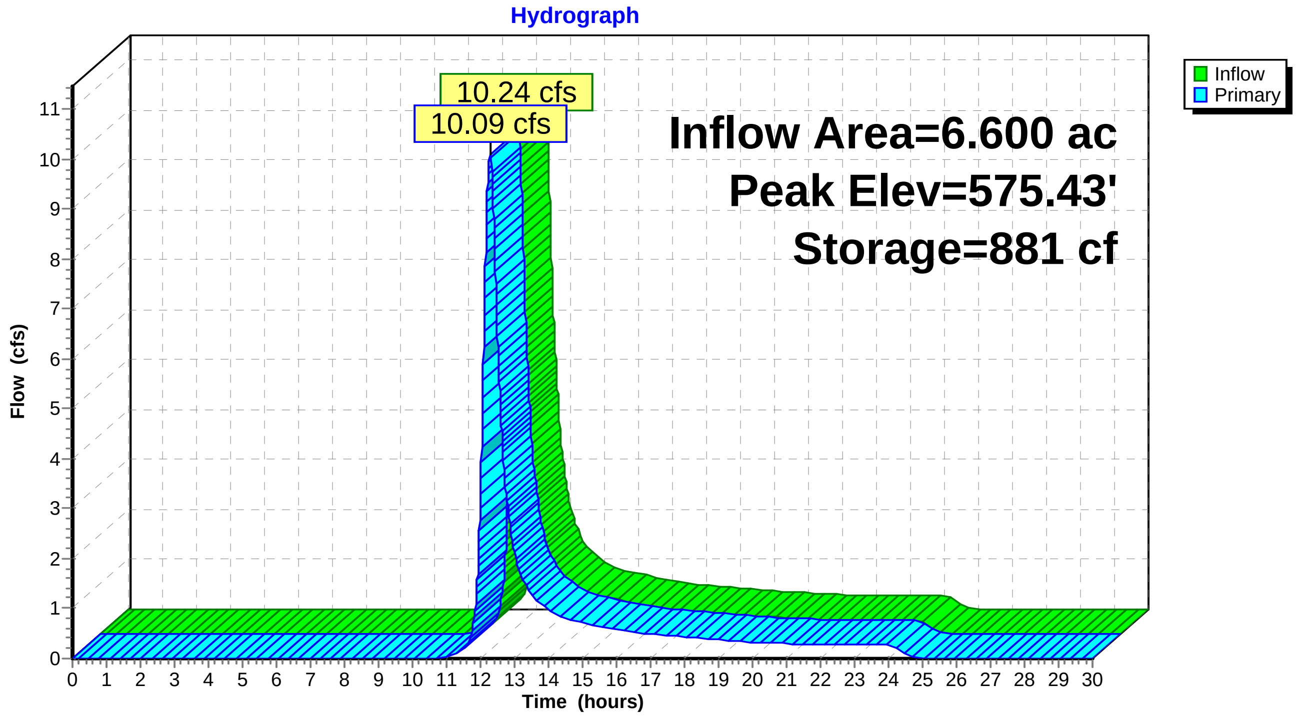
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 574.25' | 26,528 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 574.25 | 0 | 0 | 0 |
| 575.00 | 830 | 311 | 311 |
| 576.00 | 3,040 | 1,935 | 2,246 |
| 577.00 | 6,434 | 4,737 | 6,983 |
| 578.00 | 9,813 | 8,124 | 15,107 |
| 579.00 | 13,030 | 11,422 | 26,528 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 572.14' | **24" CMP rating curve**<br>Head (feet) 0.00 2.72 3.09 3.79 5.17 8.24 11.33<br>Disch. (cfs) 0.000 1.000 2.200 4.600 6.800 10.000 13.300 |
| #2 | Primary | 574.25' | **24.0" Vert. Orifice/Grate** C= 0.600 |

**Primary OutFlow** Max=10.08 cfs @ 12.28 hrs HW=575.43' TW=573.12' (Dynamic Tailwater)
**1=24" CMP rating curve** (Custom Controls 2.90 cfs)
**2=Orifice/Grate** (Orifice Controls 7.18 cfs @ 3.71 fps)

## Pond 4P: North perimeter stormwater pond w/ 24" CMP



## Summary for Pond 5P: Discharge Channel

Inflow Area = 11.732 ac, 16.47% Impervious, Inflow Depth > 5.85" for 25-Year 24-hour event
Inflow = 19.97 cfs @ 12.29 hrs, Volume= 5.721 af
Outflow = 19.14 cfs @ 12.37 hrs, Volume= 5.712 af, Atten= 4%, Lag= 4.5 min
Primary = 19.14 cfs @ 12.37 hrs, Volume= 5.712 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 566.84' @ 12.37 hrs Surf.Area= 0.504 ac Storage= 0.143 af

Plug-Flow detention time= 5.2 min calculated for 5.712 af (100% of inflow)
Center-of-Mass det. time= 3.9 min ( 889.7 - 885.8 )

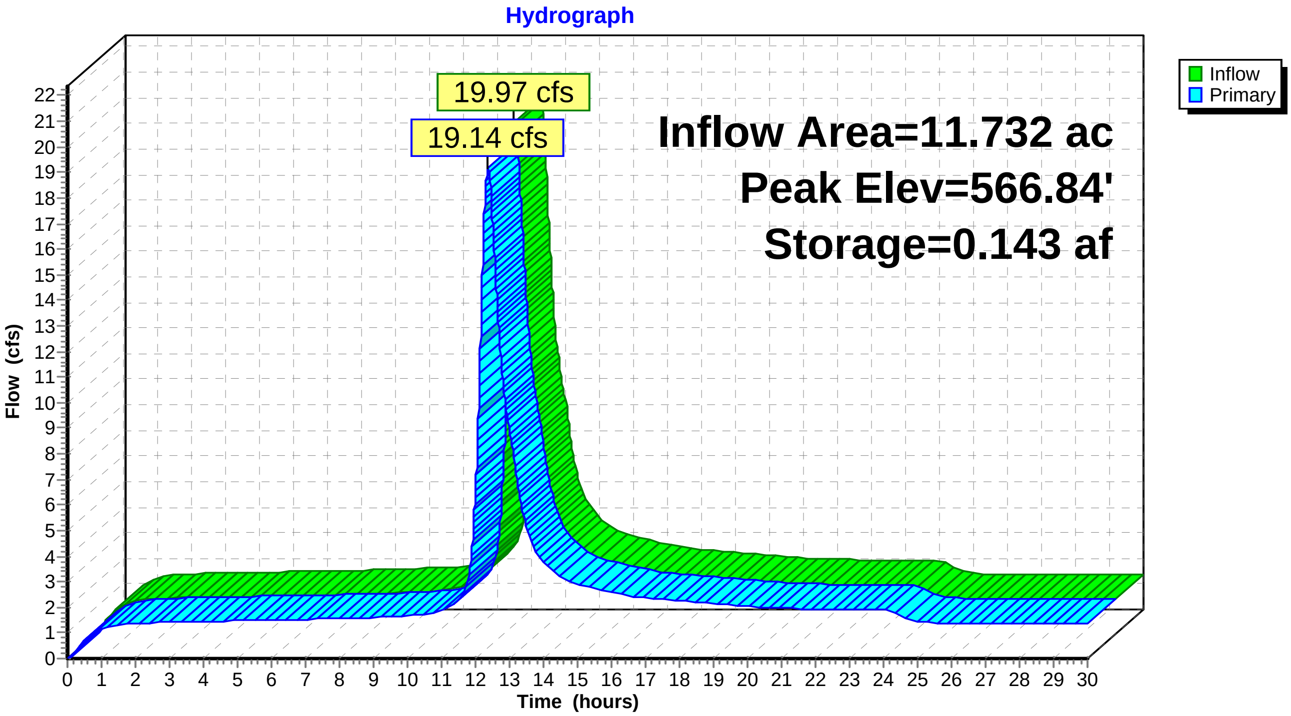
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 566.50' | 2.995 af | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (acres) | Inc.Store (acre-feet) | Cum.Store (acre-feet) |
|---|---|---|---|
| 566.50 | 0.000 | 0.000 | 0.000 |
| 566.60 | 0.500 | 0.025 | 0.025 |
| 572.00 | 0.600 | 2.970 | 2.995 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 566.50' | **Custom Weir/Orifice, C= 2.62**<br>Head (feet) 0.00 5.50<br>Width (feet) 30.00 31.00 |

**Primary OutFlow** Max=19.14 cfs @ 12.37 hrs HW=566.84' (Free Discharge)
└─**1=Custom Weir/Orifice** (Weir Controls 19.14 cfs @ 1.90 fps)

## Pond 5P: Discharge Channel



## Summary for Pond 6P: 18" CMP

[57] Hint: Peaked at 580.32' (Flood elevation advised)

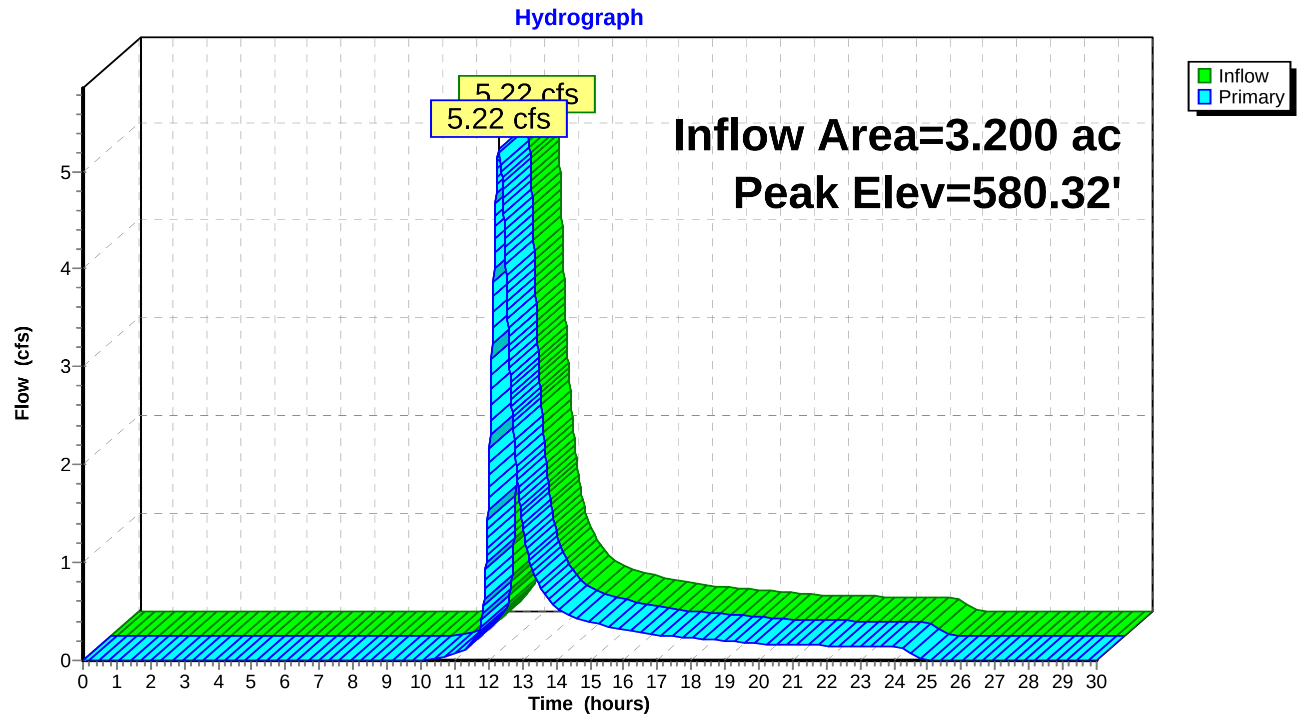
| | | | | |
|---|---|---|---|---|
| Inflow Area = | 3.200 ac, | 0.00% Impervious, Inflow Depth = 2.14" | for 25-Year 24-hour event | |
| Inflow = | 5.22 cfs @ | 12.33 hrs, Volume= | 0.571 af | |
| Outflow = | 5.22 cfs @ | 12.33 hrs, Volume= | 0.571 af, | Atten= 0%, Lag= 0.0 min |
| Primary = | 5.22 cfs @ | 12.33 hrs, Volume= | 0.571 af | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 580.32' @ 12.33 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 572.14' | **18" CMP rating curve**<br>Head (feet) 0.00 3.19 3.36 3.84 5.13 8.13 11.33<br>Disch. (cfs) 0.000 0.730 1.400 2.600 3.600 5.200 6.600 |
| #2 | Device 1 | 575.00' | **18.0" Vert. Orifice/Grate** C= 0.600 |

**Primary OutFlow** Max=5.22 cfs @ 12.33 hrs HW=580.32' TW=573.11' (Dynamic Tailwater)
└─**1=18" CMP rating curve** (Custom Controls 5.22 cfs)
└─**2=Orifice/Grate** (Passes 5.22 cfs of 18.19 cfs potential flow)

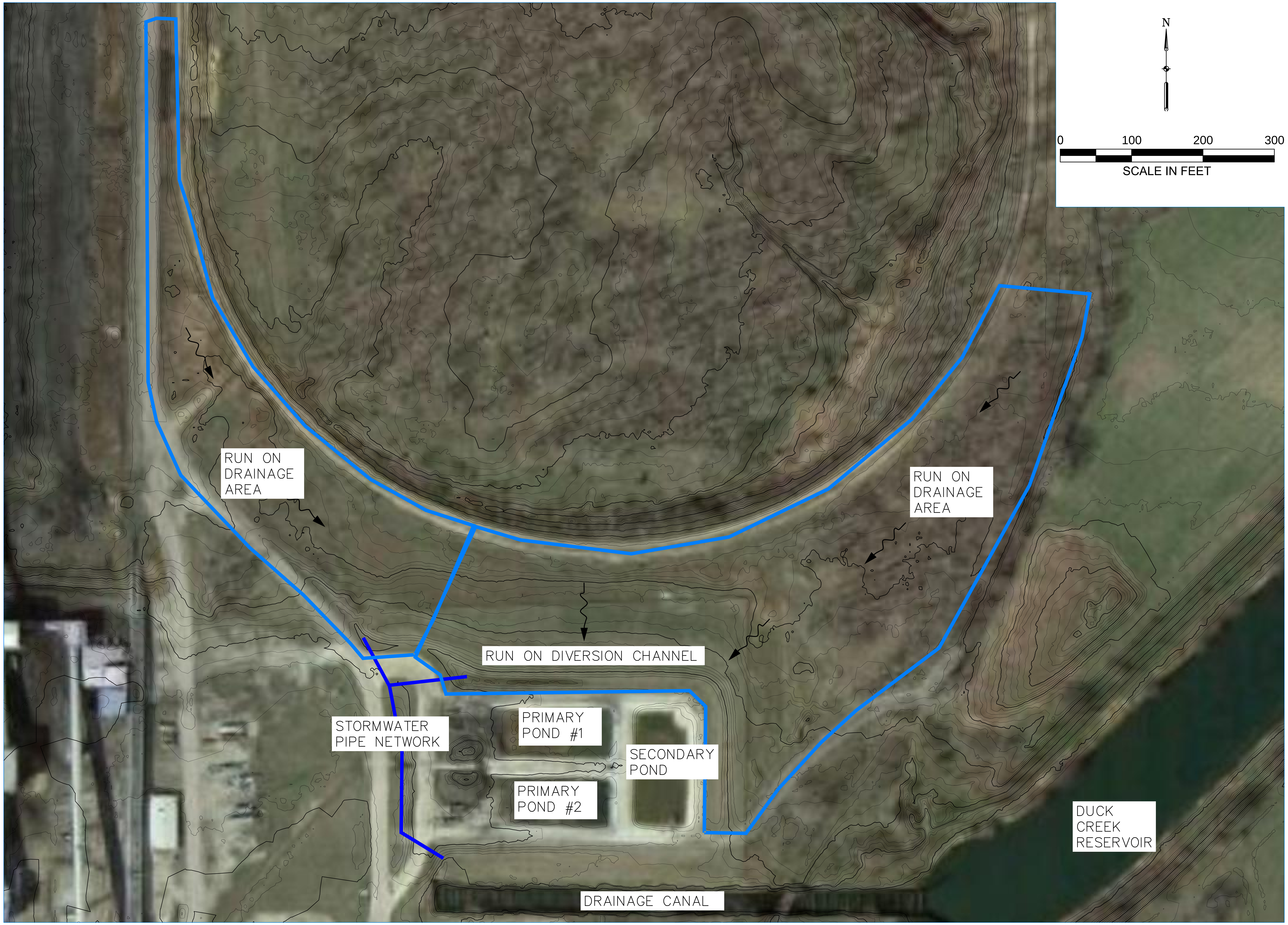
### Pond 6P: 18" CMP



# Attachment B.3

# Run-on Drainage Basins

FISCHER, NICHOLAS, 4/12/2016 2:35 PM

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Dynegy Inc.
1500 East Port Plaza Drive
Collinsville, IL 62234

DUCK CREEK
POWER PLANT
FULTON COUNTY, IL

**DRAFT**

ISSUED FOR BIDDING DATE BY

ISSUED FOR CONSTRUCTION DATE BY

REVISIONS

| NO. | DESCRIPTION | DATE |
|---|---|---|
| 1 | | |
| | | |
| | | |
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| | | |

| | |
|---|---|
| AECOM PROJECT NO: | 60440115 |
| DRAWN BY: | LEH |
| DESIGNED BY: | LEH |
| CHECKED BY: | RHH |
| DATE CREATED: | 2016-02-04 |
| PLOT DATE: | 2016-02-04 |
| SCALE: | 1" = 100' |
| ACAD VER: | 2015 |

SHEET TITLE

BOTTOM ASH
POND
CERTIFICATION

**FIGURE B.3**

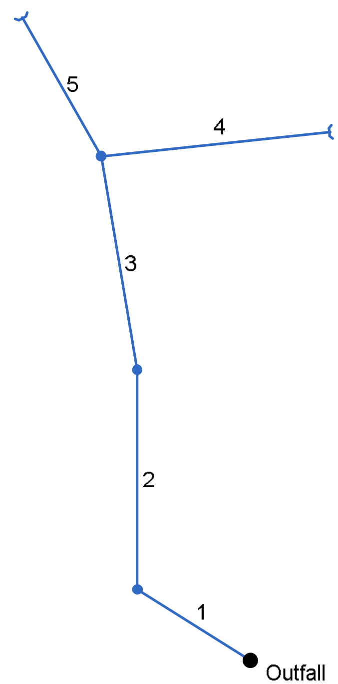
SHEET 1 OF 1

AECOM DRAWING PATH: H:\DuckCreekReview\Bottom ash pond\Duck Creek Contours.dwg

# Attachment B.4

# Civil 3D Hydraflow Storm Sewers Output

# Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan




| | | |
|---|---|---|
| Project File: DuckCreekHydraflow.stm | Number of lines: 5 | Date: 3/30/2016 |

Storm Sewers v10.30

# Storm Sewer Inventory Report



| Line No. | Alignment | | | | Flow Data | | | | Physical Data | | | | | | | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dnstr Line No. | Line Length (ft) | Defl angle (deg) | Junc Type | Known Q (cfs) | Drng Area (ac) | Runoff Coeff (C) | Inlet Time (min) | Invert El Dn (ft) | Line Slope (%) | Invert El Up (ft) | Line Size (in) | Line Shape | N Value (n) | J-Loss Coeff (K) | Inlet/ Rim El (ft) | |
| 5 | 3 | 80.019 | -20.000 | Hdwl | 6.60 | 0.00 | 0.00 | 0.0 | 574.00 | 1.25 | 575.00 | 18 | Cir | 0.025 | 1.00 | 3.59 | Pipe - (43) |
| 4 | 3 | 115.288 | 93.481 | Hdwl | 13.30 | 0.00 | 0.00 | 0.0 | 574.00 | 0.22 | 574.25 | 24 | Cir | 0.025 | 1.00 | 577.84 | Pipe - (39) |
| 3 | 2 | 109.161 | -9.518 | MH | 0.00 | 0.00 | 0.00 | 0.0 | 573.60 | 0.37 | 574.00 | 24 | Cir | 0.025 | 1.00 | 577.84 | Pipe - (40) |
| 2 | 1 | 110.713 | 57.684 | MH | 0.00 | 0.00 | 0.00 | 0.0 | 573.00 | 0.54 | 573.60 | 24 | Cir | 0.025 | 0.20 | 577.84 | Pipe - (41) |
| 1 | End | 67.237 | -147.726 | MH | 0.00 | 0.00 | 0.00 | 0.0 | 572.14 | 1.28 | 573.00 | 24 | Cir | 0.025 | 0.87 | 577.84 | Pipe - (42) |

Project File: DuckCreekHydraflow.stm | Number of lines: 5 | Date: 3/30/2016

`

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**APPENDIX D**

# Concrete Specifications

## DIVISION 5 – STRUCTURAL REQUIREMENTS

501. **GENERAL**

501.1 Scope of Work

a. This division covers the civil and structural requirements applicable to the procurement, fabrication, installation, erection, excavation and demolition activities as indicated by the Specification and as shown on the Design Drawings.

b. Scope of work is defined in Section 102 of this specification

501.2 Reference Documents

a. Related standard specifications are referenced in this Division. The work performed shall comply with the referenced and applicable requirements of the latest issue date of these documents, in addition to Federal, State, or local codes having jurisdiction.

b. A list of agencies with applicable codes and standards is given in Section 112 of this Specification.

502. **CONCRETE WORK**

502.1 Extent

a. Concrete construction shall conform to the requirements of this Section and to the requirements indicated on the design drawings. The work shall include, but not be limited to, the following:

a1. Furnishing, erecting and removing formwork.

a2. Furnishing and placing reinforcing steel, including stirrups, spirals, and other reinforcement materials with all necessary wire ties, bar supports, spacers, block supports and other devices required to install and secure reinforcement properly.

a3. Setting miscellaneous steel embedments, inserts and anchor bolts, including pipe sleeves, piping and conduit for mechanical and electrical work and Purchaser furnished building column anchor bolts.

a4. Furnishing, placing, finishing and curing of all concrete.

a5. Furnishing of miscellaneous accessories required to properly execute the work.

a6. Furnishing and placing joint filler.

502.2 Quality Assurance

a. Inspection Before Erection: Examine the areas and conditions under which concrete work is to be installed and notify Purchaser of any quality concerns.

b. The Purchaser will engage an independent testing and inspection agency to inspect the concrete work in progress and to perform tests and prepare test reports.

c. Materials and fabrication procedures may be subject to inspection and tests in the shop and in the field, and will be conducted by an independent qualified inspection agency hired by the Purchaser. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements. The Purchaser reserves the right, at any time before final acceptance, to reject material not complying with the specified requirements.

d. Correct deficiencies in concrete work which inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expense, as may be necessary to reconfirm any noncompliance of the original work, and as may be necessary to show compliance of corrected work.

e. Tolerances for concrete construction, including tolerances on structure dimensions, concrete finishing tolerances and tolerances on placing reinforcing and embedded materials, shall be in accordance with the applicable chapters of ACI 301.

f. Errors or flaws in the concrete materials, components and accessories discerned during construction and which prevent the proper assembly, fit-up, and/or alignment of components shall be corrected promptly. Contractor shall make immediate substitution of the non-complying component or shall make field changes to make the non-complying component acceptable. Whether the correction is made by substitution or field correction, it shall be performed at no cost to Purchaser.

g. Reinforcing steel with rust, mill scale, or a combination of both shall be considered satisfactory, provided the minimum dimensions, including height of deformations and weight of a hand-wire-brushed test specimen are not less than ASTM A-615 requirements.

502.3 Formwork

a. Conform to the applicable requirements of ACI 301.

b. Plywood Forms: Plywood shall be water-resistant and shall be treated to prevent raising of the grain. If a lining is used it shall consist of accepted nonabsorptive fiberboard plastic coated to resist moisture and with a hard smooth surface on contact side.

c. Steel Forms: Provide minimum gauge thickness, stiffened to support weight of concrete with minimum deflection.

d. Glass Fiber Reinforced Resin Type: Preformed shape, stiffened to support weight of concrete with minimum deflection.

e. Form Ties:

e1. Factory fabricated, removable or snapoff metal form ties, designed to prevent form deflection, and to prevent the spalling of concrete surfaces upon their removal.

e2. Provide ties so that the portion remaining within concrete after removal is at least 1-1/2 inches inside concrete, and which will not leave holes larger than one-inch diameter in concrete surface for concrete exposed above grade.

f. Form Release Agent: Nonstaining type. Contractor shall select with acceptance of the Purchaser.

502.4 Reinforcing Steel

a. Welded Steel Wire Fabric: Plain type, ASTM A 185; in flat sheets and uncoated. Spacing and gauge of wires as indicated on the design drawings.

b. Reinforcing Steel: ASTM A 615, Grade 60 billet steel, deformed bars, uncoated. Bar spacing and size as indicated on the design drawings.

c. Reinforcement Support: Provide bolsters, chairs, spacers, etc., required for spacing and support of reinforcement in accordance with CRSI Manual of Standard Practice Class C. Wood and brick

ARE NOT PERMITTED. Use precast concrete blocks of the same strength as the concrete to support reinforcing steel placed on soil.

502.5 Concrete

a. Cement: Per ASTM C 150, Type I/II.

b. Fly ash: If fly ash is used, it shall conform to ASTM C 618, Class C or Class F, with loss on ignition not to exceed six percent.

c. Aggregates: Per ASTM C 33, and as herein specified:

c1. Fine: Use only graded natural sand.

c2. Coarse Aggregate: Use only graded crushed stone or gravel. For concrete 12 inches or less in thickness the coarse aggregate shall be graded from 3/4" to No. 4 (Size No. 67). For all other concrete work the coarse aggregate shall be graded from 1-1/2" to No. 4 (Size No. 467).

d. Water: Clean, fresh, free from oils, acid, organic matter or other matter deleterious to concrete. Potable water is preferred.

e. Air-entraining admixture: Per ASTM C 260. Type and manufacturer as follows:

e1. Darex AEA: W. R. Grace & Co., Cambridge, MA, 617-876-1400

e2. MB-VR: Master Builders Inc., Cleveland, OH, 216-831-5500

e3. Sika AER: Sika Corp., Lynhurst, NJ, 800-631-7270

e4. Toxement AEA: Toch Div., Carboline Co., St. Louis, MO, 314-644-1000

e5. Others as accepted by the Purchaser.

f. Water-reducing admixture: Per ASTM C 494, Type A. Type and manufacturer as follows:

f1. WRDA with Hycol (nonair-entraining): W. R. Grace & Co.

f2. Pozzolith-Normal Set (nonair-entraining): Master Builders Inc.

f3. Plastocrete 161 (nonair-entraining): Sika Corp.

f4. Others as accepted by the Purchaser.

g. Accelerating admixture: Per ASTM C 494 Type C or E. Non-chloride type only. The use of calcium chloride IS NOT PERMITTED. See use restrictions in this Section. Type and manufacturer as follows:

g1. Pozzutec 20: Master Builders, Inc.

g2. Gilco: Cormix, Inc. (Gifford-Hill), Des Plaines, IL, 800-621-5506.

g3. Lubricon NCA: Cormix, Inc. (Gifford-Hill).

g4. Daraset: W. R. Grace & Co.

g5. Prokrete NCA: Prokrete Industries, Denver CO, 501-227-7580.

g6. Others as accepted by the Purchaser.

h. Retarding admixture: Per ASTM C 494 Type B (retarding) or Type D (retarding and water reducing). Non-chloride type only. See use restrictions in this Section. Type and manufacturer as follows:

h1. Pozzolith 100-XR: Master Builders, Inc.

h2. PSI-R Series: Cormix, Inc. (Gifford-Hill).

h3. Daratard: W. R. Grace & Co.

h4. Eucan Retarder: Euclid Chemical Company, Cleveland, OH, 216-531-9222.

h5. Others as accepted by the Purchaser.

502.6 Concrete Strength And Proportions

a. General: Proposed concrete proportions shall be subject to acceptance by the Purchaser and Consulting Engineer based on demonstrated ability to produce concrete meeting all requirements of the Specification.

b. Proportions of materials for concrete shall be established to provide:

b1. Adequate workability and proper consistency to permit concrete to be worked readily into the forms and around reinforcement without excessive segregation or bleeding under conditions of placement to be employed.

b2. Resistance to freezing and thawing and other aggressive actions.

b3. Conformance with strength test requirements specified in this Section.

c. Concrete proportions shall be established on the basis of previous field experience, laboratory trial batches as specified in Section 3.9, ACI 301 with the materials to be employed in the work, or using empirical data as specified in Section 3.10, ACI 301.

d. The procedure as given in Appendix 3, ACI Standard 211.1, Recommended Practice for Selecting Proportions for Normal and Heavy-weight Concrete, may be used as a guide in performing concrete trial mixes.

e. Prepare design mixes for 4,000 psi concrete (28-day strength) for all concrete work unless otherwise specified. 2,000 psi concrete (28-day strength) may be used for mud slab concrete. Develop the design mixes using the services of the Testing Laboratory furnished by Purchaser. Submit the design mixes to the Engineer for approval. If fly ash is used, it shall not exceed 25% of the cement plus fly ash by weight.

f. Water-Cement Ratio: Not more than 0.50, including free surface moisture on aggregates.

g. Fine Aggregate: In accordance with ASTM C 33 and as specified in this Section.

h. Coarse Aggregate: In accordance with ASTM C 33 and as specified in this Section.

i. Proportions and Slump:

i1. The proportions of cement to coarse aggregate shall be at least that which will produce a plastic mix of suitable workability for each portion of the WORK so as to result in uniformly dense concrete free from aggregate pockets or honeycomb.

i2. Slump limits: Proportion and design mixes to result in concrete slump at point of placement of not less than two inches nor more than five inches.

i3. Proportions to meet these requirements are established by design mixes as set forth herein. All concrete for the WORK shall be in strict conformance with these design mixes.

j. Admixture Use:

j1. Add air-entraining admixture at manufacturer's prescribed rate so that concrete at point of placement has an air content not less than two percent nor more than six percent of the volume of the concrete. The admixture shall be added as a solution in a portion of the mixing water, using a suitable mechanically activated dispenser.

j2. A water-reducing admixture may be used at the Contractor's option. When used a water-reducing admixture shall meet the requirements of this Section and shall be added at rates recommended by the manufacturer.

j3. The use of an accelerating admixture requires the written authorization of the Purchaser. When so authorized, the accelerating admixture shall meet the requirements of this Section and shall be added at rates recommended by the manufacturer.

j4. The use of a retarding admixture requires the written authorization of the Purchaser. When so authorized, the retarding admixture shall meet the requirements of this Section and shall be added at rates recommended by the manufacturer.

502.7 Concrete Testing And Job Control Of Concrete

a. Contractor shall furnish Testing Laboratory with sufficient quantities of cement, fly ash, and aggregates, from same sources as will be used for the WORK, for testing of these materials and preparation of 6 test cylinders for each design mix. Materials thus furnished shall be used for the entire Project without changes.

b. Contractor shall make all concrete test cylinders, as specified in Table 03315-1, from fresh samples of concrete taken on Project Site from discharge of stationary mixers, pumpcrete machines, truck mixers or truck agitators. Locations for taking samples shall be acceptable to the Purchaser. Making of test cylinders shall include slump tests, taking temperatures, curing, storing, packing, and delivery to Testing Laboratory of test cylinders and all required data as to materials, name and quality of air-entraining admixtures, water-cement ratio, proportions, slumps, air contents, temperatures, etc., as referenced on the approved mix design.

Table 03315-1, Schedule of Concrete Test Cylinders

| Total Cylinders Required from Each 100 cubic yards of Concrete, or from Each Day's Pour if Less than 100 cubic yards | Cylinders For Strength Test At | | |
|---|---|---|---|
| | 7 Days | 28 Days | Spare |
| 3 Sets of 2 Each - Total, 6 | 2 | 2 | 2 |

Notes:
1. One set of 2 cylinders comprises a strength test.
2. If one cylinder in a strength test shows evidence of improper sampling, molding, or testing, discard the specimen and use the other to determine the strength. Spare cylinders may be used only when authorized by the purchaser.

c. Unless otherwise indicated, Contractor shall furnish equipment for and shall check the slump of concrete and air content of air-entrained concrete by direct measurement of fresh samples of concrete taken on Project Site from discharge of stationary mixers, pumpcrete machines, truck mixers or truck agitators. Locations of samples for testing slump and air entrainment shall be the same as for samples for test cylinders. At least one air test shall be made for each 100 yards of concrete, provided further that no less than 2 air tests shall be made for each day's pour if less than 100 cubic yards.

d. Concrete shall be sampled and tested at time of placement, as follows:

d1. Sampling of fresh concrete: Per ASTM C 172; except that requirements shall be modified to comply with the requirements of ASTM C 94.

d2. Slump: Per ASTM C 143; one test for each set of compressive strength test specimens made.

d3. Air content: Per ASTM C 231, pressure method, one test for each set of compressive strength specimens.

d4. Temperature of concrete: Test at point of discharge, hourly when ambient temperature if 40°F or below, and when 80°F and over; and each time a set of compressive strength test specimens is made.

e. The data collected shall be forwarded to the Purchaser's Testing Laboratory along with the cured concrete cylinders to be tested.

f. If the results of strength tests indicate that concrete does not meet specified requirements, the following steps shall be taken:

f1. The Testing Laboratory will be directed to visit Project Site and set up proper controls and inspection of job concrete, and Contractor shall pay entire costs of such services.

f2. Contractor may be directed to take concrete cores and/or make load tests, at his own expense, of any work that he has installed with concrete not meeting specified strength requirements. If cores and/or load tests established that such work in place does not meet requirements, Contractor shall correct the work as requested without cost to Purchaser.

502.8 Ready-Mixed Concrete

a. Ready-mixed concrete shall conform to the requirements of this specification in addition to the applicable requirements of ASTM C 94.

b. Ready-mixed concrete shall be mixed and delivered in accordance with applicable requirements of ASTM C 94, except that only trucks equipped with a rotary drum or agitator may be used.

c. When using ready mix concrete per ASTM C 94, delete the reference which allows additional water to be added for concrete with insufficient slump. Addition of water in excess of design quantity is NOT PERMITTED.

502.9 Detailing And Fabrication Of Reinforcement

a. Prepare setting plans and bar lists of the reinforcing steel bars to be fabricated in accordance with the design drawings. The setting drawings shall show the quantity, grade, size, length, mark, location, and bending diagrams for all reinforcing steel in accordance with the applicable requirements of ACI 315. These shop detail drawings which include the setting plans, bending details and bar lists shall be submitted to the Purchaser and Consulting Engineers for review and acceptance prior to fabrication. Do not start fabrication until these shop drawings have been reviewed and accepted.

b. Fabricate reinforcing bars in accordance with the reviewed and accepted shop drawings prepared from the design drawings.

c. Field fabrications when required shall be accomplished by cold bending. Heat bending is NOT PERMITTED. Welding of reinforcing steel is NOT PERMITTED. Bending of reinforcing bars in hardened concrete is NOT PERMITTED.

d. Splicing of reinforcing steel shall conform to the applicable requirements of ACI 318 unless otherwise indicated on the Design Drawings. Splice by the cadweld method shall be in accordance with the manufacturer's requirements.

e. All materials shall be new and in accordance with the ASTM specification or other recognized standards specified.

f. Bending and Concrete Cover Requirements: Bending and concrete cover requirements for reinforcing bars shall be as indicated on the design drawings, and in accordance with the applicable requirements of ACI 318 and CRSI Manual of Standard Practice, unless otherwise indicated.

502.10 Construction Details

a. Construction Joints:

a1. Major construction joints are indicated on the design drawings. Drawings indicating location of construction joints required in addition to or different from those indicated in the design drawings shall be submitted to the Purchaser and Consulting Engineers for review. These drawings shall be submitted and accepted by the Purchaser and Consulting Engineers before rebar details are submitted for review.

a2. If Contractor desires to revise locations of the accepted construction joints or to add or delete construction joints as the work progresses, then drawings showing proposed changes shall be submitted for review by the Purchaser and Consulting Engineers. No changes shall be made until acceptance is received. All changes, including required waterstops, if any, shall be made at no cost to Purchaser.

a3. Provide keyways at least 1-1/2 inches deep in construction joints in walls, slabs, and between walls and footings unless the Design Drawings indicate otherwise when smooth forms are used for the construction joints. Acceptable prefabricated bulkheads designed for this purpose may be used for slabs. As an alternate, expanded metal of sufficient strength may be used as a bulkhead material.

a4. Concrete for turbine-generator foundation, and for supporting foundation structures and foundation slabs for pulverizers, pumps, fan and similar equipment subject to vibration and/or impact operating loads shall have only those construction joints indicated on the design drawings.

b. Beveled Corners:

b1. Bevel all exposed projecting corners of concrete work, such as piers, columns, beams, equipment foundations, switchyard foundations, etc., 1" by 1" unless otherwise indicated. For exposed vertical corners in contact with ground, extend bevels 1'-0" below finish grade.

b2. Bevel all projecting corners of turbine foundations 2" by 2" unless otherwise indicated on the design drawings.

b3. The foregoing specified dimensions refer to the horizontal and/or vertical legs of the bevels.

c. Openings in Concrete:

c1. Provide openings, pockets, chases, recesses, slots, etc., in walls, piers, floors or other portions of concrete Work for structural steel, conduit, pipe, building sewers, sleeves, and similar items, as indicated on the design drawings.

c2. Fill all such openings, pockets, chases, etc., with concrete when indicated on the design drawings after preceding items, whether they are by Contractor or are by others, are installed as the WORK progresses. Finish exposed surfaces of such concrete fills to match adjoining concrete work.

502.11 Connecting to Existing Concrete:

a. Connections of new concrete to existing concrete shall include all necessary cutting, patching and fitting required for a neat and workmanlike job. All exposed surfaces shall be cut true and smooth and shall be patched and finished to match adjoining concrete surfaces.

b. Existing reinforcing uncovered in removing concrete and which is not indicated to be retained shall be cut back 1" from new surfaces before patching. Existing reinforcing indicated to be retained shall be stripped clean and lapped into new concrete a minimum of the specified lap length for the bar size involved unless otherwise indicated on the design drawings.

502.12 Accessories

a. Joint filler material:

a1. For expansion joints in concrete paving and concrete structures use preformed expansion joint filler per ASTM D 1752.

a2. For expansion joints in concrete slabs on grade and non-building structures use preformed expansion joint filler per ASTM D 1752 or ASTM D 1751.

a3. For non-expansion control joints use preformed expansion joint filler per ASTM D 1751.

b. Curing Compound: Membrane forming per ASTM C 309. Type 1, for concrete floors and stair treads. Type 1-D with fugitive dye for all other work (wax base not permitted). Type and manufacturer as follows:

b1. Burke Res-X or Cure-Seal-Hardener: The Burke Company, San Mateo, CA, 800-423-9140

b2. Clear Seal Standard. Code 2802, Dekote T-130 or Horncure 30D: A. C. Horn, Inc., Beltsville, MD, 800-654-0402

b3. Masterseal MB-429: Master Builders Inc.

b4. Sealtight AR-30-D or CS-309: W. R. Meadows, Inc., Elgin, IL, 708-683-4500

b5. Kure-N-Seal: Hydrocide Curing (Resin Base): Sonneborn Building Products/ChemRex, Inc., Minneapolis, MN, 612-835-3434

b6. Cure and Seal (High Solids): Symons Corp., Des Plaines, IL, 708-298-3200

b7. Thorocure: Thoro System Products, Miami, FL, 800-327-1570

b8. Others as accepted by the Purchaser.

502.13 Installation Of Formwork

a. General Requirements: Conform to the applicable requirements of ACI 301.

502.14 Placing Reinforcement

a. Reinforcing Bars:

a1. Comply with CRSI Manual for details and methods for reinforcing bar support and placement, as indicated on the design drawings and as specified herein.

a2. Clean reinforcement free of loose rust, mill scale, oil, grease, mud, dirt, ice and other foreign material which could reduce or destroy the bar's bond with concrete.

a3. Accurately position, support and secure reinforcement against displacement by construction activities and placement of concrete by metal supports or spacers, except use precast concrete blocks to support reinforcement placed on soil.

a4. Place reinforcement to obtain the minimum concrete coverage as indicated on the design drawings. Set wire ties so that ends are directed into concrete and not toward exposed concrete surfaces.

a5. Bending of reinforcing bars in hardened concrete will not be permitted.

a6. Heating and welding of reinforcing bars for any purpose WILL NOT BE PERMITTED.

b. Placing of Welded Wire Fabric: Carefully place fabric in position indicated on the design drawings, and maintain in this position before and during placing of concrete.

c. Anchoring Dowels: Securely anchor all dowels in place by wire tieing, etc., before starting placement of concrete.

d. Coating Dowels for Future Extensions: Exposed reinforcing bars for bonding with future work shall be protected from corrosion with two coats of "Bitumastic No. 50" as made by Koppers Company, Inc., Tar Products Division. Before coating the dowels, apply two coats of Bitumastic Concrete Penetrant on the concrete surface adjacent to the dowels. When the dowels are coated, the coated concrete surface shall be included as an integral part of the dowel coating.

502.15 Installation Of Embedded Items

a. Build in reglets and install anchors, building column anchor bolts, equipment anchor bolts, dowels, inserts, hangers, nailing strips, grounding, sleeves, conduit, and other items furnished by Contractor, other Subcontractors or the Purchaser. Use setting drawings, diagrams, instructions and directions provided by suppliers of the items to be installed. Maintain items plumb, in alignment and in proper position. Use care in placing concrete so as not to dislodge any of these installations.

b. Electrical conduit and piping embedded in concrete shall be located by the Contractor between the bottom and top reinforcement. Joints and ends of conduit and piping shall be sealed to prevent concrete from entering them. Where conduit or piping crossovers are necessary, they shall not displace reinforcement from its required positions.

c. Embedded conduit or piping parallel the main reinforcing steel shall be installed so that at least 2 in. of concrete can completely surround the main reinforcing steel.

d. Embedded items shall be sufficiently anchored to maintain their position during concrete placement and to prevent their flotation.

502.16 Concrete Mixing

a. All concrete shall be mixed until there is a uniform distribution of materials. Production of concrete shall be in accordance with the applicable requirements of ACI 301.

b. Site-mixed concrete shall be mixed in a batch mixer. Mixer shall be rotated at a speed recommended by manufacturer, and mixing shall be continued for not less than 1-1/2 minutes after all materials are in drum. For batches larger than 1 cubic yard, mixing time shall be in-creased 15 seconds for each additional cubic yard or fraction thereof. Where site-mixed concrete is conveyed by trucks from a central batch plant, trucks shall be equipped with an approved rotary drum or agitator. The mixer shall be discharged completely before recharging.

502.17 Conveying Concrete

a. Convey concrete from mixer to place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients.

b. Chutes or other equipment for conveying concrete shall be of such size and design as to insure a continuous flow of concrete at delivery end without separation of ingredients, and shall be thoroughly cleaned before each run. If use of pumping equipment to convey concrete is accepted, aluminum pipe shall not be used.

c. Concrete shall not be allowed to drop freely more than 5 ft. For drops which exceed 5 ft., use a hopper and drop chute. For all walls, use a hopper for any depth, with addition of a drop chute for drops which exceed 5 ft.

502.18 Preparations For Placing Concrete

a. Before concrete is placed, clean the forms and reinforcing of dirt and debris, remove snow and ice, and do all necessary trenching, damming, draining and pumping so that all concrete can be placed in the dry. Do not place any concrete until forms and reinforcing have been inspected and approved by Purchaser.

b. Before fresh concrete is placed on or against hardened new concrete or old concrete, thoroughly clean surfaces of all laitance, soft or loose materials and deleterious substances. The surfaces shall then be washed clean and thoroughly moistened. Where concrete has dried out, it shall be saturated for at least 24 hours. Immediately before fresh concrete is deposited, horizontal surfaces shall be thoroughly covered with a sand/water/cement mortar of same mix as concrete to be poured. Fresh concrete shall then be placed before cement mortar has obtained its initial set.

502.19 Placing Concrete

a. General:

a1. Comply with ACI 301 and as herein specified.

a2. Place all concrete in a continuous and uninterrupted operation in such manner as to form a monolithic structure, the component parts of which are securely bonded together. No concrete shall be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within a given section. If a section cannot be placed continuously, provide construction joints as specified in this Section. Do not deposit segregated concrete or concrete that has partially hardened or been contaminated by foreign materials, nor use retempered concrete. Time interval between placing of successive batches of concrete shall not be greater than 30 minutes.

a3. Deposit all concrete in forms within 1-1/2 hours after introduction of mixing water to cement and aggregates.

a4. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing.

a5. All concrete in vertical members, such as columns, caissons and walls, shall be in place not less than 2 hours before any concrete is placed in girders, beams or slabs supported thereon. Place concrete for beams, girders, brackets, column caps, caisson caps and haunches monolithic with floor slabs.

a6. Massive concrete (concrete components greater than 18 inches in thickness) shall be placed in layers approximately 18 inches thick, in accordance with ACI 301.

a7. Thoroughly compact all concrete work by means of mechanical vibrators.

a8. The temperature limitations of plastic concrete shall be according to ACI 301.

b. Cold Weather Placement:

b1. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 301 and as herein specified.

b2. The use of frozen materials or materials containing ice or snow IS NOT PERMITTED. Do not place concrete on frozen subgrade, or on subgrade containing frozen materials.

b3. Do not use calcium chloride, salt or other materials containing antifreeze agents. The use of an accelerating admixture requires the written approval of the Purchaser as noted in this Section.

c. Hot Weather Placement:

c1. When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 301 and as herein specified.

c2. The use of a retarding admixture requires the written approval of the Purchaser as noted in this Section.

502.20 Finishing Formed Surfaces

a. All formed concrete surfaces shall be finished in accordance with ACI 301 and as follows:

a1. Exposed Surface Finish:

- Upon removal of forms, all fins and other projections shall be removed and offsets leveled. All voids, holes, honeycomb or other damaged surfaces shall be cleaned back to solid concrete, saturated with water and filled with cement mortar of same composition as that used in the concrete. The concrete shall be finished free from streaks, discoloration or other imperfections as to produce an extremely smooth, dense and true finish of uniform color.

- This finish shall be used for all formed surfaces exposed to view.

a2. Unexposed Surface Finish:

- Upon removal of forms, all voids, holes, honeycomb or other damaged surfaces shall be cleaned back to solid concrete, saturated with water and filled with cement mortar of same composition as that used in the concrete.

- This finish shall be used for all formed surfaces unexposed to view.

502.21 SLAB Finishes

a. All concrete slab surfaces shall be finished in accordance with Chapter 11 of ACI 301.

b. Top surface of structural concrete slabs and equipment foundations shall be level unless otherwise indicated. Screeds shall be used for all structural slabs and shall be securely and accurately set to elevations indicated. After concrete has been compacted by vibrating, it shall be screeded to required level.

c. Floated Finish: Provide in accordance with Paragraph 11.7.2 of ACI 301 and as follows:

c1. Surface shall first be screeded, and then be bull floated to a smooth, compact surface. After bull floating, surface shall be floated after concrete has hardened sufficiently to retain the float finish and water sheen has disappeared.

c2. Uses:

- Structural concrete roof slabs. Finish shall be free of all depressions or projections which would prevent proper application of roofing.
- Structural floor slabs only where specifically indicated on the design drawings.
- Top of concrete walls, curbs, piers, pads, pedestals and switchyard and equipment foundations.
- Floors of tunnels, crib houses, manholes, sump pits, elevator pits, valve pits, miscellaneous pits, etc. Roofs, if any, of these structures shall also have a float finish, except that where such roofs are integral with other concrete work, the roofs shall have the same finish as the other concrete work.

d. Troweled Finish: Provide in accordance with Paragraph 11.7.3 of ACI 301 and as follows:

d1. Surface shall first be screeded, and then be floated to a smooth, compact surface. After floating, the surface of concrete shall be steel troweled to a smooth, slate-like surface. Final troweling shall be done after concrete is so hard that no mortar accumulates on trowel and a ringing sound is produced as trowel is drawn over surface. Finish surface shall not be brushed off or scored in any manner.

d2. Uses:

- Structural concrete floor slabs where monolithic finish is indicated. A monolithic finish is one produced on structural concrete slabs which are poured all at one time with one concrete mix. Concrete for structural slabs with monolithic finish shall be of the driest consistency possible to work with a sawing motion of screed.
- Floor areas where resilient tile finishes (asphalt, rubber, vinyl, etc.) are indicated.
- Stair treads.

e. Broom Finish: Provide in accordance with Paragraph 11.7.4 of ACI 301 and as follows:

e1. The surface shall first be screeded, and shall then be bull floated to a smooth, compact surface. Following the bull floating, the surface shall be broomed with a medium-stiff bristled broom only after the concrete has hardened sufficiently to retain the scoring. The strokes shall be square across the surface and shall be so made as to produce regular scoring without tearing the surface or exposing any aggregate. The scoring shall run transverse to the direction of traffic.

e2. This finish shall be used for sidewalks and driveways. It shall be used for other surfaces only if specifically indicated.

502.22 Concrete Curing And Protection

a. Concrete shall be cured and protected in accordance with the requirements of Chapter 12 of ACI 301. Curing should start as soon as the concrete has hardened sufficiently to prevent surface damage. Cure for the minimum periods herein specified before subjecting concrete to live loads, earth loads, traffic, etc.

b. Protect freshly placed concrete from premature drying, excessive heat or cold, and maintain at a relatively constant temperature for the period of time required for the hydration of cement and proper hardening.

c. All concrete shall be protected so as to prevent the temperature at the surface from going below 50°F or loss of moisture from the surface.

d. Curing shall continue for at least 7 days.

e. Alternatively, if tests are made of cylinders kept adjacent to the structure and cured by the same methods, moisture retention measures may be discontinued when the average compressive strength has reached 70% of the specified strength. Moisture retention measures may also be discontinued when the temperature of the concrete is maintained at least at 50°F for the same length of time that laboratory-cured cylinders, representative of the concrete-in-place, require to achieve 85% of the specified *f'c*.

f. When the temperature of surrounding air is 40°F, or below, or is expected to drop to 40°F or below in the next 12 hours, provide adequate means for maintaining the temperature of the concrete between 50°F and 70°F for the required curing period.

g. The housing or covering of concrete for cold weather protection and the means of providing artificial heat shall be in accordance with industry practice. Such housing or covering shall remain in place and intact for at least 24 hours after artificial heating is discontinued.

h. The mass of concrete contained in a mat foundation thicker than 30" generates enough heat in the process of hydration that use of artificial heating may not be required. Insulation blankets of sufficient thickness shall be provided to maintain the surface temperature of the concrete above 40°F for a period of 7 days or until the average compressive strength of the concrete conforms to requirements above.

i. Avoid rapid drying at the end of the final curing period.

j. Curing Methods:

j1. Provide membrane curing by applying membrane forming curing compound to damp concrete surfaces as soon as water film has disappeared. Apply uniformly in a two-coat continuous operation by means of power spray equipment in accordance with manufacturer's directions. Re-coat areas which are subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period. Liquid membrane forming curing compounds shall conform to the requirements and shall be applied in accordance with the manufacturer's recommendations.

j2. Do not use membrane forming curing compounds on surfaces against which additional concrete or other materials such as waterproofing, membrane roofing, flooring, painting or other coatings will be bonded unless the Contractor can prove that the curing compound will not prevent bond, or unless the Contractor takes positive measures to remove the curing compound completely from those areas. If the Contractor cannot comply with this provision, he shall select one of the other curing methods specified in Section 12.2.1 of ACI 301.

j3. Where forms are left in place for entire period for which curing is specified, the use of curing compound may be omitted, provided that in warm weather, temperatures above 80°F, the forms are kept wet until they can be safely removed.

j4. Where forms are stripped before completion of specified curing period, apply curing compound to such surfaces immediately after completion of specified surface treatment.

k. Protection of Concrete: Fully protect all concrete from damage or injury during construction operations. Protect exposed external corners of concrete with wood strips securely fastened in place.

l. Cleaning of Surfaces: After concrete is placed, all exposed surfaces which have been contaminated by concrete splashing, dripping, etc., caused by such concrete work shall be cleaned to restore these surfaces to their original condition.

502.23 Removal of Forms

a. Do not remove forms from any concrete work until the concrete has acquired sufficient strength to safely carry its own weight and any construction loads that may be imposed on it. Methods used for removal of formwork shall be such as to prevent marring, breakage or other damage to concrete. Removal of formwork shall conform to the applicable requirements of ACI 301.

503. **GROUT WORK**

503.1 Intent

a. This section covers the material and procedures for grouting of the following unless otherwise indicated on the Design Drawings:

a1. Column base plates.

a2. Conduit, piping, etc., through concrete floors or walls.

a3. Anchor bolts in drilled holes in concrete.

a4. Grouting of equipment

b. Grouting shall be performed using non-shrink grout, unless otherwise indicated on the Design Drawings.

503.2 Quality Assurance

a. Purchaser may engage an independent testing laboratory to inspect the grout work in progress and to perform test to verify compliance with the requirements specified herein. Such inspections and tests shall not relieve Contractor of responsibility for providing materials and procedures in compliance with the specified requirements.

**APPENDIX E**

# Earthwork Specifications

## SECTION 319005

## EARTHWORK AND CLAY LINING FOR A CLAY/GEOMEMBRANE COMPOSITE LINED POND

### PART 1 - GENERAL

101. EXTENT

101.1 The intent of this Section is to define the material and installation requirements for earthwork and clay lining for ponds in accordance with the Design Drawings and as specified herein.

101.2 Work Included:

101.3 The work shall include, but not be limited to, the following items:

a. Installation of sediment and erosion control facilities prior to the start of construction and maintenance of the facilities during construction.

b. Dust Control during the construction period.

c. Earth excavation.

d. Preparation of the subgrade to receive fill, including clearing and grubbing.

e. Placement and compaction of general and structural fills.

f. Placement and compaction of dike fills.

g. Supply of clay liner materials from an offsite or onsite (if available) borrow area.

h. Placement and compaction of the clay liner.

i. Preparation of the clay liner to be geomembrane lined.

j. Excavation and backfill of anchor trenches for geomembrane lining.

k. Fine finishing of completed slopes and embankments.

l. Disposal of excess or unsuitable excavated material if required.

m. Placement and seeding of topsoil on exterior slopes.

n. Placement of rock surfacing on the top of the dikes.

o. Closure and seeding of borrow areas.

p. Offsite disposal of excess or unsuitable excavated earthen material and debris.

102. RELATED WORK SPECIFIED IN OTHER SECTIONS

102.1 Section 014362 – Quality Assurance for Installation of Earthwork and Clay Lining for a Clay Lined Pond

102.2 Section 329219 – Temporary and Permanent Seeding (Illinois)

102.3 Section 321124 – Crushed Stone Surfacing for Unpaved Roads, Parking Lots and Laydown Areas

102.4 Section 015713 – Temporary Sediment Control During Construction

102.5 Section 311101 – Site Clearing and Grubbing

103. REFERENCE DOCUMENTS

103.1 Standards, specifications, manuals, codes and other publications of nationally recognized organizations and associations are referenced herein. Methods, equipment and materials specified herein shall comply with the specified and applicable portions of the referenced documents, in addition to federal, state or local codes having jurisdiction.

103.2 References to these documents are to the latest issue of each document, unless otherwise indicated, together with the latest additions, addenda, amendments, supplements, etc., thereto, in effect as of the date of the Contract for the Work.

103.3 Abbreviations listed indicate the form used to identify the reference documents in the Specification.

103.4 ASTM - American Society for Testing and Materials:

a. ASTM D422 - Test Method for Particle Size Analysis of Soils.

b. ASTM D698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.

c. ASTM D1140 - Test Method for Amount of Material in Soils finer than the No. 200 Sieve.

d. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

e. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

f. ASTM D5084 - Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter.

104. SUBMITTALS

104.1 Contractor shall submit drawings and data as specified. Contractor's Drawings and Data shall be submitted via electronic medium in a format compatible for importing into the Purchaser's information systems specified by the Purchaser.

104.2 Data required to be submitted by the CQA Engineer is specified in Section 014362 – Quality Assurance for Installation of Earthwork and Clay Lining for a Clay Lined Pond.

104.3 The Contractor shall submit for the Purchaser's review catalog data on all compaction equipment and proofrolling equipment he plans to use on the project.

105. QUALITY ASSURANCE

105.1 Inspection Before Working: The Contractor shall examine the areas and conditions under which earthwork is to be done and notify the Purchaser in writing of conditions detrimental to the proper and timely completion of the Work.

105.2 Material, placing procedures and installations are subject to inspection and tests conducted by an Independent Testing Service hired by Purchaser. Such inspections and tests shall not relieve Contractor of responsibility for providing material and placement in compliance with this specification. The Purchaser reserves the right, at any time before final acceptance, to reject material not complying with the specified requirements.

105.3 The Contractor shall correct all deficiencies in earthwork and liner installation which inspections and laboratory and field tests have indicated are not in compliance with the specifications. The Contractor shall perform additional tests, at his expense, as may be necessary to reconfirm any noncompliance of the original work, and as may be necessary to show compliance of corrected work.

105.4 The Contractor shall promptly correct errors or flaws in the work or material identified during construction and which prevent proper installation. The Contractor shall make immediate substitution of the noncomplying material or shall make field changes to make the noncomplying material acceptable. The correction or substitution shall be performed at no cost to the Purchaser.

106. GEOTECHNICAL DATA AND TOPOGRAPHY

106.1 Geotechnical Data:

a. Reference drawings in the geotechnical report indicate location of the borings taken at the Project Site and the boring logs indicate the character of the soil. This information is available and, on request, will be furnished to the Contractor for his convenience and use. The Purchaser assumes no responsibility for the accuracy of information provided.

106.2 The Contractor may be permitted to make his own soil investigations. If permitted, investigations shall be performed at no cost to the Purchaser.

106.3 Topography:

a. A topographical survey is available with Purchaser. The Design Drawings indicate contour lines, elevations and dimensions of existing ground. This information is furnished for Contractor's convenience and use. The Purchaser assumes no responsibility for the accuracy of information provided.

b. The Contractor may be permitted to make his own topography assessment or check the existing survey data. Any additional surveying of the project site shall be at no cost to the Purchaser.

107. LINE AND GRADES

107.1 The Contractor shall lay out lines and grades from the existing monuments and bench marks on the Project Site.

107.2 The Purchaser reserves the right to verify correctness of lines and grades during progress of the Work. Such verification by Purchaser shall not relieve the Contractor of responsibility as herein specified.

107.3 The Contractor shall notify the Purchaser of any difference in location of existing construction and conditions from those indicated wherever such difference may affect his work.

107.4 The Contractor shall preserve and maintain bench marks and reference points established on the Project site. Should Contractor, during prosecution of the Work, destroy or remove any bench mark or reference point established by the Purchaser, the cost of reestablishing the bench mark or reference point shall be borne by the Contractor.

108. DUST CONTROL

108.1 The Contractor shall be responsible for controlling dust caused by the grading operation in compliance with any dust control permit obtained by the Purchaser. Water shall be applied uniformly and lightly to prevent muddy, slippery or other hazardous conditions. The application shall be frequent enough to adequately control the dust nuisance. However, excessive application that would affect compacting operations shall be avoided.

109. TEMPORARY SEDIMENT CONTROL DURING CONSTRUCTION

109.1 The Contractor shall be responsible for providing temporary facilities for the control of sediment in site area runoff during construction.

109.2 Silt fences, straw bale dikes and other temporary facilities shall be provided as required.

110. EROSION CONTROL

110.1 The Contractor shall be responsible for temporary protection of graded areas against erosion and for correction of erosion, which occurs.

110.2 Temporary seeding or application of topsoil and permanent seeding or other erosion control measures specified on the Design Drawings shall be applied to completed slopes, ditches and other disturbed areas not subject to additional construction activities within 30 days of completion of the grading activity.

110.3 Slopes, ditches or other disturbed areas, which will be exposed for more than 30 days without a permanent cover because they will be subject to additional future construction activities, shall be provided with temporary seeding. Included are cut and fill slopes, pond dikes, and spoils disposal areas.

**PART 2 - PRODUCTS**

201. DESCRIPTION OF EARTHWORK

201.1 Earthwork for the ponds includes constructing dikes, excavating the pond area, and lining the interior of the dikes with clay obtained from a borrow area. The clay liner will be covered with a geomembrane. The top of the dikes shall be surfaced with crushed rock. The exterior slope of exterior dikes shall be covered with topsoil and seeded.

202. MATERIAL FOR DIKES AND GENERAL AND STRUCTURAL FILLS

202.1 Definitions:

a. "Dike Fill" is fill for pond dikes.

b. "General Fill" is fill, which does not support structures. "General Fill" includes fill around the inlet and discharge structure where it is not part of the dikes.

c. "Structural Fill" is fill placed beneath equipment, walls, retaining walls, inlet and outlet structures, pump stations, and other similar structures sensitive to settlement. "Structural Fill" is also fill placed in the upper 3 feet beneath roads, fill supporting buried structures such as drainage manholes, electrical manholes and vaults where they are not incorporated in the dikes.

202.2 Satisfactory Fill Material:

a. Granular Material:

a1. Granular material is suitable for use as "General Fill" and "Structural Fill" if it contains not more than 1 percent organic or other deleterious material, is free of excess moisture and has a maximum particle size of 3 inches.

a2. Acceptable granular material comes from soils which are classified as coarse-grained soils in the Unified Soil Classification System, ASTM D2487. Classifications are GW, GP, GM, GC, SW, SP, SM or SC, or combinations of these such as SP-SC.

a3. Restrictions on the use of poorly graded sand (SP) or silty sand (SM) material are as follows: No material with a silt content of greater than 15 percent shall be used for "Dike Fill" or "Structural Fill" nor shall it be used for fill behind retaining walls or within 12 inches of the surface of ditches or slopes.

b. Cohesive Material:

b1. Cohesive material is suitable for use as "Dike Fill", "General Fill" and "Structural Fill" if it contains not more than 1 percent organic or other deleterious material, has a maximum particle size of 3 inches, has a liquid limit of less than 45 and a plasticity index of less than 25.

b2. Acceptable cohesive material comes from soils which are classified as fine-grained soils in the Unified Soil Classification System, ASTM D2487. Classification is CL.

202.3 Unsatisfactory Fill Material:

a. Material unsatisfactory for use as either a "General Fill" or a "Structural Fill" are as follows:

a1. Soils classified as silt or organic soils in the Unified Soil Classification System, ASTM D2487. Classifications are ML, MH, PT, OL and OH.

a2. Clay soils classified as CH with a liquid limit greater than 50.

a3. Rock material without a soil matrix in which nesting of rocks could occur.

b. Material classified as CL-ML (Plasticity Index of 4 to 7) shall not be used to construct Pond Dikes. However, limited amounts of that material may be blended with CL material to meet the limits of cohesive material listed above and used for "General Fill."

203. MATERIAL FOR CLAY LINER

203.1 Satisfactory Material:

a. Materials for the clay liner shall be clay, silty clay, sandy clay, or clayey sand classified as CL soils in the Unified Soil Classification System, ASTM D2487. Clay liner material shall meet requirements shown below.

| No. | Test | Item | ASTM | Requirement |
|---|---|---|---|---|
| 1 | Atterberg Limits | Liquid Limit<br>Plasticity Index | D 4318<br>D 4318 | 30% minimum<br>15% minimum<br>40% maximum |
| 2 | Gradation | Passing No. 200 sieve (0.074mm size)<br>Passing 2 micron (0.002mm) size<br>Retained on the 3/8 inch sieve | D1140<br>D 422<br>D 422 | 50% minimum<br>30% minimum<br>10% maximum |
| 3 | Permeability | Permeability | D 5084 | $1x10^{-6}$ cm/sec maximum |

b. Clay shall be free from trash, vegetation, organic matter, hard lumps of earth, and frozen, corrosive or perishable material.

c. Clay shall not contain any earth particles or pieces of rock greater than 3/4 inch in any dimension.

d. Soils amended with additives such as bentonite, cement, or asphalt shall not be used as liner materials.

203.2 Source of Liner Material:

a. Clay for use as liner material shall be obtained from an approved borrow source.

b. Materials shall not be borrowed from any source until it has been qualified for use by the Purchaser.

204. RESTRICTIONS ON THE USE OF MATERIAL FOR ANY PURPOSE

204.1 Any material, which is frozen, contains an excessive amount of organic material or trash, or contains large rocks, shall be considered unsatisfactory for use as fill.

204.2 Fill and backfill soils placed by previous construction shall be considered unsatisfactory for use as fill unless they meet the requirements for satisfactory material.

205. TOPSOIL

205.1 Topsoils are friable sandy-loam surficial soils suitable to sustain the growth of vegetation. See Section 329219, Temporary and Permanent Seeding (Illinois). Topsoil shall be used only for surfacing of exterior side slopes of dikes and ditches.

## PART 3 - EXECUTION

301. DEMOLITION, CLEARING, GRUBBING AND STRIPPING

301.1 General:

a. The work required is shown on the Design Drawings. No work shall be performed outside of the designated area without prior written approval of the Purchaser.

b. All work incidental to excavation or fill work will not be specifically indicated on the Design Drawings but shall be performed as part of the work.

301.2 Demolition:

a. No demolition of any structures is required.

b. Demolition and removal of minor items which are incidental to the earthwork may be required. The Contractor shall identify any such items during his pre-bid walkdown. The Contractor shall demolish such items as required as part of the performance of the work.

c. All waste resulting from demolition work shall be disposed of by the Contractor in an offsite disposal area.

301.3 Clearing and Grubbing:

a. All areas to be excavated or receive fill shall be cleared and grubbed, stripped of topsoil and debris and shall be inspected and approved by the Purchaser prior to beginning the earthwork operations.

301.4 Topsoil Stripping:

a. Areas designated for excavation or fill shall be stripped of all topsoil. Striped topsoil shall be placed in an onsite stockpile and used to cover finished ditches, slopes and other designated areas.

302. EXCAVATION

302.1 Classification of Excavation:

a. Excavation is classified as follows:

a1. Earth Excavation.

a2. Rock Excavation.

b. Earth excavation shall consist of removal of all material encountered which can be excavated using common earthmoving equipment.

c. Rock excavation shall consist of the excavation of boulders 1/2 cubic yard in volume or greater, all rock in ledges, and bedded and conglomerated deposits so firmly cemented that they cannot be removed by common earthmoving equipment.

302.2 Earth Excavation:

a. After topsoil removal has been completed, excavation within the limits of grading shall be performed to the lines and grades indicated on the Design Drawings.

b. Excavated material shall be used for fill unless it is classified as unsatisfactory.

c. Excavations shall not be carried below grades indicated on the Design Drawings without approval of the Purchaser. Over excavations shall be refilled with compacted satisfactory fill material to the proper grade at the Contractor's expense.

d. If unsatisfactory material is encountered at the bottom of an excavation, this material shall be removed to a depth as directed by the Purchaser and backfilled to the proper grade with compacted satisfactory fill material.

e. Excavation shall be performed in a sequence which will provide proper drainage at all times. Excavations shall be kept free of standing water while construction is in progress.

302.3 Rock Excavation:

a. No rock excavation is anticipated for this project.

302.4 Excavation of Drainage Facilities:

a. Drainage ditches, gutters, swales and channels shall be cut accurately to the cross section and grades indicated on the Design Drawings.

b. Roots, stumps, rocks and foreign material in the sides and bottom of drainage facilities shall be removed and the facility trimmed and dressed.

c. Care shall be taken not to excavate ditches and channels below the grades indicated. Excessive excavation shall be backfilled with compacted satisfactory backfill material.

d. Drainage facilities shall be maintained until final acceptance of the work by the Purchaser.

e. Material excavated from the drainage facilities shall be used as fill or transported to a designated stockpile or disposal area.

302.5 Stockpile of Select Material:

a. Stockpiling of excavated material suitable for use shall be as directed directed by the Purchaser.

302.6 Disposal of Excess Material:

a. Excess excavated material shall be placed in a designated onsite stockpile or disposal area as directed by Purchaser. Material may be removed from the stockpile or disposal area as directed by the Purchaser.

b. After completion of earthwork operations, all disposal and stockpile areas shall be dressed to drain properly and control erosion and seeded or removed from the site as directed by the Purchaser.

303. PREPARATION OF SUBGRADE TO RECEIVE FILL

303.1 Removal of Unsatisfactory Material Beneath Dikes:

a. Any material which is unsatisfactory for use for dike construction shall be removed and placed in a disposal area. The subgrade soils shall be inspected and approved by the Purchaser prior to the start of dike construction.

303.2 Preparation of Sloping Areas and Hillsides:

a. If fill is to be placed on an original hillside or an existing embankment with a slope of between 5 and 20 percent, the original ground shall be scarified to provide a bond between the ground and the fill to be placed thereon and the first layer of fill shall be placed, blended and compacted.

b. If fill is to be placed on an existing hillside or embankment which has a slope of greater than 20 percent, the fill shall be keyed at the toe of the slopes of the original hillside or existing fill and shall be continuously benched to key the fill to the underlying ground to ensure that new work is constructed on a firm foundation free of loose or disturbed material.

c. Keys at the toe shall be approximately 10 feet wide by 1 foot deep.

d. Benches on the slope shall be a minimum of 1 foot deep normal to the slope and about 10 feet wide. Benches shall slope 2 percent downhill and shall be horizontal longitudinally following the natural contours. Material excavated from benches may be mixed with new fill and compacted.

303.3 Compaction and Proofrolling:

a. Extent: The subgrade of areas to receive fill shall be compacted and proofrolled prior to placing the fill. The subgrade shall be compacted to a minimum degree of compaction specified in Table 1. Compaction shall be performed using suitable equipment for the type of soil present. Proofrolling shall consist of furnishing and operating heavy pneumatic tired compaction equipment for testing the stability of subgrade prior to receiving the fill. The intent is to locate any unstable areas. Compaction and proofrolling shall be performed in the presence of the Testing Service to allow for observation of unstable areas.

b. Proofrolling Equipment: The compaction equipment used for proofrolling shall be equipment such as a fully loaded water wagon having a gross weight of not less than 25 tons or a pneumatic-tired roller having not less than 4 pneumatic wheels. Under working conditions the roller shall deliver a compression of not less than 150 pounds per square inch of tire tread.

c. Operation: Compact the surface of the subgrade to be proofrolled. Proofroll the surface by making a minimum of two coverages with the compaction equipment at a speed of not greater than 5 mph. Each succeeding trip of the proofroller shall be offset by not greater than one tire width. Make additional passes over areas of suspected instability.

d. Failure: The subgrade shall be considered failed if, under the action of proofrolling, the subgrade yields, pumps, or is otherwise unstable. Yielding is defined as rutting of more than 1 inch measured from the top of the construction grade to the bottom of the rut.

e. Remedial Action: Remove all failed areas a minimum depth of 1 foot or deeper as directed by the Purchaser and replace with satisfactory fill compacted as specified in Table 1.

304. PLACEMENT OF GENERAL AND STRUCTURAL FILLS

304.1 Material Sources:

a. Borrow material from an onsite cut on an onsite borrow area shall be used for obtaining material for this purpose unless an offsite borrow area is identified by the Purchaser.

304.2 Moisture Content of Fill Material:

a. If the material is too dry, cut areas shall be pre-wetted to raise the moisture content. If the material is too wet, both cut and fill areas may require wind rowing or blending to dry the material. The moisture content of dike fill shall be within the range of (-) 1 to (+) 3 percent of optimum moisture content at the time of compaction. The moisture content of structural fill material shall be within $\pm 2$ percent of optimum moisture content at the time of compaction. The moisture content of general fill material shall be within $\pm 3$ percent of optimum moisture content at the time of compaction.

b. Fill material, which contains excessive moisture, shall not be compacted unless the material has dried and the moisture content is within the specified limits.

c. Fill material, which is too dry, shall have moisture added and then be blended so that the moisture content is uniform throughout the thickness prior to compaction.

d. Moisture control shall be applied to the upper 6 inches of the undercut subgrade soils.

304.3 Thickness:

a. Fill shall be placed in horizontal layers in thicknesses compatible with the material being placed, equipment being used and the compaction requirements.

b. Unless otherwise approved by the Purchaser the loose thickness shall not exceed the following:

b1. 8 inches maximum loose lift thickness for compaction by self-propelled equipment.

b2. 3 inches maximum loose lift thickness for compaction by hand-operated equipment.

b3. These lift thicknesses may be increased if the results of a test section prove that a thicker loose lift can be compacted to the required specified densities. The maximum loose lift thickness shall be 12 inches.

304.4 Placement of General and Structural Fills:

a. Each layer of fill shall be evenly spread and moistened or aerated as required to achieve the required moisture content.

b. Large continuous areas shall be uniformly filled to cover the entire length and width of the area to be filled before the next higher layer of material is placed.

c. The top surface of each layer shall be approximately level but shall have sufficient crown or cross fall to provide adequate drainage of water at all times during the construction period. The crown or crossfall shall be at least 1 in 50 (2 percent) but no greater than 1 in 20 (5 percent).

d. Fill slopes steeper than 20 percent (i.e., 5 horizontal to 1 vertical) shall be overfilled a minimum of 6 inches beyond the face of the slope, measured horizontally, and then cut back and trimmed to the required line and grade to expose a smooth surface uniformly compacted to the required density.

Installing the fill slope to lines and grades shown on the Design Drawings and then running over the surface with compaction equipment is not acceptable.

304.5 Placement of Dike Fills:

a. The fill material shall be brought to the required moisture content prior to being placed as dike fill.

b. The fill material shall be placed in horizontal lifts with a 2 percent cross slope. The entire length of the dike shall be uniformly raised for the entire length and width of the dike before the next higher layer of material is placed.

c. The width of a lift shall be the entire width of the finished dike at the height of the lift plus 6 inches beyond the face of each slope, measured horizontally to the slope. After compaction is complete the face of each slope shall be trimmed back to a uniformly compacted surface meeting density requirements. Compacting a slope by running up and down the slope is not acceptable.

304.6 Compacting Fills:

a. Equipment:

a1. Each layer of fill shall be compacted by tamping, sheepsfoot roller, pneumatic-tired roller, smooth drum steel-wheeled roller or other mechanical means acceptable to the Purchaser that will produce the specified compaction.

a2. At locations where it would be impractical because of inaccessibility to use self-propelled compacting equipment, fill layers shall be compacted using hand directed compaction equipment.

a3. When soils are used that develop a densely packed surface as a result of spreading or compacting equipment, the surface of each layer of fill shall be sufficiently roughened after compaction to ensure bonding of the succeeding layer.

b. Inspection and Testing:

b1. All work is subject to inspection and testing by an Independent Testing Service. The Testing Service shall have access to the work at all times. Testing shall be in accordance with Section 014362, "Quality Assurance for Installation of Earthwork and Clay Lining for a Clay Lined Pond".

b2. Each layer of compacted fill shall be tested before proceeding with the next layer.

b3. It is the Contractor's responsibility to request inspection prior to proceeding with further work that would make parts of the work inaccessible for inspection.

b4. If the fill material fails to meet the required density, the material shall be removed and replaced or reworked, altering the construction method as necessary to obtain the required density and compaction. Sufficient time shall be allotted between lifts for the necessary testing of the soils.

c. Compaction Densities:

c1. The degree of compaction shall be expressed as a percentage of the maximum laboratory dry density obtained at optimum moisture content in accordance with ASTM D698.

c2. Compaction requirements are specified in Table 1.

305. PLACEMENT OF THE CLAY LINER

305.1 Excavation:

a. In-Place Material:

a1. Acceptable in-place liner materials SHALL NOT be compacted in-place. They shall be excavated and stockpiled or conditioned as specified herein before being placed and compacted.

a2. Liner material to be excavated from within the area to be lined may be stockpiled within the area to be lined as determined by the Contractor. Stockpiles outside of the area to be lined shall be approved by the Purchaser prior to stockpiling.

a3. Stockpile areas shall be properly prepared by clearing, grubbing and stripping.

a4. The Contractor shall provide and maintain suitable drainage in stockpile areas to prevent excessive wetting of the material. Stockpiled material shall be placed with a sufficient slope to assure rapid runoff of rainfall.

b. Borrow:

b1. Borrow areas shall first be cleared, grubbed and stripped before proceedings with borrow excavation of the liner material.

b2. The Contractor shall be responsible for maintenance of proper drainage and erosion control within the borrow area until the area is closed.

b3. Upon closure, all borrow areas shall be graded to drain and seeded or surfaced in accordance with final landscaping plans.

305.2 Blending and Conditioning of Material:

a. Selection and Blending:

a1. Selective use of material or blending of clay materials may be required to produce the required quality and uniformity. The soil shall be mixed and blended as it is excavated to produce as homogeneous a soil as possible. Methods such as cutting across zones of stratification and sieving out and crushing large clods shall be followed as necessary during excavation.

b. Conditioning:

b1. If a change in moisture content is required then conditioning shall be as follows:

b1.1 If a change of less than 2% is required then the change may be accomplished after the soil is in-place at the site, but before it is compacted.

b1.2 If a change of more than 2% is required then conditioning to adjust the moisture content to within 2% of moisture content required for compaction shall be done at the borrow source. Corrective moisture content of more than 2% IS NOT PERMITTED at the site.

b2. If a substantial change in moisture content is required it shall be done so that moistening or drying occurs uniformly throughout the soil. Materials shall be mixed and blended with discs or harrows as necessary so that the soil is uniform and homogeneous as to material and moisture content and so that clods are thoroughly wetted.

305.3 Preparation of the Subgrade to Receive Clay Liner Material:

a. The top 12 inches of subgrade shall be compacted to the degree of compaction specified in Table 1 and then proofrolled using equipment specified in Paragraph 303.3 to determine suitability of the subgrade. Proofrolling shall be performed in the presence of the Purchaser to allow for observance of deflection, pumping, or rutting. The Purchaser shall make the determination of unsuitable areas. Soft spots shall be excavated a minimum depth of 1 foot by the Contractor and backfilled with suitable material compacted to a minimum of 95% of maximum dry density as determined by ASTM D 698.

b. Prior to placement of the liner, the Contractor and the Purchaser shall inspect the subgrade for the following:

b1. Moisture seeps in the base or side slopes of the ponds.

b2. Side slope or base softening or failure due to moisture seeps.

b3. Presence of zones of high permeability that could present a pathway to seepage. Zones of high permeability can be fissures or fractures in the base or side slope or pockets of high permeability gravel or rock.

c. The Purchaser shall define the regions of high permeability requiring sealing. The Contractor shall seal all regions of high permeability identified by the Purchaser by over excavating a minimum of 2 feet and backfilling the over excavation with material meeting the requirements for satisfactory clay liner material compacted to a minimum of 95% of maximum dry density as determined by ASTM D 698. This type of work shall be performed in the presence of the Purchaser.

d. The Purchaser shall define and work required to eliminate moisture seeps and/or repair damage due to moisture seeps.

305.4 Weather Related Restrictions on Placement:

a. Placement and compaction operations during periods of rainfall, snowfall, high winds, or when the air temperature drops below 30°F IS NOT PERMITTED.

b. Liner material shall not be placed on frozen ground or on surfaces having visual signs of ponded water, frost or snow.

c. Frozen material shall not be incorporated into liner fill.

d. Before resumption or liner placement after freezing weather the surfaces to receive liner fill shall be scarified to the depth of frost penetration and recompacted to the specification requirements. The surfaces to receive fill shall be approved by the Purchaser prior to placement of a new lift.

e. After a prolonged shutdown the surfaces to receive liner fill shall be scarified and moistened to a minimum depth of 6 inches or as directed by the Purchaser and recompacted to the required density.

305.5 Placement of Lifts:

a. On the bottom crowned or sloped sections, the liner material shall be placed and compacted in nearly horizontal lifts.

b. On side slopes 2-1/2 horizontal to 1 vertical and flatter, the liner material shall be placed and compacted in lifts parallel to the slope.

c. On slopes steeper than 2-1/2 to 1, the liner material shall be placed and compacted in horizontal lifts. The width of a lift shall be a minimum of 12 feet or the width of the largest piece of construction equipment in use whichever is greater. After compaction, the face of the slope shall be trimmed. The width of trimming shall be a minimum of 12 inches, measured horizontally.

305.6 Material Placement and Conditioning:

a. Prior to compaction, the moisture content of the clay shall be adjusted to between +1% and +6% WET of the optimum moisture content.

b. Changes in moisture content of up to 2% may be accomplished at the site. If substantial changes are required, see Paragraph 305.2.

c. The maximum size of hard clods prior to compaction shall be 3/4 inch. This shall be determined by visual inspection. If the maximum clod size exceeds 3/4 inch, additional mixing and blending shall be provided as required to reduce clods to that size or the larger clods shall be sieved out.

d. The maximum loose thickness of a lift shall be 9 inches or the length of the compaction sheepsfoot roller feet, whichever is less. The maximum thickness of a compacted lift shall be 6 inches.

305.7 Compacting Clay Liner Material:

a. Compaction Equipment:

a1. Sheepsfoot Roller: The Contractor shall use sheepsfoot rollers of adequate weight to achieve compaction densities specified herein and to achieve the kneading action necessary to breakdown clods blended in liner materials, and eliminate interclod voids. Sheepsfoot rollers shall conform to the following:

a1.1 Have long thin feet capable of fully penetrating a loose lift and blending and compacting the bottom of the lift directly into the top of the previous lift. The minimum preferable length of the feet is 8 inch.

a1.2 Have a roller weight of not less than 50,000 lb. and a minimum weight of 3000 lb. per linear foot of roller. A roller with a weight of 4,000 to 5,000 lb./linear foot is preferred.

a1.3 The area of each foot shall be such that the foot contact pressure is not less than 300 psi, preferably 400-500 psi.

a2. Breakdown Roller: The Breakdown Roller used for fine finishing shall be a heavy wheel roller with 18,000 to 25,000 lb. wheel loads and tire inflation pressures in excess of 65 psi.

a3. Smooth Drum Roller: The Smooth Drum Roller used for compaction and fine finishing shall be a 3-axle tandem roller with a minimum weight in the range of 15 to 20 tons. Heavy rollers with a weight over 20 tons are acceptable.

b. Compaction:

b1. Compaction shall be accomplished using heavy sheepsfoot rollers.

b2. Compaction equipment shall pass over the soil liner a sufficient number of times to maximize compaction. Each lift shall receive a minimum of 5 passes of a footed roller. Additional passes shall be made as necessary to blend the soil, break up clods, and obtain the specified degree of compaction.

b3. The clay shall be compacted to at least the minimum dry density specified in Table 1.

b4. If a compacted lift fails to meet the specified density, the clay shall either be compacted further or removed and replaced. If a density moisture content test of the clay fails to meet specifications, the clay shall be scarified, the moisture content adjusted, and the material recompacted for an area extending from the failed test to one-half the distance to the nearest passed tests, in all directions. The Contractor shall alter compaction methods of subsequent work as necessary to obtain the specified compaction. The recompacted area shall then be retested for conformance with specifications.

b5. Compaction of bottom crowned sections shall start by rolling at the sides and proceed toward the center of the crowned section.

b6. Compaction of sloped areas shall start longitudinally at the low side and proceed toward the high side.

b7. Alternate trips of rollers shall be slightly different in length and shall overlap on successive trips by at least one-half of the width of the roller unit.

b8. After compaction of a lift is completed, the surface shall be smoothed using a rubber-tired breakdown roller or a heavy steel smooth drum roller to provide protection against over moistening during a rainfall and provide a smooth surface so that Construction Quality Control Tests can be made.

305.8 Fine Finishing of the Lining Surface:

a. After the lining has been brought to its final thickness and lift compaction is complete, the surface of the lining shall be fine finished as follows:

a1. Visually inspect the surface, remove clods and stones that would be retained on a 3/4 in sieve.

a2. Irregularities such as desiccation cracks and holes shall be corrected. Soil from irregularities, which cannot be corrected in-place, shall be removed and replaced with acceptable material.

a3. Shape the lining and form a flat uniform working surface free of bumps, ridges, gullies, holes, ruts, desiccation cracks or pockets of non-cohesive material.

a4. Compact the surface using a heavy rubber-tired roller or a heavy smooth steel drum roller to obtain a smooth, uniform surface. The last two passes of the surface shall be made using a heavy smooth steel drum roller.

b. The finished compacted surface of the clay liner shall be placed to the locations and elevations shown on the Design Drawings. Tolerances shall be as shown in Table 2.

305.9 Protection of Liner:

a. The Contractor shall make provisions to protect the liner until the geomembrane is in place. Protection shall be provided against over-moistening or erosion during rainfall or cracking resulting from desiccation or freezing.

b. If soft spots, subsidence or cracks larger than 1 inch wide or 2 inches deep occur in the clay liner prior to placement of the protective cover, the Contractor shall be responsible for blading down the lining material to the unaffected soil and then preparing and recompacting the disturbed soil to meet the requirements specified herein.

306. PREPARATION OF SUBGRADE BENEATH GEOMEMBRANE LINER

306.1 Intersections Between Planes:

a. Intersections between planes shall be rounded as specified below to provide a firm bearing without abrupt change:

| | Intersection of Slope | Radius of Rounding |
|---|---|---|
| a1. | Side slope and bottom plane......................................................... | 3 feet minimum |

| | | |
|---|---|---|
| a2. | Side slope and top of dike or grade ............................................ | 6 inch minimum |
| a3. | Intersection of 2 bottom planes (planes sloped at 10% or less)..... | Straight line is acceptable |

306.2 Responsibility:

a. The Contractor shall be responsible for preparing the surface of the subgrade beneath a geomembrane liner prior to placement of the liner. The subgrade is subject to inspection and acceptance by the Purchaser and the Geomembrane Liner Contractor prior to installation of the liner.

306.3 Inspection:

a. When requested by the Contractor, the Purchaser and the Geomembrane Liner Contractor shall inspect and document the following:

a1. Lines, grades and slopes are in conformance with the Design Drawings.

a2. Surface has been graded and rolled such that it is free of irregularities, protrusions, loose soil and abrupt changes in grade.

a3. The surface is free of debris, clods, stones, roots and organic material.

a4. That no settlement has occurred.

a5. That there are no side slope failures.

a6. That there are no moisture seeps, puddling or ponding.

a7. That there are no soft spots.

306.4 Certification:

a. The Geomembrane Liner Contractor shall provide written certification that the surface is acceptable. The acceptance shall be recorded and copies of the certification given to both the Contractor and the Purchaser.

b. Only as much surface as will be lined the following day shall be inspected, certified and documented as acceptable.

306.5 Geomembrane Liner Contractor's Responsibility:

a. After the surface has been accepted by the Geomembrane Liner Contractor, it becomes its responsibility and changes or repair work are the Geomembrane Liner Contractor's responsibility. Requests for changes or repair work to the subgrade by the Geomembrane Liner Contractor may be made through the Purchaser. The expense of such work shall be by the Geomembrane Liner Contractor.

## 307. PREPARATION OF CONCRETE SURFACES

307.1 All portions of concrete walls, curbs and foundation that will come in contact with a geomembrane shall be free of sharp edges or rough spots that can puncture or abrade the geomembrane. Where necessary, the concrete shall be ground smooth. Where specified on the plans, a geomembrane scuff strip shall be placed between the concrete and the geomembrane to act as a protective layer for the liner.

308. ANCHOR TRENCH EXCAVATION AND BACKFILLING

308.1 Excavation and Shaping:

a. The anchor trench shall be excavated by the Contractor to the lines and widths shown on the Design Drawings, prior to geomembrane liner system placement.

b. A slightly rounded corner shall be provided in the trench where the geomembrane adjoins the trench to avoid sharp bends in the geomembrane. The radius of rounding is shown on the Design Drawings. No loose soil shall be allowed to underlie the geomembrane in the anchor trench.

c. The anchor trench shall be adequately drained to prevent ponding or otherwise softening of the adjacent soils while the trench is open.

308.2 Backfilling:

a. The anchor trench shall be backfilled by the Contractor after the geomembrane is in place.

b. Backfilling of the anchor trench shall occur during the morning or during extended periods of overcast skies when the liner is at its most contracted state.

c. Backfill shall be placed in layers not exceeding 6 inches loose thickness and compacted using hand compaction equipment to 95 percent of maximum density as determined by ASTM D698 at a recommended moisture content of optimum water content ±3%.

d. The material used for backfilling the first 8 inches of the anchor trench may be screened material from an onsite stockpile or material excavated from the trench which has a maximum size stone of 2 inches. The material used to backfill the remainder of the trench shall be material excavated from the trench which has a maximum size stone of 2 inches.

309. GRADING TOLERANCES

309.1 The acceptable deviation from lines and grades indicated on the Design Drawings shall be as shown in Table 2.

309.2 Slopes shall be finished in conformance with the lines and grades shown on the Design Drawings. When completed, the average plane of a slope shall conform to the slope indicated on the Design Drawings and no point on the completed slope shall vary from the designated plane by more than 6 inches measured at right angles to the slope.

310. CLEAN-UP

310.1 All waste, excess materials and debris shall be disposed of in an onsite or offsite disposal area as directed by the Purchaser.

**TABLE 1**

| MINIMUM DEGREE OF COMPACTION | |
|---|---|
| **AREA** | **ASTM D698 (percent)** |
| **Subgrade beneath fills, Dikes and Clay Lining** | 95 |
| **Pond Dike** | 95 |
| **Clay Liner** | 95 |
| **General Site Fills** | 95 |
| **Structural Fills** | |
| Fills supporting structures (1) | 98 |
| Upper 3 feet of fills supporting roads or pavement | 98 |
| Deeper fills supporting roads or pavement | 95 |
| Drainage facilities (ditches, etc.) | 95 |

Notes:

(1) Structures include items such as equipment, buildings, pump structures, inlet and outlet structures, walls, and retaining walls and any other structures or equipment that are sensitive to settlement.

**TABLE 2**

| ACCEPTABLE DEVIATION | | |
|---|---|---|
| **Type of Installation Excavation or Fill** | **Maximum Acceptable Deviation From Line (Feet)** | **Maximum Acceptable Deviation From Grade(l) (Feet)** |
| **General Earthwork** | | |
| Pond Dike and Top Edge of Excavated Ponds | ±0.5 | +0.25 to -0.0 |
| Pond Bottom (Top of Liner) (2) | ±0.3 | ±0.0 to ±0.1 |
| General Site Area | ±0.3 | ±0.2 |
| **Roads** | | |
| Road Embankment or Subgrade | ±0.2 | +0.1 to -0.0 |
| **Drainage Facilities** | | |
| Permanent Drainage Channel | ±0.3 | 0.0 to - 0.1 |
| Slope Drainage Benches and Drainage Diversion Dikes | ±0.5 | ±0.1 |

Notes:

(1) After initial settlement has taken place. Initial settlement is that settlement that will occur up to the time of determination and acceptance of final grade elevation as approved by Purchaser.

(2) Zero minus tolerance for thickness.

END OF SECTION

**APPENDIX F**

# Geomembrane Specifications

**SECTION 319022**

**HIGH DENSITY POLYETHYLENE GEOMEMBRANE LINER**

## PART 1 - GENERAL

101. EXTENT

101.1 The intent of this specification is to define the minimum requirements for material and installation of High Density Polyethylene (HDPE) Non-Textured and Textured Geomembrane to be used as a liner for the bottom and side slopes of a pond, all in accordance with the Design Drawings and as specified herein.

101.2 Work Included:

101.3 The work shall include, but not be limited to, the following items:

a. Manufacture, shipping, handling, and storage of geomembrane materials.

b. Inspection and approval of surfaces to be lined.

c. Placement and field seaming of geomembrane.

d. Crest anchorage and attachment of the geomembrane to structures and penetrations.

e. Non-destructive field testing of geomembrane seams.

f. Removal of samples of geomembrane seams and transportation to an independent third party laboratory for destructive testing.

g. Repair of defective geomembrane seams.

h. Repair of defects in the geomembrane and locations where samples were taken.

i. Visual inspection of the completed geomembrane liner.

101.4 Definition of Terms:

a. The following definition of terms shall apply throughout this section.

a1. Purchaser: Ameren Resource Generation Company

a2. Earthwork Contractor: The Contractor who will be responsible for earthwork for the facility and for excavation and backfill of crest anchorage trenches.

a3. Geomembrane Contractor (Contractor): The Contractor who is responsible for supply and installation of all geomembrane and geotextile materials and unloading and storage of the materials.

a4. Construction Quality Assurance (CQA) Contractor: The Contractor who is responsible for all CQA work.

a5. Construction Quality Assurance (CQA) Geomembrane Inspector: An inspector who works for the CQA Contractor and is responsible for inspection of the Geomembrane Contractor's work.

a6. Manufacturer: The Manufacturer who is responsible for manufacture of materials and for transporting materials to the site.

101.5 Qualifications:

a. Manufacturer:

a1. The Manufacturer shall be approved by the Purchaser.

b. Geomembrane Contractor:

b1. The Geomembrane Contractor shall be approved by the geomembrane Manufacturer for installation of the Manufacturer's products.

b2. The Geomembrane Contractor shall be approved by the Purchaser.

102. <u>RELATED WORK SPECIFIED IN OTHER SECTIONS</u>

102.1 Section 319040 – Geotextiles for Lined Ponds.

102.2 Section 319005 – Earthwork and Clay Lining for a Clay/Geomembrane Composite Lined Pond.

103. <u>REFERENCE DOCUMENTS</u>

103.1 Standards, specifications, manuals, codes and other publications of nationally recognized organizations and associations are referenced herein. Methods, equipment and materials specified herein shall comply with the specified and applicable portions of the referenced documents, in addition to federal, state or local codes having jurisdiction.

103.2 References to these documents are to the latest issue date of each document, unless otherwise indicated, together with the latest additions, addenda, amendments, supplements, etc., thereto, in effect as of the date of Contract for the Work.

103.3 Abbreviations listed indicate the form used to identify the reference documents in the Specification text.

103.4 ASTM - American Society for Testing and Materials:

a. A276 Specification for Stainless and Heat Resisting Steel Bars and Shapes.

b. B633 Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

c. D638 Test Method for Tensile Properties of Plastic.

d. D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.

e. D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

f. D1004 Test Method for Initial Tear Resistance of Plastic Film and Sheeting.

g. D1505 Test Method for Density of Plastics by the Density-Gradient Technique.

h. D1603 Test Method for Carbon Black in Olefin Plastics.

i. D3895 Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Colorimetry.

j. D4218 Standard Test Method for Determination of Carbon Black Content of Polyethylene Compounds by the Muffle-Furnace Technique.

k. D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

l. D5199 Test Method for Measuring Normal Thickness of Geotextiles and Geomembranes.

m. D5397 Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test.

n. D5596 Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.

o. D5641 Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.

p. D5721 Standard Practice for Air-Oven Aging of Polyolefin Geomembranes.

q. D5820 Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes.

r. D5885 Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Colorimetry.

s. D5994 Test Method for Measuring Core Thickness of Textured Geotextile.

t. D6392 Standard Test Method for Determining the Integrity of Non-Reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.

103.5 GRI – Geosynthetic Research Institute:

a. GM 6 Standard Practice for Pressurized Air Channel Test for Dual Seamed Geomembrane.

b. GM 10 Specification for the Stress Crack Resistance of Geomembrane Sheet.

c. GM 11 Accelerated Weathering of Geomembranes Using a Fluorescent UVA-Condensation Exposure Device.

d. GM 12 Measurement of the Asperity Height of Textured Geomembranes Using a Depth Gage.

e. GM 13 Standard Specification for Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes.

f. GM 14 Standard Guide for Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using the Method of Attributes.

g. GS 7 Determining the Index Friction Properties of Geosynthetics.

104. SUBMITTALS

104.1 Contractor shall submit the drawings and data as specified below within 30 days prior to use. Contractor's drawings and data shall be submitted via electronic medium in a format compatible for importing into the Purchaser's information systems specified by the Purchaser.

104.2 Contractor shall submit status reports at regular intervals as specified by the Purchaser. The reports shall indicate the status of the schedule. The reports shall be submitted via electronic medium in a format compatible for importing into the Purchaser's information system specified by the Purchaser.

104.3 Submittals with the Bid Proposal:

a. HDPE Geomembrane Material:

a1. Certification of Compliance from the Manufacturer of the HDPE geomembrane sheeting signed by its authorized representative, indicating that the material meets the criteria specified herein.

a2. One representative sample of each type of geosynthetic material.

a3. Manufacturer's Quality Control and Quality Assurance Policies and Procedures.

b. Warranty:

b1. Written warranties from the Manufacturer and the Geomembrane Contractor covering the quality of the material and workmanship as applicable.

b2. The minimum period of warranty for materials shall be 20 years with first year non-prorated. The minimum period of warranty for installation shall be 5 years with the first year non-prorated.

b3. Warranty conditions proposed, including limits of liability, will be evaluated by the Purchaser in approving the liner Manufacturer and the Geomembrane Contractor.

c. Geomembrane Contractor:

c1. Geomembrane Contractor's name, address and telephone number.

c2. Geomembrane Contractor's qualifications.

c3. Installer's qualifications if the Geomembrane Contractor is proposing to subcontract installation work.

d. Testing Laboratory:

d1. Name, address, and telephone number of the off-site, independent third party laboratory that will perform destructive testing on cut samples of field seams.

d2. Laboratory's qualifications.

104.4 Submittals After Award of the Contract:

a. Geomembrane Resin:

a1. Manufacturer's signed Certificate that the resin meets specification requirements.

a2. Manufacturer's signed Certification of the origin of the resin and that all resin is from the same manufacturer (Contractor's name, identification brand name, and number).

a3. Copies of Manufacturer and resin suppliers' QA/QC certificates. Certificates shall include a summary report of test results conducted to verify the quality of the resin used in each batch used to manufacture geomembrane for this project. As a minimum, the report shall include tests on specific gravity, melt flow index and percent carbon black.

b. Geomembrane Sheeting:

b1. Signed certification that the properties of the manufactured sheeting meet specification requirements and are guaranteed by the Manufacturer.

b2. Statement certifying that no post consumer resin (PCR) has been added to the formulation.

b3. Copy of all of the geomembrane Manufacturer's Quality Assurance certificates. The certificates shall include documents of test results.

c. Extrudate Resins or Rod for Seaming Geomembranes:

c1. Certification that all extrudate is the same resin type as the geomembrane and was obtained from the same resin supplier as the resin used to manufacture the geomembranes.

d. Installation Data:

d1. Manufacturer's proposed geomembrane panel layout for each installation.

d2. Manufacturer's recommended procedures for making and testing seams if different from this specification.

d3. Manufacturer's recommended procedures for repairing damaged geomembrane sections and seams if different from this specification.

d4. Manufacturer's details of geomembrane liner anchorage, and attachment to structures and penetrations if different from this specification and the details on the Design Drawings.

104.5 Submittals After Construction is Complete:

a. Geomembrane Contractor:

a1. As-built panel layout.

a2. Drawing showing location of repairs and type of repairs made.

a3. Location of destructive tests.

a4. Results of destructive tests.

a5. Results of non-destructive tests.

105. <u>QUALITY ASSURANCE</u>

105.1 Materials and construction procedures shall be subject to inspection by a Construction Quality Assurance (CQA) Testing Service employed by the Purchaser.

## PART 2 - PRODUCTS

201. HIGH DENSITY POLYETHYLENE GEOMEMBRANE

201.1 Manufacturers of HDPE Geomembrane Products:

a. The products of the following manufacturers meeting the requirements herein are acceptable:

a1. Agru/America Manufacturing, Inc., 500 Garrison Road, Georgetown, SC 29440, Tel.: 800-373-2478.

a2. Polyflex, 2000 W. Marshall Drive, Grand Prairie, TX 75051, Tel.: 888-765-9359.

a3. GSE Lining Technology, Inc., 19103 Gundle Road, Houston, TX 77073, Tel.: 281-443-8564 or 800-435-2008.

a4. Other as approved by the Purchaser.

201.2 HDPE Geomembrane - General Requirements:

a. The HDPE geomembrane shall be manufactured from first quality, virgin resin. Blending of resins shall not be allowed. No recycled or reworked geomembrane may be used except edge trim generated during the manufacturing process (no more than 10%). No post consumer resin (PCR) of any type shall be added to the formulation.

b. The resin used to produce the geomembrane shall be formulated to be resistant to chemical and ultraviolet degradation.

c. The geomembrane shall be free of plasticizers.

d. The geomembrane shall be free of leachable additives.

e. During manufacture, each roll of geomembrane shall be continuously monitored across the width to assure uniformity of thickness. Thickness measurements shall meet the requirements of Table 1 for Non-Textured Geomembrane and Table 2 for Textured Geomembrane.

f. The geomembrane shall be free of factory seams.

g. The geomembrane shall be free from dirt, oil, foreign matter, scratches, cracks, creases, bubbles, blisters, pits, tears, holes, pores, pinholes, voids, undispersed raw material, any sign of contamination or other defects that may affect serviceability, and shall be uniform in color, thickness and surface texture.

h. The geomembrane shall be capable of being seamed in the field to yield seams that are as resistant to waste liquids as the sheeting.

i. The geomembrane shall be manufactured in the United States or Canada.

201.3 HDPE Non - Textured Geomembrane:

a. HDPE Non-Textured Geomembrane shall meet the requirements of Table 1.

b. The location of HDPE Non-Textured Geomembrane to be used for each installation shall be as shown on the Design Drawings.

201.4 HDPE Textured Geomembrane:

a. HDPE Textured Geomembrane shall meet the requirements of Table 2.

b. The location of HDPE Textured Geomembrane to be used for each installation shall be as shown on the Design Drawings.

c. The textured liner shall be manufactured using a co-extrusion process.

d. The textured coating shall be applied to both sides of the base sheet.

e. Textured geomembrane shall have uniform texturing appearance. It shall be free from agglomerated texturing material and such defects that would affect the specified properties of the geomembrane.

f. Each roll shall have 6 inch wide smooth edges to provide suitable seaming surfaces. Textured geomembrane without smooth edges may be provided if approved by the Purchaser.

# TABLE 1
## HIGH DENSITY POLYETHYLENE NON-TEXTURED GEOMEMBRANE REQUIREMENTS[1]

| Property | Test Method | Polyethylene Base Compound | GEOMEMBRANE MINIMUM AVERAGE ROLL VALUE | | | | Testing Frequency |
|---|---|---|---|---|---|---|---|
| Nominal thickness, mil | -- | -- | 40 | 60 | 80 | 100 | --- |
| Resin Properties | | | | | | | |
| Oxidative Induction Time (OIT), minimum average minutes | | | | | | | |
| Standard OIT or | D3895 | 100 | -- | -- | -- | -- | 200,000 lbs. of Resin |
| High Pressure OIT | D5885 | 400 | -- | -- | -- | -- | 200,000 lbs. of Resin |
| Oven Aging at 85° C | D5721 | -- | -- | -- | -- | -- | |
| Standard OIT (min avg), percent retained after 90 days or | D3895 | 55 | -- | -- | -- | -- | one per formulation |
| High Pressure OIT (min avg), percent retained after 90 days | D5885 | 80 | -- | -- | -- | -- | one per formulation |
| High Pressure OIT (min avg), percent retained after 1600 Hrs | D5885 | 50 | -- | -- | -- | -- | one per formulation |
| Analytical Properties | | | | | | | |
| Density of base resin, g/cc minimum | D1505/D792 | 0.940 | -- | -- | -- | -- | 200,000 lbs. of Resin |
| Carbon black content, % | D1603 or D4218 | 2.0-3.0 | -- | -- | -- | -- | 20,000 lbs. of Resin |
| Carbon black dispersion for 10 different views | D5596 | All 10 in Categories 1,2 & 3 | -- | -- | -- | -- | 45,000 lbs. .of Resin |
| Mechanical Properties | | | | | | | |
| Thickness, mils | D5199 | -- | -- | -- | -- | -- | One per roll |
| Average | | -- | 40 | 60 | 80 | 100 | |
| Lowest individual of 10 values | | -- | 36 | 54 | 72 | 90 | |
| Tensile properties, in each direction (minimum): | D638 (Type IV Specimen at 2 ipm) | | | | | | |
| Tensile stress at yield, ppi minimum | | -- | 84 | 126 | 168 | 210 | 20,000 lbs. of Resin |
| Elongation at yield, % minimum | | -- | 12 | 12 | 12 | 12 | 20,000 lbs. of Resin |
| Tensile stress at break, ppi minimum | | -- | 152 | 228 | 304 | 380 | 20,000 lbs. of Resin |
| Elongation at break, % minimum 2" gage length | | -- | 700 | 700 | 700 | 700 | 20,000 lbs. of Resin |
| Tear resistance, lb (minimum avg) | D1004 | -- | 28 | 42 | 56 | 70 | 45,000 lbs. of Resin |
| Puncture resistance, lb. (minimum avg) | D4833 | -- | 72 | 108 | 144 | 180 | 45,000 lbs. of Resin |
| Bonded seam strength[2] | D6392 | -- | -- | -- | -- | -- | |
| Shear strength, ppi | | -- | 81 | 121 | 162 | 203 | |
| Peel adhesion (fusion), ppi | | -- | 65 | 98 | 130 | 162 | |
| Peel adhesion (extrusion), ppi | | -- | 52 | 78 | 104 | 200 | |
| Environmental and Aging Effect on Properties | | | | | | | |
| Stress Crack Resistance, hours (min) | D5397 | -- | 200 | 200 | 200 | 200 | per GRI GM10 |

Notes:

1. Requirements shown in this table meet the minimum requirements of GRI Standard GM13, adopted June 17, 1997 except for bonded seam strength.
2. Seam requirements.

## TABLE 2

## HIGH DENSITY POLYETHYLENE TEXTURED GEOMEMBRANE REQUIREMENTS[1]

| Property | Test Method | Polyethylene Base Compound | GEOMEMBRANE MINIMUM AVERAGE ROLL VALUE | | | | Testing Frequency |
|---|---|---|---|---|---|---|---|
| Nominal thickness, mil | -- | -- | 40 | 60 | 80 | 100 | --- |
| Resin Properties | | | | | | | |
| Oxidative Induction Time (OIT), minimum average minutes | | | -- | -- | -- | -- | |
| Standard OIT or | D3895 | 100 | | | | | 200,000 lbs. of Resin |
| High Pressure OIT | D5885 | 400 | -- | -- | -- | -- | 200,000 lbs. of Resin |
| Oven Aging at 85° C | D5721 | -- | -- | -- | -- | -- | |
| Standard OIT (min avg), percent retained after 90 days or | D3895 | 55 | -- | -- | -- | -- | one per formulation |
| High Pressure OIT (min avg), percent retained after 90 days | D5885 | 80 | -- | -- | -- | -- | one per formulation |
| High Pressure OIT (min avg), percent retained after 1600 hrs. | D5885 | 50 | -- | -- | -- | -- | one per formulation |
| Analytical Properties | | | | | | | |
| Density of base resin, g/cc minimum | D1505/D792 | 0.932 | -- | -- | -- | -- | 200,000 lbs. of Resin |
| Carbon black content, % | D1603 or D4218 | 2.0-3.0 | -- | -- | -- | -- | 20,000 lbs. of Resin |
| Carbon black dispersion for 10 different views | D5596 | All 10 in Categories 1,2 & 3 | -- | -- | -- | -- | 45,000 lbs. of Resin |
| Mechanical Properties | | | | | | | |
| Thickness, mils | D5994 | -- | -- | -- | -- | -- | One per roll |
| Minimum Average | | -- | 38 | 51 | 76 | 95 | |
| Lowest individual for 8 out of 10 values | | -- | 36 | 54 | 72 | 90 | |
| Lowest individual for 10 out of 10 values | | -- | 34 | 51 | 68 | 85 | |
| Asperity Height, mils (min avg) | GM 12 | -- | 10 | 10 | 10 | 10 | Every second roll |
| Tensile properties, in each direction (minimum average) | D638 (Type IV Specimen at 2 ipm) | | | | | | |
| Tensile stress at yield, ppi minimum | | -- | 84 | 126 | 168 | 210 | 20,000 lbs. of Resin |
| Elongation at yield, % minimum | | -- | 12 | 12 | 12 | 12 | 20,000 lbs. of Resin |
| Tensile stress at break, ppi minimum | | -- | 60 | 90 | 120 | 150 | 20,000 lbs. of Resin |
| Elongation at break, % minimum 2" gage length | | -- | 100 | 100 | 100 | 100 | 20,000 lbs. of Resin |
| Tear resistance, lb. (minimum avg) | D1004 | -- | 28 | 42 | 56 | 70 | 45,000 lbs. of Resin |
| Puncture resistance, lb. (minimum avg) | D4833 | -- | 60 | 90 | 120 | 150 | 45,000 lbs. of Resin |
| Bonded seam strength[2] | D6392 | -- | -- | -- | -- | -- | |
| Shear strength, ppi | | -- | 81 | 121 | 162 | 203 | |
| Peel adhesion (fusion), ppi | | -- | 65 | 98 | 130 | 162 | |
| Peel adhesion (extrusion), ppi | | -- | 52 | 78 | 104 | 130 | |
| Environmental and Aging Effect on Properties | | | | | | | |
| Stress Crack Resistance, hours (min) | D5397 | -- | 200 | 200 | 200 | 200 | per GRI GM10 |

Notes:

1. Requirements shown in this table meet the minimum requirements of GRI Standard GM13, adopted June 17, 1997 except for bonded seam strength.
2. Seam requirements.

201.5 Panel Layout:

a. Prior to manufacture of the geomembrane, a panel layout of the surface to be lined shall be made. Each panel to be used for the installation shall be given a numeric or alphanumeric identification number.

b. The panel identification number shall be related in writing to the manufacturing roll number that identifies the resin type, batch number, and date of manufacturer.

c. The panel layout shall be made considering the following requirements:

c1. Panel lengths shall include slope gain and anchorage.

c2. Perpendicular tie-ins shall be made a minimum of 5 feet beyond the toe of the slope.

c3. A minimum of 6 inch overlap shall be allowed at double fusion welded seams.

c4. All field seams on slopes shall be oriented parallel to the slope (oriented along, not across the slope).

c5. The number of seams in corners or odd shaped geometric locations shall be minimized.

201.6 Packaging and Shipping:

a. The geomembrane shall be shipped to the project site in rolls. No material shall be folded.

b. A label shall be attached or adhered to each roll of the geomembrane identifying the following:

b1. Manufacturer.

b2. Product Identification, which can be traced back to the origin of the base material (resin supplier's name, resin production plant, resin brand name type, resin brand number, and production date of the resin).

b3. Date of manufacture of the geomembrane.

b4. Roll identification number.

b5. Geomembrane thickness and type.

b6. Roll dimensions (length and width).

b7. Batch number.

b8. Order number.

b9. Panel number.

201.7 Packaging and Transportation:

a. Packaging and transportation shall be the responsibility of the Manufacturer, who shall retain responsibility until the geomembrane is accepted at the site by the Geomembrane Contractor.

202. MATERIALS FOR ATTACHMENT OF GEOMEMBRANE TO CONCRETE

202.1 Batten Strip:

a. Batten strip material shall be hot rolled, annealed and pickled Type 306 L stainless steel in accordance with ASTM A276.

b. Strips shall be 1/4 inch thick by 2 inches wide. Random lengths are acceptable.

202.2 Expansion Anchors:

a. Expansion anchors shall be stud type with a single piece three section wedge and zinc plated in accordance with ASTM B633. Wedges shall be manufactured from ANSI Type 304 stainless steel. Hilti Kwik Bolt 3 Expansion Anchors, or equal, are acceptable.

b. Minimum yield strength of 60,000 psi for wedge-type anchors and a minimum tensile strength of 65,000 psi for stud type anchors.

c. Anchors shall be 3/8 inch diameter x 3 1/2 inch long.

d. Washers for anchors shall be Type 18-8 stainless steel flat washers for 3/8 inch bolt size.

202.3 Neoprene Gasket:

a. Neoprene gaskets shall be 1/4 inch thick x 2 inches wide closed cell neoprene sponge sealing strips. Operating temperature range of neoprene shall be –40° F to +220° F.

b. Neoprene gaskets placed against concrete shall have a pressure sensitive adhesive on the side of the gasket placed against the concrete.

202.4 Mechanical Anchorage:

a. Extruded HDPE mechanical anchorage, set in cast-in-place concrete structures for liner attachment, shall be per Manufacturer's standard.

## PART 3 - EXECUTION

301. ONSITE HANDLING AND STORAGE

301.1 Receipt/Unloading:

a. Unloading and storage of materials shall be the responsibility of the Manufacturer.

b. The unloading and other handling of materials shall be performed by the Manufacturer to ensure that the material is handled with care and not damaged.

301.2 Storage:

a. The Purchaser shall provide on-site storage space in a location near the area to be lined such that on-site transportation and handling are minimized. The Contractor shall be responsible for protecting stored material from theft and vandalism.

b. The rolls of geomembrane shall be placed on a smooth surface free of rocks and standing water.

301.3 Inspection:

a. Upon delivery of the material to the project site, the Geomembrane Contractor shall conduct a visual inspection of all rolls of geomembrane for damage or defects. This inspection shall be done without unrolling any rolls unless damage to the inside of a roll is found or suspected.

b. Any damage or defects shall be noted and immediately reported to the Purchaser, the Manufacturer and to the carrier that transported the material. Any roll or portion thereof, which, in the judgement of the Purchaser, is seriously damaged, shall be removed from the project site and replaced with complying material at no additional cost to the Purchaser.

302. PREPARATION OF SURFACES TO BE LINED

302.1 General:

a. The Earthwork Contractor shall be responsible for preparing and maintaining the surfaces to be lined as specified in Section 319005, "Earthwork and Clay Lining for a Clay/Geomembrane Composite Lined Pond" prior to placement of the geomembrane.

b. The Geomembrane Contractor shall confirm the conditions of the finished surfaces to be lined prior to placement of the liner.

302.2 Grading Requirements:

a. The subgrade surface on which a lining is to be placed shall be graded to elevations shown on the Design Drawings. Tolerances shall be as specified in Section 319005, "Earthwork and Clay Lining for a Clay/Geomembrane Composite Lined Pond".

302.3 Preparation of Concrete Surfaces:

a. All portions of concrete walls, curbs and foundations that will come in contact with a geomembrane shall be free of sharp edges or rough spots that can puncture or abrade the geomembrane. Where necessary, the concrete shall be ground smooth by the Earthwork Contractor. Where specified on the Design Drawings, one or more layers of geomembrane scuff strips shall be placed between the concrete and the geomembrane to act as a protective layer for the liner.

302.4 Subgrade Acceptance:

a. See Section 319005, "Earthwork and Clay Lining for a Clay/Geomembrane Composite Lined Pond" regarding inspection and acceptance of surfaces to be lined.

302.5 Geotextile:

a. See Section 319040, "Geotextiles for Lined Ponds" regarding installation, inspection, and acceptance of a geotextile used to protect the geomembrane liner.

303. FIELD PLACEMENT OF THE GEOMEMBRANE LINER

303.1 General Requirements:

a. Placement Procedure: The placement procedure used for the geomembrane liner shall include the conditions listed below.

b. Weather:

b1. Geomembrane shall not be placed when the air temperature is above 104°F or below 41°F unless it can be demonstrated to the approval of the Purchaser by trial welds that acceptable welds can be made at the prevailing temperature. Trial welds shall be as described in Paragraph 303.2.c.

b2. Geomembrane shall not be placed when there is any rainfall or snowfall, in the presence of excessive moisture due to fog or dew, in ponded water, on a frozen subgrade, or during high winds.

c. Panel Layout:

c1. The panels shall be placed in accordance with the Manufacturer's panel layout drawing to ensure that they are placed in the proper direction for seaming.

c2. If panels are installed in a location other than indicated on the panel layout drawing, the revised location shall be indicated on an "as-built" layout drawing. The "as-built" record drawing shall be submitted to the Purchaser at the completion of the project.

d. Panel Deployment:

d1. Only the panels that can be anchored and seamed together in one shift shall be unrolled.

d2. Unroll and layout panels in as close to the final position as possible. Pulling geomembrane panels should be minimized to reduce the chance of permanent tension.

d3. The methods and equipment used to deploy the panels shall not damage the geomembrane or the supporting surface.

d4. Wrinkles shall be minimized. However, enough slack shall be provided in both directions so that there will be no tension in the geomembrane at the lowest expected operating temperature.

e. Precautions to Prevent Wind Damage:

e1. If possible, work shall be oriented in the direction of the prevailing wind.

e2. Provide adequate temporary loading and/or anchoring of the geomembrane by the use of sandbags, tires or other means which will not damage the geomembrane, to prevent uplift of the geomembrane by wind.

f. Other Precautions to Prevent Damage:

f1. Protection of the geomembrane from damage due to foot traffic on the slopes shall be provided.

f2. Provisions of facilities for safe entrance and egress of employees from sloped depressions is required.

g. Replacement of Damaged Geomembrane:

g1. Any area of a panel, which, in the judgement of the Purchaser, becomes seriously damaged (torn, twisted, or crimped permanently) shall be replaced at no additional cost to the Purchaser.

303.2 Field Seaming:

a. Method of Seaming:

a1. The primary welding procedure for seams shall be double wedge fusion welding.

a2. Extrusion welding shall be used only for repairs, detail work, and for seaming where double wedge fusion welding is not possible.

a3. The rods used for extrusion welding shall be the same type of resin as the geomembrane, unless otherwise approved by the Purchaser.

a4. The use of solvents or adhesives is NOT PERMITTED.

b. General Requirements for Seaming:

b1. On slopes steeper than 10 horizontal to 1 vertical, seams shall be oriented parallel to the line of maximum slope (oriented up and down, not across the slope) when possible. No seams oriented across the slope shall be used unless approved by the Purchaser.

b2. Seams parallel to the toe of the slope shall be located a minimum of 5 feet from the toe.

b3. Seams parallel to the crest of the slope shall be located a minimum of 2 feet from the crest.

b4. Seams on the floor of the pond shall be overlapped so that the upslope sheet is positioned above the downslope sheet.

b5. Seaming shall extend to the outside edge of panels to be placed in the anchor trench. Seams at sheet corners of three or four sheets shall be completed with a patch having a minimum dimension of 24 inches, and extrusion welded to the parent sheets.

b6. All cross seams between the two rows of seamed panels shall be welded during the coolest time of the day to allow for contraction of geomembrane.

c. Trial Welds Prior to Beginning Seaming:

c1. Trial welds are required for pre-qualification of personnel, equipment and procedures for making seams on identical geomembrane material under the same climatic conditions as the actual field production seams will be made.

c2. Trial welds shall be made as follows:

c2.1 Prior to each seaming period.

c2.2 Every 4 to 5 hours (i.e., at the beginning of the work shift and after the lunch break).

c2.3 Whenever personnel or equipment are changed.

c2.4 When climatic conditions result in wide changes in geomembrane temperature.

c2.5 When requested by CQA Geomembrane Inspector for any seaming crew or piece of welding equipment if problems are suspected.

c3. Once qualified by passing a trial weld, welding technicians shall not change parameters without performing another trial weld.

c4. Trial welds shall be made on both double wedge fusion welds and on extrusion welds.

c5. A test strip shall be prepared by joining two pieces of geomembrane, each piece shall be at least 6 inches wide. The length of double wedge fusion welded seams shall be a minimum of 10 feet long. The length of an extrusion welded seam shall be a minimum of 4 feet long. The CQA Geomembrane Inspector shall witness the fabrication of each test strip.

c6. All test welds shall be tested by destructive testing. Testing can be done as soon as the seam cools.

c7. A minimum of three (3) one (1) inch wide sample strips shall be cut from each test strip, one from each end and one from the middle. The location of each sample shall be selected by the CQA Geomembrane Inspector. The test strips shall be tested in peel at 2 inches per minute using a field tensiometer. The CQA Geomembrane Inspector shall witness all tests.

c8. If any of the test specimens fail, a new test strip shall be fabricated and the tests repeated for the new strip. If additional specimens fail, the seaming apparatus and the seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and successful trial welds have been achieved.

c9. The trial weld is considered acceptable if, when tested for peel adhesion using the field tensiometer, all three specimens meet the criteria specified in Tables 1 and 2, respectively, for both the peel and shear under Bonded Seam Strength, or the three specimens exhibit Film Tear Bond

(FTB) (yielding of the parent material before seam failure). In the case of double wedge fusion welded seams, both welds must pass in order to be considered acceptable.

c10. If the specimens pass the tests, production seaming operations can begin.

c11. The Contractor shall document all data on each trial weld, including:

c11.1 Date.

c11.2 Time.

c11.3 Operator.

c11.4 Machine number.

c11.5 Ambient temperature.

c11.6 Operating temperature.

c11.7 Speed setting.

c11.8 Pass/Fail designation.

d. Preparation for Seaming:

d1. Prior to seaming, the surface of the geomembrane shall be wiped with a clean cloth to ensure that it is clean and free from moisture, grease, dust, dirt, and debris of any kind before seam welding is started.

d2. The panels shall be adjusted so that the seams are aligned to eliminate wrinkles and fish mouths. Where necessary, fish mouths and wrinkles shall be cut to achieve flat overlap.

e. Seaming:

e1. Seaming shall be performed in accordance with the Manufacturer's accepted procedure.

e2. Double Wedge Fusion Welds:

e2.1 The panels shall be overlapped a minimum of 4 inches prior to welding.

e2.2 Vehicle mounted automated hot wedge welding apparatus shall be used to make the seam.

e3. Extrusion Fillet Welding:

e3.1 Geomembrane overlap shall be a minimum of 3 inches for extrusion welding.

e3.2 Geomembrane panels shall be temporarily bonded using a hot air device prior to extrusion welding.

e3.3 The edge of the geomembrane to be fillet welded shall be pre-beveled before heat-tacking the seam in place.

e3.4 The seam overlap shall be ground (abraded) no more than one hour prior to welding.

e3.5 Grinding shall be performed in accordance with the Manufacturer's instructions in a manner that does not damage the geomembrane.

e3.6 Grinding shall not extend more than 1/4 inch past the area to be covered with extrudate during welding.

e3.7 All grind marks shall be covered with extrudate.

e3.8 Geomembrane overlap shall be a minimum of 3 inches for extrusion welding.

303.3 Non-Destructive Field Testing – Geomembrane:

a. General:

a1. All non-destructive field testing shall be performed and documented by the Geomembrane Contractor.

a2. The CQA Geomembrane Inspector shall observe all non-destructive test procedures.

a3. One hundred (100) percent of the seam length shall be tested using non-destructive procedures to check the continuity of the field seams. Non-destructive testing is not meant to qualify seam strength.

a4. Air pressure testing shall be performed in accordance with ASTM D5820 and GRI GM 6.

a5. Vacuum Box testing shall be performed in accordance with ASTM D5641 and as specified herein.

a6. Continuity testing shall be performed as seaming progresses or as soon as a suitable length of seam is available, not at the completion of all field seaming.

b. Double Wedge Fusion Welded Seams:

b1. Double fusion welded seams shall be tested using air pressure testing.

b2. The procedure for testing shall be as specified in GRI GM 6 for the type and thickness of geomembrane in use.

b3. The following test pressures are applicable to both smooth and textured HDPE. After an initial 2 minute pressure stabilization period, the pressure shall be maintained between 24 and 30 psi for 40 mil HDPE, 27 and 30 psi for 60 mil HDPE, and 30 and 35 psi for 80 and 100 mil HDPE. The pressure shall be sustained for a minimum of 5 minutes. The loss of pressure shall not exceed a maximum of 3 psi in 5 minutes. If the pressure does not stabilize in the first two minutes or the pressure loss exceeds the loss specified, the seam test shall be considered a failure.

b4. The leak or suspected leak shall be located and repaired.

b5. The repaired seam shall be re-tested as required until all leaks are identified, and repaired, and the seam passes a subsequent air pressure test.

b6. When the geometry of a double wedge fusion weld makes air testing impossible or impractical, vacuum testing may be used to test the seam.

c. Extrusion Welded Seams:

c1. Extrusion welded seams shall be tested using vacuum chamber testing in accordance with ASTM D5641.

c2. The completed seam shall exhibit no leakage when tested between 4 and 8 psi minimum vacuum for approximately 10 seconds.

c3. If leaks are discovered during testing, they shall be located, marked, and repaired.

c4. The repaired area shall be re-tested and exhibit no leakage.

d. Inaccessible Seams:

d1. Where extrusion welded seam locations make use of vacuum box testing impractical, then the electric wire method of testing shall be used or the seam shall be cap stripped as approved by the Purchaser.

d2. If cap stripping is approved by the Purchaser, the seams shall be cap stripped as described in Paragraph 304.4, with strips of the same type and thickness of geomembrane being installed. The cap stripping shall be performed in the presence of the Purchaser.

d3. The electric wire test method shall consist of placing a 24 gauge copper wire 1/8 inch beneath the top sheet overlap of the two sheets prior to welding with the extruder. The wire shall be imbedded in the seam. After welding, a holiday spark detector, operating at 20,000 volts, shall be connected to one end of the wire and slowly moved over the length of the seam. A seam defect between the probe and the embedded wire shall result in an audible alarm indicating where the defect is located.

e. Test Reports:

e1. Test reports for all air pressure tests shall contain all data specified in ASTM D5820 and GRI GM 6.

e2. Test reports for vacuum box testing shall contain all the data specified in ASTM D5641.

e3. Test reports for other types of non-destructive tests shall contain as a minimum for each test:

e3.1 Location.

e3.2 Type of test.

e3.3 Test parameters.

e3.4 Test data.

e3.5 Test number.

e3.6 Name of tester.

e3.7 Outcome of the test.

303.4 Destructive Testing – Geomembrane:

a. Testing:

a1. Destructive testing shall be performed by an independent third party laboratory employed by the Geomembrane Contractor on samples cut from production welds in the field by the Geomembrane Contractor.

a2. Samples shall be taken by the Geomembrane Contractor to the third party laboratory and tested for shear strength and peel adhesion. For double wedge seam samples, both welds shall be tested for peel adhesion.

a3. The third party laboratory that will perform testing shall be identified by the Geomembrane Contractor with the bid proposal and agreed-to in writing by the Purchaser.

b. Location and Frequency:

b1. Test locations shall be determined after seaming. The location where the test samples shall be taken shall be marked by the CQA Geomembrane Inspector. Locations may be prompted by the appearance of excessive heating, contaminations, offset welds, or a suspected defect. Destructive test samples shall be taken at a minimum average frequency of one per every 500 linear feet of seam length.

b2. The Method of Attributes described in GRI GM 14 may be exercised to minimize the number of test samples taken if more than 100 destructive seam samples will be required based on the sampling strategy given in Paragraph 303.4.b1.

b3. Each sample location shall be numbered and marked with permanent identification and the location of the sample and the locations shall be indicated on a plan drawing prepared and maintained by the Geomembrane Contractor. The following shall be recorded for each sample:

b3.1 Date and Time.

b3.2 Ambient Temperature.

b3.3 Seam Number and Location.

b3.4 Welding Apparatus Used.

b3.5 Name of Master Seamer.

b3.6 Reason for Taking the Sample.

b3.7 Size of Sample.

b3.8 Test Results.

b3.9 Name of Tester.

b4. Samples shall be cut by the Geomembrane Contractor. The CQA Geomembrane Inspector shall witness test sample cutting.

b5. Test samples shall be cut every shift and taken by the Geomembrane Contractor to the third party laboratory the same day that the sample is prepared.

c. Sample Size:

c1. The minimum sample size shall be 12 inches wide with a seam 16 inches long centered length wise in the sample. As agreed to with Purchaser, a sample may be increased in size to accommodate the requirements of the testing laboratory.

d. Field Testing:

d1. A one-inch wide specimen shall be cut from each end of each sample for field testing.

d2. Each one-inch wide specimen shall be tested with a field tensiometer for peel adhesion.

d3. The CQA Geomembrane Inspector shall witness each field test.

d4. A test is considered acceptable if a specimen meets the criteria specified in Tables 1 and 2, respectively, for both peel and shear under Bonded Seam Strength or, exhibits Film Tear Bond (FTB). For double wedge fusion welds, both welds must pass the test. If either sample fails the field test, it shall be assumed that the seam will not pass the specified laboratory testing and the sample shall be given a fail designation.

e. Laboratory Testing:

e1. Full size (12 inch minimum length) samples shall be taken to an independent third-party laboratory for testing.

e2. Samples shall be tested for shear strength and peel adhesion in accordance with ASTM D6392. Five specimens shall be tested for each test method. All samples shall meet minimum requirements for shear strength and peel adhesion given in Tables 1 and 2, respectively, under Bonded Seam Strength.

f. Test Results:

f1. Verbal test results shall be given to the Geomembrane Contractor within 24 hours of receipt of the samples. Written results shall follow within one week.

f2. All test locations shall be marked with a pass/fail designation on the liner and on the drawings maintained by the Geomembrane Contractor for submittal to the Purchaser after construction is complete.

g. Re-Testing if Failure Occurs:

g1. If a seam fails testing, one additional sample shall be taken 10 feet on each side of the location of the failed test. Additional samples shall continue to be taken at 10 foot intervals until tests show that seam strength is adequate and the zone in which the seam requires reconstruction is identified.

g2. All passing seams shall be bounded by two locations from which samples passing laboratory destructive tests have been taken.

g3. The entire seam length failing strength tests shall be reconstructed at no additional cost to the Purchaser.

g4. If the length of reconstructed seam exceeds 150 feet, a sample shall be taken of the reconstructed seam every 150 feet and shall pass destructive testing.

303.5 Inspection – Geomembrane:

a. After seaming is complete, the Geomembrane Contractor and the CQA Geomembrane Inspector shall conduct a detailed walk-down to visually check all seams and non-seam areas of the geomembrane.

b. All defects, holes, blisters, tears, signs of damage during installation, areas of undispersed carbon and holes from destructive or non-destructive testing shall be marked and repaired.

304. REPAIR OF DEFECTS AND SEAMS - GEOMEMBRANE

304.1 Patching:

a. Patching shall be used to repair large holes, tears and destructive sample locations.

b. All patches shall be round, oval, or shall have rounded corners.

c. All patches shall be made of the base geomembrane material and shall extend a minimum of 3 inches beyond the edges of the defect.

d. Patches shall be extrusion welded to the base sheet.

304.2 Grinding and Welding:

a. Grinding and welding shall be used to repair sections of extruded fillet seams with small defects.

304.3 Spot Welding:

a. Spot welding shall be used to repair small tears, pinholes, or other minor localized flaws.

304.4 Capping:

a. Capping shall be used to repair lengths of extrusion welded seams with large defects and to repair double wedge fusion welded seams.

b. Cap strips shall be made with strips of the same type and thickness of geomembrane being installed. Strips shall extend a minimum of 6 inches beyond the weld, and shall have rounded corners.

c. Cap strips shall be extrusion welded to the base sheet.

304.5 Cut Out and Replacement:

a. When approved by the Purchaser, a length of defective seam may be cut out and replaced with a strip of new material seamed into place.

304.6 Verification of Repairs:

a. All repairs shall be non-destructive tested using one of the procedures described in Paragraph 303.3.

b. Repairs, which pass the non-destructive test, shall be deemed acceptable.

c. Repairs of a seam in excess of 150 feet in length shall have one destructive seam test per 150 feet in length.

305. <u>CREST ANCHOR TRENCH EXCAVATION AND BACKFILLING</u>

305.1 Excavation and Shaping:

a. Unless specified otherwise on the Design Drawings, the geomembrane liner shall be anchored in an anchor trench at the top of the slope. The anchor trench shall be excavated by the Earthwork Contractor to the lines and widths shown on the Design Drawings prior to placement of the liner.

b. A slightly rounded corner shall be provided in the trench where the geomembrane adjoins the trench to avoid sharp bends in the geomembrane. No loose soil shall be allowed to underlie the geomembrane in the anchor trench.

c. The anchor trench shall be adequately drained to prevent ponding or otherwise softening of the adjacent soils while the trench is open.

305.2 Backfilling:

a. Anchor trench backfill shall be placed as shown on the Design Drawings by the Earthwork Contractor.

b. Backfilling of the anchor trench shall occur during the morning or during extended periods of overcast skies when the liners are at their most contracted state.

c. Backfill shall be placed in layers not exceeding 4 inches loose thickness and compacted using hand compaction equipment to a minimum of 95% of the maximum dry density as determined by ASTM D698 at optimum water content ± 2%.

306. ATTACHMENT TO CONCRETE

306.1 Geomembrane shall be attached to concrete using batten strips or to extruded HDPE mechanical anchorages set in cast-in-place concrete in accordance with details on the Design Drawings.

307. ATTACHMENT TO PIPE PENETRATIONS

307.1 Geomembrane shall be attached to pipe penetrations through the lining in accordance with details on the Design Drawings.

307.2 Prefabricated or field fabricated HDPE sleeves (pipe boots) used for attaching the geomembrane to the pipe shall be supplied by the Manufacturer.

END OF SECTION

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# ATTACHMENT C

**Duck Creek Power Plant – Bottom Basin System's Chemical Constituents**

In accordance with 35 I.A.C. 845.230(d)(2)(C), IPRG is submitting available/existing analyses of "the chemical constituents of all waste streams, chemical additives and sorbent materials entering or contained in" the CCR impoundments, Bottom Ash Basin.

A list of the chemical constituents contained in the CCR surface impoundment Bottom Ash can be found in Appendix A. A list of chemical additives, sorbent materials and waste streams that were submitted in the facility's NPDES permit applications to IEPA within the past ten years and/or listed in the current NPDES permit (IL0055620) can be found in Appendix B. For the chemical additives used, IPRG is also including in Appendix C the safety data sheet's Section 3 Composition/Information on Ingredients. Analytical data is not available for the internal waste streams that flowed to the bottom ash Basin when the Duck Creek Power Plant was operating.

## Appendix A: Bottom Ash Chemical Constituents

| Pollutant | Bottom Ash | Units |
|---|---|---|
| Aluminum | 49,100 | mg/kg |
| Antimony | < 0.57 | mg/kg |
| Arsenic | 6 | mg/kg |
| Barium | 2,130 | mg/kg |
| Beryllium | 2.2 | mg/kg |
| Boron | 263 | mg/kg |
| Cadmium | 1.4 | mg/kg |
| Calcium | 86,300 | mg/kg |
| Chromium | 53.6 | mg/kg |
| Chromium * | 53.6 | mg/kg |
| Cobalt | 9.7 | mg/kg |
| Copper | 54.5 | mg/kg |
| Fluoride | 1.7 | mg/kg |
| Iron | 19,700 | mg/kg |
| Lead | 17.3 | mg/kg |
| Lithium | 18.4 | mg/kg |
| Magnesium | 11,100 | mg/kg |
| Manganese | 144 | mg/kg |
| Mercury | < 0.025 | mg/kg |
| Molybdenum | 3.9 | mg/kg |
| Nickel | 26.8 | mg/kg |
| pH | 9.5 | SU |
| Potassium | 1,050 | mg/kg |
| Selenium | 1 | mg/kg |
| Silver | < 0.57 | mg/kg |
| Sodium | 2,310 | mg/kg |
| Thallium | 1 | mg/kg |
| Vanadium | 101 | mg/kg |
| Zinc | 57.8 | mg/kg |

*Chromium screened as both Total Chromium and Hexavalent Chromium to be conservative.

**Appendix B: List of Chemical Additives, Waste Streams and Sorbent Materials**

| Chemical Additives |
|---|
| Cationic Polymer (RO Quest or equivalent) |
| Sodium hypochlorite solution (15% w/v) |
| Sodium Hydroxide (50%) |
| Sulfuric Acid (93%) |
| Biocide (DB20 or equivalent) |
| Sodium metabisulfite |
| Anti-scalant (BULAB 8807 or equivalent) |
| Ammonia hydroxide (16% w/v) |
| Calcium hypochlorite (solid) |

| Waste Streams and Sorbent Materials* |
|---|
| Air Heater Wash |
| Bottom Ash Collection Tank |
| Bottom Ash Hopper Overflow |
| Boiler & Turbine Room Sumps |
| Boiler Sample Lines & Miscellaneous Drains |
| Water Treatment Sump |
| • Raw Water Treatment Clarifier Blowdown |
| • Water Treatment Clarifier Filter Backwash |
| • Reverse Osmosis Reject |
| • Demineralizers Regeneration |

*No sorbent materials

## Appendix C: SDS Section 3 Composition/Information on Ingredients

1. Cationic Polymer (RO Quest or equivalent)

Avista® TECHNOLOGIES

**RoQuest® 4000**
**SAFETY DATA SHEET**

### 3. COMPOSITION and INFORMATION ON INGREDIENTS

| Chemical name<br>CAS #<br>EINECS # | % w/w | US OSHA | GHS/EU CLP | WHMIS |
|---|---|---|---|---|
| Iron salt<br>Proprietary<br>Proprietary | 40 - 50 | Corrosive | H290 May be corrosive to metals.<br>H302 Harmful if swallowed.<br>H315 Causes skin irritation.<br>H318 Causes serious eye damage.<br>P234 Keep only in original container.<br>P264 Wash skin thoroughly after handling.<br>P270 Do not eat, drink or smoke when using this product.<br>P280 Wear protective gloves/ eye protection/ face protection.<br>P301 + P312 IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell.<br>P302 + P352 IF ON SKIN: Wash with plenty of soap and water.<br>P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.<br>P310 Immediately call a POISON CENTER or doctor/ physician.<br>P321 Specific treatment (see supplemental first aid instructions on this label).<br>P330 Rinse mouth.<br>P332 + P313 If skin irritation occurs: Get medical advice/ attention.<br>P362 Take off contaminated clothing and wash before reuse.<br>P390 Absorb spillage to prevent material damage.<br>P406 Store in corrosive resistant stainless steel container with a resistant inner liner.<br>P501 Dispose of contents/ container to an approved waste disposal plant. | E. corrosive materials<br> |
| Coagulant 1<br>Proprietary<br>Proprietary | 10 - 15 | Skin/Eye Irritant | Skin Corrosion/Irritation Category 3<br>Serious eye damage/eye irritation, Category 2B<br>Acute Hazards to the aquatic Environment Category 3<br>H316 Causes mild skin irritation<br>H320 Causes eye irritation<br>H402 Harmful to aquatic life<br>P261 Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.<br>P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. | Not regulated |
| Coagulant 2<br>Proprietary<br>Proprietary | 5 - 10 | Not regulated | Acute Hazards to the aquatic Environment Category 3<br>H402 Harmful to aquatic life | Not regulated |
| Water or other chemicals do not contribute to any additional hazards of this product | balance | N/A | N/A | N/A |

NE = Not Established. C = Ceiling Limit. See Section 16 for Definitions of Terms Used.

2. Sodium hypochlorite solution (15% w/v)

# SAFETY DATA SHEET

**Version** 2

## 3. Composition / Information on Ingredients

**Hazardous**

| Chemical Name | CAS No | Weight-% | EC No |
|---|---|---|---|
| Caustic soda | 1310-73-2 | 0.8 | 215-185-5 |
| Sodium hypochlorite | 7681-52-9 | 10-15.6 | 231-668-3 |

3. Sodium Hydroxide (50%)

# SAFETY DATA SHEET

**Version** 2

## 3. Composition / Information on Ingredients

**Hazardous**

| Chemical Name | CAS No | Weight-% | EC No |
|---|---|---|---|
| Sodium Hydroxide | 1310-73-2 | 50 | 215-185-5 |

4. Sulfuric Acid (93%)

# SAFETY DATA SHEET

**Version** 2

## 3. Composition / Information on Ingredients

**Hazardous**

| Chemical Name | CAS No | Weight-% | EC No |
|---|---|---|---|
| Sulfuric acid | 7664-93-9 | 93-98 | 231-639-5 |

5. Biocide (DB20 or equivalent)

# Material Safety Data Sheet
The Dow Chemical Company

**Product Name:** AQUCAR™ DB 20 Water Treatment Microbiocide **Issue Date:** 07/25/2012
**Print Date:** 26 Jul 2012

## 3. Composition Information

| Component | CAS # | Amount |
|---|---|---|
| Polyethylene glycol | 25322-68-3 | >= 46.5 - <= 54.5 % |
| 2,2-Dibromo-3-nitrilopropionamide | 10222-01-2 | 20.0 % |
| Dibromoacetonitrile | 3252-43-5 | <= 3.0 % |
| Sodium bromide | 7647-15-6 | <= 4.0 % |

6. Sodium metabisulfite

ThermoFisher SCIENTIFIC

# SAFETY DATA SHEET

**Creation Date** 08-February-2010 **Revision Date** 18-January-2018 **Revision Number** 5

## 3. Composition/Information on Ingredients

| Component | CAS-No | Weight % |
|---|---|---|
| Sodium metabisulfite | 7681-57-4 | >95 |

7. Anti-scalant (BULAB 8807 or equivalent 7016)

Buckman

# SAFETY DATA SHEET
BULAB 7016

## Section 3. Composition/information on ingredients

**Substance/mixture** : Mixture

**Other means of identification** : Not available.

**Product code** : BLB7016

| Ingredient name | % | CAS number |
|---|---|---|
| Organic phosphonate | Proprietary | - |
| Phosphonic acid | 0 - 2.5 | 13598-36-2 |

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

*While some substances are claimed as trade secret in accordance with the provision of OSHA 29 CFR 1910.1200(i), all known hazards are clearly communicated within this document.*

Per Appendix D 1910.1200 OSHA, ranges can be used when there is batch-to-batch variability in a mixture or a trade secret claim.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

8. Ammonia hydroxide (16% w/v)

**Safety Data Sheet**
according to 29CFR1910/1200 and GHS Rev. 3

**Effective date** : 11.05.2014

**Ammonium Hydroxide, 3M**

**SECTION 3 : Composition/information on ingredients**

| **Ingredients:** | | |
|---|---|---|
| CAS 1336-21-6 | Ammonium Hydroxide, ACS | 20 % |
| CAS 7732-18-5 | DI Water | 80 % |
| | | Percentages are by weight |

9. Calcium hypochlorite (solid)

Safety Data Sheet (SDS) HTH® CALCIUM HYPOCHLORITE TABLETS

Page 1 of 10

According to ISO &SANS 11014:2010 & SANS 10234

**Version: 18**

## SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

**Substance/Mixture:** Mixture

**Ingredients:**

| Substance name (IUPAC) | CAS-No. / EC-No. | Concentration % by weight | Classification EC1272/2008 |
|---|---|---|---|
| Calcium hypochlorite | 7778-54-3 / 231-908-7 | 60 – 70 | Oxidizing Solid (Category 2) H272. Acute Toxicity (Category 4) H302. Skin Corrosive (Category 1B) H314. Aquatic Acute (Category 1) H400. |
| Hydrated lime | 1305-62-0 / 215-137-3 | 1-5 | Skin Irritation (Category 2) H315. Serious Eye Damage (Category 1) H318. STOT SE (Category 3) H335. |

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

# ATTACHMENT D

# Memorandum

Date: 25 October 2021

Subject: 35 Ill. Admin. Code Part 845 - Fault Area Location Demonstration for Bottom Ash Pond at Duck Creek Power Plant

Illinois Power resources Generating, LLC operates the coal-fired Duck Creek Power Plant located in Fulton County, Illinois. The Duck Creek Bottom Ash Pond is an existing surface impoundment storing coal combustion residuals (CCR). The requirements for the Duck Creek Bottom Ash Pond are found in 35 Ill. Admin. Code (I.A.C.) 845 (Part 845).

This memorandum addresses the requirements of Section 845.320 Fault Areas, which states:

*Section 845.320 Fault Areas*

a) *Existing and new CCR surface impoundments, and all lateral expansions of CCR surface impoundments must not be located within 60 meters (200 feet) of the outermost damage zone of a fault that has had displacement in Holocene time unless the owner or operator demonstrates that an alternative setback distance of less than 60 meters (200 feet) will prevent damage to the structural integrity of the CCR surface impoundment.*

b) *The owner or operator of the CCR surface impoundment must obtain a certification from a qualified professional engineer stating that the demonstration meets the requirements of subsection (a).*

Pursuant to Section 845.210(d)(2), for existing CCR surface impoundments, the owner or operator of the CCR surface impoundment may use a previously completed location restriction demonstration required by Section 845.300 (Placement Above the Uppermost Aquifer), Section 845.310 (Wetlands), Section 845.320 (Fault Areas), Section 845.330 (Seismic Impact Zones), and Section 845.340 (Unstable Areas), provided that the previously completed assessments meet the applicable requirements of those Sections.

The previous fault area demonstration was certified by a qualified professional engineer stating that the demonstration meets the requirements of 40 C.F.R. § 257.62. The requirements described in 40 C.F.R. § 257.62 are nearly identical to the requirements contained in I.A.C. Section 845.320. Pursuant to Section 845.210(d)(2), a certification is not required for this demonstration. The previously completed fault area demonstration is included in Attachment D.

HALEY & ALDRICH, INC.
6500 Rockside Road
Suite 200
Cleveland, OH 44131
216.739.0555

**MEMORANDUM**

16 October 2018
File No. 129788

SUBJECT: Location Restriction Demonstration - Fault Areas
Duck Creek Power Station
Bottom Ash Basin
Canton, Illinois

Illinois Power Resources Generating, LLC operates the coal-fired Duck Creek Power Station (Plant) located near Canton, Illinois. The Bottom Ash Basin (Unit) is an existing coal combustion residuals (CCR) surface impoundment. This demonstration addresses the requirements of 40 CFR §257.62 *(Fault Areas)* of the U.S. Environmental Protection Agency's (EPA) rule entitled *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities.* 80 Fed. Reg. 21,302 (Apr. 17, 2015) (promulgating 40 CFR §257.62); 83 Fed. Reg. 36,435 (July 30, 2018) (amending 40 CFR §257.62).

*<u>§257.62(a)</u>: New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located within 60 meters (200 feet) of the outermost damage zone of a fault that has had displacement in Holocene time unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that an alternative setback distance of less than 60 meters (200 feet) will prevent damage to the structural integrity of the CCR unit.*

A review of available data from the U.S. Geological Survey, the Illinois State Geological Survey, and other available information was completed for this demonstration. The nearest known mapped fault is the Sicily Fault, which is located approximately 64 miles southeast and the timeframe of the most recent activity on this fault is not known. Based on the available published geologic data and information reviewed, there are no active faults or fault damage zones that have had displacement in Holocene time reported or indicated within 200 feet of the Unit.

*§257.62(b): The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority stating that the demonstration meets the requirements of paragraph (a) of this section.*

I, Steven F. Putrich, 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 demonstration that the CCR Unit is not located within 60 meters (200 feet) of the outermost damage zone of a fault that has had a displacement in Holocene time as included in the CCR Rule Location Restrictions Evaluation memorandum dated 12 October 2018 meets the requirements of 40 CFR §257.62(a).

Signed: ______________________
Consulting Engineer

| | |
|---|---|
| Print Name: | Steven F. Putrich |
| Illinois License No.: | 62048779 |
| Title: | Vice President |
| Company: | Haley & Aldrich, Inc. |

Professional Engineer's Seal:

STEVEN F. PUTRICH
062-048-779
REGISTERED
PROFESSIONAL
ENGINEER
STATE OF ILLINOIS
10/16/18

# Memorandum

BURNS McDONNELL

Date: 25 October 2021

Subject: 35 Ill. Admin. Code Part 845 - Placement Above the Uppermost Aquifer Location Demonstration for Bottom Ash Pond at Duck Creek Power Plant

Illinois Power resources Generating, LLC operates the coal-fired Duck Creek Power Plant located in Fulton County, Illinois. The Duck Creek Bottom Ash Pond is an existing surface impoundment storing coal combustion residuals (CCR). The requirements for the Duck Creek Bottom Ash Pond are found in 35 Ill. Admin. Code (I.A.C.) 845 (Part 845).

This memorandum addresses the requirements of Section 845.300 Placement Above the Uppermost Aquifer, which states:

*Section 845.300 Placement Above the Uppermost Aquifer*

a) *Existing and new CCR surface impoundments, and all lateral expansions of CCR surface impoundments must, be constructed with a base that is located at least 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR surface impoundment and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high water table).*

b) *The owner or operator of the CCR surface impoundment must obtain a certification from a qualified professional engineer stating that the demonstration meets the requirements of subsection (a).*

Pursuant to Section 845.210(d)(2), for existing CCR surface impoundments, the owner or operator of the CCR surface impoundment may use a previously completed location restriction demonstration required by Section 845.300 (Placement Above the Uppermost Aquifer), Section 845.310 (Wetlands), Section 845.320 (Fault Areas), Section 845.330 (Seismic Impact Zones), and Section 845.340 (Unstable Areas), provided that the previously completed assessments meet the applicable requirements of those Sections.

The previous upper aquifer demonstration was certified by a qualified professional engineer stating that the demonstration meets the requirements of 40 C.F.R. § 257.60. The requirements described in 40 C.F.R. § 257.60 are nearly identical to the requirements contained in I.A.C. Section 845.300. Pursuant to Section 845.210(d)(2), a certification is not required for this demonstration. The previously completed upper aquifer demonstration is included in Attachment D.

HALEY & ALDRICH, INC.
6500 Rockside Road
Suite 200
Cleveland, OH 44131
216.739.0555

**MEMORANDUM**

16 October 2018
File No. 129788

SUBJECT: Location Restriction Demonstration – Placement Above Uppermost Aquifer
Duck Creek Power Station
Bottom Ash Basin
Canton, Illinois



Illinois Power Resources Generating, LLC operates the coal-fired Duck Creek Power Station (Plant) located near Canton, Illinois. The Bottom Ash Basin (Unit) is an existing coal combustion residuals (CCR) surface impoundment. This demonstration addresses the requirements of 40 CFR §257.60 *(Placement above the uppermost aquifer)* of the U.S. Environmental Protection Agency's (EPA) rule entitled *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities*. 80 Fed. Reg. 21,302 (Apr. 17, 2015) (promulgating 40 CFR §257.60); 83 Fed. Reg. 36,435 (July 30, 2018) (amending 40 CFR §257.60).

*§257.60(a): New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must be constructed with a base that is located no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high water table). The owner or operator must demonstrate by the dates specified in paragraph (c) of this section that the CCR unit meets the minimum requirements for placement above the uppermost aquifer.*

O'Brien & Gere (OB&G) evaluated groundwater conditions and prepared a Top of Uppermost Aquifer contour map (TOA Map) contour map dated 1 November 2017 where the upper limit of the uppermost aquifer is a gradually sloping surface generally from south to northeast ranging in elevation from 557+/- feet to 551+/- feet across the base of the Unit.

Haley & Aldrich reviewed available information provided by Vistra including historic record drawings and design drawings and identified a drawing that provided well documented information regarding the base of the unit. A 2009 detail drawing prepared by Sargent & Lundy provided bottom of unit elevation across the length of the unit from west to east. The drawing shows the elevations across the base of the Unit are relatively flat surfaces with the lowest elevation of 568.3+/- occurring in the Secondary Pond at the east end of the unit.

When the critical low points at the base of unit were compared to the corresponding contours on the TOA Map, the resulting minimum separation was determined to exceed the 5.0 feet minimum separation requirement of §257.60(a) of the Rule.

*<u>§257.60(b):</u> The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority stating that the demonstration meets the requirements of paragraph (a) of this section.*

I, Steven F. Putrich, 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 demonstration regarding the location of the base of the CCR Unit is at least 1.52 meters above the upper limit of the uppermost aquifer as included in the CCR Rule Locations Restrictions Evaluation memorandum dated 12 October 2018 meets the requirements of 40 CFR §257.60(a).

Signed: ______________________
Consulting Engineer

| | |
|---|---|
| Print Name: | Steven F. Putrich |
| Illinois License No.: | 62048779 |
| Title: | Vice President |
| Company: | Haley & Aldrich, Inc. |

Professional Engineer's Seal:

STEVEN F. PUTRICH
062-048-779
REGISTERED
PROFESSIONAL
ENGINEER
10/16/18
STATE OF ILLINOIS

# Memorandum

BURNS McDONNELL

Date: 25 October 2021

Subject: 35 Ill. Admin. Code Part 845 – Seismic Impact Zone Location Demonstration for Bottom Ash Pond at Duck Creek Power Plant

Illinois Power resources Generating, LLC operates the coal-fired Duck Creek Power Plant located in Fulton County, Illinois. The Duck Creek Bottom Ash Pond is an existing surface impoundment storing coal combustion residuals (CCR). The requirements for the Duck Creek Bottom Ash Pond are found in 35 Ill. Admin. Code (I.A.C.) 845 (Part 845).

This memorandum addresses the requirements of Section 845.330 Seismic Impact Zone, which states.

*Section 845.330 Seismic Impact Zones*

a) *Existing and new CCR surface impoundments, and all lateral expansions of CCR surface impoundments must not be located in seismic impact zones unless the owner or operator demonstrates that all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site.*

b) *The owner or operator of the CCR surface impoundment must obtain a certification from a qualified professional engineer stating that the demonstration meets the requirements of subsection (a).*

Pursuant to Section 845.210(d)(2), for existing CCR surface impoundments, the owner or operator of the CCR surface impoundment may use a previously completed location restriction demonstration required by Section 845.300 (Placement Above the Uppermost Aquifer), Section 845.310 (Wetlands), Section 845.320 (Fault Areas), Section 845.330 (Seismic Impact Zones), and Section 845.340 (Unstable Areas), provided that the previously completed assessments meet the applicable requirements of those Sections.

The previous seismic impact zone demonstration was certified by a qualified professional engineer stating that the demonstration meets the requirements of 40 C.F.R. § 257.63. The requirements described in 40 C.F.R. § 257.63 are nearly identical to the requirements contained in I.A.C. Section 845.330. Pursuant to Section 845.210(d)(2), a certification is not required for this demonstration. The previously completed seismic impact zone demonstration is included in Attachment D.

HALEY & ALDRICH, INC.
6500 Rockside Road
Suite 200
Cleveland, OH 44131
216.739.0555

**MEMORANDUM**

16 October 2018
File No. 129788

SUBJECT: Location Restriction Demonstration – Seismic Impact Zone
Duck Creek Power Station
Bottom Ash Basin
Canton, Illinois



Illinois Power Resources Generating, LLC operates the coal-fired Duck Creek Power Station (Plant) located near Canton, Illinois. The Bottom Ash Basin (Unit) is an existing coal combustion residuals (CCR) surface impoundment. This demonstration addresses the requirements of 40 CFR §257.63 *(Seismic Impact Zones)* of the U.S. Environmental Protection Agency's (EPA) rule entitled *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities*. 80 Fed. Reg. 21,302 (Apr. 17, 2015) (promulgating 40 CFR §257.63); 83 Fed. Reg. 36,435 (July 30, 2018) (amending 40 CFR §257.63).

*§257.63(a)*: *New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located in seismic impact zones unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site.*

A Seismic Impact Zone is defined in the CCR Rule (40 CFR §257.63) as "an area having a 2% or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10 g in 50 years". The 2014 US Geological Survey Hazard Map raw data for the Duck Creek Power Station Bottom Ash Basin indicates that the maximum expected horizontal acceleration for 2 percent probability of exceedance in 50 years is 0.06g. Accordingly, the Unit is not located in a seismic impact zone and a demonstration that the structural components have been designed to resist the maximum horizontal acceleration in lithified earth material for the site is not required.

*<u>§257.63(b):</u> The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority stating that the demonstration meets the requirements of paragraph (a) of this section.*

I, Steven F. Putrich, 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, that the CCR Unit is not located in a seismic impact zone as included in the CCR Rule Location Restrictions Evaluation memorandum dated 12 October 2018 and, therefore, satisfies all requirements of 40 CFR §257.63(a).

Signed: ____________________
Consulting Engineer

| | |
|---|---|
| Print Name: | Steven F. Putrich |
| Illinois License No.: | 62048779 |
| Title: | Vice President |
| Company: | Haley & Aldrich, Inc. |

Professional Engineer's Seal:

STEVEN F. PUTRICH
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10/16/18
STATE OF ILLINOIS

# Memorandum

BURNS McDONNELL

Date: 25 October 2021

Subject: 35 Ill. Admin. Code Part 845 – Unstable Areas and Floodplains Location Standard Demonstration for the Bottom Ash Basin at Duck Creek Power Plant

Illinois Power Resources Generating, LLC is the owner of the coal fired Duck Creek Power Plant (Plant) located in Fulton County, Illinois. The Bottom Ash Basin is an existing surface impoundment storing coal combustion residuals (CCR). The requirements for the Bottom Ash Basin are found in 35 Ill. Admin. Code (I.A.C.) 845 (Part 845).

This certification addresses the requirements of Part 845, Section 845.340 Unstable Areas and Floodplains, which states:

> <u>*Section 845.340 (a):*</u> *An existing or new CCR surface impoundment, or any lateral expansion of a CCR surface impoundment must not be located in an unstable area unless the owner or operator demonstrates that recognized and generally accepted engineering practices have been incorporated into the design of the CCR surface impoundment to ensure that the integrity of the structural components of the CCR surface impoundment will not be disrupted.*
>
> <u>*Section 845.340 (b):*</u> *The owner or operator must consider all the following factors, at a minimum, when determining whether an area is unstable: 1) On-site or local soil conditions, including but not limited to liquefaction, that may result in significant differential settling; 2) On-site or local geologic or geomorphologic features; and 3) On-site or local human-made features or events (both surface and subsurface).*

Pursuant to Section 845.210(d)(2), for existing CCR surface impoundments, the owner or operator of the CCR surface impoundment may use a previously completed location restriction demonstration required by Section 845.300 (Placement Above the Uppermost Aquifer), Section 845.310 (Wetlands), Section 845.320 (Fault Areas), Section 845.330 (Seismic Impact Zones), and Section 845.340 (Unstable Areas), provided that the previously completed assessments meet the applicable requirements of those Sections.

The previous unstable area demonstration was certified by a qualified professional engineer stating that the demonstration meets the requirements of 40 C.F.R. § 257.64. The requirements described in 40 C.F.R. § 257.64 are nearly identical to the requirements contained in I.A.C. Section 845.340 (a). Pursuant to Section 845.210(d)(2), a certification is not required for the unstable area demonstration. The previously completed unstable area demonstration meeting the requirements of Section 845.340 (a) is included in Attachment D.

> Section 845.340 (c): *An existing or new CCR surface impoundment, or any lateral expansion of a CCR surface impoundment, must not be located in a floodplain unless the owner or operator demonstrates that recognized and generally accepted engineering practices have been incorporated into the design of the CCR surface impoundment to ensure that the CCR surface impoundment will not restrict the flow of the base flood , reduce the temporary water storage capacity of a floodplain , or result in washout of CCR , so as to pose a hazard to human life, wildlife, or land or water resources.*

The boundaries of the impoundment were determined by a survey conducted by a professional surveyor licensed in the State of Illinois. The surveyed boundaries were compared to the existing floodplain boundary from the effective FEMA Flood Insurance Rate Map (FIRM) Number 17057C0375E, dated February 4, 2011. The location of the Duck Creek Bottom Ash Pond is outside of the FEMA 100-year floodplain therefore, it was determined that the Duck Creek Bottom Ash Pond is not located within the floodplain.

> Section 845.330 (d): *The owner or operator of the CCR surface impoundment must obtain a certification from a qualified professional engineer stating that the demonstration meets the requirements of subsections (a) and (c).*

Pursuant to Section 845.210(d)(2), for existing CCR surface impoundments, the owner or operator of the CCR surface impoundment may use a previously completed location restriction demonstration required by Section 845.340 (Unstable Areas) and demonstrated in Attachment D. Therefore, a new certification is not included for Section 845.340 (a). Certification for Section 845.340 (c) is included below.

**<u>35 Illinois Administration Code Part 845:</u>**
**<u>Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments</u>**
**<u>Section 845.340 (c): Certification</u>**

I, *<u>Sarah Espinosa</u>*, being a Professional Engineer in good standing in the State of Illinois, do hereby certify, to the best of my knowledge, information, and belief that this floodplain demonstration meets the requirements of 35 Ill. Adm. Code 845.340(c).

Sarah Espinosa, P.E.

*Printed Name*


*October 21, 2021*

*Date*

HALEY ALDRICH

HALEY & ALDRICH, INC.
6500 Rockside Road
Suite 200
Cleveland, OH 44131
216.739.0555

**MEMORANDUM**

16 October 2018
File No. 129788

SUBJECT: Location Restriction Demonstration – Unstable Areas
Duck Creek Power Station
Bottom Ash Basin
Canton, Illinois

Illinois Power Resources Generating, LLC operates the coal-fired Duck Creek Power Station (Plant) located near Canton, Illinois. The Bottom Ash Basin (Unit) is an existing coal combustion residuals (CCR) surface impoundment. This demonstration addresses the requirements of 40 CFR §257.64 *(Unstable Areas)* of the U.S. Environmental Protection Agency's (EPA) rule entitled *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities*. 80 Fed. Reg. 21,302 (Apr. 17, 2015) (promulgating 40 CFR §257.64); 83 Fed. Reg. 36,435 (July 30, 2018) (amending 40 CFR §257.64).



*§257.64(a): An existing or new CCR landfill, existing or new CCR surface impoundment, or any lateral expansion of a CCR unit must not be located in an unstable area unless the owner or operator demonstrates by the dates specified in paragraph (d) of this section that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted.*

*§257.64(b): The owner or operator must consider all of the following factors, at a minimum, when determining whether an area is unstable:*

*(1) On-site or local soil conditions that may result in significant differential settling;*
*(2) On-site or local geologic or geomorphologic features; and*
*(3) On-site or local human-made features or events (both surface and subsurface).*

*Determination of compliance with §257.64(b)(1)* – The Unit is incised and local soil conditions that may result in significant differential settling do not exist.

*Determination of compliance with §257.64(b)(2)* - Based on available United States Geological Survey (USGS), Illinois State Geological Survey (ISGS) information, and communication with Vistra representatives familiar with the Plant's history, karst topography or physiographic features such as sinkholes, vertical shafts, sinking streams, caves, large springs, or blind valleys do not exist at the Plant. To evaluate the susceptibility of landslides, we reviewed readily available USGS and ISGS data. The USGS data indicates that the Plant is in an area of low landslide incidence. A review of ISGS data indicated that there has not been a landslide occurrence at the Unit. The closest documented landslide is to the east along U.S. Highway 24 and is associated with roadside cuts. Accordingly, it is our opinion that the Unit is not located in an area that has high susceptibility to landslides.

*Determination of compliance with §257.64(b)(3)* - There are no documented surface or subsurface anthropogenic activities that would be indicative of creating unstable foundation conditions.

*§257.64(c): The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority stating that the demonstration meets the requirements of paragraph (a) of this section.*

I, Steven F. Putrich, 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 demonstration indicating the CCR Unit is not located in an unstable area as included in the CCR Rule Location Restrictions Evaluation memorandum dated 12 October 2018 meets the requirements of 40 CFR §257.64(a).

Signed: ____________________
Consulting Engineer

| | |
|---|---|
| Print Name: | Steven F. Putrich |
| Illinois License No.: | 62048779 |
| Title: | Vice President |
| Company: | Haley & Aldrich, Inc. |

Professional Engineer's Seal:

STEVEN F. PUTRICH
062-048-779
REGISTERED
PROFESSIONAL
ENGINEER
10/16/18
STATE OF ILLINOIS

# Memorandum

BURNS & McDONNELL

Date: 25 October 2021

Subject: 35 Ill. Admin. Code Part 845 - Wetland Location Demonstration for Bottom Ash Pond at Duck Creek Power Plant

Illinois Power resources Generating, LLC operates the coal-fired Duck Creek Power Plant located in Fulton County, Illinois. The Duck Creek Bottom Ash Pond is an existing surface impoundment storing coal combustion residuals (CCR). The requirements for the Duck Creek Bottom Ash Pond are found in 35 Ill. Admin. Code (I.A.C.) 845 (Part 845).

This memorandum addresses the requirements of Section 845.310 Wetlands, which states:

*Section 845.310 Wetlands*

a) *Existing and new CCR surface impoundments, and all lateral expansions of CCR surface impoundments must not be located in wetlands unless the owner or operator demonstrates* [that the requirements listed in 845.310(a)(1) through (5) are met.]

b) *The owner or operator of the CCR surface impoundment must obtain a certification from a qualified professional engineer stating that the demonstration meets the requirements of subsection (a).*

Pursuant to Section 845.210(d)(2), for existing CCR surface impoundments, the owner or operator of the CCR surface impoundment may use a previously completed location restriction demonstration required by Section 845.300 (Placement Above the Uppermost Aquifer), Section 845.310 (Wetlands), Section 845.320 (Fault Areas), Section 845.330 (Seismic Impact Zones), and Section 845.340 (Unstable Areas), provided that the previously completed assessments meet the applicable requirements of those Sections.

The previous wetlands demonstration was certified by a qualified professional engineer stating that the demonstration meets the requirements of 40 C.F.R. § 257.61. The requirements described in 40 C.F.R. § 257.61 are nearly identical to the requirements contained in I.A.C. Section 845.310. Pursuant to Section 845.210(d)(2), a certification is not required for this demonstration. The previously completed wetlands demonstration is included in Attachment D.

HALEY & ALDRICH, INC.
6500 Rockside Road
Suite 200
Cleveland, OH 44131
216.739.0555

**MEMORANDUM**

16 October 2018
File No. 129788

SUBJECT: Location Restriction Demonstration - Wetland Areas
Duck Creek Power Station
Bottom Ash Basin
Canton, Illinois



Illinois Power Resources Generating, LLC operates the coal-fired Duck Creek Power Station (Plant) located near Canton, Illinois. The Bottom Ash Basin (Unit) is an existing coal combustion residuals (CCR) surface impoundment. This demonstration addresses the requirements of 40 CFR §257.61 *(Wetlands)* of the U.S. Environmental Protection Agency's (EPA) rule entitled *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities*. 80 Fed. Reg. 21,302 (Apr. 17, 2015) (promulgating 40 CFR §257.61); 83 Fed. Reg. 36,435 (July 30, 2018) (amending 40 CFR §257.61.

*§257.61(a): New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located in wetlands, as defined in §232.2 of this chapter, unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that the CCR unit meets the requirements of paragraphs (a)(1) through (5) of this section.*

Based on a review of the U.S. Fish and Wildlife Service's National Wetland Inventory mapping, 0.5-meter resolution aerial imagery (2016) and the results of on-site field assessments, the Unit is not located in wetlands as defined by 40 CRF §232.2.

*<u>§257.61(b):</u> The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority stating that the demonstration meets the requirements of paragraph (a) of this section.*

I, Steven F. Putrich, 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 CCR Unit is not located in wetlands as included in the CCR Rule Location Restrictions Evaluation memorandum dated 12 October 2018 and, therefore, meets the requirements of 40 CFR §257.61(a).

Signed: ______________________
Consulting Engineer

| | |
|---|---|
| Print Name: | Steven F. Putrich |
| Illinois License No.: | 62048779 |
| Title: | Vice President |
| Company: | Haley & Aldrich, Inc. |

Professional Engineer's Seal:

# ATTACHMENT E


DUCK CREEK
BOTTOM ASH BASIN
ID #: W0578010001-03
ILLINOIS POWER RESOURCES
GENERATING, LLC

# ATTACHMENT F

# Illinois Power Resources Generating, LLC

## DUCK CREEK POWER PLANT

*FULTON COUNTY, ILLINOIS*

# Emergency Action Plan (EAP)

**40 C.F.R. § 257.73(a)(3), Ill. Adm. Code 845.520**
**Coal Combustion Residual (CCR) Impoundment**
**& Related Facilities**

- Ash Basin No. 1 (NID # IL50715) (IEPA # 05780 000 0 )
- Ash Pond No. 2 (NID # IL50014) (IEPA # 05780 000 02)
- Bottom Ash Basin (NID # IL50716) (IEPA # W0578010001-03)
- Gypsum Management Facility (GMF) Pond (NID # IL50573) (IEPA # 05780 000 04)

**Revision Date: September 16, 2021**

**Qualified Professional Engineer Certification; Emergency Action Plan for the Duck Creek Power Plant Ash Pond 1, Ash Pond 2, Bottom Ash Pond, and GMF Pond**

In accordance with 40 C.F.R. § 257.73(a)(3)(iv) and 35 Ill. Adm. Code 845.520(e), the owner or operator of a CCR unit that is required to prepare a written Emergency Action Plan under 40 C.F.R. § 257.73(a)(3) and 35 Ill. Adm. Code 845.520(a) must obtain a certification from a qualified professional engineer stating that the written Emergency Action Plan meets the requirements of 40 C.F.R. § 257.73(a)(3) and 35 Ill. Adm. Code 845.520.

I, Phil Morris, being a Professional Engineer in good standing in the State of Illinois, do hereby certify, to the best of my knowledge, information, and belief that:

1. the information contained in this Emergency Action Plan was prepared in accordance with the accepted practice of engineering; and

2. this Emergency Action Plan meets the requirements of 40 C.F.R. § 257.73(a)(3) and 35 Ill. Adm. Code 845.520.

Phil Morris
Senior Director, Corporate Environmental

9/27/21

*Date*

PHIL L. MORRIS
062-058763
REGISTERED
PROFESSIONAL
ENGINEER
OF
ILLINOIS
9/27/21

**DUCK CREEK POWER PLANT**
**EMERGENCY ACTION PLAN**
**CCR IMPOUNDMENTS & RELATED FACILITIES**

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## List of Figures

**DUCK CREEK POWER PLANT**
**EMERGENCY ACTION PLAN**
**CCR IMPOUNDMENTS & RELATED FACILITIES**

# 1 STATEMENT OF PURPOSE

The Duck Creek Power Plant (Power Plant) is a retired facility located near Canton in Fulton County, Illinois. The location is shown in Figure 1-1. The Power Plant is a coal-fired electricity producing power plant owned and operated by Illinois Power Resources Generating, LLC, a subsidiary of Dynegy Midwest Generation, LLC (DMG). This Emergency Action Plan (EAP) was prepared in accordance with 40 CFR **§** 257.73(a)(3) and Title 35, Section 845.520 of IEPA Administrative Code and covers the following Coal Combustion Residual (CCR) surface impoundments located at the site:

- Ash Pond No. 1 (Capped/Closed) (NID # IL50715) (IEPA # 05780 000 0 )
- Ash Pond No. 2 (Capped/Closed) (NID # IL50014) (IEPA # 05780 000 02)
- Bottom Ash Basin (NID # IL50716) (IEPA # W0578010001-03)
- Gypsum Management Facility (GMF) Pond (NID # IL50573) (IEPA # 05780 000 04)

The locations of these impoundments are shown in Figure 1-2. Section 6 of this EAP includes a description of each impoundment.

The purpose of this Emergency Action Plan (EAP) is to:

1. Safeguard the lives, as well as to reduce property damage, of citizens living within potential downstream flood inundation areas of CCR impoundments and related facilities at the Duck Creek Power Plant.
2. Define the events or circumstances involving the CCR impoundments and related facilities at the Duck Creek Power Plant that represent atypical operating conditions that pose a safety hazard or emergency and how to identify those conditions.
3. Define responsible persons, their responsibilities, and notification procedures in the event of a safety emergency.
4. Provide contact information of emergency responders.
5. Identify emergency actions in the event of a potential or imminent failure of the impoundments.
6. Identify the downstream area that would be affected by failure of the impoundments.
7. Provide for effective facility surveillance, prompt notification to local Emergency Management Agencies, citizen warning and notification responses, and preparation should an emergency occur.

Information provided by Illinois Power Resources Generating, LLC was utilized and relied upon in preparation of this report.


0 6,000 Feet

1:36,000 (At original document size of 11x17)


**Notes**

1. Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
2. Aerial Source: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO,
3. USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User



Stantec DYNEGY

Project Location
Latitude: 40.466181
Longitude: -89.984236
Fulton County, Illinois

175605019
Prepared by CAJ on 2017-03-23
Technical Review by PV on 2017-03-23
Independent Review by NS on 2017-03-23

Client/Project
Duck Creek Power Station
Emergency Action Plan

Figure No.
**1-1**

Title
**Location Map**

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## Legend

CCR Surface Impoundment Boundary

0 3,000 Feet

1:18,000 (At original document size of 11x17)

Project Location 175605019
Latitude: 40.466181
Longitude: -89.984236
Fulton County, Illinois

Prepared by CAJ on 2017-03-16
Technical Review by PV on 2017-03-16
Independent Review by NS on 2017-03-16

Client/Project
Duck Creek Power Station
Emergency Action Plan

Figure No.
**1-2**

Title
**CCR Impoundments**

**Notes**
1. Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
2. Aerial Source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA,
3. USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community2015 NAIP Imagery

# 2 COMMUNICATION

To facilitate understanding among everyone involved in implementing this EAP, four response levels are used to identify the condition of an impoundment. These are:

**Response Levels:**

- **Level 0:** Normal conditions and routine operations, including surveillance and initial investigation of unusual conditions and effects of storm events.
- **Level 1:** Potentially hazardous condition exists, requiring investigation and possible corrective action.
- **Level 2:** Potential failure situation is developing; possible mode of failure is being assessed; corrective measures are underway.
- **Level 3:** Failure is occurring or is imminent, public protective actions are required.

The 4-Step Incident Response Process is outlined in Figure 2-1. This should be used in conjunction with the Notification Flowchart (Figure 2-2) and EAP Decision Tree (Figure 2-3). Section 4 provides guidance tables for determining Response Levels and a table providing emergency actions to be taken given various situations. Table 2-1 lists contact information for the emergency responders.

**Figure 2-1. Summary/Sequence of Tasks 4-Step Incident Response Process**

**Step 1: Detection, Evaluation, and Response Level Determination**

Sequence of Tasks:

- Notify EAP Coordinator, Power Plant Management (Director and Engineering), and DMG Dam Safety Manager of unusual condition detected and confer on next steps needed.
- Conduct technical evaluation of conditions as needed.
- Determine Response Level based on evaluation. **(Table 4-1)**
- Reset Response Level as revised evaluations warrant.

**Step 2: Notification**

Sequence of Tasks:

- Notify authorities, designated personnel, and external response partners of change in Response Level, using the Notification Flowchart. **(Figure 2-2)**
- *Re-notify authorities, designated personnel, and external response partners as Response Level is changed.*

**Step 3: Emergency Actions**

Sequence of Tasks:

- Perform emergency actions with goal of saving the impoundment and minimizing impacts to life, property, and environment. **(Table 4-3)**
- Take continuous actions to include situation assessment, information sharing, remediation, and public safety advisories or warnings, as warranted.
- *Revise action plan as changes in conditions warrant.*

**Step 4: Follow-up**

Sequence of Tasks:

- Document conditions and decisions in the Emergency Incident Log.
- Notify authorities, designated personnel, and external response partners that condition is stabilized; limit incident termination declarations to conditions at the site.
- Conduct and document after-action review of incident and response.

**Figure 2-2. Notification Flowchart**

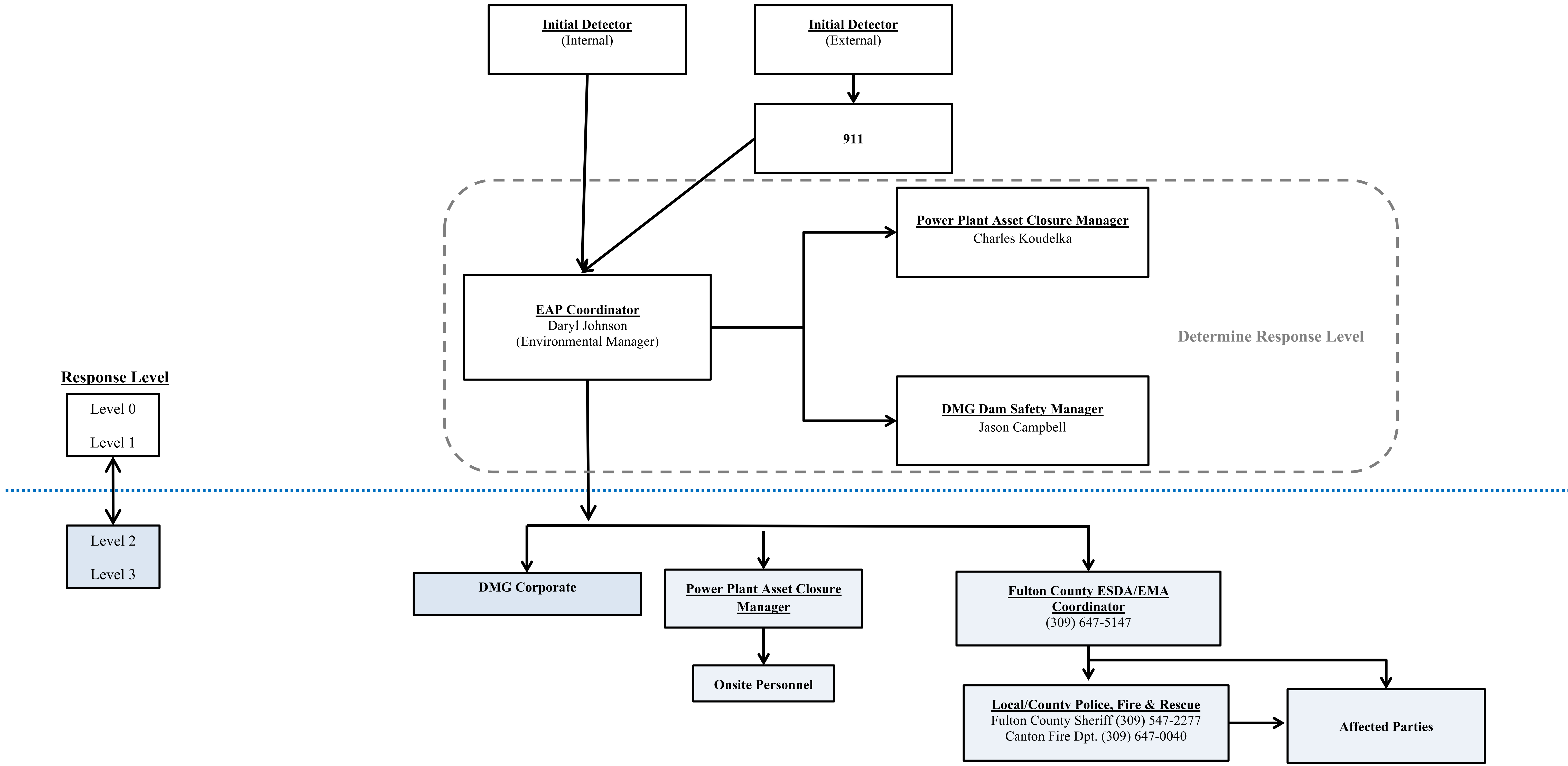

**Figure 2-3. EAP Response Process Decision Tree**

**Note:** At any given below, if failure is imminent or actively occurring **CALL 911 IMMEDIATELY** to notify emergency responders and then continue with process afterwards.

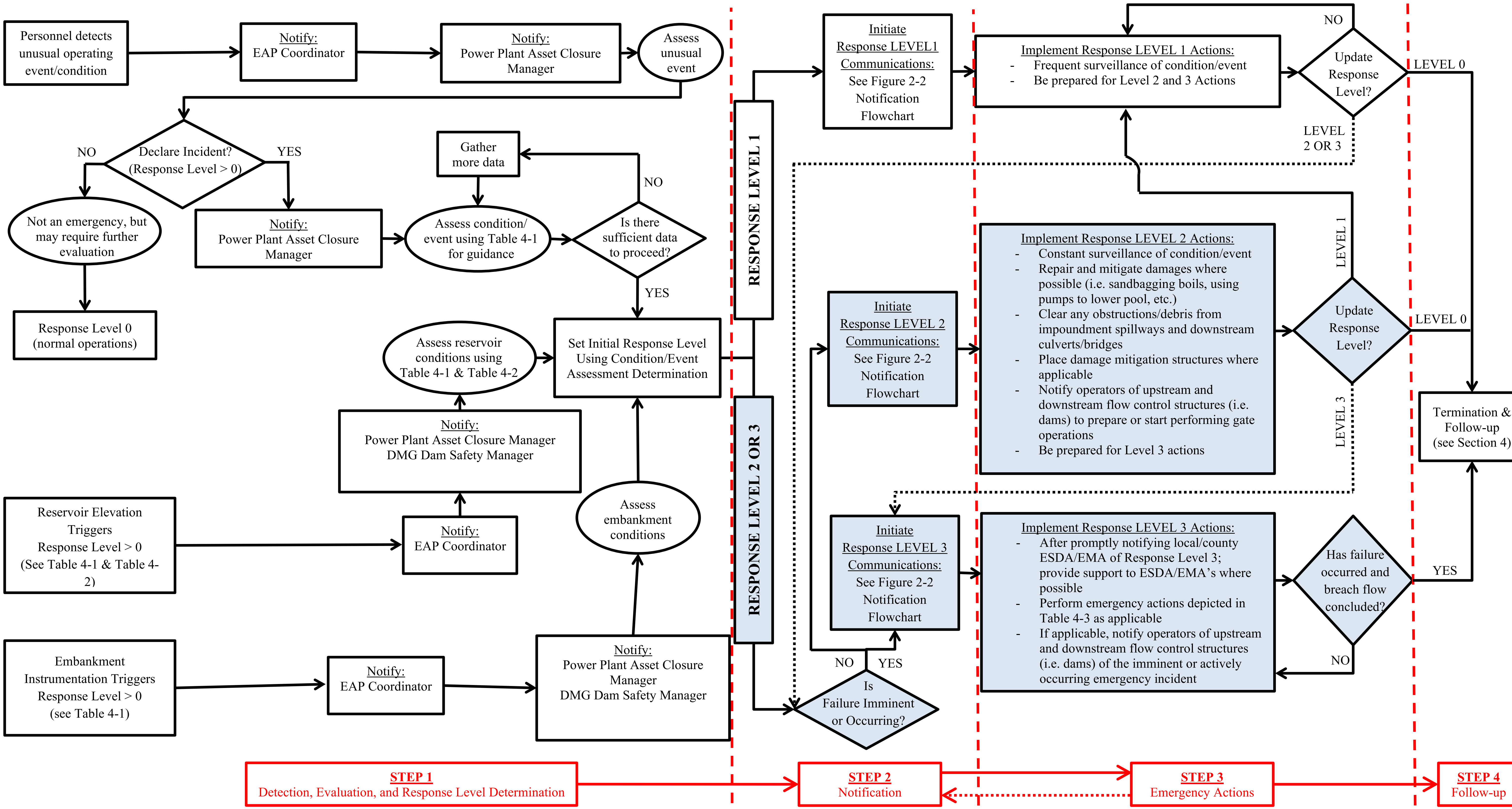

**Table 2-1. EAP Emergency Responders**

| Position / Entity | Contact Information | |
|---|---|---|
| **Internal Contacts** | | |
| **Duck Creek Power Plant** | **Contact** | |
| Asset Closure Manager | (903) 577-5207 | |
| EAP Coordinator (Environmental Manager) | (309) 668-3816 | |
| **DMG Corporate Operations** | | |
| Dam Safety Manager | (618) 792-8488 | |
| **External Contacts** | | |
| **Local/County ESDA/EMA, Police, & Fire** | **Phone #** | **Alternate Phone #** |
| Fulton County Sheriff | (309) 547-2277 | 911 |
| Fulton County ESDA/EMA | (309) 224-7701 | |
| City of Canton Police Department | (309) 647-5131 | |
| City of Canton Fire Department | (309) 647-0040 | |
| Fulton County Ambulance | (309) 647-5147 | |
| **State Emergency Management Agencies & Organizations** | **Phone #** | **Alternate Phone #** |
| IDNR-OWR Dam Safety Section Manager | (217) 782-4427 | |
| Rice Lake State Fish & Wildlife Area | (309) 647-9184 | (309) 338-0496 |
| Illinois Conservation Police | (309) 338-1017 | |
| Illinois State Police | (309) 833-4046 | |

# 3 EAP ROLES AND RESPONSIBILITIES

Table 3-1 provides a summary of the EAP roles during an emergency event.

**Table 3-1. Summary of EAP Roles**

| Entity | Role Description |
|---|---|
| **DMG Emergency Response Team (ERT)** | **ERT:** DMG personnel responsible for EAP implementation, distribution, updates/maintenance, and training activities. The *ERT* is comprised of the following roles;<br>1. **DMG Corporate:** DMG corporate entity, committee, team, or position with relevant responsibility for a given generating power plant.<br>2. **Power Plant Management:** Personnel responsible for day-to-day operation and management of the Power Plant.<br>3. **Dam Safety Manager:** Personnel that is most knowledgeable about the design and technical operation of facilities at a given power plant.<br>4. **EAP Coordinator:** Personnel responsible for implementing the EAP and associated activities.<br>**Emergency Event – EAP Responsibilities**<br>1. Respond to emergencies at the Power Plant.<br>2. Verify and assess emergency conditions.<br>3. Notify and coordinate as appropriate with participating emergency services disaster agencies or emergency management agencies (ESDA/EMA's), emergency responders, regulatory agencies, and all other entities involved or affected by this EAP.<br>4. Take corrective action at the Power Plant.<br>5. Declare termination of emergencies at the Power Plant. |
| **Fulton County ESDA/EMA** | 1. Receive Response Level reports from *DMG Corporate* through *EAP Coordinator*.<br>2. Coordinate emergency response activities with local authorities: police, fire and rescue, etc.<br>3. Coordinate notification of public as necessary through established channels, which may include door-to-door contact.<br>4. Coordinate notification activities to affected parties within inundation areas.<br>5. Evaluate risk to areas beyond the inundation areas, communicate needs to the *DMG Corporate* and/or *EAP Coordinator*, and coordinate aid as appropriate.<br>6. Responsible for declaring termination of an emergency condition off-site upon receiving notification of an emergency status termination from the *DMG Corporate*.<br>7. If necessary, coordinate with *State ESDA/EMA*. |
| **Canton Police, Fire, and Rescue** | 1. Receive alert status reports from the *ERT* or the Fulton County *ESDA/EMA*.<br>2. If necessary, notify affected parties and general public within inundation areas (see Section 7).<br>3. Render assistance to Fulton County *ESDA/EMA*, as necessary.<br>4. Render assistance to *DMG Corporate* and *Power Plant Management*, as necessary. |
| **Fulton County Police, Fire and Rescue, and Emergency Services** | 1. Receive alert status reports from the *ERT* or the Fulton County *ESDA/EMA*.<br>2. If necessary, notify affected parties within the inundation area.<br>3. Provide mutual aid to other affected areas, if requested and able. |

# 4 EAP RESPONSE

The 4-Step Incident Response Process is shown in Figure 2-1. The Decision Tree shown in Figure 2-3 provides a flowchart for the various elements of the response process. Upon reaching Step 4 of the response process (termination and follow-up), the EAP Coordinator is responsible for notifying the ESDA/EMA's that the condition of the dam/impoundment has been stabilized. The purpose of this section is to provide specific information that can be used during a response. This information is provided in the following tables:

- Table 4-1 provides guidance for determining the response level.
- Table 4-2 provides impoundment pool level trigger elevations.
- Table 4-3 lists emergency actions to be taken depending on the situation.

**Table 4-1. Guidance for Determining the Response Level**

| Event | Situation | Response Level |
|---|---|---|
| Spillway flow (See Table 4-2 for relevant elevations) | Primary spillway flow is not causing active erosion and impoundment water surface elevation is below auxiliary spillway crest elevation (if equipped). | Level 0 |
| | Impoundment water surface elevation is at or above auxiliary spillway crest elevation (if equipped). No active erosion caused by spillway flow. | Level 1 |
| | Spillway flow actively causing minor erosion that is not threatening the control section or dam/impoundment stability. | Level 2 |
| | Spillway flow that could result in flooding of people downstream if the reservoir level continues to rise. | Level 2 |
| | Abnormal operation of the spillway system due to blockage or damage that could lead to flooding. | Level 2 |
| | Spillway flow actively eroding the soil around the spillway that is threatening the control section (e.g. undermining) or dam/impoundment stability. | Level 3 |
| | Spillway flow that is flooding people downstream. | Level 3 |
| Embankment Overtopping (See Table 4-2 for relevant elevations) | Impoundment water surface elevation at or below typical normal pool fluctuation elevation. | Level 0 |
| | Impoundment water surface elevation above typical high pool fluctuation elevation. | Level 1 |
| | Impoundment water surface elevation within 2 feet of the embankment crest elevation | Level 2 |
| | Impoundment water surface elevation at or above embankment crest elevation. | Level 3 |
| Seepage | New seepage areas in or near the dam/impoundment with clear flow. | Level 1 |
| | New seepage areas with cloudy discharge or increasing flow rate. | Level 2 |
| | Heavy seepage with active erosion, muddy flow, and/or sand boils. | Level 3 |
| Sinkholes | Observation of new sinkhole in impoundment area or on embankment. | Level 2 |
| | Rapidly enlarging sinkhole and/or whirlpool in the impoundment. | Level 3 |
| Embankment cracking | New cracks in the embankment greater than ¼ inch wide without seepage. | Level 1 |
| | Any crack in the embankment with seepage. | Level 2 |
| | Enlarging cracks with muddy seepage. | Level 3 |

**Table 4-1. Guidance for Determining the Response Level**

| Event | Situation | Response Level |
|---|---|---|
| Embankment movement | Visual signs of movement/slippage of the embankment slope. | Level 1 |
| | Detectable active movement/slippage of the embankment slope or other related effects (tension cracking, bulges/heaves, etc.) that could threaten the integrity of the embankment. | Level 2 |
| | Sudden or rapidly proceeding slides of the embankment slopes. | Level 3 |
| Embankment Monitoring Equipment (piezometers, inclinometers, surface displacement mounts, etc.) | Instrumentation readings beyond historic normal. | Level 1 |
| | Instrumentation readings indicate the embankment is susceptible to failure. | Level 2 |
| | Instrumentation readings indicate embankment is at threshold of failure or is currently failing. | Level 3 |
| Earthquake or other event | Measurable earthquake felt or reported on or within 100 miles of the impoundment. | Level 1 |
| | Earthquake or other event resulting in visible damage to the impoundment or appurtenances. | Level 2 |
| | Earthquake or other event resulting in uncontrolled release of water or materials from the impoundment. | Level 3 |
| Security threat | Verified bomb threat or other physical threat that, if carried out, could result in damage to the impoundment. | Level 2 |
| | Detonated bomb or other physical damage that has resulted in damage to the impoundment or appurtenances. | Level 3 |
| Sabotage/ vandalism | Damage to impoundment or appurtenance with no impact to the functioning of the impoundment. | Level 1 |
| | Modification to the impoundment or appurtenances that could adversely impact the functioning of the impoundment. This would include unauthorized operation of spillway facilities. | Level 2 |
| | Damage to impoundment or appurtenances that has resulted in seepage flow. | Level 2 |
| | Damage to impoundment or appurtenances that has resulted in uncontrolled water release. | Level 3 |

**Table 4-2. Impoundment Trigger Elevations**

| Impoundment | Embankment Crest Elevation | Auxiliary Spillway Crest Elevation | Normal Pool Fluctuation | |
|---|---|---|---|---|
| | | | Typical | High |
| Ash Pond No. 1 | 625 ft. | N/A | N/A | N/A |
| Ash Pond No. 2 | 640 ft. | N/A | N/A | N/A |
| Bottom Ash Basin | | | | |
| GMF Pond | 620 ft. | Not Applicable | 616 ft. | 618 ft. |

Notes:
*Elevation estimated from Digital Elevation Model (DEM) developed by the Illinois State Geological Survey.

**Table 4-3. Step 3: Emergency Actions**

| Condition | Description of Condition | Action to be Taken |
|---|---|---|
| High Water Level/ Large Spillway Release | Not applicable to capped impoundments. See Table 4-1 and Table 4-2 for elevations and triggering water levels associated with the impoundments and spillways covered by this EAP. | 1. Assess cause of increased reservoir stage, especially during fair weather conditions.<br>2. Determine Response Level.<br>3. Make proper notifications as outlined in the Figure 2-2 Notification Flowchart.<br>4. Perform additional tasks as determined through consultation with the ERT.<br>5. Make notifications if condition worsens such that downstream flooding is imminent.<br>**Response Level 0**: require enhanced surveillance 3 times per day<br>**Response Level 1**: contact internal chain of command and external response partners as necessary; inspect impoundment minimum 1 time per hour<br>**Response Level 2**: contact internal chain of command; notify ESDA/EMA's and notify external response partners. ESDA/EMA's notify affected parties.<br>**Response Level 3**: contact internal chain of command; notify ESDA/EMA's and notify external response partners. ESDA/EMA's notify affected parties of emergency incident. |
| Seepage | Localized new seepage or boil(s) observed along downstream face / toe of earthen embankment with muddy discharge and increasing but controllable discharge of water. | 1. Measure and record feature dimensions, approximate flow rate, and relative location to existing surface features. Take photos. Document location on a site plan and in inspection notes.<br>2. Determine Response Level.<br>3. Make proper notifications as outlined in the Figure 2-2 Notification Flowchart.<br>4. ERT (with Dam Safety Manager as lead) to determine mitigation actions. The following actions may apply:<br>a) Place a ring of sand bags with a weir at the top towards the natural drainage path to monitor flow rate. If boil becomes too large to sand bag, place a blanket filter over the area using non-woven filter fabric and pea gravel. Attempt to contain flow in such a manner (without performing any excavations) that flow rates can be measured. Stockpile gravel and sand fill for later use, if necessary. |

**Table 4-3. Step 3: Emergency Actions**

| Condition | Description of Condition | Action to be Taken |
|---|---|---|
| | | b) Inspect the embankment and collect piezometer, water level and seepage flow data daily unless otherwise instructed by the Dam Safety Manager. Record any changes of conditions. Carefully observe embankment for signs of depressions, seepage, sinkholes, cracking or movement.<br>c) Maintain continuous monitoring of feature. Record measured flow rate and any changes of condition, including presence or absence of muddy discharge.<br>5. Make notifications as outlined in the lower portion of the Notification Flowchart (Figure 2-2) if condition worsens such that failure is imminent. |
| Sabotage and Miscellaneous Other Issues | Criminal action with significant damage to embankment or structures where significant repairs are required and the integrity of the facility is compromised—condition appears stable with time. | 1. Contact law enforcement authorities and restrict all access (except emergency responders) to impoundment. Restrict traffic on embankment crest to essential emergency operations only.<br>2. Determine Response Level.<br>3. Make internal notifications as outlined in the upper portion of the Notification Flowchart (Figure 2-2).<br>4. In conjunction with the Dam Safety Manager, assess extent of damage and visually inspect entire embankment and ancillary structures for additional less obvious damage. Based on inspection results, confirm if extent of damage to various components of the impoundment warrants a revised Response Level and additional notifications.<br>5. Perform additional tasks as directed by the ERT.<br>6. Make notifications if conditions worsen. |
| Embankment Deformation | **Cracks:**<br>New longitudinal (along the embankment) or transverse (across the embankment) cracks more than 6 inches deep or more than 3 inches wide or increasing with time. New concave cracks on or near the embankment crest associated with slope movement. | 1. Measure and record feature dimensions, approximate flow rate, and relative location to existing surface features. Take photos. Document location on a site plan and in inspection notes.<br>2. Restrict traffic on embankment crest to essential emergency operations only.<br>3. Determine Response Level.<br>4. Make notifications as outlined in the Figure 2-2 Notification Flowchart.<br>5. ERT (with Dam Safety Manager as lead) to determine mitigation actions. The following actions may apply:<br>a) Place buttress fill against base of slope immediately below surface feature. Stockpile additional fill.<br>b) Place sandbags as necessary around crack area to divert any storm water runoff from flowing into crack(s).<br>6. As directed by the Dam Safety Manager, additional inspection and monitoring of the dam may be required. Items may include; inspect the dam on a schedule determined by the Dam Safety Manager; collect piezometer and water level data; and record any changes of condition. Carefully observe dam for signs of depressions, seepage, sinkholes, cracking or movement.<br>7. Make notifications as outlined in the Figure 2-2 Notification Flowchart if conditions worsen such that failure is imminent. |
| | **Slides / Erosion:**<br>Deep slide / erosion (greater than 2 feet deep) on the embankment that may also extend beyond the | 1. Measure and record feature dimensions, approximate flow rate, and relative location to existing surface features. Take photos. Document location on a site plan and in inspection report.<br>2. Restrict traffic on embankment crest to essential emergency operations only.<br>3. Determine the Response Level. |

**Table 4-3. Step 3: Emergency Actions**

| Condition | Description of Condition | Action to be Taken |
|---|---|---|
| | embankment toe but does not encroach onto the embankment crest and appears stable with time. | 4. Make notifications as outlined in the Figure 2-2 Notification Flowchart.<br>5. ERT (with Dam Safety Manager as lead) to determine mitigation actions. Additional actions may include the following items.<br>a) Place sandbags as necessary around slide area to divert any storm water runoff from flowing into slide(s).<br>b) Increase inspections of the dam; collect piezometer and water level data; and record any changes of condition. During inspections, carefully observe dam for signs of depressions, seepage, sinkholes, cracking or movement.<br>6. Make notifications as outlined in the Figure 2-2 Notification Flowchart if conditions worsen such that failure is imminent. |
| | **Sinkholes:** Small depression observed on the embankment or within 50 feet of the embankment toe that is less than 5 feet deep and 30 feet wide or which is increasing with time. | 1. Slowly open drain gates to lower pool elevation.<br>2. Measure and record feature dimensions, approximate flow rate, and relative location to existing surface features. Take photos. Document location on a site plan and in inspection notes.<br>3. Restrict traffic on embankment crest to essential emergency operations only.<br>4. Determine Response Level.<br>5. Make notifications as outlined in the Figure 2-2 Notification Flowchart.<br>6. ERT (with Dam Safety Manager as lead) to determine mitigation actions. Additional actions may include the following items:<br>a) Backfill the depression with relatively clean earth fill (free of organic materials) generally even with surrounding grade and slightly mounded (6 to 12 inches higher) in the center to shed storm water away from the depression. Stockpile additional fill.<br>b) Increase inspections of the dam; collect piezometer and water level data daily unless otherwise instructed by Dam Safety Manager; and record any changes of condition. Carefully observe dam for signs of depressions, seepage, sinkholes, cracking or movement.<br>7. Make notifications as outlined in the Figure 2-2 Notification Flowchart if conditions worsen such that failure is imminent. |
| Gate Malfunction or Failure | Sluice gate damaged structurally (sabotage, debris, etc.) with uncontrolled release of water at a constant volume. Condition appears stable. | 1. Close any other gates, if open.<br>2. Determine Response Level.<br>3. Make notifications as outlined in the Figure 2-2 Notification Flowchart.<br>4. Obtain instructions from the Dam Safety Manager to determine if there are other methods to stop or slow down the flow of water.<br>5. If conditions worsen such that failure is imminent, make notifications as outlined in the lower portion of the Figure 2-2 Notification Flowchart. |

## 5 PREPAREDNESS

The intent of this section is to provide information that will be utilized during a response. Established emergency supplies and locations, suppliers, and equipment are provided in Table 5-1. Supplier contact information is listed in Table 5-2.

A coordination meeting shall be conducted annually between representatives of the Illinois Power Resources Generating, LLC and local emergency responders. This meeting may be in the form of a face-to-face meeting, tabletop exercise, or additional training regarding the EAP.

**Table 5-1. Emergency Supplies and Equipment**

| Item | On-site (Yes/No/Occasionally) | Remarks |
|---|---|---|
| Flashlights | Yes | Typically, at Duck Creek Power Plant Maintenance Facility: contact Asset Closure Manager for location(s). |
| Generator | | |
| Extension Cords | | |
| Fire extinguishers | | |
| Floodlights | | |
| Backhoe | Yes | John Deere 301 Backhoe/Loader and Caterpillar 426C Backhoe/Loader; contact Asset Closure Manager for location(s). |
| Dozer | Yes | Caterpillar D9R Dozer and Caterpillar D10R Dozer; contact Asset Closure Manager for location(s). |
| Large Equipment (Rental – including excavating equipment, pumps, lighting) | Yes | Two Caterpillar 834 Rubber Tired Bucket Loader, Fiatt Road Grader, two farm tractors with end loaders, and a Caterpillar Skid Steer with end loaders are also available; contact Asset Closure Manager for location(s). Contact Altorfer, Inc., Bolon's Repair, MH Equipment, or Sunbelt Rentals for additional large equipment (see Table 5-2). |
| Dump Truck | No | Contact Captain Hook Roll-Off Boxes or Done Rite Construction Co. Inc. for additional dump trucks (see Table 5-2). |
| Pump and Hoses | No | Contact Bolon's Repair or Pratt Lumber Do It Center for additional pumps and hoses (see Table 5-2). |
| Sandbags and Sand | No | Contact Duck Creek Sand and Gravel, Davis Sand and Gravel, or Pratt Lumber Do It Center for additional sandbags and sand (see Table 5-2). |
| Fill (Stone, aggregate, sand) | No | Contact Duck Creek Sand and Gravel, Davis Sand and Gravel, or Pratt Lumber Do It Center for additional fill (see Table 5-2). |
| Concrete/grout | No | Contact Canton Redi-Mix for additional batch plant concrete or Pratt Lumber Do It Center for additional bagged concrete (see Table 5-2). |
| Geotextile Filter Fabric | Yes | Two rolls of 10-ounce, non-woven filter fabric are available on site; contact Asset Closure Manager for location(s). |
| Plastic Sheeting | No | Contact Pratt Lumber Do It Center for additional plastic sheeting (see Table 5-2). |
| Rope | No | Contact Alexander Lumber, Bolon's Repair, and Pratt Lumber Do It Center for additional rope (see Table 5-2). |
| Personal Flotation Devices | Yes | Typically, at Duck Creek Power Plant Maintenance Facility, contact Asset Closure Manager for location(s). |

**Table 5-2. Supplier Addresses**

| Supply/Rental Item(s) | Supplier Contact Information | Distance from Site (miles) | Address |
|---|---|---|---|
| Rope | **Alexander Lumber Co**.<br>(309) 647-0396 | 8.4 | 406 South 5th Ave<br>Canton, IL 61520 |
| Large Equipment | **Altorfer, Inc.**<br>(309) 697-1234 | 33.5 | 6315 West Fauber Road<br>Bartonville, IL 61607 |
| Large Equipment, Pump and Hoses, Rope | **Bolon's Repair**<br>(309) 647-2203 | 10.5 | 999 West Locust<br>Canton, IL 61520 |
| Concrete/grout | **Canton Redi-Mix**<br>(309) 668-2261 | 13.1 | 22381 IL-78<br>Canton, IL 61520 |
| Dump Truck | **Captain Hook Roll-Off Boxes**<br>(309) 565-7676 | 18.2 | 309 South Glasford Road<br>Glasford, IL 61533 |
| Sandbags and Sand | **Davis Sand and Gravel**<br>(309) 647-0019 | 10.7 | 1130 West Locust Street<br>Canton, IL 61520 |
| Dump Truck | **Done Rite Construction Co Inc**.<br>(309) 331-4983 | 55.6 | 10277 IL RT 101<br>Littleton, IL 61452 |
| Fill (Stone, aggregate, sand) | **Duck Creek Sand and Gravel**<br>(309) 668-2278 | 5.5 | 17505 North Duck Island Road<br>Canton, IL 61520 |
| Large Equipment | **MH Equipment**<br>(309) 699-4024 | 38.4 | 111 Carver Lane<br>East Peoria, IL 61611 |
| Concrete/grout, Pump and Hoses, Sandbags and Sand, Fill (Stone, aggregate, sand), Plastic Sheeting, Rope | **Pratt Lumber Do It Center**<br>(309) 547-3587 | 13.4 | 311 East Avenue E<br>Lewistown, IL 61542 |
| Large Equipment | **Sunbelt Rentals**<br>(309) 694-6201 | 39.7 | 1601 North Main Street<br>East Peoria, IL 61611 |

# 6 FACILITY/IMPOUNDMENT DESCRIPTION

The impoundments included in this EAP are described as follows and illustrated in Figure 1-2. Table 6-1 contains additional geometric details for each impoundment.

The Duck Creek Power Plant is a retired plant located in Canton, Illinois, roughly 50 miles west of Bloomington, Illinois east of IL-78 and west of US-24.

Ash Pond No. 1 is a diked impoundment that was commissioned in 1976. The main inflow into Ash Pond No. 1 was precipitation, which accumulated and transported through channels around the inside perimeter of the pond, reaching two small internal impoundments. It has a maximum embankment height of 28 feet, a crest elevation of 625 feet above Mean Sea Level (MSL), and a crest width of 20 feet. The total length of the embankment is approximately 6,500 feet. The storage capacity of the pond is approximately 1,300 acre-feet at normal pool elevation. Approximately three-fourths of Ash Pond No. 1 is stacked ash, located on the southern side. Free water volume accounts for approximately one-fourth of the pond and is located on the northern end.

Ash Pond No. 2 is a diked impoundment that was commissioned in 1986. The main inflows into Ash Pond No. 2 are precipitation and stormwater pumped from Ash Pond No. 1. The diked fly ash is constructed in a serpentine channel to direct process water and allow for additional time to filter suspended solids before entering the main pond. The outlet structure is in the northeast corner of the pond and transports water into the Recycle Pond, along with a seepage blanket and pump. It has a maximum embankment height of 30 feet, a crest elevation of 640 feet above MSL, and a crest width of 20 feet. The total length of the embankment is approximately 9,000 feet. The storage capacity of the pond is approximately 1,000 acre-feet at normal pool elevation.

The GMF Pond is located directly north of the GMF Recycle Pond, east of North Bethel Cemetery Road. The pond encompasses approximately 30 acres and is graded to the south, where water discharges into a channel to flow into the GMF Recycle Pond. From the GMF Recycle Pond, water exits through piping into the Duck Creek Cooling Pond.

**Table 6-1. Power Plant Impoundment Characteristics**

| Feature/Parameter | Ash Pond No. 1 | Ash Pond No. 2 | Bottom Ash Basin | GMF Pond |
|---|---|---|---|---|
| Maximum Embankment Height | 28 feet* | 30 feet* | | 11 feet |
| Length of Dam | 6,500 feet* | 9,000 feet* | | 4,560 feet |
| Crest Width | N/A | N/A | | 30 feet |
| Crest Elevation | ±625 feet | ±640 feet* | | ±620 feet |
| Reservoir Area at Top of Dam | N/A | N/A | | 31.6 acres |
| Storage Capacity at Top of Dam | N/A | N/A | | Unknown |
| Primary Spillway Type | Stormwater let-down structures are now the spillways | Stormwater let-down structures are now the spillways | | Lined open channel |
| Primary Spillway Crest Elevation | None | None | | 615 feet |
| Storage Capacity at Primary Spillway Elevation | None | None | | None |
| Reservoir Area at Normal Water Surface Elevation | N/A | N/A | | 31 acres |
| Auxiliary Spillway Type | None | None | | None |
| Auxiliary Spillway Crest Elevation | None | None | | None |

Notes:
*Source: "COAL ASH IMPOUNDMENT SITE ASSESSMENT FINAL REPORT", May 10, 2011. Elevations are in reference to original construction drawings by Commonwealth Associates, Inc.
All remaining values are GIS estimated.

# 7 BREACH INUNDATION MAPS AND POTENTIAL IMPACTS

Inundation maps for Ash Pond No. 1, Ash Pond No. 2, Bottom Ash Basin, and the GMF Pond potential breach scenarios are provided in this section. It is the Fulton County ESDA/EMA's responsibility to keep a current list of affected parties/properties to contact in the case of emergencies that result in Response Level 2 or 3. This list should encompass all properties within and adjacent to the probable inundation extents shown in the provided maps.

The methodology used to identify probable inundation extents for potential breach scenarios varied as a function of the impoundment size, location, surrounding topography, and surrounding structures/facilities/waterbodies.

Ash Pond No. 1, Ash Pond No. 2, Bottom Ash Basin, and the GMF Pond inundation maps were developed from visual assessments. Topographic data and basemap imagery were used to identify the mapped inundation areas.

Three failure scenarios were identified at Ash Pond No. 1 and Ash Pond No. 2. At both impoundments, the breach would be contained in either the Duck Creek Cooling Pond or the unnamed body of water west of N. Cilco Road. The Bottom Ash Basin is incised and no failure scenarios were identified. Four failure scenarios were identified at the GMF Pond. Only Duck Creek Power Plant owned structures were identified in the potential breach paths, with a breach contained in the Duck Creek Cooling Pond. The land between the impoundments and the Duck Creek Cooling Pond and unnamed body of water west of N. Cilco Road would also be inundated during a breach.

Approximate inundation areas are illustrated on Figure 7-1, Figure 7-2, Figure 7-3, and Figure 7-4.



**Legend**

Disposal Area Approximate Limits

Approximate Anticipated Inundation Extents

0 1,500 3,000 Feet

1:18,000 (At original document size of 11x17)

Project Location
Latitude: 40.466181
Longitude: -89.984236
Fulton County, Illinois

175605019
Prepared by CAJ on 2017-03-06
Technical Review by MAT on 2017-03-10

Client/Project
Duck Creek Power Station
Emergency Action Plan

Figure No.
**7-1**

Title
**Inundation Map**
**Ash Pond No. 1**

**Notes**
1. Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
2. Aerial Source: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO,
3. USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User



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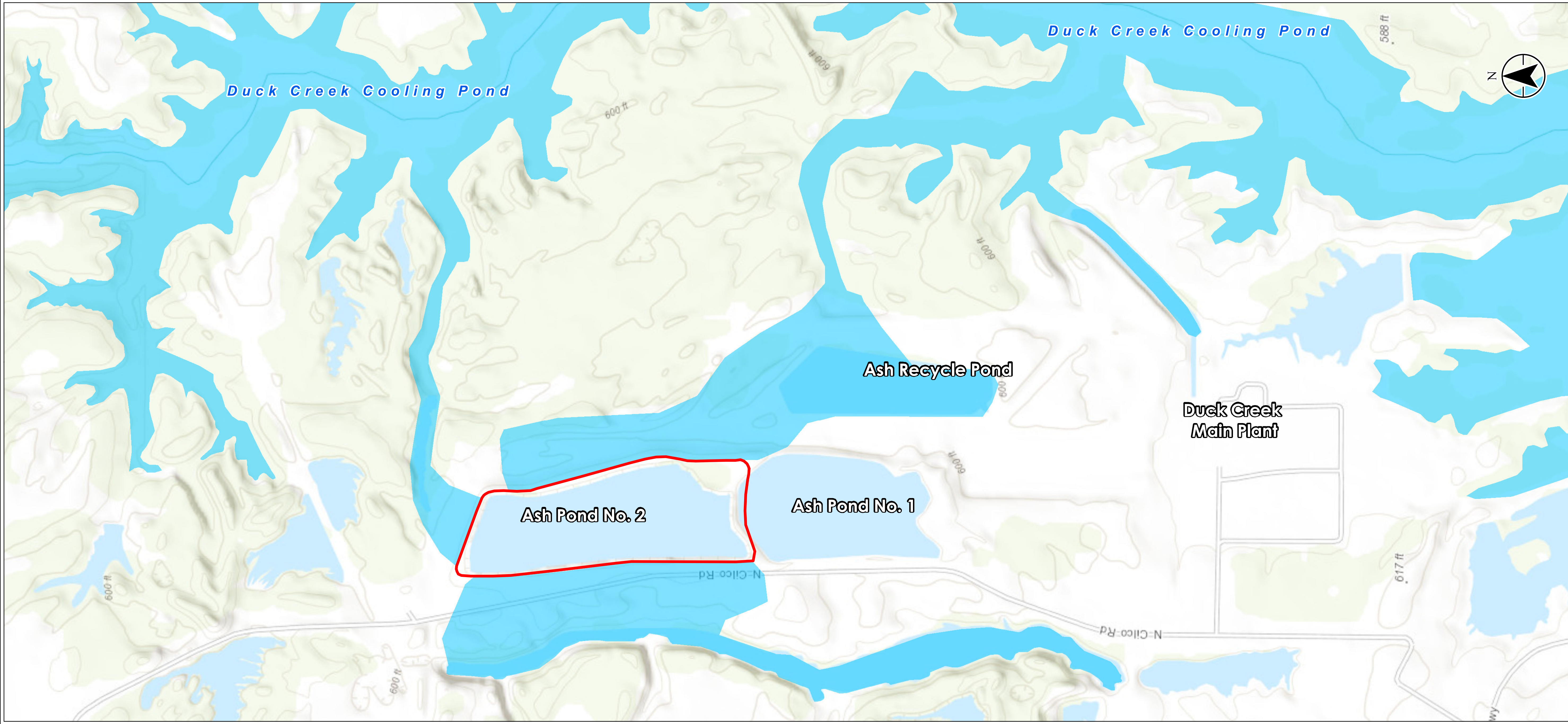



**Legend**

Disposal Area Approximate Limits

Approximate Anticipated Inundation Extents

0 1,500 3,000 Feet

1:18,000 (At original document size of 11x17)

Stantec DYNEGY

Project Location
Latitude: 40.466181
Longitude: -89.984236
Fulton County, Illinois

175605019
Prepared by CAJ on 2017-03-06
Technical Review by MAT on 2017-03-10

Client/Project
Duck Creek Power Station
Emergency Action Plan

Figure No.
**7-2**

Title
**Inundation Map**
**Ash Pond No. 2**

**Notes**
1. Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
2. Aerial Source: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO,
3. USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User

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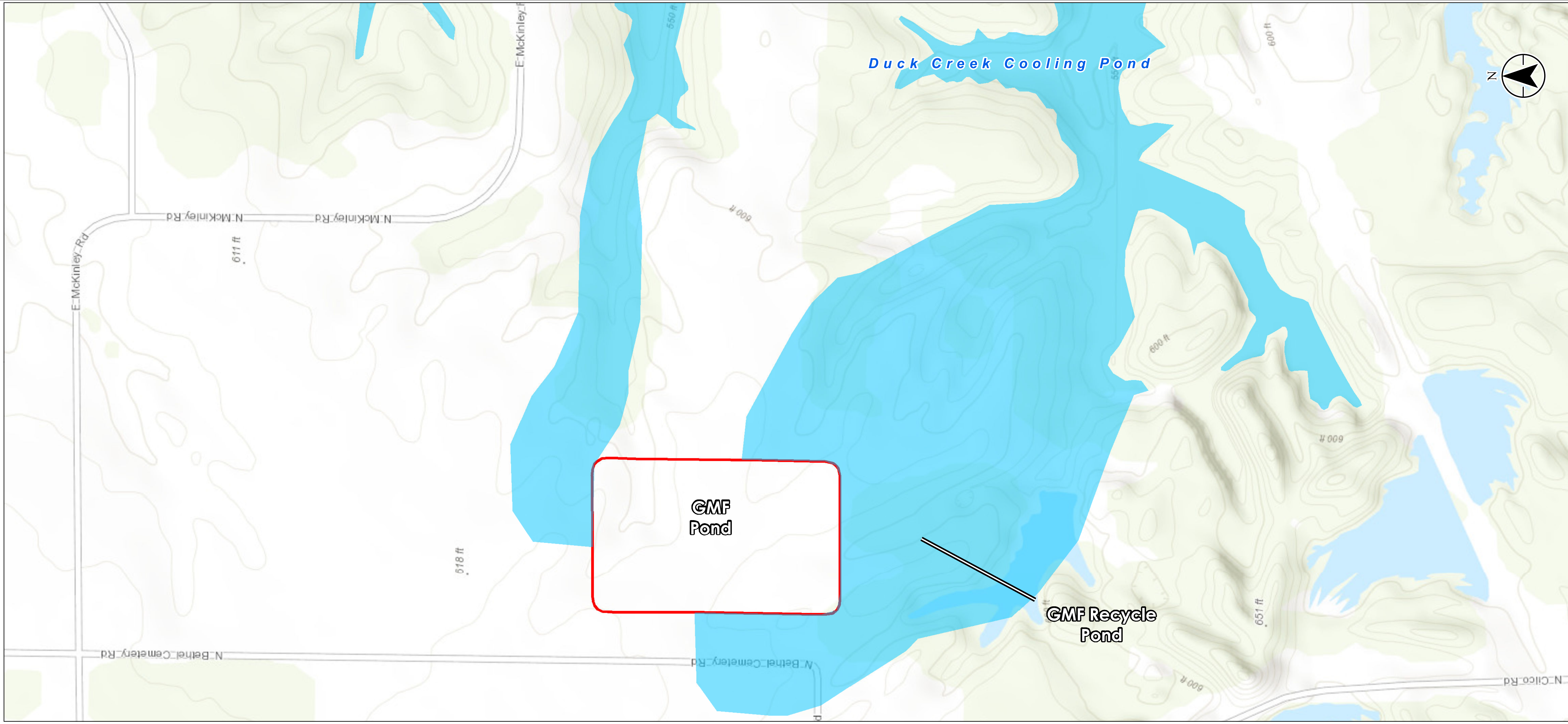



**Legend**

- Disposal Area Approximate Limits
- Approximate Anticipated Inundation Extents

0 800 1,600 Feet

1:9,600 (At original document size of 11x17)

Stantec DYNEGY

Project Location
Latitude: 40.466181
Longitude: -89.984236
Fulton County, Illinois

175605019
Prepared by CAJ on 2017-03-06
Technical Review by MAT on 2017-03-10
Independent Review by MC on 2017-03-14

Client/Project
Duck Creek Power Station
Emergency Action Plan

Figure No.
**7-3**

Title
**Inundation Map**
**GMF Pond**

**Notes**
1. Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
2. Aerial Source: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO,
3. USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User



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# ATTACHMENT G

# CCR Fugitive Dust Control Plan

# for

# Duck Creek Power Plant

***Prepared for:***

**Illinois Power Resources Generating, LLC**

**Duck Creek Power Plant**
**17751 North Cilco Road**
**Canton, IL 61520**

***Prepared by:***

**Burns & McDonnell**
**Kansas City, Missouri**

Amendment 1

October 2021

# Table of Contents



# List of Tables

# 1 Introduction

This Coal Combustion Residuals (CCR) fugitive dust control plan has been prepared for the Duck Creek Power Plant, located in Fulton County, Illinois. This plan addresses the air criteria in 40 C.F.R. § 257.80 of the United States Environmental Protection Agency's CCR rule, which requires the owner or operator of a CCR unit to "adopt measures that will effectively minimize CCR from becoming airborne at the facility" and to "prepare and operate in accordance with a CCR fugitive dust control plan." The plan also addresses the air criteria in 35 I.A.C. 845.500 of the Illinois Environmental Protection Agency's CCR rule, which contains similar requirements to the federal CCR rule.

## 1.1 Facility Information

- Facility Name: Duck Creek Power Plant (Retired)
- Facility Address: 17751 North Cilco Road, Canton, IL 61520
- Owner/Operator: Illinois Power Resources Generating, LLC

## 1.2 Certification

The owner or operator must obtain a certification from a qualified professional engineer that the initial CCR fugitive dust control plan, or any subsequent amendment of it, meets the requirements of 40 C.F.R. § 257.80 and 35 I.A.C. 845.500. See 40 C.F.R. §257.80(b)(7); 35 I.A.C. 845.500(b)(7).

I certify under penalty of law that, to the best of my knowledge, this plan meets the requirements of 40 C.F.R. § 257.80 and 35 I.A.C. 845.500. This certification is based on my review of the document and conditions at the site and on my inquiry of the person or persons who managed the preparation of this document.

John R. Hesemann
Printed Name of Qualified Professional Engineer

9/09/2021
Signature of Qualified Professional Engineer and Date

062.058523 – Illinois – Expires 11/30/2021
Registration Number and State

JOHN ROBERT HESEMANN
062-058523
LICENSED PROFESSIONAL ENGINEER OF
ILLINOIS

# 2 CCR Fugitive Dust Control Measures and Appropriateness

CCR fugitive dust has the potential to become airborne at the facility during periods of CCR management in the CCR units, CCR handling and CCR transport. Areas at the facility that have the potential for airborne CCR fugitive dust are CCR surface impoundments, a CCR landfill, CCR handling equipment and CCR transport in trucks. This section identifies and describes the control measures selected and adopted by the facility to minimize CCR from becoming airborne at the facility and explains how the selected measures are applicable and appropriate for site conditions. The control measures may be adjusted or modified based on observed effectiveness of minimizing CCR from becoming airborne and weather conditions.

## 2.1 Management of CCR in the CCR Units

The facility manages CCR in surface impoundments and a landfill located at the facility. Table 2-1 below identifies CCR fugitive dust control measures that have been selected for use by the facility during CCR management in the CCR units, including placement of CCR into the CCR units, and explains how the selected measures are applicable and appropriate for site conditions. The facility will use the identified measures during CCR management in the CCR units to minimize CCR from becoming airborne at the facility.

| CCR Activity | CCR Fugitive Dust Control Measure | Applicability and Appropriateness of Control Measure |
|---|---|---|
| Management of CCR in the facility's CCR units | Condition CCR to be emplaced in the landfill before emplacement. | Conditioning CCR to be placed in the landfill allows CCR to bind together and thus minimizes the potential for CCR fugitive dust generation when CCR is managed in the landfill. The added moisture content will prevent wind dispersal of the CCR but will not result in free liquids. |
| | Cover exposed dry CCR in the landfill. | Applying approved cover material, such as conditioned fly ash, minimizes wind entrainment of CCR. |
| | Wet management of CCR bottom ash and flue gas desulfurization materials in CCR surface impoundments. | Wet management of CCR minimizes the potential for CCR fugitive dust generation. |
| | Water areas of exposed CCR in CCR units, as necessary. | Water will be applied to areas of exposed CCR to maintain moisture content to minimize the potential for CCR fugitive dust generation in excessively dry or windy conditions. Wetting activities will not generate "free liquids" within the landfill. |
| | Naturally occurring grass vegetation in areas of exposed CCR in CCR surface impoundments. | Vegetation provides a wind screen and/or cover and reduces wind entrainment of CCR. |
| | Apply chemical dust suppressant on areas of exposed CCR in CCR units, as necessary. | Mixing an appropriate chemical dust suppressant with water and applying to areas of exposed CCR will minimize the potential for CCR fugitive dust generation in excessively dry or windy conditions. |
| | Reduce or halt operations during high wind events, as necessary. | Reducing or halting operations during high wind events minimizes the potential for CCR fugitive dust generation. |

**Table 2-1. Control Measures for CCR Management in CCR Units**

## 2.2 Handling of CCR

Bottom ash may be periodically removed from the CCR surface impoundments and remains sufficiently wet during and after handling activities, including dewatering, associated with transfer of the CCR. Table 2-2 below identifies CCR fugitive dust control measures that have been selected for use by the facility during handling of CCR and explains how the selected measures are applicable and appropriate for site conditions. The facility will use the identified measures when handling CCR to minimize CCR from becoming airborne at the facility.

| CCR Activity | CCR Fugitive Dust Control Measure | Applicability and Appropriateness of Control Measure |
|---|---|---|
| Handling of CCR at the facility | CCR bottom ash removed from CCR surface impoundments and loaded into trucks for transport remains conditioned during handling. | Conditioned CCR allows CCR to bind together and thus minimizes the potential for CCR fugitive dust generation when CCR is handled. |
| | CCR to be emplaced in the landfill is conditioned before emplacement. | Conditioning allows CCR to bind together and thus minimizes the potential for CCR fugitive dust generation. |
| | Condition CCR materials to be transported offsite before they are loaded into trucks, as necessary. | Conditioning allows CCR to bind together and thus minimizes the potential for CCR fugitive dust generation while loading CCR into trucks and during transport. |
| | Reduce or halt operations during high wind events, as necessary. | Reducing or halting operations during high wind events minimizes the potential for CCR fugitive dust generation. |

**Table 2-2. Control Measures for Handling CCR**

### 2.2.1 Conditioning of CCR Prior to Emplacement in CCR Landfill

Conditioned CCR is CCR that has been wetted with water or an appropriate chemical dust suppressant. Water or a chemical dust suppressant is added to raise the moisture content of the CCR to prevent wind dispersal but will not result in free liquids. Conditioning allows for the CCR to bind together, which minimizes the potential for CCR fugitive dust.

All CCR generated on site that is placed into the facility’s landfill, as well as CCR generated offsite that is authorized for placement in the facility’s landfill, is conditioned before emplacement. All CCR that is added to the facility’s landfill is emplaced in the landfill as conditioned CCR.

## 2.3 Transportation of CCR

CCR is transported via truck at the facility using a combination of paved and unpaved facility roads. Table 2-3 below identifies CCR fugitive dust control measures that have been selected for use by the facility during transport of CCR. The facility will use the identified measures when transporting CCR to minimize CCR from becoming airborne at the facility.

| CCR Activity | CCR Fugitive Dust Control Measure | Applicability and Appropriateness of Control Measure |
|---|---|---|
| Transportation of CCR at the facility | Condition CCR to be emplaced in the landfill before emplacement. | Conditioning CCR increases moisture content of the CCR and minimizes the potential for CCR fugitive dust generation during CCR transport (and emplacement in the landfill). |
| | Condition CCR materials to be transported offsite before they are loaded into trucks, as necessary. | Conditioning allows CCR to bind together and thus minimizes the potential for CCR fugitive dust generation while loading CCR into trucks and during transport. |
| | Cover or enclose trucks used to transport CCR fly ash. | Covering or enclosing trucks transporting CCR on facility roads minimizes the potential for CCR fugitive dust generation from the CCR transport trucks. |
| | Limit the speed of vehicles to no more than 15 mph on facility roads. | Limiting the speed of vehicles traveling on facility roads minimizes the potential for CCR fugitive dust generation from the CCR transport trucks. |
| | Cover or enclose trucks used to transport CCR other than fly ash, as necessary. | Covering or enclosing trucks transporting CCR on facility roads minimizes the potential for CCR fugitive dust generation from the CCR transport trucks. |
| | Sweep or rinse CCR off of the outside of the trucks transporting CCR, as necessary. | Removing CCR present on the outside of the truck minimizes the potential for movement of the truck or wind to cause CCR fugitive dust to become airborne. |
| | Remove CCR, as necessary, deposited on facility road surfaces during transport. | Removing CCR deposited on facility road surfaces as a result of transport minimizes the potential for CCR fugitive dust generation from vehicle traffic. |
| | Condition CCR haul roads with water or dust suppressant, as necessary. | Watering CCR haul roads minimizes the potential for dust generation to occur as a result of CCR hauling traffic and heavy equipment use. |
| | Reduce or halt operations during high wind events, as necessary. | Reducing or halting operations during high wind events minimizes the potential for CCR fugitive dust generation. |

**Table 2-3. Control Measures for Transportation of CCR**

# 3 Procedures for Periodic Assessment of Effectiveness of the Plan

The facility conducts inspections associated with CCR fugitive dust control. The facility also uses the procedures identified in section 5 of this plan to log every citizen complaint involving CCR fugitive dust events at the facility. These inspections and the investigations of citizen complaints will be used to periodically assess the effectiveness of the CCR fugitive dust control plan per 40 C.F.R. § 257.80(b)(4) and 35 I.A.C. 845.500(b)(3).

The facility routinely performs inspections to verify the effectiveness of the CCR fugitive dust control measures used at the facility. Inspections are conducted during daylight working hours and include observing for the presence of CCR fugitive dust emissions from vehicles transporting CCR on facility roads, CCR handling and CCR management activities, including CCR placement in CCR units. Inspection records include information such as the name of the person conducting the inspection, the date and time of the inspection, the results of the inspection, and any corrective action taken.

When a CCR fugitive dust event is observed or a citizen complaint involving a CCR fugitive dust event at the facility is received, current CCR management practices will be reviewed to see that the selected control measures are being properly implemented. If the control measures are not being properly implemented, relevant operating personnel will be notified and, as warranted, re-trained in the proper implementation of CCR fugitive dust control measures. If appropriate, use of revised and/or additional control measures will be evaluated. As warranted, revised and/or additional control measures found to be applicable and appropriate to control CCR fugitive dust emissions will be incorporated into an amended CCR fugitive dust control plan.

The plan also will be reassessed in the event of material changes in site conditions potentially resulting in CCR fugitive dust becoming airborne at the facility.

# 4 Recordkeeping, Notification, Internet Site

The written CCR fugitive dust control plan, any amendment of the written plan, and the annual CCR fugitive dust control report required by 40 C.F.R. § 257.80(c) and 35 I.A.C. 845.500(c) will be placed in the facility's written operating record and posted to the company's CCR website in accordance with 40 C.F.R. § 257.105(g), § 257.107(g), and 845.800(d)(7), (14), and 845.810(e). Notification of the availability of the CCR fugitive dust control plan, any amendment of the plan, and the annual CCR fugitive dust control report will be provided to IEPA in accordance with 40 C.F.R. § 257.106(g). Any amendment of the fugitive dust control plan will be submitted to IEPA in accordance with 845.500(b)(5).

Additionally, pursuant to 845.500(b)(6), this fugitive dust control plan is being placed in facility's operating record and posted to the company's CCR website prior to the submission of any permits for the Duck Creek Power Plant.

# 5 Procedures to Log Citizen Complaints

In the event the owner or operator of the facility receives a citizen complaint involving a CCR fugitive dust event at the facility, relevant information about the complaint will be logged. Information that will be recorded includes, as applicable:

- Date/Time the complaint is received
- Date/Time and duration of the CCR fugitive dust event
- Description of the nature of the CCR fugitive dust event
- Name of the citizen entering the complaint
- Address & phone number of citizen entering the complaint
- Name of the personnel who took the complaint
- All actions taken to assess and resolve the complaint

All citizen complaints involving CCR fugitive dust events at the facility will be investigated promptly. As deemed appropriate or necessary, corrective measures will be taken and a follow-up response will be provided to the complainant.

Pursuant to 35 I.A.C. 845.500(b)(2), quarterly reports will be submitted to IEPA no later than 14 days from the end of the quarter for all complaints received in that quarter. At a minimum, the quarterly report will include the date of the complaint, the date of the incident, the name and contact information of the complainant (if given), and all actions taken to assess and resolve the complaint.

# 6 Amendments

The written CCR fugitive dust control plan may be amended at any time provided the revised plan is placed in the facility's operating record as required by 40 C.F.R. § 257.105(g)(1) and 845.500(b)(6). Any amendment of the fugitive dust control plan will be submitted to IEPA in accordance with 845.500(b)(5). The written CCR fugitive dust control plan must be amended whenever there is a change in conditions that would substantially affect the written plan in effect.

| Amendment Number and Date | Pages or Section | Description of Amendment | Professional Engineer Certifying Plan |
|---|---|---|---|
| Version 0<br>October 2015 | -- | Initial Plan | Wendy M. Pennington |
| Amendment 1<br>October 2021 | Various | Administrative changes and adjustments to site condition controls as appropriate. | John R. Hesemann |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**Table 6-1. CCR Fugitive Dust Control Plan Amendments**

# ATTACHMENT H

Intended for
**Illinois Power Resources Generating, LLC**

Date
**October 25, 2021**

Project No.
**1940100806-003**

# HYDROGEOLOGIC SITE CHARACTERIZATION REPORT

## BOTTOM ASH BASIN
## DUCK CREEK POWER PLANT
## CANTON, ILLINOIS

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# DUCK CREEK POWER PLANT BOTTOM ASH BASIN

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|---|---|
| Project Name | **Duck Creek Power Plant Bottom Ash Basin** |
| 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 |
| BAB | Bottom Ash Basin |
| bgs | below ground surface |
| CCR | coal combustion residuals |
| CCR Rule | 40 C.F.R. § 257 Subpart D |
| cm/s | centimeters per second |
| CSM | conceptual site model |
| 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 |
| 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/OBG | Natural Resource Technology, Inc., an OBG Company |
| 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. |
| 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 Bottom Ash Basin (BAB) 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 BAB. 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 BAB, which has been collected from 2015 to 2021. The BAB (Vistra identification [ID] number [No.] 205, Illinois Environmental Protection Agency [IEPA] ID No. W0578010001-03, and National Inventory of Dams [NID] No. IL50716) 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 BAB is an inactive 2.2-acre lined coal combustion residuals (CCR) surface impoundment (SI) formerly used to manage CCR and non-CCR waste streams at DCPP. The BAB consists of three cells. The bottom and side slopes of all three cells are concrete lined. Gravel surfaced roads surround the basin cells. A sluice pipe delivered CCR material to the pond. An outlet structure for water is located in the southeast corner of the south cell. The western two cells are designed with a gently sloping ramp so that front-end loaders can remove bottom ash. The east cell flows toward a discharge structure that drains accumulated water. All bottom ash (*i.e.,* CCR) was removed from the BAB when the plant was retired in November 2019; the basin currently contains no impounded water or CCR materials.

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 BAB 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 BAB was constructed in close proximity to mined areas and mine spoils were observed in some boring logs (*e.g.,* BA01, BA05 and BA06).

Three distinct water-bearing layers have been identified at the Site based on stratigraphic relationships and common hydrogeologic characteristics:

- **Fill Unit:** Shallow groundwater present in fill material and coal mine spoils.
- **Uppermost Aquifer**: The uppermost aquifer in the area of the BAB includes the Peoria/Roxanna Loess and the sand and silt zones within the Radnor Till. Within the till sequences at the BAB, a continuous intercalated sand exists below the basin from approximately 18 to 40 feet below ground surface (bgs). The sand zone is typically very dense, very fine- to coarse-grained, with few silt and trace small gravel. This sand unit is the

primary horizontal migration pathway and generally ranges in thickness from about 2 to 7 feet.

- **Bedrock Confining Unit**: This unit includes the Pennsylvanian shaley siltstone and silty shale bedrock. The shale bedrock unit underlying the Springfield Coal Member has been demonstrated by packer testing to be an aquitard.

The Peoria/Roxanna Loess within the uppermost aquifer and above the sand unit has also been identified as a potential migration pathway (PMP). While the primary horizontal migration pathway consists of the sand zones of the uppermost aquifer, impacts have the potential to migrate within groundwater in the overlying Peoria/Roxanna Loess.

Groundwater migrates downward through the loess and upper Radnor Till into the shallow sands of the uppermost aquifer. Groundwater flow across the BAB within the uppermost aquifer is consistently southward toward a channel located approximately 50 feet to the south that leads to the Duck Creek Cooling Pond. Groundwater elevations of the uppermost aquifer across the BAB typically range from approximately 570 to 580 feet North American Vertical Datum of 1988 (NAVD88). Groundwater elevations may fluctuate seasonally, but the groundwater flow direction remains consistent in a south-southeast direction toward the Duck Creek Cooling Pond.

The BAB Pond is lined, has been drained, and bottom ash is no longer present in the settling basins. There is a minimal amount of water in the BAB, predominately due to precipitation. Groundwater elevation contours of surrounding monitoring wells indicate groundwater generally flows to the south, with no indication of radial flow. The minimal amount of water present in the BAB, in addition to no observations of radial flow, provide evidence that the BAB does not impact groundwater flow directions.

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:

Groundwater migrates downward through the loess and upper Radnor Till into the shallow sands of the uppermost aquifer. Groundwater flow across the BAB within the uppermost aquifer is consistently southward toward a channel located approximately 50 feet to the south that leads to the Duck Creek Cooling Pond. Groundwater elevations of the uppermost aquifer across the BAB typically range from approximately 570 to 580 feet NAVD88. Groundwater elevations may fluctuate seasonally, but the groundwater flow direction remains consistent in a south-southeast direction toward the Duck Creek Cooling Pond.

- Total arsenic, beryllium, boron, cobalt, lead, and pH were detected at least once at concentrations greater than the GWPS in downgradient uppermost aquifer wells (including PMP wells). All of these parameters, with the exception of pH, were also detected in one or both background wells at least once at concentrations greater than the GWPS. Total chloride, lithium, radium 226 and 228 combined, sulfate, and total dissolved solids (TDS) were also detected at least once at concentrations greater than the GWPS in one or both background wells.

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
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| 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<br>Figure 3-1<br>Appendix B |
| 845.620(b)(2) | Climatic aspects of the site, including seasonal and temporal fluctuations in groundwater flow; | Sections 3.2.2 & 3.3.1<br>Figure 3.3 |
| 845.620(b)(3) | Identification of nearby surface water bodies and drinking water intakes; | Sections 3.3.2 & 5.2<br>Appendix A |
| 845.620(b)(4) | Identification of nearby pumping wells and associated uses of the groundwater; | Section 5.1<br>Appendix A |
| 845.620(b)(5) | Identification of nearby dedicated nature preserves; | Section 5.3<br>Appendix A |
| 845.620(b)(6) | Geologic setting; | Section 2<br>Figures 2-1 to 2-5 |
| 845.620(b)(7) | Structural characteristics; | Section 2.4.3<br>Figure 2-3 |
| 845.620(b)(8) | Geologic cross-sections; | Figures 2-5 & 2-6 |
| 845.620(b)(9) | Soil characteristics; | Section 2.3<br>Figure 2-2 |
| 845.620(b)(10) | Identification of confining layers; | Section 3.2.1 |

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| Part 845 Reference | Part 845 Components | Location of Information in HCR |
|---|---|---|
| 845.620(b)(11) | Identification of potential migration pathways; | Section 3.2.3 |
| 845.620(b)(12) | Groundwater quality data; | Section 4.2<br>Table 4-1 |
| 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<br>Figures 2-5 & 2-6 |
| 845.620(b)(14) | A map displaying any known underground mines beneath a CCR surface impoundment; | Section 2.4.5<br>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<br>Tables 2-1, 2-2, & 2-4<br>Appendix C |
| 845.620(b)(16) | Hydraulic characteristics of the geologic layers identified as migration pathways and geologic layers that limit migration, including: | Sections 3.2.1, 3.2.1.1 & 3.2.1.2<br>Tables 3-2 to 3-4<br>Appendices C & E |
| 845.620(b)(16)(A) | water table depth; | Section 3.2.4<br>Figure 3-3<br>Appendix D |
| 845.620(b)(16)(B) | hydraulic conductivities; | Section 3.2.5<br>Table 3-3<br>Appendix E |
| 845.620(b)(16)(C) | effective and total porosities; | Sections 2.5 & 3.2<br>Table 2-1 |
| 845.620(b)(16)(D) | direction and velocity of groundwater flow; and | Sections 3.2.4, 3.2.5 & 3.2.6<br>Tables 3-2 & 3-4<br>Figures 3-3 |

**TABLE ES-1. PART 845 REQUIREMENTS CHECKLIST**
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| Part 845 Reference | Part 845 Components | Location of Information in HCR |
|---|---|---|
| 845.620(b)(16)(E) | map of the potentiometric surface; | Figures 3-3<br>Appendix D |
| 845.620(b)(17) | Groundwater classification pursuant to 35 I.A.C. § 620 | Section 3.2.7 |

[O: EDP 08/06/21, U: SSW 09/17/21, C: SSW 09/22/21]

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 BAB. However, information gathered to evaluate other CCR units in the vicinity regarding geology, hydrogeology, and groundwater quality is included, where appropriate. The Duck Creek BAB is an inactive 2.2-acre lined CCR SI formerly used to manage CCR and non-CCR waste streams at the DCPP. The BAB consists of three cells. The bottom and side slopes of all three cells are concrete lined. Gravel surfaced roads surround the basin cells. A sluice pipe delivered CCR material to the pond. An outlet structure for water is located in the southeast corner of the south cell. The western two cells are designed with a gently sloping ramp so that front-end loaders can remove bottom ash. The east cell flows toward a discharge structure that drains accumulated water. All bottom ash (*i.e.,* CCR) was removed from the BAB when the plant was retired in November 2019, the basin currently contains no impounded water or CCR materials. This HCR includes Part 845 content requirements specific to 35 I.A.C. § 845.620(b) (Hydrogeologic Site Characterization) for the BAB 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. The 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 located 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 presented in prior hydrogeologic investigation reports (recent to oldest), including, but not limited to, the following:

- **Natural Resource Technology, an OBG Company (NRT/OBG), October 17, 2017. *Hydrogeologic Monitoring Plan, Bottom Ash Basin – CCR Unit ID 205, 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 Subpart D (CCR Rule; published in 80 FR 21302-21501, April 17, 2015) for the DCPP.

- **Hanson Professional Services, Inc. (Hanson), September 2015. *Initial Assessment and Rationale for Proposed Well Locations, Duck Creek Power Station, Bottom Ash Basins, Fulton County, Illinois*.**
  Results of initial assessment and proposed monitoring well locations and installation schedule.
- **Hanson, March 2010. *Hydrogeologic Report Ameren Duck Creek Power Generating Station Solid Waste Disposal System (Ash Pond 1, Ash Pond 2, and Recycle Pond).***
  Report summarizes data from previous groundwater investigations in support of closure activities at the DCPP related to Ash Pond 1, Ash Pond 2, and the Recycle Pond; identifies groundwater impacts related to those ponds; and provides preliminary recommendations related to future monitoring.
- **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 BAB in conjunction with this report and is included in the Operating Permit to which this HCR 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 BAB is located north of the power plant in Section 30 of Township 6 North, Range 5 East (**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. The BAB is located just north of the Duck Creek Cooling Pond and just south of nearby surface mining (**Figure 1-2**). Prior to construction of the power plant and associated facilities, strip mining of coal took place within the property boundary of the DCPP (**Figures 1-1 and 1-2**). Currently, land use adjacent to the DCPP is agriculture, pasture, and forest with minimal development.

## 1.5 Site History and CCR Units

Construction of the BAB took place sometime in late 2007 or early 2008. In 2016, a History of Construction was provided by AECOM for the DCPP, but the BAB was small enough in volume (less than 20-acre feet) to be exempt from this history by 40 C.F.R. § 257.73(b).

A liner design criteria evaluation was performed by AECOM in 2016 and states that the BAB was constructed with a lower and upper liner; the lower consists of a 1 foot thick layer of compacted clay overlain by a 60-millimeter high density polyethylene (HDPE) membrane, and the upper consists of 8 inches of reinforced concrete. Permeability and hydraulic conductivity could not be determined from the records available; therefore, the BAB does not meet the §257.71(a)(1) criteria for a lined impoundment. The BAB is estimated to enable storage of approximately 25,000 cubic yards of CCR material (IPRG, 2016). During operation, CCR (bottom ash) was sluiced to the western cells of the pond. Particles settled within the cell and decant water was piped to the eastern cell. The western cells required frequent clean out events using heavy equipment to remove bottom ash from the cell for permanent disposal at the on-site landfill.

Several other CCR units are located on the DCPP property, including: the closed units, Ash Pond No. 1 and Ash Pond No 2 located north of the BAB; the Gypsum Management Facility (GMF) Pond and GMF Recycle Pond located north of the closed ponds; and the permitted Landfill located north of the GMF Pond.

# 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). Topography adjacent to the BAB 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 BAB 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 Orthents (#801B). Orthents consists of somewhat poorly-drained to well-drained loess in uplands. This soil is unsuitable for cultivated crops due to low fertility, low pH, and water erosion, and moderately suitable for dwellings due to shrink-well and wetness.

Areas surrounding the BAB are classified as Dumps, mine (#536), Lenzburg silt loam (#871C, #871D, #871G, and #876B), Lenzwheel silt loam (#876B), Rozetta silt loam (#279B and #279C2), Fayette silt loam (#280gD2 and #280E2), Seaton silt loam (#274E2), Hickory silt loam (#8cF and #8E2), and Keomah silt loam (#17A). The Dumps, mine zone represents the former surface mined materials. The Lenzburg silt loam consists of a well-drained loam situated in graded spoil banks in the uplands. These soils formed from cast overburden from surface mining. Most areas of this association are moderately suitable for cultivated crops due to water erosion. The Lenzwheel silt loam consists of well-drained loam situated in graded spoil banks in the uplands. These soils formed from cast overburden from surface mining. Most areas of this association are moderately suitable for cultivated crops due to crusting and water erosion. The

Rozetta series consists of well drained loess in interfluvial areas, head slopes, and sideslopes along upland drainageways. These soils are moderately suitable for cultivated crops due to crusting and water erosion. The Fayette series consists of well drained loess on sideslopes along upland drainageways. These soils are moderately suitable for cultivated crops due to crusting and water erosion. The Seaton silt loam consists of well-drained loam on side slopes along upland drainageways. These soils formed from loess. Most areas of this association are unsuitable for cultivated crops due to equipment limitations, low pH, and water erosion. 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 Keomah series consists of somewhat poorly drained loess in interfluvial areas. These soils are moderately suitable for cultivated crops due to crusting and flooding.

## 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, 2017).

Areas near the BAB are part of several large surface coal mines 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, 2017).

### 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) Coal, the Springfield (No. 5) Coal, the Colchester (No. 2) Coal, and the Danville (No. 7) Coal. 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 an elevation of 560 feet NAVD88. The bedrock mapping indicates the beds dip to the east-southeast at approximately 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 2-3**. 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 (**Appendix A**). Mining operations in the area have ceased. As indicated in **Section 2.4.2**, 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 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 wells 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 BAB was constructed in close proximity to mined areas and mine spoils were observed in some boring logs (*e.g.,* BA01, BA05, and BA06).

### 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 bgs as specified in 35 I.A.C. § 845.620(b). The 2021 field investigation locations are shown on **Figure 2-4**. The major geomorphic features occurring within and nearby the BAB include Peoria/Roxanna Loess overlying Glasford Formation clayey diamictons (Radnor Till).

#### 2.5.1 Site-Specific Unlithified Geology

The unlithified stratigraphy within and immediately surrounding the BAB consists of the following in descending order: fill material and CCR; silt and clayey silt loess (Peoria/Roxanna Loess); weathered till; shallow, medium-grained sand to silt; and 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 BAB are provided in **Appendix B**.

##### 2.5.1.1 Fill and CCR

Areas immediately north of the BAB are part of several large surface coal mines where unlithified materials are present within the excavated strip mine spoils, but have been mixed due to the surface mining activities. Strip mine spoils are present in borings BA01, BA05, and BA06, north of the BAB. The Fill ranges in thickness from 8 to 28 feet bgs and is deepest adjacent to the railroad tracks north of the BAB. The Fill generally consists of silts and clays with fine- to coarse-grained sand and trace small gravel. Trace coal fragments are also observed at depth. Mining operations in the area have ceased.

All bottom ash (*i.e.,* CCR) was removed from the BAB when the plant was retired in 2019; the basin currently contains no impounded water or CCR materials. The BAB overlies the Loess Unit (**Section 2.5.1.2**). Because the BAB is empty, no bottom ash or leachate samples were collected for characterization.

#### 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 14 to 34 feet. The loess consists of medium to very stiff silt with little clay and trace very fine- to fine-grained sand. The loess is saturated below depths varying from approximately 4 to 12 feet in wells adjacent to the BAB. Trace wood fragments were observed at the loess contact with the underlying till in BA02 (NRT/OBG, 2017).

Geotechnical analysis results from samples collected from Peoria/Roxanna Loess yielded Unified Soil Classification System (USCS) soil classifications of silt and lean clay. Sample locations are shown on **Figure 2-4**, 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 27.1 percent, with a range of 24.1 to 29.0 percent.
- Average total porosity (calculated) of 41.6 percent, with a range of 39.2 to 44.2 percent.
- Average dry density of 96.3 pounds per cubic foot (pcf), with a range of 94.4 to 100.1 pcf.
- Average specific gravity of 2.69, with a range of 2.60 to 2.71.
- Average grain size composition of 0 percent gravel, 6.3 percent sand, and 93.7 percent fines (silt and clay). The fines content ranged from 91 to 99 percent, with a median value of 91 percent.
- Geometric mean vertical hydraulic conductivity of $2.1 \times 10^{-5}$ centimeters per second (cm/s) and ranged from $4.5 \times 10^{-6}$ to $2.4 \times 10^{-4}$ cm/s.

Solid samples were also collected in 2021 for chemical analysis. The results of solid samples collected from the Peoria/Roxanna Loess are summarized in **Table 2-2**.

#### 2.5.1.3 Radnor Till

The Radnor Till underlies the Peoria/Roxanna Loess and ranges in thickness from 10 to 17 feet, extending to the termination depth of each boring. The till consists of 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. The shallow till is generally weathered and exhibits signs of oxidation. The till sequences typically extend from the base of the loess unit to the bedrock surface (NRT/OBG, 2017). Based on geotechnical results and field observations, there are three distinct layers identified within the Radnor Till: upper Radnor Till, shallow sand zone, and lower Radnor till. Each of these layers of the Radnor Till is discussed below. Sample locations are shown on **Figure 2-4**, the geotechnical results from the most recent investigation are summarized in **Table 2-1**, and geotechnical laboratory reports are included in **Appendix C**.

Solid samples were also collected from the Radnor Till in 2021 for chemical analysis. The results of solid samples collected from the Radnor Till are summarized in **Table 2-2**.

**Upper Radnor Till**

Geotechnical analysis results from samples collected from the upper Radnor Till yielded USCS soil classifications of lean to fat clay, silt and clayey sand. Geotechnical results (**Table 2-1**) of the upper Radnor Till indicated the following:

- Average moisture content of 19.7 percent, with a range of 11.2 to 24.8 percent.
- Average total porosity (calculated) of 33.6 percent, with a range of 24.6 to 40.7 percent.
- Average dry density of 109.5 pcf, with a range of 100.2 to 128.0 pcf.
- Average specific gravity of 2.69, with a range of 2.63 to 2.73.
- Average grain size composition of 0 percent gravel, 42 percent sand, and 58 percent fines (silt and clay).
- Geometric mean vertical hydraulic conductivity of 7.6 x $10^{-7}$ cm/s and ranged from 5.5 x $10^{-8}$ to 7.5 x $10^{-5}$ 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 2-2**.

**Shallow Sand Zone**

There are sand and silt zones within the till sequences; a continuous intercalated sand exists within the till below the BAB from approximately 18 to 40 feet bgs. The shallow sand zone is typically very dense, very fine- to coarse-grained, with few silt and trace small gravel. This unit generally ranges in thickness from approximately 2 to 7 feet. This sand unit also exhibits some lateral facies changes to include silty materials. These silty materials are generally described as hard silt with little clay, few very fine- to coarse-grained sand, and trace small gravel (NRT/OBG 2017). Similar sand and silt zones were observed underlying the Landfill and GMF Pond further north of the DCPP (Hanson 2005; Hanson, 2009). Geotechnical analysis results (**Table 2-1**) from one sample collected from the shallow sand zone in 2021 indicated the following:

- Moisture content of 9.9 percent.
- Specific gravity of 2.73.
- Grain size composition of 11 percent gravel, 78 percent sand, and 11 percent fines (silt and clay).

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 2-2**.

**Lower Radnor Till**

Geotechnical analysis results from samples collected from the lower Radnor Till yielded USCS soil classifications of silt and clay. Geotechnical results (**Table 2-1**) of the lower Radnor Till indicated the following:

- Average moisture content of 13.0 percent, with a range of 11.6 to 14.6 percent.
- Average total porosity (calculated) of 26.0 percent, with a range of 23.7 to 28.1 percent.

- Average dry density of 122.3 pcf, with a range of 117.6 to 127.6 pcf.
- Average specific gravity of 2.65, with a range of 2.60 to 2.68.
- Average grain size composition of 0 percent gravel, 32 percent sand, and 69 percent fines (silt and clay). The sand content ranged from 19 to 41 percent and fines content ranged from 59 to 81 percent.

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 2-2**.

### 2.5.2 Site Specific Bedrock Geology

The bedrock below the Radnor Till is Pennsylvanian-aged bedrock encountered at greatly varying depths across the DCPP. Bedrock depths ranged from a minimum of 52 feet to a maximum of 108 feet. Although bedrock was encountered at the BAB at 26 feet bgs at well BA03, this is not typical. Top of bedrock was observed at soil boring SB01 (located at well nest BA01) at 46 feet bgs and other locations were drilled between 30 to 40 feet bgs without encountering bedrock. Where the Springfield (No. 5) Coal Member was mined, bedrock consists of a Carbondale Formation shale unit. The bedrock shows little compositional variation across the site and consists primarily of shaley siltstone and silty shale. These units often contained thin dolomite ledges and nodules and some fractures.

Boring locations for the BAB are provided in **Appendix B** and geologic cross-sections are provided in **Figures 2-5** and **2-6**.

# 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 site provide a very modest specific capacity and groundwater yield (Hanson, 2009).

## 3.2 Site Hydrogeology

Wells used for groundwater monitoring at the BAB have been constructed in phases since 2015. Four monitoring wells were installed in 2015, and two were installed in 2016. In 2021, four additional wells were installed to provide information to meet the requirements of Part 845. A summary of the current monitoring well network and construction details are included in **Table 3-1** and depicted in **Figure 3-1**. Boring logs, monitoring well, and piezometer construction forms are provided in **Appendix B**. This section discusses the recently collected information, focusing on the existing well network and monitoring wells installed after 2015 around the BAB, as well as appropriate historical data from wells outside the focus of the current investigation.

Surface water drainage over much of the Site flows 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 is used for thermal treatment of cooling water discharging from the DCPP. Groundwater generally mimics the surface topography and flows southward toward a channel leading to the Duck Creek Cooling Pond.

### 3.2.1 Hydrostratigraphic Units

Three distinct water-bearing layers have been identified at the Site based on stratigraphic relationships and common hydrogeologic characteristics.

- **Fill Unit**: As observed in previous investigations at the DCPP (Hanson, 2010), shallow groundwater at the Site also occurs within coal mine spoils, which have been observed north of the BAB in borings BA01, BA05, and BA06.
- **Uppermost Aquifer**: At the BAB, the uppermost aquifer includes the Peoria/Roxanna Loess and the Radnor Till. The Peoria/Roxanna Loess present at the BAB is 14 to34 feet thick, medium to very stiff silt and trace fine- to very fine-grained sand, and is saturated below depths ranging from 4 to 12 feet. The Radnor Till consists of clay, silts, and sands, ranging in thickness from 10 to 25 feet. The till sequence typically extends from the base of the loess to the bedrock surface.
- **Bedrock Confining Unit**: The lower limit of the aquifer is the top of the underlying Pennsylvanian shaley siltstone and silty shale bedrock; top of bedrock occurs from 26 to 46 feet bgs at the BAB. The shale bedrock unit underlying the Springfield Coal Member has been demonstrated by packer testing to be an aquitard (Hanson, 2016).

### 3.2.2 Uppermost Aquifer

The uppermost aquifer in the area of the BAB includes the Peoria/Roxanna Loess and the sand and silt zones within the Radnor Till, similar to the GMF Pond located approximately 2.5 miles north of the BAB. Within the till sequences at the BAB, a continuous intercalated sand exists below the basin from approximately 18 to 40 feet bgs described as the shallow sand zone in Section 2.5.1.3 and illustrated on **Figures 2-5 and 2-6**. This sand unit is the primary horizontal migration pathway within the till and generally ranges in thickness from about 2 to 7 feet. The top of the uppermost aquifer (top of sand) is presented in **Figure 3-2**. The lower limit of the uppermost aquifer is the top of bedrock.

### 3.2.3 Potential Migration Pathway

The Peoria/Roxanna Loess within the uppermost aquifer and above the sand unit has also been identified as a PMP. While the primary horizontal migration pathway is the sand zones of the uppermost aquifer, impacts have the potential to migrate within groundwater in the overlying Peoria/Roxanna Loess. The PMP intersects the well screens of all "L" wells and is saturated at depths of 4 to 12 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 BAB within the uppermost aquifer is consistently southward toward a channel located approximately 50 feet to the south that leads to the Duck Creek Cooling Pond (**Figure 3-3**). Groundwater elevations of the uppermost aquifer across the BAB typically range from approximately 570 to 580 feet NAVD88 (additional groundwater contour maps and groundwater elevations are provided in **Appendix D**). Groundwater elevations may fluctuate seasonally, but the groundwater flow direction remains consistent in a south-southeast direction.

#### 3.2.4.1 Vertical Hydraulic Gradients

Vertical hydraulic gradients were calculated using available groundwater elevation data from April to August 2021 at well locations within the PMP and sands of the uppermost aquifer. Vertical hydraulic gradients for the BAB are presented in **Table 3-2**. The results of the vertical hydraulic gradient calculations for the uppermost aquifer to PMP are summarized below:

- Vertical hydraulic gradients between wells BA01L (PMP) and BA01 (uppermost aquifer) ranged from 0.095 feet per feet (ft/ft) to 0.245 ft/ft downward, averaging 0.14 ft/ft downward;
- Vertical hydraulic gradients between wells BA02L (PMP) and BA02 (uppermost aquifer) ranged from 0.0154 ft/ft to 0.04 ft/ft downward, averaging 0.02 ft/ft downward; and
- Vertical hydraulic gradients between wells BA03L (PMP) and BA03 (uppermost aquifer) ranged from 0.0055 ft/ft downward to 0.0113 ft/ft upward, averaging 0.004 ft/ft upward.

#### 3.2.4.2 Impact of Existing Ponds and Ash Saturation

The BAB Pond is lined, as described in **Section 1.5**. The basin has been drained and bottom ash is no longer present in the settling basins. There is a minimal amount of water (from precipitation) in the BAB, predominately due to precipitation. Groundwater elevation contours of surrounding monitoring wells indicate groundwater generally flows to the south, with no indication of radial flow. The minimal amount of water present in the BAB, in addition to no observations of radial flow, provide evidence that the BAB does not impact groundwater flow directions.

The flat horizontal groundwater gradient beneath this area (**Table 3-3**) and the small downward vertical gradients at well pairs BA01L and BA01, and BA02L and BA02 (**Table 3-2**), suggests the BAB is not an area of increased recharge or infiltration.

#### 3.2.4.3 Impact of Surface Water Bodies

The nearest surface water body to the BAB is the Duck Creek Cooling Pond, which is located approximately 500 feet to the east of the BAB. Groundwater flow across the BAB within the uppermost aquifer is consistently southward toward a channel located approximately 50 feet to the south that leads to the Duck Creek Cooling Pond. The surface water elevation of the Duck Creek Cooling Pond is estimated from 562.5 to 565 feet NAVD88, which is approximately 12 feet lower than downgradient groundwater at the BAB.

### 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 BA01L, BA02L, BA03L, BA01, BA03, and BA01C indicated hydraulic conductivity measuring from $1.5 \times 10^{-4}$ to $3.9 \times 10^{-3}$ cm/s and a geometric mean of $6.3 \times 10^{-4}$ cm/s.

As discussed in the hydrogeologic monitoring plan (NRT/OBG 2017), the 6 to 7 feet thick continuous intercalated sand within the till (uppermost aquifer) intersected by the well screens at BA01 and BA04 indicate the sand zone, when present, is highly permeable with a geometric mean hydraulic conductivity of $3.4 \times 10^{-2}$ cm/sec. Hydraulic conductivity of the less permeable downgradient materials, intersected by wells BA02 and BA03, had a geometric mean hydraulic conductivity of $9.1 \times 10^{-5}$ cm/sec, or 374 times lower permeability than the wells screened across the sand zone (*i.e.*, BA01 and BA04) (NRT/OBG 2017).

#### 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 2-4**. The geotechnical laboratory report is provided in **Appendix C**. The results are summarized in **Table 2-1** and discussed below.

- Three samples were collected from the Peoria/Roxanna Loess from soil borings SB01, SB02, and SB03. Laboratory falling head permeability test results in the uppermost aquifer indicated vertical hydraulic conductivities ranging from $4.5 \times 10^{-6}$ to $2.4 \times 10^{-4}$ cm/s, and a geometric mean vertical hydraulic conductivity of $2.1 \times 10^{-5}$ cm/s.
- Four samples were collected from the upper Radnor Till from soil borings SB01, SB02, and SB03. Laboratory falling head permeability test results in the upper Radnor Till indicated a vertical hydraulic conductivity ranging from $5.5 \times 10^{-8}$ to $7.5 \times 10^{-5}$ cm/s, and a geometric mean vertical hydraulic conductivity of $7.6 \times 10^{-7}$ cm/s.

### 3.2.6 Horizontal Groundwater Gradients and Flow Velocity

Groundwater flow below the BAB is consistently in a south-southeastern direction (**Figure 3-3**). Seasonal variation of groundwater levels at the BAB are indicated in the additional groundwater elevation contour maps and elevations shown in **Appendix D**. Observed groundwater elevations may fluctuate seasonally by approximately 1 to 2 feet. There is no observable seasonal variation of groundwater flow direction at the BAB.

Horizontal hydraulic gradients and groundwater velocities for the uppermost aquifer were calculated based upon groundwater elevation measurements from April through August 2021 between BA05 and BA04 (west side of basin), BA01 and BA03 (center of basin), and BA06 and BA02 (east side of basin) (**Table 3-4**). Horizontal hydraulic gradients are slight across the BAB and ranged from 0.0006 ft/ft between BA06 and BA02 in August 2021 to 0.0342 between BA06 and BA02 in July 2021.

Horizontal hydraulic gradients calculated to the west of the BAB, between BA05 and BA04, were on average 0.0132 ft/ft with an average groundwater velocity of 0.032 feet per day (ft/day). Horizontal hydraulic gradients calculated through the center of the BAB, between BA01 and BA03, were on average 0.0062 ft/ft with an average groundwater velocity of 0.05 ft/day. Horizontal hydraulic gradients calculated to the east of the BAB, between BA06 and BA02, were on average 0.0078 ft/ft, with an average groundwater velocity of 0.03 ft/day. In April through June 2021, average groundwater flow velocities at the BAB were 0.04 ft/day; from July to August 2021, groundwater flow velocities at the BAB were also on average 0.04 ft/day. Lower hydraulic gradients observed near the center of the BAB, between BA01 and BA03, are consistent with previous calculations of horizontal hydraulic conductivity at upgradient locations (NRT/OBG, 2017).

### 3.2.7 Groundwater Classification

Per 35 I.A.C. § 620.210, groundwater within the uppermost aquifer at the BAB 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 $1 \times 10^{-4}$ 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 BAB had geometric mean hydraulic conductivities exceeding $1 \times 10^{-4}$ 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 BAB that have been surface mined and present a significant alternative source for groundwater impacts.

## 3.3 Surface Water Hydrology

### 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 below 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 BAB. Surface water elevations of the Duck Creek Cooling Pond (**Figure 1-1**) are estimated 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 BAB 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 BAB 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 is currently being conducted at the BAB as required by 40 C.F.R. § 257. 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 six monitoring wells screened in the uppermost aquifer nearby and adjacent to the BAB including: two background monitoring wells (BA05 and BA06) and four compliance monitoring wells (BA01, BA02, BA03, and BA04). The boring logs, well construction forms, and other related monitoring well forms for the BAB 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 BAB 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 BAB (NRT/OBG, 2017). 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, as 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 are recorded during sample collection.

### 4.1.2 Part 845 Well Installation and Groundwater Monitoring

In 2021, four additional monitoring wells (BA01L, BA01C, BA02L, and BA03L) were installed at the BAB 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).

Prospective Part 845 monitoring wells were sampled for eight rounds from April to August 2021 and the results were assessed for selection of the BAB Part 845 monitoring well network presented in the GMP. Samples were collected from the new monitoring points and analyzed for 35 I.A.C. § 845.600 parameters summarized in **Table C** below. Part 845 groundwater monitoring results are included below in **Section 4.2**.

**Table C. Part 845 Groundwater Monitoring Program Parameters**

| Part 845 Groundwater Monitoring 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 BAB 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 the 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 Arsenic

Total arsenic was detected greater than the GWPS (0.01 milligrams per liter [mg/L]) in two downgradient wells (BA02 and BA02L), one upgradient well BA01, and one background well BA06. Total arsenic concentrations in downgradient and upgradient wells ranged from non-detect to 0.019 mg/L. Total arsenic in the background well ranged from non-detect to 0.024 mg/L.

### 4.2.2 Total Beryllium

Total beryllium was detected greater than the GWPS (0.004 mg/L) in one downgradient well BA02 and one background well BA06. Total beryllium concentrations in the downgradient well ranged from non-detect to 0.0068. Total beryllium concentrations in the background well ranged from non-detect to 0.02 mg/L.

[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.

#### 4.2.3 Total Boron

Total boron was detected greater than the GWPS (2 mg/L) in downgradient well BA04, and background well BA06. Total boron concentrations in the downgradient well ranged from non-detect to 2.6 mg/L. Total boron concentrations in the background well ranged from non-detect to 4.75 mg/L.

#### 4.2.4 Total Chloride

Total chloride was detected greater than the GWPS (200 mg/L) in background well BA06. Total chloride concentrations in the background well ranged from 470 to 598 mg/L.

#### 4.2.5 Total Cobalt

Total cobalt was detected greater than the GWPS (0.006 mg/L) in two downgradient wells (BA02L and BA03L), one upgradient well BA01C, and two background wells (BA05 and BA06). Total cobalt concentrations in the downgradient wells ranged from non-detect to 0.017 mg/L. Total cobalt concentrations in the upgradient well ranged from 0.0024 to 0.01 mg/L. Total cobalt concentrations in the background wells ranged from non-detect to 0.037 mg/L.

#### 4.2.6 Total Lead

Total lead was detected greater than the GWPS (0.0075 mg/L) in two downgradient wells (BA02L and BA03L), two upgradient wells (BA01 and BA01C), and background well BA06. Total lead concentrations in the downgradient wells ranged from non-detect to 0.023 mg/L. Total lead concentrations in the upgradient wells ranged from non-detect to 0.027 mg/L. Total lead concentrations in the background well ranged from non-detect to 0.042 mg/L.

#### 4.2.7 Total Lithium

Total lithium was detected greater than the GWPS (0.04 mg/L) in background well BA06. Total lithium concentrations in the background well ranged from non-detect to 0.068 mg/L.

#### 4.2.8 pH

The GWPS lower standard for pH (6.5 standard units [SU]) was exceeded once at one downgradient well BA02 and one upgradient well BA01. Measurements of pH ranged from 6.3 to 7.3 SU at BA02. Measurements of pH ranged from 6.2 to 7.1 SU at BA01.

#### 4.2.9 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 15 samples collected from background well BA06. Observations ranged from 0.06 to 9.64 pCi/L.

#### 4.2.10 Total Sulfate

Total sulfate was detected greater than the GWPS (400 mg/L) in background wells BA05 and BA06. Total sulfate concentrations in the background wells ranged from 110 to 890 mg/L.

#### 4.2.11 Total Dissolved Solids

TDS was detected greater than the GWPS (1,200 mg/L) in background wells BA05 and BA06. TDS concentrations in the background wells ranged from 380 to 2,300 mg/L.

# 5. EVALUATION OF POTENTIAL RECEPTORS

## 5.1 Water Well Survey

A water well survey was conducted for a 1,000 meter radius of the BAB (Hanson, 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 BAB. 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 BAB 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, there are no public or private water supply wells or intakes located within 1,000 meters of the BAB (**Appendix A**). There is no data for Fulton County available from USGS NGWMN.

## 5.2 Surface Water

A comprehensive 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 BAB.

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 BAB. Surface waters in the vicinity of the BAB include various freshwater ponds to the east, south, and west (**Appendix A**).

The predominant surface water body in the vicinity of both the BAB and DCPP is the Duck Creek Cooling Pond (**Figure 1-1**), which was formed by damming a portion of Duck Creek, a minor tributary of the Illinois River. The Illinois River and associated lowland backwater lakes, including Duck Lake, are located further east. According to the topographic map, the surface water elevation of Duck Creek (*i.e.*, Duck Creek Cooling Pond) is estimated from 562.5 to 565 feet NAVD88. The USGS National Map places the DCPP within the Lower Illinois-Lake Chautauqua watershed subbasin (Hydrologic Unit Code [HUC] 07130003) (**Appendix A**).

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

[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/

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 BAB 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 BAB.

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 BAB. 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 BAB.

[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

Numerous hydrogeologic investigations have been performed concerning the CCR Units located at the DCPP and have been most recently updated for this HCR. Results of previous hydrogeologic studies were reintroduced in this HCR and updated to include geologic, hydrogeologic, and groundwater quality data collected with a focus on the BAB (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 BAB 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 BAB GMF Pond consists of the following in descending order: fill material; silt and clayey silt loess (Peoria/Roxanna Loess); weathered till (upper Radnor Till); shallow, medium-grained sand to silt (shallow sand zone); and till (lower Radnor Till).
- The unlithified units overlay Pennsylvanian-age shaley siltstone and silty shale bedrock (Carbondale Formation). Bedrock was encountered at 26 and 46 feet bgs at the BAB.
- 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 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 BAB was constructed in close proximity to mined areas and mine spoils were observed in some boring logs (*e.g.,* BA01, BA05 and BA06).
- Three distinct water-bearing layers have been identified at the Site based on stratigraphic relationships and common hydrogeologic characteristics:
  - **Fill Unit:** shallow groundwater present in fill material and coal mine spoils.
  - **Uppermost Aquifer**: The uppermost aquifer in the area of the BAB includes the Peoria/Roxanna Loess and the sand and silt zones within the Radnor Till. Within the till sequences at the BAB, a continuous intercalated sand exists below the basin from approximately 18 to 40 feet bgs. The sand zone is typically very dense, very fine- to coarse-grained, with few silt and trace small gravel. This sand unit is the primary horizontal migration pathway and generally ranges in thickness from about 2 to 7 feet.
  - **Bedrock Confining Unit**: This unit includes the Pennsylvanian shaley siltstone and silty shale bedrock. The shale bedrock unit underlying the Springfield Coal Member has been demonstrated by packer testing to be an aquitard.
- The Peoria/Roxanna Loess within the uppermost aquifer and above the sand unit has also been identified as a PMP.
- Groundwater flow across the BAB within the uppermost aquifer is consistently southward toward a channel located approximately 50 feet to the south that leads to the Duck Creek

Cooling Pond. Groundwater elevations of the uppermost aquifer across the BAB typically range from approximately 570 to 580 feet NAVD88. Groundwater elevations may fluctuate seasonally, but the groundwater flow direction remains consistent in a south-southeast direction toward the Duck Creek Cooling Pond.

- 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.
- Groundwater flow velocities in the uppermost aquifer are estimated from $2.0 \times 10^{-3}$ to $1.3 \times 10^{-1}$ ft/day.
- The BAB is lined, has been drained, and bottom ash is no longer present in the settling basins. There is a minimal amount of water in the BAB, predominately due to precipitation. Groundwater elevation contours of surrounding monitoring wells indicate groundwater generally flows to the south, with no indication of radial flow. The minimal amount of water (from precipitation) present in the BAB, in addition to no observations of radial flow, provide evidence that the BAB does not impact groundwater flow directions.
- Based on the detailed geologic information provided, and the hydrogeologic and groundwater quality data, groundwater within the uppermost aquifer at the BAB is classified as Class I – Potable Resource Groundwater. However, background (upgradient) groundwater originates from areas north and west of the BAB that have been extensively surface mined and present a significant alternative source for groundwater impacts.
- Total arsenic, beryllium, boron, cobalt, lead, and pH were detected at least once at concentrations greater than the GWPS in downgradient uppermost aquifer wells (including PMP wells). All of these parameters, with the exception of pH were also detected in one or both background wells at least once at concentrations greater than the GWPS. Total chloride, lithium, radium 226 and 228 combined, sulfate, and TDS were also detected at least once at concentrations greater than the GWPS in one or both background wells.

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 BAB at the DCPP.

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# TABLES

**TABLE 2-1. GEOTECHNICAL RESULTS**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
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** | | | | | | | | | | | | | | | |
| SB01/Comp 1 | BA01L | 10 | 24 | 24.1 | 100.1 | 2.640 | 39.2 | -- | 31 | 19 | 12 | CL | 0 | 9.0 | 91 |
| SB-01/ST-9 | BA01L | 16 | 18 | 27.2 | 95.8 | -- | -- | 4.50E-06 | -- | -- | -- | CL | -- | -- | -- |
| SB02/Comp 1 | BA02L | 4 | 6 | 27.2 | 95.0 | 2.600 | 41.4 | -- | 28 | 24 | 4 | ML | 0.0 | 1 | 99 |
| SB-02/ST-5 | BA02L | 8 | 10 | 27.7 | 96.8 | -- | -- | 8.00E-06 | -- | -- | -- | CL | -- | -- | -- |
| SB03/Comp 1 | BA03L | 6 | 16 | 29.0 | 94.4 | 2.710 | 44.2 | -- | 35 | 22 | 13 | CL | 0.0 | 9 | 91 |
| SB-03/ST-5 | BA03L | 8 | 10 | 27.4 | 95.5 | -- | -- | 2.40E-04 | -- | -- | -- | CL | -- | -- | -- |
| **Upper Radnor Till** | | | | | | | | | | | | | | | |
| SB01/Comp 2 | BA01L | 26 | 30 | 11.4 | 127.9 | 2.720 | 24.6 | -- | 23 | 14 | 9 | CL | 0.0 | 41 | 59 |
| SB-01/ST-15 | BA01L | 28 | 30 | 24.6 | 100.7 | -- | -- | 5.90E-08 | -- | -- | -- | CL/CH | -- | -- | -- |
| SB02/Comp 2 | BA02L | 16 | 22 | 24.8 | 101.0 | 2.730 | 40.7 | -- | 33 | 17 | 16 | ML | 0.0 | 30 | 70 |
| SB02/Comp 3 | BA02L | 22 | 26 | 19.3 | 106.0 | 2.630 | 35.4 | -- | 31 | 16 | 15 | SC | 0.0 | 54 | 46 |
| SB-02/ST-10 | BA02L | 18 | 20 | 22.8 | 102.7 | -- | -- | 7.50E-05 | -- | -- | -- | CL | -- | -- | -- |
| SB-02/ST-13 | BA02L | 24 | 26 | 24.1 | 100.2 | -- | -- | 5.50E-08 | -- | -- | -- | CL/CH | -- | -- | -- |
| SB-03/ST-10 | BA03L | 18 | 20 | 11.2 | 128.0 | -- | -- | 1.40E-06 | -- | -- | -- | CL | -- | -- | -- |
| **Shallow Sand Zone** | | | | | | | | | | | | | | | |
| SB01/Comp 3 | BA01L | 32 | 38 | 9.9 | -- | 2.730 | -- | -- | NP | NP | NP | SP | 11.0 | 78 | 11 |
| **Lower Radnor Till** | | | | | | | | | | | | | | | |
| SB01/Comp 4 | BA01L | 38 | 46 | 14.6 | 119.3 | 2.660 | 28.1 | -- | 18 | 15 | 3 | ML | 0.0 | 25 | 75 |
| SB02/Comp 4 | BA02L | 28 | 40 | 14.3 | 117.6 | 2.600 | 27.5 | -- | 30 | 17 | 13 | CL | 0.0 | 19 | 81 |
| SB03/Comp 3 | BA03L | 20 | 26 | 11.6 | 127.6 | 2.680 | 23.7 | -- | 23 | 14 | 9 | CL | 0.0 | 41 | 59 |

[O:FPO 7/13/21, U: EDP 8/25/21, C:LDC 09/07/21; C:SSW 09/24/21]

Notes:
[1] Porosity calculated as relationship of bulk density ($p_b$) to particle density ($p_d$) ($n = 100[1- (p_b/p_d)]$)
-- = Not Analyzed
% = Percent
bgs = below ground surface
cm/s = centimeters per second
ft = foot/feet
LL = Liquid limit
NP = Non Plastic
pcf = pounds per cubic foot
PI = Plasticity Index
PL = Plastic Limit

**USCS = Unified Soil Classification System**
CL = Lean Clay
CL/CH = Lean to Fat Clay
ML = Silt
SC = Clayey Sand
SP = Poorly Graded Sand

**HSU = Hydrostratigraphic Unit**
UA = uppermost aquifer

**TABLE 2-2. SOIL ANALYTICAL RESULTS**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
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-01C | Peoria/Roxana Loess | 10-24 | 02/05/2021 | <2.8 | <0.93 | 62 | <0.93 | <9.3 | <0.93 | <10 | 13 | 2.3 | 3.8 | 7.1 | 5.8 | <0.19 | <0.93 | <0.93 | 48 | <0.93 |
| SB-01C | Upper Radnor Till | 26-30 | 02/05/2021 | <2.3 | 2.6 | 9 | <0.76 | <7.6 | <0.76 | 38 | 4.7 | 2.7 | <2.5 | 3.7 | <3.8 | <0.15 | <0.76 | <0.76 | 12 | <0.76 |
| SB-01C | Shallow Sand Zone | 32-38 | 02/05/2021 | <3 | 6.2 | 21 | <1 | <10 | <1 | <10 | 5.6 | 5.1 | <2.5 | 5.9 | <5 | <0.2 | 2.8 | <1 | 10 | <1 |
| SB-01C | Lower Radnor Till | 38-46 | 02/05/2021 | <3.3 | 4.8 | 27 | <1.1 | <11 | 1.6 | <11 | 11 | 8 | <2.7 | 10 | 11 | <0.22 | 4.6 | <1.1 | 3900 | <1.1 |
| SB-02 | Peoria/Roxana Loess | 4-6 | 02/03/2021 | <2.8 | 1.1 | 38 | <0.92 | <9.2 | <0.92 | <10 | 11 | 2.2 | <2.5 | 4 | 6 | <0.18 | <0.92 | <0.92 | 320 | <0.92 |
| SB-02 | Upper Radnor Till | 16-22 | 02/03/2021 | <3 | 1.1 | 78 | <1 | <10 | <1 | <10 | 11 | 5.2 | <2.5 | 13 | 5.3 | <0.2 | <1 | <1 | <10 | <1 |
| SB-02 | Upper Radnor Till | 22-26 | 02/03/2021 | <3 | 3 | 51 | <1 | <10 | 1.8 | <10 | 36 | 7.4 | <2.5 | 10 | 12 | <0.2 | 1.4 | <2 | 18 | <1 |
| SB-02 | Lower Radnor Till | 28-40 | 02/04/2021 | <3.4 | 4.4 | 170 | 1.6 | 29 | 6.2 | <11 | 26 | 11 | 7 | 8.1 | 7.9 | <0.22 | 4.8 | 4.9 | 5600 | <1.1 |
| SB-03 | Peoria/Roxana Loess | 6-16 | 02/02/2021 | <2.8 | 1.2 | 49 | <0.92 | <9.2 | <0.92 | <10 | 16 | 4.6 | <2.5 | 5.4 | 6.9 | <0.18 | <0.92 | <0.92 | 150 | <0.92 |
| SB-03 | Shallow Sand Zone | 18-20 | 02/02/2021 | <3 | 5.4 | 56 | <1 | <10 | <1 | <10 | 11 | 5.4 | <2.5 | 6.7 | 6.2 | <0.2 | <1 | <1 | 15 | <1 |
| SB-03 | Lower Radnor Till | 20-26 | 02/02/2021 | <3 | 4.4 | 54 | <1 | <10 | <1 | <10 | 11 | 5.7 | <2.5 | 8 | 9 | <0.2 | 1.2 | <1 | <10 | <1 |

**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
BOTTOM ASH BASIN
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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BA01 | UA | 12/16/2015 | -- | 587.09 | Top of Disk | 584.44 | 33.06 | 37.73 | 551.49 | 546.82 | 38.20 | 544.10 | 4.7 | 2 | 40.468895 | -89.982141 |
| BA01C | BR | 02/08/2021 | 586.64 | 586.64 | Top of PVC | 584.35 | 35.81 | 45.26 | 548.54 | 539.09 | 45.90 | 538.45 | 9.45 | 2 | 40.468897 | -89.982103 |
| BA01L | PMP | 02/05/2021 | 586.80 | 586.80 | Top of PVC | 584.24 | 11.90 | 21.37 | 572.34 | 562.87 | 22.15 | 562.09 | 9.47 | 2 | 40.468897 | -89.982116 |
| BA02 | UA | 12/30/2015 | -- | 579.92 | Top of Disk | 577.18 | 23.63 | 28.43 | 553.65 | 548.85 | 28.80 | 547.90 | 4.8 | 2 | 40.468427 | -89.981325 |
| BA02L | PMP | 02/04/2021 | 579.91 | 579.91 | Top of PVC | 577.17 | 6.98 | 11.66 | 570.19 | 565.51 | 12.09 | 565.08 | 9.52 | 2 | 40.468439 | -89.981326 |
| BA03 | UA | 12/29/2015 | -- | 578.34 | Top of Disk | 575.73 | 16.11 | 25.57 | 559.75 | 550.29 | 26.20 | 548.40 | 9.5 | 2 | 40.468091 | -89.982136 |
| BA03L | PMP | 02/02/2021 | 577.75 | 577.75 | Top of PVC | 575.13 | 5.25 | 9.94 | 569.88 | 565.19 | 10.29 | 564.84 | 4.69 | 2 | 40.468077 | -89.982135 |
| BA04 | UA | 12/29/2015 | -- | 578.19 | Top of Disk | 575.55 | 24.58 | 29.38 | 551.07 | 546.27 | 29.80 | 545.70 | 4.8 | 2 | 40.468382 | -89.982991 |
| BA05 | UA | 07/28/2016 | -- | 595.72 | Top of Disk | 593.23 | 36.48 | 46.08 | 556.39 | 546.79 | 46.60 | 546.30 | 9.6 | 2 | 40.469355 | -89.983075 |
| BA06 | UA | 08/03/2016 | -- | 595.63 | Top of Disk | 593.12 | 32.32 | 41.93 | 560.58 | 550.97 | 42.40 | 548.90 | 9.6 | 2 | 40.469324 | -89.980961 |

**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
ft = foot or feet
HSU = Hydrostratigraphic Unit
PMP = potential migration pathway
PVC = polyvinyl chloride
UA = uppermost aquifer

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**TABLE 3-2. VERTICAL HYDRAULIC GRADIENTS**

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
CANTON, ILLINOIS

| Date | BA01L Groundwater Elevation (ft NAVD88) | BA01 Groundwater Elevation (ft NAVD88) | Head Change (ft) | Distance Change [1] (ft) | Vertical Hydraulic Gradient [2] (dh/dl) | |
|---|---|---|---|---|---|---|
| | PMP | UA | | | | |
| 4/14/2021 | 579.44 | 574.89 | 4.55 | 18.58 | 0.245 | down |
| 4/28/2021 | 577.00 | 574.31 | 2.69 | 18.58 | 0.145 | down |
| 5/10/2021 | 577.47 | 575.26 | 2.21 | 18.58 | 0.119 | down |
| 6/1/2021 | 577.92 | 575.03 | 2.89 | 18.58 | 0.156 | down |
| 6/10/2021 | 576.38 | 573.97 | 2.41 | 18.58 | 0.130 | down |
| 6/21/2021 | 574.68 | 572.91 | 1.77 | 18.58 | 0.095 | down |
| 7/12/2021 | 577.60 | 574.85 | 2.75 | 18.58 | 0.148 | down |
| 7/26/2021 | 576.65 | 574.02 | 2.63 | 18.58 | 0.142 | down |
| 8/5/2021 | 574.73 | 572.68 | 2.05 | 18.58 | 0.110 | down |
| | | | Middle of screen elevation BA01L | | | 567.6 |
| | | | Middle of screen elevation BA01 | | | 549.0 |

| Date | BA02L Groundwater Elevation (ft NAVD88) | BA02 Groundwater Elevation (ft NAVD88) | Head Change (ft) | Distance Change [1] (ft) | Vertical Hydraulic Gradient [2] (dh/dl) | |
|---|---|---|---|---|---|---|
| | PMP | UA | | | | |
| 4/14/2021 | 574.63 | 574.38 | 0.25 | 14.27 | 0.0175 | down |
| 4/28/2021 | 573.24 | 572.97 | 0.27 | 14.27 | 0.0189 | down |
| 5/10/2021 | 574.75 | 574.46 | 0.29 | 14.27 | 0.0203 | down |
| 6/1/2021 | 573.94 | 573.72 | 0.22 | 14.27 | 0.0154 | down |
| 6/10/2021 | 572.77 | 572.51 | 0.26 | 14.27 | 0.0182 | down |
| 6/21/2021 | 571.54 | 571.28 | 0.26 | 14.27 | 0.0182 | down |
| 7/12/2021 | 574.21 | 573.64 | 0.57 | 14.27 | 0.0399 | down |
| 7/26/2021 | 572.81 | 572.55 | 0.26 | 14.27 | 0.0182 | down |
| 8/5/2021 | 571.42 | 571.20 | 0.22 | 14.27 | 0.0154 | down |
| | | | Middle of screen elevation BA02L | | | 565.4 |
| | | | Middle of screen elevation BA02 | | | 551.2 |

**TABLE 3-2. VERTICAL HYDRAULIC GRADIENTS**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
CANTON, ILLINOIS

| Date | BA03L Groundwater Elevation (ft NAVD88) | BA03 Groundwater Elevation (ft NAVD88) | Head Change (ft) | Distance Change [1] (ft) | Vertical Hydraulic Gradient [2] (dh/dl) | |
|---|---|---|---|---|---|---|
| | PMP | UA | | | | |
| 4/14/2021 | 574.20 | 574.29 | -0.09 | 12.83 | -0.0070 | up |
| 4/28/2021 | 571.92 | 572.05 | -0.13 | 12.83 | -0.0101 | up |
| 5/10/2021 | 574.42 | 574.38 | 0.04 | 12.83 | 0.0031 | down |
| 6/1/2021 | 572.87 | 572.94 | -0.07 | 12.83 | -0.0055 | up |
| 6/10/2021 | 570.79 | 570.90 | -0.11 | 12.83 | -0.0086 | up |
| 6/21/2021 | 570.52 | 570.54 | -0.02 | 12.83 | -0.0016 | up |
| 7/12/2021 | 574.31 | 574.24 | 0.07 | 12.83 | 0.0055 | down |
| 7/26/2021 | 571.92 | 571.93 | -0.01 | 12.83 | -0.0008 | flat |
| 8/5/2021 | 569.95 | 570.12 | -0.17 | 15.08 | -0.0113 | up |
| | | | Middle of screen elevation BA03L | | | 567.7 |
| | | | Middle of screen elevation BA03 | | | 554.9 |

[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
BOTTOM ASH BASIN
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** | | | | | | | | | | | |
| BA01L | U | 562.87 | 9.47 | ML, CL | Solid | KGS Model | 3.00E-04 | 3.40E-04 | 1.50E-04 | 3.90E-03 | 6.3E-04 |
| BA02L | D | 565.51 | 9.52 | ML | Solid | KGS Model | 1.70E-04 | 2.30E-04 | | | |
| BA03L | D | 565.19 | 4.69 | ML | Solid | KGS Model | 1.10E-03 | 1.50E-03 | | | |
| BA01 | U | 546.71 | 4.70 | SP, CL | Solid | Hvorslev | 1.50E-04 | --- | | | |
| BA03 | D | 550.16 | 9.50 | ML, SP | Solid | KGS Model | 6.90E-04 | --- | | | |
| BA01C | U | 539.09 | 9.45 | SP, ML | Solid | KGS Model | 3.90E-03 | 3.90E-03 | | | |

[O:EDP 8/25/21 U: LDC 09/09/21, U: 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
cm/s = centimeters per second
D = downgradient
ft = foot/feet
K = hydraulic conductivity
KGS = Kansas Geological Survey
NAVD88 = North American Vertical Datum of 1988
U = upgradient

USCS = Unified Soil Classification System
CL = Lean clay
ML = Silt
SP= Poorly graded sand

**TABLE 3-4. HORIZONTAL HYDRAULIC GRADIENTS AND GROUNDWATER FLOW VELOCITIES**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
CANTON, ILLINOIS

$\mathbf{V = K\,i\ /\ n_e}$

V = Groundwater Velocity
K = Hydraulic Conductivity [1]
i = hydraulic gradient
$n_e$ = Effective Porosity [2]

**Western Bottom Ash Basin Uppermost Aquifer (BA05 to BA04)**

Distance between Wells (ft): 354
Hydraulic Conductivity (ft/day): 0.67
Effective Porosity (%): 28 Assumes: sand

| Date | BA05 Groundwater Elevation (ft NAVD88) | BA04 Groundwater Elevation (ft NAVD88) | Change in Elevation (ft) | Horizontal Gradient (ft/ft) | Velocity (ft/day) |
|---|---|---|---|---|---|
| | UA | UA | | | |
| 4/14/2021 | 580.32 | 573.94 | 6.38 | 0.0180 | 0.043 |
| 4/28/2021 | 579.05 | 573.52 | 5.53 | 0.0156 | 0.038 |
| 5/10/2021 | 580.53 | 574.42 | 6.11 | 0.0173 | 0.042 |
| 6/1/2021 | 579.53 | 574.28 | 5.25 | 0.0148 | 0.036 |
| 6/10/2021 | 576.85 | 573.30 | 3.55 | 0.0100 | 0.024 |
| 6/21/2021 | 576.22 | 572.39 | 3.83 | 0.0108 | 0.026 |
| 7/12/2021 | 578.96 | 574.38 | 4.58 | 0.0129 | 0.031 |
| 7/26/2021 | 577.38 | 573.63 | 3.75 | 0.0106 | 0.025 |
| 8/5/2021 | 575.53 | 572.38 | 3.15 | 0.0089 | 0.021 |
| | | | **Average** | 0.0132 | 0.032 |

**Central Bottom Ash Basin Uppermost Aquifer (BA01 to BA03)**

Distance between Wells (ft): 294
Hydraulic Conductivity (ft/day): 1.21
Effective Porosity (%): 15 Assumes: sand/silt

| Date | BA01 Groundwater Elevation (ft NAVD88) | BA03 Groundwater Elevation (ft NAVD88) | Change in Elevation (ft) | Horizontal Gradient (ft/ft) | Velocity (ft/day) |
|---|---|---|---|---|---|
| | UA | UA | | | |
| 4/14/2021 | 574.89 | 574.29 | 0.60 | 0.0020 | 0.016 |
| 4/28/2021 | 574.31 | 572.05 | 2.26 | 0.0077 | 0.062 |
| 5/10/2021 | 575.26 | 574.38 | 0.88 | 0.0030 | 0.024 |
| 6/1/2021 | 575.03 | 572.94 | 2.09 | 0.0071 | 0.057 |
| 6/10/2021 | 573.97 | 570.90 | 3.07 | 0.0104 | 0.084 |
| 6/21/2021 | 572.91 | 570.54 | 2.37 | 0.0081 | 0.065 |
| 7/12/2021 | 574.85 | 574.24 | 0.61 | 0.0021 | 0.017 |
| 7/26/2021 | 574.02 | 571.93 | 2.09 | 0.0071 | 0.057 |
| 8/5/2021 | 572.68 | 570.12 | 2.56 | 0.0087 | 0.070 |
| | | | **Average** | 0.0062 | 0.050 |

**TABLE 3-4. HORIZONTAL HYDRAULIC GRADIENTS AND GROUNDWATER FLOW VELOCITIES**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
CANTON, ILLINOIS

**Eastern Bottom Ash Basin Uppermost Aquifer (BA06 to BA02)**

Distance between Wells (ft): 341
Hydraulic Conductivity (ft/day): 0.67
Effective Porosity (%): 17.5 Assumes: clay/sand

| Date | BA06 Groundwater Elevation (ft NAVD88) | BA02 Groundwater Elevation (ft NAVD88) | Change in Elevation (ft) | Horizontal Gradient (ft/ft) | Velocity (ft/day) |
|---|---|---|---|---|---|
| | UA | UA | | | |
| 4/14/2021 | 575.98 | 574.38 | 1.60 | 0.0047 | 0.02 |
| 4/28/2021 | 575.54 | 572.97 | 2.57 | 0.0075 | 0.03 |
| 5/10/2021 | 576.13 | 574.46 | 1.67 | 0.0049 | 0.02 |
| 6/1/2021 | 575.88 | 573.72 | 2.16 | 0.0063 | 0.02 |
| 6/10/2021 | 574.58 | 572.51 | 2.07 | 0.0061 | 0.02 |
| 6/21/2021 | 572.53 | 571.28 | 1.25 | 0.0037 | 0.01 |
| 7/12/2021 | 585.29 | 573.64 | 11.65 | 0.0342 | 0.13 |
| 7/26/2021 | 573.29 | 572.55 | 0.74 | 0.0022 | 0.01 |
| 8/5/2021 | 571.40 | 571.20 | 0.20 | 0.0006 | 0.002 |
| | | | **Average** | 0.0078 | 0.03 |

[O: EDP 8/28/21, C: SSW 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 (44%) 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
BOTTOM ASH BASIN
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 |
| BA01 | 02/05/2016 | <0.003 | 0.0028 | 0.18 | <0.001 | 0.017 | <0.001 | 120 | 11 | <0.004 | <0.002 | <0.25 | 0.0057 | <0.01 | 0.0002 | 0.0022 | 6.2 | 0.758 | <0.001 | 120 | <0.001 | 560 |
| BA01 | 04/22/2016 | <0.003 | 0.001 | 0.17 | <0.001 | 0.019 | <0.001 | 120 | 9.6 | <0.004 | <0.002 | 0.272 | 0.0032 | <0.01 | <0.0002 | 0.0019 | 6.8 | 0.852 | <0.001 | 120 | <0.001 | 360 |
| BA01 | 06/28/2016 | <0.003 | <0.001 | 0.18 | <0.001 | 0.017 | <0.001 | 140 | 11 | <0.004 | <0.002 | <0.25 | <0.001 | <0.01 | <0.0002 | 0.002 | 6.9 | 0.62 | <0.001 | 120 | <0.001 | 600 |
| BA01 | 08/11/2016 | <0.003 | 0.0055 | 0.17 | <0.001 | 0.03 | <0.001 | 130 | 11 | <0.004 | <0.002 | 0.29 | 0.0083 | <0.01 | <0.0002 | 0.0019 | 7.0 | 1.08 | <0.001 | 130 | <0.001 | 540 |
| BA01 | 10/29/2016 | <0.003 | 0.0055 | 0.14 | <0.001 | 0.033 | <0.001 | 98 | 11 | <0.004 | <0.002 | 0.287 | 0.0077 | <0.01 | <0.0002 | 0.0022 | 6.9 | 0.983 | <0.001 | 130 | <0.001 | 590 |
| BA01 | 01/25/2017 | <0.003 | 0.006 | 0.14 | <0.001 | 0.019 | <0.001 | 100 | 9.6 | <0.004 | <0.002 | <0.25 | 0.0051 | <0.01 | <0.0002 | 0.002 | 6.9 | 0.403 | <0.001 | 120 | <0.001 | 600 |
| BA01 | 05/03/2017 | <0.003 | 0.013 | 0.23 | <0.001 | 0.13 | <0.001 | 140 | 13 | 0.0084 | 0.0047 | 0.266 | 0.027 | <0.01 | <0.0002 | 0.009 | 6.8 | 0.422 | 0.002 | 130 | <0.001 | 560 |
| BA01 | 06/26/2017 | <0.003 | 0.0079 | 0.17 | <0.001 | 0.023 | <0.001 | 110 | 12 | <0.004 | 0.0022 | <0.25 | 0.0089 | <0.01 | <0.0002 | 0.0028 | 7.0 | 1.84 | <0.001 | 140 | <0.001 | 500 |
| BA01 | 11/07/2017 | -- | -- | -- | -- | 0.044 | -- | 120 | 11 | -- | -- | 0.317 | -- | -- | -- | -- | 6.9 | -- | -- | 150 | -- | 580 |
| BA01 | 06/05/2018 | -- | -- | -- | -- | 0.019 | -- | 120 | 11 | -- | -- | 0.254 | -- | -- | -- | -- | 7.1 | -- | -- | 140 | -- | 520 |
| BA01 | 10/13/2018 | -- | -- | -- | -- | 0.024 | -- | 130 | 9.9 | -- | -- | <0.25 | -- | -- | -- | -- | 7.1 | -- | -- | 150 | -- | 640 |
| BA01 | 02/07/2019 | -- | -- | -- | -- | 0.036 | -- | 120 | 9.9 | -- | -- | <0.25 | -- | -- | -- | -- | 7.0 | -- | -- | 140 | -- | 640 |
| BA01 | 07/10/2019 | -- | -- | -- | -- | 0.032 | -- | 130 | 8.4 | -- | -- | 0.278 | -- | -- | -- | -- | 7.0 | -- | -- | 140 | -- | 610 |
| BA01 | 01/13/2020 | -- | -- | -- | -- | 0.033 | -- | 130 | 11 | -- | -- | 0.251 | -- | -- | -- | -- | 6.7 | -- | -- | 140 | -- | 570 |
| BA01 | 06/09/2020 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 6.9 | -- | -- | -- | -- | -- |
| BA01 | 08/13/2020 | -- | -- | -- | -- | 0.021 | -- | 120 | 13 | -- | -- | <0.25 | -- | -- | -- | -- | 6.5 | -- | -- | 150 | -- | 540 |
| BA01 | 11/19/2020 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 6.9 | -- | -- | -- | -- | -- |
| BA01 | 02/19/2021 | -- | -- | -- | -- | 0.026 | -- | 120 | 13 | -- | -- | <0.25 | -- | -- | -- | -- | 6.9 | -- | -- | 140 | -- | 520 |
| BA01C | 04/14/2021 | <0.003 | 0.0064 | 0.31 | <0.001 | 0.12 | <0.001 | 140 | 16 | 0.045 | 0.01 | 0.297 | 0.011 | 0.028 | <0.0002 | 0.0094 | 7.2 | 4.76 | 0.0018 | 140 | <0.001 | 610 |
| BA01C | 04/29/2021 | <0.003 | 0.005 | 0.24 | <0.001 | 0.094 | <0.001 | 150 | 14 | 0.034 | 0.006 | 0.257 | 0.0069 | <0.02 | <0.0002 | 0.0072 | 7.2 | -- | 0.0015 | 140 | <0.001 | 610 |
| BA01C | 05/12/2021 | <0.003 | 0.0026 | 0.21 | <0.001 | 0.073 | <0.001 | 140 | 14 | 0.014 | 0.0027 | <0.25 | 0.0021 | <0.02 | <0.0002 | 0.0058 | 7.3 | 0.437 | <0.001 | 140 | <0.001 | 570 |
| BA01C | 06/01/2021 | <0.003 | 0.0017 | 0.2 | <0.001 | 0.086 | <0.001 | 120 | 14 | 0.012 | 0.0024 | 0.35 | 0.0018 | <0.02 | <0.0002 | 0.0054 | 7.3 | 1.93 | <0.001 | 150 | <0.001 | 630 |

**TABLE 4-1. GROUNDWATER ANALYTICAL RESULTS**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
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 |
| BA01C | 06/14/2021 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0.658 | -- | -- | -- | -- |
| BA01L | 04/14/2021 | <0.003 | 0.0082 | 0.13 | <0.001 | 0.23 | <0.001 | 130 | <50 | 0.013 | 0.0031 | <0.25 | 0.004 | <0.02 | <0.0002 | 0.0015 | 6.7 | 0.388 | <0.001 | 110 | <0.001 | 660 |
| BA01L | 04/29/2021 | <0.003 | 0.0019 | 0.085 | <0.001 | 0.18 | <0.001 | 150 | 8.4 | <0.004 | <0.002 | 0.29 | <0.001 | <0.02 | <0.0002 | 0.0013 | 6.9 | -- | <0.001 | 120 | <0.001 | 720 |
| BA01L | 05/13/2021 | <0.003 | 0.0016 | 0.075 | <0.001 | 0.18 | <0.001 | 140 | 7.8 | <0.004 | <0.002 | <0.25 | <0.001 | <0.02 | <0.0002 | 0.0013 | 6.9 | 0.213 | <0.001 | 130 | <0.001 | 710 |
| BA01L | 06/01/2021 | <0.003 | 0.0014 | 0.074 | <0.001 | 0.2 | <0.001 | 140 | 7.8 | <0.004 | <0.002 | 0.278 | <0.001 | <0.02 | <0.0002 | 0.0013 | 7.0 | 0.171 | <0.001 | 110 | <0.001 | 720 |
| BA01L | 06/14/2021 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1.33 | -- | -- | -- | -- |
| BA02 | 02/05/2016 | <0.003 | 0.019 | 0.25 | <0.001 | 0.045 | <0.001 | 100 | 6.8 | <0.004 | <0.002 | <0.25 | <0.001 | <0.01 | <0.0002 | 0.0056 | 6.3 | 0.897 | 0.015 | 3.9 | <0.001 | 440 |
| BA02 | 04/22/2016 | <0.003 | 0.0021 | 0.22 | <0.001 | 0.04 | <0.001 | 100 | 6.2 | <0.004 | <0.002 | 0.261 | <0.001 | <0.01 | <0.0002 | 0.005 | 6.5 | 0.927 | <0.001 | 3.4 | <0.001 | 320 |
| BA02 | 06/28/2016 | <0.003 | 0.0052 | 0.25 | 0.0068 | 0.033 | <0.001 | 130 | 7.4 | <0.004 | <0.002 | <0.25 | 0.0071 | <0.01 | <0.0002 | 0.0046 | 6.6 | 0.753 | <0.001 | 4.2 | <0.001 | 500 |
| BA02 | 08/11/2016 | <0.003 | <0.001 | 0.16 | <0.001 | 0.036 | <0.001 | 83 | 7.3 | <0.004 | <0.002 | <0.25 | <0.001 | <0.01 | <0.0002 | 0.0036 | 7.1 | 0.93 | <0.001 | 6.6 | <0.001 | 460 |
| BA02 | 10/29/2016 | <0.003 | 0.0043 | 0.19 | <0.001 | 0.045 | <0.001 | 100 | 8 | <0.004 | <0.002 | 0.25 | <0.001 | <0.01 | <0.0002 | 0.0037 | 7.2 | 1.52 | <0.001 | 5.5 | <0.001 | 420 |
| BA02 | 01/25/2017 | <0.003 | 0.0056 | 0.18 | <0.001 | 0.027 | <0.001 | 80 | 8.5 | <0.004 | <0.002 | <0.25 | <0.001 | <0.01 | <0.0002 | 0.0033 | 7.1 | 0.346 | <0.001 | 6.9 | <0.001 | 440 |
| BA02 | 05/03/2017 | <0.003 | 0.01 | 0.24 | <0.001 | 0.046 | <0.001 | 110 | 10 | <0.004 | <0.002 | <0.25 | 0.0013 | <0.01 | <0.0002 | 0.0066 | 7.2 | 0.443 | 0.0062 | 15 | <0.001 | 430 |
| BA02 | 06/26/2017 | <0.003 | 0.012 | 0.26 | <0.001 | 0.037 | <0.001 | 91 | 9.6 | <0.004 | <0.002 | <0.25 | 0.0013 | <0.01 | <0.0002 | 0.0068 | 7.3 | 0.983 | <0.001 | 10 | 0.001 | 380 |
| BA02 | 11/07/2017 | -- | -- | -- | -- | 0.046 | -- | 82 | 9.7 | -- | -- | 0.308 | -- | -- | -- | -- | 7.1 | -- | -- | 10 | -- | 480 |
| BA02 | 06/05/2018 | -- | -- | -- | -- | 0.041 | -- | 100 | 9.3 | -- | -- | <0.25 | -- | -- | -- | -- | 7.3 | -- | -- | 13 | -- | 420 |
| BA02 | 10/13/2018 | -- | -- | -- | -- | 0.057 | -- | 110 | 9.9 | -- | -- | <0.25 | -- | -- | -- | -- | 7.2 | -- | -- | 11 | -- | 500 |
| BA02 | 02/07/2019 | -- | -- | -- | -- | 0.071 | -- | 110 | 10 | -- | -- | <0.25 | -- | -- | -- | -- | 7.3 | -- | -- | 21 | -- | 540 |
| BA02 | 07/10/2019 | -- | -- | -- | -- | 0.061 | -- | 110 | 10 | -- | -- | 0.282 | -- | -- | -- | -- | 7.3 | -- | -- | 16 | -- | 520 |
| BA02 | 01/13/2020 | -- | -- | -- | -- | 0.058 | -- | 92 | 9.6 | -- | -- | <0.25 | -- | -- | -- | -- | 7.3 | -- | -- | 19 | -- | 450 |
| BA02 | 08/13/2020 | -- | -- | -- | -- | 0.065 | -- | 100 | 10 | -- | -- | <0.25 | -- | -- | -- | -- | 6.6 | -- | -- | 15 | -- | 490 |
| BA02 | 11/19/2020 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 7.1 | -- | -- | -- | -- | -- |

**TABLE 4-1. GROUNDWATER ANALYTICAL RESULTS**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
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 |
| BA02 | 02/19/2021 | -- | -- | -- | -- | 0.059 | -- | 94 | 12 | -- | -- | <0.25 | -- | -- | -- | -- | 7.0 | -- | -- | 15 | -- | 410 |
| BA02L | 04/14/2021 | <0.003 | 0.014 | 0.12 | <0.001 | 0.085 | <0.001 | 65 | 7.1 | 0.018 | 0.0066 | 0.672 | 0.0087 | <0.02 | <0.0002 | 0.013 | 7.5 | 1.52 | <0.001 | 4.3 | <0.001 | 240 |
| BA02L | 04/28/2021 | <0.003 | 0.011 | 0.052 | <0.001 | 0.086 | <0.001 | 50 | 7.4 | <0.004 | <0.002 | 0.575 | <0.001 | <0.02 | <0.0002 | 0.015 | 7.4 | -- | <0.001 | 1.3 | <0.001 | 280 |
| BA02L | 05/12/2021 | <0.003 | 0.01 | 0.049 | <0.001 | 0.081 | <0.001 | 45 | 6 | <0.004 | <0.002 | 0.692 | <0.001 | <0.02 | <0.0002 | 0.013 | 7.6 | 0.117 | <0.001 | 5.3 | <0.001 | 200 |
| BA02L | 06/01/2021 | <0.003 | 0.0099 | 0.046 | <0.001 | 0.089 | <0.001 | 45 | 5.4 | <0.004 | <0.002 | 0.627 | <0.001 | <0.02 | <0.0002 | 0.013 | 7.6 | 1.82 | <0.001 | 6.9 | <0.001 | 200 |
| BA02L | 06/14/2021 | <0.003 | 0.011 | 0.046 | <0.001 | 0.088 | <0.001 | 48 | 5.9 | <0.004 | <0.002 | 0.627 | <0.001 | <0.02 | <0.0002 | 0.015 | 7.5 | 0.0508 | <0.001 | 3.7 | <0.001 | 240 |
| BA02L | 06/21/2021 | <0.003 | 0.011 | 0.048 | <0.001 | 0.096 | <0.001 | 46 | 5.9 | <0.004 | <0.002 | 0.686 | <0.001 | <0.02 | <0.0002 | 0.014 | 7.6 | 0.394 | <0.001 | 3 | <0.001 | 230 |
| BA02L | 07/12/2021 | <0.003 | 0.012 | 0.057 | <0.001 | 0.1 | <0.001 | 47 | 3.5 | <0.004 | <0.002 | 0.564 | 0.0017 | <0.02 | <0.0002 | 0.0099 | 7.5 | 0.442 | <0.001 | 13 | <0.001 | 230 |
| BA02L | 07/27/2021 | <0.003 | 0.012 | 0.052 | <0.001 | 0.1 | <0.001 | 42 | 3.9 | <0.004 | <0.002 | 0.702 | <0.001 | <0.02 | <0.0002 | 0.011 | 7.4 | 0.267 | <0.001 | 5.4 | <0.001 | 190 |
| BA03 | 02/05/2016 | <0.003 | <0.001 | 0.19 | <0.001 | 0.03 | <0.001 | 99 | 9.3 | <0.004 | <0.002 | 0.252 | <0.001 | <0.01 | <0.0002 | 0.007 | 7.1 | 1.25 | 0.0038 | 26 | <0.001 | 420 |
| BA03 | 04/22/2016 | <0.003 | <0.001 | 0.21 | <0.001 | 0.028 | <0.001 | 100 | 6.8 | <0.004 | <0.002 | 0.291 | 0.0018 | <0.01 | <0.0002 | 0.0043 | 7.1 | 1.3 | <0.001 | 22 | <0.001 | 290 |
| BA03 | 06/28/2016 | <0.003 | 0.001 | 0.26 | <0.001 | 0.031 | <0.001 | 120 | 5.8 | 0.0046 | <0.002 | <0.25 | 0.0018 | <0.01 | <0.0002 | 0.005 | 7.2 | 0.264 | <0.001 | 21 | <0.001 | 460 |
| BA03 | 08/11/2016 | <0.003 | <0.001 | 0.23 | <0.001 | 0.038 | <0.001 | 97 | 5.8 | <0.004 | <0.002 | 0.287 | <0.001 | <0.01 | <0.0002 | 0.0025 | 7.3 | 0.857 | <0.001 | 21 | <0.001 | 400 |
| BA03 | 10/29/2016 | <0.003 | <0.001 | 0.21 | <0.001 | 0.05 | <0.001 | 100 | 6.1 | <0.004 | <0.002 | 0.303 | <0.001 | <0.01 | <0.0002 | 0.0025 | 7.3 | 0.264 | <0.001 | 21 | <0.001 | 430 |
| BA03 | 01/25/2017 | <0.003 | <0.001 | 0.17 | <0.001 | 0.026 | <0.001 | 79 | 6.4 | <0.004 | <0.002 | <0.25 | <0.001 | <0.01 | <0.0002 | 0.0029 | 7.2 | 1.12 | 0.0011 | 18 | <0.001 | 380 |
| BA03 | 05/03/2017 | <0.003 | 0.0022 | 0.2 | <0.001 | 0.033 | <0.001 | 110 | 7.3 | 0.0053 | <0.002 | 0.264 | 0.0024 | <0.01 | 0.0012 | 0.0033 | 7.1 | 0.489 | 0.0086 | 21 | <0.001 | 440 |
| BA03 | 06/26/2017 | <0.003 | <0.001 | 0.21 | <0.001 | 0.027 | <0.001 | 86 | 6.3 | <0.004 | <0.002 | <0.25 | <0.001 | <0.01 | <0.0002 | 0.0024 | 7.3 | 1.41 | <0.001 | 19 | <0.001 | 380 |
| BA03 | 11/07/2017 | -- | -- | -- | -- | 0.037 | -- | 92 | 5.7 | -- | -- | 0.335 | -- | -- | -- | -- | 7.3 | -- | -- | 16 | -- | 440 |
| BA03 | 06/05/2018 | -- | -- | -- | -- | 0.021 | -- | 110 | 6.5 | -- | -- | 0.265 | -- | -- | -- | -- | 7.4 | -- | -- | 18 | -- | 390 |
| BA03 | 10/13/2018 | -- | -- | -- | -- | 0.046 | -- | 150 | 6.4 | -- | -- | <0.25 | -- | -- | -- | -- | 7.3 | -- | -- | 18 | -- | 470 |
| BA03 | 02/07/2019 | -- | -- | -- | -- | 0.026 | -- | 110 | 6.1 | -- | -- | <0.25 | -- | -- | -- | -- | 7.5 | -- | -- | 19 | -- | 500 |
| BA03 | 07/10/2019 | -- | -- | -- | -- | 0.032 | -- | 110 | 6 | -- | -- | 0.314 | -- | -- | -- | -- | 7.3 | -- | -- | 18 | -- | 480 |


RAMBOLL

**TABLE 4-1. GROUNDWATER ANALYTICAL RESULTS**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
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 |
| BA03 | 01/13/2020 | -- | -- | -- | -- | 0.027 | -- | 110 | 6.3 | -- | -- | <0.25 | -- | -- | -- | -- | 7.1 | -- | -- | 20 | -- | 490 |
| BA03 | 08/13/2020 | -- | -- | -- | -- | 0.038 | -- | 100 | 5.9 | -- | -- | <0.25 | -- | -- | -- | -- | 6.9 | -- | -- | 17 | -- | 410 |
| BA03 | 11/19/2020 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 7.0 | -- | -- | -- | -- | -- |
| BA03 | 02/19/2021 | -- | -- | -- | -- | 0.028 | -- | 100 | 6.3 | -- | -- | <0.25 | -- | -- | -- | -- | 7.2 | -- | -- | 19 | -- | 390 |
| BA03L | 04/14/2021 | <0.003 | 0.0013 | 0.15 | <0.001 | 0.2 | <0.001 | 180 | 24 | 0.0084 | <0.002 | <0.25 | 0.0016 | <0.02 | <0.0002 | <0.001 | 6.8 | 0.313 | <0.001 | 330 | <0.001 | 920 |
| BA03L | 04/28/2021 | <0.003 | <0.001 | 0.13 | <0.001 | 0.23 | <0.001 | 180 | 24 | <0.004 | <0.002 | <0.25 | <0.001 | <0.02 | <0.0002 | 0.001 | 6.8 | -- | <0.001 | 350 | <0.001 | 1100 |
| BA03L | 05/12/2021 | <0.003 | <0.001 | 0.13 | <0.001 | 0.19 | <0.001 | 190 | 21 | <0.004 | <0.002 | <0.25 | <0.001 | <0.02 | <0.0002 | <0.001 | 6.9 | 0.356 | <0.001 | 350 | <0.001 | 990 |
| BA03L | 06/01/2021 | <0.003 | <0.001 | 0.12 | <0.001 | 0.21 | <0.001 | 190 | 22 | <0.004 | <0.002 | <0.25 | <0.001 | <0.02 | <0.0002 | <0.001 | 7.0 | 0.614 | <0.001 | 340 | <0.001 | 1100 |
| BA03L | 06/14/2021 | <0.003 | 0.0051 | 0.33 | 0.0015 | 0.29 | <0.001 | 280 | 24 | 0.055 | 0.017 | 0.311 | 0.023 | 0.026 | <0.0002 | 0.0016 | 6.9 | 4.29 | 0.0017 | 370 | <0.001 | 1200 |
| BA03L | 06/21/2021 | <0.003 | 0.0012 | 0.17 | <0.001 | 0.26 | <0.001 | 200 | 20 | 0.012 | 0.0025 | <0.25 | 0.0035 | <0.02 | <0.0002 | 0.0011 | 6.9 | 0.238 | <0.001 | 370 | <0.001 | 1000 |
| BA03L | 07/12/2021 | <0.003 | <0.001 | 0.15 | <0.001 | 0.24 | <0.001 | 180 | 23 | 0.0075 | <0.002 | 0.262 | 0.0023 | <0.02 | <0.0002 | 0.001 | 6.8 | 1.35 | <0.001 | 350 | <0.001 | 1000 |
| BA03L | 07/27/2021 | <0.003 | <0.001 | 0.15 | <0.001 | 0.27 | <0.001 | 170 | 24 | 0.0051 | <0.002 | 0.265 | 0.0015 | <0.02 | <0.0002 | <0.001 | 6.8 | 1.38 | <0.001 | 350 | <0.001 | 960 |
| BA04 | 02/05/2016 | <0.003 | <0.001 | 0.19 | <0.001 | 0.018 | <0.001 | 100 | 23 | <0.004 | <0.002 | 0.282 | <0.001 | <0.01 | <0.0002 | 0.0069 | 6.9 | 0.831 | 0.0031 | 100 | <0.001 | 560 |
| BA04 | 04/22/2016 | <0.003 | <0.001 | 0.14 | <0.001 | 0.21 | <0.001 | 120 | 27 | <0.004 | <0.002 | 0.336 | <0.001 | <0.01 | <0.0002 | 0.0023 | 7.1 | 1.12 | <0.001 | 110 | <0.001 | 390 |
| BA04 | 06/28/2016 | <0.003 | <0.001 | 0.13 | <0.001 | 0.2 | <0.001 | 140 | 26 | <0.004 | <0.002 | 0.283 | 0.0011 | <0.01 | <0.0002 | 0.0033 | 7.2 | 1.2 | <0.001 | 120 | <0.001 | 600 |
| BA04 | 08/11/2016 | <0.003 | <0.001 | 0.17 | <0.001 | 0.15 | <0.001 | 130 | 22 | <0.004 | <0.002 | 0.362 | <0.001 | <0.01 | <0.0002 | 0.0018 | 7.4 | 0.084 | <0.001 | 99 | <0.001 | 560 |
| BA04 | 10/29/2016 | <0.003 | <0.001 | 0.1 | <0.001 | 0.2 | <0.001 | 100 | 22 | <0.004 | <0.002 | 0.38 | <0.001 | <0.01 | <0.0002 | 0.002 | 7.4 | 0.915 | <0.001 | 100 | <0.001 | 550 |
| BA04 | 01/25/2017 | <0.003 | <0.001 | 0.099 | <0.001 | 0.16 | <0.001 | 97 | 25 | <0.004 | <0.002 | 0.26 | <0.001 | <0.01 | <0.0002 | 0.0023 | 7.3 | 0.42 | <0.001 | 90 | <0.001 | 590 |
| BA04 | 05/03/2017 | <0.003 | 0.0018 | 0.18 | <0.001 | 0.18 | <0.001 | 130 | 45 | <0.004 | <0.002 | 0.311 | <0.001 | <0.01 | <0.0002 | 0.0027 | 7.2 | 0.744 | <0.001 | 150 | <0.001 | 640 |
| BA04 | 06/26/2017 | <0.003 | <0.001 | 0.13 | <0.001 | 0.1 | <0.001 | 110 | 55 | <0.004 | <0.002 | 0.255 | <0.001 | <0.01 | <0.0002 | 0.0016 | 7.1 | 1.42 | <0.001 | 120 | <0.001 | 510 |
| BA04 | 11/07/2017 | -- | -- | -- | -- | 0.28 | -- | 110 | 33 | -- | -- | 0.361 | -- | -- | -- | -- | 7.3 | -- | -- | 140 | -- | 600 |
| BA04 | 06/05/2018 | -- | -- | -- | -- | 0.1 | -- | 120 | 25 | -- | -- | 0.327 | -- | -- | -- | -- | 6.9 | -- | -- | 120 | -- | 520 |



RAMBOLL

**TABLE 4-1. GROUNDWATER ANALYTICAL RESULTS**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
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 |
| BA04 | 10/13/2018 | -- | -- | -- | -- | 0.54 | -- | 120 | 28 | -- | -- | 0.291 | -- | -- | -- | -- | 7.1 | -- | -- | 120 | -- | 670 |
| BA04 | 02/07/2019 | -- | -- | -- | -- | 1.8 | -- | 120 | 36 | -- | -- | <0.25 | -- | -- | -- | -- | 7.1 | -- | -- | 140 | -- | 680 |
| BA04 | 07/17/2019 | -- | -- | -- | -- | 0.09 | -- | 120 | 36 | -- | -- | 0.326 | -- | -- | -- | -- | 7.1 | -- | -- | 120 | -- | 700 |
| BA04 | 01/13/2020 | -- | -- | -- | -- | 0.33 | -- | 150 | 35 | -- | -- | <0.25 | -- | -- | -- | -- | 7.0 | -- | -- | 150 | -- | 710 |
| BA04 | 08/13/2020 | -- | -- | -- | -- | 1.9 | -- | 130 | 66 | -- | -- | 0.289 | -- | -- | -- | -- | 6.8 | -- | -- | 160 | -- | 690 |
| BA04 | 11/19/2020 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 6.9 | -- | -- | -- | -- | -- |
| BA04 | 02/19/2021 | -- | -- | -- | -- | 2.6 | -- | 130 | 57 | -- | -- | 0.388 | -- | -- | -- | -- | 7.0 | -- | -- | 140 | -- | 580 |
| BA05 | 09/12/2016 | <0.003 | 0.0023 | 0.058 | <0.001 | 0.28 | <0.001 | 72 | 72 | <0.004 | 0.002 | 0.611 | <0.001 | <0.01 | 0.00026 | 0.0058 | 7.6 | 1.93 | <0.001 | 110 | <0.001 | 380 |
| BA05 | 11/01/2016 | <0.003 | 0.0039 | 0.13 | <0.001 | 0.38 | <0.001 | 120 | 42 | <0.004 | 0.0049 | 0.365 | 0.0022 | 0.011 | <0.0002 | 0.0046 | 7.2 | 1.34 | <0.001 | 320 | <0.001 | 750 |
| BA05 | 12/14/2016 | <0.003 | 0.0023 | 0.18 | <0.001 | 0.26 | <0.001 | 110 | 28 | <0.004 | 0.0037 | 0.426 | <0.001 | <0.01 | <0.0002 | 0.0041 | 7.7 | 3.48 | <0.001 | 310 | <0.001 | 940 |
| BA05 | 01/28/2017 | <0.003 | 0.0012 | 0.13 | <0.001 | 0.28 | <0.001 | 110 | 30 | <0.004 | <0.002 | 0.314 | <0.001 | <0.01 | <0.0002 | 0.0042 | 7.4 | 1.22 | <0.001 | 390 | <0.001 | 900 |
| BA05 | 03/06/2017 | <0.003 | 0.0019 | 0.083 | <0.001 | 0.39 | <0.001 | 110 | 81 | <0.004 | <0.002 | 0.4 | 0.0015 | <0.01 | <0.0002 | 0.0063 | 7.2 | 0.498 | <0.001 | 230 | <0.001 | 680 |
| BA05 | 05/03/2017 | <0.003 | 0.005 | 0.18 | <0.001 | 0.26 | <0.001 | 180 | 28 | 0.0058 | 0.0054 | 0.328 | 0.0038 | <0.01 | <0.0002 | 0.0042 | 7.4 | 1.27 | <0.001 | 370 | <0.001 | 890 |
| BA05 | 06/09/2017 | <0.003 | 0.0034 | 0.19 | <0.001 | 0.2 | <0.001 | 170 | 16 | <0.004 | 0.003 | <0.25 | <0.001 | <0.01 | <0.0002 | 0.003 | 7.4 | 1.57 | <0.001 | 420 | <0.001 | 880 |
| BA05 | 06/26/2017 | <0.003 | 0.002 | 0.097 | <0.001 | 0.36 | <0.001 | 110 | 54 | <0.004 | <0.002 | 0.304 | 0.0014 | <0.01 | <0.0002 | 0.0049 | 7.3 | 0.475 | <0.001 | 260 | <0.001 | 610 |
| BA05 | 11/09/2017 | -- | -- | -- | -- | 0.19 | -- | 220 | 20 | -- | -- | 0.349 | -- | -- | -- | -- | 7.3 | -- | -- | 380 | -- | 920 |
| BA05 | 06/05/2018 | -- | -- | -- | -- | 0.16 | -- | 190 | 13 | -- | -- | 0.305 | -- | -- | -- | -- | 7.1 | -- | -- | 440 | -- | 960 |
| BA05 | 10/13/2018 | -- | -- | -- | -- | 0.15 | -- | 200 | 11 | -- | -- | <0.25 | -- | -- | -- | -- | 7.2 | -- | -- | 450 | -- | 1100 |
| BA05 | 02/07/2019 | -- | -- | -- | -- | 0.33 | -- | 160 | 41 | -- | -- | 0.254 | -- | -- | -- | -- | 7.3 | -- | -- | 350 | -- | 970 |
| BA05 | 07/17/2019 | -- | -- | -- | -- | 0.16 | -- | 200 | 10 | -- | -- | 0.295 | -- | -- | -- | -- | 7.2 | -- | -- | 490 | -- | 1200 |
| BA05 | 01/13/2020 | -- | -- | -- | -- | 0.14 | -- | 210 | 11 | -- | -- | <0.25 | -- | -- | -- | -- | 7.0 | -- | -- | 470 | -- | 1100 |
| BA05 | 08/17/2020 | -- | -- | -- | -- | 0.13 | -- | 190 | 8.9 | -- | -- | <0.25 | -- | -- | -- | -- | 6.8 | -- | -- | 500 | -- | 1200 |

**TABLE 4-1. GROUNDWATER ANALYTICAL RESULTS**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
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 |
| BA05 | 11/19/2020 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 6.9 | -- | -- | -- | -- | -- |
| BA05 | 02/19/2021 | -- | -- | -- | -- | 0.12 | -- | 200 | 8.2 | -- | -- | <0.25 | -- | -- | -- | -- | 6.8 | -- | -- | 480 | -- | 1100 |
| BA05 | 04/14/2021 | <0.003 | 0.0027 | 0.075 | <0.001 | 0.12 | <0.001 | 190 | 12 | <0.004 | <0.002 | <0.25 | <0.001 | <0.02 | <0.0002 | 0.0024 | 7.0 | 0.152 | <0.001 | 490 | <0.001 | 1000 |
| BA05 | 04/28/2021 | <0.003 | 0.0037 | 0.07 | <0.001 | 0.1 | <0.001 | 200 | 2 | <0.004 | <0.002 | <0.25 | <0.001 | <0.02 | <0.0002 | 0.0022 | 7.1 | -- | <0.001 | 490 | <0.001 | 1300 |
| BA05 | 05/12/2021 | <0.003 | 0.0034 | 0.07 | <0.001 | 0.1 | <0.001 | 210 | 8.7 | <0.004 | <0.002 | <0.25 | <0.001 | <0.02 | <0.0002 | 0.0022 | 7.0 | 0.275 | <0.001 | 550 | <0.001 | 1100 |
| BA05 | 06/01/2021 | <0.003 | 0.0035 | 0.067 | <0.001 | 0.11 | <0.001 | 200 | 12 | <0.004 | <0.002 | <0.25 | <0.001 | <0.02 | <0.0002 | 0.0025 | 7.0 | 0.109 | <0.001 | 490 | <0.001 | 1200 |
| BA05 | 06/14/2021 | <0.003 | 0.0038 | 0.072 | <0.001 | 0.11 | <0.001 | 200 | 9 | <0.004 | <0.002 | <0.25 | <0.001 | <0.02 | <0.0002 | 0.0021 | 7.0 | 0.239 | <0.001 | 480 | <0.001 | 1200 |
| BA05 | 06/21/2021 | <0.003 | 0.0022 | 0.066 | <0.001 | 0.11 | <0.001 | 210 | 9.8 | <0.004 | <0.002 | <0.25 | <0.001 | <0.02 | <0.0002 | 0.0022 | 7.0 | 0.147 | <0.001 | 500 | <0.001 | 1200 |
| BA05 | 07/12/2021 | <0.003 | 0.0032 | 0.067 | <0.001 | 0.11 | <0.001 | 200 | 8.9 | <0.004 | <0.002 | <0.25 | <0.001 | <0.02 | <0.0002 | 0.0022 | 7.0 | 0.321 | <0.001 | 480 | <0.001 | 1200 |
| BA05 | 07/26/2021 | <0.003 | 0.0026 | 0.069 | <0.004 | 0.19 | <0.001 | 180 | 7.4 | <0.004 | <0.008 | 0.301 | <0.004 | <0.02 | <0.0008 | 0.0019 | 7.1 | 0.359 | 0.0019 | 500 | <0.001 | 1200 |
| BA06 | 09/12/2016 | <0.003 | 0.0024 | 0.22 | <0.001 | 2.8 | <0.001 | 250 | 470 | 0.0044 | 0.012 | 0.461 | 0.0023 | 0.013 | <0.0002 | 0.0027 | 7.1 | 0.842 | <0.001 | 370 | <0.001 | 1600 |
| BA06 | 11/01/2016 | <0.003 | 0.0029 | 0.2 | <0.001 | 3.4 | <0.001 | 290 | 650 | <0.004 | 0.011 | 0.258 | 0.0019 | 0.014 | <0.0002 | 0.002 | 7.0 | 1.68 | <0.001 | 570 | <0.001 | 1800 |
| BA06 | 12/14/2016 | <0.003 | 0.024 | 0.45 | 0.0021 | 3.1 | <0.001 | 270 | 580 | 0.073 | 0.037 | 0.322 | 0.037 | 0.068 | <0.0002 | 0.0058 | 7.2 | 9.64 | 0.0023 | 430 | <0.001 | 1900 |
| BA06 | 01/28/2017 | <0.003 | 0.023 | 0.48 | 0.0018 | 2.8 | <0.001 | 360 | 610 | 0.073 | 0.037 | 0.294 | 0.042 | 0.063 | <0.0002 | 0.0066 | 7.3 | 1.77 | 0.0018 | 540 | <0.001 | 1700 |
| BA06 | 03/06/2017 | <0.003 | 0.0016 | 0.2 | <0.001 | 2.4 | <0.001 | 270 | 490 | <0.004 | 0.0068 | 0.254 | 0.0012 | 0.018 | <0.0002 | 0.0027 | 7.3 | 0.0607 | <0.001 | 390 | <0.001 | 1600 |
| BA06 | 05/03/2017 | <0.003 | 0.0042 | 0.21 | <0.001 | 3.9 | <0.001 | 370 | 620 | 0.0094 | 0.012 | 0.276 | 0.005 | 0.013 | <0.0002 | 0.0027 | 7.1 | 0.838 | <0.001 | 460 | <0.001 | 1700 |
| BA06 | 06/09/2017 | <0.003 | <0.001 | 0.19 | <0.001 | 3.3 | <0.001 | 350 | 640 | <0.004 | 0.017 | <0.25 | <0.001 | <0.01 | <0.0002 | 0.0017 | 7.0 | 1.46 | <0.001 | 440 | <0.001 | 1500 |
| BA06 | 06/26/2017 | <0.003 | 0.0017 | 0.16 | <0.001 | 2.2 | <0.001 | 240 | 480 | <0.004 | 0.0057 | <0.25 | 0.0014 | 0.013 | <0.0002 | 0.0016 | 7.2 | 0.135 | <0.001 | 380 | <0.001 | 1400 |
| BA06 | 11/09/2017 | -- | -- | -- | -- | 3.5 | -- | 340 | 530 | -- | -- | <0.25 | -- | -- | -- | -- | 6.9 | -- | -- | 400 | -- | 1500 |
| BA06 | 06/05/2018 | -- | -- | -- | -- | 2.9 | -- | 510 | 610 | -- | -- | 0.319 | -- | -- | -- | -- | 7.2 | -- | -- | 450 | -- | 1900 |
| BA06 | 10/13/2018 | -- | -- | -- | -- | 3.8 | -- | 390 | 640 | -- | -- | 0.31 | -- | -- | -- | -- | 7.2 | -- | -- | 480 | -- | 2000 |
| BA06 | 02/07/2019 | -- | -- | -- | -- | 1.5 | -- | 280 | 480 | -- | -- | <0.25 | -- | -- | -- | -- | 7.3 | -- | -- | 300 | -- | 1900 |



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**TABLE 4-1. GROUNDWATER ANALYTICAL RESULTS**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
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 |
| BA06 | 07/17/2019 | -- | -- | -- | -- | 5.2 | -- | 380 | 700 | -- | -- | 0.314 | -- | -- | -- | -- | 7.2 | -- | -- | 500 | -- | 2100 |
| BA06 | 01/13/2020 | -- | -- | -- | -- | 4.9 | -- | 390 | 690 | -- | -- | <0.25 | -- | -- | -- | -- | 6.7 | -- | -- | 480 | -- | 2000 |
| BA06 | 06/09/2020 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 6.5 | -- | -- | -- | -- | -- |
| BA06 | 08/13/2020 | -- | -- | -- | -- | 6 | -- | 360 | 680 | -- | -- | 0.269 | -- | -- | -- | -- | 6.7 | -- | -- | 480 | -- | 2200 |
| BA06 | 11/19/2020 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 6.6 | -- | -- | -- | -- | -- |
| BA06 | 02/19/2021 | -- | -- | -- | -- | 3.9 | -- | 320 | 610 | -- | -- | 0.254 | -- | -- | -- | -- | 6.5 | -- | -- | 380 | -- | 1900 |
| BA06 | 04/14/2021 | <0.003 | 0.0043 | 0.11 | <0.001 | 6.9 | <0.001 | 330 | 600 | <0.004 | 0.0065 | 0.275 | <0.001 | <0.02 | <0.0002 | 0.0015 | 6.7 | 0.478 | <0.001 | 890 | <0.001 | 2000 |
| BA06 | 04/28/2021 | <0.003 | 0.004 | 0.11 | <0.001 | 7.1 | <0.001 | 370 | 660 | <0.004 | 0.0062 | 0.262 | <0.001 | <0.02 | <0.0002 | 0.0018 | 6.6 | -- | <0.001 | 470 | <0.001 | 2200 |
| BA06 | 05/12/2021 | <0.003 | 0.004 | 0.11 | <0.001 | 6.2 | <0.001 | 340 | 630 | <0.004 | 0.0071 | <0.25 | <0.001 | <0.02 | <0.0002 | 0.0013 | 6.7 | 0.137 | <0.001 | 450 | <0.001 | 1700 |
| BA06 | 06/01/2021 | <0.003 | 0.0027 | 0.086 | <0.001 | 7.8 | <0.001 | 350 | 610 | <0.004 | 0.0052 | 0.25 | <0.001 | <0.02 | <0.0002 | 0.0017 | 6.7 | 0.806 | <0.001 | 430 | <0.001 | 2100 |
| BA06 | 06/14/2021 | <0.003 | 0.0023 | 0.093 | <0.001 | 7.5 | <0.001 | 340 | 610 | <0.004 | 0.0046 | <0.25 | <0.001 | <0.02 | <0.0002 | 0.0014 | 6.7 | 0.248 | <0.001 | 420 | <0.001 | 2300 |
| BA06 | 06/21/2021 | <0.003 | 0.0023 | 0.097 | <0.001 | 7.2 | <0.001 | 350 | 580 | <0.004 | 0.006 | <0.25 | <0.001 | <0.02 | <0.0002 | 0.0013 | 6.6 | 0.894 | <0.001 | 390 | <0.001 | 2300 |
| BA06 | 07/12/2021 | <0.003 | 0.0026 | 0.082 | <0.001 | 7.9 | <0.001 | 340 | 580 | <0.004 | 0.0041 | 0.264 | <0.001 | <0.02 | <0.0002 | 0.0015 | 6.7 | 1.18 | <0.001 | 410 | <0.001 | 2000 |
| BA06 | 07/26/2021 | <0.003 | 0.0017 | 0.088 | <0.02 | 7.8 | <0.001 | 310 | 600 | <0.004 | <0.04 | 0.457 | <0.02 | <0.02 | <0.004 | 0.001 | 6.8 | 0.181 | <0.001 | 430 | <0.001 | 2300 |

**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



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**TABLE 4-2. GROUNDWATER FIELD PARAMETERS**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
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) |
|---|---|---|---|---|---|---|---|
| BA01 | 02/05/2016 | 0 | 5 | 6.2 | 1040 | 11.8 | 0 |
| BA01 | 04/22/2016 | 0 | -12 | 6.8 | 1070 | 13.2 | 0 |
| BA01 | 06/28/2016 | 0 | -15 | 6.9 | 1240 | 15.9 | 0 |
| BA01 | 08/11/2016 | 0 | -32 | 7.0 | 1030 | 18.5 | 18.3 |
| BA01 | 10/29/2016 | 0 | -30 | 6.9 | 1095 | 15.0 | 15.6 |
| BA01 | 01/25/2017 | 0 | -62 | 6.9 | 996 | 11.4 | 16.3 |
| BA01 | 05/03/2017 | 0 | -53 | 6.8 | 1020 | 14.0 | 20.4 |
| BA01 | 06/26/2017 | 0 | -63 | 7.0 | 975 | 18.6 | 20.2 |
| BA01 | 11/07/2017 | 0 | -78 | 6.9 | 968 | 13.9 | 19.7 |
| BA01 | 06/05/2018 | 0 | -74 | 7.1 | 1030 | 16.0 | 20.8 |
| BA01 | 10/13/2018 | 0 | -57 | 7.1 | 928 | 14.1 | 21.9 |
| BA01 | 02/07/2019 | 0 | -72 | 7.0 | 981 | 12.4 | 42.6 |
| BA01 | 07/10/2019 | 0 | -60 | 7.0 | 980 | 16.1 | 25.9 |
| BA01 | 01/13/2020 | 0.10 | 50.8 | 6.7 | 974.9 | 10.3 | 88.9 |
| BA01 | 06/09/2020 | 0.50 | -7.5 | 6.9 | 980 | 14.4 | 0.83 |
| BA01 | 08/13/2020 | 0.09 | 16.7 | 6.5 | 923 | 19.2 | 10 |
| BA01 | 11/19/2020 | -- | -- | 6.9 | -- | -- | -- |
| BA01 | 02/19/2021 | 0.34 | -16.1 | 6.9 | 968 | 7.6 | 4.33 |
| BA01C | 04/14/2021 | 2.30 | 46.5 | 7.2 | 1013 | 12.2 | 707 |
| BA01C | 04/29/2021 | 1.30 | -42.1 | 7.2 | 959 | 13.0 | 389 |
| BA01C | 05/12/2021 | 1.60 | 43.7 | 7.3 | 1025 | 14.8 | 119 |
| BA01C | 06/01/2021 | 1.80 | -1.3 | 7.3 | 1003 | 14.4 | 128 |
| BA01L | 04/14/2021 | 1.30 | 12.5 | 6.7 | 1128 | 11.3 | 290 |
| BA01L | 04/29/2021 | 1.30 | -33.1 | 6.9 | 1213 | 12.3 | 57.6 |
| BA01L | 05/13/2021 | 1.80 | -18.8 | 6.9 | 300.9 | 13.8 | 10.7 |
| BA01L | 06/01/2021 | 0.59 | -36.3 | 7.0 | 1182 | 13.5 | 7.15 |
| BA02 | 02/05/2016 | 0 | 44 | 6.3 | 851 | 10.0 | 7.6 |
| BA02 | 04/22/2016 | 0 | 39 | 6.5 | 962 | 13.0 | 11.2 |
| BA02 | 06/28/2016 | 0 | 61 | 6.6 | 990 | 16.1 | 18.5 |
| BA02 | 08/11/2016 | 0 | 61 | 7.1 | 980 | 18.9 | 19.8 |
| BA02 | 10/29/2016 | 0 | 73 | 7.2 | 1044 | 14.8 | 19.8 |
| BA02 | 01/25/2017 | 0 | 65 | 7.1 | 997 | 12.5 | 10.1 |
| BA02 | 05/03/2017 | 0 | 65 | 7.2 | 975 | 14.3 | 13.9 |
| BA02 | 06/26/2017 | 0 | 69 | 7.3 | 1040 | 17.5 | 11.3 |
| BA02 | 11/07/2017 | 0 | 78 | 7.1 | 979 | 13.2 | 13.7 |
| BA02 | 06/05/2018 | 0 | 80 | 7.3 | 996 | 15.4 | 9.3 |
| BA02 | 10/13/2018 | 0 | 70 | 7.2 | 1080 | 14.6 | 11.6 |
| BA02 | 02/07/2019 | 0 | 59 | 7.3 | 1031 | 12.6 | 22.3 |
| BA02 | 07/10/2019 | 0 | 65 | 7.3 | 1025 | 16.0 | 14.8 |
| BA02 | 01/13/2020 | 8.10 | 141 | 7.3 | 644.1 | 8.7 | 32.3 |
| BA02 | 08/13/2020 | 2.10 | 13 | 6.6 | 502 | 22.2 | 152 |
| BA02 | 11/19/2020 | -- | -- | 7.1 | -- | -- | -- |
| BA02 | 02/19/2021 | 3.30 | 71.1 | 7.0 | 880 | 8.4 | 64.5 |
| BA02L | 04/14/2021 | 0.16 | -99 | 7.5 | 334 | 10.1 | 811 |


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**TABLE 4-2. GROUNDWATER FIELD PARAMETERS**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
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) |
|---|---|---|---|---|---|---|---|
| BA02L | 04/28/2021 | 0.77 | -141 | 7.4 | 410.9 | 14.0 | 79.8 |
| BA02L | 05/12/2021 | 0.21 | -162 | 7.6 | 366.1 | 13.0 | 61.1 |
| BA02L | 06/01/2021 | 0.74 | -151 | 7.6 | 334 | 14.5 | 29.2 |
| BA02L | 06/14/2021 | 0.46 | -163 | 7.5 | 320 | 15.4 | 99.9 |
| BA02L | 06/21/2021 | 0.97 | -144 | 7.6 | 373.4 | 16.1 | 59.4 |
| BA02L | 07/12/2021 | 0.98 | -146 | 7.5 | 289 | 18.4 | 54.3 |
| BA02L | 07/27/2021 | 1.20 | -134 | 7.4 | 389 | 20.5 | 151 |
| BA03 | 02/05/2016 | 0 | 115 | 7.1 | 824 | 12.5 | 21.1 |
| BA03 | 04/22/2016 | 0 | 129 | 7.1 | 921 | 13.4 | 17.9 |
| BA03 | 06/28/2016 | 0 | 134 | 7.2 | 1050 | 16.6 | 10.8 |
| BA03 | 08/11/2016 | 0 | 123 | 7.3 | 1010 | 16.8 | 40.2 |
| BA03 | 10/29/2016 | 0 | 99 | 7.3 | 887 | 15.8 | 44.9 |
| BA03 | 01/25/2017 | 0 | 91 | 7.2 | 935 | 11.8 | 37.8 |
| BA03 | 05/03/2017 | 0 | 85 | 7.1 | 924 | 14.1 | 29.9 |
| BA03 | 06/26/2017 | 0 | 81 | 7.3 | 815 | 17.2 | 27.1 |
| BA03 | 11/07/2017 | 0 | 101 | 7.3 | 926 | 13.7 | 36.5 |
| BA03 | 06/05/2018 | 0 | 68 | 7.4 | 843 | 14.8 | 30.6 |
| BA03 | 10/13/2018 | 0 | 77 | 7.3 | 765 | 15.1 | 23.6 |
| BA03 | 02/07/2019 | 0 | 91 | 7.5 | 810 | 11.9 | 31 |
| BA03 | 07/10/2019 | 0 | 79 | 7.3 | 826 | 16.5 | 28 |
| BA03 | 01/13/2020 | 3.60 | 162 | 7.1 | 808.7 | 10.6 | 127 |
| BA03 | 08/13/2020 | 0.31 | 174 | 6.9 | 843 | 17.9 | 1.61 |
| BA03 | 11/19/2020 | -- | -- | 7.0 | -- | -- | -- |
| BA03 | 02/19/2021 | 6.60 | 45.9 | 7.2 | 797 | 10.6 | 90.8 |
| BA03L | 04/14/2021 | 1.40 | 10.4 | 6.8 | 1270 | 11.2 | 89.1 |
| BA03L | 04/28/2021 | 0.24 | 139 | 6.8 | 1504 | 12.3 | 20.9 |
| BA03L | 05/12/2021 | 0.27 | 91.8 | 6.9 | 1473 | 13.3 | 44.2 |
| BA03L | 06/01/2021 | 0.22 | 77.2 | 7.0 | 1472 | 15.1 | 16.7 |
| BA03L | 06/14/2021 | 0.45 | 62.4 | 6.9 | 1466 | 15.7 | 1490 |
| BA03L | 06/21/2021 | 1.50 | 68.5 | 6.9 | 1475 | 16.3 | 189 |
| BA03L | 07/12/2021 | 0.23 | 85.5 | 6.8 | 1478 | 19.0 | 134 |
| BA03L | 07/27/2021 | 0.97 | 104 | 6.8 | 1526 | 20.8 | 68.8 |
| BA04 | 02/05/2016 | 0 | -30 | 6.9 | 1000 | 13.4 | 12.1 |
| BA04 | 04/22/2016 | 0 | -55 | 7.1 | 974 | 13.9 | 17.4 |
| BA04 | 06/28/2016 | 0 | -39 | 7.2 | 1030 | 15.4 | 15.2 |
| BA04 | 08/11/2016 | 0 | -69 | 7.4 | 950 | 18.2 | 24.1 |
| BA04 | 10/29/2016 | 0 | -55 | 7.4 | 989 | 14.3 | 26.5 |
| BA04 | 01/25/2017 | 0 | -44 | 7.3 | 1030 | 12.6 | 26.9 |
| BA04 | 05/03/2017 | 0 | -48 | 7.2 | 1060 | 13.7 | 27.7 |
| BA04 | 06/26/2017 | 0 | -44 | 7.1 | 1110 | 18.5 | 36.2 |
| BA04 | 11/07/2017 | 0 | -41 | 7.3 | 1090 | 12.9 | 28.6 |
| BA04 | 06/05/2018 | 0 | -68 | 6.9 | 1170 | 16.3 | 39.9 |
| BA04 | 10/13/2018 | 0 | -61 | 7.1 | 1140 | 14.8 | 41.7 |
| BA04 | 02/07/2019 | 0 | -52 | 7.1 | 1090 | 12.1 | 32.9 |

**TABLE 4-2. GROUNDWATER FIELD PARAMETERS**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
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) |
|---|---|---|---|---|---|---|---|
| BA04 | 07/17/2019 | 0 | -52 | 7.1 | 1098 | 15.7 | 29.1 |
| BA04 | 01/13/2020 | 0.84 | 147 | 7.0 | 999.6 | 12.7 | 23.2 |
| BA04 | 08/13/2020 | 1.20 | 183 | 6.8 | 1177 | 17.6 | 4.89 |
| BA04 | 11/19/2020 | -- | -- | 6.9 | -- | -- | -- |
| BA04 | 02/19/2021 | 5.00 | 103 | 7.0 | 1109 | 10.3 | 2.1 |
| BA05 | 09/12/2016 | 0 | 75 | 7.6 | 664 | 16.1 | 16.2 |
| BA05 | 11/01/2016 | 0.30 | -80 | 7.2 | 979 | 14.8 | 109 |
| BA05 | 12/14/2016 | 0.29 | -84 | 7.7 | 1200 | 12.2 | 132 |
| BA05 | 01/28/2017 | 0 | -73 | 7.4 | 1350 | 12.3 | 77.8 |
| BA05 | 03/06/2017 | 0 | -91 | 7.2 | 1195 | 14.8 | 1000 |
| BA05 | 05/03/2017 | 0 | -57 | 7.4 | 1380 | 14.5 | 87.4 |
| BA05 | 06/09/2017 | 0 | <-500 | 7.4 | 1360 | 17.0 | 97.5 |
| BA05 | 06/26/2017 | 0 | -61 | 7.3 | 1250 | 19.4 | 114 |
| BA05 | 11/09/2017 | 0 | -36 | 7.3 | 1210 | 13.6 | 113 |
| BA05 | 06/05/2018 | 0 | -55 | 7.1 | 1320 | 14.8 | 95.6 |
| BA05 | 10/13/2018 | 0 | -74 | 7.2 | 1230 | 15.8 | 128 |
| BA05 | 02/07/2019 | 0 | -64 | 7.3 | 1207 | 12.2 | 106 |
| BA05 | 07/17/2019 | 0 | -60 | 7.2 | 1198 | 16.0 | 90.4 |
| BA05 | 01/13/2020 | 1.30 | -87.4 | 7.0 | 1546 | 10.7 | 148 |
| BA05 | 08/17/2020 | 2.20 | -53.1 | 6.8 | 1663 | 17.7 | 21.9 |
| BA05 | 11/19/2020 | -- | -- | 6.9 | -- | -- | -- |
| BA05 | 02/19/2021 | 0.19 | -43.2 | 6.8 | 1602 | 8.6 | 165 |
| BA05 | 04/14/2021 | 0.54 | -64.6 | 7.0 | 1645 | 13.6 | 36.6 |
| BA05 | 04/28/2021 | 3.10 | -70.7 | 7.1 | 1664 | 16.1 | 2.24 |
| BA05 | 05/12/2021 | 0.60 | -70.7 | 7.0 | 1660 | 13.6 | 1.11 |
| BA05 | 06/01/2021 | 0.24 | -79 | 7.0 | 1647 | 15.2 | 7.39 |
| BA05 | 06/14/2021 | 1.40 | -59.3 | 7.0 | 1598 | 16.8 | 49 |
| BA05 | 06/21/2021 | 0.70 | -43.2 | 7.0 | 1540 | 13.8 | 18.1 |
| BA05 | 07/12/2021 | 1.80 | -43.9 | 7.0 | 1321 | 14.9 | 7.19 |
| BA05 | 07/26/2021 | 3.80 | -74.5 | 7.1 | 310.5 | 20.7 | 6.01 |
| BA06 | 09/12/2016 | 0 | -93 | 7.1 | 2842 | 16.8 | 27.1 |
| BA06 | 11/01/2016 | 0.38 | -51 | 7.0 | 1629 | 14.8 | 86.2 |
| BA06 | 12/14/2016 | 0.21 | -40 | 7.2 | 1730 | 12.4 | 84.5 |
| BA06 | 01/28/2017 | 0 | -50 | 7.3 | 815 | 11.6 | 67.5 |
| BA06 | 03/06/2017 | 0 | -69 | 7.3 | 1532 | 15.1 | 99.3 |
| BA06 | 05/03/2017 | 0 | -60 | 7.1 | 845 | 14.7 | 73.5 |
| BA06 | 06/09/2017 | 0 | -65 | 7.0 | 883 | 17.1 | 68.1 |
| BA06 | 06/26/2017 | 0 | -46 | 7.2 | 1010 | 18.3 | 56.5 |
| BA06 | 11/09/2017 | 0 | 74 | 6.9 | 1340 | 12.8 | 45.2 |
| BA06 | 06/05/2018 | 0 | -38 | 7.2 | 1050 | 16.1 | 58.7 |
| BA06 | 10/13/2018 | 0 | -42 | 7.2 | 969 | 13.9 | 40 |
| BA06 | 02/07/2019 | 0 | -57 | 7.3 | 970 | 12.1 | 64.1 |
| BA06 | 07/17/2019 | 0 | -48 | 7.2 | 1014 | 15.9 | 60.7 |
| BA06 | 01/13/2020 | 0.49 | 8.3 | 6.7 | 3295 | 10.5 | 77.2 |



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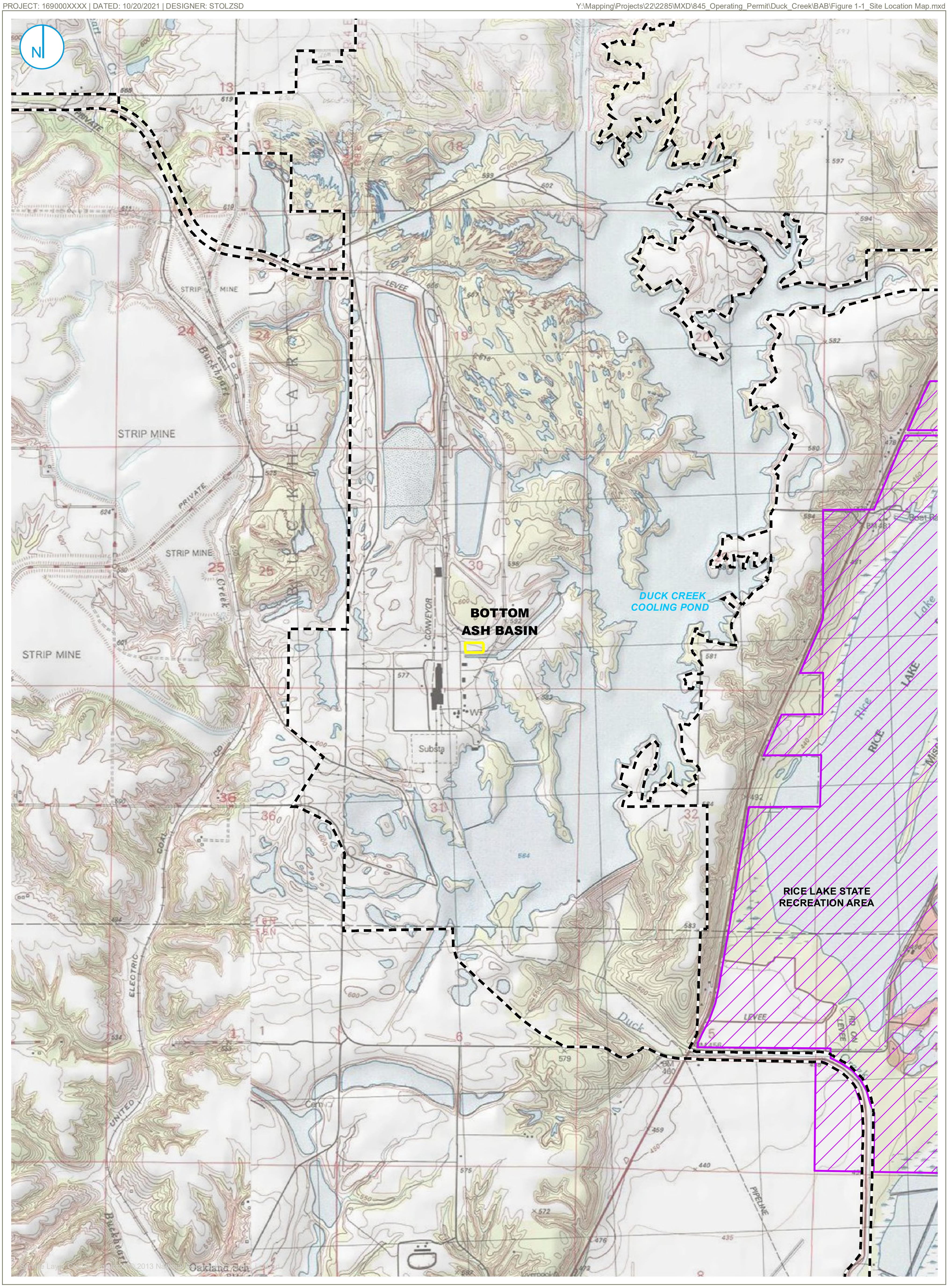
**TABLE 4-2. GROUNDWATER FIELD PARAMETERS**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
CANTON, ILLINOIS

| Sample Location | Sample Date | Dissolved Oxygen (mg/L) | Oxidation Reduction Potential (mV) | pH (field) (SU) | Specific Conductance (micromhos/cm) | Temperature (deg. C) | Turbidity (NTU) |
|---|---|---|---|---|---|---|---|
| BA06 | 06/09/2020 | 1.80 | -4 | 6.5 | 3095 | 16.2 | 97.8 |
| BA06 | 08/13/2020 | 1.80 | 32.9 | 6.6 | 3326 | 17.1 | 66.9 |
| BA06 | 11/19/2020 | -- | -- | 6.6 | -- | -- | -- |
| BA06 | 02/19/2021 | 0.18 | -40.7 | 6.5 | 3083 | 8.3 | 1020 |
| BA06 | 04/14/2021 | 0.52 | 5.4 | 6.7 | 2958 | 11.9 | 69.3 |
| BA06 | 04/28/2021 | 0.30 | -26.2 | 6.6 | 3257 | 16.0 | 15.9 |
| BA06 | 05/12/2021 | 1.10 | -17.6 | 6.7 | 3294 | 14.9 | 7.33 |
| BA06 | 06/01/2021 | 0.30 | -11.6 | 6.7 | 3270 | 15.0 | 6.71 |
| BA06 | 06/14/2021 | 6.90 | 24 | 6.7 | 3144 | 18.0 | 93.9 |
| BA06 | 06/21/2021 | 0.27 | -5.2 | 6.6 | 3228 | 14.2 | 11.8 |
| BA06 | 07/12/2021 | 0.29 | -11.6 | 6.7 | 3262 | 15.6 | 3.56 |
| BA06 | 07/26/2021 | 0.69 | -28.6 | 6.8 | 3224 | 19.2 | 8.9 |

**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 10/05/2021, 3:56:33 PM CDT


RAMBOLL

# FIGURES



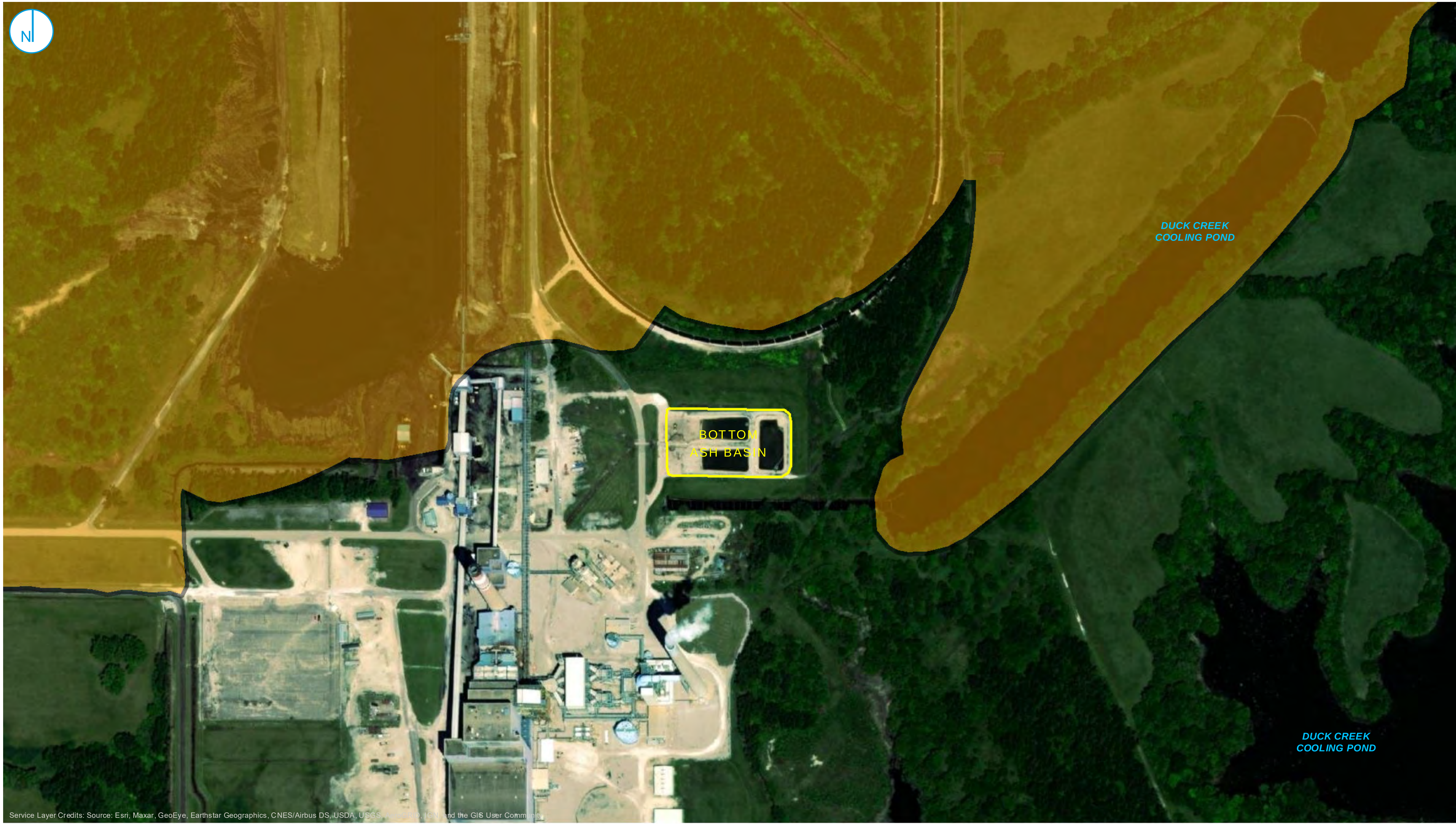

## SITE LOCATION MAP

## FIGURE 1-1

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
BOTTOM ASH BASIN
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL




SURFACE COAL MINE
PART 845 REGULATED UNIT (SUBJECT UNIT)
PROPERTY BOUNDARY

0 150 300 Feet

## SITE MAP

## FIGURE 1-2

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

**HYDROGEOLOGIC SITE CHARACTERIZATION REPORT**
**BOTTOM ASH BASIN**
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

PROJECT: 169000XXXX | DATED: 10/11/2021 | DESIGNER: HOTCALD

Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Duck_Creek\BAB\Figure 1-2_Site Map.mxd


PROJECT: 169000XXXX | DATED: 9/22/2021 | DESIGNER: STOLZSD

Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Duck_Creek\BAB\Figure 2-1_Topo Map.mxd

10 FOOT ELEVATION CONTOUR
2 FOOT ELEVATION CONTOUR
PART 845 REGULATED UNIT (SUBJECT UNIT)

0 50 100 Feet

**SOURCE:**
INGENAE SURVEY, 2021

## SITE TOPOGRAPHIC MAP

**HYDROGEOLOGIC SITE CHARACTERIZATION REPORT**
**BOTTOM ASH BASIN**
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

## FIGURE 2-1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Duck_Creek\BAB\Figure 2-2_Soil Survey.mxd

PROJECT: 169000XXXX | DATED: 9/23/2021 | DESIGNER: STOLZSD


| MAP UNIT SYMBOL | MAP UNIT NAME |
|---|---|
| 17A | Keomah silt loam, 0 to 2 percent slopes |
| 274E2 | Seaton silt loam, 18 to 25 percent slopes, eroded |
| 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 |
| 536 | Dumps, mine |
| 801B | Orthents, silty, undulating |
| 871B | Lenzburg silt loam, 1 to 7 percent slopes |
| 871D | Lenzburg silty clay loam, 7 to 20 percent slopes |
| 871G | Lenzburg silty clay loam, 20 to 60 percent slopes |
| 876B | Lenzwheel silt loam, 1 to 7 percent slopes |
| 8cF | Hickory silt loam, cool mesic, 18 to 35 percent slopes |
| 8E2 | Hickory silt loam, 18 to 25 percent slopes, eroded |
| W | Water |

PART 845 REGULATED UNIT (SUBJECT UNIT)

NRCS SOIL SURVEY MAP UNIT BOUNDARY

0 150 300 Feet

SOURCE:
NATURAL RESOURCES CONSERVATION SERVICE (NRCS)

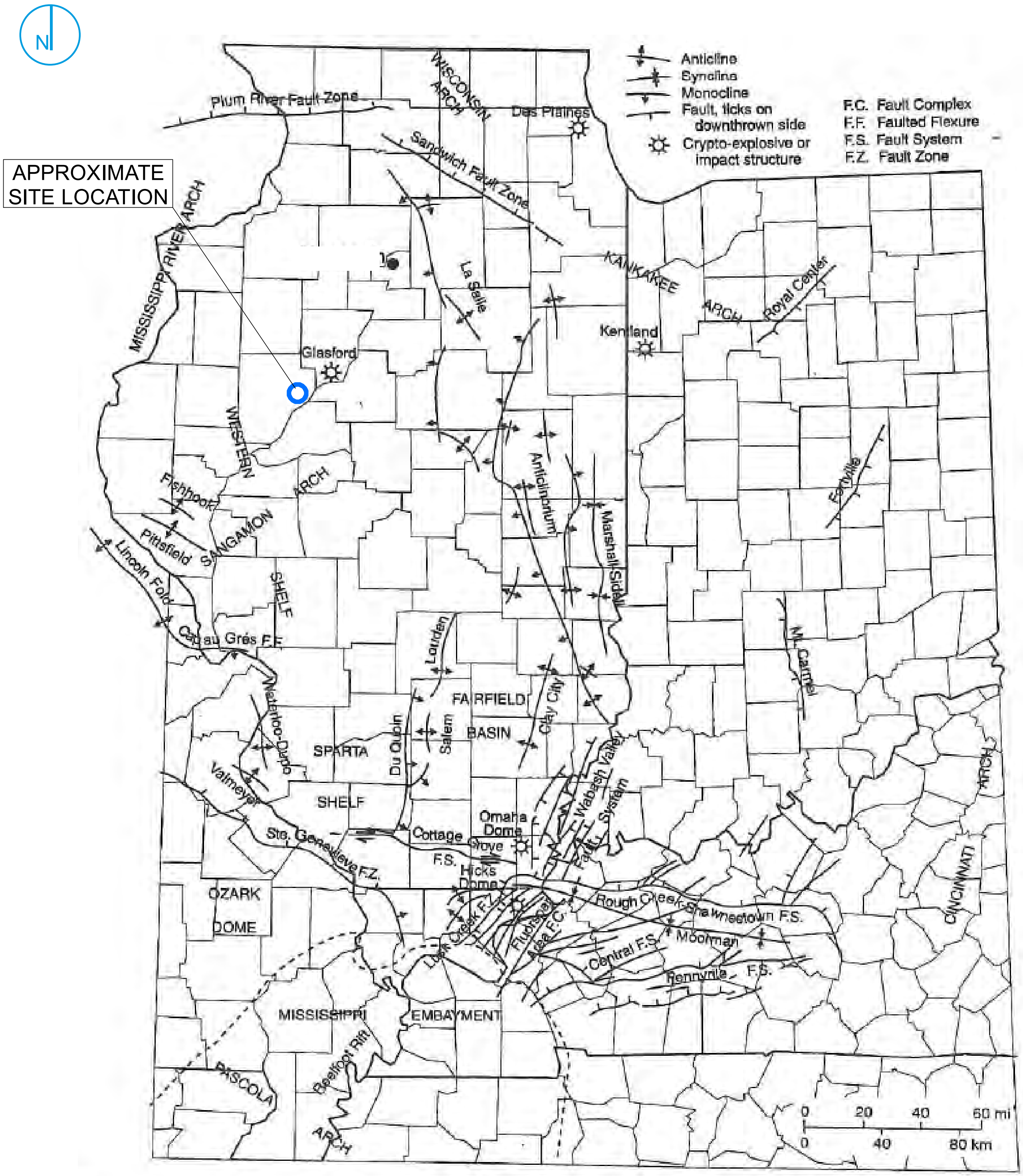
## SOIL SURVEY MAP

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
BOTTOM ASH BASIN
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

## FIGURE 2-2

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\BAB\Figure 2-3_Major Structural Features of Illinois.mxd

PROJECT: 169000XXXX | DATED: 9/23/2021 | DESIGNER: STOLZSD

## MAJOR STRUCTURAL FEATURES OF ILLINOIS

## FIGURE 2-3

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
BOTTOM ASH BASIN
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.


MONITORING WELL

PART 845 REGULATED UNIT (SUBJECT UNIT)

0 50 100 Feet

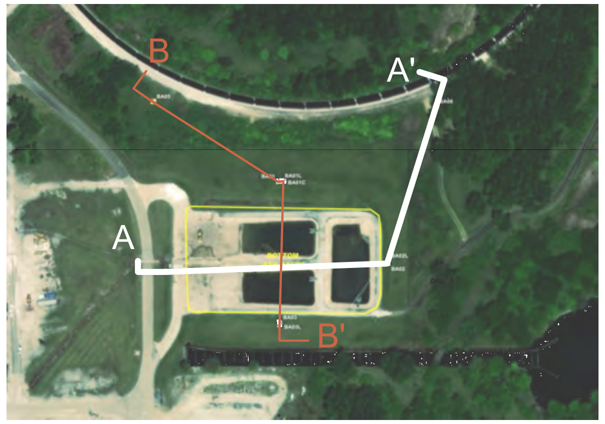
**FIELD INVESTIGATION LOCATION MAP**

**HYDROGEOLOGIC SITE CHARACTERIZATION REPORT**
**BOTTOM ASH BASIN**
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

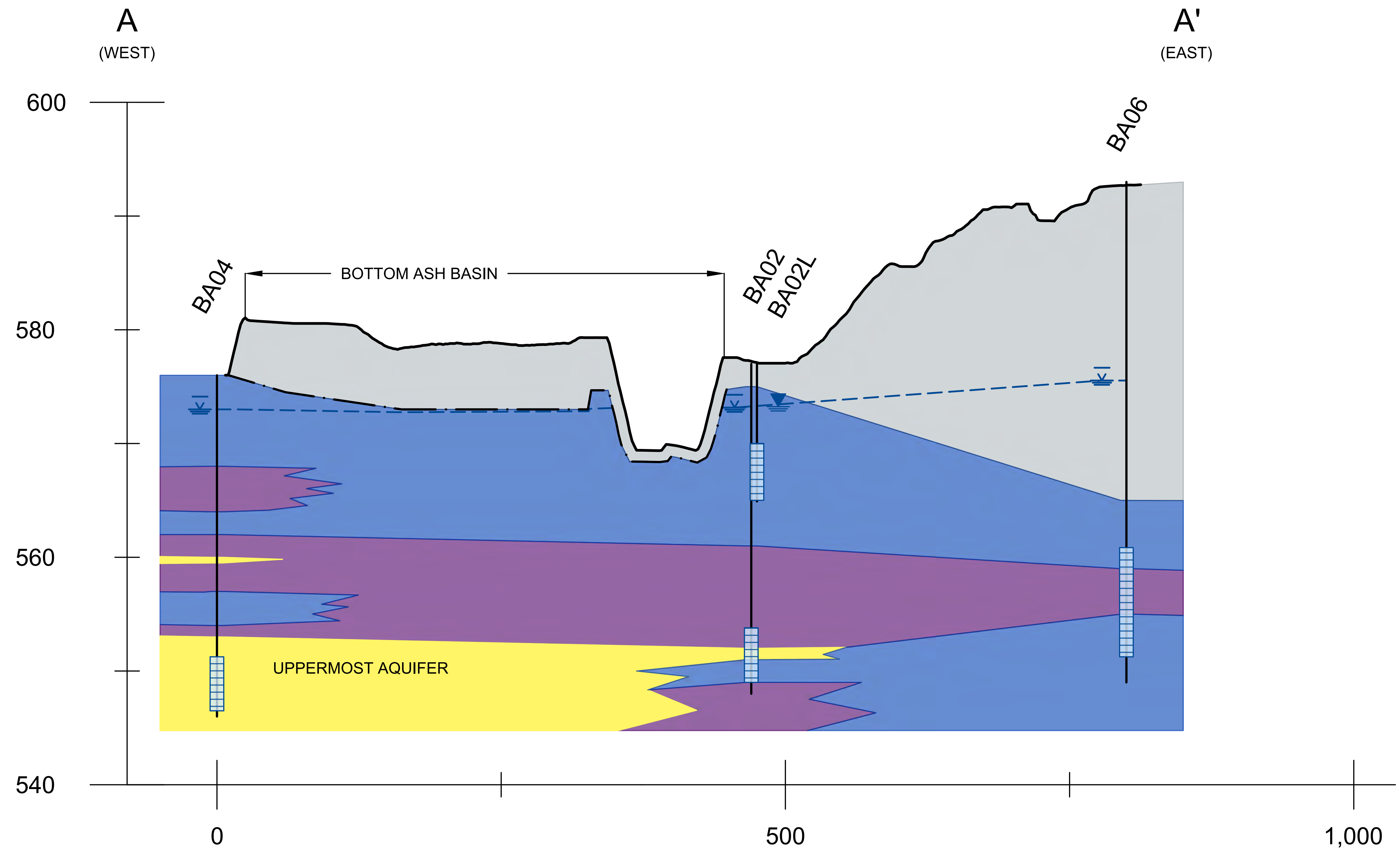
**FIGURE 2-4**

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 28, 2021.




LEGEND
FILL
CLAY (CL/CH)
SILT (ML)
SAND (SP/SM/SW)

WELL SCREEN INTERVAL
UPPERMOST AQUIFER POTENTIOMETRIC SURFACE
UPPER AQUIFER GROUNDWATER ELEVATION
OTHER GROUNDWATER ELEVATIONS
ESTIMATED BASE OF BOTTOM ASH BASIN LINER

10'
0
100'

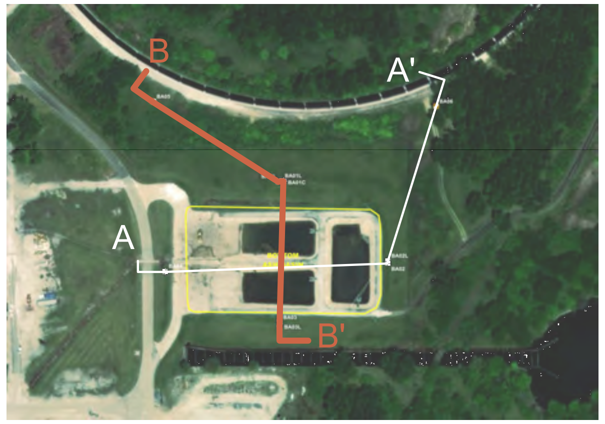
**GEOLOGIC CROSS SECTION**
A-A'

**HYDROGEOLOGIC SITE CHARACTERIZATION REPORT**
**BOTTOM ASH BASIN**
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

**FIGURE 2-5**

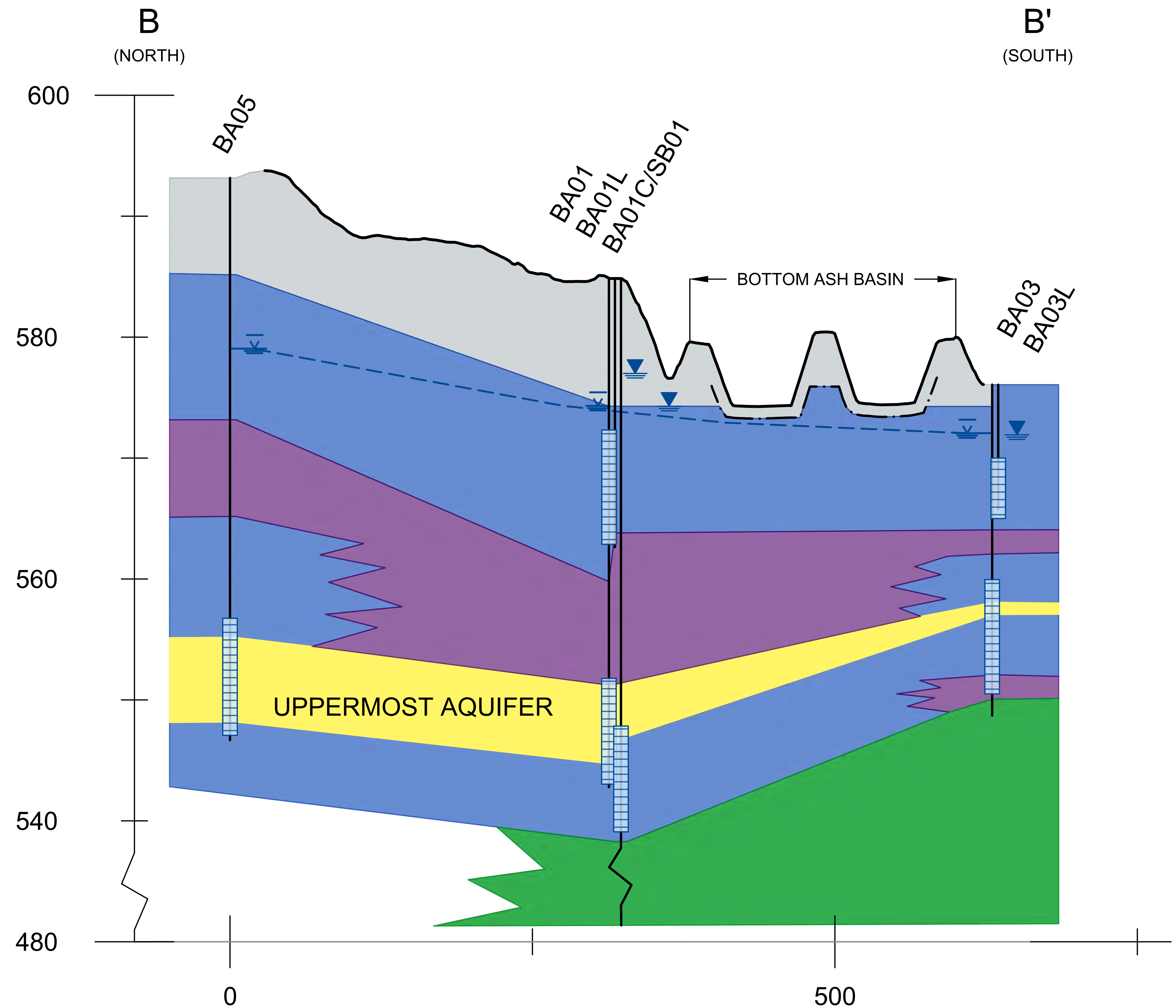
RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

PROJECT: 1940100806



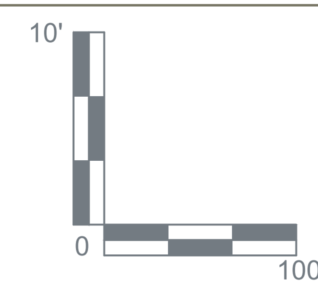

### NOTES

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 28, 2021.




### LEGEND

- 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
- OTHER GROUNDWATER WATER ELEVATIONS
- ESTIMATED BASE OF BOTTOM ASH BASIN LINER




**GEOLOGIC CROSS SECTION**
B-B'

**HYDROGEOLOGIC SITE CHARACTERIZATION REPORT**
**BOTTOM ASH BASIN**
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

**FIGURE 2-6**

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

PROJECT: 1940100806


BACKGROUND WELL
MONITORING WELL
PART 845 REGULATED UNIT (SUBJECT UNIT)

0 50 100 Feet

PROJECT: 169000XXXX | DATED: 9/24/2021 | DESIGNER: STOLZSD

Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Duck_Creek\BAB\Figure 3-1_Monitoring Well Location Map.mxd

## MONITORING WELL LOCATION MAP

## FIGURE 3-1

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
BOTTOM ASH BASIN
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL


Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Duck_Creek\BAB\Figure 3-2_Top of Uppermost Aquifer.mxd

PROJECT: 169000XXXX | DATED: 10/11/2021 | DESIGNER: HOTCALD

UPPERMOST AQUIFER ELEVATION, TOP OF SAND (1-FOOT INTERVAL)

PART 845 REGULATED UNIT (SUBJECT UNIT)

0 50 100 Feet

NOTE:
TOP OF AQUIFER CONTOURS GENERATED IN 2018 (HALEY & ALDRICH, INC., 2018) FOR 40 C.F.R. § 257; CONTOURS HAVE NOT BEEN MODIFIED USING BORING DATA COLLECTED IN 2021, ALTHOUGH THE SEPARATION DISTANCE BETWEEN TOP OF UPPERMOST AQUIFER AND BASE OF CCR IS CONSISTENT

**TOP OF UPPERMOST AQUIFER**

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
BOTTOM ASH BASIN
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

**FIGURE 3-2**

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL


BACKGROUND WELL

MONITORING WELL

GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)

PART 845 REGULATED UNIT (SUBJECT UNIT)

0 50 100 Feet

NOTE
PARENTHESIS INDICATES WELL NOT USED FOR CONTOURING

## UPPERMOST AQUIFER GROUNDWATER ELEVATION CONTOURS
## APRIL 28, 2021

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
BOTTOM ASH BASIN
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

FIGURE 3-3

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

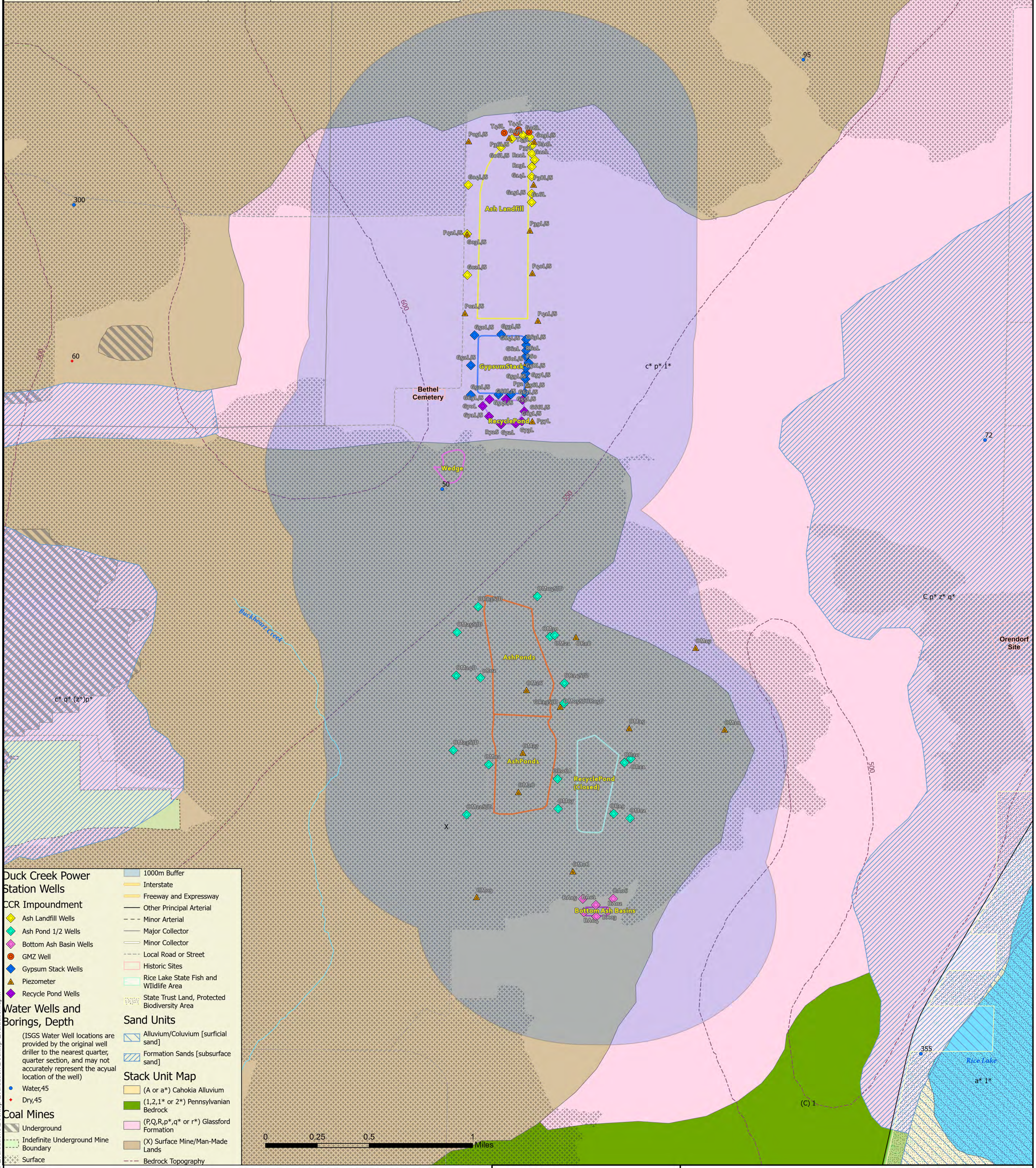
Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Duck_Creek\BAB\Figure 3-3_GWE Contours 20210428.mxd

PROJECT: 169000XXXX | DATED: 9/23/2021 | DESIGNER: STOLZSD

# 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 |

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Duck Creek Power Station

HANSON
Hanson Professional Services Inc.

Work Plan Desktop Evaluation
Fulton County
Canton, Illinois

Job Number: 20E0111A

Sheet 1

# APPENDIX B
# BORING LOGS AND WELL CONSTRUCTION LOGS

## BORING AND WELL LOCATIONS MAP


BACKGROUND WELL
MONITORING WELL
PART 845 REGULATED UNIT (SUBJECT UNIT)

0 50 100 Feet

## SOIL BORING AND MONITORING WELL LOCATION MAP

## FIGURE B-1

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
BOTTOM ASH BASIN
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Duck_Creek\BAB\Figure B-1_SB and MW Location Map.mxd

PROJECT: 169000XXXX | DATED: 10/13/2021 | DESIGNER: STOLZSD

# BORING LOGS

# FIELD BORING LOG

HANSON

**CLIENT:** Natural Resource Technology, Inc.
**Site:** Duck Creek Power Station
**Location:** Canton, Illinois
**Project:** 15E0030
**DATES: Start:** 12/16/2015
**Finish:** 12/16/2015
**WEATHER:**

**CONTRACTOR:** Geotechnics
**Rig mfg/model:** CME-55 on Marooka Track Vehicle
**Drilling Method:** 4 ¼" HSA, split spoon sampler

**FIELD STAFF: Driller:** M. Sick
**Helper:** B. Janson
**Eng/Geo:** R. Hasenyager

**BOREHOLE ID:** BA01
**Well ID:** BA01
**Surface Elev:** 584.75 ft. MSL
**Completion:** 40.42 ft. BGS
**Station:** 1,684.03N
2,374.44E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▼ = 24.50 - During Drilling
▼ =
▽ =

| SAMPLE | | | TESTING | | | | |
|---|---|---|---|---|---|---|---|
| Number | Recov / Total (in) *% Recovery* | Type | *Blows / 6 in* N - Value **RQD** | Moisture (%) | Dry Den. (lb/ft$^3$) | Qu (tsf) *Qp* (tsf) Failure Type | |
| 1A | 17/24 *71%* | SS | *1-2 4-5* N=6 | 19 | | 0.50 P | |
| 2A | 6/24 *25%* | SS | *woh-1 3-3* N=4 | | | 1.00 P | |
| 3A | 19/24 *79%* | SS | *3-8 10-7* N=18 | 20 | | 1.00 P | |
| 4A | 18/24 *75%* | SS | **-4 4-5* N=8 | 26 | | 2.00 P | |
| 5A | 19/24 *79%* | SS | *1-3 2-2* N=5 | 26 | | 1.50 P | |
| 6A | 21/24 *88%* | SS | **-* 1-9* | 49 | | 1.75 P | |
| 7A | 21/24 *88%* | SS | *woh-1 3-3* N=4 | 26 | | | |
| 8A | 22/24 *92%* | SS | *woh-1 3-3* N=4 | 28 | | 0.50 | |

| Depth ft. BGS | Lithologic Description | Borehole Detail | Elevation ft. MSL | Remarks |
|---|---|---|---|---|
| 0 – 9.5 | Dark yellowish brown (10YR4/6), moist, soft, SILT with few clay and trace very fine- to coarse-grained sand - FILL. | | 584, 582, 580, 578, 576 | |
| 9.5 – 12 | Yellowish brown (10YR5/6) with 10% gray (10YR5/1) mottles, wet, stiff, SILT with few clay and trace very fine-grained sand. | | 574 | |
| 12 – 15.8 | Gray (10YR5/1) with 20% yellowish brown (10YR5/8) mottles, set, stiff, SILT with few clay and trace very fine-grained sand. | | 572, 570 | |
| 15.8 – 18 | Very dark gray (10YR3/1), moist, stiff, SILT with few clay and trace very fine-grained sand. | | 568 | |
| 18 – | Gray (10YR5/1), moist, medium, SILT with few clay and trace very fine-grained sand. | | 566, 564 | |

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

**NOTE(S):** BA01 installed in boring.
Station coordinates are on Plant (Local) grid.
*Rig geometry required pushing split spoon sampler for designated interval.

# FIELD BORING LOG

HANSON

**CLIENT:** Natural Resource Technology, Inc.
**Site:** Duck Creek Power Station
**Location:** Canton, Illinois
**Project:** 15E0030
**DATES: Start:** 12/16/2015
**Finish:** 12/16/2015
**WEATHER:**

**CONTRACTOR:** Geotechnics
**Rig mfg/model:** CME-55 on Marooka Track Vehicle
**Drilling Method:** 4 ¼" HSA, split spoon sampler
**FIELD STAFF: Driller:** M. Sick
**Helper:** B. Janson
**Eng/Geo:** R. Hasenyager

**BOREHOLE ID:** BA01
**Well ID:** BA01
**Surface Elev:** 584.75 ft. MSL
**Completion:** 40.42 ft. BGS
**Station:** 1,684.03N
2,374.44E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▼ = 24.50 - 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 |
|---|---|---|---|---|---|---|
| | | | | | | P |
| 9A | 21/24 *88%* | SS | **-1* *3-4* N=4 | 21 | | 1.00 P |
| 10A | 24/24 *100%* | SS | *woh-1* *3-4* N=4 | 25 | | 1.00 P |
| 11A | 24/24 *100%* | SS | **-** *2-3* | 17 | | |
| 12A | 24/24 *100%* | SS | *woh-3* *12-15* N=15 | 12 | | |
| 13A | 24/24 *100%* | SS | *2-12* *27-43* N=39 | 11 | | |
| 14A | 4/6 *67%* | SS | *36-50/2"* | 18 | | |
| 15A | 24/24 *100%* | SS | *18-26* *14-39* N=40 | 8 | | |
| | 0/24 *0%* | SS | | | | |
| 17A | 12/22 *55%* | SS | *3-26* *43-50/4"* N=69 | 8 | | |
| 18A | 9/11 *82%* | SS | *15-50/5"* | | | |

| Depth ft. BGS | Lithologic Description |
|---|---|
| 22–25 | Gray (10YR5/1), moist, medium, SILT with few clay and little very fine- to coarse-grained sand. |
| | Gray (10YR5/1) with 30% dark yellowish brown (10YR3/6) mottles, moist, stiff, CLAY with little very fine- to very coarse-grained sand and trace small gravel. |
| 26 | Yellowish brown (10YR5/6), moist, soft, CLAY with some silt, trace very fine- to very coarse-grained sand, and trace small gravel. |
| | Gray (10YR5/1), wet, soft, CLAY with some silt, trace very fine- to very coarse-grained sand, and trace small gravel. |
| 28–30 | Yellowish brown (10YR5/6), moist, hard, CLAY some silt, trace very fine- to very coarse-grained sand, and trace small gravel. |
| 32 | Gray (10YR5/1), moist, hard, CLAY some silt, little very fine- to very coarse-grained sand, and trace small gravel. |
| 34–38 | Yellowish brown (10YR5/6), wet, dense, very fine- to very coarse-grained SAND with trace small gravel. |
| 40 | Gray (10YR5/1), moist, hard, SILT with few clay and trace very fine-grained sand. |

Elevation ft. MSL: 562, 560, 558, 556, 554, 552, 550, 548, 546

Remarks

**End of boring = 40.4 feet**

**NOTE(S):** BA01 installed in boring.
Station coordinates are on Plant (Local) grid.
*Rig geometry required pushing split spoon sampler for designated interval.

# FIELD BORING LOG

**CLIENT:** Illinois Power Resource Generating, LLC
**Site:** Duck Creek Part 845 Groundwater
**Location:** Canton, Illinois
**Project:** 20E0111A
**DATES: Start:** 2/8/2021
**Finish:** 2/8/2021
**WEATHER:** Overcast, cold (hi-20's)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** CME-550 ATV Drill
**Drilling Method:** Hollow Stem Auger
**FIELD STAFF: Driller:** Dusty
**Helper:** Mosley
**Eng/Geo:** R. Hasenyager

HANSON

**BOREHOLE ID:** BA01C
**Well ID:** BA01C
**Surface Elev:** 584.24 ft. MSL
**Completion:** 45.90 ft. BGS
**Station:** 1,384,728.21N
2,347,929.30E

**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 |
| | | | | | | | 0–6.4 | Brownish yellow (10YR5/6), moist, medium, SILT with little clay and trace sand. | | | |
| | | | | | | | 6.4–10.5 | Yellowish brown (10YR5/4), moist, soft, SILT with few clay, trace sand, and trace gravel. | | | |
| | | | | | | | 10.5–14.7 | Brownish yellow (10YR5/6), moist, soft, SILT with few clay and trace sand. | | | |
| | | | | | | | 14.7–18 | Gray (10YR5/1), moist, soft, SILT with few clay and trace sand. | | | |
| | | | | | | | 18–19.5 | Brown (10YR4/3) with 10% yellowish brown (10YR5/6) mottles, moist, soft, SILT with few clay and trace sand. | | | |
| | | | | | | | 19.5–20 | Dark yellowish brown (10YR4/4), wet, soft, SILT with few clay and trace sand. | | | |

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20
Elevation scale: 584, 582, 580, 578, 576, 574, 572, 570, 568, 566

**NOTE(S):** BA01C blind drilled adjacent to SB01. Lithology copied from SB01.

# FIELD BORING LOG

HANSON

**CLIENT:** Illinois Power Resource Generating, LLC
**Site:** Duck Creek Part 845 Groundwater
**Location:** Canton, Illinois
**Project:** 20E0111A
**DATES: Start:** 2/8/2021
**Finish:** 2/8/2021
**WEATHER:** Overcast, cold (hi-20's)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** CME-550 ATV Drill
**Drilling Method:** Hollow Stem Auger
**FIELD STAFF: Driller:** Dusty
**Helper:** Mosley
**Eng/Geo:** R. Hasenyager

**BOREHOLE ID:** BA01C
**Well ID:** BA01C
**Surface Elev:** 584.24 ft. MSL
**Completion:** 45.90 ft. BGS
**Station:** 1,384,728.21N
2,347,929.30E

**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 | Borehole Detail | Elevation ft. MSL | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Dark yellowish brown (10YR4/4), wet, soft, SILT with few clay and trace sand. *[Continued from previous page]* | | 564 | |
| | | | | | | | 22 | Gray (10YR5/1), moist, soft, CLAY with some silt and trace sand. | | 562 | |
| | | | | | | | 24 | | | 560 | |
| | | | | | | | 26 | Gray (10YR5/1) with 30% yellowish brown (10YR5/8) mottles, moist, medium, CLAY with some silt and trace sand. | | 558 | |
| | | | | | | | 28 | Gray (10YR5/1) with 20% yellowish brown (10YR5/8) mottles, moist, medium, CLAY with some silt, little sand, and trace gravel. | | 556 | |
| | | | | | | | 30 | | | 554 | |
| | | | | | | | 32 | Dark gray (10YR4/1), moist, hard, CLAY with some silt, little sand, and trace gravel. | | 552 | |
| | | | | | | | 34 | Yellowish brown (10YR5/6), wet, dense, very fine- to very coarse-grained SAND with few silt and little gravel. | | 550 | |
| | | | | | | | 36 | | | 548 | |
| | | | | | | | | Gray (10YR5/1), wet, dense, very fine- to very coarse-grained SAND with few silt and little gravel. | | | |
| | | | | | | | 38 | Dark gray (10YR4/1), moist, very hard, SILT with some clay, little sand, and trace gravel. | | 546 | |
| | | | | | | | 40 | | | | |

**NOTE(S):** BA01C blind drilled adjacent to SB01. Lithology copied from SB01.

# FIELD BORING LOG

**HANSON**

**CLIENT:** Illinois Power Resource Generating, LLC
**Site:** Duck Creek Part 845 Groundwater
**Location:** Canton, Illinois
**Project:** 20E0111A
**DATES: Start:** 2/8/2021
**Finish:** 2/8/2021
**WEATHER:** Overcast, cold (hi-20's)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** CME-550 ATV Drill
**Drilling Method:** Hollow Stem Auger

**FIELD STAFF: Driller:** Dusty
**Helper:** Mosley
**Eng/Geo:** R. Hasenyager

**BOREHOLE ID:** BA01C
**Well ID:** BA01C
**Surface Elev:** 584.24 ft. MSL
**Completion:** 45.90 ft. BGS
**Station:** 1,384,728.21N
2,347,929.30E

**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 |
| | | | | | | | 42<br>44 | Gray (10YR5/1), moist, hard, SILT with few clay and trace sand. | | 544<br>542<br>540 | |

**End of boring = 45.9 ft.**

**NOTE(S):** BA01C blind drilled adjacent to SB01. Lithology copied from SB01.

# FIELD BORING LOG

HANSON

**CLIENT:** Illinois Power Resource Generating, LLC
**Site:** Duck Creek Part 845 Groundwater
**Location:** Canton, Illinois
**Project:** 20E0111A
**DATES: Start:** 2/5/2021
**Finish:** 2/23/2021
**WEATHER:** Overcast, cold (hi-20's)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** CME-550 ATV Drill
**Drilling Method:** Hollow Stem Auger
**FIELD STAFF: Driller:** Dusty
**Helper:** Mosley
**Eng/Geo:** R. Hasenyager

**BOREHOLE ID:** BA01L
**Well ID:** BA01L
**Surface Elev:** 577.19 ft. MSL
**Completion:** 22.15 ft. BGS
**Station:** 1,384,728.82N
2,347,929.30E

**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 |
| | | | | | | | 0–6.4 | Brownish yellow (10YR5/6), moist, medium, SILT with little clay and trace sand. | | | |
| | | | | | | | 6.4–10.5 | Yellowish brown (10YR5/4), moist, soft, SILT with few clay, trace sand, and trace gravel. | | | |
| | | | | | | | 10.5–14.7 | Brownish yellow (10YR5/6), moist, soft, SILT with few clay and trace sand. | | | |
| | | | | | | | 14.7–18 | Gray (10YR5/1), moist, soft, SILT with few clay and trace sand. | | | |
| | | | | | | | 18–19.5 | Brown (10YR4/3) with 10% yellowish brown (10YR5/6) mottles, moist, soft, SILT with few clay and trace sand. | | | |
| | | | | | | | 19.5–20 | Dark yellowish brown (10YR4/4), wet, soft, SILT with few clay and trace sand. | | | |

**NOTE(S):** BA01L blind drilled adjacent to SB01. Lithology copied from SB01.

# FIELD BORING LOG

HANSON

**CLIENT:** Illinois Power Resource Generating, LLC
**Site:** Duck Creek Part 845 Groundwater
**Location:** Canton, Illinois
**Project:** 20E0111A
**DATES: Start:** 2/5/2021
**Finish:** 2/23/2021
**WEATHER:** Overcast, cold (hi-20's)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** CME-550 ATV Drill
**Drilling Method:** Hollow Stem Auger
**FIELD STAFF: Driller:** Dusty
**Helper:** Mosley
**Eng/Geo:** R. Hasenyager

**BOREHOLE ID:** BA01L
**Well ID:** BA01L
**Surface Elev:** 577.19 ft. MSL
**Completion:** 22.15 ft. BGS
**Station:** 1,384,728.82N
2,347,929.30E

**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 |
| | | | | | | | | Dark yellowish brown (10YR4/4), wet, soft, SILT with few clay and trace sand. *[Continued from previous page]* | | | |
| | | | | | | | 22 | Gray (10YR5/1), moist, soft, CLAY with some silt and trace sand. | | 556 | |

**End of boring = 22.15 ft.**

**NOTE(S):** BA01L blind drilled adjacent to SB01. Lithology copied from SB01.

# FIELD BORING LOG

HANSON

**CLIENT:** Natural Resource Technology, Inc.
**Site:** Duck Creek Power Station
**Location:** Canton, Illinois
**Project:** 15E0030
**DATES: Start:** 12/29/2015
**Finish:** 12/30/2015
**WEATHER:** Overcast, windy, cold, lo-30s.

**CONTRACTOR:** Bulldog Drilling, Inc.
**Rig mfg/model:** CME-550X ATV Drill
**Drilling Method:** 4 ¼" HSA, split spoon sampler
**FIELD STAFF: Driller:** C. Dutton
**Helper:** C. Jones
**Eng/Geo:** S. Keim

**BOREHOLE ID:** BA02
**Well ID:** BA02
**Surface Elev:** 577.48 ft. MSL
**Completion:** 29.42 ft. BGS
**Station:** 1,513.78N
2,601.74E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▼ = 5.65 - 12/30/2015
▼ =
▽ =

| 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 |
| 1A | 16/24 *67%* | ss | *1-4 6-5* N=10 | 17 | | 2.50 P | 0–2 | Brown (10YR5/3) with 10% dark yellowish brown (10YR4/6) mottles, moist, very stiff, SILT with few clay, trace very fine- to medium-grained sand, and trace roots - FILL. | | 576 | |
| 2A | 14/24 *58%* | ss | *3-3 4-5* N=7 | 23 | | 3.00 P | 2–4 | Dark yellowish brown (10YR4/6), moist, very stiff, SILT with little clay and trace very fine- to fine-grained sand. | | 574 | |
| 3A | 20/24 *83%* | ss | *5-9 8-10* N=17 | 19 | | 4.00 P | 4–6 (▼ 5.65) | Light brownish gray (2.5Y6/2) with 15% yellowish brown (10YR5/6) mottles, dry, very stiff, SILT with few clay and trace very fine- to fine-grained sand. | | 572 | |
| 4A | 16/24 *67%* | ss | *1-2 3-3* N=5 | 24 | | 0.50 P | 6–8.5 | Greenish gray (5GY6/1), with 5% dark yellowish brown (10YR4/6) mottles, moist, soft, SILT with few clay and trace very fine- to fine-grained sand. | | 570 | |
| 5A | 18/24 *75%* | ss | *1-1 3-6* N=4 | 25 | | 1.00 P | 8.5–10 | Greenish gray (5GY6/1), with 35% olive (5Y4/3) mottles, wet, medium, SILT with few clay and trace very fine- to fine-grained sand. | | 568 | |
| 6A | 16/24 *67%* | ss | *1-2 3-4* N=5 | 27 | | 1.00 P | 10–14 | Greenish gray (5GY6/1), with 10% olive (5Y4/3) mottles, wet, medium, SILT with few clay and trace very fine- to fine-grained sand. | | 566 | |
| 7A | 12/24 *50%* | ss | *1-1 1-1* N=2 | 26 | | 0.75 P | | | | 564 | |
| 8A | 20/24 *83%* | ss | *1-2 5-6* N=7 | 66 | | 1.75 P | 14–15.6 | Very dark brown (10YR2/2), moist, very stiff, SILT with few clay, trace very fine- to fine-grained sand and trace wood fragments. | | 562 | |
| 9A | 19/24 *79%* | ss | *1-2 2-2* N=4 | 25 | | 0.75 P | 15.6–20 | Dark gray (10YR4/1), moist, medium, silty CLAY with trace very fine-to fine-grained sand. | | 560 | |
| 10A | 20/24 *83%* | ss | *1-1 3-3* N=4 | 25 | | 0.75 P | | | | 558 | |

**NOTE(S):** BA02 installed in boring.
Station coordinates are on Plant (Local) grid.

# FIELD BORING LOG

**CLIENT:** Natural Resource Technology, Inc.
**Site:** Duck Creek Power Station
**Location:** Canton, Illinois
**Project:** 15E0030
**DATES: Start:** 12/29/2015
**Finish:** 12/30/2015
**WEATHER:** Overcast, windy, cold, lo-30s.

**CONTRACTOR:** Bulldog Drilling, Inc.
**Rig mfg/model:** CME-550X ATV Drill
**Drilling Method:** 4 ¼" HSA, split spoon sampler
**FIELD STAFF: Driller:** C. Dutton
**Helper:** C. Jones
**Eng/Geo:** S. Keim

HANSON

**BOREHOLE ID:** BA02
**Well ID:** BA02
**Surface Elev:** 577.48 ft. MSL
**Completion:** 29.42 ft. BGS
**Station:** 1,513.78N
2,601.74E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▼ = 5.65 - 12/30/2015
▼ =
▽ =

| 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 |
| 11A | 19/24 *79%* | ss | *1-2 3-4* N=5 | 27 | | 1.00 P | | Greenish gray (10GY5/1), moist, medium, CLAY with little silt and few very fine- to medium-grained sand. | 556 | |
| 12A | 23/24 *96%* | ss | *1-3 3-3* N=6 | 24 | | 1.75 P | 22 | Greenish gray (10GY5/1), moist, medium, CLAY with little silt, few very fine- to coarse-grained sand, and trace small gravel. | 554 | |
| 13A | 23/24 *96%* | ss | *wor-1 3-3* N=4 | 33 | | 1.50 P | 24 | Dark gray (10YR4/1), wet, loose, very fine- to coarse-grained SAND with some clay, little silt, and trace small gravel. | 552 | |
| 14A | 15/24 *63%* | ss | *4-8 12-18* N=20 | 19 | | 4.50 P | 26 | Gray (10YR5/1), moist, hard, SILT with little clay and trace very fine- to medium-grained sand. | 550 | |
| 15A | 9/17 *53%* | ss | *16-12 50/5"* | 19 | | 4.50 P | 28 | Dark gray (10YR4/1), moist, hard, CLAY with little silt. | | |

**End of boring = 29.4 feet**

**NOTE(S):** BA02 installed in boring.
Station coordinates are on Plant (Local) grid.

# FIELD BORING LOG

HANSON

| | | | |
|---|---|---|---|
| **CLIENT:** Illinois Power Resource Generating, LLC | **CONTRACTOR:** Ramsey Geotechnical Engineering, LLC | | |
| **Site:** Duck Creek Part 845 Groundwater | **Rig mfg/model:** CME-550 ATV Drill | **BOREHOLE ID:** BA02L | |
| **Location:** Canton, Illinois | **Drilling Method:** Hollow Stem Auger | **Well ID:** BA02L | |
| **Project:** 20E0111A | | **Surface Elev:** 577.17 ft. MSL | |
| **DATES: Start:** 2/4/2021 | **FIELD STAFF: Driller:** Dusty | **Completion:** 12.09 ft. BGS | |
| **Finish:** 2/4/2021 | **Helper:** Mosley | **Station:** 1,384,558.03N | |
| **WEATHER:** Sunny, cold (lo-30's) | **Eng/Geo:** R. Hasenyager | 2,348,149.66E | |

**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 |
| | | | | | | | 0–3.7 | Brownish yellow (10YR5/6), moist, medium, SILT with little clay and trace sand. | | | |
| | | | | | | | 3.7–12.09 | Gray (10YR5/1), moist, medium, SILT with little clay and trace sand. | | | |

Depth scale (ft. BGS): 2, 4, 6, 8, 10, 12

Elevation scale (ft. MSL): 576, 574, 572, 570, 568, 566

**End of boring = 12.09 ft.**

**NOTE(S):** BA02L blind drilled adjacent to SB02. Lithology copied from SB02.

# FIELD BORING LOG

HANSON

**CLIENT:** Natural Resource Technology, Inc.
**Site:** Duck Creek Power Station
**Location:** Canton, Illinois
**Project:** 15E0030
**DATES: Start:** 12/29/2015
**Finish:** 12/29/2015
**WEATHER:** Overcast, windy, cold, lo-30s.

**CONTRACTOR:** Bulldog Drilling, Inc.
**Rig mfg/model:** CME-550X ATV Drill
**Drilling Method:** 4 ¼" HSA, split spoon sampler
**FIELD STAFF: Driller:** C. Dutton
**Helper:** C. Jones
**Eng/Geo:** S. Keim

**BOREHOLE ID:** BA03
**Well ID:** BA03
**Surface Elev:** 576.06 ft. MSL
**Completion:** 27.42 ft. BGS
**Station:** 1,390.83N
2,376.20E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▼ = 10.00 - 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 |
| 1A | 13/24 *54%* | ss | *1-4 7-9* N=11 | 19 | | 2.50 P |
| 2A | 15/24 *63%* | ss | *2-3 4-3* N=7 | 26 | | 1.00 P |
| 3A | 17/24 *71%* | ss | *1-2 3-4* N=5 | 29 | | 0.25 P |
| 4A | 18/24 *75%* | ss | *2-2 3-3* N=5 | 26 | | 0.75 P |
| 5A | 15/24 *63%* | ss | *1-2 2-3* N=4 | 27 | | 0.50 P |
| 6A | 16/24 *67%* | ss | *1-1 2-2* N=3 | 27 | | 0.25 P |
| 7A | 17/24 *71%* | ss | *1-2 3-3* N=5 | 17 | | 1.00 P |
| 8A | 19/24 *79%* | ss | *1-2 3-4* N=5 | 27 | | 1.00 P |
| 9A | 20/24 *83%* | ss | *1-2 6-11* N=8 | 23 | | 0.75 P |
| 9B | | | | 12 | | 4.50 P |
| 10A | 19/24 *79%* | ss | *wor-2 8-11* N=10 | 14 | | |
| 10B | | | | 12 | | 4.50 P |

| Depth ft. BGS | Lithologic Description | Elevation ft. MSL |
|---|---|---|
| | Grayish brown (10YR5/2), wet, soft, silty CLAY with trace very fine- to fine-grained sand, roots - TOPSOIL. | |
| | Yellowish brown (10YR5/4) with 5% gray (10YR6/1) mottles, moist, very stiff, SILT with little clay, trace very fine- to fine-grained sand, and trace roots. | |
| 2 | Gray (10YR6/1) with 3% dark yellowish brown (10YR4/6), dry, stiff, SILT with few clay and trace very fine- to fine-grained sand. | 574 |
| | Light brownish gray (10YR6/2) with 5% dark yellowish brown (10YR4/6) mottles, wet, medium, SILT with little clay and trace very fine- to fine-grained sand. | |
| 4 | Light brownish gray (10YR6/2) with 5% dark yellowish brown (10YR4/6) mottles, wet, soft, SILT with little clay and trace very fine- to fine-grained sand. | 572 |
| 6 | | 570 |
| 8 | Brown (7.5YR4/3) with 10% dark yellowish (10YR4/6) mottles, moist, medium, SILT with little clay and trace very fine- to fine-grained sand. | 568 |
| ▼ 10 | Brown (7.5YR5/3) with 10% dark yellowish (10YR4/6) mottles, moist, medium, SILT with little clay and trace very fine- to medium-grained sand. | 566 |
| 12 | Brown (10YR5/3) with 20% dark yellowish brown (10YR4/6) mottles, moist, medium, silty CLAY with trace very fine- to coarse-grained sand. | 564 |
| 14 | Dark yellowish brown (10YR4/6) with 15% gray (10YR6/1) mottles, moist, medium, SILT with some clay, trace very fine- to coarse-grained sand, and trace small gravel. | 562 |
| 16 | Yellowish brown (10YR4/4), moist, medium, SILT with some clay and trace very fine- to coarse-grained sand. | 560 |
| | Dark yellowish brown (10YR4/6), moist, hard, SILT with little clay, few very fine- to coarse-grained sand, and trace small gravel. | |
| 18 | Yellowish brown (10YR5/6), wet, very loose, silty, very fine- to coarse-grained SAND with trace small gravel. | 558 |
| | Brown (10YR5/3) with 10% dark yellowish brown (10YR4/6) mottles, moist, hard, SILT with little clay, few fine- to coarse-grained sand, and trace small gravel. | |
| 20 | | |

Borehole Detail | Remarks

**NOTE(S):** BA03 installed in boring.
Station coordinates are on Plant (Local) grid.

# FIELD BORING LOG

HANSON

**CLIENT:** Natural Resource Technology, Inc.
**Site:** Duck Creek Power Station
**Location:** Canton, Illinois
**Project:** 15E0030
**DATES: Start:** 12/29/2015
**Finish:** 12/29/2015
**WEATHER:** Overcast, windy, cold, lo-30s.

**CONTRACTOR:** Bulldog Drilling, Inc.
**Rig mfg/model:** CME-550X ATV Drill
**Drilling Method:** 4 ¼" HSA, split spoon sampler
**FIELD STAFF: Driller:** C. Dutton
**Helper:** C. Jones
**Eng/Geo:** S. Keim

**BOREHOLE ID:** BA03
**Well ID:** BA03
**Surface Elev:** 576.06 ft. MSL
**Completion:** 27.42 ft. BGS
**Station:** 1,390.83N
2,376.20E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▼ = 10.00 - During Drilling
▼ =
▽ =

| SAMPLE | | | TESTING | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Number | Recov / Total (in) *% Recovery* | Type | *Blows / 6 in* N - Value **RQD** | Moisture (%) | Dry Den. ($lb/ft^3$) | Qu (tsf) *Qp* (tsf) Failure Type | Depth ft. BGS | Lithologic Description | Borehole Detail | Elevation ft. MSL | Remarks |
| 11A | 19/24 *79%* | ss | *2-9* *11-12* N=20 | 12 | | 4.50 P | 22 | Brown (10YR5/3) with 10% dark yellowish brown (10YR4/6) mottles, moist, hard, SILT with little clay, few fine- to coarse-grained sand, and trace small gravel. *[Continued from previous page]* | | 554 | |
| 12A | 13/24 *54%* | ss | *7-10* *27-16* N=37 | 12 | | 4.50 P | 24 | | | 552 | |
| 13A | 15/24 *63%* | ss | *6-12* *15-22* N=27 | 11 | | 4.50 P | 26 | Dark gray (10YR4/1), moist, hard, CLAY with little silt. | | 550 | |
| 14A | 3/17 *18%* | ss | *10-16* *50/5"* | 14 | | 4.50 P | | Gray (10YR5/1), dry, weathered SHALE. | | | |

**End of boring = 27.4 feet**

**NOTE(S):** BA03 installed in boring.
Station 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:** 2/2/2021
**Finish:** 2/2/2021
**WEATHER:** Overcast, cold (lo-20's)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** CME-550 ATV Drill
**Drilling Method:** Hollow Stem Auger
**FIELD STAFF: Driller:** Dusty
**Helper:** Mosley
**Eng/Geo:** R. Hasenyager

**BOREHOLE ID:** BA03L
**Well ID:** BA03L
**Surface Elev:** 575.13 ft. MSL
**Completion:** 10.29 ft. BGS
**Station:** 1,384,429.96N
2,347,924.50E

**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 |
| | | | | | | | 0–5 | Light yellowish brown (10YR6/4), moist, medium, SILT with little clay and trace sand. | | | |
| | | | | | | | 5–6 | Light yellowish brown (10YR6/4), wet, soft, SILT with little clay and trace sand. | | | |
| | | | | | | | 6–10.3 | Yellowish brown (10YR5/6), wet, soft, SILT with little clay and trace sand. | | | |

Depth scale: 2, 4, 6, 8, 10. Elevation scale: 574, 572, 570, 568, 566.

**End of Boring = 10.3 feet**

**NOTE(S):** BA03L blind drilled adjacent to SB03. Lithology copied from SB03.

# FIELD BORING LOG

HANSON

**CLIENT:** Natural Resource Technology, Inc.
**Site:** Duck Creek Power Station
**Location:** Canton, Illinois
**Project:** 15E0030
**DATES: Start:** 12/29/2015
**Finish:** 12/29/2015
**WEATHER:** Overcast, windy, cold, lo-30s.

**CONTRACTOR:** Bulldog Drilling, Inc.
**Rig mfg/model:** CME-750 ATV Drill
**Drilling Method:** 4 ¼" HSA, split spoon sampler
**FIELD STAFF: Driller:** J. Dittmaier
**Helper:** M. Hill
**Eng/Geo:** .

**BOREHOLE ID:** BA04
**Well ID:** BA04
**Surface Elev:** 575.85 ft. MSL
**Completion:** 30.00 ft. BGS
**Station:** 1,496.62N
2,138.12E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▼ = 16.00 - During Drilling
▼ =
▽ =

| SAMPLE: Number | Recov / Total (in) *% Recovery* | Type | TESTING: *Blows / 6 in* N - Value **RQD** | Moisture (%) | Dry Den. (lb/ft$^3$) | Qu (tsf) *Qp* (tsf) Failure Type | Depth ft. BGS | Lithologic Description | Borehole Detail | Elevation ft. MSL | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 0–0.6 | Brown (10YR4/3), moist, medium, silty CLAY with trace very fine- to fine-grained sand, and trace roots - FILL. | | | |
| 1A | 18/24 *75%* | ss | *1-1 4-12* N=5 | 17 | | 2.50 P | 0.6–2 | Dark yellowish brown (10YR4/5), dry, stiff, SILT with little clay and trace very fine- to fine-grained sand. | | 574 | |
| 2A | 22/24 *92%* | ss | *9-9 4-3* N=13 | 27 | | 0.75 P | 2–4 | Dark yellowish brown (10YR4/5), moist, soft, SILT with little clay and trace very fine- to fine-grained sand. | | 572 | |
| 3A | 24/24 *100%* | ss | *1-2 3-2* N=5 | 24 | | 0.50 P | 4–6 | Strong brown (7.5YR4/6), moist, soft, SILT with some clay and trace very fine- to fine-grained sand. | | 570 | |
| 4A | 19/24 *79%* | ss | *1-2 2-3* N=4 | 22 | | 0.50 P | 6–8 | Strong brown (7.5YR4/6), moist, soft, SILT with some clay, few very fine- to coarse-grained sand, and trace small gravel. | | 568 | |
| 5A | 18/24 *75%* | ss | *2-2 3-4* N=5 | 23 | | 2.00 P | 8–10 | Yellowish red (5YR4/6), moist, stiff, silty CLAY with trace very fine- to fine-grained sand and trace small gravel. | | 566 | |
| 6A | 22/24 *92%* | ss | *1-2 3-3* N=5 | 19 | | 1.00 P | 10–12 | Yellowish brown (10YR5/4) with 20% light brownish gray (10YR6/2) mottles, moist, stiff, silty CLAY with trace very fine- to fine-grained sand. | | 564 | |
| 7A | 18/24 *75%* | ss | *1-1 1-2* N=2 | 30 | | 0.75 P | 12–14 | Grayish brown (10YR5/4) with 40% dark yellowish brown (10YR4/6) mottles, moist, medium, SILT with little clay and trace very fine- to medium-grained sand. | | 562 | |
| 8A | 22/24 *92%* | ss | *4-9 14-20* N=23 | 11 | | 4.50 P | 14–16 | Strong brown (7.5YR4/6) with 10% brown (7.5YR5/2) mottles, dry, hard, CLAY with little silt and little very fine- to medium-grained sand. | | 560 | |
| 9A | 24/24 *100%* | ss | *1-6 8-13* N=14 | 14 | | | 16–16.6 (▼ 16) | Yellowish brown (10YR5/6), wet, loose, very fine- to medium-grained SAND with some clay. | | | |
| 9B | | | | 12 | | 4.50 P | 16.6–19 | Yellowish brown (10YR5/6), moist, hard, silty CLAY with few very fine- to coarse-grained sand and trace small gravel. | | 558 | |
| 10A | 22/24 *92%* | ss | *2-11 12-13* N=23 | 11 | | 4.50 P | | | | | |
| 10B | | | | 11 | | | 19–20 | Gray (10YR5/1), hard, SILT with some clay, little very fine- to coarse-grained sand, and trace small gravel. | | 556 | |

**NOTE(S):** BA04 installed in boring.
Station coordinates are on Plant (Local) grid.

# FIELD BORING LOG

**CLIENT:** Natural Resource Technology, Inc.
**Site:** Duck Creek Power Station
**Location:** Canton, Illinois
**Project:** 15E0030
**DATES: Start:** 12/29/2015
**Finish:** 12/29/2015
**WEATHER:** Overcast, windy, cold, lo-30s.

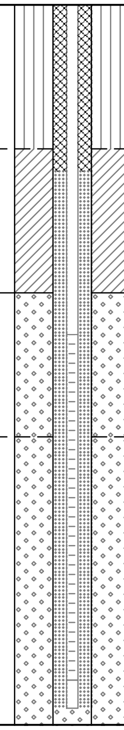
**CONTRACTOR:** Bulldog Drilling, Inc.
**Rig mfg/model:** CME-750 ATV Drill
**Drilling Method:** 4 ¼" HSA, split spoon sampler
**FIELD STAFF: Driller:** J. Dittmaier
**Helper:** M. Hill
**Eng/Geo:** .

HANSON
**BOREHOLE ID:** BA04
**Well ID:** BA04
**Surface Elev:** 575.85 ft. MSL
**Completion:** 30.00 ft. BGS
**Station:** 1,496.62N
2,138.12E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▼ = 16.00 - During Drilling
▼ =
∇ =

| SAMPLE: Number | Recov / Total (in) *% Recovery* | Type | TESTING: *Blows / 6 in* N - Value **RQD** | Moisture (%) | Dry Den. (lb/ft$^3$) | Qu (tsf) *Qp (tsf)* Failure Type | Depth ft. BGS | Lithologic Description | Elevation ft. MSL | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 11A | 23/24 *96%* | ss | *1-5* *9-13* N=14 | 10 | | 4.50 P | 20–22 | Gray (10YR5/1), hard, SILT with some clay, little very fine- to coarse-grained sand, and trace small gravel. *[Continued from previous page]* | 554 | |
| 12A | 22/24 *92%* | ss | *12-10* *16-22* N=26 | 11 | | 4.50 P | 22–24 | Dark grayish brown (10YR4/2), dry, hard, silty CLAY with trace very fine- to fine-grained sand and trace small gravel. | 552 | |
| 13A | 18/24 *75%* | ss | *5-6* *20-29* N=26 | 9 | | | 24–26 | Dark grayish brown (10YR4/2), wet, medium dense, very fine- to very coarse-grained SAND. | 550 | |
| 14A | 19/24 *79%* | ss | *5-6* *12-27* N=18 | 9 | | | 26–28 | Gray (10YR5/1), wet, dense, very fine- to very coarse-grained SAND with few small to large gravel. | 548 | |
| 15A | 21/24 *88%* | ss | *4-17* *22-40* N=39 | 6 | | | 28–30 | | 546 | |



**End of boring = 30.0 feet**

**NOTE(S):** BA04 installed in boring.
Station coordinates are on Plant (Local) grid.

# FIELD BORING LOG

BA05 (BA05b)

HANSON

**CLIENT:** Illinois Power Generating Company, LLC
**Site:** Duck Creek Power Station - Bottom Ash Basin
**Location:** Canton, Illinois
**Project:** 16E0106
**DATES: Start:** 7/27/2016
**Finish:** 7/28/2016
**WEATHER:** Sunny, humid, hot (hi-80s)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** Diedrich D-50
**Drilling Method:** 4 ¼" HSA, split spoon sampler

**FIELD STAFF: Driller:** B. Williamson
**Helper:** M. Bly
**Eng/Geo:** S. Keim

**BOREHOLE ID:** ~~BA-05b~~
**Well ID:** ~~BA-05~~
**Surface Elev:** 593.17 ft. MSL
**Completion:** 46.57 ft. BGS
**Station:** 1,850.48N
2,114.51E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▼ = 16.00 - During Drilling
▼ = 13.44 - 8/8/16 @ 09:12
▽ =

| SAMPLE Number | Recov / Total (in) *% Recovery* | Type | TESTING *Blows / 6 in* N - Value **RQD** | Moisture (%) | Dry Den. ($lb/ft^3$) | Qu (tsf) *Qp* (tsf) Failure Type |
|---|---|---|---|---|---|---|
| 1A | 16/24 *67%* | ss | *1-1 3-4* N=4 | 28 | | *2.00* |
| 2A | 19/24 *79%* | ss | *3-3 4-4* N=7 | 22 | | *2.25* |
| 3A | 24/24 *100%* | ss | *1-3 2-3* N=5 | 27 | | *0.50* |
| 4A | 18/24 *75%* | ss | *1-2 2-5* N=4 | 24 | | *1.00* |
| 5A | 17/24 *71%* | ss | *2-3 4-2* N=7 | 24 | | *0.75* |
| 6A | 17/24 *71%* | ss | *3-3 3-3* N=6 | 24 | | *1.00* |
| 7A | 18/24 *75%* | ss | *2-2 3-4* N=5 | 26 | | *0.75* |
| 8A | 18/24 *75%* | ss | *2-3 2-4* N=5 | 28 | | *0.50* |
| 9A | 20/24 *83%* | ss | *2-2 3-3* N=5 | 28 | | *1.00* |
| 10A | 17/24 *71%* | ss | *1-2 2-2* N=4 | 25 | | *1.00* |

| Depth ft. BGS | Lithologic Description |
|---|---|
| 0–0.6 | Dark brown (10YR3/3), moist, soft, SILT with little clay, few very fine- to coarse-grained sand, roots - TOPSOIL |
| 0.6–4 | Yellowish brown (10YR5/6), moist, very stiff, SILT with some clay, few very fine- to coarse-grained sand and trace roots. [Fill] |
| 4–8 | Brown (10YR5/3) with 30% dark yellowish brown (10YR4/6) mottles, moist, medium, CLAY with some silt. [Fill] |
| 8–16 | Grayish brown (10YR5/2) with 30% dark yellowish brown (10YR4/6) mottles, moist, medium, SILT with some clay. |
| 16–17 | Grayish brown (10YR5/2) with 30% dark yellowish brown (10YR4/6) mottles, wet, medium, SILT with some clay. |
| 17–20 | Brown (10YR4/3) with 10% dark yellowish brown (10YR4/6) mottles, wet, medium, SILT with some clay. |

Depth scale (ft. BGS): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

Elevation (ft. MSL): 592, 590, 588, 586, 584, 582, 580, 578, 576, 574

Borehole Detail | Remarks

**NOTE(S):** BA-05 installed in boring.
Station coordinates are on Plant (Local) grid.

# FIELD BORING LOG

**CLIENT:** Illinois Power Generating Company, LLC
**Site:** Duck Creek Power Station - Bottom Ash Basin
**Location:** Canton, Illinois
**Project:** 16E0106
**DATES: Start:** 7/27/2016
**Finish:** 7/28/2016
**WEATHER:** Sunny, humid, hot (hi-80s)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** Diedrich D-50
**Drilling Method:** 4 ¼" HSA, split spoon sampler
**FIELD STAFF: Driller:** B. Williamson
**Helper:** M. Bly
**Eng/Geo:** S. Keim

HANSON

**BOREHOLE ID:** BA-05b
**Well ID:** BA-05
**Surface Elev:** 593.17 ft. MSL
**Completion:** 46.57 ft. BGS
**Station:** 1,850.48N
2,114.51E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▼ = 16.00 - During Drilling
▼ = 13.44 - 8/8/16 @ 09:12
▽ =

| Number | Recov / Total (in) *% Recovery* | Type | *Blows / 6 in* N - Value **RQD** | Moisture (%) | Dry Den. (lb/ft³) | Qu (tsf) *Qp (tsf)* Failure Type |
|---|---|---|---|---|---|---|
| 11A | 17/24 *71%* | ss | *3-2 4-4* N=6 | 23 | | *1.00* |
| 12A | 16/24 *67%* | ss | *1-2 1-3* N=3 | 24 | | *1.00* |
| 13A | 20/24 *83%* | ss | *2-2 2-3* N=4 | 25 | | *1.30* |
| 14A | 21/24 *88%* | ss | *3-4 4-4* N=8 | 22 | | *1.50* |
| 15A | 22/24 *92%* | ss | *2-2 4-5* N=6 | 24 | | *0.50* |
| 16A | 20/24 *83%* | ss | *3-7 7-9* N=14 | 23 | | *1.50* |
| 17A | 20/24 *83%* | ss | *6-11 13-23* N=24 | 16 | | *3.50* |
| 18A | 16/24 *67%* | ss | *5-11 15-22* N=26 | 21 | | *4.50* |
| 19A | 14/24 *58%* | ss | *13-17 22-30* N=39 | 11 | | *4.50* |
| 20A | 20/24 *83%* | ss | *22-41 50-39* N=91 | 16 | | |

| Depth ft. BGS | Lithologic Description |
|---|---|
| 20–24 | Yellowish brown (10YR5/6) with 10% dark yellowish brown (10YR4/6) mottles, moist, stiff, CLAY with some silt and few very fine- to fine-grained sand. |
| 24–28 | Brown (10YR5/3) with 30% dark yellowish brown (10YR4/6) mottles, moist, stiff, CLAY with some silt, few very fine- to coarse-grained sand, and trace small gravel. |
| 28–30.6 | Gray (10YR6/1) with 30% yellowish brown (10YR5/6) mottles, wet, medium, SILT with some clay and trace very fine- to fine-grained sand. |
| 30.6–32 | Gray (10YR5/1), very moist, stiff, SILT with little clay and trace very fine- to coarse-grained sand. |
| 32–34.3 | Gray (10YR5/1) with 40% yellowish brown (10YR5/4) mottles, very moist, very stiff, SILT with little clay, few very fine- to coarse-grained sand and trace small gravel. |
| 34.3–38 | Gray (10YR5/1), moist, hard, SILT with little clay, little very fine- to coarse-grained sand and trace small to large gravel. |
| 38–40 | Dark gray (10YR4/1) with 10% black (2.5/N) mottles, wet, very dense, very fine- to coarse-grained SAND with few silt and trace small gravel. |

Depth ticks: 22, 24, 26, 28, 30, 32, 34, 36, 38, 40
Elevation ft. MSL: 572, 570, 568, 566, 564, 562, 560, 558, 556, 554

Borehole Detail | Remarks

**NOTE(S):** BA-05 installed in boring.
Station coordinates are on Plant (Local) grid.

# FIELD BORING LOG

HANSON

**CLIENT:** Illinois Power Generating Company, LLC
**Site:** Duck Creek Power Station - Bottom Ash Basin
**Location:** Canton, Illinois
**Project:** 16E0106
**DATES: Start:** 7/27/2016
**Finish:** 7/28/2016
**WEATHER:** Sunny, humid, hot (hi-80s)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** Diedrich D-50
**Drilling Method:** 4 ¼" HSA, split spoon sampler
**FIELD STAFF: Driller:** B. Williamson
**Helper:** M. Bly
**Eng/Geo:** S. Keim

**BOREHOLE ID:** BA-05b
**Well ID:** BA-05
**Surface Elev:** 593.17 ft. MSL
**Completion:** 46.57 ft. BGS
**Station:** 1,850.48N
2,114.51E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▼ = 16.00 - During Drilling
▼ = 13.44 - 8/8/16 @ 09:12
▽ =

| SAMPLE | | | TESTING | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Number | Recov / Total (in) *% Recovery* | Type | *Blows / 6 in* N - Value **RQD** | Moisture (%) | Dry Den. (lb/ft$^3$) | Qu (tsf) *Qp (tsf)* Failure Type | Depth ft. BGS | Lithologic Description | Borehole Detail | Elevation ft. MSL | Remarks |
| 21A | 20/24 *83%* | SS | *16-23* *19-32* N=42 | 13 | | | 42 | Dark gray (10YR4/1) with 10% black (2.5/N) mottles, wet, very dense, very fine- to coarse-grained SAND with few silt and trace small gravel. *[Continued from previous page]* | | 552 | |
| 22A | 20/24 *83%* | SS | *15-24* *40-96* N=64 | 14 | | | 44 | | | 550 | |
| 23A | 16/24 *67%* | SS | *8-7* *12-18* N=19 | 19 | | *4.50* | 46 | Dark gray (10YR4/1), moist, hard, SILT with some clay. | | 548 | |
| | 0/7 *0%* | BD | | | | | | | | | |

**End of boring = 46.57 feet**

**NOTE(S):** BA-05 installed in boring.
Station coordinates are on Plant (Local) grid.

# FIELD BORING LOG

BA06 (BA05c)

HANSON

**CLIENT:** Illinois Power Generating Company, LLC
**Site:** Duck Creek Power Station - Bottom Ash Basin
**Location:** Canton, Illinois
**Project:** 16E0106
**DATES: Start:** 8/3/2016
**Finish:** 8/3/2016
**WEATHER:** Partly cloudy, humid, warm (mid-80s)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** Diedrich D-50
**Drilling Method:** 4 ¼" HSA, split spoon sampler
**FIELD STAFF: Driller:** B. Williamson
**Helper:** M. Bly
**Eng/Geo:** S. Keim

**BOREHOLE ID:** ~~BA-05c~~
**Well ID:** ~~BA-06~~
**Surface Elev:** 593.20 ft. MSL
**Completion:** 44.00 ft. BGS
**Station:** 1,840.64N
2,702.30E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▼ = 35.00 - During Drilling
▼ = 14.36 - 8/8/16 @ 09:07
▽ =

| 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 | 15/24 63% | SS | 7-6 4-8 N=10 | 19 | | 3.00 | 0–2 | Brown (10YR4/3), dry, very stiff, SILT with little clay, few very fine- to medium-grained sand, roots. [Fill] | 592 | |
| 2A | 14/24 58% | SS | 6-7 8-6 N=15 | 12 | | 2.00 | 2–4 | Yellowish brown (10YR5/6), dry, very stiff, SILT with some clay and few very fine- to medium-grained sand. [Fill] | 590 | |
| 3A | 16/24 67% | SS | 5-5 4-5 N=9 | 16 | | 2.50 | 4–10 | Brown (10YR4/3), moist, very stiff, SILT with little clay and trace very fine- to fine-grained sand. [Fill] | 588 | |
| 4A | 18/24 75% | SS | 6-5 5-6 N=10 | 14 | | 2.30 | | | 586 | |
| 5A | 19/24 79% | SS | 6-7 8-9 N=15 | 18 | | 2.80 | | | 584 | |
| 6A | 12/24 50% | SS | 3-3 7-7 N=10 | 15 | | | 10–12 | Brown (10YR4/3) with 40% light gray (10YR7/1) mottles, moist, stiff, SILT with some clay and trace very fine- to fine-grained sand. [Fill] | 582 | |
| 7A | 15/24 63% | SS | 5-6 7-7 N=13 | 18 | | 2.50 | 12–14 | Brown (10YR4/3) with 10% dark yellowish brown (10YR4/6) and 10% light gray (10YR7/1) mottles, moist, stiff, SILT with some clay and trace very fine- to fine-grained sand. [Fill] | 580 | |
| 8A | 11/24 46% | SS | 3-1 2-2 N=3 | 27 | | 1.00 | 14–16 ▼ | Yellowish brown (10YR5/6) with 35% gray (10YR5/1) mottles, moist, medium, CLAY with some silt and trace very fine- to fine-grained sand. [Fill] | 578 | |
| 9A | 11/24 46% | SS | 1-5 8-8 N=13 | 19 | | 1.80 | 16–18 | Yellowish brown (10YR5/6), moist, stiff, SILT with little clay, trace very fine- to coarse-grained sand, and trace small gravel. [Fill] | 576 | |
| 10A | 14/24 58% | SS | 1-3 4-4 N=7 | 20 | | 2.00 | 18–20 | Gray (10YR5/1) with 40% olive gray (5Y5/2) mottles, moist, stiff, SILT with some clay and trace coal fragments. [Fill] | 574 | |

**NOTE(S):** BA-06 installed in boring.
Station coordinates are on Plant (Local) grid.

# FIELD BORING LOG

HANSON

**CLIENT:** Illinois Power Generating Company, LLC
**Site:** Duck Creek Power Station - Bottom Ash Basin
**Location:** Canton, Illinois
**Project:** 16E0106
**DATES: Start:** 8/3/2016
**Finish:** 8/3/2016
**WEATHER:** Partly cloudy, humid, warm (mid-80s)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** Diedrich D-50
**Drilling Method:** 4 ¼" HSA, split spoon sampler
**FIELD STAFF: Driller:** B. Williamson
**Helper:** M. Bly
**Eng/Geo:** S. Keim

**BOREHOLE ID:** BA-05c
**Well ID:** BA-06
**Surface Elev:** 593.20 ft. MSL
**Completion:** 44.00 ft. BGS
**Station:** 1,840.64N
2,702.30E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▼ = 35.00 - During Drilling
▼ = 14.36 - 8/8/16 @ 09:07
▽ =

| 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 | *4-5 6-8* N=11 | 25 | | *2.00* |
| 12A | 16/24 *67%* | ss | *6-5 7-9* N=12 | 24 | | *2.80* |
| 13A | 19/24 *79%* | ss | *3-4 5-7* N=9 | 25 | | *2.00* |
| 14A | 19/24 *79%* | ss | *6-7 10-10* N=17 | 23 | | *2.30* |
| 15A | 20/24 *83%* | ss | *3-5 7-7* N=12 | 29 | | *2.50* |
| 16A | 17/24 *71%* | ss | *3-3 7-8* N=10 | 21 | | *2.00* |
| 17A | 13/24 *54%* | ss | *3-4 5-8* N=9 | 23 | | *1.50* |
| 18A | 24/24 *100%* | ss | *4-6 7-5* N=13 | 19 | | *3.00* |
| 19A | 20/24 *83%* | ss | *4-7 10-11* N=17 | 19 | | *2.50* |
| 20A | 22/24 *92%* | ss | *8-9 14-22* N=23 | 14 | | *4.50* |

| Depth ft. BGS | Lithologic Description |
|---|---|
| to 24.4 | Yellowish brown (10YR5/6) with 30% gray (10YR5/1) mottles. moist, very stiff, CLAY with little silt and trace very fine- to coarse-grained sand. [Fill] |
| 24.4 – 26.9 | Yellowish brown (10YR5/6) with 25% gray (10YR5/1) mottles, moist, stiff, CLAY with little silt, and trace very fine- to fine-grained sand. [Fill] |
| 26.9 – 28 | Dark gray (10YR4/1), moist, very stiff, CLAY with some silt and trace very fine- to fine-grained sand. [Fill] |
| 28 – 34 | Very dark gray (10YR3/1) moist, very stiff, SILT with some clay, trace very fine- to fine-grained sand, and roots. |
| 34 – 35.6 | ▼ Yellowish brown (10YR5/6) with 10% gray (10YR5/1) mottles, moist, very stiff, CLAY with some silt, few very fine- to coarse-grained sand, and trace small gravel. |
| 35.6 – 38 | Yellowish brown (10YR5/6) with 20% gray (10YR5/1) and 10% very dark gray (10YR3/1) mottles, moist, very stiff, CLAY with some silt, little very fine- to coarse-grained sand, and trace small to large gravel. |
| 38 – 40 | Dark gray (10YR4/1), moist, hard, SILT with little clay, few very fine- to coarse-grained sand, and trace small to large gravel. |

Depth scale (ft. BGS): 22, 24, 26, 28, 30, 32, 34, 36, 38, 40
Elevation (ft. MSL): 572, 570, 568, 566, 564, 562, 560, 558, 556, 554

Borehole Detail | Remarks

**NOTE(S):** BA-06 installed in boring.
Station coordinates are on Plant (Local) grid.

# FIELD BORING LOG

HANSON

**CLIENT:** Illinois Power Generating Company, LLC
**Site:** Duck Creek Power Station - Bottom Ash Basin
**Location:** Canton, Illinois
**Project:** 16E0106
**DATES: Start:** 8/3/2016
**Finish:** 8/3/2016
**WEATHER:** Partly cloudy, humid, warm (mid-80s)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** Diedrich D-50
**Drilling Method:** 4 ¼" HSA, split spoon sampler

**FIELD STAFF: Driller:** B. Williamson
**Helper:** M. Bly
**Eng/Geo:** S. Keim

**BOREHOLE ID:** BA-05c
**Well ID:** BA-06
**Surface Elev:** 593.20 ft. MSL
**Completion:** 44.00 ft. BGS
**Station:** 1,840.64N
2,702.30E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▼ = 35.00 - During Drilling
▼ = 14.36 - 8/8/16 @ 09:07
▽ =

| SAMPLE: Number | Recov / Total (in) *% Recovery* | Type | TESTING: *Blows / 6 in* N - Value **RQD** | Moisture (%) | Dry Den. ($lb/ft^3$) | Qu (tsf) *Qp (tsf)* Failure Type | Depth ft. BGS | Lithologic Description | Borehole Detail | Elevation ft. MSL | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21A | 19/24 *79%* | SS | *4-7* *6-6* N=13 | 14 | | *4.50* | 42 | Dark gray (10YR4/1), moist, hard, SILT with little clay, few very fine- to coarse-grained sand, and trace small to large gravel. *[Continued from previous page]* | | 552 | |
| 22A | 0/24 *0%* | SS | *8-18* *25-28* N=43 | | | | 44 | | | 550 | |

**End of boring = 44.0 feet**

**NOTE(S):** BA-06 installed in boring.
Station 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:** 2/5/2021
**Finish:** 2/23/2021
**WEATHER:** Overcast, cold (hi-20's)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** CME-550 ATV Drill
**Drilling Method:** Hollow Stem Auger & Conventional Rock Core
**FIELD STAFF: Driller:** Dusty
**Helper:** Mosley
**Eng/Geo:** R. Hasenyager

**BOREHOLE ID:** SB01
**Well ID:** n/a
**Surface Elev:** 584.2 ft. MSL
**Completion:** 100.0 ft. BGS
**Station:** 1,384,727.73N
2,347,911.27E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▽ = 20.00 - durring drilling
▽ =
▼ =

| Number | Recov / Total (in) *% Recovery* | Type | *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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 14/24 *58%* | SS | *2-2 5-4* N=7 | | | *1.5* | 0–6.4 | Brownish yellow (10YR5/6), moist, medium, SILT with little clay and trace sand. | | 584 | |
| 2A | 6/24 *25%* | SS | *1-2 1-2* N=3 | | | *2.0* | 2 | | | 582 | |
| 3A | 11/24 *46%* | SS | *1-3 3-4* N=6 | | | *2.5* | 4 | | | 580 | |
| 4A | 13/24 *54%* | SS | *1-1 3-4* N=4 | | | *1.5* | 6.4–10.5 | Yellowish brown (10YR5/4), moist, soft, SILT with few clay, trace sand, and trace gravel. | | 578 | |
| 5A | 6/24 *25%* | SS | *2-2 2-2* N=4 | | | *1.5* | 8 | | | 576 | |
| 6A | 15/24 *63%* | SS | *2-1 2-4* N=3 | | | *3.5* | 10.5–14.7 | Brownish yellow (10YR5/6), moist, soft, SILT with few clay and trace sand. | | 574 | |
| 7A | 12/24 *50%* | SS | *woh-1 3-4* N=4 | | | *3.0* | 12 | | | 572 | |
| 8A | 12/24 *50%* | SS | *2-3 3-3* N=6 | | | | 14.7–18 | Gray (10YR5/1), moist, soft, SILT with few clay and trace sand. | | 570 | |
| ST9 | 24/24 *100%* | SH | | | | *2.5* | 16 | | | 568 | |
| 10A | 20/24 *83%* | SS | *3-1 3-3* N=4 | | | *0.5* | 18–19.5 | Brown (10YR4/3) with 10% yellowish brown (10YR5/6) mottles, moist, soft, SILT with few clay and trace sand. | | 566 | |
| | | | | | | | 19.5–20 ▽ | Dark yellowish brown (10YR4/4), wet, soft, SILT with few clay and trace sand. | | | |

**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:** 2/5/2021
**Finish:** 2/23/2021
**WEATHER:** Overcast, cold (hi-20's)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** CME-550 ATV Drill
**Drilling Method:** Hollow Stem Auger & Conventional Rock Core
**FIELD STAFF: Driller:** Dusty
**Helper:** Mosley
**Eng/Geo:** R. Hasenyager

**BOREHOLE ID:** SB01
**Well ID:** n/a
**Surface Elev:** 584.2 ft. MSL
**Completion:** 100.0 ft. BGS
**Station:** 1,384,727.73N
2,347,911.27E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▽ = 20.00 - durring drilling
▼ =
▼ =

| 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 | Elevation ft. MSL | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 11A | 19/24 *79%* | SS | *2-2* *3-3* N=5 | | | | | Dark yellowish brown (10YR4/4), wet, soft, SILT with few clay and trace sand. *[Continued from previous page]* | 564 | |
| 12A | 18/24 *75%* | SS | *2-2* *2-4* N=4 | | | *1.5* | 22 | Gray (10YR5/1), moist, soft, CLAY with some silt and trace sand. | 562 | |
| 13A | 24/24 *100%* | SS | *2-3* *4-3* N=7 | | | *2.0* | 24 | | 560 | |
| 14A | 24/24 *100%* | SS | *3-4* *9-16* N=13 | | | | 26 | Gray (10YR5/1) with 30% yellowish brown (10YR5/8) mottles, moist, medium, CLAY with some silt and trace sand. | 558 | |
| | 24/24 *100%* | SH | | | | *4.5* | 28 | Gray (10YR5/1) with 20% yellowish brown (10YR5/8) mottles, moist, medium, CLAY with some silt, little sand, and trace gravel. | 556 | |
| 16A | 24/24 *100%* | SS | *9-13* *14-29* N=27 | | | *3.5* | 30 | Dark gray (10YR4/1), moist, hard, CLAY with some silt, little sand, and trace gravel. | 554 | |
| 17A | 17/17 *100%* | SS | *24-45* *50/5"* | | | | 32 | | 552 | |
| 18A | 22/24 *92%* | SS | *25-26* *28-41* N=54 | | | | 34 | Yellowish brown (10YR5/6), wet, dense, very fine- to very coarse-grained SAND with few silt and little gravel. | 550 | |
| 19A | 23/24 *96%* | SS | *21-25* *33-50* N=58 | | | | 36 | Gray (10YR5/1), wet, dense, very fine- to very coarse-grained SAND with few silt and little gravel. | 548 | |
| 20A | 17/17 *100%* | SS | *27-41* *50/5"* | | | *4.5* | 38 | Dark gray (10YR4/1), moist, very hard, SILT with some clay, little sand, and trace gravel. | 546 | |
| | | | | | | | 40 | | | |

**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:** 2/5/2021
**Finish:** 2/23/2021
**WEATHER:** Overcast, cold (hi-20's)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** CME-550 ATV Drill
**Drilling Method:** Hollow Stem Auger & Conventional Rock Core
**FIELD STAFF: Driller:** Dusty
**Helper:** Mosley
**Eng/Geo:** R. Hasenyager

**BOREHOLE ID:** SB01
**Well ID:** n/a
**Surface Elev:** 584.2 ft. MSL
**Completion:** 100.0 ft. BGS
**Station:** 1,384,727.73N
2,347,911.27E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▽ = 20.00 - durring drilling
▼ =
▼ =

## SAMPLE / TESTING

| Number | Recov / Total (in) % Recovery | Type | Blows / 6 in N - Value **RQD** | Water Content (%) | Dry Density (lb/ft³) | Qu (tsf) *Qp* (tsf) Failure Type |
|---|---|---|---|---|---|---|
| 21A | 23/24 *96%* | SS | *13-33 34-36* N=67 | | | *3.0* |
| 22A | 21/23 *91%* | SS | *14-35 42-50/5"* N=77 | | | *4.0* |
| 23A | 16/17 *94%* | SS | *7-34 50/5"* | | | |
| 24A | 17/24 *71%* | SS | *4-9 20-42* N=29 | | | *4.5* |
| 25A | 16/16 *100%* | SS | *16-38 50/4"* | | | *4.5* |
| | 24/24 *100%* | SS | *18-29 38-48* N=67 | | | |
| | 36/36 *100%* | RC | | | | |
| | 55/60 *92%* | RC | **RQD = 91.7%** | | | |

Depth ft. BGS: 42, 44, 46, 48, 50, 52, 54, 56, 58, 60
Elevation ft. MSL: 544, 542, 540, 538, 536, 534, 532, 530, 528, 526

## Lithologic Description

Gray (10YR5/1), moist, hard, SILT with few clay and trace sand.

Black (10YR2/1), moist, very hard, weathered SHALE.

Dark gray (10YR4/1), moist, very hard, LIMESTONE.

Gray (10YR5/1), moist, very hard, SHALE.

Borehole Detail | Remarks

**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:** 2/5/2021
**Finish:** 2/23/2021
**WEATHER:** Overcast, cold (hi-20's)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** CME-550 ATV Drill
**Drilling Method:** Hollow Stem Auger & Conventional Rock Core
**FIELD STAFF: Driller:** Dusty
**Helper:** Mosley
**Eng/Geo:** R. Hasenyager

**BOREHOLE ID:** SB01
**Well ID:** n/a
**Surface Elev:** 584.2 ft. MSL
**Completion:** 100.0 ft. BGS
**Station:** 1,384,727.73N
2,347,911.27E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▽ = 20.00 - durring drilling
▼ =
▼ =

| SAMPLE: Number | SAMPLE: Recov / Total (in) *% Recovery* | SAMPLE: Type | TESTING: *Blows / 6 in* N - Value **RQD** | TESTING: Water Content (%) | TESTING: Dry Density ($lb/ft^3$) | TESTING: Qu (tsf) *Qp (tsf)* Failure Type | Depth ft. BGS | Lithologic Description | Borehole Detail | Elevation ft. MSL | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | 524 | |
| | | | | | | | 62 | | | 522 | |
| | | | | | | | 64 | | | 520 | |
| | 117/120 *98%* | RC | **RQD = 95.8%** | | | | | | | | |
| | | | | | | | 66 | | | 518 | |
| | | | | | | | 68 | | | 516 | |
| | | | | | | | 70 | Gray (10YR5/1), moist, very hard, SHALE. *[Continued from previous page]* | | 514 | |
| | | | | | | | 72 | | | 512 | |
| | | | | | | | 74 | | | 510 | |
| | 119/120 *99%* | RC | **RQD = 93.3%** | | | | | | | | |
| | | | | | | | 76 | | | 508 | |
| | | | | | | | 78 | | | 506 | |
| | | | | | | | 80 | | | | |

**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:** 2/5/2021
**Finish:** 2/23/2021
**WEATHER:** Overcast, cold (hi-20's)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** CME-550 ATV Drill
**Drilling Method:** Hollow Stem Auger & Conventional Rock Core
**FIELD STAFF: Driller:** Dusty
**Helper:** Mosley
**Eng/Geo:** R. Hasenyager

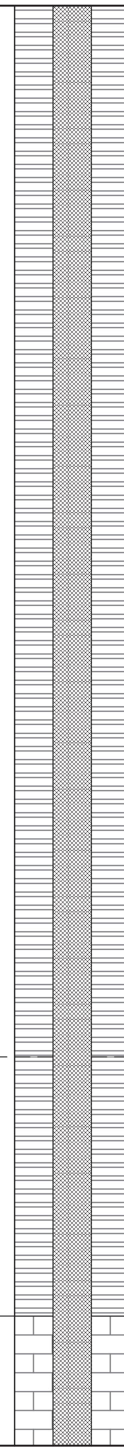
**BOREHOLE ID:** SB01
**Well ID:** n/a
**Surface Elev:** 584.2 ft. MSL
**Completion:** 100.0 ft. BGS
**Station:** 1,384,727.73N
2,347,911.27E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
= 20.00 - durring drilling
=
=

| 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 |
| | 120/120 *100%* | RC | **RQD = 85.0%** | | | | 80–94.6 | Gray (10YR5/1), moist, very hard, SHALE. *[Continued from previous page]* | | | |
| | 120/120 *100%* | RC | **RQD = 36.7%** | | | | 94.6–98.2 | Very dark grayish brown (10YR3/1), moist, very hard, SHALE. | | | |
| | | | | | | | 98.2–100 | Dary gray (10YR4/1), moist, very hard, LIMESTONE. **End of boring = 100 ft.** | | | |

Depth scale (ft. BGS): 82, 84, 86, 88, 90, 92, 94, 96, 98, 100
Elevation scale (ft. MSL): 504, 502, 500, 498, 496, 494, 492, 490, 488, 486



**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:** 2/4/2021
**WEATHER:** Sunny, cold (lo-30's)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** CME-550 ATV Drill
**Drilling Method:** Hollow Stem Auger

**FIELD STAFF: Driller:** Dusty
**Helper:** Chris
**Eng/Geo:** R. Hasenyager

**BOREHOLE ID:** SB02
**Well ID:** n/a
**Surface Elev:** 577.2 ft. MSL
**Completion:** 43.5 ft. BGS
**Station:** 1,384,558.21N
2,348,157.14E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▽ = 6.00 - durring drilling
▼ =
▼ =

| SAMPLE 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 |
|---|---|---|---|---|---|---|
| 1A | 18/24 *75%* | SS | *WOH-3 5-6* N=8 | | | *4.0* |
| 2A | 21/24 *88%* | SS | *3-4 4-8* N=8 | | | *2.5* |
| 3A | 20/24 *83%* | SS | *4-8 7-8* N=15 | | | *2.5* |
| 4A | 18/24 *75%* | SS | *1-3 2-4* N=5 | | | *1.5* |
| ST5 | 24/24 *100%* | SH | | | | *2.5* |
| 6A | 18/24 *75%* | SS | *1-2 3-3* N=5 | | | *2.0* |
| 7A | 15/24 *63%* | SS | *1-2 3-3* N=5 | | | *1.5* |
| 8A | 14/24 *58%* | SS | *woh-2 3-4* N=5 | | | *1.5* |
| 9A | 17/24 *71%* | SS | *1-2 2-3* N=4 | | | *2.0* |
| ST10 | 24/24 *100%* | SH | | | | *2.0* |

| Depth ft. BGS | Lithologic Description |
|---|---|
| 0 – ~3.7 | Brownish yellow (10YR5/6), moist, medium, SILT with little clay and trace sand. |
| ~3.7 – ~12.3 | Gray (10YR5/1), moist, medium, SILT with little clay and trace sand. |
| ~12.3 – ~14.8 | Gray (7.5YR5/1) with 20% strong brown (7.5YR5/6) mottles, wet, soft SILT with little clay and trace sand. |
| ~14.8 – 16 | Brown (10YR4/3), wet, soft, PEAT. |
| 16 – 20 | Gray (10YR5/1), wet, soft, CLAY with some silt and trace sand. |

Depth ft. BGS: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

Elevation ft. MSL: 576, 574, 572, 570, 568, 566, 564, 562, 560, 558

Borehole Detail | Remarks

**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:** 2/4/2021
**WEATHER:** Sunny, cold (lo-30's)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** CME-550 ATV Drill
**Drilling Method:** Hollow Stem Auger
**FIELD STAFF: Driller:** Dusty
**Helper:** Chris
**Eng/Geo:** R. Hasenyager

**BOREHOLE ID:** SB02
**Well ID:** n/a
**Surface Elev:** 577.2 ft. MSL
**Completion:** 43.5 ft. BGS
**Station:** 1,384,558.21N
2,348,157.14E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▽ = 6.00 - durring drilling
▼ =
▼ =

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| 11A | 24/24 100% | SS | 1-3 3-3 N=6 | | | 15.0 | | Gray (10YR5/1), wet, soft, CLAY with some silt and trace sand. *[Continued from previous page]* | 556 | |
| 12A | 24/24 100% | SS | 2-2 4-4 N=6 | | | | 22 | Yellowish brown (10YR5/6), wet, dense, very fine to medium grained SAND with few silt. | 554 | |
| ST13 | 24/24 100% | SH | | | | | 24 | | 552 | |
| 14A | 20/24 83% | SS | 1-8 12-16 N=20 | | | | 26 | Gray (10YR5/1), wet, very dense, SILT and very fine to fine grained SAND. | 550 | |
| 15A | 24/24 100% | SS | 8-12 11-20 N=23 | | | 4.5 | 28 | | 548 | |
| 16A | 20/24 83% | SS | 8-20 46-50/5 N=66 | | | 4.5 | 30 | | 546 | |
| 17A | 9/9 100% | SS | 24-50/3 --- | | | 4.5 | 32 | | 544 | |
| 18A | 14/24 58% | SS | 18-15 9-10 N=24 | | | 4.5 | 34 | Gray (10YR5/1), moist, hard, SILT with some clay, few sand, and trace gravel. | 542 | |
| 19A | 17/24 71% | SS | 6-10 14-32 N=24 | | | 4.5 | 36 | | 540 | |
| 20A | 15/15 100% | SS | 41-26 50/3-- | | | 4.5 | 38 | | 538 | |
| | | | | | | | 40 | | | |

**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:** 2/4/2021
**WEATHER:** Sunny, cold (lo-30's)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** CME-550 ATV Drill
**Drilling Method:** Hollow Stem Auger
**FIELD STAFF: Driller:** Dusty
**Helper:** Chris
**Eng/Geo:** R. Hasenyager

**BOREHOLE ID:** SB02
**Well ID:** n/a
**Surface Elev:** 577.2 ft. MSL
**Completion:** 43.5 ft. BGS
**Station:** 1,384,558.21N
2,348,157.14E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▽ = 6.00 - durring drilling
▼ =
▼ =

| 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 |
| | | | | | | | | Gray (10YR5/1), moist, hard, SILT with some clay, few sand, and trace gravel. *[Continued from previous page]* | | | |
| 21A | 17/17 *100%* | SS | *20-45* *50/5--* | | | | | | | 536 | |
| | | | | | | | 42 | Black (10YR2/1), weathered SHALE. | | | |
| 22A | 16/16 *100%* | SS | *17-32* *50/4--* | | | | | | | 534 | |

**End of boring = 43.5 ft.**

**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:** 2/2/2021
**Finish:** 2/2/2021
**WEATHER:** Overcast, cold (lo-20's)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** CME-550 ATV Drill
**Drilling Method:** Hollow Stem Auger

**FIELD STAFF: Driller:** Dusty
**Helper:** Mosley
**Eng/Geo:** R. Hasenyager

**BOREHOLE ID:** SB03
**Well ID:** n/a
**Surface Elev:** 575.1 ft. MSL
**Completion:** 25.3 ft. BGS
**Station:** 1,384,427.60N
2,347,928.05E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
▽ = 5.00 - durring drilling
▼ =
▼ =

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1A | 12/24 50% | SS | 2-3 8-7 N=11 | | | | 0–5.0 | Light yellowish brown (10YR6/4), moist, medium, SILT with little clay and trace sand. (FILL) | | |
| 2A | 13/24 54% | SS | 5-4 4-4 N=8 | | | 1.5 | | | | |
| 3A | 12/24 50% | SS | woh-3 3-4 N=6 | | | 1.5 | 5.0–6.0 (▽ 5.0) | Light yellowish brown (10YR6/4), wet, soft, SILT with little clay and trace sand. | | |
| 4A | 20/24 83% | SS | 1-3 3-3 N=6 | | | 1.5 | 6.0–13.2 | Yellowish brown (10YR5/6), wet, soft, SILT with little clay and trace sand. | | |
| ST5 | 23/24 96% | SH | | | | | | | | |
| 6A | 20/24 83% | SS | 1-3 3-4 N=6 | | | 1.0 | | | | |
| 7A | 20/24 83% | SS | 1-2 3-3 N=5 | | | 2.0 | 13.2–20 | Yellowish brown (10YR5/8), moist, soft, SILT with few clay and trace sand. | | |
| 8A | 20/24 83% | SS | 2-3 3-3 N=6 | | | 3.5 | | | | |
| 9A | 24/24 100% | SS | woh-3 3-5 N=6 | | | 3.0 | | | | |
| ST10 | 24/24 100% | SH | | | | | | | | |

Depth scale (ft. BGS): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20
Elevation scale (ft. MSL): 574, 572, 570, 568, 566, 564, 562, 560, 558, 556

**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:** 2/2/2021
**Finish:** 2/2/2021
**WEATHER:** Overcast, cold (lo-20's)

**CONTRACTOR:** Ramsey Geotechnical Engineering, LLC
**Rig mfg/model:** CME-550 ATV Drill
**Drilling Method:** Hollow Stem Auger
**FIELD STAFF: Driller:** Dusty
**Helper:** Mosley
**Eng/Geo:** R. Hasenyager

**BOREHOLE ID:** SB03
**Well ID:** n/a
**Surface Elev:** 575.1 ft. MSL
**Completion:** 25.3 ft. BGS
**Station:** 1,384,427.60N
2,347,928.05E

**TOPOGRAPHIC MAP INFORMATION:**
**Quadrangle:** Duck Island
**Township:** Banner
**Section** 30, **Tier** 6N; **Range** 5E

**WATER LEVEL INFORMATION:**
$\nabla$ = 5.00 - durring drilling
$\nabla$ =
$\nabla$ =

| 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 |
| 11<br>11A | 20/24<br>*83%* | SS | *2-8*<br>*11-14*<br>N=19 | | | *4.0* | 22 | Yellowish brown (10YR5/6), moist, medium, CLAY with some silt, trace sand, and trace gravel. | | 554 | |
| 12A | 20/24<br>*83%* | SS | *7-11*<br>*14-14*<br>N=25 | | | *4.5* | 24 | | | 552 | |
| 13A<br>13 | 16/17<br>*94%* | SS | *1-6*<br>*50/5"* | | | | | Gray (10YR5/1), moist, very hard, CLAY with some silt, little sand, and trace gravel. | | 550 | |

**End of boring = 25.3 feet**

**NOTE(S):** Borehole sealed with high solids bentonite grout.

# WELL CONSTRUCTION LOGS

# Illinois Environmental Protection Agency — Well Completion Report

Site #: 0570255197 County: Fulton County Well #: BA01

Site Name: Duck Creek Power Station Borehole #: BA01

~~State~~ Plant ~~Plane~~ Coordinate: X 2,374.4 Y 1,684.0 (or) Latitude: 40° 28' 7.995" Longitude: -89° 58' 55.707"

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Geotechnics Driller: M. Sick

Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): water

Logged By: Rhonald W. Hasenyager Date Started: 12/16/2015 Date Finished: 12/16/2015

Report Form Completed By: Suzanna L. Keim Date: 12/21/2015

## 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

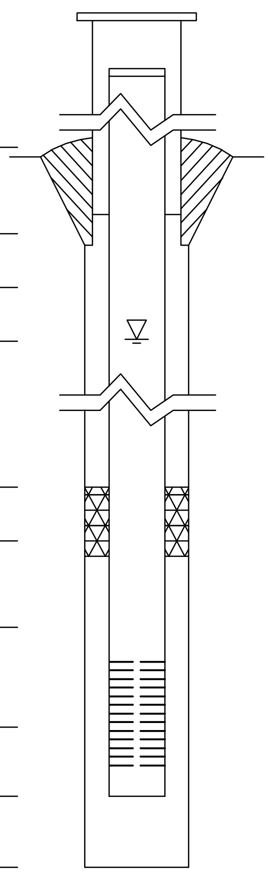
Type of Sand Pack: Quartz Sand

Grain Size: 10-20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Filter Sand (if applicable)

Installation Method: Gravity



| Elevations (MSL)* | Depths (BGS) | (0.01 ft.) |
|---|---|---|
| 587.95 | -3.20 | Top of Protective Casing |
| 587.29 | -2.54 | Top of Riser Pipe |
| 584.75 | 0.00 | Ground Surface |
| 582.75 | 2.00 | Top of Annular Sealant |
| 572.75 | 12.00 | Static Water Level (After Completion) 1/20/2016 |
| 556.00 | 28.75 | Top of Seal |
| 553.30 | 31.45 | Top of Sand Pack |
| 551.69 | 33.06 | Top of Screen |
| 547.02 | 37.73 | Bottom of Screen |
| 546.55 | 38.20 | Bottom of Well |
| 544.33 | 40.42 | Bottom of Borehole |

* Referenced to a National Geodetic Datum

### 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) | 35.60 |
| Bottom of Screen to End Cap | (feet) | 0.47 |
| Screen Length (1st slot to last slot) | (feet) | 4.67 |
| Total Length of Casing | (feet) | 40.74 |
| Screen Slot Size ** | (inches) | 0.010 |

**Hand-Slotted Well Screens Are Unacceptable

### 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: |

# Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Fulton Well #: BA01C

Site Name: Duck Creek Part 845 Groundwater Borehole #: BA01C

State Plane Coordinate: X 2,347,929.3 Y 1,384,728.2 (or) Latitude: ______ Longitude: ______

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Ramsey Geotechnical Engineering, LLC Driller: Dusty

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: 2/8/2021 Date Finished: 2/8/2021

Report Form Completed By: Tad A. Gass Date: 2/8/2021

## 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: ______

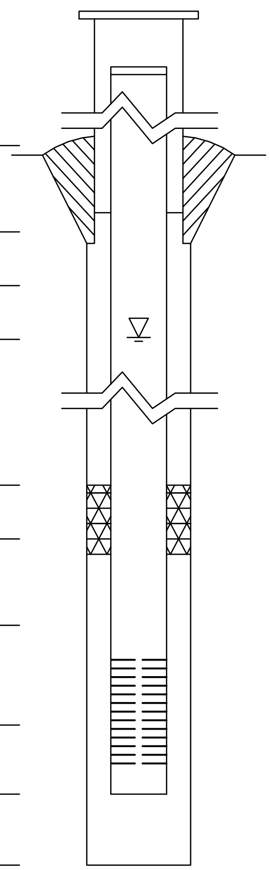
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: gravity

Type of Backfill Material: ______ (if applicable)

Installation Method: ______



| Elevations (MSL)* | Depths (BGS) | (0.01 ft.) |
|---|---|---|
| 587.13 | -2.78 | Top of Protective Casing |
| 586.64 | -2.29 | Top of Riser Pipe |
| 584.35 | 0.00 | Ground Surface |
| 581.45 | 2.90 | Top of Annular Sealant |
| | | Static Water Level (After Completion) |
| n/a | n/a | Top of Seal |
| 549.77 | 34.58 | Top of Sand Pack |
| 548.54 | 35.81 | Top of Screen |
| 539.09 | 45.26 | Bottom of Screen |
| 538.45 | 45.90 | Bottom of Well |
| 538.45 | 45.90 | Bottom of Borehole |

* Referenced to a National Geodetic Datum

### 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) | 38.10 |
| Bottom of Screen to End Cap | (feet) | 0.64 |
| Screen Length (1st slot to last slot) | (feet) | 9.45 |
| Total Length of Casing | (feet) | 48.19 |
| Screen Slot Size ** | (inches) | 0.010 |

**Hand-Slotted Well Screens Are Unacceptable

### 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: |

Well Completion Form (revised 02/06/02)

# Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Fulton Well #: BA01L

Site Name: Duck Creek Part 845 Groundwater Borehole #: BA01L

State Plane Coordinate: X 2,347,929.3 Y 1,384,728.8 (or) Latitude: ______ Longitude: ______

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Ramsey Geotechnical Engineering, LLC Driller: Dusty

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: 2/5/2021 Date Finished: 2/23/2021

Report Form Completed By: Tad A. Gass Date: 2/5/2021

## 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: ______

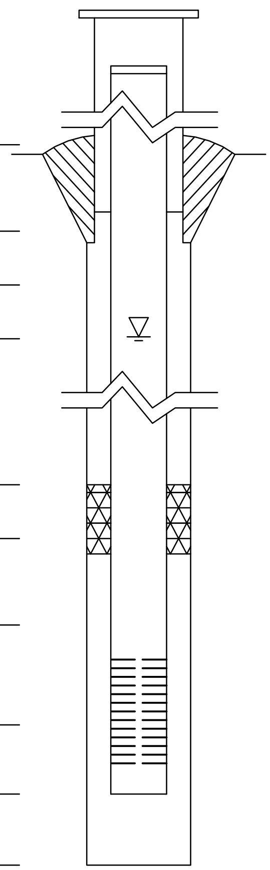
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: gravity

Type of Backfill Material: ______ (if applicable)

Installation Method: ______



| Elevations (MSL)* | Depths (BGS) | (0.01 ft.) |
|---|---|---|
| 587.19 | -2.95 | Top of Protective Casing |
| 586.80 | -2.57 | Top of Riser Pipe |
| 584.24 | 0.00 | Ground Surface |
| 581.94 | 2.30 | Top of Annular Sealant |
| | | Static Water Level (After Completion) |
| n/a | n/a | Top of Seal |
| 573.29 | 10.95 | Top of Sand Pack |
| 572.34 | 11.90 | Top of Screen |
| 562.87 | 21.37 | Bottom of Screen |
| 562.09 | 22.15 | Bottom of Well |
| 562.09 | 22.15 | Bottom of Borehole |

* Referenced to a National Geodetic Datum

### 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) | 14.61 |
| Bottom of Screen to End Cap | (feet) | 0.64 |
| Screen Length (1st slot to last slot) | (feet) | 9.47 |
| Total Length of Casing | (feet) | 24.72 |
| Screen Slot Size ** | (inches) | 0.010 |

### 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: |

Well Completion Form (revised 02/06/02)

**Hand-Slotted Well Screens Are Unacceptable

# Illinois Environmental Protection Agency — Well Completion Report

Site #: 0570255197 County: Fulton County Well #: BA02

Site Name: Duck Creek Power Station Borehole #: BA02

~~State~~ Plant ~~Plane~~ Coordinate: X 2,601.7 Y 1,513.8 (or) Latitude: 40° 28' 6.308" Longitude: -89° 58' 52.770"

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Bulldog Drilling, Inc. Driller: C. Dutton

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 L. Keim Date Started: 12/29/2015 Date Finished: 12/30/2015

Report Form Completed By: Suzanna L. Keim Date: 12/30/2015

## 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) — selected: Pellet

Installation Method: Gravity

Setting Time: 45 minutes

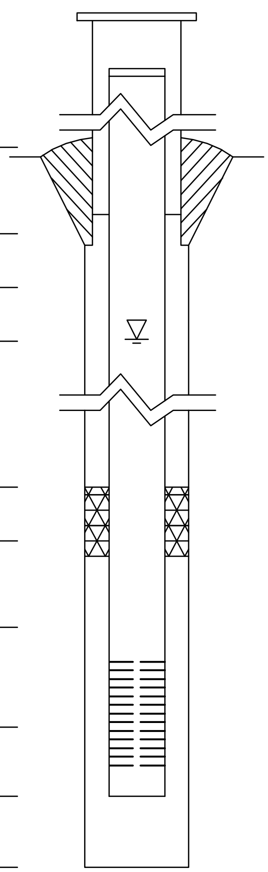
Type of Sand Pack: Quartz Sand

Grain Size: 10-20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Filter Sand (if applicable)

Installation Method: Gravity



| Elevations (MSL)* | Depths (BGS) | (0.01 ft.) |
|---|---|---|
| 580.74 | -3.26 | Top of Protective Casing |
| 580.13 | -2.65 | Top of Riser Pipe |
| 577.48 | 0.00 | Ground Surface |
| 575.48 | 2.00 | Top of Annular Sealant |
| 571.98 | 5.50 | Static Water Level (After Completion) 1/20/2016 |
| 557.58 | 19.90 | Top of Seal |
| 555.68 | 21.80 | Top of Sand Pack |
| 553.85 | 23.63 | Top of Screen |
| 549.05 | 28.43 | Bottom of Screen |
| 548.65 | 28.83 | Bottom of Well |
| 548.06 | 29.42 | Bottom of Borehole |

* Referenced to a National Geodetic Datum

### 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) | 26.28 |
| Bottom of Screen to End Cap | (feet) | 0.40 |
| Screen Length (1st slot to last slot) | (feet) | 4.80 |
| Total Length of Casing | (feet) | 31.48 |
| Screen Slot Size ** | (inches) | 0.010 |

**Hand-Slotted Well Screens Are Unacceptable

### 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 (selected) | OTHER: |
| Riser Pipe Below W.T. | SS304 | SS316 | PTFE | PVC (selected) | OTHER: |
| Screen | SS304 | SS316 | PTFE | PVC (selected) | OTHER: |

## Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Fulton Well #: BA02L

Site Name: Duck Creek Part 845 Groundwater Borehole #: BA02L

State Plane Coordinate: X 2,348,149.7 Y 1,384,558.0 (or) Latitude: ______ ______ ______ Longitude: ______ ______ ______

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Ramsey Geotechnical Engineering, LLC Driller: Dusty

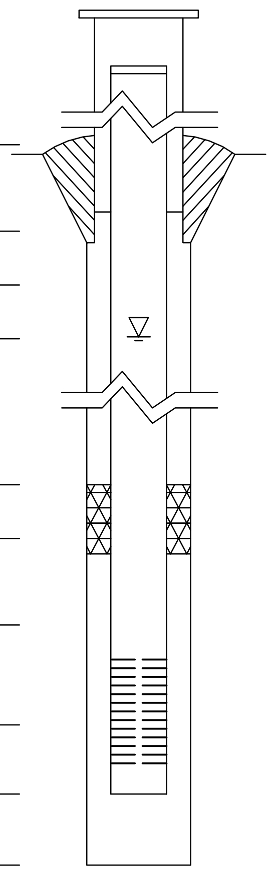
Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow Stem Auger Drilling Fluid (Type): none

Logged By: Rhonald W. Hasenyager Date Started: 2/4/2021 Date Finished: 2/4/2021

Report Form Completed By: Tad A. Gass Date: 2/4/2021

### 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.) |
|---|---|---|
| 580.15 | -2.98 | Top of Protective Casing |
| 579.71 | -2.54 | Top of Riser Pipe |
| 577.17 | 0.00 | Ground Surface |
| 574.97 | 2.20 | Top of Annular Sealant |
| | | Static Water Level (After Completion) |
| n/a | n/a | Top of Seal |
| 571.08 | 6.09 | Top of Sand Pack |
| 570.19 | 6.98 | Top of Screen |
| 565.51 | 11.66 | Bottom of Screen |
| 565.08 | 12.09 | Bottom of Well |
| 565.08 | 12.09 | Bottom of Borehole |

* Referenced to a National Geodetic Datum

### 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) | 9.52 |
| Bottom of Screen to End Cap | (feet) | 0.43 |
| Screen Length (1st slot to last slot) | (feet) | 4.68 |
| Total Length of Casing | (feet) | 14.63 |
| Screen Slot Size ** | (inches) | 0.010 |

**Hand-Slotted Well Screens Are Unacceptable

### 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: |

# Illinois Environmental Protection Agency — Well Completion Report

Site #: 0570255197 County: Fulton County Well #: BA03

Site Name: Duck Creek Power Station Borehole #: BA03

~~State~~ Plant ~~Plane~~ Coordinate: X 2,376.2 Y 1,390.8 (or) Latitude: 40° 28' 5.097" Longitude: -89° 58' 55.691"

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Bulldog Drilling, Inc. Driller: C. Dutton

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 L. Keim Date Started: 12/29/2015 Date Finished: 12/29/2015

Report Form Completed By: Suzanna L. Keim Date: 12/30/2015

## 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

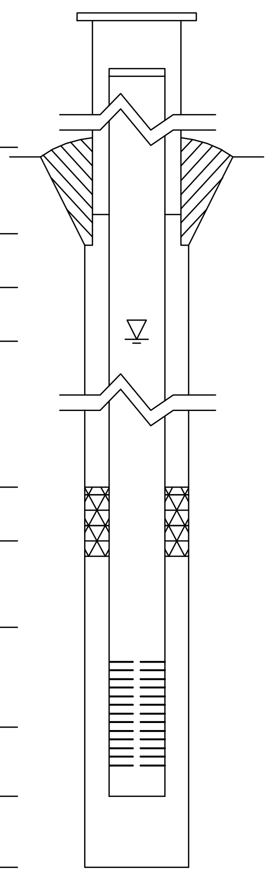
Type of Sand Pack: Quartz Sand

Grain Size: 10-20 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Filter Sand (if applicable)

Installation Method: Gravity



| Elevations (MSL)* | Depths (BGS) | (0.01 ft.) |
|---|---|---|
| 579.14 | -3.08 | Top of Protective Casing |
| 578.54 | -2.48 | Top of Riser Pipe |
| 576.06 | 0.00 | Ground Surface |
| 574.06 | 2.00 | Top of Annular Sealant |
| 570.32 | 5.74 | Static Water Level (After Completion) 1/21/2016 |
| 562.73 | 13.33 | Top of Seal |
| 561.57 | 14.49 | Top of Sand Pack |
| 559.95 | 16.11 | Top of Screen |
| 550.49 | 25.57 | Bottom of Screen |
| 549.87 | 26.19 | Bottom of Well |
| 548.64 | 27.42 | Bottom of Borehole |

* Referenced to a National Geodetic Datum

### 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) | 18.59 |
| Bottom of Screen to End Cap | (feet) | 0.62 |
| Screen Length (1st slot to last slot) | (feet) | 9.46 |
| Total Length of Casing | (feet) | 28.67 |
| Screen Slot Size ** | (inches) | 0.010 |

**Hand-Slotted Well Screens Are Unacceptable

### 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: |

# Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Fulton Well #: BA03L

Site Name: Duck Creek Part 845 Groundwater Borehole #: BA03L

State Plane Coordinate: X 2,347,924.5 Y 1,384,430.0 (or) Latitude: ______ Longitude: ______

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Ramsey Geotechnical Engineering, LLC Driller: Dusty

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: 2/2/2021 Date Finished: 2/2/2021

Report Form Completed By: Rhonald W. Hasenyager Date: 2/8/2021

## 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: ______

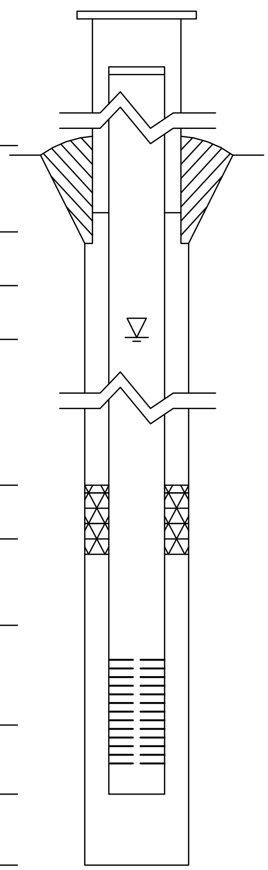
Type of Sand Pack: Quartz sand

Grain Size: 10/20 (sieve size)

Installation Method: gravity

Type of Backfill Material: ______ (if applicable)

Installation Method: ______



| Elevations (MSL)* | Depths (BGS) | (0.01 ft.) |
|---|---|---|
| 578.27 | -3.14 | Top of Protective Casing |
| 577.75 | -2.62 | Top of Riser Pipe |
| 575.13 | 0.00 | Ground Surface |
| 573.33 | 1.80 | Top of Annular Sealant |
| | | Static Water Level (After Completion) |
| n/a | n/a | Top of Seal |
| 571.11 | 4.02 | Top of Sand Pack |
| 569.88 | 5.25 | Top of Screen |
| 565.19 | 9.94 | Bottom of Screen |
| 564.84 | 10.29 | Bottom of Well |
| 564.84 | 10.29 | Bottom of Borehole |

* Referenced to a National Geodetic Datum

### 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) | 7.87 |
| Bottom of Screen to End Cap | (feet) | 0.35 |
| Screen Length (1st slot to last slot) | (feet) | 4.69 |
| Total Length of Casing | (feet) | 12.91 |
| Screen Slot Size ** | (inches) | 0.010 |

**Hand-Slotted Well Screens Are Unacceptable

### 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: |

# Illinois Environmental Protection Agency — Well Completion Report

Site #: 0570255197 County: Fulton County Well #: BA04

Site Name: Duck Creek Power Station Borehole #: BA04

~~State~~ Plant ~~Plane~~ Coordinate: X 2,138.1 Y 1,496.6 (or) Latitude: 40° 28' 6.147" Longitude: -89° 58' 58.769"

Surveyed By: Michael J. Graminski IL Registration #: 035-002901

Drilling Contractor: Bulldog Drilling, Inc. Driller: J. Dittmaier

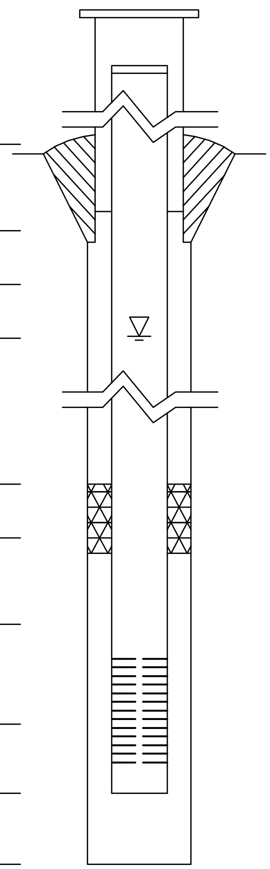
Consulting Firm: Hanson Professional Services Inc. Geologist: Rhonald W. Hasenyager, LPG #196-000246

Drilling Method: Hollow stem auger Drilling Fluid (Type): none

Logged By: Suzanna L. Keim Date Started: 12/29/2015 Date Finished: 12/29/2015

Report Form Completed By: Suzanna L. Keim Date: 12/30/2015

## 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: Filter Sand (if applicable)

Installation Method: Gravity

| Elevations (MSL)* | Depths (BGS) | (0.01 ft.) |
|---|---|---|
| 578.96 | -3.11 | Top of Protective Casing |
| 578.39 | -2.54 | Top of Riser Pipe |
| 575.85 | 0.00 | Ground Surface |
| 573.85 | 2.00 | Top of Annular Sealant |
| 572.20 | 3.65 | Static Water Level (After Completion) 1/20/2016 |
| 556.55 | 19.30 | Top of Seal |
| 553.55 | 22.30 | Top of Sand Pack |
| 551.27 | 24.58 | Top of Screen |
| 546.47 | 29.38 | Bottom of Screen |
| 546.08 | 29.77 | Bottom of Well |
| 545.85 | 30.00 | Bottom of Borehole |

* Referenced to a National Geodetic Datum

### 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) | 27.12 |
| Bottom of Screen to End Cap | (feet) | 0.39 |
| Screen Length (1st slot to last slot) | (feet) | 4.80 |
| Total Length of Casing | (feet) | 32.31 |
| Screen Slot Size ** | (inches) | 0.010 |

**Hand-Slotted Well Screens Are Unacceptable

### 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: |

# Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Fulton Well #: BA-05

Site Name: Duck Creek Power Station - Bottom Ash Basin Borehole #: BA-05b

~~State~~ Plant ~~Plane~~ Coordinate: X 2,114.5 Y 1,850.5 (or) Latitude: 40° 28' 9.650" Longitude: -89° 58' 59.070"

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): water

Logged By: Suzanna L. Keim Date Started: 7/27/2016 Date Finished: 7/28/2016

Report Form Completed By: Suzanna L. Keim Date: 8/1/2016

## ANNULAR SPACE DETAILS

Type of Surface Seal: Bentonite Chips

Type of Annular Sealant: High-solids bentonite

Installation Method: Tremie

Setting Time: >24 hours

Type of Bentonite Seal -- Granular (circled) Pellet Slurry (choose one)

Installation Method: Gravity

Setting Time: 25 minutes

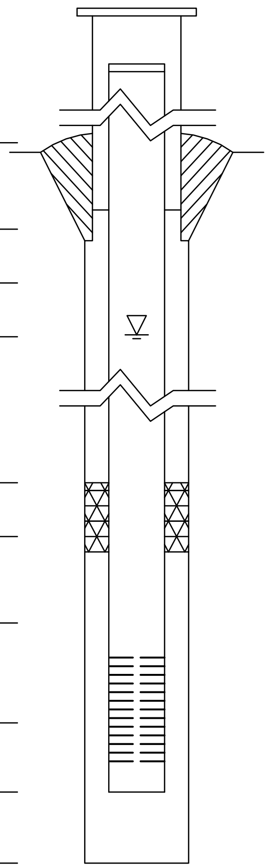
Type of Sand Pack: Quartz Sand

Grain Size: 10-40 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Filter Sand (if applicable)

Installation Method: Gravity



| Elevations (MSL)* | Depths (BGS) | (0.01 ft.) |
|---|---|---|
| | | Top of Protective Casing |
| 596.02 | -2.85 | Top of Riser Pipe |
| 593.17 | 0.00 | Ground Surface |
| 591.17 | 2.00 | Top of Annular Sealant |
| 579.73 | 13.44 | Static Water Level (After Completion) 8/8/2016 |
| 559.67 | 33.50 | Top of Seal |
| 558.57 | 34.60 | Top of Sand Pack |
| 556.69 | 36.48 | Top of Screen |
| 547.09 | 46.08 | Bottom of Screen |
| 546.60 | 46.57 | Bottom of Well |
| 546.60 | 46.57 | Bottom of Borehole |

* Referenced to a National Geodetic Datum

## CASING MEASUREMENTS

| | | |
|---|---|---|
| Diameter of Borehole | (inches) | 8.0 |
| ID of Riser Pipe | (inches) | 2.0 |
| Protective Casing Length | (feet) | |
| Riser Pipe Length | (feet) | 39.33 |
| Bottom of Screen to End Cap | (feet) | 0.49 |
| Screen Length (1st slot to last slot) | (feet) | 9.60 |
| Total Length of Casing | (feet) | 49.42 |
| Screen Slot Size ** | (inches) | 0.010 |

**Hand-Slotted Well Screens Are Unacceptable

## WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

| | | | | | |
|---|---|---|---|---|---|
| Protective Casing | SS304 | SS316 | PTFE | PVC | OTHER: none |
| Riser Pipe Above W.T. | SS304 | SS316 | PTFE | PVC (circled) | OTHER: |
| Riser Pipe Below W.T. | SS304 | SS316 | PTFE | PVC (circled) | OTHER: |
| Screen | SS304 | SS316 | PTFE | PVC (circled) | OTHER: |

# Illinois Environmental Protection Agency — Well Completion Report

Site #: 

County: Fulton

Well #: BA-06

Site Name: Duck Creek Power Station - Bottom Ash Basin

Borehole #: BA-05c

~~State Plane~~ Plant Coordinate: X 2,702.3 Y 1,840.6 (or) Latitude: 40° 28' 9.539" Longitude: -89° 58' 51.461"

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): water

Logged By: Suzanna L. Keim

Date Started: 8/3/2016

Date Finished: 8/3/2016

Report Form Completed By: Suzanna L. Keim

Date: 8/8/2016

## ANNULAR SPACE DETAILS

Type of Surface Seal: Bentonite Chips

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

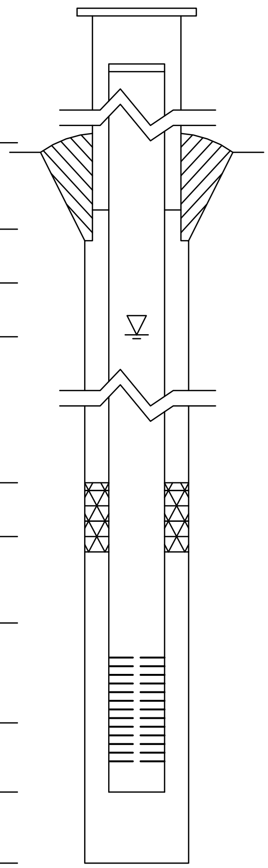
Type of Sand Pack: Quartz Sand

Grain Size: 10-40 (sieve size)

Installation Method: Gravity

Type of Backfill Material: Filter Sand (if applicable)

Installation Method: Gravity



| Elevations (MSL)* | Depths (BGS) | (0.01 ft.) |
|---|---|---|
| | | Top of Protective Casing |
| 595.93 | -2.73 | Top of Riser Pipe |
| 593.20 | 0.00 | Ground Surface |
| 587.20 | 6.00 | Top of Annular Sealant |
| 578.84 | 14.36 | Static Water Level (After Completion) 8/8/2016 |
| 563.80 | 29.40 | Top of Seal |
| 562.48 | 30.72 | Top of Sand Pack |
| 560.88 | 32.32 | Top of Screen |
| 551.27 | 41.93 | Bottom of Screen |
| 550.77 | 42.43 | Bottom of Well |
| 549.20 | 44.00 | Bottom of Borehole |

* Referenced to a National Geodetic Datum

### CASING MEASUREMENTS

| | | |
|---|---|---|
| Diameter of Borehole | (inches) | 8.0 |
| ID of Riser Pipe | (inches) | 2.0 |
| Protective Casing Length | (feet) | |
| Riser Pipe Length | (feet) | 35.05 |
| Bottom of Screen to End Cap | (feet) | 0.50 |
| Screen Length (1st slot to last slot) | (feet) | 9.61 |
| Total Length of Casing | (feet) | 45.16 |
| Screen Slot Size ** | (inches) | 0.010 |

**Hand-Slotted Well Screens Are Unacceptable

### WELL CONSTRUCTION MATERIALS

(Choose one type of material for each area)

| | | | | | |
|---|---|---|---|---|---|
| Protective Casing | SS304 | SS316 | PTFE | PVC | OTHER: **none** |
| 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: |

# APPENDIX C
# GEOTECHNICAL LABORATORY REPORTS

**Via email: dramsey@ramgeoeng.com**

February 19, 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
Bottom Ash Basins
Fulton County, Illinois

Dear Mr. Ramsey:

Included in this report are the test results from seven Shelby tube samples received in our laboratory on February 12, 2021. The samples were tested in general accordance with the test method listed below.

| Test to Determine | Method of Test |
|---|---|
| Water (Moisture) Content of Soils | ASTM D2216 |
| Unconsolidated-Undrained Triaxial Compression Test | ASTM D2850 |
| Hydraulic Conductivity of Soil Using Flexible Wall Permeameter | ASTM D5084 |
| Density (Unit Weight) of Soil Specimens | ASTM D7263 |

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 Sheets
Shelby Tube Logs
Testing Assignment Sheets

**TEST RESULT SUMMARY**

**Duck Creek Power Station**
**Bottom Ash Basins**
**Fulton County, Illinois**

| | | | ASTM D2216 | ASTM D7263 | ASTM D5084 | |
|---|---|---|---|---|---|---|
| Boring Number | Sample Number | Depth, feet | Moisture Content, % | Dry Unit Weight, pcf | Hydraulic Conductivity, cm/sec | Range of Hydraulic Gradient |
| SB-01 | ST-9 | 16.0-18.0 | 27.2 | 95.8 | $4.5 \times 10^{-6}$ | 0.9 - 1.3 |
| SB-01 | ST-15 | 28.0-30.0 | 24.6 | 100.7 | $5.9 \times 10^{-8}$ | 6.9 - 17.9 |
| SB-02 | ST-5 | 8.0-10.0 | 27.7 | 96.8 | $8.0 \times 10^{-6}$ | 1.1 - 1.8 |
| SB-02 | ST-10 | 18.0-20.0 | 22.8 | 102.7 | $7.5 \times 10^{-5}$ | 0.2 - 1.5 |
| SB-02 | ST-13 | 24.0-26.0 | 24.1 | 100.2 | $5.5 \times 10^{-8}$ | 5.8 - 20.0 |
| SB-03 | ST-5 | 8.0-10.0 | 27.4 | 95.5 | $2.4 \times 10^{-4}$ | 0.1 - 1.5 |
| SB-03 | ST-10 | 18.0-20.0 | 11.2 | 128.0 | $1.4 \times 10^{-6}$ | 0.7 - 1.6 |

| | | | ASTM D2488 |
|---|---|---|---|
| Boring Number | Sample Number | Depth, feet | Material Description |
| SB-01 | ST-9 | 16.0-18.0 | Very dark gray-brown, LEAN CLAY – CL |
| SB-01 | ST-15 | 28.0-30.0 | Green-gray, LEAN to FAT CLAY – CL/CH |
| SB-02 | ST-5 | 8.0-10.0 | Olive-gray, LEAN CLAY – CL |
| SB-02 | ST-10 | 18.0-20.0 | Gray, LEAN CLAY, trace sand – CL |
| SB-02 | ST-13 | 24.0-26.0 | Green-gray, LEAN to FAT CLAY – CL/CH |
| SB-03 | ST-5 | 8.0-10.0 | Dark yellow-brown, LEAN CLAY – CL |
| SB-03 | ST-10 | 18.0-20.0 | Yellow-brown, LEAN CLAY with SAND, some gravel – CL |

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.: | J037264.01.6001 | | | WET UNIT WEIGHT, pcf: | 121.9 | WET UNIT WEIGHT, pcf: | 122.4 |
| BORING NO.: | SB-01 | | | DRY UNIT WEIGHT, pcf: | 95.8 | DRY UNIT WEIGHT, pcf: | 96.5 |
| SAMPLE NO.: | ST-9 | | | | | | |
| DEPTH (Feet): | 16.0-18.0 | | | | | | |

| | Initial | As Tested** | | Initial | As Tested | INITIAL MOISTURE CONTENT | | FINAL MOISTURE CONTENT | |
|---|---|---|---|---|---|---|---|---|---|
| LENGTH, in.: | 4.021 | 4.014 | LENGTH, cm: | 10.213 | 10.196 | WET WT SPLE+TARE | 1113.89 | WET WT SPLE+TARE | 1111.96 |
| DIAMETER, in.: | 2.873 | 2.866 | DIAMETER, cm | 7.297 | 7.280 | DRY WT SPLE+TARE | 935.62 | DRY WT SPLE+TARE | 935.62 |
| WET WT., gms.: | 833.87 | 832.25 | | | | TARE WEIGHT | 280.02 | TARE WEIGHT | 280.02 |
| AREA, sq.in.: | 6.483 | 6.451 | AREA, sq cm: | 41.824 | 41.621 | **% MOISTURE** | 27.2 | % MOISTURE | 26.9 |

*B VALUE* (before Permeation): 99%  Cell / Back Pressure, psi: 44 / 40

| HEAD ( PSI ) | DATE (YR,MO,DY) | TIME (HR,MN,SC) | TEMP °C | | ELAPSED MINUTES | BOTTOM BURETTE | TOP BURETTE | Q (CC) | K CM/SEC | | HYDRAULIC GRADIENT | HYDRAULIC HEAD | HEAD LOSS,% | k (in/sec) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 13-Feb-21 | 12:28 PM | 19.4 | * | 0 | 10.35 | 23.50 | | | | 1.29 | 13.15 | | |
| 0.0 | 13-Feb-21 | 01:24 PM | 20.0 | * | 56 | 10.93 | 22.61 | 0.58 | 4.5E-06 | * | 1.14 | 11.68 | 11.18 | 1.8E-06 |
| 0.0 | 13-Feb-21 | 02:17 PM | 20.2 | * | 53 | 11.50 | 21.97 | 0.57 | 4.4E-06 | * | 1.03 | 10.47 | 10.36 | 1.7E-06 |
| 0.0 | 13-Feb-21 | 02:59 PM | 20.2 | * | 42 | 11.93 | 21.50 | 0.43 | 4.6E-06 | * | 0.94 | 9.57 | 8.60 | 1.8E-06 |
| 0.0 | 15-Feb-21 | 07:34 AM | 15.2 | * | 0 | 11.70 | 23.40 | | | | 1.15 | 11.70 | | |
| 0.0 | 15-Feb-21 | 08:49 AM | 17.8 | * | 75 | 12.40 | 22.62 | 0.70 | 3.9E-06 | * | 1.00 | 10.22 | 12.65 | 1.5E-06 |
| | | **Average Temp. =** | **18.8** | * | | | | **AVERAGE K =** | **4.4E-06** | * | | | **AVERAGE K =** | **1.7E-06** |
| | | | | | | | | **Corrected K for 20ºC =** | **4.5E-06** | | | | **Corrected K for 20ºC =** | **1.8E-06** |

** Measurements at end of test

## HYDRAULIC CONDUCTIVITY TEST DATA
**(ASTM D 5084, Method F)**

JOB NO.: J037264.01.6001
BORING NO.: SB-01
SAMPLE NO.: ST-15
DEPTH (Feet): 28.0-30.0

| Initial Unit Weight | |
|---|---|
| WET UNIT WEIGHT, pcf: | 125.5 |
| DRY UNIT WEIGHT, pcf: | 100.7 |

| Unit Weight as Tested | |
|---|---|
| WET UNIT WEIGHT, pcf: | 126.0 |
| DRY UNIT WEIGHT, pcf: | 102.1 |

| | Initial | As Tested** | | Initial | As Tested |
|---|---|---|---|---|---|
| LENGTH, in.: | 4.021 | 4.004 | LENGTH, cm: | 10.213 | 10.170 |
| DIAMETER, in.: | 2.882 | 2.871 | DIAMETER, cm: | 7.320 | 7.292 |
| WET WT., gms.: | 864.14 | 857.27 | AREA, sq cm: | 42.087 | 41.766 |
| AREA, sq.in.: | 6.523 | 6.474 | | | |

| INITIAL MOISTURE CONTENT | | FINAL MOISTURE CONTENT | |
|---|---|---|---|
| WET WT SPLE+TARE | 1135.51 | WET WT SPLE+TARE | 1126.91 |
| DRY WT SPLE+TARE | 964.89 | DRY WT SPLE+TARE | 964.89 |
| TARE WEIGHT | 271.34 | TARE WEIGHT | 271.37 |
| **% MOISTURE** | 24.6 | % MOISTURE | 23.4 |

*B VALUE* (before Permeation): 99% Cell / Back Pressure, psi: 34 / 30

| | $M_1$ | $M_2$ | | |
|---|---|---|---|---|
| Manometer Constants | 0.0302 | 1.0410 | Sample Constant (L/A) | 0.2435 |

| DATE (YR,MO,DY) | TIME (HR,MN,SC) | TEMP ºC | | ELAPSED MINUTES | PIPET READING | ANNULUS READING | SPECIFIC GRAVITY | C TEST CONSTANT | T TRIAL CONSTANT | K CM/SEC | | HYDRAULIC GRADIENT | HYDRAULIC HEAD | k (in/sec) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18-Feb-21 | 11:54 AM | 19.9 | * | 0 | 15.65 | 1.17 | 12.570 | 0.000585 | 0.0719 | | | 17.90 | 182.01 | |
| 18-Feb-21 | 12:22 PM | 19.8 | * | 28 | 13.40 | 1.22 | 12.570 | 0.000585 | 0.0855 | 7.4E-08 | * | 15.05 | 153.10 | 2.9E-08 |
| 18-Feb-21 | 01:03 PM | 20.1 | * | 41 | 11.48 | 1.30 | 12.570 | 0.000585 | 0.1023 | 5.2E-08 | * | 12.58 | 127.96 | 2.0E-08 |
| 18-Feb-21 | 02:48 PM | 20.2 | * | 105 | 8.18 | 1.42 | 12.570 | 0.000585 | 0.1540 | 6.6E-08 | * | 8.36 | 84.97 | 2.6E-08 |
| 18-Feb-21 | 03:39 PM | 20.2 | * | 51 | 7.05 | 1.47 | 12.570 | 0.000585 | 0.1866 | 4.5E-08 | * | 6.90 | 70.14 | 1.8E-08 |

**Average Temp. = 20.0** *

**AVERAGE K = 5.9E-08** *
**Corrected K for 20ºC = 5.9E-08**

**AVERAGE K = 2.3E-08**
**Corrected K for 20ºC = 2.3E-08**

** Measurements at end of test

# HYDRAULIC CONDUCTIVITY TEST DATA
## (ASTM D 5084)

| | | Initial Unit Weight | | Unit Weight as Tested | |
|---|---|---|---|---|---|
| JOB NO.: | J037264.01.6001 | WET UNIT WEIGHT, pcf: | 123.6 | WET UNIT WEIGHT, pcf: | 124.6 |
| BORING NO.: | SB-02 | DRY UNIT WEIGHT, pcf: | 96.8 | DRY UNIT WEIGHT, pcf: | 98.8 |
| SAMPLE NO.: | ST-5 | | | | |
| DEPTH (Feet): | 8.0-10.0 | | | | |

| | Initial | As Tested** | | Initial | As Tested | INITIAL MOISTURE CONTENT | | FINAL MOISTURE CONTENT | |
|---|---|---|---|---|---|---|---|---|---|
| LENGTH, in.: | 3.969 | 3.888 | LENGTH, cm: | 10.081 | 9.876 | WET WT SPLE+TARE | 1097.43 | WET WT SPLE+TARE | 1086.88 |
| DIAMETER, in.: | 2.858 | 2.859 | DIAMETER, cm | 7.259 | 7.262 | DRY WT SPLE+TARE | 918.22 | DRY WT SPLE+TARE | 918.22 |
| WET WT., gms.: | 826.16 | 816.17 | | | | TARE WEIGHT | 271.27 | TARE WEIGHT | 271.27 |
| AREA, sq.in.: | 6.415 | 6.420 | AREA, sq cm: | 41.389 | 41.418 | **% MOISTURE** | 27.7 | % MOISTURE | 26.1 |

*B VALUE* (before Permeation): 97%    Cell / Back Pressure, psi: 24 / 20

| 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 | 13-Feb-21 | 01:14 PM | 19.5 | | 0 | 5.54 | 23.42 | | | | 1.77 | 17.88 | | |
| 0.0 | 13-Feb-21 | 01:31 PM | 20.4 | * | 17 | 6.07 | 22.66 | 0.53 | 9.2E-06 | | 1.65 | 16.59 | 7.21 | 3.6E-06 |
| 0.0 | 13-Feb-21 | 02:18 PM | 20.3 | * | 47 | 7.47 | 21.27 | 1.40 | 8.2E-06 | * | 1.37 | 13.80 | 16.82 | 3.2E-06 |
| 0.0 | 13-Feb-21 | 03:04 PM | 20.0 | * | 46 | 8.65 | 20.08 | 1.18 | 8.5E-06 | * | 1.13 | 11.43 | 17.17 | 3.4E-06 |
| 0.0 | 15-Feb-21 | 07:39 AM | 15.4 | * | 0 | 7.20 | 23.45 | | | * | 1.61 | 16.25 | | |
| 0.0 | 15-Feb-21 | 08:18 AM | 18.4 | * | 39 | 8.20 | 22.46 | 1.00 | 7.0E-06 | * | 1.41 | 14.26 | 12.25 | 2.8E-06 |
| 0.0 | 15-Feb-21 | 08:54 AM | 18.1 | * | 36 | 9.04 | 21.60 | 0.84 | 7.4E-06 | * | 1.25 | 12.56 | 11.92 | 2.9E-06 |
| | | **Average Temp. =** | **18.8** | * | | | | **AVERAGE K =** | **7.8E-06** | * | | | **AVERAGE K =** | **3.1E-06** |
| | | | | | | | | **Corrected K for 20ºC =** | **8.0E-06** | | | | **Corrected K for 20ºC =** | **3.2E-06** |

** Measurements at end of test

## HYDRAULIC CONDUCTIVITY TEST DATA
**(ASTM D 5084)**

| | | Initial Unit Weight | | Unit Weight as Tested | |
|---|---|---|---|---|---|
| JOB NO.: | J037264.01.6001 | WET UNIT WEIGHT, pcf: | 126.1 | WET UNIT WEIGHT, pcf: | 126.0 |
| BORING NO.: | SB-02 | DRY UNIT WEIGHT, pcf: | 102.7 | DRY UNIT WEIGHT, pcf: | 102.2 |
| SAMPLE NO.: | ST-10 | | | | |
| DEPTH (Feet): | 18.0-20.0 | | | | |

| | Initial | As Tested** | | Initial | As Tested | INITIAL MOISTURE CONTENT | | FINAL MOISTURE CONTENT | |
|---|---|---|---|---|---|---|---|---|---|
| LENGTH, in.: | 4.373 | 4.385 | LENGTH, cm: | 11.107 | 11.138 | WET WT SPLE+TARE | 1239.10 | WET WT SPLE+TARE | 1242.77 |
| DIAMETER, in.: | 2.883 | 2.889 | DIAMETER, cm | 7.323 | 7.338 | DRY WT SPLE+TARE | 1063.71 | DRY WT SPLE+TARE | 1063.71 |
| WET WT., gms.: | 944.70 | 950.56 | | | | TARE WEIGHT | 294.40 | TARE WEIGHT | 294.40 |
| AREA, sq.in.: | 6.528 | 6.555 | AREA, sq cm: | 42.116 | 42.291 | **% MOISTURE** | 22.8 | % MOISTURE | 23.3 |

*B VALUE* (before Permeation): 98%     Cell / Back Pressure, psi: 34 / 30

| HEAD ( PSI ) | DATE (YR,MO,DY) | TIME (HR,MN,SC) | TEMP °C | | ELAPSED MINUTES | BOTTOM BURETTE | TOP BURETTE | Q (CC) | K CM/SEC | | HYDRAULIC GRADIENT | HYDRAULIC HEAD | HEAD LOSS,% | k (in/sec) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 17-Feb-21 | 08:56 AM | 20.0 | * | 0 | 5.87 | 22.68 | | | | 1.51 | 16.81 | | |
| 0.0 | 17-Feb-21 | 09:03 AM | 20.1 | * | 7 | 7.63 | 20.81 | 1.76 | 8.0E-05 | * | 1.19 | 13.18 | 21.59 | 3.2E-05 |
| 0.0 | 17-Feb-21 | 09:32 AM | 20.1 | * | 29 | 11.80 | 16.51 | 4.17 | 8.2E-05 | * | 0.42 | 4.71 | 64.26 | 3.2E-05 |
| 0.0 | 17-Feb-21 | 10:57 AM | 20.9 | * | 85 | 13.90 | 14.35 | 2.10 | 6.4E-05 | * | 0.04 | 0.45 | 90.45 | 2.5E-05 |
| 0.0 | 17-Feb-21 | 10:58 AM | 20.9 | * | 0 | 7.27 | 23.00 | | | | 1.42 | 15.73 | | |
| 0.0 | 17-Feb-21 | 11:09 AM | 21.0 | * | 11 | 9.81 | 20.42 | 2.54 | 8.2E-05 | * | 0.96 | 10.61 | 32.55 | 3.2E-05 |
| 0.0 | 17-Feb-21 | 12:08 PM | 20.7 | * | 59 | 14.27 | 15.90 | 4.46 | 7.3E-05 | * | 0.15 | 1.63 | 84.64 | 2.9E-05 |

**Average Temp. = 20.5** *

**AVERAGE K = 7.6E-05** *
**Corrected K for 20°C = 7.5E-05**

**AVERAGE K = 3.0E-05**
**Corrected K for 20°C = 3.0E-05**

** Measurements at end of test

# HYDRAULIC CONDUCTIVITY TEST DATA
## (ASTM D 5084, Method F)

| | | **Initial Unit Weight** | | **Unit Weight as Tested** | |
|---|---|---|---|---|---|
| JOB NO.: | J037264.01.6001 | WET UNIT WEIGHT, pcf: | 124.4 | WET UNIT WEIGHT, pcf: | 125.9 |
| BORING NO.: | SB-02 | DRY UNIT WEIGHT, pcf: | 100.2 | DRY UNIT WEIGHT, pcf: | 101.4 |
| SAMPLE NO.: | ST-13 | | | | |
| DEPTH (Feet): | 24.0-26.0 | | | | |

| | Initial | As Tested** | | Initial | As Tested | INITIAL MOISTURE CONTENT | | FINAL MOISTURE CONTENT | |
|---|---|---|---|---|---|---|---|---|---|
| LENGTH, in.: | 4.052 | 4.040 | LENGTH, cm: | 10.292 | 10.262 | WET WT SPLE+TARE | 1148.97 | WET WT SPLE+TARE | 1149.19 |
| DIAMETER, in.: | 2.878 | 2.867 | DIAMETER, cm: | 7.310 | 7.282 | DRY WT SPLE+TARE | 981.69 | DRY WT SPLE+TARE | 981.69 |
| WET WT., gms.: | 860.89 | 862.02 | AREA, sq cm: | 41.970 | 41.650 | TARE WEIGHT | 288.08 | TARE WEIGHT | 288.08 |
| AREA, sq.in.: | 6.505 | 6.456 | | | | **% MOISTURE** | 24.1 | % MOISTURE | 24.1 |

*B VALUE* (before Permeation): 96% Cell / Back Pressure, psi: 64 / 60

| | $M_1$ | $M_2$ | | |
|---|---|---|---|---|
| Manometer Constants | 0.0302 | 1.0410 | Sample Constant (L/A) | 0.2464 |

| DATE (YR,MO,DY) | TIME (HR,MN,SC) | TEMP ºC | | ELAPSED MINUTES | PIPET READING | ANNULUS READING | SPECIFIC GRAVITY | C TEST CONSTANT | T TRIAL CONSTANT | K CM/SEC | | HYDRAULIC GRADIENT | HYDRAULIC HEAD | k (in/sec) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18-Feb-21 | 02:52 PM | 20.8 | * | 0 | 8.45 | 1.18 | 12.570 | 0.000592 | 0.1432 | | | 8.91 | 91.38 | |
| 18-Feb-21 | 03:41 PM | 20.6 | * | 49 | 7.17 | 1.23 | 12.570 | 0.000592 | 0.1752 | 5.1E-08 | * | 7.28 | 74.67 | 2.0E-08 |
| 18-Feb-21 | 04:40 PM | 20.6 | * | 59 | 6.03 | 1.27 | 12.570 | 0.000592 | 0.2187 | 4.8E-08 | * | 5.83 | 59.83 | 1.9E-08 |
| 18-Feb-21 | 05:06 PM | 20.5 | * | 0 | 17.13 | 0.81 | 12.570 | 0.000592 | 0.0638 | | | 19.99 | 205.14 | |
| 18-Feb-21 | 05:33 PM | 20.6 | * | 27 | 14.90 | 0.90 | 12.570 | 0.000592 | 0.0744 | 6.6E-08 | * | 17.15 | 175.98 | 2.6E-08 |
| 18-Feb-21 | 05:51 PM | 20.8 | * | 18 | 13.70 | 0.93 | 12.570 | 0.000592 | 0.0815 | 5.6E-08 | * | 15.64 | 160.52 | |

**Average Temp. = 20.7** *

**AVERAGE K = 5.5E-08** * **AVERAGE K = 2.2E-08**

**Corrected K for 20ºC = 5.5E-08** **Corrected K for 20ºC = 2.1E-08**

** Measurements at end of test

## HYDRAULIC CONDUCTIVITY TEST DATA
**(ASTM D 5084)**

| | | Initial Unit Weight | | Unit Weight as Tested | |
|---|---|---|---|---|---|
| JOB NO.: | J037264.01.6001 | WET UNIT WEIGHT, pcf: | 121.6 | WET UNIT WEIGHT, pcf: | 122.9 |
| BORING NO.: | SB-03 | DRY UNIT WEIGHT, pcf: | 95.5 | DRY UNIT WEIGHT, pcf: | 96.4 |
| SAMPLE NO.: | ST-5 | | | | |
| DEPTH (Feet): | 8.0-10.0 | | | | |

| | Initial | As Tested** | | Initial | As Tested | INITIAL MOISTURE CONTENT | | FINAL MOISTURE CONTENT | |
|---|---|---|---|---|---|---|---|---|---|
| LENGTH, in.: | 5.417 | 5.405 | LENGTH, cm: | 13.759 | 13.729 | WET WT SPLE+TARE | 1395.98 | WET WT SPLE+TARE | 1396.33 |
| DIAMETER, in.: | 2.874 | 2.864 | DIAMETER, cm | 7.300 | 7.275 | DRY WT SPLE+TARE | 1154.76 | DRY WT SPLE+TARE | 1154.76 |
| WET WT., gms.: | 1121.88 | 1123.10 | | | | TARE WEIGHT | 274.10 | TARE WEIGHT | 274.10 |
| AREA, sq.in.: | 6.487 | 6.442 | AREA, sq cm: | 41.853 | 41.563 | **% MOISTURE** | 27.4 | % MOISTURE | 27.4 |

*B VALUE* (before Permeation): 97%  Cell / Back Pressure, psi: 44 / 40

| 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 | 15-Feb-21 | 07:50 AM | 15.4 | * | 0 | 9.54 | 23.22 | | | | 0.99 | 13.68 | | |
| 0.0 | 15-Feb-21 | 07:57 AM | 15.6 | * | 7 | 12.18 | 20.60 | 2.64 | 2.0E-04 | * | 0.61 | 8.42 | 38.45 | 7.9E-05 |
| 0.0 | 15-Feb-21 | 08:11 AM | 15.9 | * | 14 | 14.71 | 17.96 | 2.53 | 2.0E-04 | * | 0.24 | 3.25 | 61.40 | 7.7E-05 |
| 0.0 | 15-Feb-21 | 08:19 AM | 16.1 | * | 8 | 15.47 | 17.23 | 0.76 | 2.2E-04 | * | 0.13 | 1.76 | 45.85 | 8.7E-05 |
| 0.0 | 15-Feb-21 | 08:50 AM | 18.4 | * | 0 | 3.60 | 23.83 | | | | 1.47 | 20.23 | | |
| 0.0 | 15-Feb-21 | 08:54 AM | 18.3 | * | 4 | 6.78 | 21.12 | 3.18 | 2.5E-04 | * | 1.04 | 14.34 | 29.12 | 9.8E-05 |

**Average Temp. = 16.6** *

**AVERAGE K = 2.2E-04** *
**Corrected K for 20ºC = 2.4E-04**

**AVERAGE K = 8.5E-05**
**Corrected K for 20ºC = 9.3E-05**

** Measurements at end of test

# HYDRAULIC CONDUCTIVITY TEST DATA
## (ASTM D 5084)

| | | **Initial Unit Weight** | | **Unit Weight as Tested** | |
|---|---|---|---|---|---|
| JOB NO.: | J037264.01.6001 | WET UNIT WEIGHT, pcf: | 142.3 | WET UNIT WEIGHT, pcf: | 142.7 |
| BORING NO.: | SB-03 | DRY UNIT WEIGHT, pcf: | 128.0 | DRY UNIT WEIGHT, pcf: | 128.2 |
| SAMPLE NO.: | ST-10 | | | | |
| DEPTH (Feet): | 18.0-20.0 | | | | |

| | Initial | As Tested** | | Initial | As Tested | INITIAL MOISTURE CONTENT | | FINAL MOISTURE CONTENT | |
|---|---|---|---|---|---|---|---|---|---|
| LENGTH, in.: | 4.490 | 4.484 | LENGTH, cm: | 11.405 | 11.389 | WET WT SPLE+TARE | 1377.35 | WET WT SPLE+TARE | 1378.61 |
| DIAMETER, in.: | 2.894 | 2.895 | DIAMETER, cm | 7.351 | 7.353 | DRY WT SPLE+TARE | 1266.66 | DRY WT SPLE+TARE | 1266.66 |
| WET WT., gms.: | 1103.21 | 1105.66 | | | | TARE WEIGHT | 274.14 | TARE WEIGHT | 274.14 |
| AREA, sq.in.: | 6.578 | 6.582 | AREA, sq cm: | 42.438 | 42.467 | **% MOISTURE** | 11.2 | % MOISTURE | 11.3 |

*B VALUE* (before Permeation): 95%    Cell / Back Pressure, psi: 54 / 50

| HEAD ( PSI ) | DATE (YR,MO,DY) | TIME (HR,MN,SC) | TEMP °C | | ELAPSED MINUTES | BOTTOM BURETTE | TOP BURETTE | Q (CC) | K CM/SEC | | HYDRAULIC GRADIENT | HYDRAULIC HEAD | HEAD LOSS,% | k (in/sec) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 17-Feb-21 | 11:14 AM | 20.7 | * | 0 | 5.20 | 22.90 | | | | 1.55 | 17.70 | | |
| 0.0 | 17-Feb-21 | 02:25 PM | 21.0 | * | 191 | 6.22 | 21.55 | 1.02 | 1.8E-06 | * | 1.34 | 15.33 | 13.39 | 7.0E-07 |
| 0.0 | 17-Feb-21 | 05:06 PM | 21.6 | * | 161 | 6.96 | 20.76 | 0.74 | 1.5E-06 | * | 1.21 | 13.80 | 9.98 | 6.0E-07 |
| 0.0 | 18-Feb-21 | 08:37 AM | 19.3 | * | 931 | 9.37 | 18.35 | 2.41 | 1.1E-06 | * | 0.79 | 8.98 | 34.93 | 4.3E-07 |
| 0.0 | 18-Feb-21 | 12:31 PM | 20.7 | * | 234 | 9.90 | 17.87 | 0.53 | 1.2E-06 | * | 0.70 | 7.97 | 11.25 | 4.7E-07 |

**Average Temp. = 20.7** *

**AVERAGE K = 1.4E-06** *    **AVERAGE K = 5.5E-07**

**Corrected K for 20°C = 1.4E-06**    **Corrected K for 20°C = 5.4E-07**

** Measurements at end of test

GEOTECHNOLOGY INC. FROM THE GROUND UP

## LABORATORY LOG OF TUBE SAMPLE

Project No.: J037264.01.6001 Project Name.: Duck Creek Date Opened: 2/12/21 By: JMM

Boring No.: SB-01 Sample No.: ST-9 Depth (ft): 16.0 to 18.0

Type [X] Std. "Shelby" [ ] Other:

Tube Dimensions: Outside Diameter (in): 3 Recovery (in): 24

| Tube Condition: | Dented | End(s) not sealed | Other: |
|---|---|---|---|
| | | | |

| Sample Condition | Good | Fair | Poor | Disturbed |
|---|---|---|---|---|
| | ✓ | | | |

Remarks:

| Tube Scale (in) | Sample Use (Test Type) | Soil Identification and Processing Remarks (Draw lines to indicate top and botton of soil's surface and where sample was taken. Identify cut lines with: "Cut" "Date: m/d/y" "Your Initials") |
|---|---|---|
| 0.0 | | Light Olive-brown LEAN CLAY-CL |
| 2.0 | | |
| 4.0 | | Qp = 0.75 tsf |
| 6.0 | | |
| 8.0 | | |
| 10.0 | | |
| 12.0 | | - very dark gray-brown |
| 14.0 | 'K' | |
| 16.0 | | |
| 18.0 | | |
| 20.0 | | Qp = 1.75 tsf |
| 22.0 | | |
| 24.0 | | |

Ave. Height (in.): Ave. Diameter (in.): Specimen Wt. (gms):

| Natural Moisture Content | | | | |
|---|---|---|---|---|
| Tare Number | Wet Mass + Tare (g) | Dry Mass+ Tare (g) | Tare Mass (g) | Water Content (%) |
| See 'K' Data Sheet | | | | |

Wet Unit Weight: pcf Dry Unit Weight pcf

Tested By: JMM Calculated By: Checked By:
Date: 2/12/21 Date: Date:

GEOTECHNOLOGY INC. FROM THE GROUND UP

# LABORATORY LOG OF TUBE SAMPLE

Project No.: 1037264.01.6001 Project Name.: Duck Creek Date Opened: 2/16/21 By: JMM

Boring No.: SB-01 Sample No.: ST-15 Depth (ft): 28.0 to 30.0

Type [X] Std. "Shelby" [ ] Other: ______

Tube Dimensions: Outside Diameter (in): 3 Recovery (in): 24

| Tube Condition: | Dented | End(s) not sealed | Other: |
|---|---|---|---|
| | | | |

| Sample Condition | Good | Fair | Poor | Disturbed |
|---|---|---|---|---|
| | | ✓ | | |

Remarks: Tube cut in order to extrude sample

| Tube Scale (in) | Sample Use (Test Type) | Soil Identification and Processing Remarks (Draw lines to indicate top and botton of soil's surface and where sample was taken. Identify cut lines with: "Cut" "Date: m/d/y" "Your Initials") |
|---|---|---|
| 0.0 | | Greenish-gray, LEAN to FAT CLAY, CL/CH |
| 2.0 | | |
| 4.0 | | Qp= 0.25tsf |
| 6.0 | | |
| 8.0 | 'K' | |
| 10.0 | | |
| 12.0 | | with Sand some gravel - CL |
| 14.0 | | Green-gray, Lean CLAY |
| 16.0 | | - dark yellow-brown below 15" |
| 18.0 | | Qp=4.5+ tsf |
| 20.0 | | |
| 22.0 | | |
| 24.0 | | |

Ave. Height (in.): ______ Ave. Diameter (in.): ______ Specimen Wt. (gms): ______

| Natural Moisture Content | | | | |
|---|---|---|---|---|
| Tare Number | Wet Mass + Tare (g) | Dry Mass+ Tare (g) | Tare Mass (g) | Water Content (%) |
| See 'K' Data Sheet | | | | |

Wet Unit Weight: ______ pcf Dry Unit Weight ______ pcf

Tested By: JMM Calculated By: ______ Checked By: ______

Date: 2/16/21 Date: ______ Date: ______

GEOTECHNOLOGY INC. FROM THE GROUND UP

## LABORATORY LOG OF TUBE SAMPLE

Project No.: 1037264.01.6001 Project Name.: Duck Creek Date Opened: 2/13/21 By: JMM

Boring No.: SB-02 Sample No.: ST-5 Depth (ft): 8.0 to 10.0

Type [X] Std. "Shelby" [ ] Other: ______

Tube Dimensions: Outside Diameter (in): 3 Recovery (in): 21

| Tube Condition: | Dented | End(s) not sealed | Other: |
|---|---|---|---|
| | | | |

| Sample Condition | Good | Fair | Poor | Disturbed |
|---|---|---|---|---|
| | ✓ | | | |

Remarks: ______

| Tube Scale (in) | Sample Use (Test Type) | Soil Identification and Processing Remarks (Draw lines to indicate top and botton of soil's surface and where sample was taken. Identify cut lines with: "Cut" "Date: m/d/y" "Your Initials") |
|---|---|---|
| 0.0 | | Olive-gray, LEAN CLAY-CL |
| 2.0 | | |
| 4.0 | | Qp = 0.75 tsf |
| 6.0 | | |
| 8.0 | | Sample saturated 8" from top |
| 10.0 | | |
| 12.0 | | |
| 14.0 | 'K' | Qp = 1.25 tsf |
| 16.0 | | |
| 18.0 | | |
| 20.0 | | |
| 22.0 | | |
| 24.0 | | |

Ave. Height (in.): ______ Ave. Diameter (in.): ______ Specimen Wt. (gms): ______

| Natural Moisture Content | | | | |
|---|---|---|---|---|
| Tare Number | Wet Mass + Tare (g) | Dry Mass+ Tare (g) | Tare Mass (g) | Water Content (%) |
| See 'K' Data Sheet | | | | |

Wet Unit Weight: ______ pcf Dry Unit Weight ______ pcf

Tested By: JMM Calculated By: ______ Checked By: ______

Date: 2/13/21 Date: ______ Date: ______

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GEOTECHNOLOGY INC. FROM THE GROUND UP

# LABORATORY LOG OF TUBE SAMPLE

Project No.: 1037264.01.6001 Project Name.: Duck Creek Date Opened: 2/16/21 By: JMM

Boring No.: SB-02 Sample No.: ST-10 Depth (ft): 18.0 to 20.0

Type [X] Std. "Shelby" [ ] Other: ______

Tube Dimensions: Outside Diameter (in): 3 Recovery (in): 20

| Tube Condition: | Dented | End(s) not sealed | Other: |
|---|---|---|---|
| | | | |

| Sample Condition | Good | Fair | Poor | Disturbed |
|---|---|---|---|---|
| | ✓ | | | |

Remarks: ______

| Tube Scale (in) | Sample Use (Test Type) | Soil Identification and Processing Remarks (Draw lines to indicate top and botton of soil's surface and where sample was taken. Identify cut lines with: "Cut" "Date: m/d/y" "Your Initials") |
|---|---|---|
| 0.0 | | Gray, LEAN CLAY - CL |
| 2.0 | | Qp = 2.5tsf |
| 4.0 | | |
| 6.0 | | - with sand |
| 8.0 | | Clayey sand seam @ 10-12" from top |
| 10.0 | | Gray, LEAN CLAY, trace Sand - CL |
| 12.0 | | |
| 14.0 | 'K' | |
| 16.0 | | Qp = 1.5tsf |
| 18.0 | | |
| 20.0 | | |
| 22.0 | | |
| 24.0 | | |

Ave. Height (in.): ______ Ave. Diameter (in.): ______ Specimen Wt. (gms): ______

| Natural Moisture Content | | | | |
|---|---|---|---|---|
| Tare Number | Wet Mass + Tare (g) | Dry Mass+ Tare (g) | Tare Mass (g) | Water Content (%) |
| See 'K' Data Sheet | | | | |

Wet Unit Weight: ______ pcf Dry Unit Weight ______ pcf

Tested By: JMM Calculated By: ______ Checked By: ______
Date: 2/16/21 Date: ______ Date: ______

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GEOTECHNOLOGY INC. FROM THE GROUND UP

# LABORATORY LOG OF TUBE SAMPLE

Project No.: 1037264.01.6001 Project Name.: Duck Creek Date Opened: 2/16/21 By: JMM

Boring No.: SB-02 Sample No.: ST-13 Depth (ft): 24.0 to 26.0

Type [X] Std. "Shelby" [ ] Other:

Tube Dimensions: Outside Diameter (in): 3 Recovery (in): 18+2

| Tube Condition: | Dented | End(s) not sealed | Other: |
|---|---|---|---|
| | | | |

| Sample Condition | Good | Fair | Poor | Disturbed |
|---|---|---|---|---|
| | ✓ | | | |

Remarks: Bottom of tube bent. Bottom 2" dug out

| Tube Scale (in) | Sample Use (Test Type) | Soil Identification and Processing Remarks (Draw lines to indicate top and botton of soil's surface and where sample was taken. Identify cut lines with: "Cut" "Date: m/d/y" "Your Initials") |
|---|---|---|
| 0.0 | | Green-gray, LEAN to Fat CLAY - CL/CH |
| 2.0 | 'K' | |
| 4.0 | | |
| 6.0 | | Qp=1.0tsf |
| 8.0 | | Clayey sand seam 8-10" |
| 10.0 | | Green-gray, SANDY CLAY some gravel - CL |
| 12.0 | | sample came out pitted |
| 14.0 | | |
| 16.0 | | |
| 18.0 | | |
| 20.0 | | |
| 22.0 | | |
| 24.0 | | |

Ave. Height (in.): Ave. Diameter (in.): Specimen Wt. (gms):

| Natural Moisture Content | | | | |
|---|---|---|---|---|
| Tare Number | Wet Mass + Tare (g) | Dry Mass+ Tare (g) | Tare Mass (g) | Water Content (%) |
| See 'K' Data Sheet | | | | |

Wet Unit Weight: pcf Dry Unit Weight pcf

Tested By: JMM Calculated By: Checked By:
Date: 2/16/21 Date: Date:

GEOTECHNOLOGY INC. FROM THE GROUND UP

## LABORATORY LOG OF TUBE SAMPLE

Project No.: 1037264.01.6001 Project Name.: Duck Creek Date Opened: 2/13/21 By: JMM

Boring No.: SB-03 Sample No.: ST-5 Depth (ft): 8.0 to 10.0

Type [X] Std. "Shelby" [ ] Other:

Tube Dimensions: Outside Diameter (in): 3 Recovery (in): 22

| Tube Condition: | Dented | End(s) not sealed | Other: |
|---|---|---|---|
| | | | |

| Sample Condition | Good | Fair | Poor | Disturbed |
|---|---|---|---|---|
| | | | | |

Remarks:

| Tube Scale (in) | Sample Use (Test Type) | Soil Identification and Processing Remarks (Draw lines to indicate top and botton of soil's surface and where sample was taken. Identify cut lines with: "Cut" "Date: m/d/y" "Your Initials") |
|---|---|---|
| 0.0 | | Dark yellow-brown, LEAN CLAY-CL |
| 2.0 | | Blocky structure |
| 4.0 | | Qp=1.75tsf |
| 6.0 | | |
| 8.0 | 'K' | |
| 10.0 | | |
| 12.0 | | |
| 14.0 | | |
| 16.0 | | Qp=1.25tsf |
| 18.0 | | |
| 20.0 | | |
| 22.0 | | |
| 24.0 | | |

Ave. Height (in.): Ave. Diameter (in.): Specimen Wt. (gms):

| Natural Moisture Content | | | | |
|---|---|---|---|---|
| Tare Number | Wet Mass + Tare (g) | Dry Mass+ Tare (g) | Tare Mass (g) | Water Content (%) |
| See 'K' Data Sheet | | | | |

Wet Unit Weight: pcf Dry Unit Weight pcf

Tested By: JMM Date: 2/13/21 Calculated By: Date: Checked By: Date:

102 (12/08/09) TubeLog JMM Version.xls, 2.0-Scale 6/15/2017

GEOTECHNOLOGY INC
FROM THE GROUND UP

## LABORATORY LOG OF TUBE SAMPLE

Project No.: 1037264.01.6001 Project Name.: Duck Creek Date Opened: 2/16/21 By: JMM

Boring No.: SB-03 Sample No.: ST-10 Depth (ft): 18.0 to 20.0

Type [X] Std. "Shelby" [ ] Other: ______

Tube Dimensions: Outside Diameter (in): 3 Recovery (in): 17

| Tube Condition: | Dented | End(s) not sealed | Other: |
|---|---|---|---|
| | | | |

| Sample Condition | Good | Fair | Poor | Disturbed |
|---|---|---|---|---|
| | | | | |

Remarks: ______

| Tube Scale (in) | Sample Use (Test Type) | Soil Identification and Processing Remarks (Draw lines to indicate top and botton of soil's surface and where sample was taken. Identify cut lines with: "Cut" "Date: m/d/y" "Your Initials") |
|---|---|---|
| 0.0 | | Yellow-Brown, LEAN to FAT CLAY trace sand - CL |
| 2.0 | | Qp=0.75 tsf |
| | | 1" Clayey sand seam |
| 4.0 | | Yellow-Br, LEAN CLAY with sand some gravel - CL |
| 6.0 | | |
| 8.0 | 'K' | |
| 10.0 | | |
| 12.0 | | |
| 14.0 | | Qp = 4.5+ tsf |
| 16.0 | | |
| 18.0 | | |
| 20.0 | | |
| 22.0 | | |
| 24.0 | | |

Ave. Height (in.): ______ Ave. Diameter (in.): ______ Specimen Wt. (gms): ______

| Natural Moisture Content | | | | |
|---|---|---|---|---|
| Tare Number | Wet Mass + Tare (g) | Dry Mass+ Tare (g) | Tare Mass (g) | Water Content (%) |
| See 'K' Data Sheet | | | | |

Wet Unit Weight: ______ pcf Dry Unit Weight ______ pcf

Tested By: JMM Calculated By: ______ Checked By: ______
Date: 2/16/21 Date: ______ Date: ______

**Doug Ramsey**

| | |
|---|---|
| **From:** | Rhonald Hasenyager <RHasenyager@hanson-inc.com> |
| **Sent:** | Wednesday, February 10, 2021 1:36 PM |
| **To:** | Doug Ramsey |
| **Subject:** | RE: Duck Creek |
| **Attachments:** | SCH_LabTestingSchedule-RGE.pdf |

Doug,

I have attached the testing schedule for the soil samples collected at Duck Creek. Each page is one boring. You will see a listing of jar sample number followed by Comp#. What I am looking for is a composite sample from the various jars that will be combined and then tested. I will also need to know what lithology is in the various Shelby tubes and if there are any lithology changes.

Feel free to give me a call if there are any questions.

Thanks, Rhon

**From:** Doug Ramsey <dramsey@ramgeoeng.com>
**Sent:** Wednesday, February 10, 2021 6:56 AM
**To:** Rhonald Hasenyager <RHasenyager@hanson-inc.com>
**Subject:** Duck Creek



Hi Rhon,

Do you have lab testing assignments for the Duck Creek soil samples?

Douglas P. Ramsey, P.E.
President

RAMSEY GEOTECHNICAL ENGINEERING

1701 West Market Street
Bloomington, Illinois 61701
Office 309-821-0430
Cell 309-665-2965
Email: dramsey@ramgeoeng.com

Hanson Professional Services Inc.

## Subcontract Agreement: RGE2014

## Task Order No. 20E0111A/3000A

### SCHEDULE OF LABORATORY TESTING

| | Routine Testing [1] | | | | | | | | | | | Complex Testing [1] | | | | | | | | | | | | | | | | Analytical Testing [1] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | 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 | |
| **SB01** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *12A* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Comp1* | | | | x | x | | | x | | | x | | | x | | | | | | | | | | | | | | | | | | | | |
| ST9 | | | | | | | | | | | | | | | | | | | | | x | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 14A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ST15 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Comp2* | | | | x | x | | | x | | | x | | | x | | | | | | | | | | | | | | | | | | | | |
| ST15 | | | | | | | | | | | | | | | | | | | | | x | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 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 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ST10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Comp2* | | | | x | x | | | x | | | x | | | x | | | | | | | | | | | | | | | | | | | | |
| ST10 | | | | | | | | | | | | | | | | | | | | x | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ST13 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Comp3* | | | | x | x | | | x | | | x | | | x | | | | | | | | | | | | | | | | | | | | |
| ST13 | | | | | | | | | | | | | | | | | | | | x | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 15A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 17A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 18A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 19A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Comp4* | | | | x | x | | | x | | | x | | | x | | | | | | | | | | | | | | | | | | | | |

## SCHEDULE OF LABORATORY TESTING

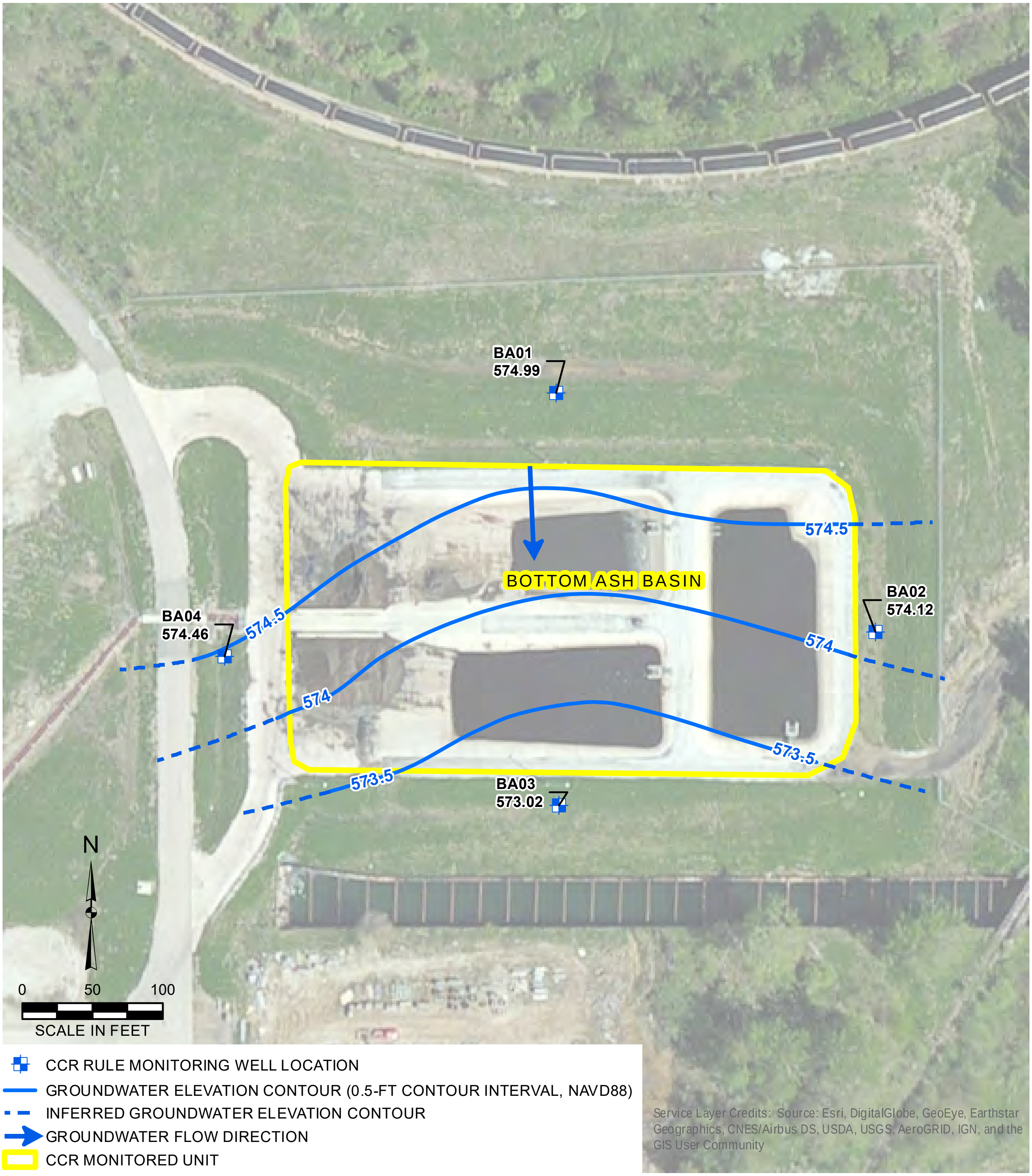
| Sample ID | Routine Testing | | | | | | | | | | | Complex Testing | | | | | | | | | | | | | | | | Analytical Testing | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rimac Comp Strength | Visual-Manual 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 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ST10* | | | | X | X | | | X | | | X | | | X | | | | | | | | | | | | | | | | | | | |
| ST10^ | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *13A* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Comp3* | | | | X | X | | | X | | | X | | | X | | | | | | | | | | | | | | | | | | | |

* If sand is present in Shelby tube.

^ if sufficient sample, use lower portion of Shelby tube.

# APPENDIX D
# GROUNDWATER CONTOUR MAPS AND ELEVATIONS

# GROUNDWATER CONTOUR MAPS

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DRAWN BY/DATE:
SDS 1/23/17
REVIEWED BY/DATE:
ANS 1/25/17
APPROVED BY/DATE:
JJW 2/7/17

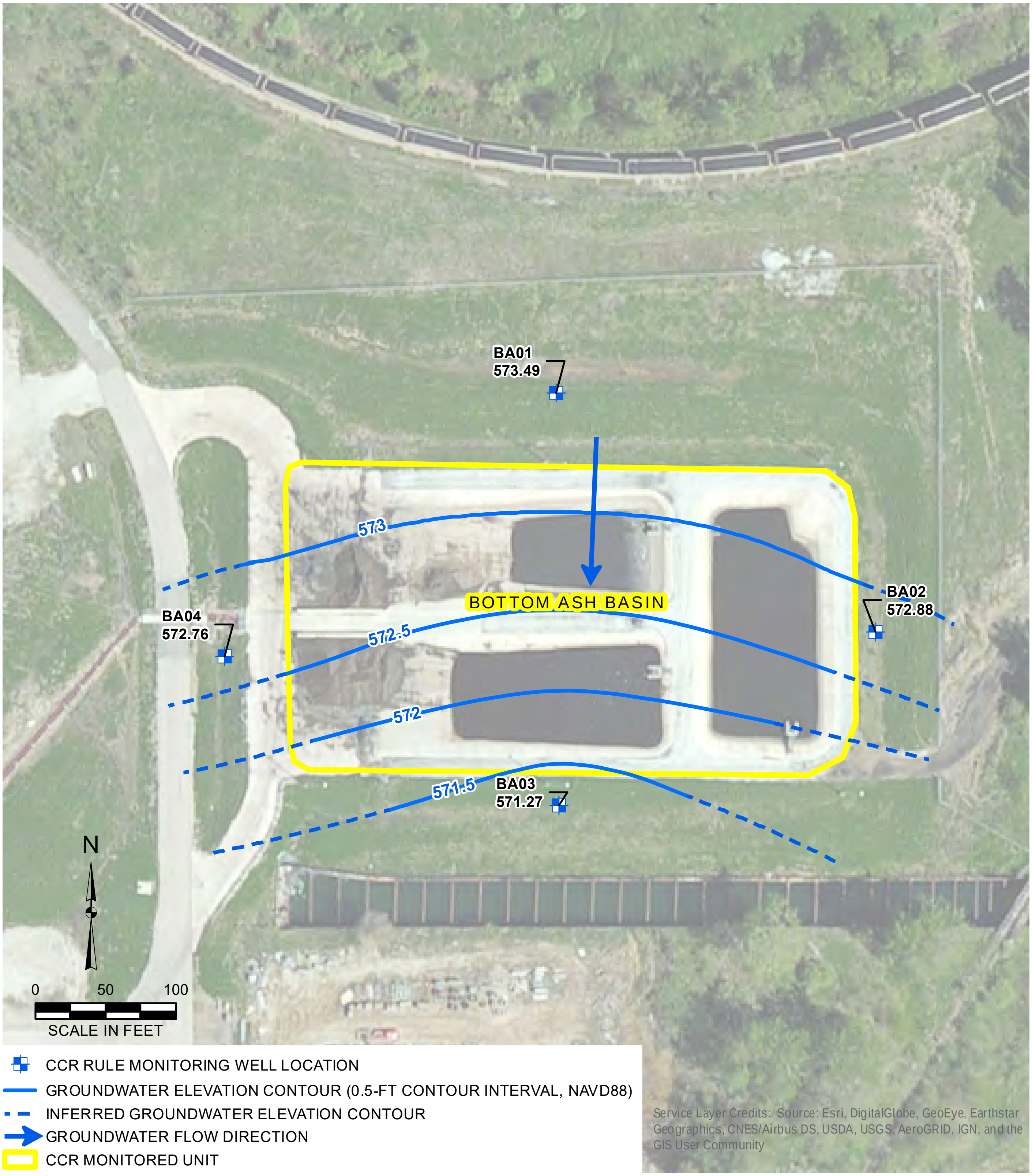
**DUCK CREEK BOTTOM ASH BASIN (UNIT ID: 205)**
**UPPERMOST AQUIFER UNIT**
**GROUNDWATER ELEVATION CONTOUR MAP**
**ROUND 1: JANUARY 25, 2016**

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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REVIEWED BY/DATE:
ANS 1/25/17
APPROVED BY/DATE:
JJW 2/8/17

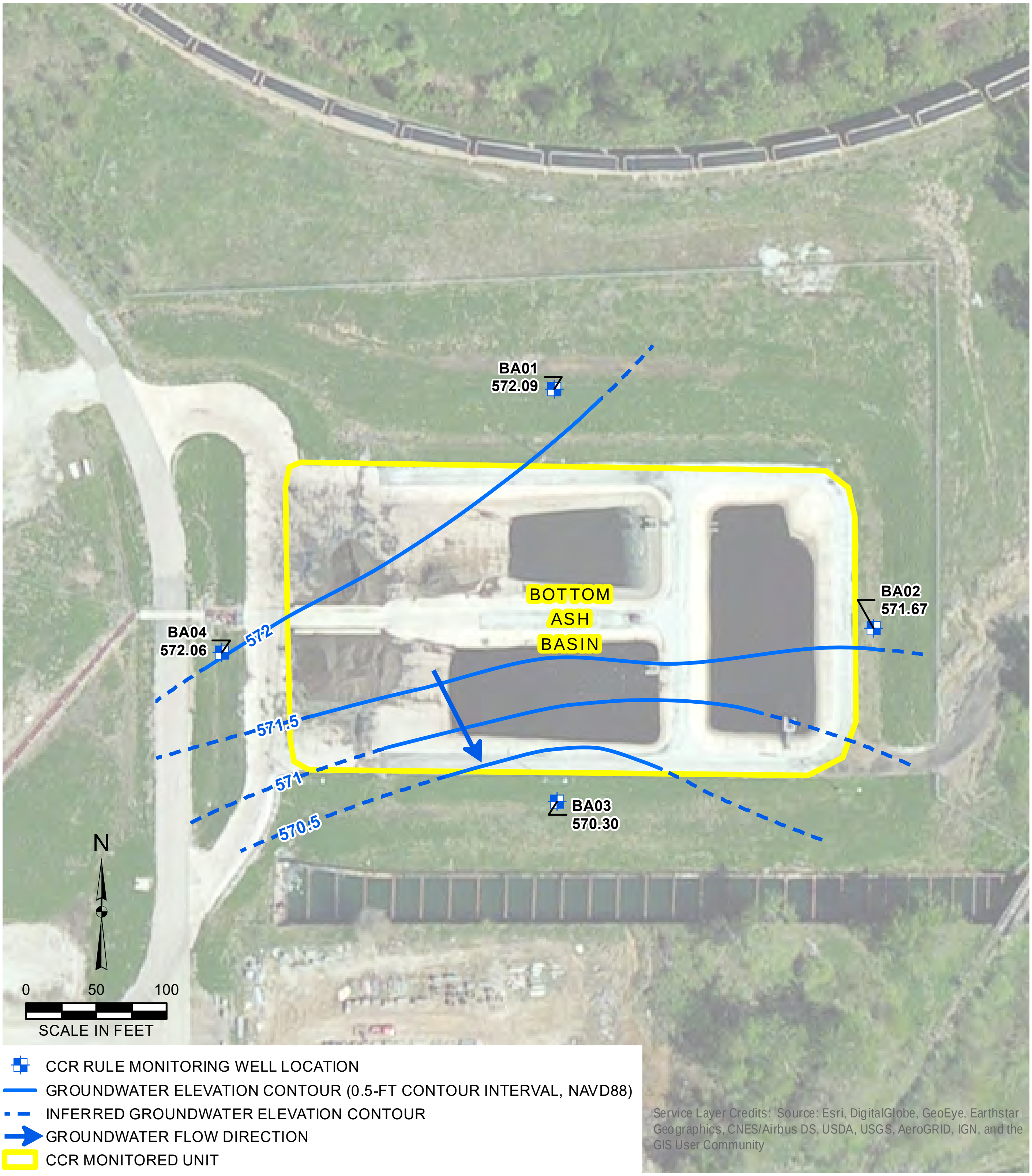
**DUCK CREEK BOTTOM ASH BASIN (UNIT ID: 205)**
**UPPERMOST AQUIFER UNIT**
**GROUNDWATER ELEVATION CONTOUR MAP**
**ROUND 2: APRIL 18, 2016**

DYNEGY CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

PROJECT NO: 2285

FIGURE NO: 1

Natural Resource Technology
AN OBG COMPANY






DRAWN BY/DATE:
SDS 1/23/17
REVIEWED BY/DATE:
ANS 1/25/17
APPROVED BY/DATE:
JJW 2/8/17

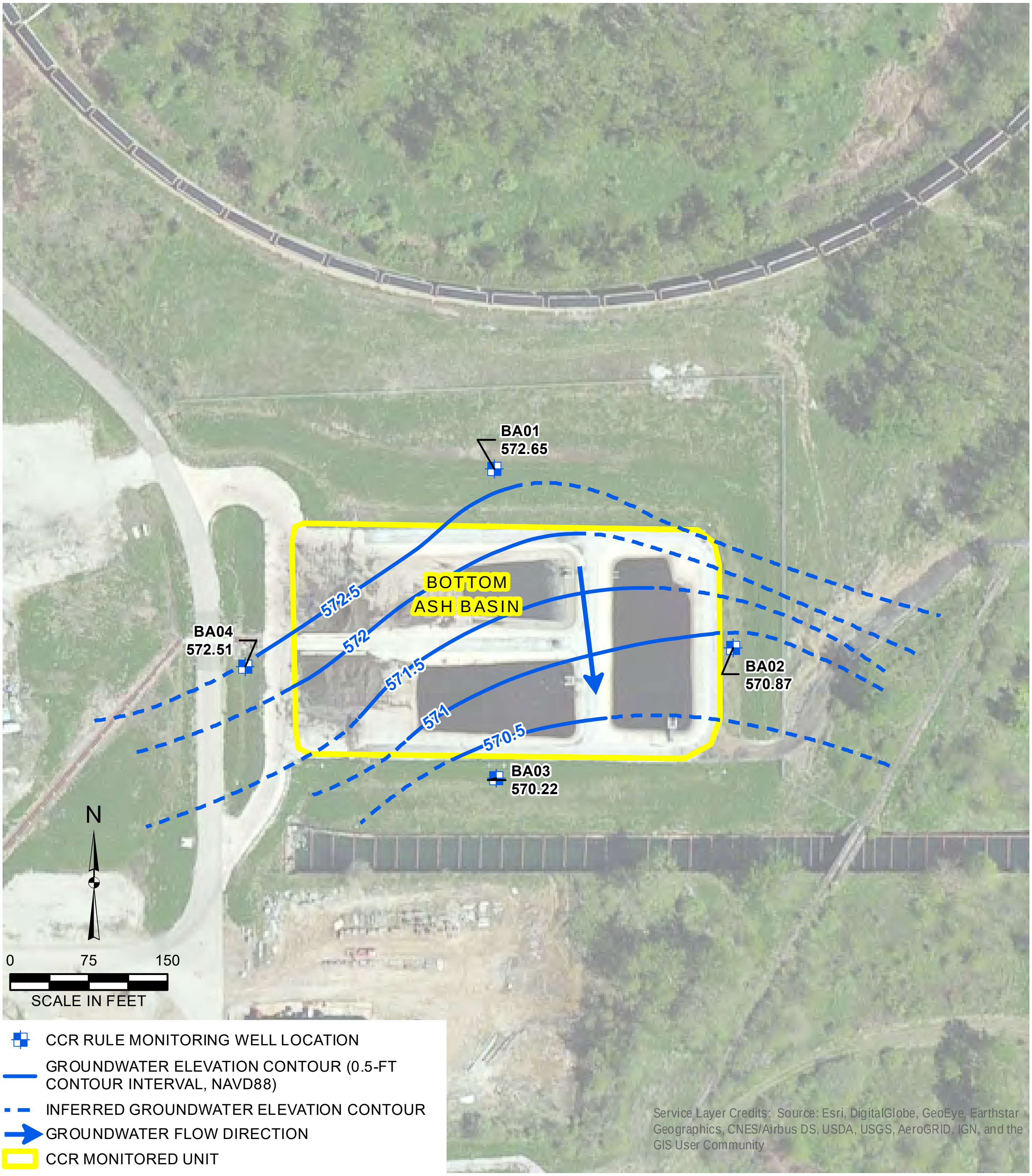
**DUCK CREEK BOTTOM ASH BASIN (UNIT ID: 205)**
**UPPERMOST AQUIFER UNIT**
**GROUNDWATER ELEVATION CONTOUR MAP**
**ROUND 3: JUNE 28, 2016**

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 1/25/17
APPROVED BY/DATE:
JJW 2/8/17

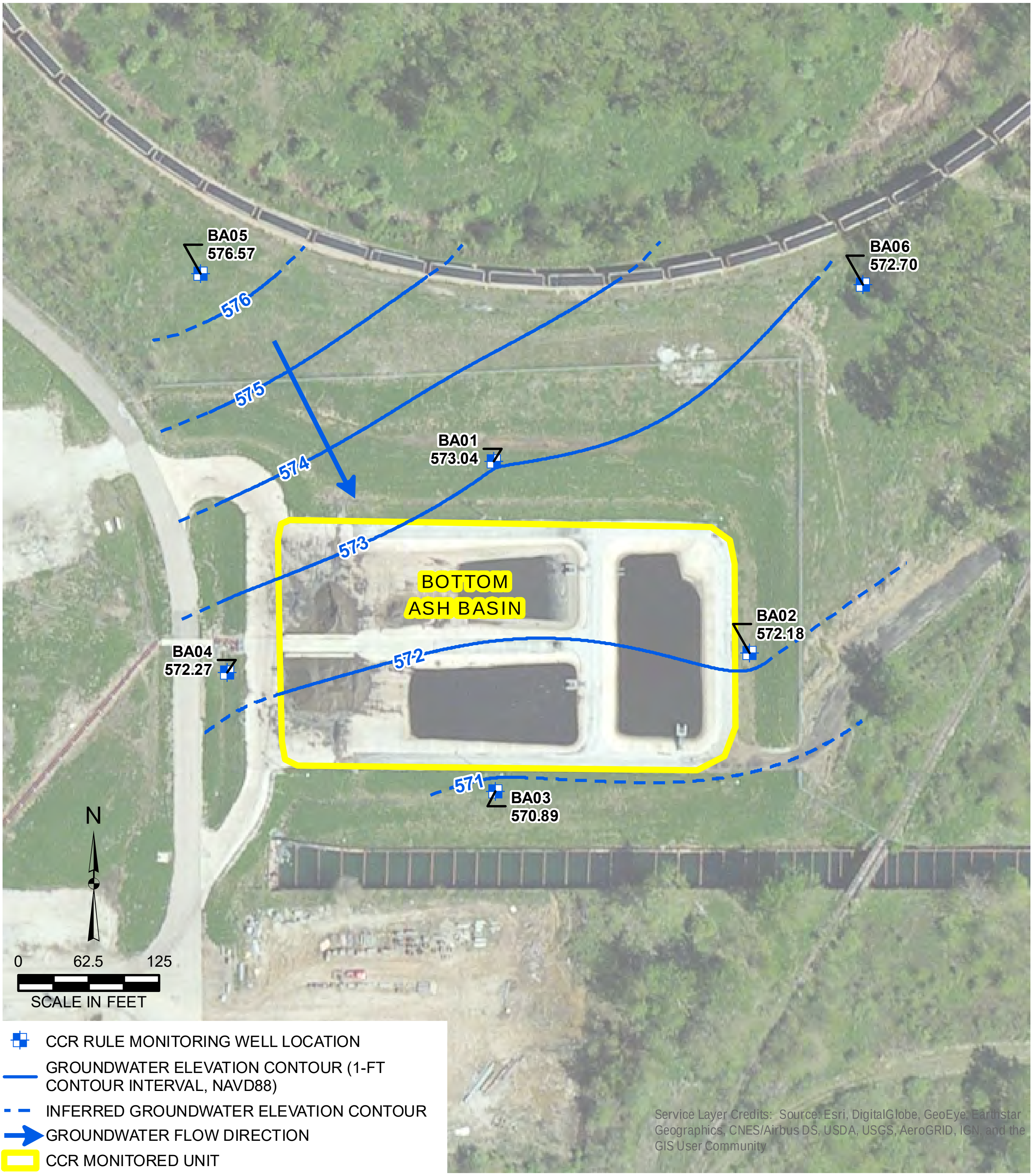
**DUCK CREEK BOTTOM ASH BASIN (UNIT ID: 205)**
**UPPERMOST AQUIFER UNIT**
**GROUNDWATER ELEVATION CONTOUR MAP**
**ROUND 4: AUGUST 9, 2016**

DYNEGY CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

PROJECT NO: 2285

FIGURE NO: 1

Natural Resource Technology
AN OBG COMPANY




DRAWN BY/DATE:
SDS 3/21/17
REVIEWED BY/DATE:
ANS 3/21/17
APPROVED BY/DATE:
JJW 9/1/17

**DUCK CREEK BOTTOM ASH BASIN (UNIT ID: 205)**
**UPPERMOST AQUIFER UNIT**
**GROUNDWATER ELEVATION CONTOUR MAP**
**ROUND 5: OCTOBER 17, 2016**

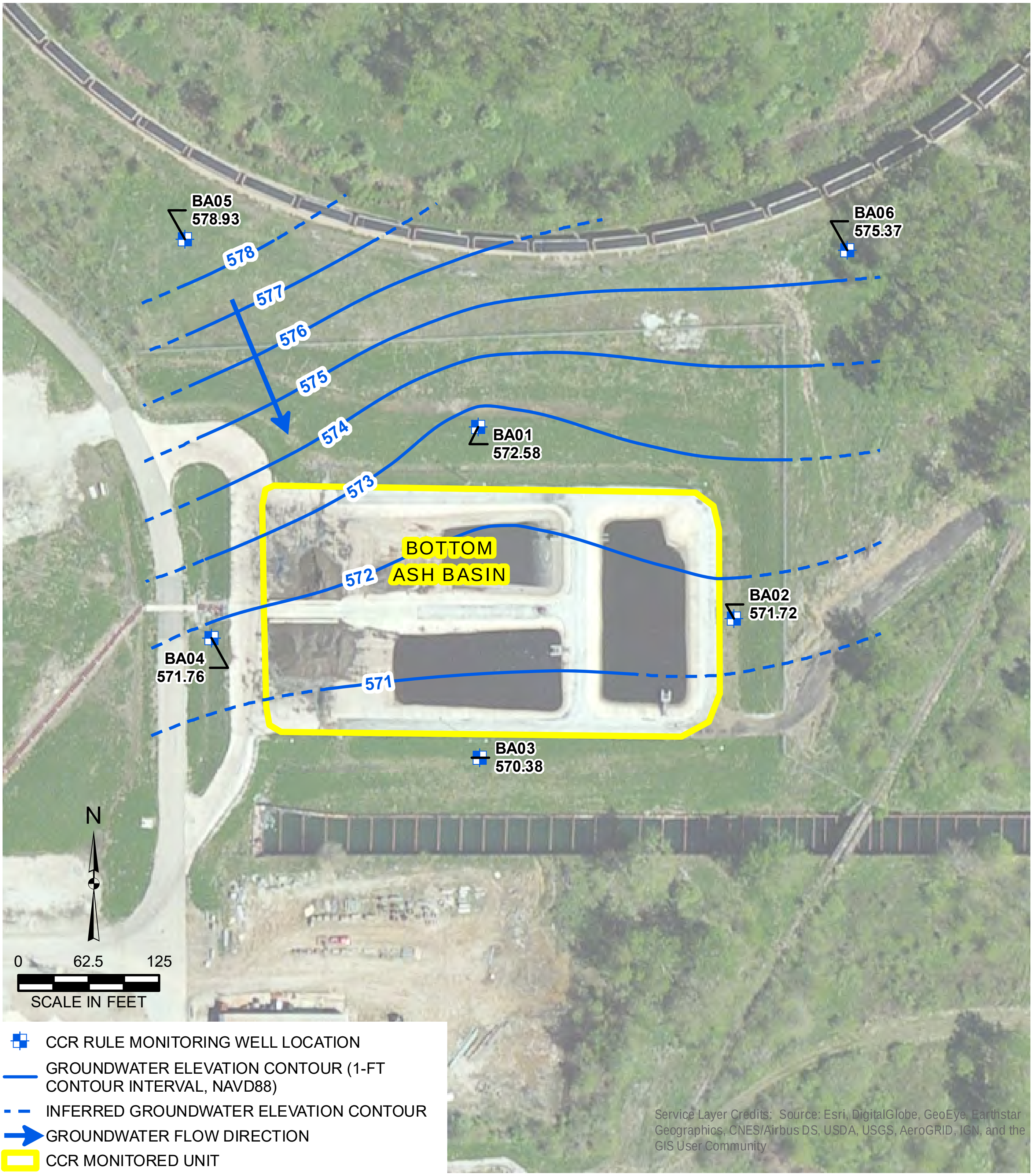
DYNEGY CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

PROJECT NO: 2285

FIGURE NO: 1

Natural Resource Technology
AN OBG COMPANY

Y:\Mapping\Projects\22\2285\MXD\GW_Contours\Round_05\R5_DuckCreekBAB_GW_Contours.mxd Author: stolzsd; Date/Time: 9/12/2017, 1:44:42 PM

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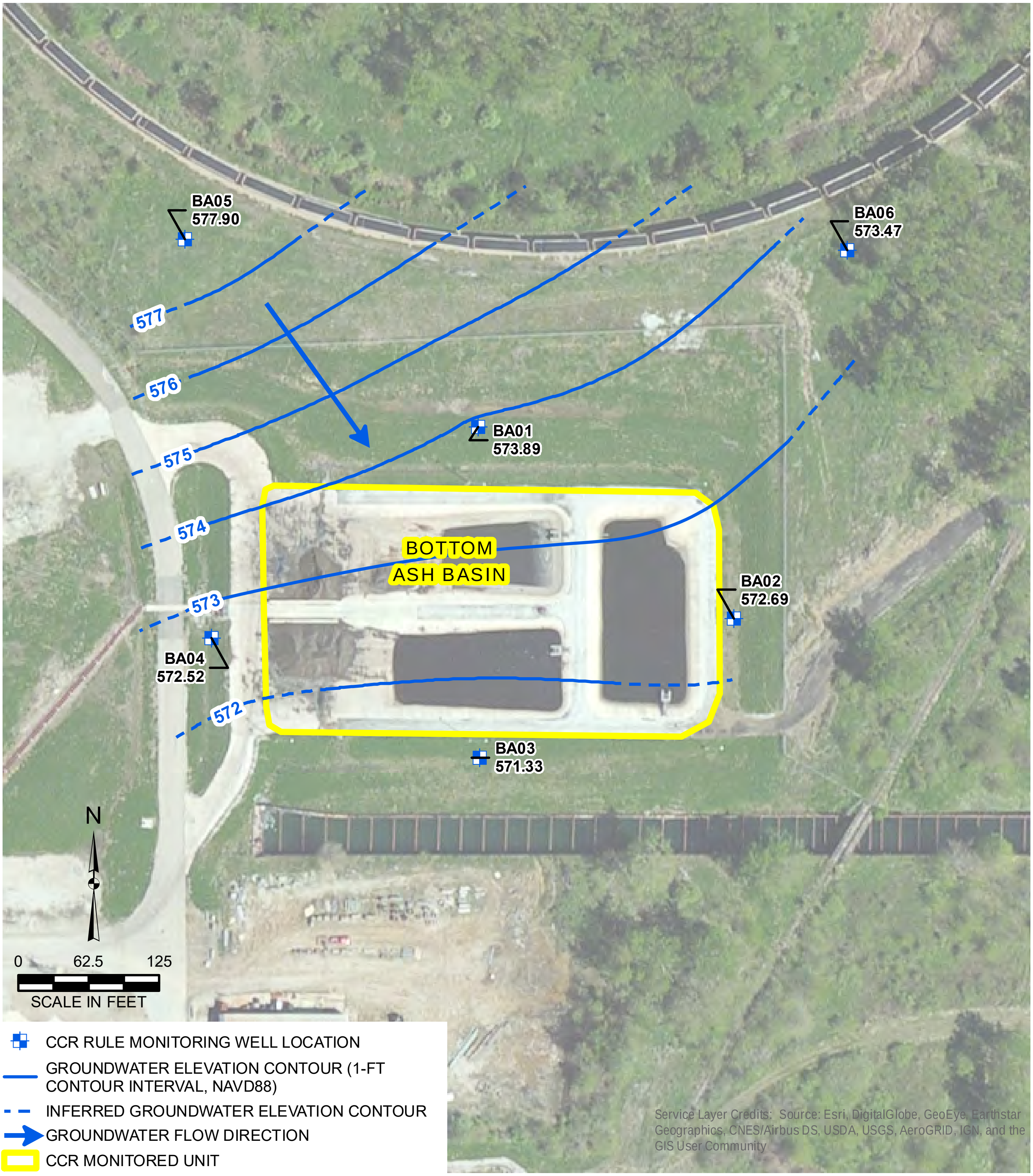
| DRAWN BY/DATE: SDS 3/21/17<br>REVIEWED BY/DATE: ANS 3/21/17<br>APPROVED BY/DATE: JJW 9/1/17 | **DUCK CREEK BOTTOM ASH BASIN (UNIT ID: 205)<br>UPPERMOST AQUIFER UNIT<br>GROUNDWATER ELEVATION CONTOUR MAP<br>ROUND 6: JANUARY 9, 2017**<br><br>DYNEGY CCR RULE GROUNDWATER MONITORING<br>DUCK CREEK POWER STATION<br>CANTON, ILLINOIS | PROJECT NO: 2285<br>FIGURE NO: 1<br>Natural Resource Technology<br>AN OBG COMPANY |
|---|---|---|

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DRAWN BY/DATE:
SDS 5/22/17
REVIEWED BY/DATE:
ANS 5/22/17
APPROVED BY/DATE:
JJW 9/1/17

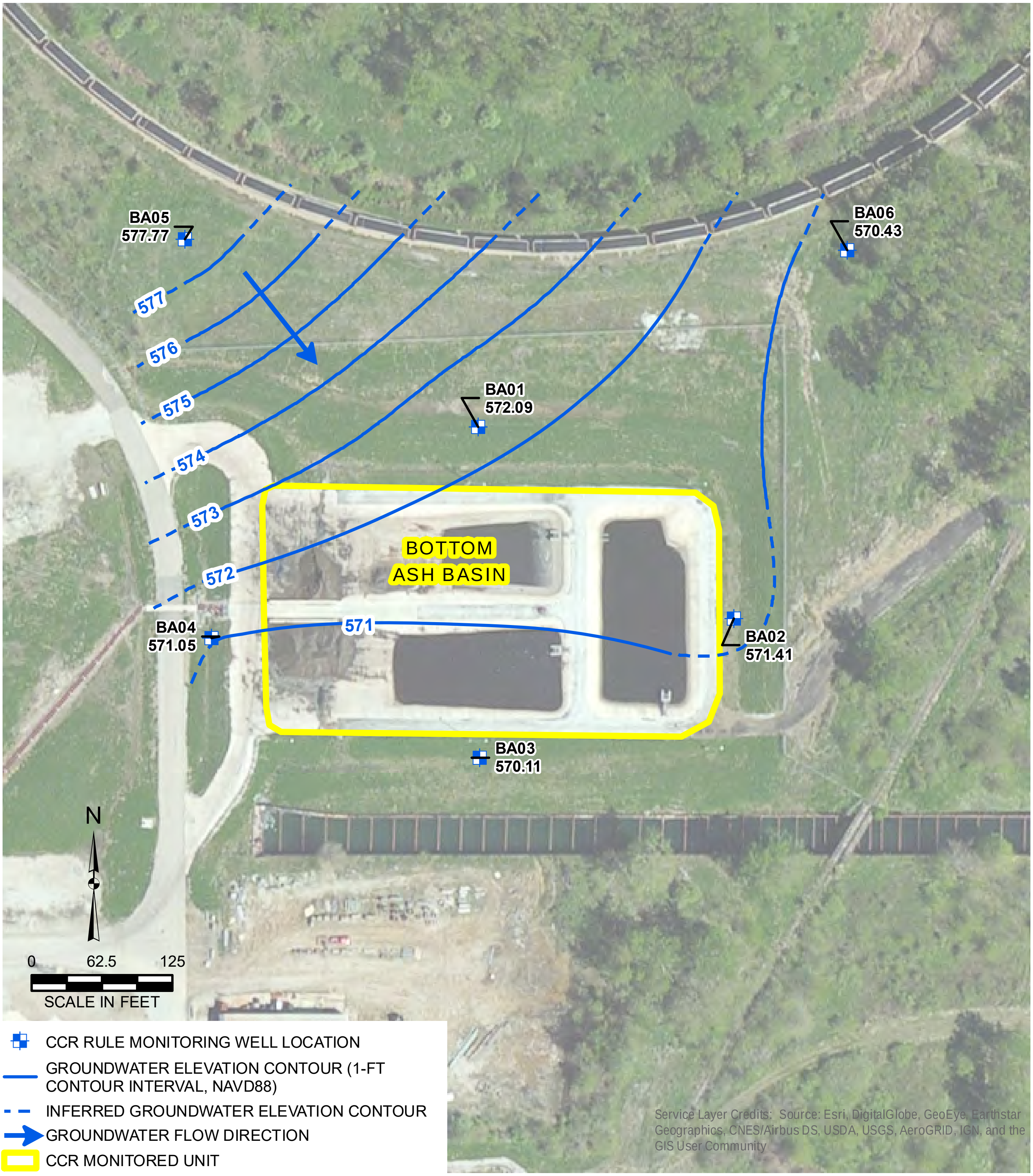
**DUCK CREEK BOTTOM ASH BASIN (UNIT ID: 205)**
**UPPERMOST AQUIFER UNIT**
**GROUNDWATER ELEVATION CONTOUR MAP**
**ROUND 7: APRIL 2, 2017**

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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DRAWN BY/DATE:
SDS 7/27/17
REVIEWED BY/DATE:
ANS 7/28/17
APPROVED BY/DATE:
JJW 9/1/17

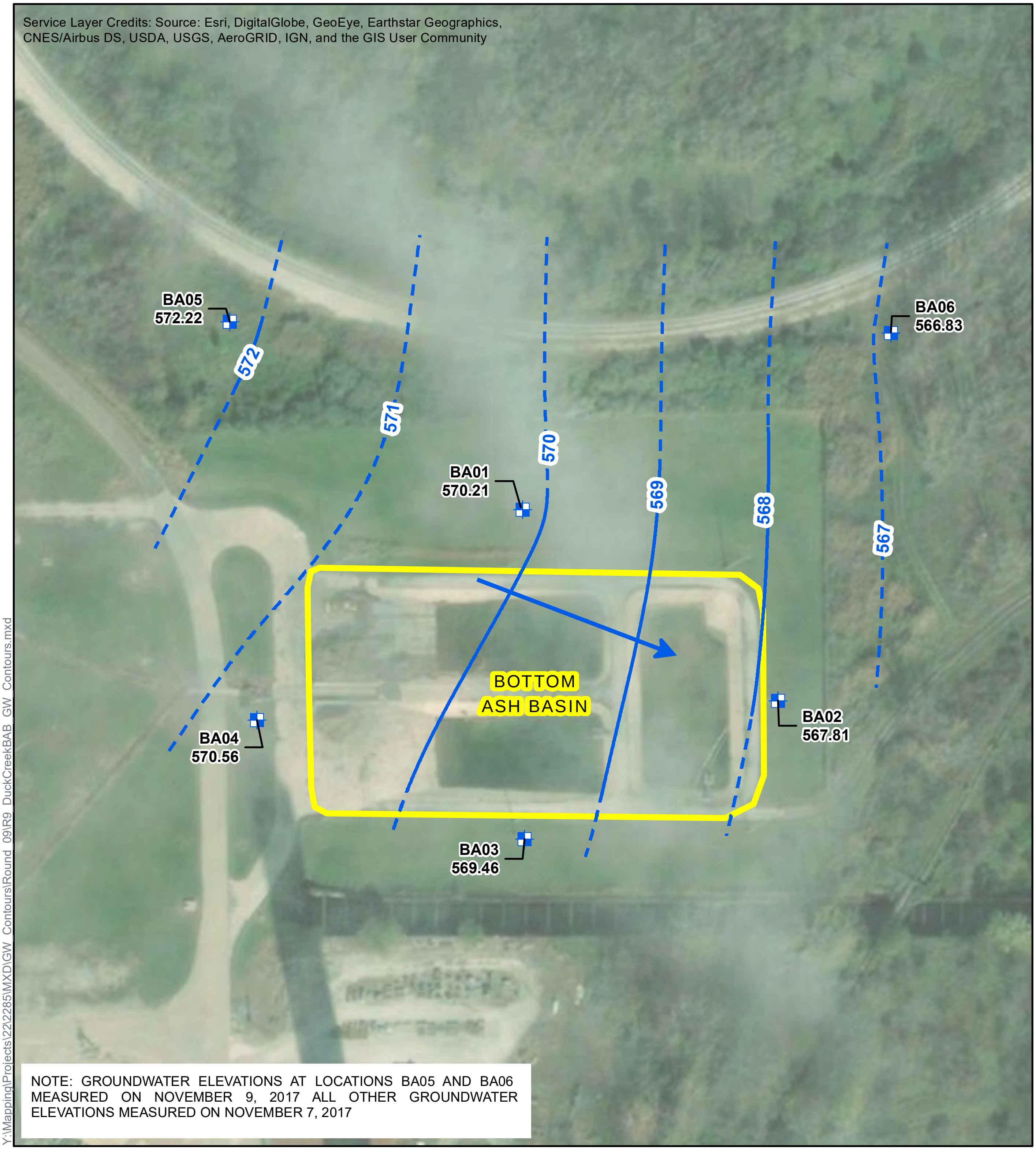
**DUCK CREEK BOTTOM ASH BASIN (UNIT ID: 205)**
**UPPERMOST AQUIFER UNIT**
**GROUNDWATER ELEVATION CONTOUR MAP**
**ROUND 8: JUNE 26, 2017**

DYNEGY CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

PROJECT NO: 2285

FIGURE NO: 1

Natural Resource Technology
AN OBG COMPANY




NOTE: GROUNDWATER ELEVATIONS AT LOCATIONS BA05 AND BA06 MEASURED ON NOVEMBER 9, 2017 ALL OTHER GROUNDWATER ELEVATIONS MEASURED ON NOVEMBER 7, 2017

- CCR RULE MONITORING WELL LOCATION
- GROUNDWATER ELEVATION CONTOUR (1-FT CONTOUR INTERVAL, NAVD88)
- INFERRED GROUNDWATER ELEVATION CONTOUR
- GROUNDWATER FLOW DIRECTION
- CCR MONITORED UNIT

**DUCK CREEK BOTTOM ASH BASIN (UNIT ID: 205)**
**GROUNDWATER ELEVATION CONTOUR MAP**
**NOVEMBER 7 AND 9, 2017**

CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

0 31.25 62.5 125
Feet

N

O'BRIEN & GERE ENGINEERS, INC.


CCR RULE MONITORING WELL LOCATION

GROUNDWATER ELEVATION CONTOUR (1-FT CONTOUR INTERVAL, NAVD88)

INFERRED GROUNDWATER ELEVATION CONTOUR

GROUNDWATER FLOW DIRECTION

CCR MONITORED UNIT

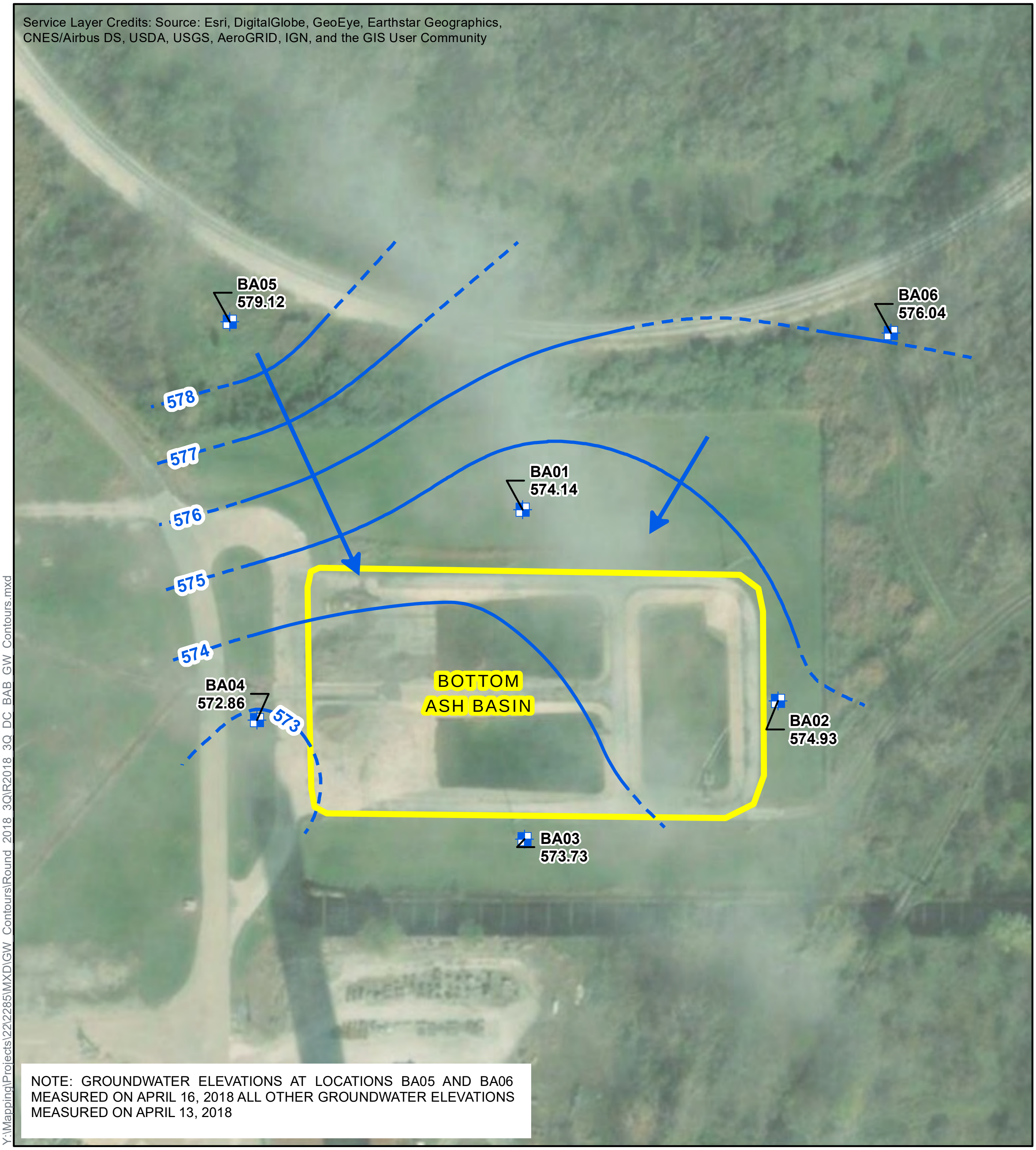
**DUCK CREEK BOTTOM ASH BASIN (UNIT ID: 205)**
**GROUNDWATER ELEVATION CONTOUR MAP**
**APRIL 13 AND 16, 2018**

CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

0 31.25 62.5 125
Feet

N

O'BRIEN & GERE ENGINEERS, INC.




Y:\Mapping\Projects\22\2285\MXD\GW_Contours\Round_2018_3Q\R2018_3Q_DC_BAB_GW_Contours.mxd

CCR RULE MONITORING WELL LOCATION

GROUNDWATER ELEVATION CONTOUR (1-FT CONTOUR INTERVAL, NAVD88)

INFERRED GROUNDWATER ELEVATION CONTOUR

GROUNDWATER FLOW DIRECTION

CCR MONITORED UNIT

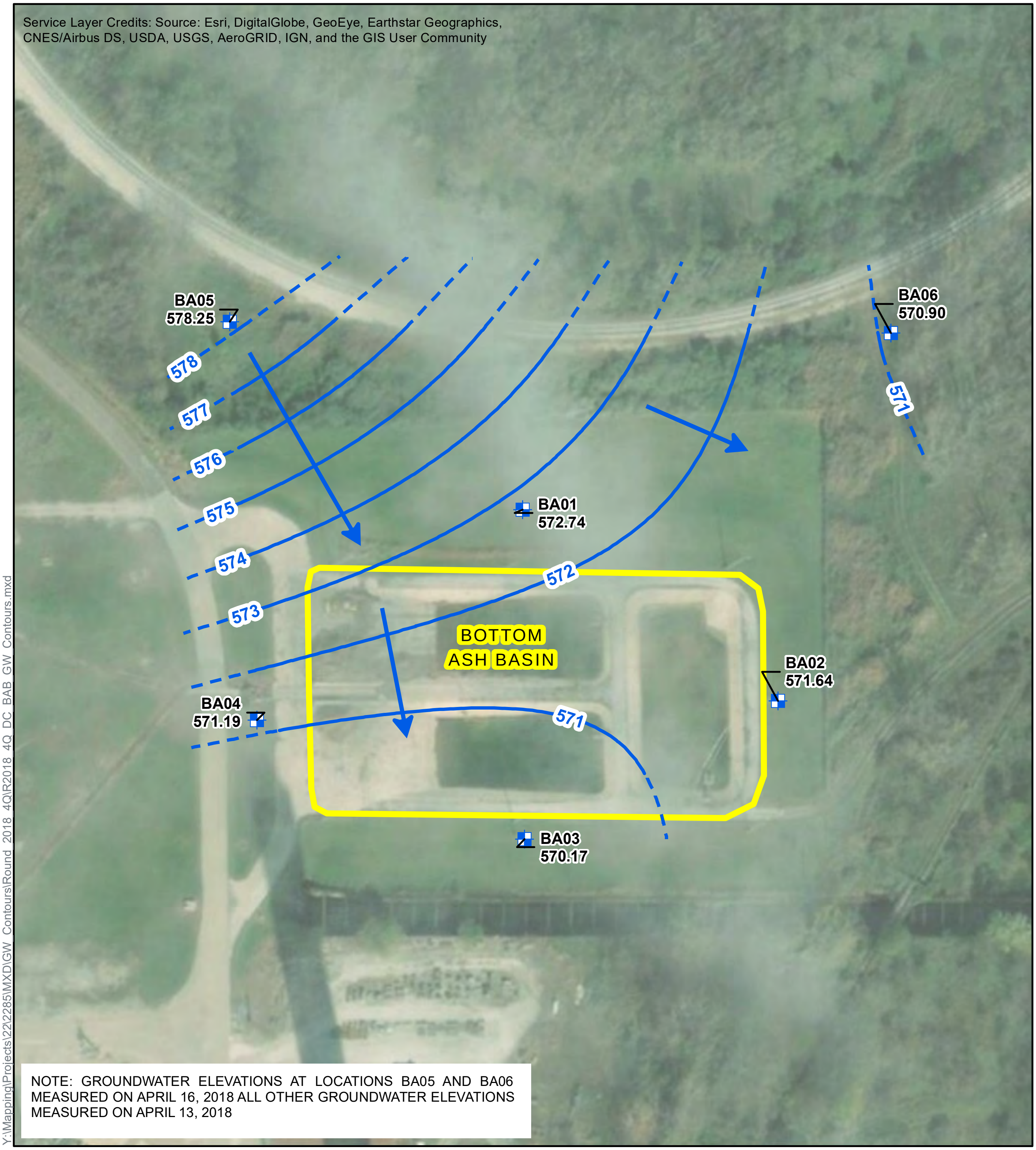
**DUCK CREEK BOTTOM ASH BASIN (UNIT ID: 205)**
**GROUNDWATER ELEVATION CONTOUR MAP**
**JULY 2, 2018**

CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

0 62.5 125 250
Feet

N

O'BRIEN & GERE ENGINEERS, INC.




Y:\Mapping\Projects\22\2285\MXD\GW_Contours\Round_2018_4Q\R2018_4Q_DC_BAB_GW_Contours.mxd

CCR RULE MONITORING WELL LOCATION

GROUNDWATER ELEVATION CONTOUR (1-FT CONTOUR INTERVAL, NAVD88)

INFERRED GROUNDWATER ELEVATION CONTOUR

GROUNDWATER FLOW DIRECTION

CCR MONITORED UNIT

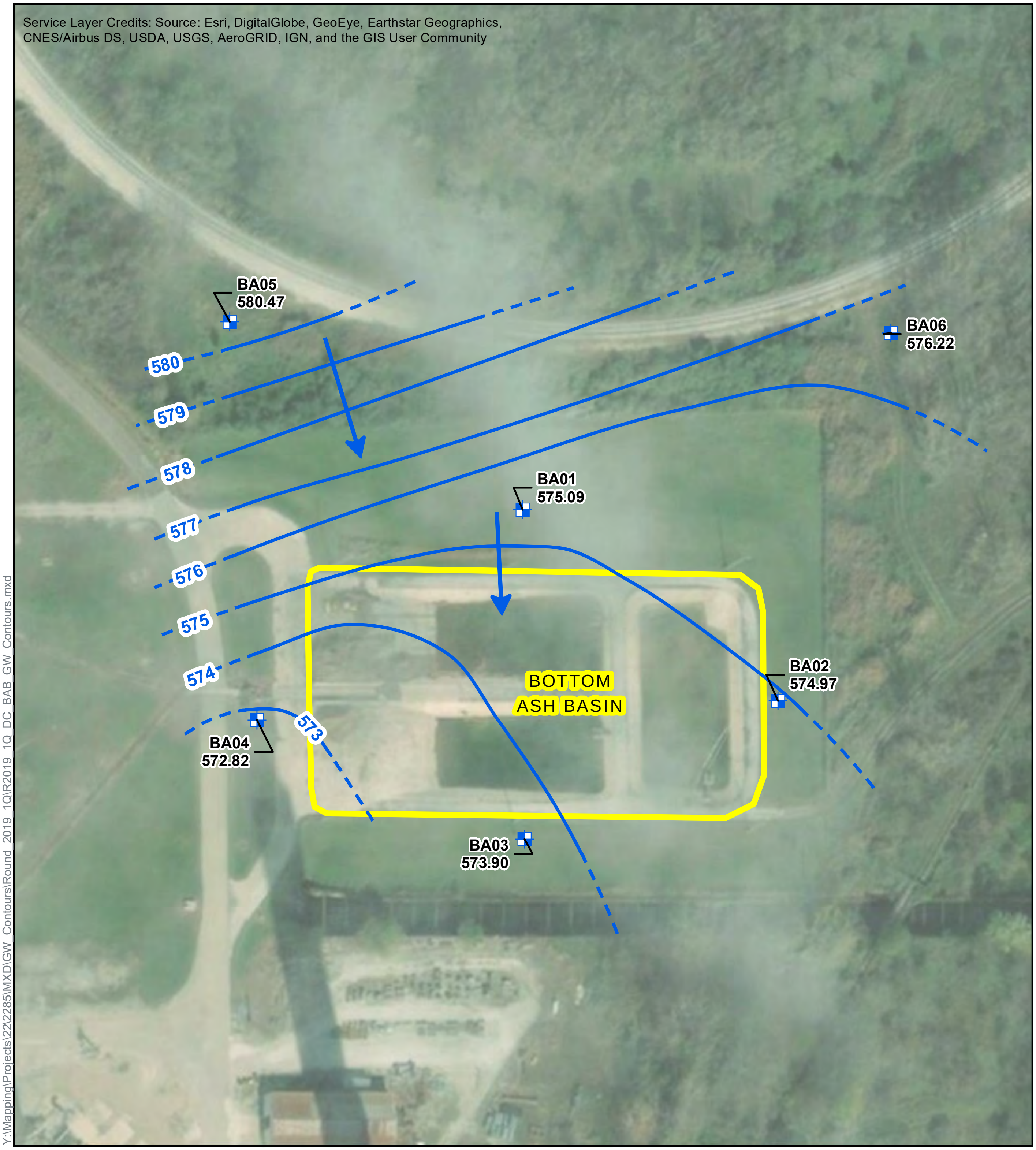
**DUCK CREEK BOTTOM ASH BASIN (UNIT ID: 205)**
**GROUNDWATER ELEVATION CONTOUR MAP**
**OCTOBER 2, 2018**

CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

0 31.25 62.5 125
Feet

N

O'BRIEN & GERE ENGINEERS, INC.




Y:\Mapping\Projects\22\2285\MXD\GW_Contours\Round_2019_1Q\R2019_1Q_DC_BAB_GW_Contours.mxd

CCR RULE MONITORING WELL LOCATION

GROUNDWATER ELEVATION CONTOUR (1-FT CONTOUR INTERVAL, NAVD88)

INFERRED GROUNDWATER ELEVATION CONTOUR

GROUNDWATER FLOW DIRECTION

CCR MONITORED UNIT

**DUCK CREEK BOTTOM ASH BASIN (UNIT ID: 205)**
**GROUNDWATER ELEVATION CONTOUR MAP**
**JANUARY 7, 2019**

CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

0 31.25 62.5 125
Feet

N

O'BRIEN & GERE ENGINEERS, INC.




CCR RULE MONITORING WELL LOCATION

GROUNDWATER ELEVATION CONTOUR (1-FT CONTOUR INTERVAL, NAVD88)

INFERRED GROUNDWATER ELEVATION CONTOUR

GROUNDWATER FLOW DIRECTION

CCR MONITORED UNIT

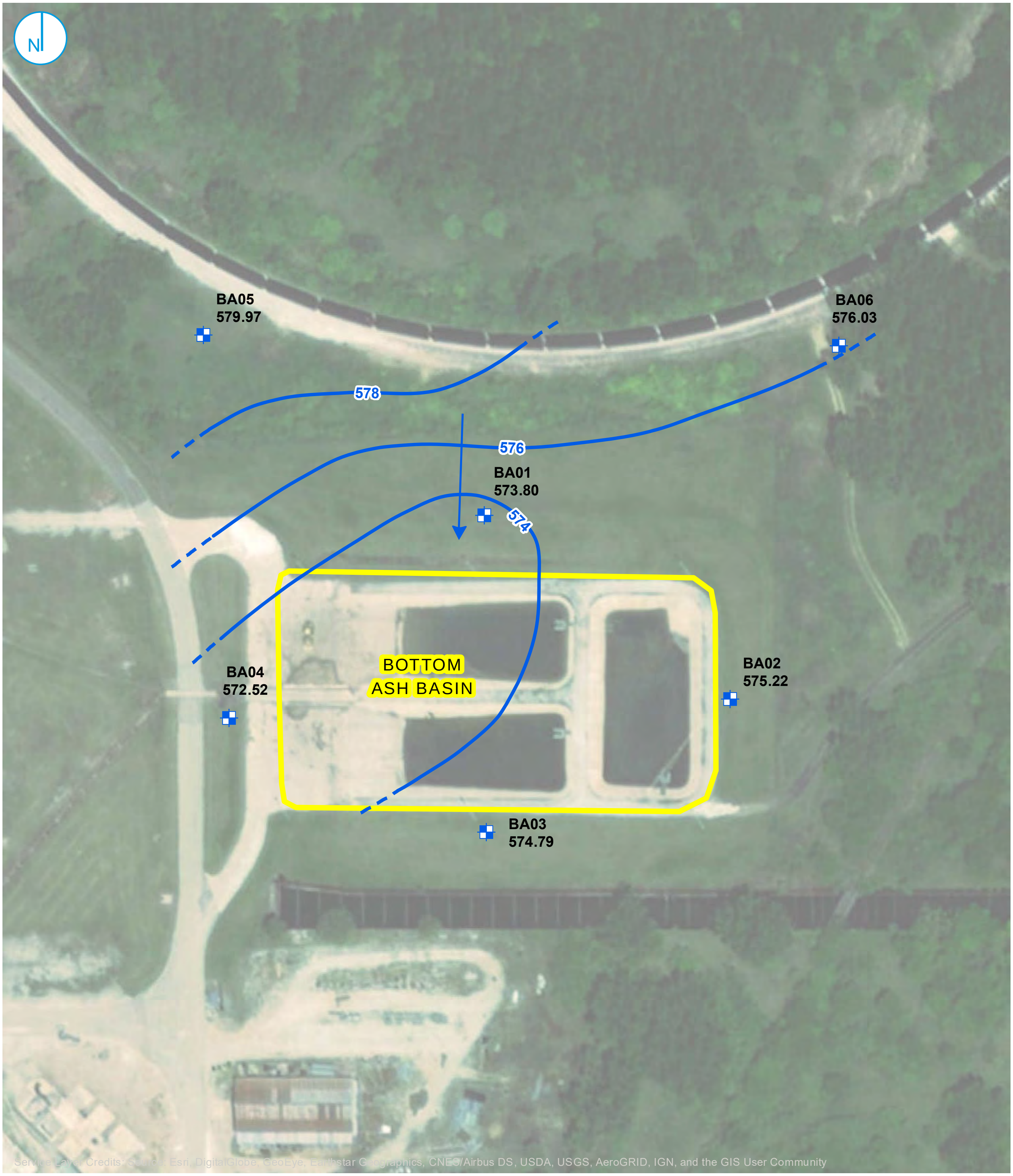
**DUCK CREEK BOTTOM ASH BASIN (UNIT ID: 205)**
**GROUNDWATER ELEVATION CONTOUR MAP**
**JULY 1, 2019**

CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

0 31.25 62.5 125
Feet

N

O'BRIEN & GERE ENGINEERS, INC.




PROJECT: 169000XXXX | DATED: 8/25/2020 | DESIGNER: galarnmc
Y:\Mapping\Projects\22\2285\MXD\GW_Contours\Round_2020_1Q\R2020_1Q_DC_BAB_GW_Contours.mxd

CCR RULE MONITORING WELL
GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)
INFERRED GROUNDWATER ELEVATION CONTOUR
GROUNDWATER FLOW DIRECTION
CCR MONITORED UNIT

0 62.5 125 Feet

## GROUNDWATER ELEVATION CONTOUR MAP
## JANUARY 13, 2020

RAMBOLL US CORPORATION
A RAMBOLL COMPANY

**DUCK CREEK BOTTOM ASH BASIN (UNIT ID: 205)**
VISTRA ENERGY
DUCK CREEK POWER STATION
CANTON, ILLINOIS

# TABLE D-1. GROUNDWATER ELEVATION RESULTS

**TABLE D-1. GROUNDWATER ELEVATIONS**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
CANTON, ILLINOIS

| Sample Location | Sample Date | Groundwater Elevation (ft NAVD88) |
|---|---|---|
| BA01 | 01/25/2016 | 574.99 |
| BA01 | 04/18/2016 | 573.49 |
| BA01 | 06/28/2016 | 572.09 |
| BA01 | 08/09/2016 | 572.65 |
| BA01 | 10/17/2016 | 573.04 |
| BA01 | 01/09/2017 | 572.58 |
| BA01 | 04/02/2017 | 573.89 |
| BA01 | 06/26/2017 | 572.09 |
| BA01 | 11/07/2017 | 570.21 |
| BA01 | 04/13/2018 | 573.99 |
| BA01 | 07/02/2018 | 574.14 |
| BA01 | 10/03/2018 | 572.74 |
| BA01 | 01/07/2019 | 575.09 |
| BA01 | 07/01/2019 | 575.09 |
| BA01 | 01/13/2020 | 573.80 |
| BA01 | 06/09/2020 | 574.61 |
| BA01 | 08/06/2020 | 570.74 |
| BA01 | 11/19/2020 | 570.38 |
| BA01 | 02/19/2021 | 572.00 |
| BA01 | 04/14/2021 | 574.89 |
| BA01 | 04/28/2021 | 574.31 |
| BA01 | 05/10/2021 | 575.26 |
| BA01 | 06/01/2021 | 575.03 |
| BA01 | 06/10/2021 | 573.97 |
| BA01 | 06/21/2021 | 572.91 |
| BA01 | 07/12/2021 | 574.85 |
| BA01 | 07/26/2021 | 574.02 |
| BA01 | 08/05/2021 | 572.68 |
| BA01C | 04/14/2021 | 574.82 |
| BA01C | 04/28/2021 | 574.26 |
| BA01C | 04/29/2021 | 574.51 |
| BA01C | 05/10/2021 | 575.24 |
| BA01C | 05/12/2021 | 575.09 |
| BA01C | 06/01/2021 | 574.96 |
| BA01C | 06/10/2021 | 573.94 |
| BA01C | 06/21/2021 | 572.89 |
| BA01C | 07/12/2021 | 574.79 |
| BA01C | 07/26/2021 | 574.01 |
| BA01C | 08/05/2021 | 572.62 |
| BA01L | 04/14/2021 | 579.44 |
| BA01L | 04/28/2021 | 577.00 |
| BA01L | 04/29/2021 | 577.21 |
| BA01L | 05/10/2021 | 577.47 |
| BA01L | 05/13/2021 | 578.12 |
| BA01L | 06/01/2021 | 577.92 |



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**TABLE D-1. GROUNDWATER ELEVATIONS**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
CANTON, ILLINOIS

| Sample Location | Sample Date | Groundwater Elevation (ft NAVD88) |
|---|---|---|
| BA01L | 06/10/2021 | 576.38 |
| BA01L | 06/21/2021 | 574.68 |
| BA01L | 07/12/2021 | 577.60 |
| BA01L | 07/26/2021 | 576.65 |
| BA01L | 08/05/2021 | 574.73 |
| BA02 | 01/25/2016 | 574.12 |
| BA02 | 04/18/2016 | 572.88 |
| BA02 | 06/28/2016 | 571.67 |
| BA02 | 08/09/2016 | 570.87 |
| BA02 | 10/17/2016 | 572.18 |
| BA02 | 01/09/2017 | 571.72 |
| BA02 | 04/02/2017 | 572.69 |
| BA02 | 06/26/2017 | 571.41 |
| BA02 | 11/07/2017 | 567.81 |
| BA02 | 04/13/2018 | 575.15 |
| BA02 | 07/02/2018 | 574.93 |
| BA02 | 10/03/2018 | 571.64 |
| BA02 | 01/07/2019 | 574.97 |
| BA02 | 07/01/2019 | 574.87 |
| BA02 | 01/13/2020 | 575.22 |
| BA02 | 08/06/2020 | 568.92 |
| BA02 | 11/19/2020 | 566.13 |
| BA02 | 02/19/2021 | 570.53 |
| BA02 | 04/14/2021 | 574.38 |
| BA02 | 04/28/2021 | 572.97 |
| BA02 | 05/10/2021 | 574.46 |
| BA02 | 06/01/2021 | 573.72 |
| BA02 | 06/10/2021 | 572.51 |
| BA02 | 06/21/2021 | 571.28 |
| BA02 | 07/12/2021 | 573.64 |
| BA02 | 07/26/2021 | 572.55 |
| BA02 | 08/05/2021 | 571.20 |
| BA02L | 04/14/2021 | 574.63 |
| BA02L | 04/28/2021 | 573.24 |
| BA02L | 05/10/2021 | 574.75 |
| BA02L | 05/12/2021 | 574.28 |
| BA02L | 06/01/2021 | 573.94 |
| BA02L | 06/10/2021 | 572.77 |
| BA02L | 06/14/2021 | 572.10 |
| BA02L | 06/21/2021 | 571.54 |
| BA02L | 07/12/2021 | 574.21 |
| BA02L | 07/26/2021 | 572.81 |
| BA02L | 07/27/2021 | 572.65 |
| BA02L | 08/05/2021 | 571.42 |
| BA03 | 01/25/2016 | 573.02 |

**TABLE D-1. GROUNDWATER ELEVATIONS**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
CANTON, ILLINOIS

| Sample Location | Sample Date | Groundwater Elevation (ft NAVD88) |
|---|---|---|
| BA03 | 04/18/2016 | 571.27 |
| BA03 | 06/28/2016 | 570.30 |
| BA03 | 08/09/2016 | 570.22 |
| BA03 | 10/17/2016 | 570.89 |
| BA03 | 01/09/2017 | 570.38 |
| BA03 | 04/02/2017 | 571.33 |
| BA03 | 06/26/2017 | 570.11 |
| BA03 | 11/07/2017 | 569.46 |
| BA03 | 04/13/2018 | 574.31 |
| BA03 | 07/02/2018 | 573.73 |
| BA03 | 10/03/2018 | 570.17 |
| BA03 | 01/07/2019 | 573.90 |
| BA03 | 07/01/2019 | 574.36 |
| BA03 | 01/13/2020 | 574.79 |
| BA03 | 08/06/2020 | 568.30 |
| BA03 | 11/19/2020 | 570.04 |
| BA03 | 02/19/2021 | 570.79 |
| BA03 | 04/14/2021 | 574.29 |
| BA03 | 04/28/2021 | 572.05 |
| BA03 | 05/10/2021 | 574.38 |
| BA03 | 06/01/2021 | 572.94 |
| BA03 | 06/10/2021 | 570.90 |
| BA03 | 06/21/2021 | 570.54 |
| BA03 | 07/12/2021 | 574.24 |
| BA03 | 07/26/2021 | 571.93 |
| BA03 | 08/05/2021 | 570.12 |
| BA03L | 04/14/2021 | 574.20 |
| BA03L | 04/28/2021 | 571.92 |
| BA03L | 05/10/2021 | 574.42 |
| BA03L | 05/12/2021 | 573.89 |
| BA03L | 06/01/2021 | 572.87 |
| BA03L | 06/10/2021 | 570.79 |
| BA03L | 06/14/2021 | 569.81 |
| BA03L | 06/21/2021 | 570.52 |
| BA03L | 07/12/2021 | 574.31 |
| BA03L | 07/26/2021 | 571.92 |
| BA03L | 07/27/2021 | 571.62 |
| BA03L | 08/05/2021 | 569.95 |
| BA04 | 01/25/2016 | 574.46 |
| BA04 | 04/18/2016 | 572.76 |
| BA04 | 06/28/2016 | 572.06 |
| BA04 | 08/09/2016 | 572.51 |
| BA04 | 10/17/2016 | 572.27 |
| BA04 | 01/09/2017 | 571.76 |
| BA04 | 04/02/2017 | 572.52 |



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**TABLE D-1. GROUNDWATER ELEVATIONS**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
CANTON, ILLINOIS

| Sample Location | Sample Date | Groundwater Elevation (ft NAVD88) |
|---|---|---|
| BA04 | 06/26/2017 | 571.05 |
| BA04 | 11/07/2017 | 570.56 |
| BA04 | 04/13/2018 | 573.02 |
| BA04 | 07/02/2018 | 572.86 |
| BA04 | 10/03/2018 | 571.19 |
| BA04 | 01/07/2019 | 572.82 |
| BA04 | 07/01/2019 | 573.19 |
| BA04 | 01/13/2020 | 572.52 |
| BA04 | 08/06/2020 | 570.70 |
| BA04 | 11/19/2020 | 570.37 |
| BA04 | 02/18/2021 | 574.46 |
| BA04 | 02/19/2021 | 571.35 |
| BA04 | 04/14/2021 | 573.94 |
| BA04 | 04/28/2021 | 573.52 |
| BA04 | 05/10/2021 | 574.42 |
| BA04 | 06/01/2021 | 574.28 |
| BA04 | 06/10/2021 | 573.30 |
| BA04 | 06/21/2021 | 572.39 |
| BA04 | 07/12/2021 | 574.38 |
| BA04 | 07/26/2021 | 573.63 |
| BA04 | 08/05/2021 | 572.38 |
| BA05 | 10/17/2016 | 576.57 |
| BA05 | 12/14/2016 | 577.06 |
| BA05 | 01/09/2017 | 578.93 |
| BA05 | 03/06/2017 | 577.26 |
| BA05 | 04/02/2017 | 577.90 |
| BA05 | 06/09/2017 | 578.91 |
| BA05 | 06/26/2017 | 577.77 |
| BA05 | 11/09/2017 | 572.22 |
| BA05 | 04/13/2018 | 579.85 |
| BA05 | 04/16/2018 | 579.85 |
| BA05 | 07/02/2018 | 579.12 |
| BA05 | 10/03/2018 | 578.25 |
| BA05 | 01/07/2019 | 580.47 |
| BA05 | 07/01/2019 | 581.26 |
| BA05 | 01/13/2020 | 579.97 |
| BA05 | 08/06/2020 | 573.78 |
| BA05 | 11/19/2020 | 573.47 |
| BA05 | 02/19/2021 | 576.56 |
| BA05 | 04/14/2021 | 580.32 |
| BA05 | 04/28/2021 | 579.05 |
| BA05 | 05/10/2021 | 580.53 |
| BA05 | 05/12/2021 | 580.50 |
| BA05 | 06/01/2021 | 579.53 |
| BA05 | 06/10/2021 | 576.85 |

**TABLE D-1. GROUNDWATER ELEVATIONS**
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
CANTON, ILLINOIS

| Sample Location | Sample Date | Groundwater Elevation (ft NAVD88) |
|---|---|---|
| BA05 | 06/14/2021 | 576.76 |
| BA05 | 06/21/2021 | 576.22 |
| BA05 | 07/12/2021 | 578.96 |
| BA05 | 07/26/2021 | 577.38 |
| BA05 | 08/05/2021 | 575.53 |
| BA06 | 10/17/2016 | 572.70 |
| BA06 | 12/14/2016 | 573.53 |
| BA06 | 01/09/2017 | 575.37 |
| BA06 | 03/06/2017 | 574.97 |
| BA06 | 04/02/2017 | 573.47 |
| BA06 | 06/09/2017 | 574.33 |
| BA06 | 06/26/2017 | 570.43 |
| BA06 | 11/09/2017 | 566.83 |
| BA06 | 04/13/2018 | 575.66 |
| BA06 | 04/16/2018 | 575.66 |
| BA06 | 07/02/2018 | 576.04 |
| BA06 | 10/03/2018 | 570.90 |
| BA06 | 01/07/2019 | 576.22 |
| BA06 | 07/01/2019 | 576.33 |
| BA06 | 01/13/2020 | 576.03 |
| BA06 | 06/09/2020 | 576.29 |
| BA06 | 08/06/2020 | 568.82 |
| BA06 | 11/19/2020 | 567.78 |
| BA06 | 02/19/2021 | 571.04 |
| BA06 | 04/14/2021 | 575.98 |
| BA06 | 04/28/2021 | 575.54 |
| BA06 | 05/10/2021 | 576.13 |
| BA06 | 05/12/2021 | 576.25 |
| BA06 | 06/01/2021 | 575.88 |
| BA06 | 06/10/2021 | 574.58 |
| BA06 | 06/14/2021 | 573.26 |
| BA06 | 06/21/2021 | 572.53 |
| BA06 | 07/12/2021 | 585.29 |
| BA06 | 07/26/2021 | 573.29 |
| BA06 | 08/05/2021 | 571.40 |

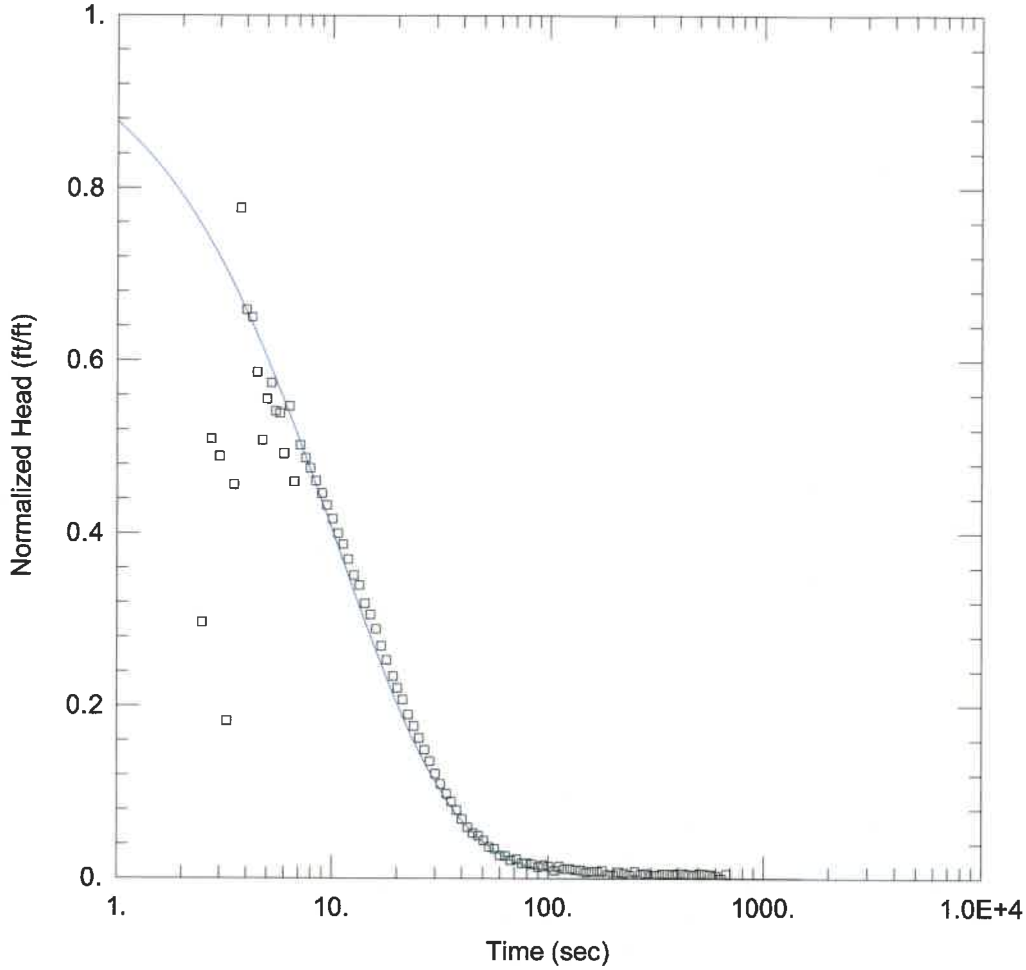
**Notes:**
ft NAVD88 = feet relative to the North American Vertical Datum 1988, GEOID 12A

generated 10/05/2021, 4:06:53 PM CDT

# APPENDIX E
# HYDRAULIC CONDUCTIVITY TEST DATA

## Slug Test data summary - Duck Creek Bottom Ash Basins

| 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 |
|---|---|---|---|---|---|---|---|---|
| BA01 | 1.50E-04 | n/a | Hvorslev | *No test results* | | | 1.50E-04 | 1.50E-04 |
| BA01C | 3.90E-03 | 8.00E-05 | KGS Model | 3.90E-03 | 7.00E-05 | KGS Model | 3.90E-03 | 3.90E-03 |
| BA01L | 3.00E-04 | 5.00E-04 | KGS Model | 3.40E-04 | 1.50E-04 | KGS Model | 3.20E-04 | 3.19E-04 |
| BA02L | 1.70E-04 | 8.00E-04 | KGS Model | 2.30E-04 | 4.00E-04 | KGS Model | 2.00E-04 | 1.98E-04 |
| BA03 | 6.90E-04 | 5.00E-06 | KGS Model | *No test results* | | | 6.90E-04 | 6.90E-04 |
| BA03L | 1.10E-03 | 1.10E-03 | KGS Model | 1.50E-03 | 5.00E-04 | KGS Model | 1.30E-03 | 1.28E-03 |




## BA01C FALLING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\BA01C-fh.aqt
Date: 06/02/21 Time: 15:58:47

## PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: BA01C
Test Date: 3 March 2021

## AQUIFER DATA

Saturated Thickness: 24.08 ft

## WELL DATA (BA01C)

Initial Displacement: 2.1 ft
Total Well Penetration Depth: 33.76 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 24.08 ft
Screen Length: 9.45 ft
Well Radius: 0.08333 ft

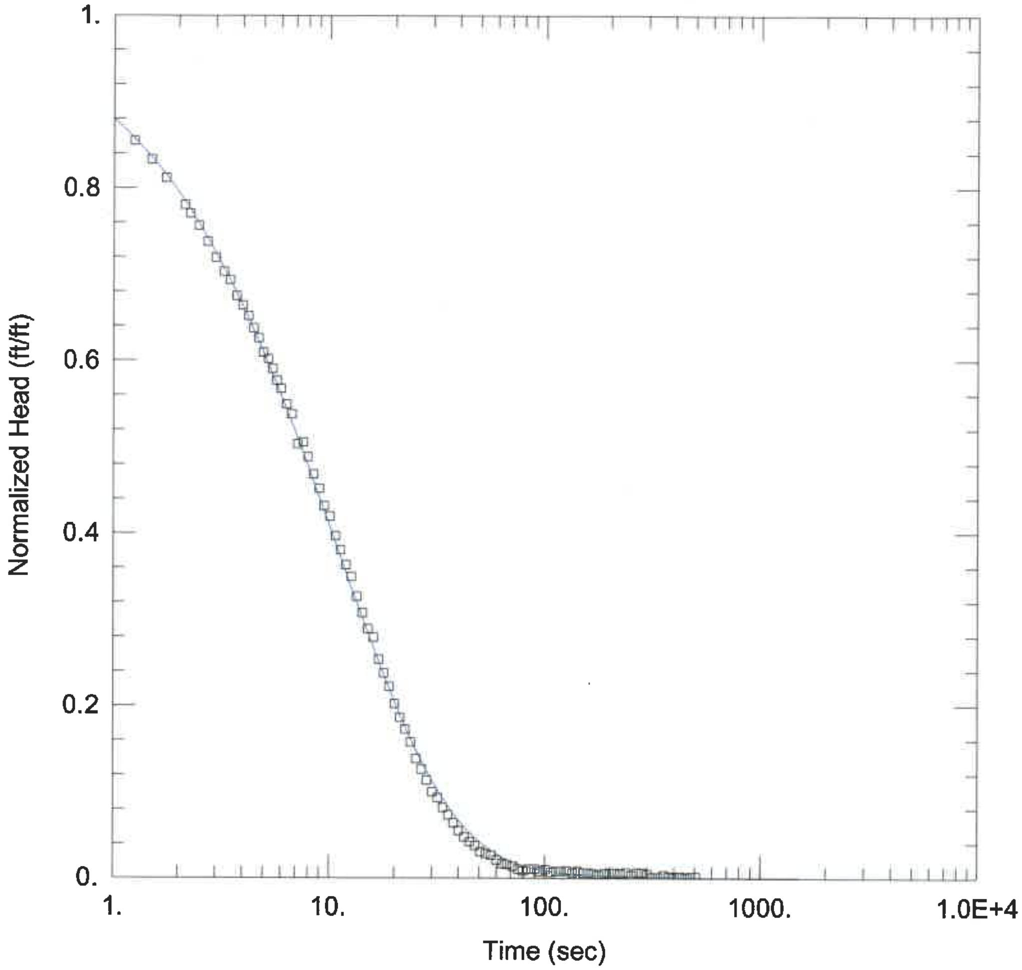
## SOLUTION

Aquifer Model: Confined

Solution Method: KGS Model

Kr = 0.0039 cm/sec
Kz/Kr = 1.

Ss = 8.0E-5 $ft^{-1}$




## BA01C RISING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\BA01C-rh.aqt
Date: 06/02/21 Time: 15:58:53

## PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: BA01C
Test Date: 3 March 2021

## AQUIFER DATA

Saturated Thickness: 24.08 ft

## WELL DATA (BA01C)

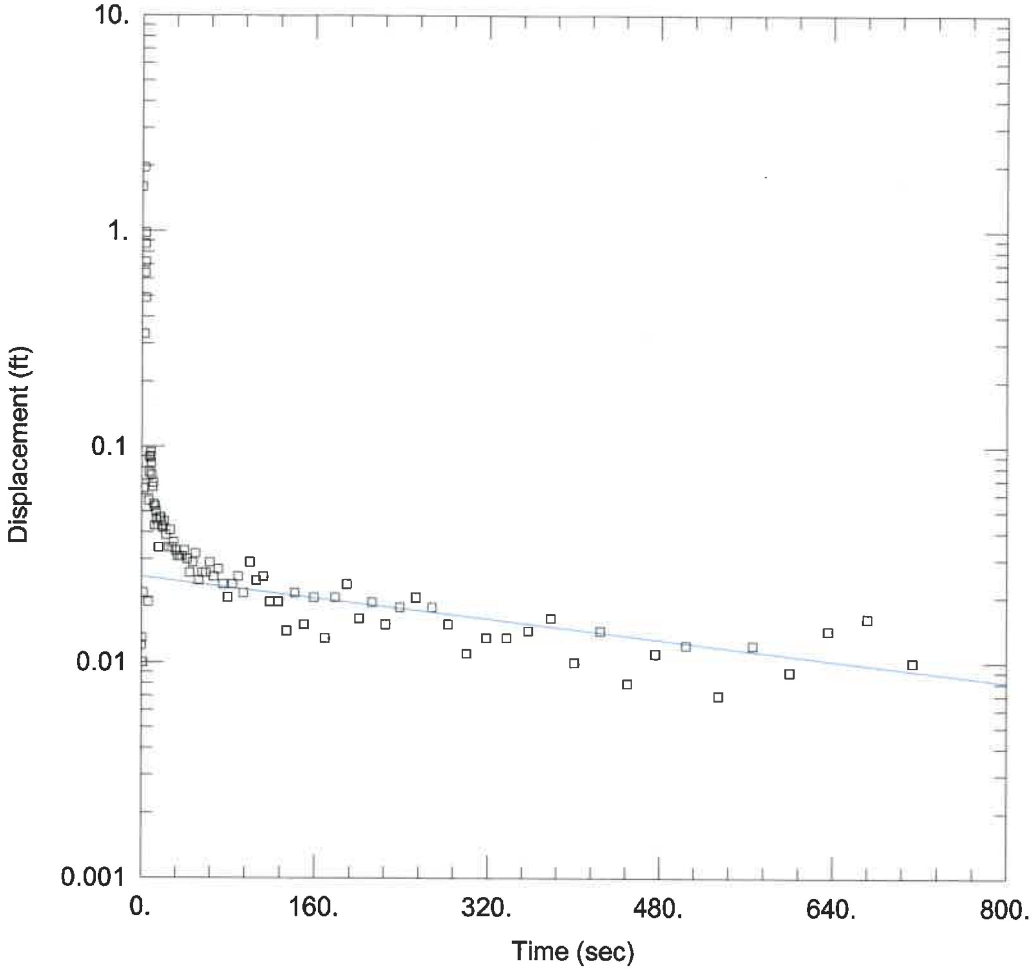
Initial Displacement: 2. ft
Total Well Penetration Depth: 33.76 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 24.08 ft
Screen Length: 9.45 ft
Well Radius: 0.08333 ft

## SOLUTION

Aquifer Model: Confined
Kr = 0.0039 cm/sec
Kz/Kr = 1.

Solution Method: KGS Model
Ss = 7.0E-5 $ft^{-1}$




BA01 FALLING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\BA01-fh.aqt
Date: 06/02/21 Time: 15:58:55

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: BA01
Test Date: 3 March 2021

AQUIFER DATA

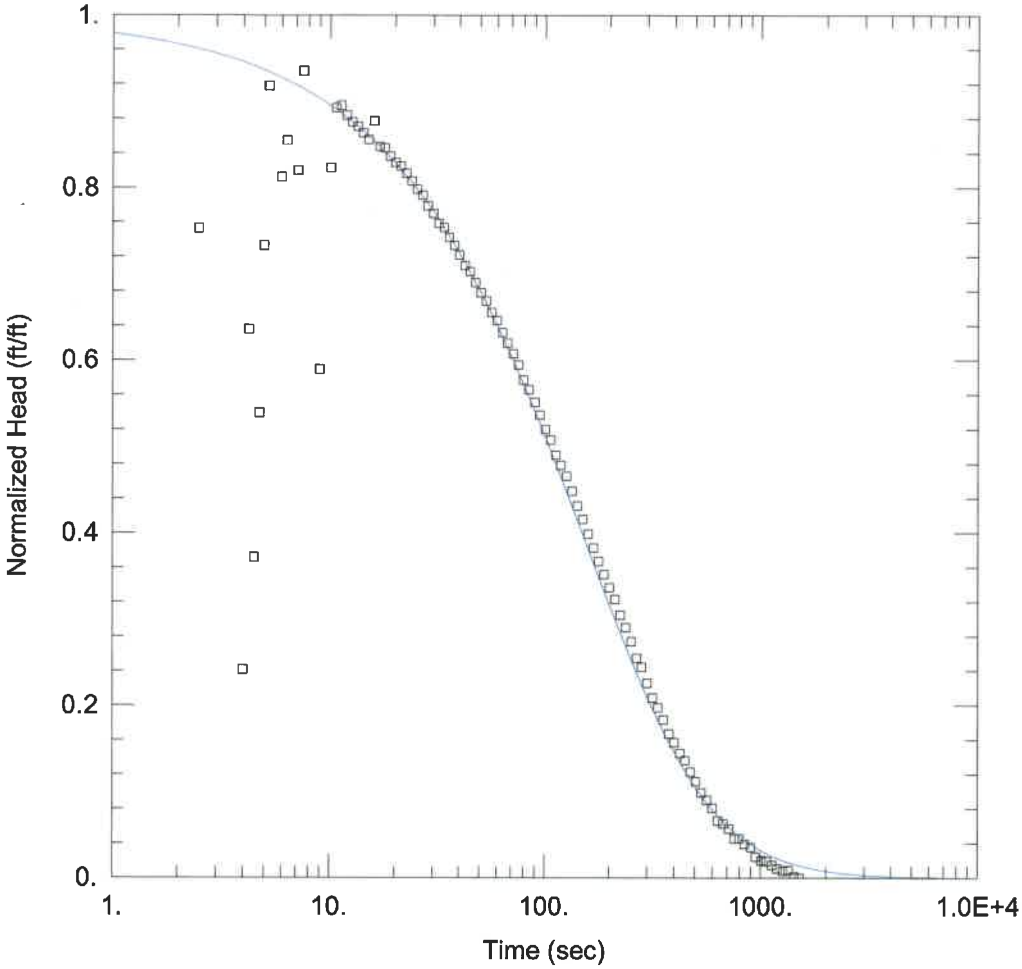
Saturated Thickness: 21.54 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BA01)

Initial Displacement: 1.6 ft
Total Well Penetration Depth: 37.73 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 24.14 ft
Screen Length: 4.67 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.00015 cm/sec
y0 = 0.025 ft




## BA01L FALLING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\BA01L-fh.aqt
Date: 06/03/21 Time: 11:19:33

## PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: BA01L
Test Date: 3 March 2021

## AQUIFER DATA

Saturated Thickness: 11.56 ft

## WELL DATA (BA01L)

Initial Displacement: 1.72 ft
Total Well Penetration Depth: 13.35 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 11.56 ft
Screen Length: 9.47 ft
Well Radius: 0.08333 ft

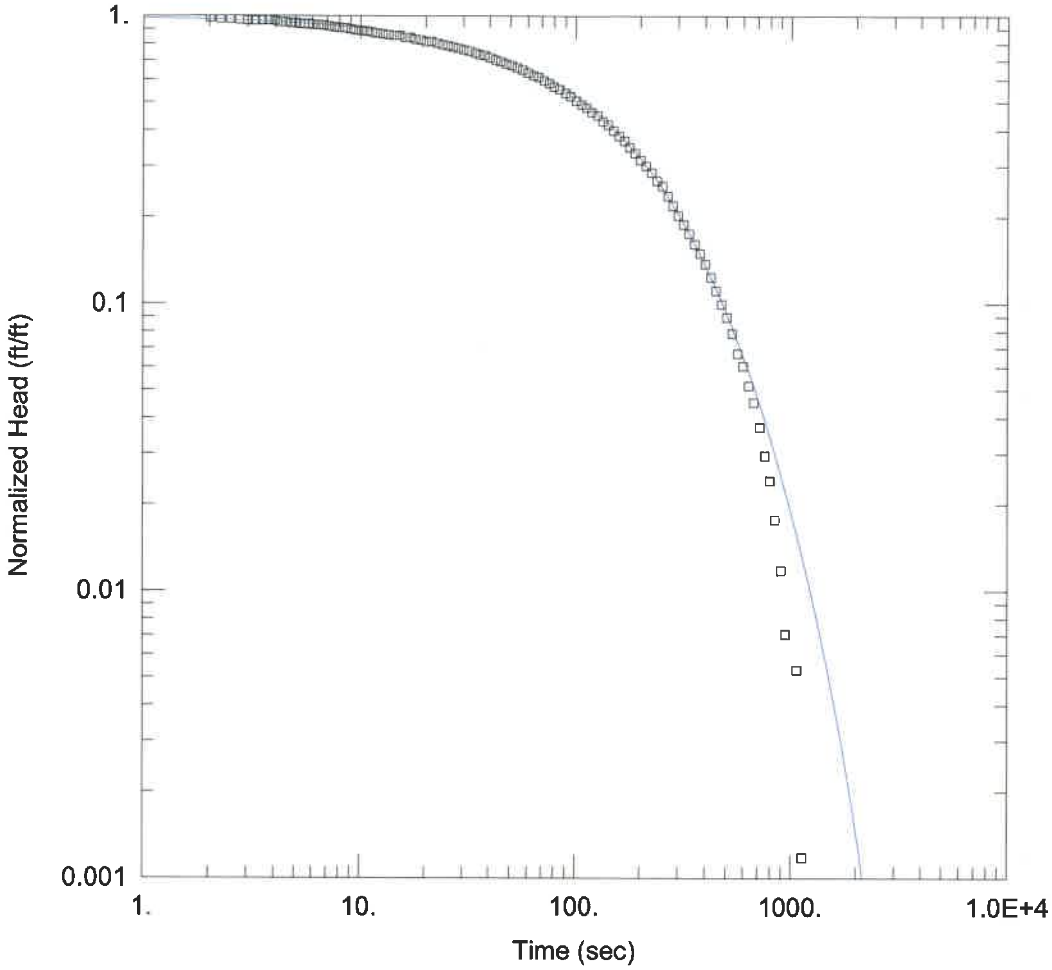
## SOLUTION

Aquifer Model: Unconfined

Kr = 0.0003 cm/sec
Kz/Kr = 1.

Solution Method: KGS Model

Ss = 0.0005 $ft^{-1}$




## BA01L RISING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\BA01L-rh.aqt
Date: 06/02/21 Time: 15:59:14

## PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: BA01L
Test Date: 3 March 2021

## AQUIFER DATA

Saturated Thickness: 11.56 ft

## WELL DATA (BA01L)

Initial Displacement: 1.7 ft
Total Well Penetration Depth: 13.35 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 11.56 ft
Screen Length: 9.47 ft
Well Radius: 0.08333 ft

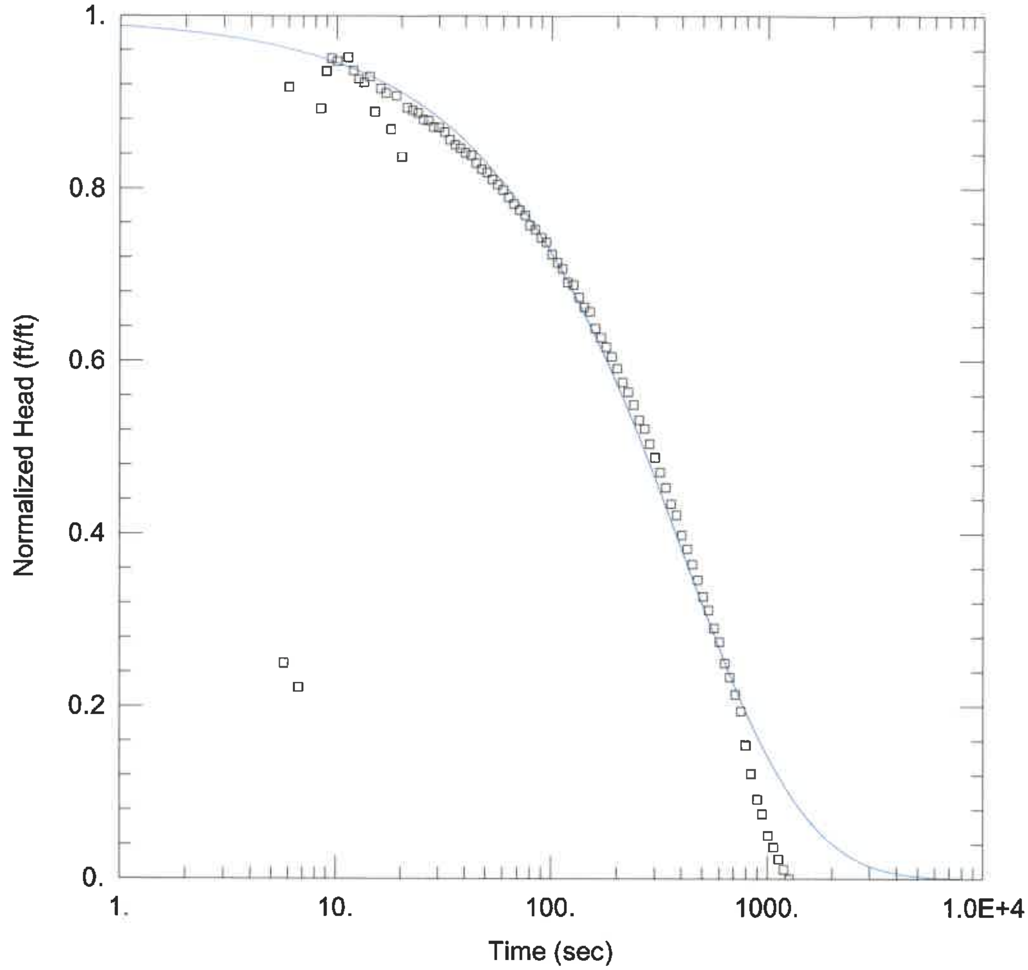
## SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 0.00034 cm/sec
Kz/Kr = 1.

Ss = 0.00015 $ft^{-1}$




## BA02L FALLING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\BA02L-fh.aqt
Date: 06/02/21 Time: 15:59:17

## PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: BA02L
Test Date: 3 March 2021

## AQUIFER DATA

Saturated Thickness: 6.16 ft

## WELL DATA (BA02L)

Initial Displacement: 1.7 ft
Total Well Penetration Depth: 10.84 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 6.16 ft
Screen Length: 4.68 ft
Well Radius: 0.08333 ft

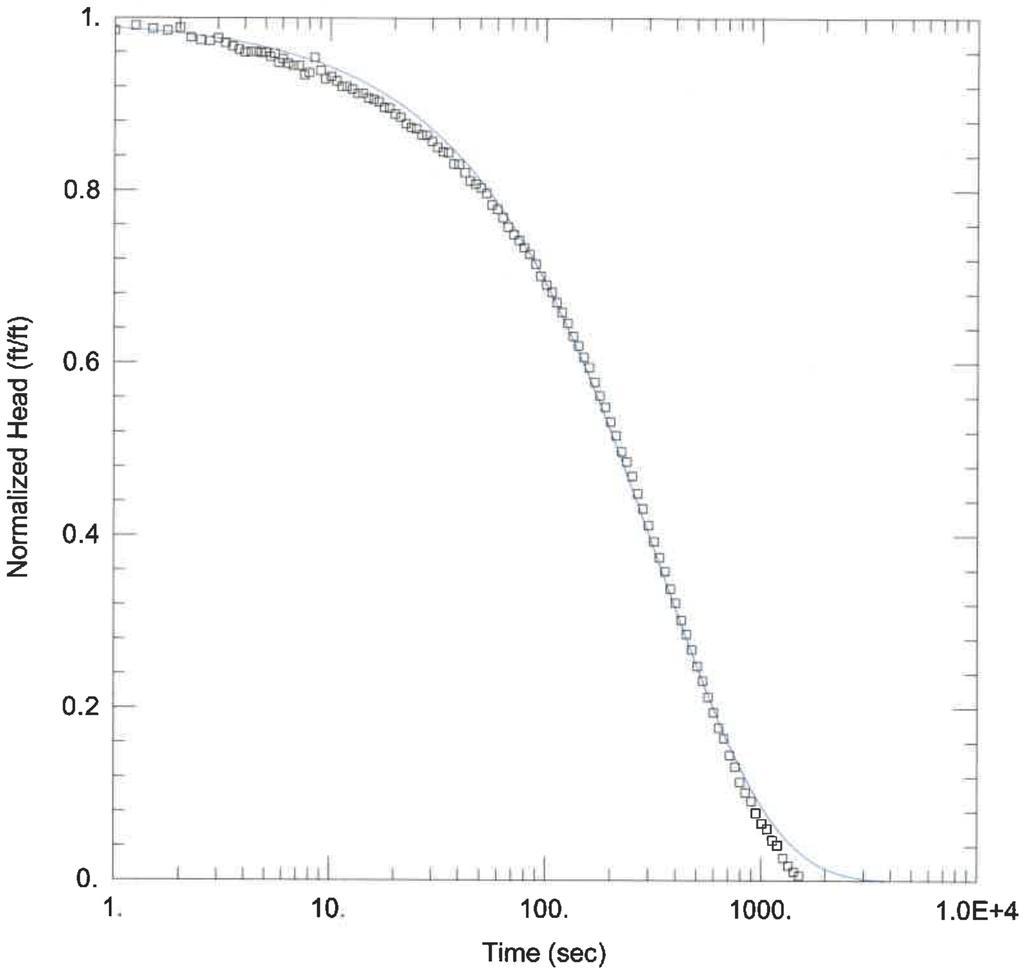
## SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 0.00017 cm/sec
Kz/Kr = 1.

Ss = 0.0008 $ft^{-1}$




BA02L RISING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\BA02L-rh.aqt
Date: 06/02/21 Time: 15:59:21

PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: BA01
Test Date: 1 March 2021

AQUIFER DATA

Saturated Thickness: 6.16 ft

WELL DATA (BA02L)

Initial Displacement: 1.575 ft
Total Well Penetration Depth: 10.84 ft
Casing Radius: 0.08333 ft

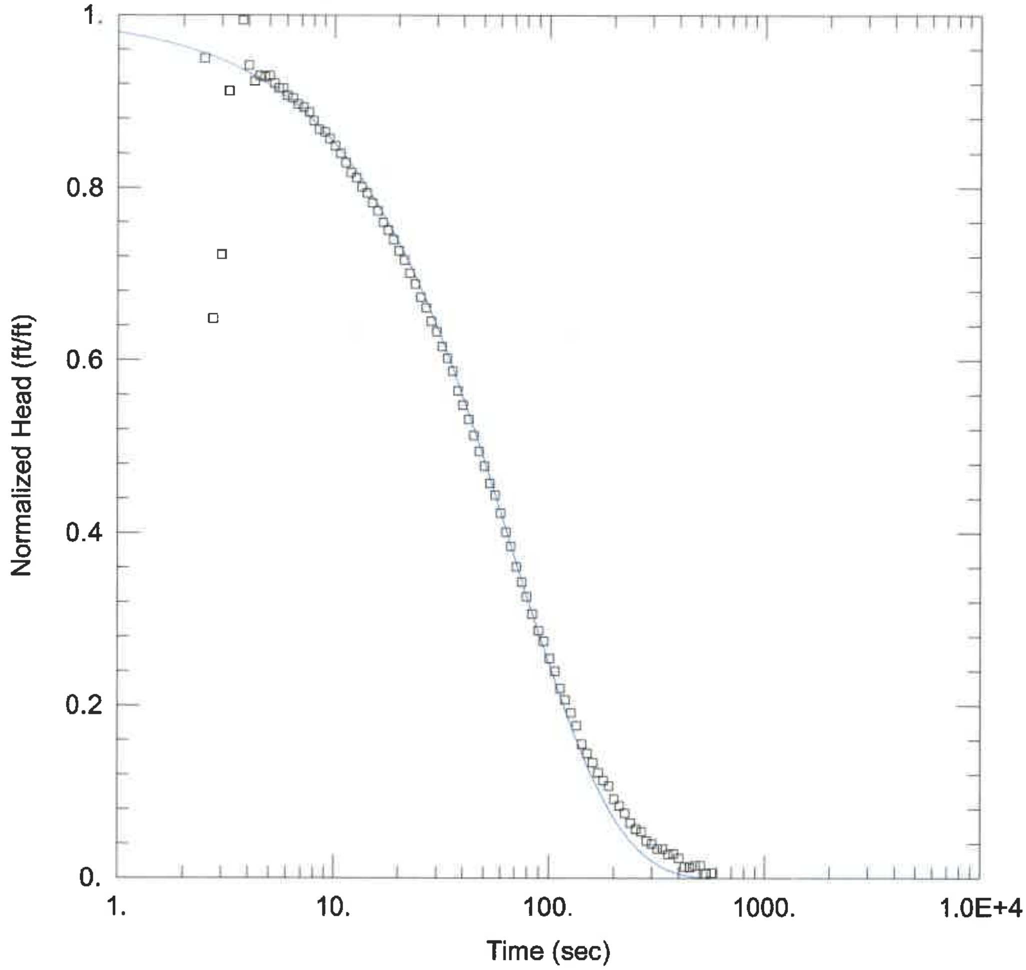
Static Water Column Height: 6.16 ft
Screen Length: 4.68 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.00023 cm/sec
Kz/Kr = 1.

Ss = 0.0004 $ft^{-1}$




## BA03 FALLING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\BA03-fh.aqt
Date: 06/02/21 Time: 15:59:23

## PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: BA01
Test Date: 1 March 2021

## AQUIFER DATA

Saturated Thickness: 23.25 ft

## WELL DATA (BA03)

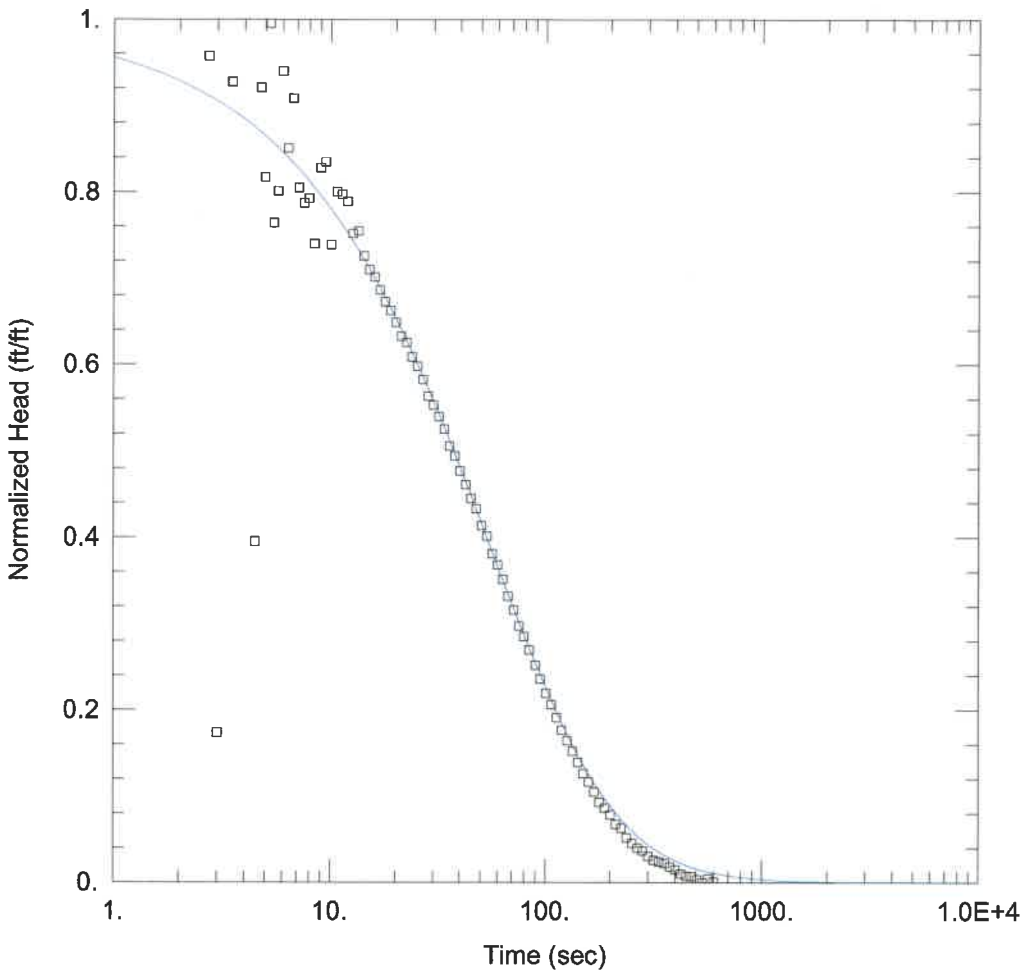
Initial Displacement: 1.3 ft
Total Well Penetration Depth: 20.15 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 23.25 ft
Screen Length: 9.46 ft
Well Radius: 0.08333 ft

## SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.00069 cm/sec
Kz/Kr = 1.
Ss = 5.0E-6 $ft^{-1}$




## BA03L FALLING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\BA03L-fh.aqt
Date: 06/02/21 Time: 15:59:24

## PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: BA03L
Test Date: 3 March 2021

## AQUIFER DATA

Saturated Thickness: 7.99 ft

## WELL DATA (BA03L)

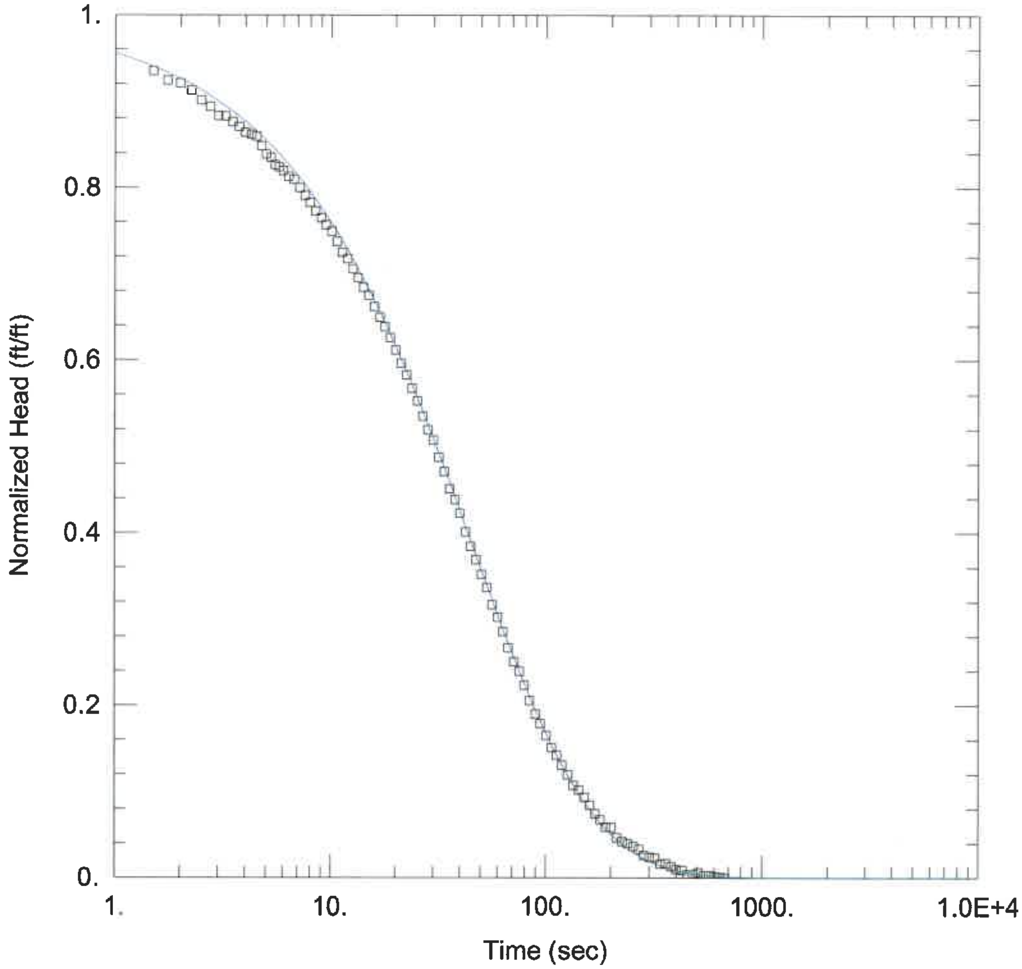
Initial Displacement: 1.625 ft
Total Well Penetration Depth: 7.64 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 7.99 ft
Screen Length: 4.69 ft
Well Radius: 0.08333 ft

## SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.0011 cm/sec
Ss = 0.0011 $ft^{-1}$
Kz/Kr = 1.




## BA03L RISING HEAD TEST

Data Set: I:\20jobs\20E0111A\Admin\13-Calculations\Slug Tests\Duck Creek\BA03L-rh.aqt
Date: 06/02/21 Time: 15:59:27

## PROJECT INFORMATION

Client: Duck Creek Power Station
Project: 20E0111A
Location: Canton, IL
Test Well: BA03L
Test Date: 3 March 2021

## AQUIFER DATA

Saturated Thickness: 7.99 ft

## WELL DATA (BA03L)

Initial Displacement: 1.8 ft
Total Well Penetration Depth: 7.64 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 7.99 ft
Screen Length: 4.69 ft
Well Radius: 0.08333 ft

## SOLUTION

Aquifer Model: Unconfined

Solution Method: KGS Model

Kr = 0.0015 cm/sec
Kz/Kr = 1.

Ss = 0.0005 $ft^{-1}$

# 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.

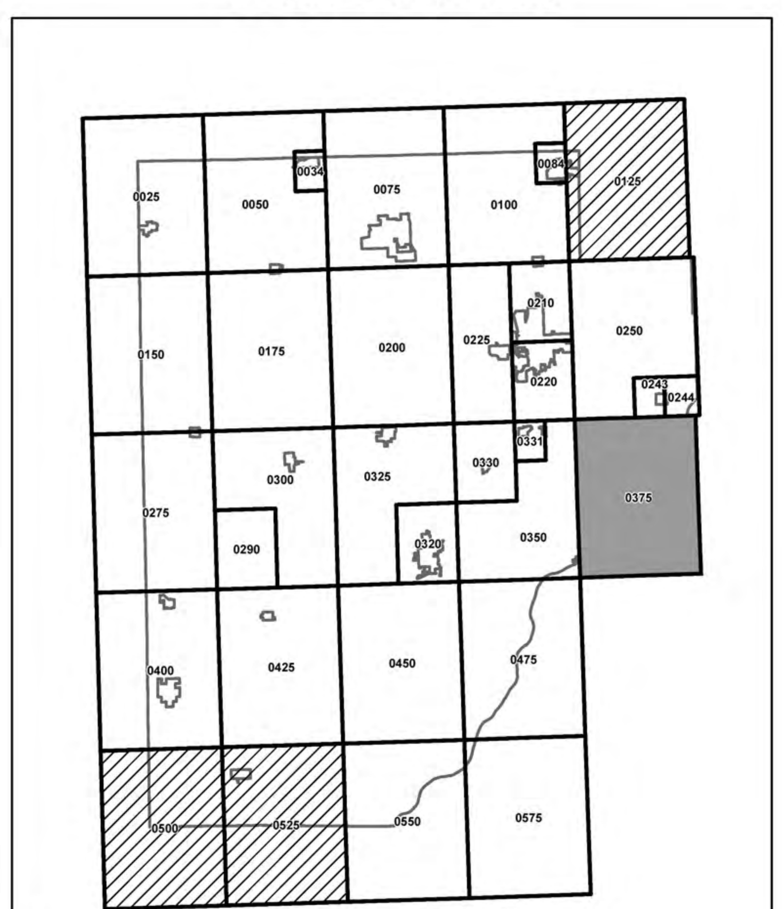
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

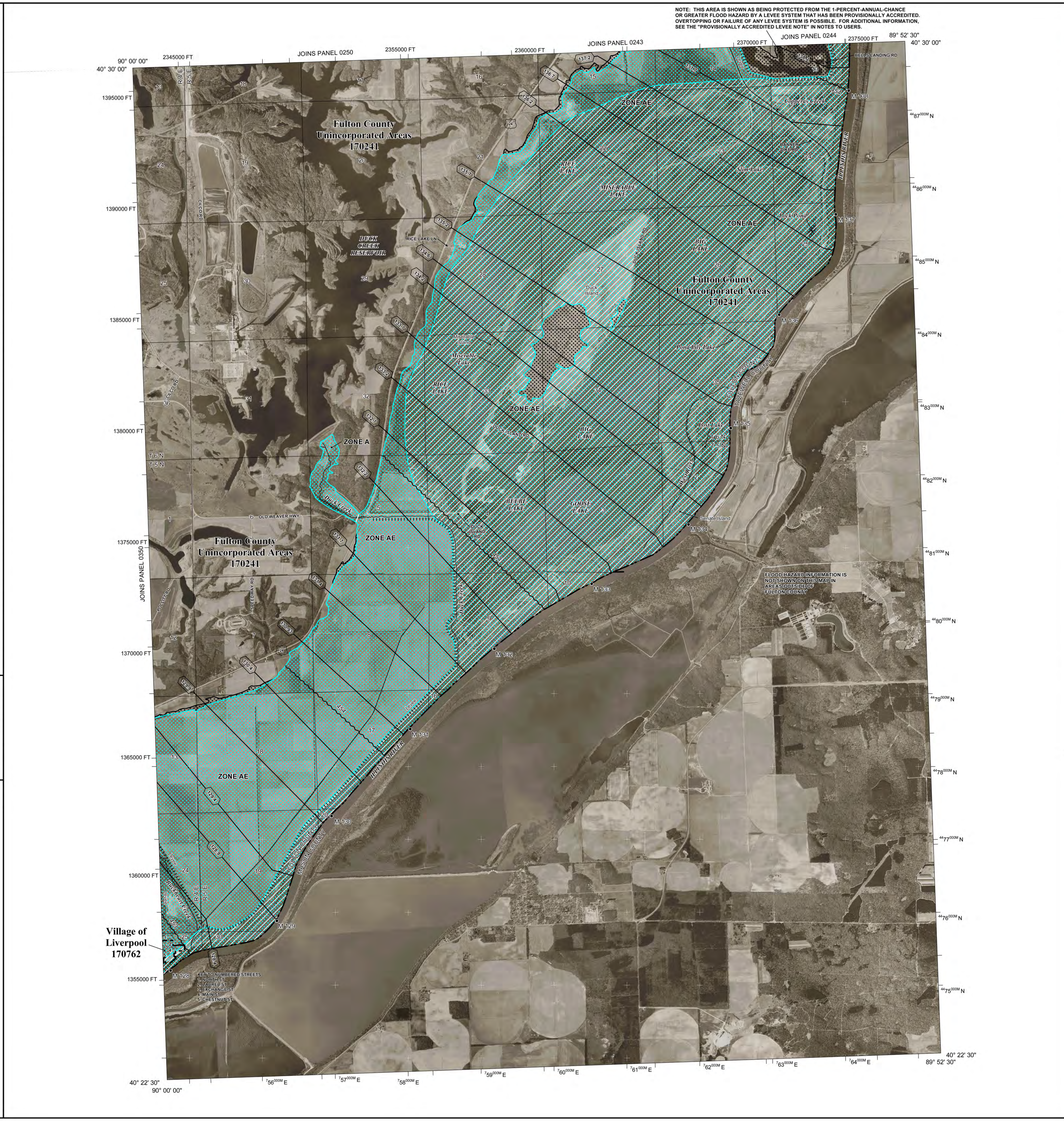
For information on available products associated with this FIRM visit the Map Service Center (MSC) website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be 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




# 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) |
| $^{49}89^{000M}$ 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 |
| DX5510× | 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

# ATTACHMENT I

Intended for
**Illinois Power Resources Generating, LLC**

Date
**October 25, 2021**

Project No.
**1940100806-003**

# GROUNDWATER MONITORING PLAN

## BOTTOM ASH BASIN

## DUCK CREEK POWER PLANT
## CANTON, ILLINOIS

RAMBOLL Bright ideas. Sustainable change.

# GROUNDWATER MONITORING PLAN
# DUCK CREEK POWER PLANT BOTTOM ASH BASIN

| | |
|---|---|
| Project Name | **Duck Creek Power Plant Bottom Ash Basin** |
| Project No. | **1940100806-003** |
| Recipient | **Illinois Power Resources Generating, LLC** |
| Document Type | **Groundwater Monitoring Plan** |
| Revision | **FINAL** |
| Date | **October 25, 2021** |

Ramboll
234 W. Florida Street
Fifth Floor
Milwaukee, WI 53204
USA

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https://ramboll.com

**Brian G. Hennings, PG**
**Senior Managing Hydrogeologist**

**Eric J. Tlachac, PE**
**Senior Managing Engineer**

**Nathaniel R. Keller**
**Senior Hydrogeologist**

**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 Bottom Ash Basin), 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 Bottom Ash Basin), 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

# CONTENTS

## TABLES (IN TEXT)



## TABLES (ATTACHED)



## FIGURES (ATTACHED)



## APPENDICES

# 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 |
| BAB | Bottom Ash Basin |
| bgs | below ground surface |
| CCR | coal combustion residuals |
| cm/s | centimeters per second |
| CSM | conceptual site model |
| DCPP | Duck Creek Power Plant |
| GMF | Gypsum Management Facility |
| 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 |
| NAVD88 | North American Vertical Datum of 1988 |
| NID | National Inventory of Dams |
| No. | number |
| NRT/OBG | Natural Resource Technology, an OBG Company |
| 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 |

# 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 Bottom Ash Basin (BAB) (Vistra identification [ID] number [No.] 205, IEPA ID No. W0578010001-03, and National Inventory of Dams [NID] No. IL50716). 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 BAB 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 BAB is located north of the DCPP within Section 30, 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. Land use adjacent to the DCPP is primarily agriculture, pasture, and forested land with minimal development.

The Duck Creek BAB is an inactive 2.2-acre lined CCR SI formerly used to manage CCR and non-CCR waste streams at DCPP (**Figure 1-2**). The BAB consists of three cells; the bottom and side slopes of all three cells are concrete lined. Gravel surfaced roads surround the basin cells. A sluice pipe delivered CCR material to the pond. An outlet structure for water is located in the southeast corner of the south cell. The western two cells are designed with a gently sloping ramp so that front-end loaders can remove bottom ash. The east cell flows toward a discharge structure that drains accumulated water. All bottom ash (*i.e.,* CCR) was removed from the BAB when the plant was retired in 2019; the basin currently contains no impounded water or CCR materials. During operation, CCR (bottom ash) was sluiced to the western cells of the pond. Particles settled within the cell and decant water was piped to the eastern cell. The western cells required frequent clean out events using heavy equipment (likely a front-end loader) to remove bottom ash from the cell for permanent disposal at the on-site landfill.

Construction of the BAB took place sometime in late 2007 or early 2008. In 2016, a History of Construction was provided by AECOM for the DCPP, but the BAB was small enough in volume (less than 20-acre feet) to be exempt from this history by Title 40 of the Code of Federal Regulations (40 C.F.R.) § 257.73(b) A liner design criteria evaluation was performed by AECOM in 2016 and states that the BAB was constructed with a lower and upper liner; the lower consists of a one foot thick layer of compacted clay overlain by a 60-millimeter high-density polyethylene (HDPE) membrane, and the upper consists of eight inches of reinforced concrete (AECOM, 2016).

Permeability and hydraulic conductivity could not be determined from the records available; therefore, the BAB does not meet the 40 C.F.R. § 257.71(a)(1) criteria for a lined impoundment. The BAB is estimated to enable storage of approximately 25,000 cubic yards of CCR material (IPRG, 2016).

Several other CCR units are located on the DCPP property, including the closed units, Duck Creek Ash Pond No. 1 and Ash Pond No. 2 located north of the BAB; the Gypsum Management Facility (GMF) Pond and GMF Recycle Pond located north of the closed ponds; and the Landfill located north of the GMF Pond.

## 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 BAB 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 BAB based on stratigraphic relationships and common hydrogeologic characteristics:

- **Fill Unit**: This unit includes shallow groundwater present in fill material and coal mine spoils.
- **Uppermost Aquifer:** The uppermost aquifer in the area of the BAB includes the Peoria/Roxanna Loess and the sand and silt zones within the Radnor Till. Within the till sequences at the BAB, a continuous intercalated sand exists below the basin between approximately 18 to 40 feet below ground surface (bgs). The sand zone is typically very dense, very fine- to coarse-grained, with few silt and trace small gravel. This sand unit is the primary horizontal migration pathway and generally ranges in thickness from about 2 to 7 feet. The base of the uppermost aquifer is the bedrock. The Peoria/Roxanna Loess within the uppermost aquifer has also been identified as a potential migration pathway (PMP). While the primary horizontal migration pathway consists of the sand zones of the uppermost aquifer, impacts have the potential to migrate within groundwater in the overlying Peoria/Roxanna Loess.
- **Bedrock Confining Unit**: This unit includes the Pennsylvanian shaley siltstone and silty shale bedrock. The shale bedrock unit underlying the Springfield Coal Member has been demonstrated by packer testing to be an aquitard.

Groundwater migrates downward through the loess and upper Radnor Till into the shallow sands of the uppermost aquifer. Groundwater flow across the BAB within the uppermost aquifer is consistently southward toward a channel located approximately 50 feet to the south that leads to the Cooling Pond. Groundwater elevations of the uppermost aquifer across the BAB typically range from approximately 570 to 580 feet North American Vertical Datum of 1988 (NAVD88). Groundwater elevations may fluctuate seasonally, but the groundwater flow direction remains consistent in a south-southeast direction toward the Cooling Pond.

The BAB is lined, has been drained, and bottom ash is no longer present in the settling basins. There is a minimal amount of water in the BAB, predominately due to precipitation. Groundwater elevation contours of surrounding monitoring wells indicate groundwater generally flows to the south, with no indication of radial flow (**Figure 1-3**). The minimal amount of water present in the

BAB, in addition to no observations of radial flow, provide evidence that the BAB does not impact groundwater flow directions.

Part 845 parameters were monitored in the uppermost aquifer and PMP monitoring wells at the BAB as part of the 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 greater than the applicable 35 I.A.C. § 845.600 groundwater protection standards (GWPSs) and are considered potential exceedances:

- Total arsenic, beryllium, boron, cobalt, lead, and pH were detected at least once at concentrations greater than the GWPS in downgradient uppermost aquifer wells (including PMP wells). All of these parameters, with the exception of pH were also detected in one or both background wells at least once at concentrations greater than the GWPS. Total chloride, lithium, radium 226 and 228 combined, sulfate, and total dissolved solids (TDS) were also detected at least once at concentrations greater than the GWPS in one or both background wells.

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 BAB 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 BAB, specifically the 40 C.F.R. § 257 monitoring program and the proposed Part 845 monitoring network.

### 2.1.1 40 C.F.R. § 257 Monitoring Program

The 40 C.F.R. § 257 well network for the BAB consists of six monitoring wells installed nearby or adjacent to the BAB in the uppermost aquifer. The BAB 40 C.F.R. § 257 well network consists of two background monitoring wells (BA05 and BA06) and four compliance monitoring wells (BA01, BA02, BA03, and BA04). 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 BAB 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 BAB (Natural Resource Technology, an OBG Company [NRT/OBG], 2017).

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 A** below.

**Table A. 40 C.F.R. § 257 Groundwater Monitoring Program Parameters**

| **Field Parameters[1]** | | |
|---|---|---|
| Groundwater Elevation | pH | |
| **Appendix III Parameters (Total, except TDS)** | | |
| Boron | Chloride | Sulfate |
| Calcium | Fluoride | TDS |
| Beryllium | Lead | |

[1]Dissolved oxygen, temperature, specific conductance, oxidation/reduction potential, and turbidity are 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.

### 2.1.2 Part 845 Well Installation and Monitoring

In 2021, four additional monitoring wells (BA01L, BA01C, BA02L, and BA03L) were installed at the BAB 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).

Prospective Part 845 monitoring wells were sampled for eight rounds between April and August 2021 and the results were assessed for selection of the BAB Part 845 monitoring well network. Groundwater samples were collected and analyzed for 35 I.A.C. § 845.600 parameters as summarized in **Table B** below.

**Table B. 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, except TDS)** | | | |
| 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 BAB. 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 six wells screened in the uppermost aquifer (BA01, BA02, BA03, BA04, BA05, and BA06) and two wells screened in the PMP (BA02L and BA03L). The proposed network is summarized in **Table C** below and displayed on **Figure 2-1**. Eight wells (two background and six compliance) will be used to monitor groundwater concentrations within the hydrostratigraphic units.

The groundwater samples collected from the eight 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 C** below.

**Table C. Proposed Part 845 Monitoring Well Network**

| Well ID | Monitored Unit | Well Screen Interval (feet bgs) | Well Type[1] |
|---|---|---|---|
| **BA01** | UA | 33.1 – 37.7 | Compliance |
| **BA02** | UA | 23.6 – 28.4 | Compliance |
| **BA02L** | PMP | 7.0 – 11.7 | Compliance |
| **BA03** | UA | 16.1 – 25.6 | Compliance |
| **BA03L** | PMP | 5.3 – 9.9 | Compliance |
| **BA04** | UA | 24.6 – 29.4 | Compliance |
| **BA05** | UA | 36.5 – 46.1 | Background |
| **BA06** | UA | 32.3 – 41.9 | Background |

[1]Well type refers to the role of the well in the monitoring network.
UA = uppermost aquifer
PMP = potential migration pathway

## 2.3 Well Abandonment

No wells are currently proposed for abandonment.

# 3. APPLICABLE GROUNDWATER QUALITY STANDARDS

## 3.1 Groundwater Classification

Groundwater at the BAB 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 BAB resulted in an overall (geometric mean) horizontal hydraulic conductivity exceeding the 1 x $10^{-4}$ centimeters per second (cm/s) criterion.

However, background (upgradient) groundwater originates from areas north and west of the BAB 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 many background concentrations in the uppermost aquifer are below 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 exceptions include arsenic, boron, chloride, cobalt, lead, lithium, mercury, pH (lower limit), radium 226 and 228 combined, sulfate, and TDS, where the background concentration is greater (or less for pH lower limit) than the 35 I.A.C. § 845.600(a)(1) standard. In these instances, 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**, two monitoring programs specific to the BAB exist: the 40 C.F.R. § 257 monitoring program and the proposed Part 845 monitoring program. These programs will continue to be monitored until USEPA approves Part 845. 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 the requirements of Part 845 have been achieved.

## 4.1 Monitoring Networks and Parameters

### 4.1.1 40 C.F.R. § 257 Groundwater Monitoring

The existing 40 C.F.R. § 257 monitoring program was discussed in detail in **Section 2.1.1**. Six wells (two 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.

### 4.1.2 Part 845 Groundwater Monitoring

The proposed Part 845 monitoring network will consist of two background monitoring wells (BA05 and BA06) and six compliance monitoring wells (BA01, BA02, BA02L, BA03, BA03L, and BA04) to monitor potential impacts from the BAB (**Figure 2-1**). The monitoring wells are screened within the uppermost aquifer (BA01, BA02, BA03, BA04, BA05, and BA06) and PMP (BA02L and BA03L) along the perimeter of the BAB. Groundwater samples will be collected and analyzed for the laboratory and field parameters in **Table D** below.

**Table D. 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, except TDS)** | | | |
| 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 E. 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 BAB 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 BAB caused the contamination and the BAB 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 4.1.2**.

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

AECOM, 2016. *CCR Certification Report: Liner Design Criteria Evaluation for Bottom Ash Basin at Duck Creek Power Station.* October 2016.

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.

Illinois Power Resources Generating, LLC (IPRG), 2016. *Closure Plan for Existing CCR Surface Impoundment*. October 2016.

Natural Resource Technology, an OBG Company (NRT/OBG), 2017. *Sampling and Analysis Plan, Final, Duck Creek Bottom Ash Basin, 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. Bottom Ash Basin. 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

BOTTOM ASH BASIN

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 2.1.2, 2.2, & 4.1.2<br>Table 2-1<br>Figure 2-1 |
| 845.630(a)<br>845.630(b)<br>845.630(c) | At least two upgradient wells and four downgradient wells (min. 1 and 3, but requires additional documentation) | Sections 2.1.2, 2.2, & 4.1.2<br>Table 2-1<br>Figure 2-1 |
| 845.630(a)<br>845.630(b)<br>845.630(c) | Downgradient Well Density | Figure 2-1 |
| 845.630(a)(2) | Downgradient wells at waste boundary | Figure 2-1 |
| **845.640** | **Groundwater Sampling and Analysis Requirements** | |
| 845.640(a) | Consistent sampling and analysis procedures | Section 4<br>Tables 4-1 & 4-2 |
| 845.640(b) | Methods are appropriate | Section 4<br>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<br>Appendix A |
| 845.640(i) | Analyze total recoverable metals | Section 4.1.2 |
| 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
BOTTOM ASH BASIN
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 4.1.2 |
| 845.650(b)(c) | Groundwater Monitoring Frequency | Sections 4.1.2 & 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 | NA |
| NA | Staff gauge/ piezometer to monitor head of neighboring surface water body | NA |

[O: CJC 09/22/21; C: LDC 09/22/21]

**Notes:**
GMP = Groundwater Monitoring Plan
NA = Not Applicable

**TABLE 2-1. MONITORING WELL LOCATIONS AND CONSTRUCTION DETAILS**
GROUNDWATER MONITORING PLAN
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BA01 | C | UA | 12/16/2015 | -- | 587.09 | Top of Disk | 584.44 | 33.06 | 37.73 | 551.49 | 546.82 | 38.20 | 544.10 | 4.7 | 2 | 40.468895 | -89.982141 |
| BA02 | C | UA | 12/30/2015 | -- | 579.92 | Top of Disk | 577.18 | 23.63 | 28.43 | 553.65 | 548.85 | 28.80 | 547.90 | 4.8 | 2 | 40.468427 | -89.981325 |
| BA02L | C | PMP | 02/04/2021 | 579.91 | 579.91 | Top of PVC | 577.17 | 6.98 | 11.66 | 570.19 | 565.51 | 12.09 | 565.08 | 9.52 | 2 | 40.468439 | -89.981326 |
| BA03 | C | UA | 12/29/2015 | -- | 578.34 | Top of Disk | 575.73 | 16.11 | 25.57 | 559.75 | 550.29 | 26.20 | 548.40 | 9.5 | 2 | 40.468091 | -89.982136 |
| BA03L | C | PMP | 02/02/2021 | 577.75 | 577.75 | Top of PVC | 575.13 | 5.25 | 9.94 | 569.88 | 565.19 | 10.29 | 564.84 | 4.69 | 2 | 40.468077 | -89.982135 |
| BA04 | C | UA | 12/29/2015 | -- | 578.19 | Top of Disk | 575.55 | 24.58 | 29.38 | 551.07 | 546.27 | 29.80 | 545.70 | 4.8 | 2 | 40.468382 | -89.982991 |
| BA05 | B | UA | 07/28/2016 | -- | 595.72 | Top of Disk | 593.23 | 36.48 | 46.08 | 556.39 | 546.79 | 46.60 | 546.30 | 9.6 | 2 | 40.469355 | -89.983075 |
| BA06 | B | UA | 08/03/2016 | -- | 595.63 | Top of Disk | 593.12 | 32.32 | 41.93 | 560.58 | 550.97 | 42.40 | 548.90 | 9.6 | 2 | 40.469324 | -89.980961 |

**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
PMP = potential migration pathway
PVC = polyvinyl chloride
UA = uppermost aquifer

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**TABLE 3-1. BACKGROUND GROUNDWATER QUALITY AND STANDARDS**
GROUNDWATER MONITORING PLAN
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
CANTON, ILLINOIS

| Parameter | Background Concentration | 845 Limit | Groundwater Protection Standard | Unit |
|---|---|---|---|---|
| Antimony, total | 0.003 | 0.006 | 0.006 | mg/L |
| Arsenic, total | 0.024 | 0.010 | 0.024 | mg/L |
| Barium, total | 0.48 | 2.0 | 2.0 | mg/L |
| Beryllium, total | 0.0021 | 0.004 | 0.004 | mg/L |
| Boron, total | 7.9 | 2 | 7.9 | mg/L |
| Cadmium, total | 0.001 | 0.005 | 0.005 | mg/L |
| Chloride, total | 700 | 200 | 700 | mg/L |
| Chromium, total | 0.073 | 0.1 | 0.1 | mg/L |
| Cobalt, total | 0.03 | 0.006 | 0.03 | mg/L |
| Fluoride, total | 0.461 | 4.0 | 4.0 | mg/L |
| Lead, total | 0.042 | 0.0075 | 0.042 | mg/L |
| Lithium, total | 0.068 | 0.04 | 0.068 | mg/L |
| Mercury, total | 0.004 | 0.002 | 0.004 | mg/L |
| Molybdenum, total | 0.0055 | 0.1 | 0.1 | mg/L |
| pH (field) | 7.5 / 6.4 | 9.0 / 6.5 | 9.0 / 6.4 | SU |
| Radium 226 and 228 combined | 7.27 | 5 | 7.27 | pCi/L |
| Selenium, total | 0.0023 | 0.05 | 0.05 | mg/L |
| Sulfate, total | 890 | 400 | 890 | mg/L |
| Thallium, total | 0.001 | 0.002 | 0.002 | mg/L |
| Total Dissolved Solids | 2590 | 1200 | 2590 | 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, 6:48:16 AM CDT

**TABLE 4-1. SAMPLING AND ANALYSIS SUMMARY**
GROUNDWATER MONITORING PLAN
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
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 | 8 | 1 | 0 | 0 | 1 | 10 | plastic | 600 mL | $HNO_3$ to pH<2 | 6 months |
| Mercury | 7470A or 6020 | 8 | 1 | 0 | 0 | 1 | 10 | plastic | 400 mL | $HNO_3$ to pH<2 | 28 days |
| **Inorganic Parameters** | | | | | | | | | | | |
| Fluoride | 9214 or EPA 300 | 8 | 1 | 0 | 0 | 1 | 10 | plastic | 300 mL | Cool to 4 °C | 28 days |
| Chloride | 9251 or EPA 300 | 8 | 1 | 0 | 0 | 1 | 10 | plastic | 100 mL | Cool to 4 °C | 28 days |
| Sulfate | 9036 or EPA 300 | 8 | 1 | 0 | 0 | 1 | 10 | plastic | 50 mL | Cool to 4 °C | 28 days |
| Total Dissolved Solids | SM 2540 C | 8 | 1 | 0 | 0 | 1 | 10 | plastic | 200 mL | Cool to 4 °C | 7 days |
| **Radium** | | | | | | | | | | | |
| Radium 226 | 9315 or EPA 903 | 8 | 0 | 0 | 0 | 0 | 8 | plastic | 1000 mL | $HNO_3$ to pH<2 | 6 months |
| Radium 228 | 9320 or EPA 904 | 8 | 0 | 0 | 0 | 0 | 8 | plastic | 1000 mL | $HNO_3$ to pH<2 | 6 months |
| **Field Parameters** | | | | | | | | | | | |
| pH | SM 4500-H+ B | 8 | NA | NA | NA | NA | 8 | flow-through cell | NA | none | immediately |
| Dissolved Oxygen [8] | SM 4500-O/405.1 | 8 | NA | NA | NA | NA | 8 | flow-through cell | NA | none | immediately |
| Temperature [8] | SM 2550 | 8 | NA | NA | NA | NA | 8 | flow-through cell | NA | none | immediately |
| Oxidation/Reduction Potential [8] | SM 2580 B | 8 | NA | NA | NA | NA | 8 | flow-through cell | NA | none | immediately |
| Specific Conductance [8] | SM 2510 B | 8 | NA | NA | NA | NA | 8 | flow-through cell | NA | none | immediately |
| Turbidity [7] | SM 2130 B | 8 | NA | NA | NA | NA | 8 | flow-through cell or hand-held turbidity meter | NA | none | immediately |

[O: CJC 09/22/21; C: LDC 09/22/21]

**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
$HNO_3$ = nitric acid
mL = milliliter
NA = not applicable
NTU = nephelometric turbidity unit



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**TABLE 4-2. DETECTION AND REPORTING LIMITS FOR PART 845 PARAMETERS**

GROUNDWATER MONITORING PLAN

DUCK CREEK POWER PLANT

BOTTOM ASH BASIN

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] |
| **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 | $^oC$ | SM 2550 | NS | NS | NA | NA |
| Specific Conductivity | NA | µS/cm | SM 2510 B | NS | NS | NA | NA |

**TABLE 4-2. DETECTION AND REPORTING LIMITS FOR PART 845 PARAMETERS**

GROUNDWATER MONITORING PLAN
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
CANTON, ILLINOIS

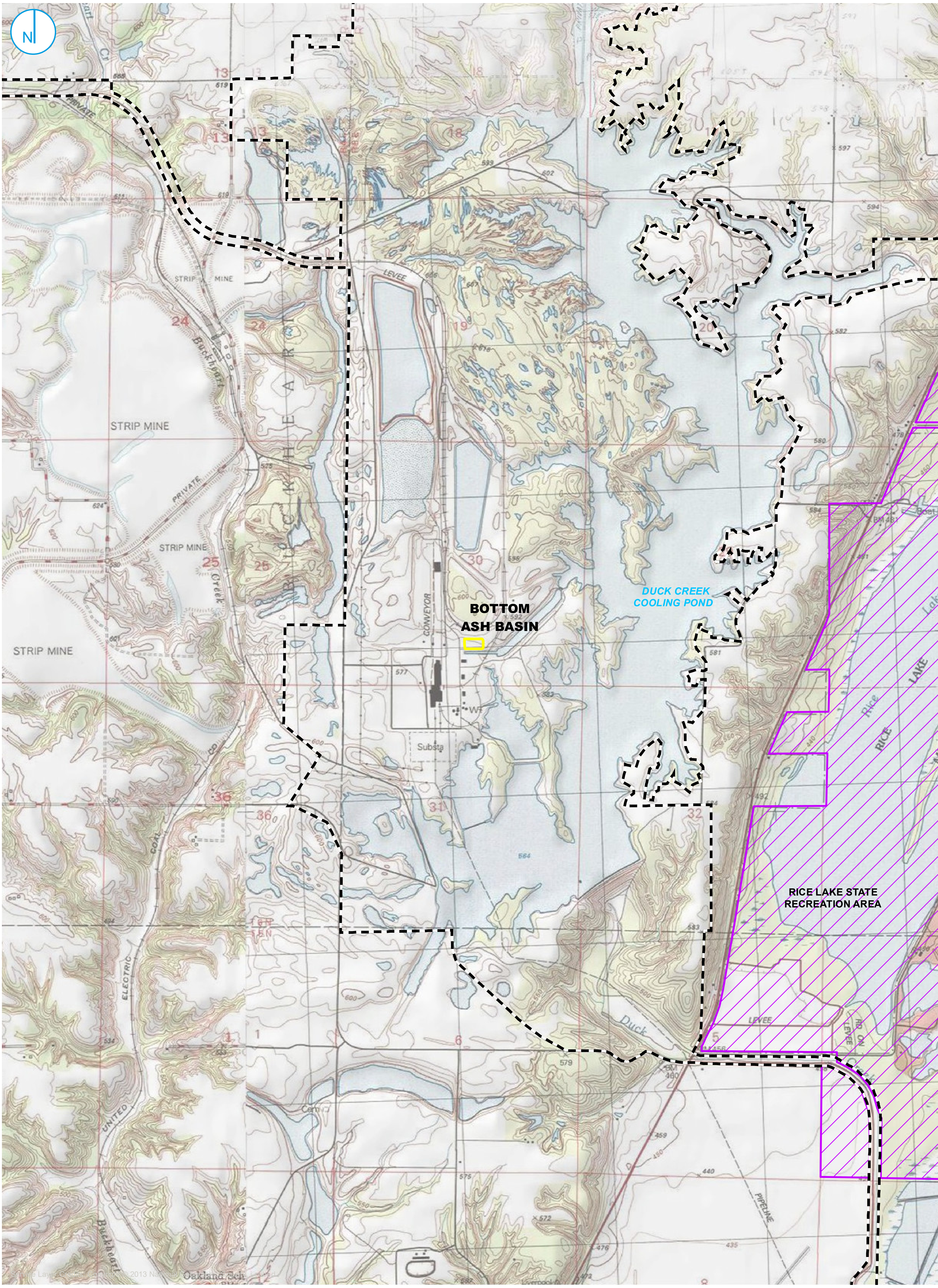
| Constituent | CAS | Unit | Analytical Methods [1] | USEPA MCL [2] | 35 I.A.C. § 845.600 | RL [4, 5] | MDL [5] |
|---|---|---|---|---|---|---|---|
| Turbidity | NA | NTU | SM 2130 B | NS | NS | NA | NA |

[O: CJC 09/22/21; C: LDC 09/22/21]

**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.
$^{o}$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
COFFEEN LAKE STATE FISH AND WILDLIFE AREA

0 1,000 2,000 Feet

## SITE LOCATION MAP

## FIGURE 1-1

GROUNDWATER MONITORING PLAN
BOTTOM ASH BASIN
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.


Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Duck_Creek\BAB\GMP\Figure 1-2_Site Map.mxd

PROJECT: 169000XXXX | DATED: 10/14/2021 | DESIGNER: HOTCALD

PART 845 REGULATED UNIT (SUBJECT UNIT)

SURFACE COAL MINE

0 150 300 Feet

## SITE MAP

**GROUNDWATER MONITORING PLAN**
**BOTTOM ASH BASIN**
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

## FIGURE 1-2

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BACKGROUND WELL

MONITORING WELL

GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)

PART 845 REGULATED UNIT (SUBJECT UNIT)

0 50 100 Feet

NOTE
PARENTHESIS INDICATES WELL NOT USED FOR CONTOURING

## UPPERMOST AQUIFER GROUNDWATER ELEVATION CONTOURS
## APRIL 28, 2021

GROUNDWATER MONITORING PLAN
BOTTOM ASH BASIN
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

FIGURE 1-3

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

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PROJECT: 169000XXXX | DATED: 9/24/2021 | DESIGNER: STOLZSD

Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Duck_Creek\BAB\GMP\Figure 2-1_Proposed 845 GW Monitoring Well Network.mxd

BACKGROUND WELL
COMPLIANCE WELL
PART 845 REGULATED UNIT (SUBJECT UNIT)

**PROPOSED PART 845 GROUNDWATER MONITORING WELL NETWORK**

**GROUNDWATER MONITORING PLAN**
**BOTTOM ASH BASIN**
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

**FIGURE 2-1**

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

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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

## BOTTOM ASH BASIN
## DUCK CREEK POWER PLANT
## CANTON, ILLINOIS

RAMBOLL Bright ideas. Sustainable change.

# STATISTICAL ANALYSIS PLAN
# DUCK CREEK POWER PLANT BOTTOM ASH BASIN

| | |
|---|---|
| Project Name | **Duck Creek Power Plant Bottom Ash Basin** |
| 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 Bottom Ash Basin. 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 Bottom Ash Basin) 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

LICENSED PROFESSIONAL ENGINEER
ERIC J. TLACHAC
062-063091
STATE OF ILLINOIS

## 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 Bottom Ash Basin) 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 Bottom Ash Basin), 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

# CONTENTS



## TABLES (IN TEXT)

# 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 | | | | | | |
|---|---|---|---|---|---|---|
| | Background Data | | | Compliance Data | | |
| Significant Trend? | 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:

$$LCL_{1-\alpha} = \bar{x} - t_{1-\alpha,n-1} \cdot \frac{s}{\sqrt{n}}$$

$\bar{x}$ = 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:

$$LCL_{1-\alpha} = \exp\left(\bar{y} - t_{1-\alpha,n-1} \cdot \frac{s_y}{\sqrt{n}}\right)$$

$\bar{y}$ = 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 100$^{th}$ percentile is (1–*P*). The number of sample values falling below the *P* x 100$^{th}$ 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 100$^{th}$ 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

$\kappa$ = 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 ($a_{const}$) 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-ɑ) 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 $\alpha^{th}$ percentile $\hat{x}_j^{[\alpha]}$ from the distribution of estimated concentrations at each time point (tj). For a UCL, compute the upper $(1-\alpha)^{th}$ 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.

# ATTACHMENT M

# HISTORY OF POTENTIAL EXCEEDANCES

This presentation of the History of Potential Exceedances, and any corrective action taken to remediate groundwater, is provided to meet the requirements of Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845.230(d)(2)(M) for the Duck Creek Power Plant Bottom Ash Basin, Illinois Environmental Protection Agency (IEPA) ID No. W0578010001-03.

***Note***

*Groundwater concentrations from 2015 to 2021 presented in the Hydrogeologic Site Characterization Report (HCR) Table 4-1, and evaluated and summarized in the following tables, 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]), which has not been reviewed or approved by IEPA at the time of submittal of the 35 I.A.C. § 845 Operating Permit application.*

*Alternate sources for potential exceedances as allowed by 35 I.A.C. § 845.650(e) have not yet been evaluated. These will be evaluated and presented in future submittals to IEPA as appropriate.*

*Table 1 summarizes how the potential exceedances were determined.*

*Background Concentrations*

*Background monitoring wells identified in the GMP include BA05 and BA06.*

*For monitoring wells that have been historically monitored in accordance with Title 40, Code of Federal Regulations, Part 257, Subpart D (Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments), background concentrations calculated from sampling events in 2015-2017 were compared to the standards identified in 35 I.A.C. § 845.600(a)(1). For constituents with calculated background concentrations in 2015-2017 greater than the standards in 35 I.A.C. § 845.600(a)(1), those calculated background concentrations were used as Groundwater Protection Standards (GWPSs) for comparing to statistical calculation results for each compliance well to determine potential exceedances. Compliance well statistical calculations consider concentrations from all sampling events in 2015-2021.*

*For all other monitoring wells, either newly constructed in 2021 or existing wells not monitored under Title 40, Code of Federal Regulations, Part 257, Subpart D, background concentrations calculated from the eight sampling events required by 35 I.A.C. § 845.650(b)(1)(A), to be collected within 180 days from April 21, 2021, were compared to the standards identified in 35 I.A.C. § 845.600(a)(1). For constituents with calculated background concentrations greater than the standards in 35 I.A.C. § 845.600(a)(1), those calculated background concentrations were used as GWPSs. Compliance well statistical calculations from that same time period were compared to the GWPSs to determine potential exceedances.*

*Corrective Action*

*No corrective actions are required to remediate the groundwater.*

**TABLE 1. DETERMINATION OF POTENTIAL EXCEEDANCES**
HISTORY OF POTENTIAL EXCEEDANCES
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
CANTON, ILLINOIS

| Sample Location | HSU | Program | Constituent | Result Unit | Sample Date Range | Statistical Calculation | Statistical Result | GWPS | Background | Part 845 Standard | GWPS Source |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BA01 | UA | 257 | Antimony, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.003 | 0.006 | 0.003 | 0.006 | Standard |
| BA01 | UA | 257 | Arsenic, total | mg/L | 02/05/2016 - 06/26/2017 | CI around mean | 0.00099 | 0.035 | 0.035 | 0.01 | Background |
| BA01 | UA | 257 | Barium, total | mg/L | 02/05/2016 - 06/26/2017 | CI around mean | 0.14 | 2.0 | 0.67 | 2 | Standard |
| BA01 | UA | 257 | Beryllium, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.001 | 0.004 | 0.0021 | 0.004 | Standard |
| BA01 | UA | 257 | Boron, total | mg/L | 02/05/2016 - 02/19/2021 | Future median | 0.026 | 3.9 | 3.9 | 2 | Background |
| BA01 | UA | 257 | Cadmium,total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.001 | 0.005 | 0.001 | 0.005 | Standard |
| BA01 | UA | 257 | Chloride, total | mg/L | 02/05/2016 - 02/19/2021 | Future median | 13 | 650 | 650 | 200 | Background |
| BA01 | UA | 257 | Chromium, total | mg/L | 02/05/2016 - 06/26/2017 | CI around median | 0.004 | 0.10 | 0.073 | 0.1 | Standard |
| BA01 | UA | 257 | Cobalt, total | mg/L | 02/05/2016 - 06/26/2017 | CI around median | 0.002 | 0.036 | 0.036 | 0.006 | Background |
| BA01 | UA | 257 | Fluoride, total | mg/L | 02/05/2016 - 02/19/2021 | CI around median | 0.25 | 4.0 | 0.55 | 4 | Standard |
| BA01 | UA | 257 | Lead, total | mg/L | 02/05/2016 - 06/26/2017 | Future median | 0.0089 | 0.042 | 0.042 | 0.0075 | Background |
| BA01 | UA | 257 | Lithium, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.010 | 0.068 | 0.068 | 0.04 | Background |
| BA01 | UA | 257 | Mercury, total | mg/L | 02/05/2016 - 06/26/2017 | Most recent sample | 0.0002 | 0.002 | 0.00026 | 0.002 | Standard |
| BA01 | UA | 257 | Molybdenum, total | mg/L | 02/05/2016 - 06/26/2017 | CI around median | 0.0019 | 0.10 | 0.0081 | 0.1 | Standard |
| BA01 | UA | 257 | pH (field) | SU | 02/05/2016 - 02/19/2021 | CI around median | 6.8 | 6.5/9.0 | 6.9/7.7 | 6.5/9 | Standard/Standard |
| BA01 | UA | 257 | Radium-226 + Radium 228, tot | pCi/L | 02/05/2016 - 06/26/2017 | CI around mean | 0.38 | 20 | 20 | 5 | Background |
| BA01 | UA | 257 | Selenium, total | mg/L | 02/05/2016 - 06/26/2017 | CI around median | 0.001 | 0.050 | 0.0023 | 0.05 | Standard |
| BA01 | UA | 257 | Sulfate, total | mg/L | 02/05/2016 - 02/19/2021 | CB around linear reg | 138 | 613 | 613 | 400 | Background |
| BA01 | UA | 257 | Thallium, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.001 | 0.002 | 0.001 | 0.002 | Standard |
| BA01 | UA | 257 | Total Dissolved Solids | mg/L | 02/05/2016 - 02/19/2021 | CI around mean | 514 | 2240 | 2240 | 1200 | Background |
| BA01C | BR | 845 | Antimony, total | mg/L | 04/14/2021 - 06/01/2021 | All ND - Last | 0.003 | 0.006 | 0.003 | 0.006 | Standard |
| BA01C | BR | 845 | Arsenic, total | mg/L | 04/14/2021 - 06/01/2021 | Future median | 0.0026 | 0.024 | 0.024 | 0.01 | Background |
| BA01C | BR | 845 | Barium, total | mg/L | 04/14/2021 - 06/01/2021 | CI around mean | 0.13 | 2.0 | 0.48 | 2 | Standard |
| BA01C | BR | 845 | Beryllium, total | mg/L | 04/14/2021 - 06/01/2021 | All ND - Last | 0.001 | 0.004 | 0.0021 | 0.004 | Standard |
| BA01C | BR | 845 | Boron, total | mg/L | 04/14/2021 - 06/01/2021 | Future median | 0.086 | 7.9 | 7.9 | 2 | Background |
| BA01C | BR | 845 | Cadmium,total | mg/L | 04/14/2021 - 06/01/2021 | All ND - Last | 0.001 | 0.005 | 0.001 | 0.005 | Standard |


RAMBOLL

**TABLE 1. DETERMINATION OF POTENTIAL EXCEEDANCES**
HISTORY OF POTENTIAL EXCEEDANCES
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
CANTON, ILLINOIS

| Sample Location | HSU | Program | Constituent | Result Unit | Sample Date Range | Statistical Calculation | Statistical Result | GWPS | Background | Part 845 Standard | GWPS Source |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BA01C | BR | 845 | Chloride, total | mg/L | 04/14/2021 - 06/01/2021 | Future median | 14 | 700 | 700 | 200 | Background |
| BA01C | BR | 845 | Chromium, total | mg/L | 04/14/2021 - 06/01/2021 | CI around mean | -0.01 | 0.10 | 0.073 | 0.1 | Standard |
| BA01C | BR | 845 | Cobalt, total | mg/L | 04/14/2021 - 06/01/2021 | CI around mean | -0.00278 | 0.030 | 0.030 | 0.006 | Background |
| BA01C | BR | 845 | Fluoride, total | mg/L | 04/14/2021 - 06/01/2021 | CI around mean | 0.18 | 4.0 | 0.46 | 4 | Standard |
| BA01C | BR | 845 | Lead, total | mg/L | 04/14/2021 - 06/01/2021 | Future median | 0.0021 | 0.042 | 0.042 | 0.0075 | Background |
| BA01C | BR | 845 | Lithium, total | mg/L | 04/14/2021 - 06/01/2021 | Future median | 0.020 | 0.068 | 0.068 | 0.04 | Background |
| BA01C | BR | 845 | Mercury, total | mg/L | 04/14/2021 - 06/01/2021 | All ND - Last | 0.0002 | 0.004 | 0.004 | 0.002 | Background |
| BA01C | BR | 845 | Molybdenum, total | mg/L | 04/14/2021 - 06/01/2021 | CI around mean | 0.00285 | 0.10 | 0.0055 | 0.1 | Standard |
| BA01C | BR | 845 | pH (field) | SU | 04/14/2021 - 06/01/2021 | CI around mean | 7.1 | 6.4/9.0 | 6.4/7.5 | 6.5/9 | Background/Standard |
| BA01C | BR | 845 | Radium-226 + Radium 228, tot | pCi/L | 04/14/2021 - 06/14/2021 | CI around mean | -2.57 | 7.3 | 7.3 | 5 | Background |
| BA01C | BR | 845 | Selenium, total | mg/L | 04/14/2021 - 06/01/2021 | CI around mean | 0.000429 | 0.050 | 0.0023 | 0.05 | Standard |
| BA01C | BR | 845 | Sulfate, total | mg/L | 04/14/2021 - 06/01/2021 | Future median | 140 | 890 | 890 | 400 | Background |
| BA01C | BR | 845 | Thallium, total | mg/L | 04/14/2021 - 06/01/2021 | All ND - Last | 0.001 | 0.002 | 0.001 | 0.002 | Standard |
| BA01C | BR | 845 | Total Dissolved Solids | mg/L | 04/14/2021 - 06/01/2021 | CI around mean | 548 | 2590 | 2590 | 1200 | Background |
| BA01L | UA/PMP | 845 | Antimony, total | mg/L | 04/14/2021 - 06/01/2021 | All ND - Last | 0.003 | 0.006 | 0.003 | 0.006 | Standard |
| BA01L | UA/PMP | 845 | Arsenic, total | mg/L | 04/14/2021 - 06/01/2021 | Future median | 0.0016 | 0.024 | 0.024 | 0.01 | Background |
| BA01L | UA/PMP | 845 | Barium, total | mg/L | 04/14/2021 - 06/01/2021 | CI around mean | 0.031 | 2.0 | 0.48 | 2 | Standard |
| BA01L | UA/PMP | 845 | Beryllium, total | mg/L | 04/14/2021 - 06/01/2021 | All ND - Last | 0.001 | 0.004 | 0.0021 | 0.004 | Standard |
| BA01L | UA/PMP | 845 | Boron, total | mg/L | 04/14/2021 - 06/01/2021 | Future median | 0.18 | 7.9 | 7.9 | 2 | Background |
| BA01L | UA/PMP | 845 | Cadmium,total | mg/L | 04/14/2021 - 06/01/2021 | All ND - Last | 0.001 | 0.005 | 0.001 | 0.005 | Standard |
| BA01L | UA/PMP | 845 | Chloride, total | mg/L | 04/14/2021 - 06/01/2021 | Future median | 7.8 | 700 | 700 | 200 | Background |
| BA01L | UA/PMP | 845 | Chromium, total | mg/L | 04/14/2021 - 06/01/2021 | CI around median | 0 | 0.10 | 0.073 | 0.1 | Standard |
| BA01L | UA/PMP | 845 | Cobalt, total | mg/L | 04/14/2021 - 06/01/2021 | CI around median | 0 | 0.030 | 0.030 | 0.006 | Background |
| BA01L | UA/PMP | 845 | Fluoride, total | mg/L | 04/14/2021 - 06/01/2021 | CI around mean | 0.22 | 4.0 | 0.46 | 4 | Standard |
| BA01L | UA/PMP | 845 | Lead, total | mg/L | 04/14/2021 - 06/01/2021 | Future median | 0.001 | 0.042 | 0.042 | 0.0075 | Background |
| BA01L | UA/PMP | 845 | Lithium, total | mg/L | 04/14/2021 - 06/01/2021 | All ND - Last | 0.020 | 0.068 | 0.068 | 0.04 | Background |

**TABLE 1. DETERMINATION OF POTENTIAL EXCEEDANCES**
HISTORY OF POTENTIAL EXCEEDANCES
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
CANTON, ILLINOIS

| Sample Location | HSU | Program | Constituent | Result Unit | Sample Date Range | Statistical Calculation | Statistical Result | GWPS | Background | Part 845 Standard | GWPS Source |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BA01L | UA/PMP | 845 | Mercury, total | mg/L | 04/14/2021 - 06/01/2021 | All ND - Last | 0.0002 | 0.004 | 0.004 | 0.002 | Background |
| BA01L | UA/PMP | 845 | Molybdenum, total | mg/L | 04/14/2021 - 06/01/2021 | CI around median | 0 | 0.10 | 0.0055 | 0.1 | Standard |
| BA01L | UA/PMP | 845 | pH (field) | SU | 04/14/2021 - 06/01/2021 | CI around mean | 6.6 | 6.4/9.0 | 6.4/7.5 | 6.5/9 | Background/Standard |
| BA01L | UA/PMP | 845 | Radium-226 + Radium 228, tot | pCi/L | 04/14/2021 - 06/14/2021 | CI around mean | -0.711 | 7.3 | 7.3 | 5 | Background |
| BA01L | UA/PMP | 845 | Selenium, total | mg/L | 04/14/2021 - 06/01/2021 | All ND - Last | 0.001 | 0.050 | 0.0023 | 0.05 | Standard |
| BA01L | UA/PMP | 845 | Sulfate, total | mg/L | 04/14/2021 - 06/01/2021 | Future median | 120 | 890 | 890 | 400 | Background |
| BA01L | UA/PMP | 845 | Thallium, total | mg/L | 04/14/2021 - 06/01/2021 | All ND - Last | 0.001 | 0.002 | 0.001 | 0.002 | Standard |
| BA01L | UA/PMP | 845 | Total Dissolved Solids | mg/L | 04/14/2021 - 06/01/2021 | CI around mean | 637 | 2590 | 2590 | 1200 | Background |
| BA02 | UA | 257 | Antimony, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.003 | 0.006 | 0.003 | 0.006 | Standard |
| BA02 | UA | 257 | Arsenic, total | mg/L | 02/05/2016 - 06/26/2017 | CI around mean | 0.00093 | 0.035 | 0.035 | 0.01 | Background |
| BA02 | UA | 257 | Barium, total | mg/L | 02/05/2016 - 06/26/2017 | CI around mean | 0.18 | 2.0 | 0.67 | 2 | Standard |
| BA02 | UA | 257 | Beryllium, total | mg/L | 02/05/2016 - 06/26/2017 | CI around median | 0.001 | 0.004 | 0.0021 | 0.004 | Standard |
| BA02 | UA | 257 | Boron, total | mg/L | 02/05/2016 - 02/19/2021 | CB around linear reg | 0.053 | 3.9 | 3.9 | 2 | Background |
| BA02 | UA | 257 | Cadmium,total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.001 | 0.005 | 0.001 | 0.005 | Standard |
| BA02 | UA | 257 | Chloride, total | mg/L | 02/05/2016 - 02/19/2021 | CB around linear reg | 10 | 650 | 650 | 200 | Background |
| BA02 | UA | 257 | Chromium, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.004 | 0.10 | 0.073 | 0.1 | Standard |
| BA02 | UA | 257 | Cobalt, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.002 | 0.036 | 0.036 | 0.006 | Background |
| BA02 | UA | 257 | Fluoride, total | mg/L | 02/05/2016 - 02/19/2021 | CI around median | 0.25 | 4.0 | 0.55 | 4 | Standard |
| BA02 | UA | 257 | Lead, total | mg/L | 02/05/2016 - 06/26/2017 | Future median | 0.0013 | 0.042 | 0.042 | 0.0075 | Background |
| BA02 | UA | 257 | Lithium, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.010 | 0.068 | 0.068 | 0.04 | Background |
| BA02 | UA | 257 | Mercury, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.0002 | 0.002 | 0.00026 | 0.002 | Standard |
| BA02 | UA | 257 | Molybdenum, total | mg/L | 02/05/2016 - 06/26/2017 | CI around mean | 0.00347 | 0.10 | 0.0081 | 0.1 | Standard |
| BA02 | UA | 257 | pH (field) | SU | 02/05/2016 - 02/19/2021 | CI around median | 6.6 | 6.5/9.0 | 6.9/7.7 | 6.5/9 | Standard/Standard |
| BA02 | UA | 257 | Radium-226 + Radium 228, tot | pCi/L | 02/05/2016 - 06/26/2017 | CI around mean | 0.47 | 20 | 20 | 5 | Background |
| BA02 | UA | 257 | Selenium, total | mg/L | 02/05/2016 - 06/26/2017 | CI around median | 0.001 | 0.050 | 0.0023 | 0.05 | Standard |
| BA02 | UA | 257 | Sulfate, total | mg/L | 02/05/2016 - 02/19/2021 | CB around linear reg | 14 | 613 | 613 | 400 | Background |

**TABLE 1. DETERMINATION OF POTENTIAL EXCEEDANCES**
HISTORY OF POTENTIAL EXCEEDANCES
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
CANTON, ILLINOIS

| Sample Location | HSU | Program | Constituent | Result Unit | Sample Date Range | Statistical Calculation | Statistical Result | GWPS | Background | Part 845 Standard | GWPS Source |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BA02 | UA | 257 | Thallium, total | mg/L | 02/05/2016 - 06/26/2017 | Most recent sample | 0.001 | 0.002 | 0.001 | 0.002 | Standard |
| BA02 | UA | 257 | Total Dissolved Solids | mg/L | 02/05/2016 - 02/19/2021 | CI around mean | 414 | 2240 | 2240 | 1200 | Background |
| BA02L | UA/PMP | 845 | Antimony, total | mg/L | 04/14/2021 - 07/27/2021 | All ND - Last | 0.003 | 0.006 | 0.003 | 0.006 | Standard |
| BA02L | UA/PMP | 845 | Arsenic, total | mg/L | 04/14/2021 - 07/27/2021 | Future median | 0.012 | 0.024 | 0.024 | 0.01 | Background |
| BA02L | UA/PMP | 845 | Barium, total | mg/L | 04/14/2021 - 07/27/2021 | CI around median | 0.046 | 2.0 | 0.48 | 2 | Standard |
| BA02L | UA/PMP | 845 | Beryllium, total | mg/L | 04/14/2021 - 07/27/2021 | All ND - Last | 0.001 | 0.004 | 0.0021 | 0.004 | Standard |
| BA02L | UA/PMP | 845 | Boron, total | mg/L | 04/14/2021 - 07/27/2021 | CB around linear reg | 0.091 | 7.9 | 7.9 | 2 | Background |
| BA02L | UA/PMP | 845 | Cadmium,total | mg/L | 04/14/2021 - 07/27/2021 | All ND - Last | 0.001 | 0.005 | 0.001 | 0.005 | Standard |
| BA02L | UA/PMP | 845 | Chloride, total | mg/L | 04/14/2021 - 07/27/2021 | Future median | 3.9 | 700 | 700 | 200 | Background |
| BA02L | UA/PMP | 845 | Chromium, total | mg/L | 04/14/2021 - 07/27/2021 | CI around median | 0.004 | 0.10 | 0.073 | 0.1 | Standard |
| BA02L | UA/PMP | 845 | Cobalt, total | mg/L | 04/14/2021 - 07/27/2021 | CI around median | 0.002 | 0.030 | 0.030 | 0.006 | Background |
| BA02L | UA/PMP | 845 | Fluoride, total | mg/L | 04/14/2021 - 07/27/2021 | CI around mean | 0.59 | 4.0 | 0.46 | 4 | Standard |
| BA02L | UA/PMP | 845 | Lead, total | mg/L | 04/14/2021 - 07/27/2021 | Future median | 0.001 | 0.042 | 0.042 | 0.0075 | Background |
| BA02L | UA/PMP | 845 | Lithium, total | mg/L | 04/14/2021 - 07/27/2021 | All ND - Last | 0.020 | 0.068 | 0.068 | 0.04 | Background |
| BA02L | UA/PMP | 845 | Mercury, total | mg/L | 04/14/2021 - 07/27/2021 | All ND - Last | 0.0002 | 0.004 | 0.004 | 0.002 | Background |
| BA02L | UA/PMP | 845 | Molybdenum, total | mg/L | 04/14/2021 - 07/27/2021 | CI around mean | 0.011 | 0.10 | 0.0055 | 0.1 | Standard |
| BA02L | UA/PMP | 845 | pH (field) | SU | 04/14/2021 - 07/27/2021 | CI around mean | 7.4 | 6.4/9.0 | 6.4/7.5 | 6.5/9 | Background/Standard |
| BA02L | UA/PMP | 845 | Radium-226 + Radium 228, tot | pCi/L | 04/14/2021 - 07/27/2021 | CI around mean | -0.185 | 7.3 | 7.3 | 5 | Background |
| BA02L | UA/PMP | 845 | Selenium, total | mg/L | 04/14/2021 - 07/27/2021 | All ND - Last | 0.001 | 0.050 | 0.0023 | 0.05 | Standard |
| BA02L | UA/PMP | 845 | Sulfate, total | mg/L | 04/14/2021 - 07/27/2021 | Future median | 5.4 | 890 | 890 | 400 | Background |
| BA02L | UA/PMP | 845 | Thallium, total | mg/L | 04/14/2021 - 07/27/2021 | All ND - Last | 0.001 | 0.002 | 0.001 | 0.002 | Standard |
| BA02L | UA/PMP | 845 | Total Dissolved Solids | mg/L | 04/14/2021 - 07/27/2021 | CI around mean | 195 | 2590 | 2590 | 1200 | Background |
| BA03 | UA | 257 | Antimony, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.003 | 0.006 | 0.003 | 0.006 | Standard |
| BA03 | UA | 257 | Arsenic, total | mg/L | 02/05/2016 - 06/26/2017 | CI around median | 0.001 | 0.035 | 0.035 | 0.01 | Background |
| BA03 | UA | 257 | Barium, total | mg/L | 02/05/2016 - 06/26/2017 | CI around mean | 0.18 | 2.0 | 0.67 | 2 | Standard |
| BA03 | UA | 257 | Beryllium, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.001 | 0.004 | 0.0021 | 0.004 | Standard |

**TABLE 1. DETERMINATION OF POTENTIAL EXCEEDANCES**
HISTORY OF POTENTIAL EXCEEDANCES
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
CANTON, ILLINOIS

| Sample Location | HSU | Program | Constituent | Result Unit | Sample Date Range | Statistical Calculation | Statistical Result | GWPS | Background | Part 845 Standard | GWPS Source |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BA03 | UA | 257 | Boron, total | mg/L | 02/05/2016 - 02/19/2021 | Future median | 0.028 | 3.9 | 3.9 | 2 | Background |
| BA03 | UA | 257 | Cadmium,total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.001 | 0.005 | 0.001 | 0.005 | Standard |
| BA03 | UA | 257 | Chloride, total | mg/L | 02/05/2016 - 02/19/2021 | Future median | 6.3 | 650 | 650 | 200 | Background |
| BA03 | UA | 257 | Chromium, total | mg/L | 02/05/2016 - 06/26/2017 | CI around median | 0.004 | 0.10 | 0.073 | 0.1 | Standard |
| BA03 | UA | 257 | Cobalt, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.002 | 0.036 | 0.036 | 0.006 | Background |
| BA03 | UA | 257 | Fluoride, total | mg/L | 02/05/2016 - 02/19/2021 | CI around median | 0.25 | 4.0 | 0.55 | 4 | Standard |
| BA03 | UA | 257 | Lead, total | mg/L | 02/05/2016 - 06/26/2017 | Future median | 0.001 | 0.042 | 0.042 | 0.0075 | Background |
| BA03 | UA | 257 | Lithium, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.010 | 0.068 | 0.068 | 0.04 | Background |
| BA03 | UA | 257 | Mercury, total | mg/L | 02/05/2016 - 06/26/2017 | CI around median | 0.0002 | 0.002 | 0.00026 | 0.002 | Standard |
| BA03 | UA | 257 | Molybdenum, total | mg/L | 02/05/2016 - 06/26/2017 | CI around mean | 0.00202 | 0.10 | 0.0081 | 0.1 | Standard |
| BA03 | UA | 257 | pH (field) | SU | 02/05/2016 - 02/19/2021 | CI around mean | 7.1 | 6.5/9.0 | 6.9/7.7 | 6.5/9 | Standard/Standard |
| BA03 | UA | 257 | Radium-226 + Radium 228, tot | pCi/L | 02/05/2016 - 06/26/2017 | CI around mean | 0.37 | 20 | 20 | 5 | Background |
| BA03 | UA | 257 | Selenium, total | mg/L | 02/05/2016 - 06/26/2017 | CI around median | 0.001 | 0.050 | 0.0023 | 0.05 | Standard |
| BA03 | UA | 257 | Sulfate, total | mg/L | 02/05/2016 - 02/19/2021 | CB around linear reg | 14 | 613 | 613 | 400 | Background |
| BA03 | UA | 257 | Thallium, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.001 | 0.002 | 0.001 | 0.002 | Standard |
| BA03 | UA | 257 | Total Dissolved Solids | mg/L | 02/05/2016 - 02/19/2021 | CI around mean | 389 | 2240 | 2240 | 1200 | Background |
| BA03L | UA/PMP | 845 | Antimony, total | mg/L | 04/14/2021 - 07/27/2021 | All ND - Last | 0.003 | 0.006 | 0.003 | 0.006 | Standard |
| BA03L | UA/PMP | 845 | Arsenic, total | mg/L | 04/14/2021 - 07/27/2021 | Future median | 0.001 | 0.024 | 0.024 | 0.01 | Background |
| BA03L | UA/PMP | 845 | Barium, total | mg/L | 04/14/2021 - 07/27/2021 | CI around median | 0.12 | 2.0 | 0.48 | 2 | Standard |
| BA03L | UA/PMP | 845 | Beryllium, total | mg/L | 04/14/2021 - 07/27/2021 | CI around median | 0.001 | 0.004 | 0.0021 | 0.004 | Standard |
| BA03L | UA/PMP | 845 | Boron, total | mg/L | 04/14/2021 - 07/27/2021 | Future median | 0.26 | 7.9 | 7.9 | 2 | Background |
| BA03L | UA/PMP | 845 | Cadmium,total | mg/L | 04/14/2021 - 07/27/2021 | All ND - Last | 0.001 | 0.005 | 0.001 | 0.005 | Standard |
| BA03L | UA/PMP | 845 | Chloride, total | mg/L | 04/14/2021 - 07/27/2021 | Future median | 23 | 700 | 700 | 200 | Background |
| BA03L | UA/PMP | 845 | Chromium, total | mg/L | 04/14/2021 - 07/27/2021 | CI around geomean | 0.00304 | 0.10 | 0.073 | 0.1 | Standard |
| BA03L | UA/PMP | 845 | Cobalt, total | mg/L | 04/14/2021 - 07/27/2021 | CI around median | 0.002 | 0.030 | 0.030 | 0.006 | Background |
| BA03L | UA/PMP | 845 | Fluoride, total | mg/L | 04/14/2021 - 07/27/2021 | CI around median | 0.25 | 4.0 | 0.46 | 4 | Standard |

**TABLE 1. DETERMINATION OF POTENTIAL EXCEEDANCES**
HISTORY OF POTENTIAL EXCEEDANCES
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
CANTON, ILLINOIS

| Sample Location | HSU | Program | Constituent | Result Unit | Sample Date Range | Statistical Calculation | Statistical Result | GWPS | Background | Part 845 Standard | GWPS Source |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BA03L | UA/PMP | 845 | Lead, total | mg/L | 04/14/2021 - 07/27/2021 | Future median | 0.0023 | 0.042 | 0.042 | 0.0075 | Background |
| BA03L | UA/PMP | 845 | Lithium, total | mg/L | 04/14/2021 - 07/27/2021 | Future median | 0.020 | 0.068 | 0.068 | 0.04 | Background |
| BA03L | UA/PMP | 845 | Mercury, total | mg/L | 04/14/2021 - 07/27/2021 | All ND - Last | 0.0002 | 0.004 | 0.004 | 0.002 | Background |
| BA03L | UA/PMP | 845 | Molybdenum, total | mg/L | 04/14/2021 - 07/27/2021 | CI around median | 0.001 | 0.10 | 0.0055 | 0.1 | Standard |
| BA03L | UA/PMP | 845 | pH (field) | SU | 04/14/2021 - 07/27/2021 | CI around mean | 6.8 | 6.4/9.0 | 6.4/7.5 | 6.5/9 | Background/Standard |
| BA03L | UA/PMP | 845 | Radium-226 + Radium 228, tot | pCi/L | 04/14/2021 - 07/27/2021 | CI around geomean | 0.22 | 7.3 | 7.3 | 5 | Background |
| BA03L | UA/PMP | 845 | Selenium, total | mg/L | 04/14/2021 - 07/27/2021 | CI around median | 0.001 | 0.050 | 0.0023 | 0.05 | Standard |
| BA03L | UA/PMP | 845 | Sulfate, total | mg/L | 04/14/2021 - 07/27/2021 | Future median | 350 | 890 | 890 | 400 | Background |
| BA03L | UA/PMP | 845 | Thallium, total | mg/L | 04/14/2021 - 07/27/2021 | All ND - Last | 0.001 | 0.002 | 0.001 | 0.002 | Standard |
| BA03L | UA/PMP | 845 | Total Dissolved Solids | mg/L | 04/14/2021 - 07/27/2021 | CI around mean | 936 | 2590 | 2590 | 1200 | Background |
| BA04 | UA | 257 | Antimony, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.003 | 0.006 | 0.003 | 0.006 | Standard |
| BA04 | UA | 257 | Arsenic, total | mg/L | 02/05/2016 - 06/26/2017 | CI around median | 0.001 | 0.035 | 0.035 | 0.01 | Background |
| BA04 | UA | 257 | Barium, total | mg/L | 02/05/2016 - 06/26/2017 | CI around mean | 0.11 | 2.0 | 0.67 | 2 | Standard |
| BA04 | UA | 257 | Beryllium, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.001 | 0.004 | 0.0021 | 0.004 | Standard |
| BA04 | UA | 257 | Boron, total | mg/L | 02/05/2016 - 02/19/2021 | Future median | 1.9 | 3.9 | 3.9 | 2 | Background |
| BA04 | UA | 257 | Cadmium,total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.001 | 0.005 | 0.001 | 0.005 | Standard |
| BA04 | UA | 257 | Chloride, total | mg/L | 02/05/2016 - 02/19/2021 | CB around linear reg | 35 | 650 | 650 | 200 | Background |
| BA04 | UA | 257 | Chromium, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.004 | 0.10 | 0.073 | 0.1 | Standard |
| BA04 | UA | 257 | Cobalt, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.002 | 0.036 | 0.036 | 0.006 | Background |
| BA04 | UA | 257 | Fluoride, total | mg/L | 02/05/2016 - 02/19/2021 | CI around mean | 0.24 | 4.0 | 0.55 | 4 | Standard |
| BA04 | UA | 257 | Lead, total | mg/L | 02/05/2016 - 06/26/2017 | Future median | 0.001 | 0.042 | 0.042 | 0.0075 | Background |
| BA04 | UA | 257 | Lithium, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.010 | 0.068 | 0.068 | 0.04 | Background |
| BA04 | UA | 257 | Mercury, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.0002 | 0.002 | 0.00026 | 0.002 | Standard |
| BA04 | UA | 257 | Molybdenum, total | mg/L | 02/05/2016 - 06/26/2017 | CI around geomean | 0.00158 | 0.10 | 0.0081 | 0.1 | Standard |
| BA04 | UA | 257 | pH (field) | SU | 02/05/2016 - 02/19/2021 | CI around mean | 7.0 | 6.5/9.0 | 6.9/7.7 | 6.5/9 | Standard/Standard |
| BA04 | UA | 257 | Radium-226 + Radium 228, tot | pCi/L | 02/05/2016 - 06/26/2017 | CI around mean | 0.38 | 20 | 20 | 5 | Background |

**TABLE 1. DETERMINATION OF POTENTIAL EXCEEDANCES**
HISTORY OF POTENTIAL EXCEEDANCES
DUCK CREEK POWER PLANT
BOTTOM ASH BASIN
CANTON, ILLINOIS

| Sample Location | HSU | Program | Constituent | Result Unit | Sample Date Range | Statistical Calculation | Statistical Result | GWPS | Background | Part 845 Standard | GWPS Source |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BA04 | UA | 257 | Selenium, total | mg/L | 02/05/2016 - 06/26/2017 | CI around median | 0.001 | 0.050 | 0.0023 | 0.05 | Standard |
| BA04 | UA | 257 | Sulfate, total | mg/L | 02/05/2016 - 02/19/2021 | CB around linear reg | 126 | 613 | 613 | 400 | Background |
| BA04 | UA | 257 | Thallium, total | mg/L | 02/05/2016 - 06/26/2017 | All ND - Last | 0.001 | 0.002 | 0.001 | 0.002 | Standard |
| BA04 | UA | 257 | Total Dissolved Solids | mg/L | 02/05/2016 - 02/19/2021 | CB around T-S line | 572 | 2240 | 2240 | 1200 | Background |

**Notes:**
Potential exceedance of GWPS (note: No potential exceedances were determined based on data collected from 2015 through 2021)
HSU = hydrostratigraphic unit:
BR = bedrock
UA = uppermost aquifer
UA/PMP = uppermost aquifer/potential migration pathway
Program = regulatory program data were collected under:
257 = 40 C.F.R. Part 257 Subpart D (Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments)
845 = 35 I.A.C. Part 845 (Sampling events completed to assess well locations for inclusion in the Part 845 monitoring well network)
mg/L = milligrams per liter
pCi/L = picocuries per liter
SU = standard units
Statistical Calculation = method used to calculate the statistical result:
All ND - Last = All results were below the reporting limit, and the last determined reporting limit is shown
CB around linear reg = Confidence band around linear regression
CB around T-S line = Confidence band around Thiel-Sen line
CI around geomean = Confidence interval around the geometric mean
CI around mean = Confidence interval around the mean
CI around median = Confidence interval around the median
Future median = Median of the three most recent samples
Most recent sample = Result for the most recently collected sample used due to insufficient data
Statistical Result = calculated in accordance with Statistical Analysis Plan using constituent concentrations observed at monitoring well during all sampling events within the specified date range
For pH, the values presented are the lower / upper limits
GWPS = Groundwater Protection Standard
GWPS Source:
Standard = standard specified in 35 I.A.C. § 845.600(a)(1)
Background = background concentration (see cover page for additional information)

# ATTACHMENT N

Certification of Financial Assurance Requirements

On June 17, 2021, Illinois Power Resources Generating, LLC provided financial assurance in the form of performance bonds to the Illinois Environmental Protection Agency in the amount of $20,670,871 for Ash Pond 1, Ash Pond 2, the Bottom Ash Basin, and the GMF Pond at the Duck Creek Power Plant.[1]

I, Matthew A. Goering, Senior Vice President of Illinois Power Resources Generating, LLC, do hereby certify to the best of my knowledge for the above referenced CCR Units that the financial assurance instruments satisfy the requirements of 35 I.A.C. Part 845, Subpart I.

______________________________

Matthew A. Goering
Senior Vice President
Illinois Power Resources Generating, LLC

[1] In the operating permit applications, the Ash Pond 1 is referred to as the Ash Pond No. 1, and the Ash Pond 2 is referred to as the Ash Pond No. 2.

# ATTACHMENT O

The Duck Creek Bottom Ash Basin is an "incised CCR surface impoundment" as defined in 40 CFR 257.53 and, in accordance with 40 CFR 257.73(a), is not subject to the 40 CFR 257.73(a)(2) hazard potential classification assessment requirement.

# ATTACHMENT P

AECOM

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

Submitted by
AECOM
1001 Highlands Plaza Drive West
Suite 300
St. Louis, MO 63110

October 2016

# CCR Rule Report: Initial Structural Stability Assessment

# For

# Bottom Ash Basin

# At Duck Creek Power Station

This Coal Combustion Residual (CCR) Rule Report documents that the Bottom Ash Basin at the Illinois Power Resources Generating, LLC Duck Creek Power Station is exempt from the structural stability assessment requirements specified in 40 Code of Federal Regulations (CFR) §257.73(d). The Bottom Ash Basin is located near Canton, Illinois in Fulton County, approximately 0.1 miles northeast of the Duck Creek Power Station.

The Bottom Ash Basin is an incised CCR surface impoundment, as defined by 40 CFR §257.53, that is used to manage sluiced bottom ash. Under 40 CFR §257.73(b), a structural stability assessment (§257.73(d)) must be performed for an existing 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.*

The Bottom Ash Basin does not satisfy either of these criteria because the incised basin does not have dikes. Therefore, the Bottom Ash Basin is not subject to the §257.73(d) structural stability assessment requirements.

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# ATTACHMENT Q

AECOM

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

Submitted by
AECOM
1001 Highlands Plaza Drive West
Suite 300
St. Louis, MO 63110

October 2016

# CCR Rule Report: Initial Safety Factor Assessment

# For

# Bottom Ash Basin

# At Duck Creek Power Station

This Coal Combustion Residual (CCR) Rule Report documents that the Bottom Ash Basin at the Illinois Power Resources Generating, LLC Duck Creek Power Station is exempt from the structural stability assessment requirements specified in 40 Code of Federal Regulations (CFR) §257.73(e). The Bottom Ash Basin is located near Canton, Illinois in Fulton County, approximately 0.1 miles northeast of the Duck Creek Power Station.

The Bottom Ash Basin is an incised CCR surface impoundment, as defined by 40 CFR §257.53, that is used to manage sluiced bottom ash. Under 40 CFR §257.73(b), a safety factor assessment (§257.73(e)) must be performed for an existing 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.*

The Bottom Ash Basin does not satisfy either of these criteria because the incised basin does not have dikes. Therefore, the Bottom Ash Basin is not subject to the §257.73(e) safety factor assessment requirements.

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AECOM (NYSE: ACM) is a global provider of professional technical and management support services to a broad range of markets, including transportation, facilities, environmental, energy, water and government. With nearly 100,000 employees around the world, AECOM is a leader in all of the key markets that it serves. AECOM provides a blend of global reach, local knowledge, innovation, and collaborative technical excellence in delivering solutions that enhance and sustain the world's built, natural, and social environments. A Fortune 500 company, AECOM serves clients in more than 100 countries and has annual revenue in excess of $19 billion.

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# ATTACHMENT R

AECOM

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

Submitted by
AECOM
1001 Highlands Plaza Drive West
Suite 300
St. Louis, MO 63110

October 2016

# CCR Rule Report:
# Initial Inflow Design Flood Control System Plan

# For

# Bottom Ash Basin

# At Duck Creek Power Station

# 1 Introduction

This Coal Combustion Residual (CCR) Rule Report documents that the initial inflow design flood control system plan for the Bottom Ash Basin at the Illinois Power Resources Generating, LLC Duck Creek Power Station meets the requirements specified in 40 Code of Federal Regulations (CFR) §257.82. The Bottom Ash Basin is located near Canton, Illinois in Fulton County, approximately 0.1 miles northeast of the Duck Creek Power Station. The Bottom Ash Basin is used to manage sluiced bottom ash produced by the Duck Creek Power Station.

The Bottom Ash Basin is an existing CCR surface impoundment as defined by 40 CFR §257.53. The CCR Rule requires that the initial inflow design flood control system plan for an existing CCR surface impoundment be prepared by October 17, 2016. The plan must document how the inflow design flood control system has been designed and constructed to meet the requirements of 40 CFR §257.82 and be supported by appropriate engineering calculations.

The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the inflow design flood control system meets the requirements of 40 CFR §257.82. The owner or operator must prepare an inflow design flood control system plan every five years.

# 2 Initial Inflow Design Flood Control System Plan

*40 CFR §257.82*
*(a) The owner or operator of an existing … CCR surface impoundment … must design, construct, operate, and maintain an inflow design flood control system as specified in paragraphs (a)(1) and (2) of this section.*
*(1) The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood specified in paragraph (a)(3) of this section.*
*(2) The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood specified in paragraph (a)(3) of this section.*
*(3) The inflow design flood is:*
*(i) For a high hazard potential CCR surface impoundment, …, the probable maximum flood;*
*(ii) For a significant hazard potential CCR surface impoundment, …, the 1,000-year flood;*
*(iii) For a low hazard potential CCR surface impoundment, …, the 100-year flood; or*
*(iv) For an incised CCR surface impoundment, the 25-year flood.*
*(b) Discharge from the CCR unit must be handled in accordance with the surface water requirements under §257.3-3.*

Analyses completed for the initial inflow design flood control system plan of the Bottom Ash Basin are described in the following subsections. Data and analysis results in the following subsection are based on spillway design information shown on design drawings, construction information, topographic surveys, information about operational and maintenance procedures provided by Illinois Power Resources Generating, LLC, and field measurements collected by AECOM. The analysis approach and results of the hydrologic and hydraulic analyses are presented in the following subsections. The Bottom Ash Basin is comprised of three separate sub-basins, including Primary Pond 1, Primary Pond 2, and the Secondary Settlement Pond.

The Bottom Ash Basin is an incised CCR surface impoundment, as defined by 40 CFR §257.53. Therefore, in accordance with 40 CFR §257.82(a)(3)(iv), the Inflow Design Flood (IDF) is the 25-year flood.

## 2.1 Initial Inflow Design Flood Control Systems (§257.82(a))

An initial inflow design flood control system plan, supported by a hydraulic and hydrologic analysis, was developed for the Bottom Ash Basin by evaluating the effects of a 24-hour duration design storm for the 25-year Inflow Design Flood (IDF) using a hydrologic HydroCAD (Version 10) computer model and a starting water surface elevation of 577.3 feet in Primary Pond 1 and Primary Pond 2 and 573.5 feet in the Secondary Settlement Pond. The computer model evaluated the Bottom Ash Basin's ability to collect and control the 25-year IDF under existing operational and maintenance procedures. Rainfall data for the 25-year IDF was obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14. The NOAA Atlas 14 rainfall depth is 5.25 inches.

The HydroCAD model results for the Bottom Ash Basin indicate that the CCR unit has sufficient storage capacity and spillway structures to adequately manage (1) flow into the CCR unit during and following the peak discharge of the 25-year IDF and (2) flow from the CCR unit to collect and control the peak discharge resulting from the 25-year IDF. The peak water surcharge elevation is 577.8 feet during the IDF in Primary Pond 1, 577.7 feet in Primary Pond 2, and 574.2 feet in the Secondary Settlement Pond. The minimum crest elevation is 579.0 feet for Primary Ponds 1 and 2 and 578.0 feet for the Secondary Settlement Pond. Therefore, overtopping is not expected.

Based on this evaluation, the Bottom Ash Basin meets the requirements in §257.82(a).

## 2.2 Discharge from the CCR Unit (§257.82(b))

40 CFR §257.82(b) provides that the discharge from the CCR unit must be handled in accordance with the surface water requirements under 40 CFR §257.3-3, which states the following:

*(a) For purposes of section 4004(a) of the Act, a facility shall not cause a discharge of pollutants into waters of the United States that is in violation of the requirements of the National Pollutant Discharge Elimination System (NPDES) under section 402 of the Clean Water Act, as amended.*

*(b) For purposes of section 4004(a) of the Act, a facility shall not cause a discharge of dredged material or fill material to waters of the United States that is in violation of the requirements under section 404 of the Clean Water Act, as amended.*

*(c) A facility or practice shall not cause non-point source pollution of waters of the United States that violates applicable legal requirements implementing an areawide or Statewide water quality management plan that has been approved by the Administrator under section 208 of the Clean Water Act, as amended.*

*(d) Definitions of the terms Discharge of dredged material, Point source, Pollutant, Waters of the United States, and Wetlands can be found in the Clean Water Act, as amended, 33 U.S.C. 1251 et seq., and implementing regulations, specifically 33 CFR part 323 (42 FR 37122, July 19, 1977).*

The handling of discharge was evaluated by reviewing design drawings, operational and maintenance procedures, conditions observed in the field by AECOM, and the inflow design flood control system plan developed per §257.82(a).

Based on this evaluation, outflow from the Bottom Ash Basin is ultimately routed through a NPDES-permitted outfall into the Duck Creek Reservoir, via the discharge channel. Hydraulic and hydrologic analyses performed as part of the initial inflow design flood control system plan found the Bottom Ash Basin adequately manages outflow during the 25-year IDF, as overtopping of the Bottom Ash Basin is not expected.

Therefore, discharge in pollutants in violation of the NPDES permit is not expected as discharge is routed and controlled through the existing spillway system and NPDES permitted outfall during both normal and IDF conditions. Based on this evaluation, the Bottom Ash Basin meets the requirements in §257.82(b).

# 3 Certification Statement

**CCR Unit:** Illinois Power Resources Generating, LLC; Duck Creek Power Station; Bottom Ash Basin

I, Victor A. Modeer, 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 CCR Rule Report, and the underlying data in the operating record, has been prepared in accordance with the accepted practice of engineering. I certify, for the above-referenced CCR Unit, that the initial inflow design flood control system plan dated October 13, 2016 meets the requirements of 40 CFR §257.82.

VICTOR A MODEER JR.

*Printed Name*

10/13/16

*Date*

VICTOR ALBERT MODEER JR.
062-043112
REGISTERED
PROFESSIONAL
ENGINEER
OF
ILLINOIS

11/30/17

About AECOM

AECOM (NYSE: ACM) is a global provider of professional technical and management support services to a broad range of markets, including transportation, facilities, environmental, energy, water and government. With nearly 100,000 employees around the world, AECOM is a leader in all of the key markets that it serves. AECOM provides a blend of global reach, local knowledge, innovation, and collaborative technical excellence in delivering solutions that enhance and sustain the world's built, natural, and social environments. A Fortune 500 company, AECOM serves clients in more than 100 countries and has annual revenue in excess of $19 billion.

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# ATTACHMENT S

# PART 845 SAFETY AND HEALTH PLAN

# DUCK CREEK POWER PLANT
# GMF POND AND BOTTOM ASH BASIN

# CONTENTS

## APPENDICES



## ACRONYMS & ABBREVIATIONS

| | |
|---|---|
| % | Percent |
| § | Section |
| 35 I.A.C. | Title 35 of the Illinois Administrative Code |
| 29 C.F.R. | Title 29 of the Code of Federal Regulations |
| ACGIH | American Conference of Governmental Industrial Hygienists |
| BAB | Bottom Ash Basin |
| CCR | Coal Combustion Residual |
| DCPP | Duck Creek Power Plant |
| GMFP | Gypsum Management Facility Pond |
| HAZWOPER | Hazardous Waste Operations and Emergency Response |
| ID | identification |
| IDLH | Immediately Dangerous to Life and Health |
| IEPA | Illinois Environmental Protection Agency |
| IPRG | Illinois Power Resources Generating, LLC |
| kV | kilovolt |
| NID | National Inventory of Dams |
| NIOSH | National Institute for Occupational Safety and Health |
| No. | number |
| OSHA | Occupational Safety and Health Administration |
| Part 845 | 35 I.A.C. Part 845: Residuals in Surface Impoundments |
| PEL | Permissible Exposure Level |
| PFAS | Per- and polyfluoroalkyl substances |
| PFD | Personal Flotation Device |
| PNOR | particulates not otherwise recognized |
| POC | Point of Contact |
| PPE | personal protective equipment |
| ppm | parts per million |
| SDS | Safety Data Sheet |
| Site | GMFP and BAB |
| STEL | Short Term Exposure Limit |
| TLV | Threshold Limit Value |
| TWA | time-weighted averages |
| USCG | United States Coast Guard |

# REVISION SUMMARY

| Revision Date | Description of Changes (Section title or number – description) | Responsible Party (individual name or title, company / agency name, document reference and date) |
|---|---|---|
| | | |
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# PREFACE

Illinois Power Resources Generating, LLC (IPRG) has prepared this Safety and Health Plan in accordance with requirements set forth in Title 35 of the Illinois Administrative Code (35 I.A.C.) Part 845: Residuals in Surface Impoundments (Part 845), Section (§) 845.530. IRPG assessed health and safety hazards of its coal combustion residual (CCR) surface impoundments to develop and update this Safety and Health Plan.

This document describes the minimum anticipated protective measures necessary for worker health and safety at Duck Creek Power Plant (DCPP) Gypsum Management Facility Pond (GMFP; Vistra identification [ID] number [No.] 203, Illinois Environmental Protection Agency [IEPA] ID No. W0578010001-04, National Inventory of Dams [NID] No. IL50573) and Bottom Ash Basin (BAB; Vistra ID No. 205, IEPA ID No. W0578010001-03, NID No. IL50716), collectively referred to as the Site. Employees of IPRG, contract workers, and third-party contractors must read and comply with the contents of this document. The contents of this document are not intended to cover all situations that may arise nor to waive any provisions specified in Federal, State, and local regulations or site owner / contractor health and safety requirements.

Third-party contractors are accountable for the health and safety of their employees. Third-party contractors are required to prepare a Safety and Health Plan that meets the minimum requirements herein. However, no requirements or provisions within this plan shall be construed as an assumption of IPRG of their legal responsibilities as an employer.

This Safety and Health Plan will be reviewed and updated annually, at a minimum. The Safety and Health Plan will also be updated if facility operations change, or a new hazard is identified.

# 1. INTRODUCTION

This Safety and Health Plan has been developed to outline the requirements to be met by employees of IPRG, contract workers, and third-party contractors while performing any activity to construct, operate, or close the CCR Units at the Site. This Safety and Health Plan has been developed to meet the requirements of 35 I.A.C. § 845.530 and describes the responsibilities, training requirements, protective equipment, and safety procedures necessary to minimize the risk of injury, fires, explosion, chemical spills, material damage incidents, and near misses related to CCR activities. This Safety and Health Plan incorporates by reference the Occupational Safety and Health Administration (OSHA) regulations contained in Title 29 of the Code of Federal Regulations (29 C.F.R.) § 1910 and 29 C.F.R. § 1926.

The requirements and guidelines in this Safety and Health Plan are based on a review of available information and data, and an evaluation of identified on-site hazards. This Safety and Health Plan will be reviewed with persons assigned to work at the Site and will be available on-site.

## 1.1 Site Description/History

The DCPP is a retired coal-fired power plant located in Section 30 of Township 6 North, Range 5 East, in Fulton County, Illinois and approximately 6 miles southeast of the town of Canton. The BAB is located immediately northeast of the power plant facility in Section 30, 31. The GMFP is located to the north in Section 18, east of Bethel Cemetery Road, and approximately 2 miles southeast of Canton, Illinois (Appendix A).

## 1.2 Facility Personnel

The following table outlines key facility personnel with respect to facility operations and health and safety.

| Name | Position | Phone Number |
|---|---|---|
| Brandon Potter | Point-of-Contact (POC) /Plant Manager | 618-210-3418 |
| Security Guard | Security Guard | 713-542-0619 |
| Daryl Johnson | Environmental Manager | 309-229-6088 |
| Matt Ballance | Engineering Manager | 618-343-7739 (office)<br>618-792-7274 (mobile) |
| Jason Campbell | Dam Safety Manager | 271-753-8904 (Springfield)<br>217-622-3491 (mobile) |
| Stu Cravens | Senior Technical Expert | 217-390-1503 (mobile) |
| Vic Modeer | Engineering Manager | 618-541-0878 |
| Charles Koudelka | Plant Closure Director | 903-235-8633 |

## 1.3 Responsibilities

The following persons have responsibilities associated with communicating and implementing the Safety and Health Plan for the Site.

### 1.3.1 IPRG Point of Contact

The IPRG Point of Contact (POC) is a management-level person who is requiring employees, contract workers, or third-party contractors to enter the Site. The IPRG POC is responsible to communicate Safety and Health Plan information and requirements to employees, contract workers, and third-party contractors, and oversee work performed at the Site to the extent necessary to confirm implementation of Safety and Health Plan requirements.

### 1.3.2 IPRG Employees

IPRG employees are directly hired by IPRG. They are required to implement and/or follow Safety and Health Plan requirements as applicable to their work and exercise their "stop work authority" if safety requirements are unclear or unanticipated site conditions or hazards are observed.

### 1.3.3 Contract Workers

Contract workers are those hired by IPRG through an agency firm. Similar to IPRG employees, contract workers are required to implement and/or follow Safety and Health Plan requirements as applicable to their work and exercise their "stop work authority" if safety requirements are unclear or unanticipated site conditions or hazards are observed.

### 1.3.4 Third-Party Contractor Employees

Third-party contractor employees work for firms under contract to IPRG. Third-party contractors include prime contractors and all of their lower tier subcontractors. Similar to IPRG employees, third-party contractors are required to implement Safety and Health Plan requirements as applicable to their work and exercise their "stop work authority" if safety requirements are unclear or unanticipated site conditions or hazards are observed.

### 1.3.5 Third-Party Contractor Safety Competent Person

Third-party contractors will be required to designate a Safety Competent Person. The Safety Competent Person must be in a management position (*e.g.,* superintendent, foreman, etc.) with OSHA 30-hour construction safety certification who may perform other duties, unless IPRG requires a dedicated Safety Competent Person. A Safety Competent Person must be on site at all times when the subcontractor has employees performing work for IPRG and must possess a sound working knowledge of pertinent OSHA regulations, this Safety and Health Plan, and other applicable safety requirements related to the scope of work. Third-party contractors must also designate a backup Safety Competent Person that possesses the same authority and training. The competent person will ensure timely correction of safety deficiencies identified by IPRG. The Safety Competent Person is responsible to ensure Safety and Health Plan requirements have been communicated to lower-tier subcontractors and enforce Safety and Health Plan requirements.

# 2. SITE ACCESS & CONTROL

This section outlines requirements for ensuring that only authorized personnel and visitors are permitted at the Site.

## 2.1 Facility Security

Elements of site control include restricting access to the CCR Units to persons until they have met the training requirements outlined in this Safety and Health Plan and have been authorized to do so by DCPP POC or their representative.

All IPRG employees, contract workers, and third-party contractors must sign in and out with the security guard.

Upon arrival to the Site, all IPRG employees, contract workers, and third-party contractors must check in/out at Security. A COVID-19 screening must also be completed per Section 3.8.

## 2.2 Third-Party Contractor Management

Prior to working at the Site, all third-party prime contractors must maintain an active registration with ISNetworld and maintain a grade of A or B. Lower tier subcontractors are currently not required to be registered in ISNetworld, but this requirement may change at the discretion of IPRG.

## 2.3 Third-Party Contractor Safety and Health Plan

Prior to being authorized to conduct work at the Site, third-party contractors must develop and submit a Safety and Health Plan. The third-party contractor's Safety and Health Plan must be specific to the scope of work that they will be performing at the Site. The third-party contractor's Safety and Health Plan must meet or exceed all the requirements in this Safety and Health Plan, other IPRG requirements, and applicable regulations. All lower tier subcontractors of third-party contractors must meet the requirements in this Safety and Health Plan as well as the requirements outlined in the Safety and Health Plan of the third-party with whom they are contracted.

## 2.4 Authorized Personnel

At a minimum, authorized personnel who will be granted unescorted access to the project include IPRG employees, contract workers, and third-party contractors that meet the following:

- Reviewed this Safety and Health Plan and other applicable safety planning documentation
- Have completed all the training, medical surveillance, and drug screen and background investigation requirements as outlined in Section 3 of this Safety and Health Plan.

## 2.5 Visitors

Visitors must be escorted by Authorized Personnel through the Site if they have not reviewed this Safety and Health Plan or completed the training requirements outlined in Section 3 of this Safety and Health Plan. Visitors may not undertake any activity to construct, operate, or close a CCR surface impoundment.

## 2.6 Communication

Communication between workers and emergency services must be maintained at all times. Cellular service is consistently available and can be relied upon to summon emergency services.

# 3. TRAINING & MEDICAL REQUIREMENTS

Project personnel must be properly trained for the type of work being performed and in accordance with 35 I.A.C. § 845.530, 29 C.F.R. § 1926 and 29 C.F.R. § 1910, and IPRG policies. Additionally, personnel working in areas regulated by the OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) standards (29 C.F.R. § 1910.120 and 29 C.F.R. § 1926.65) must have current medical surveillance. All employees, contractors, and third-party contractors must complete the following prior to beginning any activity to construct, operate or close the CCR Units at the Site.

## 3.1 HAZWOPER Training

35 I.A.C. § 845.530(c)(2)(E) requires that all employees, contract workers, and third-party contractors be trained in accordance with 29 C.F.R. § 1910.120 and 29 C.F.R. § 1926.65. The following training will be completed as required by job function:

- **OSHA 40-Hour Training** per 29 C.F.R. § 1910.120 and 29 C.F.R. § 1926.65, for those personnel who are expected to have extensive contact with contaminated materials and/or may be required to wear a respirator.
- **OSHA 24-Hour Training** per 29 C.F.R. § 1910.120 and 29 C.F.R. § 1926.65, for those personnel who are expected to have minimal contact with contaminated materials and will NOT be required to wear a respirator.
- **OSHA 8-hour Supervisor Training** per 29 C.F.R. § 1910.120 and 29 C.F.R. § 1926.65, for Site Supervisors, Foremen, Superintendents, and others who will be directing and managing site activities.
- **OSHA 8-hour Refresher** per 29 C.F.R. § 1910.120 and 29 C.F.R. § 1926.65, completed within 12 months of initial 40-hour or 24-hour training and annually thereafter.

The following matrix outlines HAZWOPER training requirements based on typical job functions at the Site. It is not intended to be all inclusive, new job functions must be evaluated per 29 C.F.R. § 1910.120 and 29 C.F.R. § 1926.65.

| Training | Job Function |
|---|---|
| OSHA 40-hour | Ash handlers |
| OSHA 24-hour | Personnel not required to handle CCR materials |
| OSHA 8-hour Supervisor Training | Third-Party Contractor Safety Competent Persons |
| OSHA 8-hour refresher | All personnel |

## 3.2 OSHA Construction Outreach Training

35 I.A.C. § 845.530(c)(2)(E) requires that all employees, contract workers, and third-party contractors complete an OSHA 10-hour or 30-hour construction safety training. These trainings will be completed as follows:

- All employees, contract workers, and third-party contract employees: OSHA 10-hour or 30-hour construction outreach training.
- Supervisors, superintendents, foreman and safety professionals: OSHA 30-hour construction outreach training.

## 3.3 Safety and Health Plan Review

Pursuant to 35 I.A.C. § 845.530(d)(e), before beginning any activity at the Site, and annually thereafter, all IPRG employees, contract workers, and third-party contractors must review the content of this HASP. After reviewing this Safety and Health Plan all personnel will understand the following:

- Procedures for using, inspecting, repairing, and replacing facility emergency and monitoring equipment
- Communications or alarm systems outlined in Section 6
- Response to fires and explosions outlined in Section 6
- Response to a spill or release of CCR
- Information about chemical hazards and hazardous materials outlined in Section 5
- The use of engineering controls, administrative controls, and personal protective equipment (PPE) outlined in Section 4

All personnel will acknowledge this HASP by signing the *Safety and Health Plan Acknowledgment Form (Appendix B).*

## 3.4 Emergency and Monitoring Equipment Training

All IPRG employees, contract workers, and third-party contractors must be aware of how to respond to alarms and other emergencies as outlined in Section 6 of this plan. Individuals may only use facility emergency and monitoring equipment if they have been trained in their use and authorized to do so by the designated POC. Additionally, a written release may need to be completed as required by Vistra Corporate Procedure FFA-POL-0006.

Individual IPRG employees and contract workers may be responsible for using, inspecting, repairing and replacing facility emergency monitoring equipment. These individuals will be trained in accordance with the Authorized Gas Testing training (or equivalent) or other procedures identified by IPRG. These individuals will review and adhere to the manufacturer’s instructions, where applicable.

Third-party contractors are responsible for inspecting, repairing, and replacing any owned emergency (*i.e.*, fire extinguishers) and monitoring equipment (*i.e.*, air monitoring equipment). Third-party contractors will maintain procedures for using, inspecting, repairing, and replacing owned emergency and monitoring equipment that is consistent with the manufacturer’s requirements. Third-party contractor employees who are responsible for this equipment will be trained in procedures for using, inspecting, and repairing owned equipment by their employer.

## 3.5 Hazard Communication

All employees, contract workers, and third-party contractors must be trained in chemical hazards (if any) associated with their work in accordance with 29 C.F.R. § 1910.1200. Work tasks performed at the Site may include exposure to compounds identified in the Hazard Communication section of this Safety and Health Plan and is included as part of the Safety and Health Plan Review outlined in Section 3.3.

## 3.6 Medical Surveillance

All employees, contract workers, and third-party contractors engaged in operations specified in 29 C.F.R. § 1910.120 and 29 C.F.R. § 1926.65 and meet one of the criteria outlined in 29 C.F.R. § 1910.120(f)(2) and 29 C.F.R. § 1926.65(f)(2) must participate in a medical surveillance program that is administered by their employer. The criteria for participating in a medical surveillance program are:

- All employees who are or may be exposed to hazardous substances at or above the established permissible exposure limit, without regard to the use of respirators, for 30 days or more a year;
- All employees who wear a respirator for 30 days or more a year; or
- All employees who are injured, become ill or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation.

The medical surveillance program must result in documentation that an individual is cleared to work on sites covered by 29 C.F.R. § 1910.120 and 20 C.F.R. § 1926.65 and is medically fit to wear a respirator when applicable.

## 3.7 Drug Screen and Background Investigations

IPRG requires that contract worker agencies and third-party contractors are responsible for ensuring that all personnel have completed and passed a drug and alcohol test and background investigation prior to on-site work as described in Appendix C.

## 3.8 COVID-19 Site Entry Guidelines

All personnel entering Vistra work sites shall review and adhere to the site entry guidelines provided in Appendix D.

## 3.9 Document Management

IPRG will maintain employee and contract employee training and medical surveillance records in the Maintenance Office. Third-party contractors are responsible for maintaining training and medical surveillance documentation for their employees. Third-party contractors will produce documentation upon IPRG request.

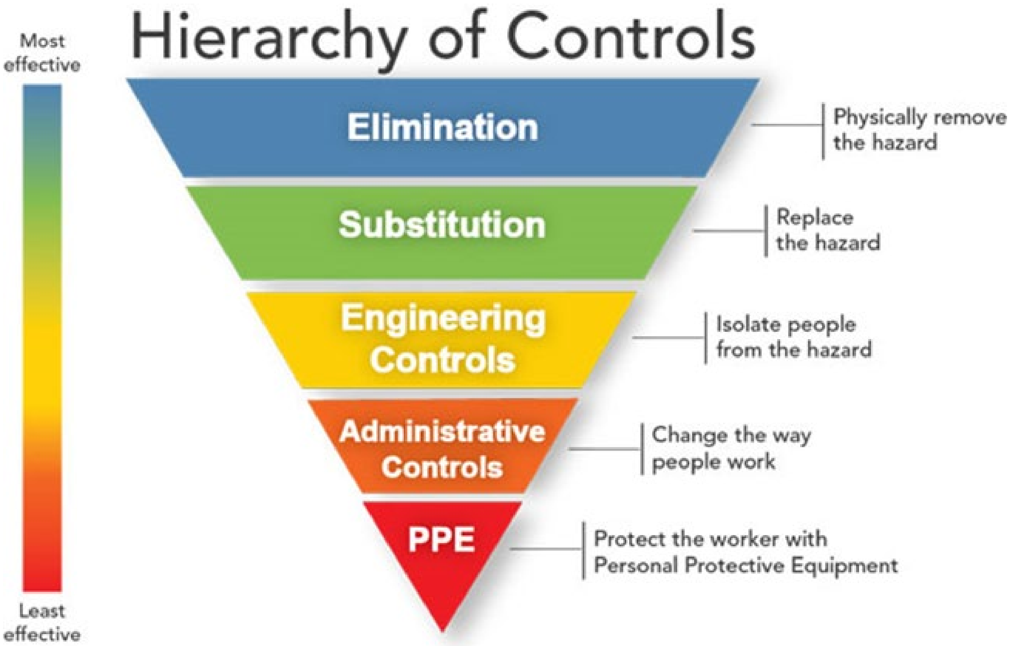
## 3.10 Industrial Hygiene Sampling Records

Upon receipt of exposure sampling results IPRG and third-party contractors must distribute exposure sampling results to employees within 15 business days unless otherwise required by applicable regulation. All personnel exposure sampling results and records must be maintained by the employee’s company for at least 30 years following termination of employment.

# 4. HAZARD & CONTROLS

The following section outlines general controls for the hazards and controls. Third-party contractors are still responsible for developing a Safety and Health Plan that incorporates requirements of this Safety and Health Plan, other safety requirements for the DCPP, as well as the third-party contractor's safety policies and procedures. Safety and Health Plans developed by third-party contractors must be specific to the site and the anticipated work means and methods. Safety and Health Plans that consist of only standard operating procedures or are not otherwise specific to the work performed at the Site will not be accepted by IPRG.

IPRG requires that a hierarchy of controls be considered when performing work at the GMFP or BAB. Implement controls that favor elimination, substitution, and engineering over the use of administrative controls and PPE when feasible. See the figure below for additional guidance (courtesy of the National Institute for Occupational Safety and Health [NIOSH]).




## 4.1 Ash/Unstable Surfaces

Prior to working in or on an ash pond, third-party contractors must notify the security guard and the POC. Work in or on an ash pond may not begin until the facility POC has approved the work and all personnel have signed in with the security guard. Upon completion of the work, third-party contractors must notify the POC and security guard that they have left the Site.

When working on ash ponds or unstable surfaces the following requirements must be implemented where applicable and feasible. The following table summarizes safety controls for work performed in ash ponds and on unstable surfaces and are aligned to the hierarchy of controls:

| Elimination | Substitution | Engineering | Administrative | PPE |
|---|---|---|---|---|
| Change the work task or work methods so that work on ash ponds is no longer required | Use the lightest available tracked equipment to reduce ground pressure | Use crane mats or other cribbing to support heavy equipment on ash ponds | Traverse compacted paths that have previously been used by heavy equipment | Use a restraint (tethering) system to prevent falls or slips into unstable ash pond surfaces or surface water that represents a drowning hazard |

| Elimination | Substitution | Engineering | Administrative | PPE |
|---|---|---|---|---|
| | | | If an unstable condition exists, complete a Next Level Up Pre-Job Brief prior to accessing the ash pond. | |
| | | | Approach the ash pond from the most stable direction | |
| | | | Inspect travel paths for recent terrain shifts, particularly following heavy rains or rapid dewatering | |
| | | | Working alone on ash ponds is prohibited without pre-approval from the POC. | |
| | | | When a drowning hazard exists, implement requirements for working on/near water as outlined in Section 4.4. | |
| | | | Implement an emergency response plan with trained responders for falls into (or engulfment by) ash | |

## 4.2 Ash Inhalation/Airborne Exposure

Ash that becomes airborne due to site activities or environmental conditions may result in an exposure to its components as outlined in Section 5.1. IPRG and third-party contractors are responsible for ensuring their respective employees' and contract workers' exposures are below occupational exposure limits. Upon request, third-party contractors must demonstrate to IPRG that exposure control methods are adequate. The following table summarizes airborne exposure controls and is aligned to the hierarchy of controls:

| Elimination | Substitution | Engineering | Administrative | PPE |
|---|---|---|---|---|
| Change the work task or work methods so that work on ash ponds is no longer required | Substitute manual work methods for those that can be completed from the cab of a vehicle | Continually wet work areas to reduce the amount of ash that becomes airborne<br><br>Equip vehicles and heavy equipment cabs with filters. Clean and change filters as required | Conduct air monitoring or exposure sampling to confirm that airborne exposure is below regulatory limits | If exposure levels are above the PEL, equip employees with respirators appropriate to the level of exposure |

## 4.3 Stuck Vehicles/Equipment

If a vehicle or piece of equipment becomes stuck, a third-party towing or wrecking company who is trained in vehicle extraction must be retained and the IPRG POC will be notified. Bob's and Swise Towing (309-647-1633) is an approved extraction company that may be used to remove stuck vehicles. Third-party contractors may extract their own vehicle if they have an approved extraction plan, and a competent person is on site to implement the extraction. The extraction plan shall be included as part of the third-party contractor's reviewed and approved Safety and Health Plan. The above notifications are still required.

The hazards presented by stuck vehicles/equipment must not be underestimated. While the weight of the stuck equipment can be calculated, it's impossible to precisely calculate the other forces that are pulling against the towing vehicle which requires special training and experience to properly size towing equipment and select towing techniques. This is especially true for "complex" or high-hazard extractions involving equipment stuck at axle depth (or beyond) or sloped surfaces or any area where extraction activities could trigger shifts in the ground surface. No chains shall be used to remove stuck vehicles/equipment.

The following table summarizes safety controls related to stuck vehicles and equipment and are aligned to the hierarchy of controls:

| Elimination | Substitution | Engineering | Administrative | PPE |
|---|---|---|---|---|
| Change the work task or work methods so that work on ash ponds is no longer required | Use the lightest available tracked equipment to reduce ground pressure<br><br>Substitute tracked equipment for wheeled equipment | Use crane mats or other cribbing to support heavy equipment on ash ponds<br><br>Lighten the load – Remove materials from stuck vehicles or equipment prior to extraction if possible | Only persons trained in vehicle extraction are permitted to remove stuck vehicles/equipment<br><br>A professional towing/wrecking service is required<br><br>Prepare for spills (damage to fuel or hydraulic systems) | All persons involved in removing stuck equipment must wear PPE that includes hard hat, safety boots, safety glasses, high visibility vests, and cut resistant gloves |

## 4.4 Working Near/Over Water

All employees, contract workers, and third-party contractors must wear a United States Coast Guard (USCG) approved personal floatation device (PFD), when within 6 feet of water, over water, and/or wading in water where the danger of drowning exists. The PFD must be properly secured to the wearer, free of all defects including rips, tears, stress, and fading, and be kept clean and free of excessive dirt and oil.

If the possibility of falling into water has been eliminated through the use of guardrails, fall restraint, or other method, the use of a PFD is no longer required.

When performing work on water from a vessel, at least one lifesaving rescue vessel (*e.g.,* a skiff) shall be immediately available at locations where employees are working over, in, on, or adjacent to water where the danger of drowning exists. However, if the water is so shallow that rescuers could simply walk/run into the water body without endangering themselves and/or others or the work was being conducted very close to shore (*e.g.,* the length of the skiff from shore would be greater than the working distance from shore and/or the skiff would foul on the bottom), a skiff would not be required.

The following table summarizes the requirements for working over/near water where a drowning hazard exists and are aligned to the hierarchy of controls:

| Elimination | Substitution | Engineering | Administrative | PPE |
|---|---|---|---|---|
| Change the work task or work methods so that work near a drowning hazard is no longer required | | Install guardrails that separate work areas from the drowning hazard | All work to be performed by at least two people where each is equipped with proper safety gear and capable of summoning emergency rescue | All personnel are required to wear suitable PFDs |
| | | Utilize equipment (crowd-control barricades, safety fence, etc.) that will keep personnel at least 6 feet from a drowning hazard | When working on water use of a rescue skiff as outlined above | |
| | | | Use of a ring buoy with 90 feet of braided polycarbonate (or equivalent) line | |
| | | | Ring buoys must be positioned within 100 feet of work (maximum of 200 feet spacing) | |

## 4.5 Heavy Equipment

All heavy equipment operators must be competent and authorized to operate each piece of heavy equipment. Forklift and telehandler (*e.g.,* Lull, JLG) operators must have a license or certificate that indicates they have passed a written test and "road" test for the equipment they will be operating within the last 3 years. Third-party contractors will provide proof of qualification upon request of IPRG.

Persons working around heavy equipment must implement the “25 Foot Rule.” The 25 Foot Rule requires that persons get the operator’s attention and permission prior to approaching closer than 25 feet to heavy equipment. Persons must walk quickly through blind spots. Loitering in heavy equipment blind spots (especially to the rear) must be avoided.

Temporary fuel storage tanks will be labelled as to their content and be protected from collision by Site vehicles using solid barricades including balusters, chain link fence, or equivalent. Spill kit (55-gallon sorbent capacity contained in an overpack) and one 20-pound Type ABC fire extinguisher will be located within 45 feet of fueling areas. Tanks will be rated for above ground use and will be double walled or have secondary containment in case of a leak. Tanks and dispensing hose will be bonded and grounded. On-site filling of fuel storage tanks will be completed with trucks that have automatic over-flow shutoffs. These trucks will be properly bonded to the storage tank and meet all of the other storage tank requirements. Temporary secondary containment must be provided in the refueling area that includes the storage tank and dispensing hoses.

| Elimination | Substitution | Engineering | Administrative | PPE |
|---|---|---|---|---|
| | | Heavy equipment (and vehicles) must be equipped with backup alarms, horns, roll-over protection (when feasible) | Operators must be competent and authorized | Operators must use seatbelts when equipped |
| | | Vehicles and heavy equipment operated at night must have headlights, tail lamps, and reflectors | Forklift operators must have a current license or certificate (within 3 years) | High visibility vests are required when working around heavy equipment |
| | | | All vehicles and equipment must be turned off when not in use | |
| | | | Operators must inspect equipment daily prior to use | |
| | | | Persons working near heavy equipment must follow the “25 Foot Rule” and avoid lingering in blind spots as outlined above | |
| | | | Always obey site speed limits – 15 mph unless otherwise posted | |

## 4.6 Overhead Powerlines

All overhead powerlines must be assumed to be energized until confirmed otherwise. The minimum clearance distance for equipment working near energized power lines must be in accordance with the table found in 29 C.F.R. § 1926.1408(h).

The following table summarizes safety controls for work near energized power lines:

| Elimination | Substitution | Engineering | Administrative | PPE |
|---|---|---|---|---|
| Plan to work away from powerlines | Use heavy equipment with shorter booms/attachments to avoid coming close to power lines | Contact the utility owner to deenergize the line | Install signs to warn personnel of overhead powerlines | |
| | | Contact the utility owner to install insulated sleeves over energized lines | Install a non-conductive distance marker to delineate minimum clearance | |
| | | | Use a dedicated spotter to ensure equipment does not enter minimum clearance distances | |

## 4.7 Severe Weather

Severe weather conditions include but are not limited to high winds, electrical storms, heavy rain, and tornados can cause hazardous conditions at CCR surface impoundments. The primary control for severe weather is monitoring weather reports prior to beginning work and as work occurs throughout the day.

Monitor lightning using a commercially available mobile application if cellular service is available. When lightning is observed within 10 miles of the CCR surface impoundment, or a storm is imminent, take shelter in the nearest solid structure or fully enclosed vehicle. If possible, secure all tools, materials, and equipment prior to the storm arriving. Work may resume 30 minutes after the last lightning strike is observed within 10 miles. The following locations are acceptable shelter locations near the CCR Units:

- GMF Pump House at the landfill area
- Dumper House at the Coal Yard
- New Stack base

Do not conduct work on a CCR surface impoundment when there is a risk for tornados in the area. If on a CCR surface impoundment and a tornado forms, seek the nearest substantial shelter. The closest tornado shelters are the same as the severe weather shelter locations; shelter locations will be reviewed during the Site Orientation Training. If no shelter is available, attempt to evacuate to a shelter using a vehicle. If a tornado forms and you are not in a shelter, take one of the following actions:

- Stay in a vehicle with the seat belt on, keep your head below the windows and cover it with your hands
- If there is an area which is noticeably lower than the work area, lie in that area and cover your head with your hands.

The following table summarizes safety controls related to severe weather:

| Elimination | Substitution | Engineering | Administrative | PPE |
|---|---|---|---|---|
| Plan outdoor tasks on days with low potential for severe weather. | | | Prior to beginning outdoor work monitor the day's weather. | |

| Elimination | Substitution | Engineering | Administrative | PPE |
|---|---|---|---|---|
| | | | Periodically monitor weather throughout the day. Use a weather app which issues alerts for severe weather and lightning, assuming cell service is available | |
| | | | Utilize a weather radio if cellular service is inconsistent | |
| | | | Stop all outdoor work and seek shelter when lightning is observed | |

## 4.8 Heat Stress

Heat stress can be a significant hazard, especially for workers wearing protective clothing. Depending on the ambient conditions and the work being performed, heat stress can occur very rapidly, within as little as 15 minutes. Employees, contract workers, and third-party contractors will be instructed in the identification of a heat stress victim, the first-aid treatment procedures for the victim, and in the prevention of heat stress incidents.

Workers will be encouraged to immediately report any heat-related problems that they experience or observe in fellow workers. Any worker exhibiting signs of heat stress and exhaustion should be made to rest in a cool location and drink plenty of water. Emergency help by a medical professional is required immediately for anyone exhibiting symptoms of heat stroke, such as red, dry skin, confusion, delirium, or unconsciousness. Heat stroke is a life-threatening condition that must be treated immediately by competent medical authority.

### 4.8.1 Heat Stress Prevention

To prevent heat stress, IPRG employees, contract workers, and third-party contractors will implement heat stress prevention measures as outlined in OSHA's Heat Index (below). A summary of these precautions is described below.

| Heat Index | Risk Level | Protective Measures |
|---|---|---|
| Less than 91°F | Lower (Caution) | Basic heat safety and planning |
| 91°F to 103°F | Moderate | Implement precautions and heighten awareness |
| 103°F to 115°F | High | Additional precautions to protect workers |
| Greater than 115°F | Very High to Extreme | Triggers even more aggressive protective measures |

**Know the Symptoms:** Some symptoms associated with heat stress are: Employees should be aware of these symptoms with themselves and with their co-workers:

- Elevated heart rate, lack of concentration, difficulty focusing on a task, fatigue
- Irritability and/or sickness
- Cramps, rash, headache
- Loss of desire to drink water
- Fainting
- Skin clammy, moist, and pale (severe heat exhaustion)
- Skin extremely dry and red (heat stroke)

**Acclimatize:** When high heat stress conditions arise, employees should be exposed to the heat for short work periods followed by longer periods of work. Acclimatization usually takes five (5) days and should be provided for all new employees and employees returning from an absence of two (2) weeks or more. Contact Corporate Health and Safety for proper procedures.

**Hydration & Pace of Work:** Make sure all employees intake plenty of water throughout the work day (sometimes as much as a quart per worker per hour) and let employees know where the drinking water is located. Adjust your work pace and expectations on how much work can be done during periods of high heat stress. Workers cannot do as much during periods of high heat stress compared with similar periods of low heat stress. After acclimatization, workers may be able to resume a more "normal" work pace as long as fluid intake is adequate.

**Work/Rest Periods:** If possible, heavy work should be scheduled during the cooler parts of the day (*i.e.,* early morning) and rest periods should be taken in cool areas for longer periods.

**Personal Protective Equipment (PPE):** Employees using PPE (*i.e.*, Tyvek® suits or other equipment which may retain heat) can be more susceptible to heat stress due to the fact that heat/sweat often cannot escape the suits and/or the equipment. Persons wearing PPE that contributes to heat stress require more hydration, longer rest periods, or a reduced pace of work. Also, more careful monitoring of each person's health status is required by co-workers and management.

The following table summarizes safety controls for heat related illnesses:

| Elimination | Substitution | Engineering | Administrative | PPE |
|---|---|---|---|---|
| Perform outdoor, strenuous, tasks at cooler times of day/year | Use mechanized equipment in place of manual labor | Install fans or air conditioning units in the work area | Train all personnel to know the signs of heat stress/stroke and how to prevent it | Implement the use of cooling vests or other similar PPE |
| | | Install a canopy to provide shade to work areas | Allow workers to acclimatize to the work environment | |
| | | Provide cool, shaded break areas | Adjust work pace to allow for the effects of heat | |
| | | | Implement work/rest periods | |

## 4.9 Cold Stress

The four environmental conditions that cause cold-related stress are low temperatures, high/cool winds (wind chill), dampness, and cold water. One, or any combination of these factors, can cause cold-related hazards. Cold stress, including frostbite and hypothermia, can result in severe health effects. Employees, contract employees, and third-party contractors will be instructed in the identification of a cold stress victim, the first-aid treatment procedures for the victim and in the prevention of heat stress incidents.

A dangerous situation of rapid heat loss may arise for any individual exposed to high winds and cold temperatures. Major risk factors for cold-related stresses include:

- Wearing inadequate or wet clothing thus increasing the effects of cold on the body.
- Taking certain drugs or medications such as alcohol, nicotine, caffeine, and medication thus inhibiting the body's response to the cold and/or impairing judgment.
- Having a cold or certain disease, such as diabetes, heart, vascular and thyroid problems, and thereby increasing susceptibility to the winter elements.
- Lower body-fat composition or other physiological differences. Statistics show that men experience far greater death rates due to cold exposure than women, potentially attributable to participation in risk-taking activities, lower body-fat composition and/or other physiological differences.
- Becoming exhausted or immobilized, especially due to injury or entrapment, thus speeding up the effects of cold weather.

The following table provides the resulting equivalent chill temperature to exposed skin because of increasing wind speeds at decreasing actual temperatures. Personnel shall be aware of predicted weather conditions before beginning site work and stay apprised of changes.

**TABLE 2. Cooling Power or Wind on Exposed Flesh Expressed as Equivalent Temperature (under calm conditions)***

| Estimated Wind Speed (in mph) | Actual Temperature Reading (°F) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 50 | 40 | 30 | 20 | 10 | 0 | −10 | −20 | −30 | −40 | −50 | −60 |
| | Equivalent Chill Temperature (°F) | | | | | | | | | | | |
| calm | 50 | 40 | 30 | 20 | 10 | 0 | −10 | −20 | −30 | −40 | −50 | −60 |
| 5 | 48 | 37 | 27 | 16 | 6 | −5 | −15 | −26 | −36 | −47 | −57 | −68 |
| 10 | 40 | 28 | 16 | 4 | −9 | −24 | −33 | −46 | −58 | −70 | −83 | −95 |
| 15 | 36 | 22 | 9 | −5 | −18 | −32 | −45 | −58 | −72 | −85 | −99 | −112 |
| 20 | 32 | 18 | 4 | −10 | −25 | −39 | −53 | −67 | −82 | −96 | −110 | −121 |
| 25 | 30 | 16 | 0 | −15 | −29 | −44 | −59 | −74 | −88 | −104 | −118 | −133 |
| 30 | 28 | 13 | −2 | −18 | −33 | −48 | −63 | −79 | −94 | −109 | −125 | −140 |
| 35 | 27 | 11 | −4 | −20 | −35 | −51 | −67 | −82 | −98 | −113 | −129 | −145 |
| 40 | 26 | 10 | −6 | −21 | −37 | −53 | −69 | −85 | −100 | −116 | −132 | −148 |
| (Wind speeds greater than 40 mph have little additional effect.) | LITTLE DANGER In < hr with dry skin. Maximum danger of false sense of security | | | | INCREASING DANGER Danger from freezing of exposed flesh within one minute. | | | | GREAT DANGER Flesh may freeze within 30 seconds. | | | |
| | Trenchfoot and immersion foot may occur at any point on this chart. | | | | | | | | | | | |

*Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.
Equivalent chilll temperature requiring dry clothing to maintain core body tempearture above 36°C (96.8°F) per cold stress TLV

The following table summarizes safety controls for preventing cold stress:

| Elimination | Substitution | Engineering | Administrative | PPE |
|---|---|---|---|---|
| Perform work during warm parts of the day or warmer parts of the year | | Install heaters in enclosed work areas | Train all personnel on the symptoms of cold stress and how to prevent it | All personnel must wear multiple layers of clothing |
| | | Provide a warm break area | Implement work/rest schedule | Utilize hand/foot warmers when required |

An additional hazard in cold weather conditions is the increased risk for slips from the accumulation of ice and snow in general work areas, ruts where water is accumulated, and heavy equipment. The following table outlines controls that may be used for preventing slips:

| Elimination | Substitution | Engineering | Administrative | PPE |
|---|---|---|---|---|
| Perform work during warm parts of the day or in areas free of accumulated areas | | Clear snow in work areas | | Use traction control devices (*i.e.,* YakTrax) on work boots to provide additional traction. |
| | | Apply salt/sand to icy areas | | |
| | | Use equipment to access work areas | | |

## 4.10 Biological Hazards

The following are biological hazards that may be present at the Site.

### 4.10.1 Ticks (Lyme Disease) & Mites

Although Lyme disease has been detected throughout the continental United States, it is prevalent primarily in certain areas in New England, the Mid-Atlantic and the northern Midwest states. Although Lyme disease is the most common tickborne illness, other tickborne illnesses include southern tick-associated rash illness, Rocky Mountain spotted fever, ehrlichiosis, and tularemia. More information on Lyme disease and other tickborne illnesses can be found from the CDC.

**Prevention**

- Standard field gear (work boots, socks, and light-colored coveralls) provides good protection against tick bites, particularly if the joints are taped. However, even when wearing field gear, the following precautions shall be taken when working in areas that might be infested with ticks:
  - Wear long pants and long-sleeved shirts that fit tightly at the ankles and wrists, tape cuffs if necessary
  - Wear light colored clothing so ticks can be easily spotted
  - Per- and polyfluoroalkyl substances (PFAS)-free tick repellents (DEET <u>and</u> Permethrin) must be used when walking in all overgrown areas. DEET (≥25 percent [%]) must be applied to skin while permethrin must be applied to clothes and allowed to dry. Spray outer clothing, particularly your pant legs and socks, BUT NOT YOUR SKIN, with an insect repellent that contains permethrin. For heavily infested tick areas, wear spun polypropylene coveralls that have been sprayed with permethrin.
  - Inspect clothing frequently
  - Inspect head and body thoroughly when you return from the field, particularly on your lower legs and areas covered with hair
  - When walking in wooded areas, wear a hard hat, and avoid contact with bushes, tall grass, or brush as much as possible

**Removal**

- Remove any ticks by tugging with tweezers or special tick removal tools
- Do not squeeze or crush the tick
- DO NOT use matches, a lit cigarette, nail polish, or any other type of chemical to "coax" the tick out

**Treatment**

- Disinfect the area with alcohol or a similar antiseptic after removal.
- Notify the Safety Competent Person of the embedded tick.
- For several days to several weeks after removal of the tick, look for the signs of the onset of Lyme disease, such as a rash.
- No further treatment is necessary for ticks embedded <48 hours.
- If other signs or symptoms of Lyme are observed (fever/chills, aches, and pains), then notify the Safety Competent Person and seek medical attention.

The following table summarizes safety controls to reduce the hazards associated with ticks and mites.

| Elimination | Substitution | Engineering | Administrative | PPE |
|---|---|---|---|---|
| Use mechanical equipment to remove overgrown vegetation | | Remove overgrowth and excessive vegetation from walkways and work areas (provide safe access) | Train personnel on tick and mite prevention. Areas of vegetation overgrowth and/or debris piles should be considered "high risk" areas | Wear light-colored long sleeved shirt tucked into pants. Tuck pant legs into socks |
| | | | Perform frequent tick checks in the field and a thorough tick check after completing work activities | Apply Permethrin to clothes and DEET (20% or more) to exposed skin |
| | | | Call licensed pesticide contractors to remove infestations of bees, wasps, fire ants, etc. | |

### 4.10.2 Insect Bites/Stings

Stinging/biting insects at the Site include spiders, wasps, and bees. Contact with these insects may result in project personnel experiencing adverse health effects that range from being mildly uncomfortable to being life-threatening. Therefore, insects present a serious hazard to project personnel, and extreme caution must be exercised whenever Site and weather conditions increase the risk of encountering stinging insects. Some of the factors related to stinging insects that increase the degree of risk associated with accidental contact are as follows:

- The nests for these insects are frequently found in remote wooded or grassy areas or equipment staging areas where equipment has not been moved recently.
- Some people are hypersensitive to the toxins injected by a sting, and when stung, experience a violent and immediate allergic reaction resulting in a life-threatening condition known as anaphylactic shock. Anaphylactic shock manifests itself very rapidly and is characterized by extreme swelling of the body, eyes, face, mouth, and respiratory passages.
- The hypersensitivity needed to cause anaphylactic shock, can in some people accumulate over time and exposure, therefore even if someone has been stung previously and not experienced an allergic reaction, there is no guarantee that they will not have an allergic reaction if they are stung again
- Spider bites generally only cause localized reactions such as swelling, pain, and redness. However, bites from a Black Widow or Brown Recluse, or if you are allergic to spiders, can cause symptoms that are more serious.
- ***If a worker knows that they are hypersensitive to bee, wasp, or hornet stings, or other insects, they must inform the Safety Competent Person prior to site work. Persons who have been prescribed epi-pens by their physician must have an epi-pen on the Site.***
- Inspect any clothing or PPE that has been left for a period of time prior to putting it on. Shake out the clothing and inspect the inside of safety shoes/boots prior to putting them on
- Nests in active work areas must be eradicated. Small nests may be handled by Site personnel using consumer-type insecticide. A pest control contractor should be hired to handle large or difficult to reach nests.

The following table outlines safety controls to reduce the risk of hazards associated with stinging/biting insects.

| Elimination | Substitution | Engineering | Administrative | PPE |
|---|---|---|---|---|
| Use mechanical equipment to remove overgrown vegetation | | Remove overgrowth and excessive vegetation from walkways and work areas (provide safe access) | Train personnel on stinging/biting insect prevention. Areas of vegetation overgrowth and/or debris piles should be considered "high risk" areas | Wear light-colored long sleeved shirt tucked into pants. Tuck pant legs into socks |
| | | Eradicate nests in the work area as outlined above. | Instruct personnel to inspect/shake out clothing and work boots that have been left for a period of time. | Apply Permethrin to clothes and DEET (20% or more) to exposed skin – NOTE this will not repel bees/wasps |
| | | | Instruct employees who are hypersensitive to insect bites/stings to carry their epi-pen while on site | |

### 4.10.3 Venomous Snakes

There are four species of venomous snakes in Illinois, they are:

- Copperhead
- Cottonmouth Water Moccasin
- Timber rattlesnake
- Eastern Massasauga

Generally, these snakes are found in the southern one-third of the state, with the Cottonmouth Water Moccasin found mostly in the southernmost portions of Illinois. Snakes are generally found in tall grass, wood piles, or other covered areas. Snakes are generally not aggressive towards humans, but if they are encountered avoid the snake and do not provoke it. If bitten by a snake that may be venomous seek medical treatment.

The following table outlines safety controls to reduce the hazard associated with venomous snakes.

| Elimination | Substitution | Engineering | Administrative | PPE |
|---|---|---|---|---|
| Use mechanical equipment to remove overgrown vegetation | | Remove debris piles, overgrowth and excessive vegetation from walkways and work areas (provide safe access) | Train personnel on the identification of venomous snakes. Areas of vegetation overgrowth and/or debris piles should be considered "high risk" areas | If working in area with snakes cannot be avoided, wear snake chaps |
| | | | Instruct personnel to not disturb snakes if they identify one in their work area | |

| Elimination | Substitution | Engineering | Administrative | PPE |
|---|---|---|---|---|
| | | | Use caution when moving staged tools or materials into which snakes may have moved | |

### 4.10.4 Poisonous Plants and Plant Hazards

Poison ivy and poison oak may be present at the Site. Poison ivy thrives in all types of light and usually grows in the form of a trailing vine; however, it can also grow as a bush and can attain heights of 10 feet or more. Poison ivy has pointed leaves that grow in clusters of three. Poison oak resembles poison ivy except that the poison oak leaves are more rounded rather than jagged like poison ivy, and the underside of poison oak leaves are covered with hair.

The skin reaction associated with contacting these plants is caused by the body's allergic reaction to toxins contained in oils produced by the plant. Becoming contaminated with the oils does not require contact with just the leaves. Contamination can be achieved through contact with other parts of the plant such as the branches, stems or berries, or contact with contaminated items such as tools and clothing. The allergic reaction associated with exposure to these plants will generally cause the following signs and symptoms:

**Symptoms**

- Blistering at the site of contact, usually occurring within 12 to 48 hours after contact and in many cases, persons experience almost immediate irritation.
- Reddening, swelling, itching, and burning at the site of contact.
- Pain, if the reaction is severe.
- Conjunctivitis, asthma, and other allergic reactions if the person is extremely sensitive to the poisonous plant toxin.

**Prevention**

- The best treatment appears to be removal of the irritating oil before it has had time to cause inflammation by wiping exposed skin with rubbing alcohol followed by washing with soap and water.
- A visual Site inspection and identification of the plants should be completed prior to starting work so that all individuals are aware of the potential exposure. Avoid contact with any poisonous plants on the Site, and keep a steady watch to identify, report, and mark poisonous plants found on the Site.
- Avoid contact with, and wash daily, contaminated tools, equipment, and clothing.
- Barrier creams (Ivy Block®) and orally administered desensitization may prove effective and should be tried to find the best preventive solution.
- Keeping the skin covered as much as possible (*i.e.*, long pants and long-sleeved shirts) in areas where these plants are known to exist will limit much of the potential exposure. PFAS-free spun polypropylene coveralls or Tyvek® may be worn to prevent contact of skin and clothes with poison ivy.

The following table outlines safety controls to mitigate the hazards associated with poisonous plants.

| Elimination | Substitution | Engineering | Administrative | PPE |
|---|---|---|---|---|
| Use mechanical equipment to remove overgrown vegetation | | Remove overgrowth and excessive vegetation from walkways and work areas (provide safe access) | Train personnel on the identification of poisonous plants | Wear pants and long sleeves when working in overgrown areas |
| | | | Instruct personnel to avoid areas where poisonous plants have been identified | Consider the use of a coverall when working in areas where these plants are present, especially for hypersensitive employees. |
| | | | Provide isopropyl alcohol along with soap and water to remove oils from skin, tools, and equipment. | |

### 4.11 Working Alone

As outlined in Section 4.1, working alone while on an ash pond must be pre-approved by the POC. Working alone is prohibited for tasks deemed to be high risk by IPRG including, but not limited to, handling highly hazardous chemicals (sulfuric acid), work over/near water, excavation and trenching, hot work (grinding, welding and torch cutting), and elevated work that requires personal fall arrest. Third-party contractors are responsible for identifying potential high-risk tasks in their Safety and Health Plan and requiring that a buddy system be implemented while high risk work is performed. The buddy must be located in a safe area but may perform other tasks that do not prevent observing the person performing high risk work. Working alone may occur on and around other parts of the Site when there is no drowning hazard or risk of severe injury due to high-risk work.

| Elimination | Substitution | Engineering | Administrative | PPE |
|---|---|---|---|---|
| | Modify work methods by substituting lower hazard methods for high hazard methods | Varies depending on the hazard, but for example, could include installing guardrails (temporary or permanent) which mitigates a fall hazard reducing the risk to levels where working alone may be permitted | Prohibit working alone on ash ponds and for other high hazard tasks without prior approval from the POC | |
| | | | Implement a buddy system whenever feasible (required for high hazard work) | |

| Elimination | Substitution | Engineering | Administrative | PPE |
|---|---|---|---|---|
| | | | Implement a worker check-in, emergency alerting, and monitoring system | |

# 5. HAZARD COMMUNICATION

As required by 35 I.A.C. § 845.530, the OSHA HAZWOPER standards (29 C.F.R. § 1910.120 and 29 C.F.R. § 1926.65) and OSHA Hazard Communication Standard, site personnel, subcontractors, and visitors must be informed of chemical hazards associated with their work area. The information in this section is based on:

- Recommendations in the most recent "NIOSH Pocket Guide to Chemical Hazards" by the Department of Health and Human Services, Centers for Disease Control and Prevention, and the NIOSH Pocket Guide.
- Requirements set forth in the OSHA regulations from as defined in Chapter 17 of 29 C.F.R. § 1910.1200(c) for all hazards not otherwise classified.

## 5.1 Coal Combustion Residuals

Primary exposure to CCR is through inhalation and skin contact. CCR is typically a fine, black, grey, or tan particulate. CCR is comprised of several components. The following table outlines the components of the CCR. The exact percentage of each component will vary based on the type of ash and location at the surface impoundment.

<table>
<tr><th>Chemical</th><th>Percentage</th><th>PEL</th><th>IDLH</th><th>ACGIH TLV</th><th>Symptoms of Exposure & Health Effects</th></tr>
<tr><td>Crystalline Silica</td><td>20-60% (total)</td><td>0.05 mg/m³ (respirable)</td><td>25 mg/m³ (respirable)</td><td>0.025 mg/m³ (respirable)</td><td>Cough, dyspnoea (breathing difficulty), wheezing; decreased pulmonary function, progressive respiratory symptoms (silicosis); irritation eyes; [potential occupational carcinogen]</td></tr>
<tr><td>Iron oxide</td><td>1-10%</td><td>5 mg/m³</td><td>2500 mg/m³</td><td>5 mg/m³</td><td>Benign pneumoconiosis with X-ray shadows indistinguishable from fibrotic pneumoconiosis (siderosis)</td></tr>
<tr><td>Calcium oxide</td><td>10-30%</td><td>5 mg/m³</td><td>25 mg/m³</td><td>2 mg/m³</td><td>irritation eyes, skin, upper respiratory tract; ulcer, perforation nasal septum; pneumonitis; dermatitis</td></tr>
<tr><td>Titanium dioxide</td><td><3%</td><td>15 mg/m³</td><td>ND</td><td>10 mg/m³</td><td>Lung fibrosis; [potential occupational carcinogen]</td></tr>
<tr><td>Aluminosilicates</td><td>10-60%</td><td rowspan="3">15 mg/m³ (PNOR)</td><td rowspan="3">ND</td><td rowspan="3">10 mg/m³ (PNOR)</td><td rowspan="3">irritation eyes, skin, throat, upper respiratory system</td></tr>
<tr><td>Magnesium oxide</td><td>2-10%</td></tr>
<tr><td>Magnesium dioxide</td><td><2%</td></tr>
<tr><td>Phosphorous pentoxide</td><td>≤2%</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Sodium oxide</td><td>1-10%</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Potassium oxide</td><td>≤1%</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Bromide salt</td><td><0.1%</td><td></td><td></td><td></td><td></td></tr>
</table>

**Footnotes:**

All values are 8-hour time-weighted averages (TWAs) unless otherwise indicated.

- PEL: Permissible Exposure Limit, the concentration an employee may be exposed to for an 8-hour work day for a 40-hour work week for which nearly all employees may be repeatedly exposed without adverse health effects.
- IDLH: IMMEDIATELY Dangerous to Life and Health, contaminant concentration which present the possibility for severe health consequences if exposed to the IDLH concentration without the appropriate personal protective equipment (PPE).
- ACGIH TLV: American Conference of Governmental Industrial Hygienists Threshold Limit Value
- $mg/m^3$ = milligrams per cubic meter of air
- PNOR: Particulates Not Otherwise Regulated
- ND: Not Determined

## 5.2 Safety Data Sheets

Pursuant to 35 I.A.C. § 845.530(b)(3), IPRG will provide Safety Data Sheets (SDSs) to all employees, contract workers, and third-party contractors for the CCR located at the Site. Third-party contractors will provide SDSs to the Environmental Manager prior to bringing a material on site. SDSs are provided in Appendix E.

## 5.3 Signage

The absence of any of the following signage does not mean that a potential hazard does not exist. Signage will be posted by IPRG, but employees, contract workers, and third-party contractors must remain vigilant for changing site conditions.

To aid in hazard communication and pursuant to 35 I.A.C. § 845.530(f), IPRG will post the following signs at the Site:

- Signs identifying the hazards of CCR, including dust inhalation when handling CCR.
- Signs identifying unstable CCR areas that make the operation of heavy equipment hazardous.
- Signs identifying the necessary safety measures and necessary precautions, including the proper use of PPE.

The following signs may also be posted at the CCR units to aid in hazard communication:

- Overhead electrical lines that may be struck by heavy equipment of vehicles will have signs warning drivers of their presence.

# 6. EMERGENCY RESPONSE PLAN

This emergency response section details actions to be taken in the event of site emergencies. This section is consistent with the DCPP Emergency Response Plan. All personnel on site must be familiar with emergency signals and the content of this section.

## 6.1 Emergency Phone Numbers & Notifications

| Emergency Number | |
|---|---|
| **Site Address** | **Emergency Phone Number** |
| 17751 North Cilco Rd<br>Canton, IL 61520 | 911 |
| | Security Guard: 713-542-0619 |

| Medical Treatment | |
|---|---|
| **Local Hospital** | **Phone Number** |
| Graham Hospital<br>410 East Elm St<br>Canton, IL | 309-647-4088 |

| Incident Notifications | | |
|---|---|---|
| **Title** | **Name** | **Contact Number** |
| Security Guard | | 712-542-0619 |
| POC | Brandon Potter | 618-210-3418 |

## 6.2 Evacuation Signal

Upon receiving notification to evacuate, all personnel will leave the work area and proceed to the muster point.

## 6.3 Muster Point

The muster point for the Site is located at the Security Office by the Main Entrance (Appendix A). The following locations are acceptable severe weather shelter locations near the CCR Units:

- GMF Pump House at the land fill area
- Dumper House at the Coal Yard
- New Stack base

## 6.4 Calls for Emergency Support

In the case of an emergency, site personnel will call **911** followed by notifying the security guard (713-542-0619). The security guard will coordinate the arrival of on-site emergency personnel. The individual calling for emergency support will briefly explain the nature of the emergency and site conditions as follows:

- Indicate his/her name
- Location of emergency
- Description of emergency conditions that may require special rescue equipment, such as confined spaces, excavations, and elevated work platforms
- Potential chemical hazards and recommended PPE

## 6.5 Fire & Explosion Response Plan

Trained site personnel may respond to incipient stage fires using a 20-pound Type ABC dry chemical fire extinguisher or hose. An incipient stage fire is a fire which is in the initial or beginning stage and which can be controlled or extinguished by portable fire extinguishers, Class

II standpipe or small hose systems without the need for protective clothing or breathing apparatus. Personnel shall only attempt to extinguish the fire if it is safe to do so.

A fire that CANNOT be readily extinguished with a fire extinguisher will require evacuation of the work area personnel to Muster Point areas per this Safety and Health Plan. If personal injuries result from any fire or explosion, the procedures outlined in the Personal Injury Response Plan will also be followed.

All fires or explosions must be reported to the contacts outlined in Section 6.1 of this Safety and Health Plan.

## 6.6 Injury Response Plan

Treatment for minor injuries will be provided on site using available first aid supplies and personnel trained in first aid. All third-party contractors must have at least one individual on site who is trained in first aid, CPR, and AED use. Third-party contractors must provide their own first aid kits and AED. For minor injuries that are not life-threatening but require further medical attention, employees should be treated by occupational physicians at occupational clinics whenever possible. Treatment of minor injuries by emergency room or personal physicians should be avoided. When injured workers are released back to work with restrictions, all subcontractors are expected to accommodate those restrictions.

Emergency medical incidents include puncture wounds to the head, chest, and abdomen, serious head and spinal cord injuries, and loss of consciousness must be treated at the hospital emergency room listed in Section 6.1 of this Safety and Health Plan.

All injuries must be reported to the contacts outlined in Section 6.1 of this Safety and Health Plan.

## 6.7 Spill Response Plan

In general, IPRG employees, contract workers, and third-party contractors are trained and equipped to handle small spills associated with their work. Third-party contractors must include an approved spill response plan in their Safety and Health Plan. Site personnel will generally respond to spills as follows:

- Stop the leak immediately if it can be done without directly contacting the leaking material.
- Remove or stop all ignition sources (hot work, generators, etc.) that are within 25 feet of any part of the spill.
- On-site personnel should immediately secure the area to prevent unauthorized entry into the spill area.
- Although not likely given the anticipated types of spills, site personnel must immediately initiate evacuation if a spill may cause an explosion, death, or serious injury.
- Site personnel may only respond to incipient stage fires regardless if such fires are associated with a spill.
- PPE for spills to open areas generally requires Modified Level D PPE (poly-coat Tyvek®, nitrile gloves, and boot covers or boot decontamination). Over-boots or boot covers may also be used if persons cleaning the spill would have to walk on spilled materials. Latex gloves are not acceptable and will degrade with exposure to petroleum products.
- Contact the Environmental Manager upon containing the spill.

## 6.8 CCR Spill or Release Response Plan

Response to minor or incidental spills of CCR will be managed as outlined in the General Spill Response Plan. An incidental release is a release of a hazardous substance which does not pose a significant safety or health hazard to employees in the immediate vicinity or to the employee cleaning it up, nor does it have the potential to become an emergency within a short time frame. Incidental releases are limited in quantity, exposure potential, or toxicity and present minor safety or health hazards to employees in the immediate work area or those assigned to clean them up. An incidental spill may be safely cleaned up by employees who are familiar with CCR. Response to major releases of CCR will be in accordance with the DCPP Emergency Action Plan, which can be found on the Luminant CCR website at https://www.luminant.com/ccr/.

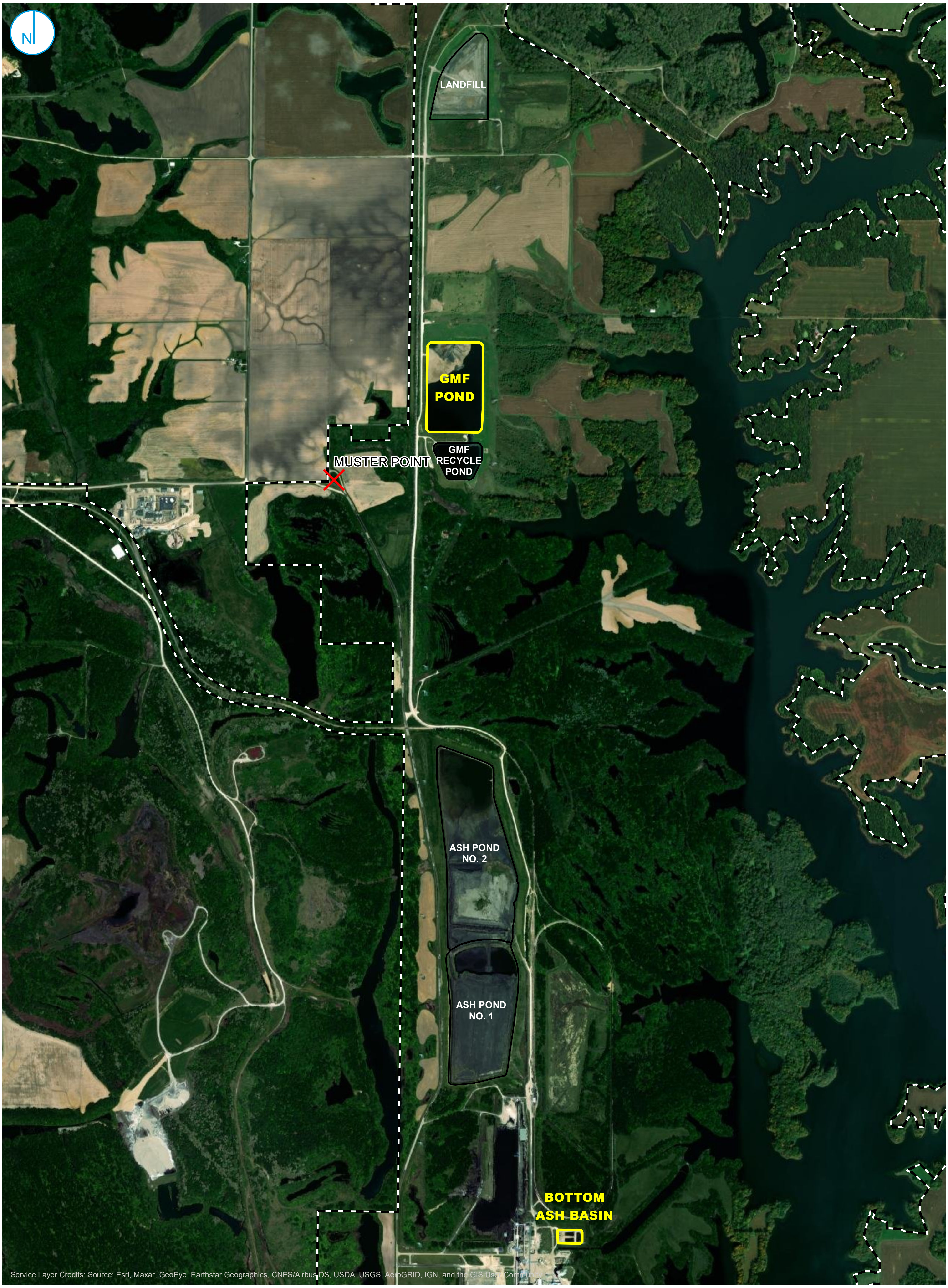
## 6.9 Ash Pond Rescue

Ash ponds may be unstable and represent an engulfment hazard if persons and equipment traverse the surface, berms, or other unstable areas. Special training is required on behalf of emergency responders to retrieve persons and equipment who become trapped in unstable ash. **Untrained persons must not enter unstable areas** in an attempt to conduct rescue because of the significant potential that they will also become victims. Call 911 and the Guard Shack emergency number and state that an "ash pond rescue" is required. The Guard Shack will notify the designated service to perform the ash pond rescue. On-site personnel should remain on stand-by to support the ash pond rescue team as necessary.

## 6.10 Incident Reporting

All incidents must be reported to the contacts outlined in Section 6.1 of this Safety and Health Plan. An Incident Report must be completed for all injuries, illnesses, spills, fire, explosion, or property damage. The absence of an injury does not preclude the need to complete an Incident Report as such incidents will be classified as "near miss" or "other." It will include, but is not limited to, the nature of the problem, time, location, and corrective actions taken to prevent recurrence.

# APPENDIX A
# SITE MAP




PART 845 REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY

0 750 1,500 Feet

## SITE MAP

## APPENDIX A

PART 845 SAFETY AND HEALTH PLAN
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

# APPENDIX B
# SAFETY AND HEALTH PLAN ACKNOWLEDGMENT FORM

## *SAFETY AND HEALTH PLAN ACKNOWLEDGEMENT FORM*

*I HEREBY CERTIFY THAT I HAVE READ AND UNDERSTOOD ALL HEALTH AND SAFETY PROCEDURES AS STATED HEREIN:*

| Name and Affiliation (printed) | Signature | Date |
| --- | --- | --- |
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# APPENDIX C
# DRUG SCREEN POLICIES AND SUPPLEMENTAL TERMS

Drug and Background Investigations

Contractor is solely responsible for ensuring that all members of Contractor Project Team have completed and passed all drug and alcohol tests and background investigations required under this Attachment and under Contractor's own programs before assigning such personnel to perform Work. Contractor is also solely responsible for ensuring that such testing and investigations are performed in accordance with all applicable laws.

1. Required Investigations. Except as otherwise required by applicable law, Required Investigations shall consist of all of the following:

   1.1 a 7-panel drug screening;

   1.2 a background investigation that includes a criminal records check in all counties where the applicable person has resided for at least the last seven (7) years;

   1.3 a third-party verification of previous employment and the highest education level completed by the applicable person;

   1.4 a check of the National Sex Offender Registry and Terrorist Watch List (Denied Parties); and

   1.5 a check of Motor Vehicles Record (if work to be performed by the applicable person requires driving as part of the defined duties).

2. Notices to Tested Persons Regarding Background Checks. All background checks will be conducted in compliance with applicable provisions of the Fair Credit Reporting Act.
3. Forms and Testing Organization for Drug Tests. Except for those positions subject to Department of Transportation ("DOT") drug and alcohol testing regulations, all drug testing shall be performed using the Universal Toxicology four part "Non-DOT" Chain of Custody and Request Form with white and blue top page, and shall be conducted by an independent third-party organization.

4. Pass/Fail Standards – Background Checks. A person shall be deemed to have failed the applicable background check if:

   4.1 information is reported through the background check process indicating that such person has failed to disclose or misrepresented information requested at any time about such a person's criminal background history; or

   4.2 such person has ever committed any felony constituting a violent crime, crime against a person, sexual offense or fraud; or

   4.3 such person has committed any other felony, or has been incarcerated for a felony, within ten (10) years prior to the date of such background check (i.e., for these felonies there must be a ten (10) year lapse in time from the later of the commission and the end of any period of incarceration); or

   4.4 such person has committed any misdemeanor that:

      4.4.1 involves violence that is sexually related; or

4.4.2 consists of a DUI that is the second (or more) DUI in the last two (2) years prior to the date of the background check; or

4.4.3 consists of a theft-related offense; provided that there can be no more than one theft by check and it must have been for an amount less that $100; or

4.4.4 consists of any drug-related misdemeanor committed at any time within forty-eight (48) months prior to the date of the background check.

4.4 For purposes of both felonies and misdemeanors, a person is deemed to have committed the applicable offense if he/she is convicted or enters a plea of guilty or nolo contendere for such offense (to include, without limitation, sentences of probation and deferred adjudication).

5. Pass/Fail Standards – Drug Tests. A person shall be deemed to have failed the applicable drug test if any of the following maximum cut-off levels are exceeded, unless there is a legitimate medical explanation for the presence of a tested substance at or above the applicable cut-off level:

5.1 Amphetamines 500ng/mL

5.2 Barbiturates 150ng/mL

5.3 Benzodiazepines 150ng/mL

5.4 Cocaine 150ng/mL

5.5 Marijuana 150ng/mL

5.6 Opiates 2000ng/mL

5.7 Phencyclidine 25ng/mL

For any positions subject to DOT drug and alcohol testing requirements, testing shall be conducted according to the applicable DOT panel and cutoff levels.

6. Other Requirements.

6.1 Background checks and drug tests will be paid for by Contractor without reimbursement by Company.

6.2 Contractor will keep background checks and drug test records while the applicable persons are working pursuant to this Agreement and for three (3) years thereafter.

6.3 Upon request, Contractor will provide a certification to Company that no person required hereunder to pass a background check or drug test has failed such investigation or test. Contractor will not provide the specific results of the background check or drug test of any individual to Company.

6.4 If any person required under this Agreement to pass a background check or drug test fails such check or test, Contractor will not report the specific results of such check or test to Company and will not allow such individual to perform any Work for Company. Although such person may not be assigned to perform any Work for Company, nothing in this Attachment requires Contractor to take any other action with respect to such person's employment with Contractor.

Supplemental Terms for Onsite Services

1. SAFETY

1.1 Contractor agrees that any safety-related assistance or initiatives undertaken by Company will not relieve Contractor while on Company Property from responsibility for the implementation of, and compliance with, safe working practices, as developed from their own experience, or as imposed by law or regulation, and will not in any way, affect the responsibilities resting with Contractor under the provisions of any agreement to which these policies are attached and to meet all safety requirements as specified by the Occupational Safety & Health Administration (OSHA), the Mine Safety Health Administration (MSHA), including the "Mining Contractor Safety Reference Handbook" located at http://www.vistraenergy.com/wp-content/uploads/2016/12/Contractors-Safety-Handbook_Final-MC-08262016.pdf, the Department of Transportation (DOT) and any other applicable state or federal safety and health laws or regulations.

1.2 In the event that a material safety data sheet, warning label, or other documentation concerning the use of hazardous chemicals at any property owned or controlled by Company or any of its affiliates (collectively, "Company Properties"), applies to any materials or equipment provided by Contractor as an aspect of the Work, such documentation will be provided by Contractor to Company prior to the commencement of any such Work.

1.3 Contractor will report to Company all accidents involving personal injuries (including death) and damage to property occurring directly or indirectly as a result of the Work performed by Contractor hereunder immediately, but in no event, no later than 24 hours after the occurrence of any such accident. Any accident or incident occurring directly or indirectly as a result of the Work which Contractor must report to a regulatory agency (e.g. OSHA, MSHA, TCEQ) must also be reported to Company immediately following notification to the regulatory agency.

2. SECURITY

2.1 It will be the affirmative duty of Contractor to ensure that Contractor Group assists in carrying out all security measures, to include reporting all information or knowledge of matters adversely affecting security to Company's designated security personnel.

2.2 Company reserves the right to exclude any of Contractor's employees from any Company Property by denial of access, suspension or revocation of access authorization, preemptory expulsion, or by any other means, without notice or cause. Former Company employees, and any of Contractor's employees who previously have been excluded from any Company Property, may be brought onto Company property or facilities only if prior approval from Company is obtained. If Contractor terminates a member of Contractor Group performing Work on Company's premises, Contractor shall inform Company immediately, but in no event, no later than twenty-four (24) hours after such employee is terminated in order for Company to remove access to Company Property for such employee.

2.3 Company measures may also include investigations, whether by Company or law enforcement officials. Contractor agrees to cooperate in such investigations and understands that Company reserves the right to require anyone in Contractor Group to authorize appropriate agencies to release his or her criminal records to Contractor as a condition of either initial or continued permission for access to any Company Property. Investigations may include searches of Contractor Group. Such searches may include searches of facilities assigned to Contractor Group, search of all Company Property areas and property at such Company Property areas, searches of including, but not limited to, offices, lockers, desks, lunch boxes, packages and motor vehicles (regardless of ownership). Without limiting the foregoing, Contractor acknowledges and agrees that all members of Contractor Group, to the extent that Company reasonably determines that such members require security badge access prior to entering onto any Company Property, shall be required to comply with Company's standard security badge requirements, including without limitation a background check to be performed by Company.

3. ISNETWORLD

3.1 Contractor agrees to maintain at Contractor's expense a subscription with ISNetworld (www.ISNetworld.com), Company's safety compliance program or any replacement program therefor, as directed by Company, for the Term of the Agreement. Contractor shall also furnish ISNetworld with any information requested by ISNetworld relating to ISNetworld's evaluation of the Contractor's safety program and practices. As a minimum, requested documents will be related to safety, health, and insurance (i.e., regulatory required training, certifications, safety plans, safe and secure workplace practices, insurance certificates, etc.), OSHA and MSHA injury rates and Experience Modification Rate (EMR).

3.2 Contractor has and during the performance of this Agreement shall continue to report full, complete and accurate information to ISNetworld concerning Contractor's employees.

4. MATERIALS, EQUIPMENT AND LABOR. Contractor will be solely responsible for the proper storage, transportation and disposal of any product or waste, other than sandblasting waste, used or generated in connection with the Work in accordance with all applicable Environmental Laws. Contractor will dispose of all waste materials, other than sandblasting waste, at an off-site disposal facility approved for such waste materials pursuant to applicable Environmental Laws and will complete and sign all waste manifests as the generator of such waste. Company will be responsible for the storage, transportation and disposal of any sandblasting waste generated during the performance of the Work.

5. CONDITIONS AFFECTING WORK

5.1 Contractor will investigate and acquaint itself with the conditions affecting the Work, including but not limited to those related to the transportation, disposal, handling and storage of materials and waste; availability of labor, water, electric power and roads; the uncertainties of weather, river stages or similar physical conditions at the site; the conformation and condition of the ground; and the character of equipment and facilities needed preliminary to and during prosecution of the Work. Contractor has satisfied itself as to the character, quality and quantity of surface and subsurface materials or obstacles to be encountered. Contractor's failure to acquaint itself with any conditions affecting the Work or any available related information will not relieve it from responsibility for properly estimating the difficulty or cost of successfully performing the Work.

5.2 Contractor assumes full responsibility for investigating conditions and determining the existence and magnitude of any hazards to the physical well-being of property of Contractor, the employees, agents, and servants of Contractor, or any other person or entity who is or may become involved in the performance of Work, and any and all other persons in the vicinity of the Work. Contractor will advise all of the above-specified persons or entities of any hazards relating to Work, and will ensure that those persons or entities are advised of and fully understand the nature of the hazards and safety precautions that can be taken to eliminate or minimize dangers relating to the hazards.

5.3 Contractor will provide information to Company regarding hazardous chemicals and/or consumable products that contain constituents listed in 40 CFR 372.65 used at any Company Property. Contractor will report the amount of such material carried on and off the site, the amount actually used and the manner of use. Contractor will provide the maximum quantity of the material stored on site at any one time and if a waste material was collected, where it was disposed of (location name and address). Contractor will provide information on the amount of material used for the previous calendar year by the first of February.

5.4 Contractor will use its best efforts to ensure that the Work is performed so as to minimize any adverse impact upon natural resources and the environment and will use best industry practices in this regard at all times.

5.5 Contractor acknowledges and agrees that all members of Contractor Group performing Work at any Company Generation or Mining Property are required to view Company's "Contractor/Visitor Safety Orientation" video (in the case of Company Generation property), when applicable, and to read and adhere to Company's "Contractor/Visitor Safety Booklet" (in the case of Company Mining property) prior to performing any Work at any Company Generation or Mining Property.

5.6 Contractor will immediately notify Company as soon as Contractor has reason to believe that Contactor, or any employee or other person performing the Work, is not or may not be performing the Work in compliance with applicable Environmental Laws. Contractor will provide Company with written notice to Company of such actual or potential non-compliance within three (3) days following the discovery thereof. Contractor will take immediate steps to ensure compliance with all applicable Environmental Laws and will, if directed by Company, cease all Work until authorized by Company to resume the Work.

5.7 Contractor will report to Company all accidents involving personal injuries (including death) and damage to property occurring directly or indirectly as a result of the Work performed by Contractor hereunder immediately, but in no event, no later than 24 hours after the occurrence of any such accident. Any accident or incident occurring directly or indirectly as a result of the Work which Contractor must report to a regulatory agency (e.g. OSHA, MSHA, TCEQ) must also be reported to Company immediately following notification to the regulatory agency.

## 6. WORK SITE PERMITS AND LICENSES

6.1 Subject to the following two paragraphs, Contractor will obtain, prior to the commencement of the Work, and provide to Company upon request, all permits, licenses and governmental authorizations, at its sole expense, required for the performance of the Work. Contractor will be solely responsible for maintaining compliance with such permits, licenses and governmental authorizations.

6.2 In the event that a storm water discharge permit is required for the performance of the Work, (i) Contractor will be responsible for filing a Notice of Intent with respect to the Work, in addition to any Notice of Intent that Company may be required to file, and (ii) Contractor will coordinate with

Company in the preparation and execution of a Storm Water Pollution Prevention Plan for the Work Site.

6.3 In the event that the performance of the Work involves the handling or abatement of asbestos-containing materials, Contractor will coordinate with Company in the preparation and filing of all required notification forms.

7. ACCESS. Should Contractor desire access to the Work Site over any land not controlled by Company, it will, at its sole expense, obtain all proper permits or written permission necessary for that access.

8. COMPANY FACILITIES. Contractor will not use Company's sanitary facilities, changehouses, shops, parks, storage buildings, tools, equipment or other facilities unless so directed by Company. Contractor will not discharge, without Company's prior written authorization, any product or waste used or generated in connection with the Work through any (i) Company-permitted outfall, (ii) Company-owned or operated pollution control equipment, or (iii) storm or sanitary sewer located at or in the vicinity of the Work Site. Any request for authorization to discharge will include, at a minimum, either a copy of the Material Safety Data Sheet for the product or a written description of the waste, including a list of the constituents of the waste and the relative concentrations thereof.

9. ENVIRONMENTAL

9.1 In the event that Contractor discovers during the performance of the Work any substance at the Work Site that is not the subject of the Work or has not otherwise been identified by Company for Contractor, which substance Contractor has reason to believe is or may be a Hazardous Substance that (i) has been or may be released or spilled into the soil, surface water, or groundwater or in a building or structure, or (ii) consists of asbestos-containing materials, lead-based paint, batteries, thermostats, lighting equipment, or equipment containing polychlorinated biphenyls, Contractor will immediately stop Work and notify Company of the discovery. Contractor will not resume the Work until receiving authorization from Company to do so.

9.2 The term "Hazardous Substance" means any product, waste, emission or substance defined, listed or designated as a hazardous or toxic substance, hazardous waste, hazardous material or pollutant by or pursuant to any Environmental Law and includes, but is not limited to, any petroleum-based product, substance or waste, including any additives associated therewith, pesticides, fertilizers, solvents, polychlorinated biphenyls, mercury, lead, lead-based paint, asbestos-containing material or explosives.

9.3 Contractor will immediately notify Company in the event of a spill or release of any material which Contractor knows or has reason to believe is a Hazardous Substance, whether onto the ground, into any body of water, a storm or sanitary sewer, or the air, or anywhere on property owned or controlled by Company, including within any building or structure. Contractor will be solely responsible, as may be required by applicable Environmental Laws, for, in consultation with Company, (i) notifying the appropriate governmental agencies of such spill or release caused or permitted by the acts or omissions of Contractor and (ii) for the cleanup and remediation of such spill or release.

10. PROTECTION OF HIGHWAYS AND RAILROADS. Contractor will make suitable arrangements with governmental authorities and railroads for the construction of all structures, whether underneath or over roads, railroads or rights-of-way to protect the public from accident or delay. Contractor will repair, at its

own expense, to the satisfaction of the governmental authorities or other owners, all roads, railroads and bridges that may be damaged by, or given undue wear due to the Work.

11. CLEANING UP

11.1 Contractor will at all times keep the Work Site free of waste materials or rubbish caused by the Work. After completing the Work, Contractor will remove all its waste materials, rubbish, tools, supplies, equipment and surplus materials from and about the Work Site.

11.2 If Contractor fails to keep the Work Site clean or to clean up after completing the Work, Company may do so and charge all costs of cleaning up to Contractor. Those costs may be deducted from the final payment to Contractor.

12. COLLATERAL WORK. Company and other contractors may be working at the Work Site. Company reserves the right to coordinate the performance of Contractor's Work with the work of others. Contractor will cooperate with and will not delay, impede or otherwise impair the work of others. Company does not guarantee Contractor continuous uninterrupted access to the Work Site, but will provide such access as good construction practices will allow, considering the other activities in the area.

13. ALCOHOLIC BEVERAGES, DRUGS AND WEAPONS. Contractor will inform all members of Contractor Group who may be involved in the performance of any Work of the following Company rules relating to alcoholic beverages, drugs and weapons, with which all personnel are expected to comply:

13.1 Bringing, attempting to bring, possessing, using or being under the influence of intoxicants, drugs, or narcotics while on any Company Property, including but not limited to parking areas, is prohibited. Possessing alcoholic beverages in sealed containers is permitted, however, in designated parking areas.

13.2 Prescription or over-the-counter medications that could affect the performance of safety-sensitive work are allowed on Company Property only if they have been previously cleared by Contractor. Contractor must confirm that the medication and dosage do not impair an individual's ability to perform safety-sensitive work before clearing the individual to perform such work while under the influence of the medication.

13.3 Bringing, attempting to bring, possessing or using firearms, whether classified as legal or illegal, while on any Company Property, including but not limited to buildings, parking areas, recreation facilities, equipment and vehicles, is prohibited, unless otherwise required by applicable law. Use or possession of firearms for specific situations is permitted if approved by function or higher level management of Company.

13.4 Off-the-job involvement with intoxicants, illegal drugs, or illegal narcotics that adversely affects Company's business, to include impairing the individual's ability to perform his job or the public trust in the safe operation of Company, is prohibited.

13.5 Any conduct on any Company Property which is in violation of any state or federal law or regulation is considered a violation of these rules and a breach of any agreement to which these policies are attached.

13.6 In order to enforce these rules, all individuals with access to any Company Property as well as the vehicles, offices, lockers and any personal belongings of such individuals on any Company Property are subject to search by Company and its agents, to include security representatives appointed or employed by Company. Individuals may be required to take a blood, urinalysis or Breathalyzer test, or submit to other recognized investigatory tests or procedures as are deemed appropriate or necessary by Company in the investigation of a violation of these rules.

14. TITLE AND RIGHT. Nothing in the Agreement will vest Contractor with any right of property in materials used after they have been attached to or incorporated into the Work, nor materials for which Contractor has received full or partial payment. All those materials, upon being so attached, incorporated or paid for, will become the property of Company. Any gravel, sand, stone, minerals, timber or other materials excavated, uncovered, developed or obtained in the Work, or on any land belonging to Company may be used, in the performance of the Work, provided such materials meet the requirements of this Agreement. Any objects or natural materials or animals excavated or exposed that may have historical significance or constitute a threatened or endangered species must be brought to the attention of Company.

15. PROTECTION AGAINST LIENS AND ENCUMBRANCES

15.1 Contractor will not at any time permit any lien, attachment or other encumbrance ("Encumbrance") by any person or persons whosoever or by reason of any claim or demand against Contractor to be placed or remain on the property of Company, including, but not limited to, the Work Site upon which Work is being performed or equipment and materials that are being furnished. To prevent an Encumbrance from being placed on the property of Company, Contractor will furnish during the progress of any Work, as requested from time to time, verified statements showing Contractor's total outstanding indebtedness in connection with the Work.

15.2 If Contractor allows any indebtedness to accrue to subcontractors or others and fails to pay or discharge that indebtedness within five (5) days after demand, then Company may withhold any money due Contractor until that indebtedness is paid or pay the indebtedness and apply that amount against the money due Contractor.

15.3 If Contractor allows any Encumbrances, whether valid or invalid to be placed on the property of Company, any and all claims or demands for payment to Contractor will be denied by Company until the Encumbrance is removed. If the Encumbrance is not removed immediately, Company may pay that claim or demand and deduct the amount paid, together with all related expenses, including attorneys' fees, from any further payment due Contractor, or at Company's election, Contractor will, upon demand, reimburse Company for the amount paid and all related expenses. Any payment made in good faith by Company will be binding on Contractor.

16. TERMINATION FOR DEFAULT

16.1 If a petition in bankruptcy should be filed by Contractor, or if Contractor should make a general assignment for the benefit of creditors, or if a receiver should be appointed due to the insolvency of Contractor, or if Contractor should refuse or fail to supply enough properly skilled workmen or proper equipment, materials or services or should fail to make prompt payment to subcontractors, or to pay promptly for materials or labor, or disregard laws, ordinances or the instruction of Company's Contract Coordinator, or if Contractor should refuse or fail to abide by the SOW Construction Schedule or otherwise violate any provisions of the Agreement or SOW, then Company, upon a determination by Company's Contract Coordinator that sufficient cause exists to justify such action, may, without prejudice to any other right or remedy available to it after giving Contractor seven (7) days' written notice, terminate the Agreement or the SOW and take possession of the Work Site. In the event of such a termination, Company may use all or part of Contractor's equipment and materials and may finish the Work by whatever method Company may deem expedient. In such event, Contractor will not be entitled to receive any further payment hereunder until the Work is finished. If the unpaid balance of the SOW fees will exceed the expense of finishing the Work, including compensation of Company's Contract Coordinator, other Company personnel, third party engineering companies, or other contractors for additional services, such excess will be paid to Contractor. If the expense of finishing the Work will exceed such unpaid balance, Contractor will pay the difference to Company within fifteen (15) days of receiving an invoice for same. The expenses incurred by Company herein, and the damage incurred through Contractor's default, will be determined by Company's Contract Coordinator, in its sole discretion, and such determination will be binding as between the parties.

16.2 In the event of a termination under the provisions of this Section 3, Contractor will transfer and assign to Company, in accordance with Company's instructions, all Work, all construction records, reports, permits, data and information, other materials (including all Company-supplied materials), supplies, Work in progress and other goods for which Contractor is entitled to receive reimbursement hereunder, and any and all plans, drawings, sketches, specifications, and information in connection with the Work, and will take such action as may be necessary to secure Company, at Company's sole election, the rights of Contractor under any or all orders and subcontracts made in connection with the Work.

16.3 In the event that Company so directs or authorizes, Contractor will sell at a price approved by Company, or retain at a mutually agreeable price, any such materials, supplies, Work in progress, or other goods as referred to in the preceding paragraph. In any event, Company will receive any and all records, plans, drawings, data, permits, specifications, sketches, reports, or other information relating to the Work. The proceeds of any such sale or the agreed price will be paid or credited to Company in such manner as Company may direct so as to reduce the amount payable by Company under this Section 3.

# APPENDIX D
# COVID-19 SITE ENTRY GUIDELINES

COVID-19 Vistra Site Entry Guidelines – *Effective: June 17, 2021*
These guidelines are applicable to ALL PERSONNEL entering Vistra work sites.

To enter a Vistra work site, each person must answer the following three questions with a "no" answer *and* pass the required temperature testing *unless* they display their Vistra vaccination sticker on their employee badge or hardhat:

Site Entry Questions:

1. In the past 10 days, have you tested positive for COVID-19 or are you currently waiting on test results?

2. In the past 10 days, have you been within six feet of someone, where masks were not worn, who:
   a. has tested positive for COVID-19,
   b. is known to be waiting on test results for COVID-19, or
   c. is under a quarantine order?

3. In the past 10 days, have you or someone who has been within six feet of you where masks were not worn had:
   a. flu-like symptoms,
   b. a deep, dry cough,
   c. recent shortness of breath or difficulty breathing,
   d. new loss of taste or smell, and/or
   e. fever of 100 degrees or above?

Temperature Testing:

You must register a temperature between 96- and 100-degrees Fahrenheit as described in the temperature procedures. (see next page for testing procedures)

- If your temperature is below 96 degrees, retest with a different device.
- If your temperature is 100-degrees Fahrenheit or above, retest on another device preferably an ear thermometer, if your temperature still registers 100-degrees Fahrenheit or above you may not enter the site.

## Clearance to enter the site:

- If you have answered **"no"** to all three questions ***and*** passed the temperature test, you may enter the site.
- ***If you have an approved Vistra vaccination sticker, you are cleared to enter the site without the temperature test or answering COVID screening questions.***
- If you passed the temperature test ***and*** answered "Yes" to any of the questions, but have been cleared through VistraTravelerSafety (HR clearance) to enter the Vistra work site for that instance of exposure, testing, or symptoms, you may enter the site.

Anyone *not* cleared to enter the work site must immediately leave the work site and notify their supervisor who will notify HR at VistraTravelerSafety@vistracorp.com for next steps.

**Any symptomatic employee, unvaccinated employee exposed to COVID-19 or any employee tested for COVID-19 as described above must be cleared through VistraTravelerSafety prior to returning to work.**

Required Temperature Testing Procedures:

All persons entering the site without a Vistra vaccination sticker, who have cleared all questions above, will also submit to temperature testing or self-administer a temperature test as required by the facility management. If a self-administered test is required, then a member of the management team or their designee will witness the testing; however, where that is not practicable, each person must attest that they are only entering the site premises because they have passed the screening questions and temperature test required for entry. Also:

a. Hats may cause false high temperatures and should not be worn for five minutes immediately preceding a forehead temperature test.
b. Each person is responsible for ensuring all self-testing materials and areas touched during testing are sanitized.
c. All personnel should maintain a **distance of at least six feet** from other people during this process or wear required masks.

Temperature Testing Requirements:

1. **All persons entering the site without a Vistra vaccination sticker must register a temperature between 96- and 100-degrees Fahrenheit. Any such person who has a temperature not within that range or who triggers an alarm on a thermal camera** must **retest with a different device**, preferably an **ear thermometer**, if available. If the second test registers a temperature of 100 degrees or above:
   a. That person **may not enter** the Vistra work site and must notify their supervisor, who will notify HR at VistraTravelerSafety@vistracorp.com for next steps.
   b. If there is significant inconsistency between the two tests, repeat another temperature test and use the two closest readings.
2. **Anyone who registers a temperature between 96- and 100-degrees Fahrenheit** may proceed to their work site.
   - **If temperature is below 96 degrees, wait a few minutes and retest with a different device.**

Control rooms and communal areas:

***All persons entering the site without a Vistra vaccination sticker should maintain at least six-feet distance from other people as much as possible and should wear face coverings when six-feet distance is not feasible. No one should gather in communal areas (including the temperature-testing area) without a Vistra vaccination sticker. Only operators are allowed in control rooms without plant manager approval.***

Vistra Vaccination Sticker protocols:

***All persons with a valid Vistra vaccination sticker do not have to socially distance or wear masks while at the site. They will also not be required to quarantine as a part of COVID-19 exposures unless exhibiting COVID-19 symptoms. To be eligible for these protocols, each person must have their approved Vistra vaccination sticker easily visible at all times while at work***. If someone who has applied for a Vistra vaccination sticker believes they have specific health conditions that may affect the ability to have a full immune response to the vaccination, please consult your health provider prior to working without a mask.

**Any symptomatic employee, unvaccinated employee exposed to COVID-19 or any employee tested for COVID-19 as described above must be cleared through VistraTravelerSafety prior to returning to work.**

# APPENDIX E
# SAFETY DATA SHEETS

DYNEGY

# Safety Data Sheet

## Section 1
## Identification of the Substance and of the Supplier

### 1.1 Product Identifier

| | |
|---|---|
| **Product Name/Identification:** | ASTM Bottom Ash |
| **Synonyms:** | Ash; Ashes; Ash residues; Ashes, residues, bottom; Bottom ash; Bottom ash residues; Coal Fly Ash; Pozzolan; Waste solids. |
| **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. |
| **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):**

- Eye Irritant, Category 2A
- STOT-SE, Category 3 (Respiratory Irritation)
- Carcinogen, Category 1A
- STOT-RE, Category 1 (Lungs)
- Toxic to Reproduction, Category 2

## 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):*** | *Causes serious eye irritation.*<br>*May cause respiratory irritation.*<br>*May cause damage to lungs after repeated/prolonged exposure via inhalation.*<br>*May cause cancer of the lung.*<br>*Suspected of damaging fertility or the unborn child.* |
| ***Precautionary Statement(s):*** | *Obtain special instructions before use.*<br>*Do not handle until all safety precautions have been read and understood.*<br>*Avoid breathing dust.*<br>*Wash thoroughly after handling.*<br>*Do not eat drink or smoke when using this product.*<br>*Wear protective gloves/protective clothing/eye protection/face protection.*<br>*Use outdoors or in a well-ventilated area.*<br>*If exposed or concerned: Get medical advice/attention.*<br>*Store in a secure area.*<br>*Dispose of product in accordance with local/national regulations.* |

** Fly ash and other coal combustion products (CCPs) are UVCB substances (unknown or variable composition or biological). Various CCPs, noted as ashes/ash residuals; Ashes, residues, bottom; Bottom ash; Bottom ash residues; Waste solids, ashes under TSCA are defined as: "The residuum from the burning of a combination of carbonaceous materials. The following elements may be present as oxides: aluminum, calcium, iron, magnesium, nickel, phosphorus, potassium, silicon, sulfur, titanium, and vanadium." Ashes including fly ash and fluidized bed combustion ash are identified by CAS number 68131-74-8. The exact composition of the ash is dependent on the fuel source and flue additives composed of many constituents. The classification of the final substance is dependent on the presence of specific identified oxides as well as other trace elements.*

## 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* |
|---|---|---|---|
| *Crystalline Silica* | *14808-60-7* | *20 - 40%* | *Repeat Dose STOT, Category 1*<br>*Carcinogen, Category 1A* |
| *Silica, crystalline respirable (RCS)* | *14808-60-7* | *See Footnote 1* | *Repeat Dose STOT, Category 1*<br>*Carcinogen. Category 1A* |
| *Aluminosilicates*[2] | *Various, see Footnote 2* | *10 - 60%* | *Single Exposure STOT, Category 3* |
| *Calcium oxide (CaO)* | *1305-78-8* | *10 - 30%* | *Skin Irritant, Category 2*<br>*Eye Irritant, Category 1*<br>*Single Exposure STOT, Category 3* |
| *Iron oxide* | *1309-37-1* | *1 - 10%* | *Not Classified* |
| *Manganese dioxide ($MnO_2$)* | *1313-13-9* | *<2%* | *Skin Irritant, Category 2*<br>*Eye Irritant, Category 2B* |
| *Magnesium oxide* | *1309-48-4* | *2 - 10%* | *Not Classified* |
| *Phosphorus pentoxide ($P_2O_5$)* | *1314-56-3* | *≤2%* | *Skin Irritant, Category 2*<br>*Eye Irritant, Category 2B* |
| *Sodium oxide* | *1313-59-3* | *1 - 10%* | *Not Classified* |
| *Potassium oxide ($K_2O$)* | *12136-45-7* | *≤1%* | *Skin Irritant Category 2*<br>*Eye Irritant Category 2B* |
| *Titanium dioxide ($TiO_2$)* | *13463-67-7* | *<3%* | *Not Classified* |
| *Bromide salt (calcium)* | *7789-41-5* | *See Footnote 3* | *Toxic to Reproduction Category 2* |

*[1]The percentage of respirable crystalline silica has not been determined. Therefore, a GHS classification of Carcinogen 1A has been assigned.*

*[2]Aluminosilicates (CAS# 1327-36-2) may be in the form of mullite (CAS# 1302-93-8); aluminosilicate glass; pozzolans (CAS# 71243-67-9); or calcium aluminosilicates such as tricalcium aluminate (C3A), or calcium sulfoaluminate (C4A3S). The form is dependent on the source of the coal and or the process used to create the CCP. Pulverized coal combustion would be more likely to create high levels of pozzolans. Aluminosilicates may have inclusions of calcium, titanium, iron, potassium, phosphorus, magnesium and other metal oxides.*

*[3]Analytical data are not available to demonstrate that the concentration of bromide salt is <0.1%; therefore, a GHS classification of Toxic to Reproduction Category 2 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:** Direct exposure may cause respiratory irritation, eye irritation and skin irritation. The product dust can dry and irritate the skin and cause dermatitis and can irritate eyes and skin through mechanical abrasion.

**Chronic Effects:** Chronic exposure may cause lung damage from repeated exposure. Prolonged inhalation of respirable crystalline silica above certain concentrations may cause lung diseases, including silicosis and lung cancer. Repeated exposure to dusts containing inorganic bromide salts may affect fertility and/or result in effects to the unborn child.

## 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:** | None known. |

### 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.<br>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 ($mg/m^3$)** |
| **Calcium oxide** | | 5 | 2 | 2 | 2 |
| **Particulates Not Otherwise Regulated** | Total | 15 | 15 | 10 | 10 |
| | Respirable | 5 | 5 | 3 | 5 |
| **Respirable Crystalline Silica** | Respirable | 0.05 | 0.05 | 0.025 | 0.05 |
| **Manganese dioxide (as manganese compounds)** | Total | 5 (Ceiling) | 1<br>3 (STEL) | 0.1 | 0.2 |
| | Respirable | - | - | 0.02 | - |

## 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.):** Fine tan/ gray particulate | **Upper/lower flammability or explosive limits:** Not applicable |
| **Odor:** Odorless[1] | **Vapor Pressure (Pa):** Not applicable |
| **Odor threshold:** Not applicable | **Vapor Density:** Not applicable |
| **pH (25 °C) (in water):** 8 - 11 | **Specific gravity or relative density:** 2.2 – 2.9 |
| **Melting point/freezing point (°C):** Not applicable | **Water Solubility:** Slight |
| **Initial boiling point and boiling range (°C):** Not applicable | **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):** Not determined |
| **Flammability (solid, gas):** Not combustible | **Viscosity:** Not applicable |

[1] The use of urea or aqueous ammonia injected into the flue gas to reduce nitrogen oxides (NOx) emissions may result in the presence of ammonium sulfate or ammonium bisulfate in the ash at less than 0.1%. When ash containing these substances becomes wet under high pH (>9), free ammonia gas may be released resulting in objectionable/nuisance ammonia odor and potential exposure to ammonia gas especially in confined spaces.

## Section 10
## Stability and Reactivity

| | |
|---|---|
| **10.1 Reactivity:** | The material is an inert, inorganic material primarily composed of elemental oxides. |
| **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; however, when ash containing ammonia becomes wet under high pH (>9), free ammonia gas may be released resulting in an objectionable/nuisance ammonia odor and potential exposure to ammonia gas especially in confined spaces. 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:** | None known. |
| **10. 6 Hazardous decomposition products:** | None known. |

# Section 11
# Toxicological Information

## 11.1 Information on Toxicological Effects

| Endpoint | Data |
|---|---|
| **Acute oral toxicity** | LD50 > 2000 mg/kg |
| **Acute dermal toxicity** | LD50 > 2000 mg/kg |
| **Acute inhalation toxicity** | LD50 > 5.0 mg/L |
| **Skin corrosion/irritation** | Does not meet the classification criteria but may cause slight skin irritation. Product dust can dry the skin which can result in irritation. |
| **Eye damage/irritation** | Causes serious eye irritation. Positive scores for conjunctiva irritation and chemosis in 2/3 animals based on average of 24, 48 and 72-hour scores with irritation clearing within 21 days; no corneal or iritis effects observed. |
| **Respiratory/skin sensitization** | Not a respiratory or dermal sensitizer. |
| **Germ cell mutagenicity** | Not mutagenic in in-vitro and in-vivo assays with or without metabolic activation. |
| **Carcinogenicity** | Not available. Respirable crystalline silica has been identified as a carcinogen by OSHA, NTP, ACGIH and IARC. |
| **Reproductive toxicity** | No developmental toxicity was observed in available animal studies. Reproductive studies on CCPs showed either no reproductive effects, or some effects on male and female reproductive organs and parameters but without a clear dose response.<br><br>Inorganic bromide salts have been shown to have adverse effects on reproductive parameters in some animal studies. |
| **STOT-SE** | CCPs when present as a nuisance dust may result in respiratory irritation. |
| **STOT-RE** | In a 180-day inhalation study with fly ash dust, no effects were observed at the highest dose tested. NOEC = 4.2 $mg/m^3$; it is not possible to assess the level at which toxicologically significant effects may occur.<br><br>Repeated inhalation exposures to high levels of respirable crystalline silica may result in lung damage (i.e., silicosis). |
| **Aspiration Hazard** | Not applicable based product form. |

# Section 12
# Ecological Information

## 12.1 Toxicity

| | |
|---|---|
| **Fly Ash (CAS# 68131-74-8)** | |
| **Toxicity to Fish** | LC50 > 100 mg/L |
| **Toxicity to Aquatic Invertebrates** | Data indicates that the test substance is not toxic to *Daphnia magna* (EC50 undetermined) |
| **Toxicity to Aquatic Algae and Plants** | EC50 = 10 mg/L |
| **Calcium oxide CAS# 1305-78-8** | |
| **Toxicity to Fish** | LC50 = 50.6 mg/L<br>The findings were closely related to the pH of the test solutions; therefore, pH is considered to be the main reason for the effects. |
| **Toxicity to Aquatic Invertebrates** | EC50 = 49.1 mg/L<br>The findings were closely related to the pH of the test solutions; therefore, pH is considered to be the main reason for the effects. |
| **Toxicity to Aquatic Algae and Plants** | NOEC =48 mg/L @ 72 hours based on $Ca(OH)_2$<br>The initial pH of the test medium was not directly related to the biologically relevant effects. The formation of precipitates is likely the result of the reaction between $CO_2$ dissolved in the medium. |

## 12.2 Persistence and Degradability

Not relevant for inorganic materials.

## 12.3 Bioaccumulative Potential

This material does not contain any compounds 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:**<br>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

  All components are listed 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
  - Titanium dioxide

- State Right-to-Know (RTK)

| Component | CAS | MA[1,2] | NJ[3,4] | PA[5] | RI[6] |
|---|---|---|---|---|---|
| Ammonium bisulfate | 7803-63-6 | No | Yes | No | No |
| Ammonium sulfate | 7783-20-2 | Yes | No | Yes | No |
| Calcium oxide | 1305-78-8 | Yes | Yes | Yes | No |
| Iron oxide | 1309-37-1 | Yes | Yes | Yes | No |
| Magnesium oxide | 1309-48-4 | No | Yes | No | No |
| Phosphorus pentoxide (or phosphorus oxide) | 1314-56-3 | Yes | Yes | Yes | No |
| Potassium oxide | 12136-45-7 | No | Yes | No | No |
| Silica-crystalline ($SiO_2$), quartz | 14808-60-7 | Yes | Yes | Yes | No |
| Sodium oxide | 1313-59-3 | No | Yes | No | No |
| Titanium dioxide | 13463-67-7 | Yes | Yes | Yes | Yes |

[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 23, 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
- GHS: Globally Harmonized System of Classification and Labelling
- IARC: International Agency for Research on Cancer
- LC50: Concentration resulting in the mortality of 50 % of an animal population
- LD50: Dose resulting 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)**<br><br>Degree of hazard (0= low, 4 = extreme) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Health:** | 2* | **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.*

DYNEGY

# Safety Data Sheet

## Section 1
## Identification of the Substance and of the Supplier

### 1.1 Product Identifier

| | |
|---|---|
| **Product Name/Identification:** | ASTM Class C Fly Ash |
| **Synonyms:** | Coal Fly Ash, Pozzolan |
| **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. |
| **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):**

- Eye Irritant, Category 2A
- STOT-SE, Category 3 (Respiratory Irritation)
- Carcinogen, Category 1A
- STOT-RE, Category 1 (Lungs)
- Toxic to Reproduction, Category 2

### 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):*** | *Causes serious eye irritation.*<br>*May cause damage to lungs after repeated/prolonged exposure via inhalation.*<br>*May cause respiratory irritation.*<br>*May cause cancer of the lung.*<br>*Suspected of damaging fertility or the unborn child.* |
| ***Precautionary Statement(s):*** | *Obtain special instructions before use.*<br>*Do not handle until all safety precautions have been read and understood.*<br>*Avoid breathing dust.*<br>*Wear protective gloves/protective clothing/eye protection/face protection.*<br>*Wash thoroughly after handling.*<br>*Do not eat drink or smoke when using this product.*<br>*Use outdoors or in a well-ventilated area.*<br>*If exposed or concerned: Get medical advice/attention.*<br>*Store in a secure area.*<br>*Dispose of product in accordance with local/national regulations.* |

** Fly ash and other coal combustion products (CCPs) are UVCB substances (unknown or variable composition or biological). Various CCPs, noted as ashes/ash residuals; Ashes, residues, bottom; Bottom ash; Bottom ash residues; Waste solids, ashes under TSCA are defined as: "The residuum from the burning of a combination of carbonaceous materials. The following elements may be present as oxides: aluminum, calcium, iron, magnesium, nickel, phosphorus, potassium, silicon, sulfur, titanium, and vanadium." Ashes including fly ash and fluidized bed combustion ash are identified by CAS number 68131-74-8. The exact composition of the ash is dependent on the fuel source and flue additives composed of many constituents. The* *classification of the final substance is dependent on the presence of specific identified oxides as well as other trace elements.*

## 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* |
|---|---|---|---|
| *Crystalline Silica* | *14808-60-7* | *30 - 60%* | *Repeat Dose STOT, Category 1*<br>*Carcinogen, Category 1A* |
| *Silica, crystalline respirable (RCS)* | *14808-60-7* | *See Footnote 1* | *Repeat Dose STOT, Category 1*<br>*Carcinogen, Category 1A* |
| *Aluminosilicates* | *71243-67-9*<br>*1327-36-2* | *30 - 60%* | *Single Exposure STOT, Category 3* |
| *Iron oxide* | *1309-37-1* | *1 - 10%* | *Not Classified* |
| *Calcium oxide (CaO)* | *1305-78-8* | *20 - 30%* | *Skin Irritant, Category 2*<br>*Eye Irritant, Category 1*<br>*Single Exposure STOT, Category 3* |
| *Magnesium oxide* | *1309-48-4* | *2 - 10%* | *Not Classified* |
| *Phosphorus pentoxide ($P_2O_5$)* | *1314-56-3* | *≤2%* | *Skin Irritant, Category 2*<br>*Eye Irritant, Category 2B* |
| *Sodium oxide* | *1313-59-3* | *1-8%* | *Not Classified* |
| *Potassium oxide ($K_2O$)* | *12136-45-7* | *≤1%* | *Skin Irritant, Category 2*<br>*Eye Irritant, Category 2B* |
| *Titanium dioxide ($TiO_2$)* | *13463-67-7* | *<3%* | *Not Classified* |
| *Bromide salt (calcium)* | *7789-41-5* | *See Footnote 2* | *Toxic to Reproduction, Category 2* |

*Footnote 1: The percentage of respirable crystalline silica has not been determined. Therefore, a GHS classification of Carcinogen, Category 1A has been assigned.*

*Footnote 2: Analytical data are not available to demonstrate that the concentration of bromide salt is <0.1%; therefore, a GHS classification of Toxic to Reproduction, Category 2 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:** Direct exposure may cause respiratory irritation, eye irritation and skin irritation. The product dust can dry and irritate the skin and cause dermatitis and can irritate eyes and skin through mechanical abrasion.

**Chronic Effects:** Chronic exposure may cause lung damage from repeated exposure. Prolonged inhalation of respirable crystalline silica above certain concentrations may cause lung diseases, including silicosis and lung cancer. Repeated exposure to dusts containing inorganic bromide salts may affect fertility and/or result in effects to the unborn child.

## 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:** | None known. |

## 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.<br>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$^3$)** |
| **Calcium oxide** | | 5 | 2 | 2 | 2 |
| **Particulates Not Otherwise Regulated** | Total | 15 | 15 | 10 | 10 |
| | Respirable | 5 | 5 | 3 | 5 |
| **Respirable Crystalline Silica** | Respirable Crystalline Silica | 0.05 | 0.05 | 0.025 | 0.05 |
| **Titanium dioxide** | Total | 15 | 2.4 (fine)<br>0.3 (ultrafine) | 10 | 10 |
| **Manganese dioxide (as manganese compounds)** | Total | 5 (Ceiling) | 1<br>3 (STEL) | 0.1 | 0.2 |
| | Respirable | - | - | 0.02 | - |

## 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.):** Fine tan/ gray particulate | **Upper/lower flammability or explosive limits:** Not applicable |
| **Odor:** Odorless[1] | **Vapor Pressure (Pa):** Not applicable |
| **Odor threshold:** Not applicable | **Vapor Density:** Not applicable |
| **pH (25 °C) (in water):** Not Determined | **Specific gravity or relative density:** 2.2 – 2.9 |
| **Melting point/freezing point (°C):** Not applicable | **Water Solubility:** Slight |
| **Initial boiling point/boiling range (°C):** NA | **Partition coefficient: n-octane/water:** NA |
| **Flash point (°C):** Not determined | **Auto ignition temperature (°C):** Not applicable |
| **Evaporation rate:** Not applicable | **Decomposition temperature (°C):** Not determined |
| **Flammability (solid, gas):** Not combustible | **Viscosity:** Not applicable |

[1] The use of urea or aqueous ammonia injected into the flue gas to reduce nitrogen oxides (NOx) emissions may result in the presence of ammonium sulfate or ammonium bisulfate in the ash at less than 0.1%. When ash containing these substances becomes wet under high pH (>9), free ammonia gas may be released resulting in objectionable/nuisance ammonia odor and potential exposure to ammonia gas especially in confined spaces.

## Section 10
## Stability and Reactivity

| | |
|---|---|
| **10.1 Reactivity:** | The material is an inert, inorganic material primarily composed of elemental oxides. |
| **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; however, when ash containing ammonia becomes wet under high pH (>9), free ammonia gas may be released resulting in an objectionable/nuisance ammonia odor and potential exposure to ammonia gas especially in confined spaces. 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:** | None known. |
| **10. 6 Hazardous decomposition products:** | None known. |

# Section 11
# Toxicological Information

## 11.1 Information on Toxicological Effects

| Endpoint | Data |
|---|---|
| **Acute oral toxicity** | LD50 > 2000 mg/kg |
| **Acute dermal toxicity** | LD50 > 2000 mg/kg |
| **Acute inhalation toxicity** | LD50 > 5.0 mg/L |
| **Skin corrosion/irritation** | Does not meet the classification criteria but may cause slight skin irritation. Product dust can dry the skin which can result in irritation. |
| **Eye damage/irritation** | Causes serious eye irritation. Positive scores for conjunctiva irritation and chemosis in 2/3 animals based on average of 24, 48 and 72-hour scores with irritation clearing within 21 days; No corneal or iritis effects observed. |
| **Respiratory/skin sensitization** | Not a respiratory or dermal sensitizer. |
| **Germ cell mutagenicity** | Not mutagenic in in-vitro and in-vivo assays with or without metabolic activation. |
| **Carcinogenicity** | Not available. Respirable crystalline silica has been identified as a carcinogen by OSHA, NTP, ACGIH and IARC. |
| **Reproductive toxicity** | No developmental toxicity was observed in available animal studies. Reproductive studies on CCPs showed either no reproductive effects, or some effects on male and female reproductive organs and parameters but without a clear dose response.<br><br>Inorganic bromide salts have been shown to have adverse effects on reproductive parameters in some animal studies. |
| **STOT-SE** | CCPs when present as a nuisance dust may result in respiratory irritation. |
| **STOT-RE** | In a 180-day inhalation study with fly ash dust, no effects were observed at the highest dose tested. NOEC = 4.2 mg/m$^3$; it is not possible to assess the level at which toxicologically significant effects may occur.<br><br>Repeated inhalation exposures to high levels of respirable crystalline silica may result in lung damage (i.e., silicosis). |
| **Aspiration Hazard** | Not applicable based product form. |

# Section 12
# Ecological Information

## 12.1 Toxicity

| **Fly Ash C (CAS# 68131-74-8)** | |
|---|---|
| **Toxicity to Fish** | LC50 > 100 mg/L |
| **Toxicity to Aquatic Invertebrates** | Data indicates that the test substance is not toxic to *Daphnia magna* (EC50 undetermined). |
| **Toxicity to Aquatic Algae and Plants** | EC50 = 10 mg/L |

| **Calcium oxide CAS# 1305-78-8** | |
|---|---|
| **Toxicity to Fish** | LC50 = 50.6 mg/L<br>The findings were closely related to the pH of the test solutions; therefore, pH is considered to be the main reason for the effects. |
| **Toxicity to Aquatic Invertebrates** | EC50 = 49.1 mg/L<br>The findings were closely related to the pH of the test solutions; therefore, pH is considered to be the main reason for the effects. |
| **Toxicity to Aquatic Algae and Plants** | NOEC =48 mg/L @ 72 hours based on $Ca(OH)_2$<br>The initial pH of the test medium was not directly related to the biologically relevant effects. The formation of precipitates is likely the result of the reaction between $CO_2$ dissolved in the medium. |

## 12.2 Persistence and Degradability

Not relevant for inorganic materials.

## 12.3 Bioaccumulative Potential

This material does not contain any compounds 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

  All components are listed 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] |
|---|---|---|---|---|---|
| Ammonium bisulfate | 7803-63-6 | No | Yes | No | No |
| Ammonium sulfate | 7783-20-2 | Yes | No | Yes | No |
| Calcium oxide | 1305-78-8 | Yes | Yes | Yes | No |
| Iron oxide | 1309-37-1 | Yes | Yes | Yes | No |
| Magnesium oxide | 1309-48-4 | No | Yes | No | No |
| Manganese oxide-as manganese compounds | 1313-13-9; Various | No | No | Yes | Yes |
| Phosphorus pentoxide (or phosphorus oxide) | 1314-56-3 | Yes | Yes | Yes | No |
| Potassium oxide | 12136-45-7 | No | Yes | No | No |
| Silica-crystalline (SiO2), quartz | 14808-60-7 | Yes | Yes | Yes | No |
| Sodium oxide | 1313-59-3 | No | Yes | No | No |
| Titanium dioxide | 13463-67-7 | Yes | Yes | Yes | Yes |

[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 23, 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

- GHS: Globally Harmonized System of Classification and Labelling
- IARC: International Agency for Research on Cancer
- LC50: Concentration resulting in the mortality of 50 % of an animal population
- LD50: Dose resulting 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:** | 2* | **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.*

# ATTACHMENT T

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

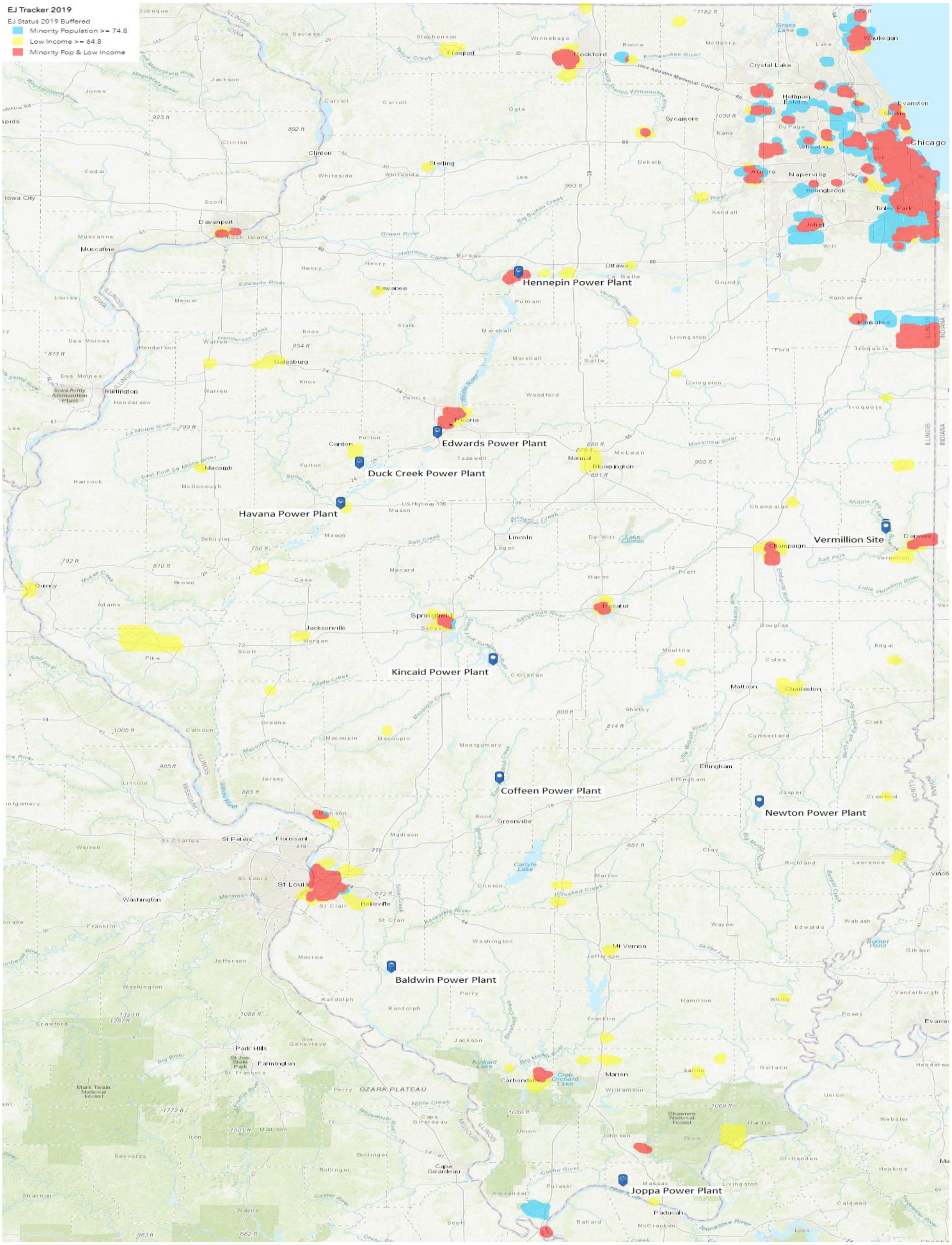
[2] Ground water analyses for purposes of categories 4-7, assumptions have been made based on current groundwater data. However, since sampling and analysis is ongoing and subject to IEPA review and approval, IPGC reserves the right to update its category designations for Categories 4-7.

[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



# ATTACHMENT U

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: USEPA CCR Rule and IEPA Part 845 Rule Applicability Cross-Reference**
**2021 USEPA CCR Rule Periodic Certification Report**
**Bottom Ash Basin, 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 5 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 | §257.82 (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.*

**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 OPERATING RECORD PERIODIC CERTIFICATION REPORT
# §257.82
# BOTTOM ASH BASIN
# 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

engineers | scientists | innovators

1 McBride and Son Center Drive, Suite 202
Chesterfield, Missouri 63005

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 Bottom Ash Basin (BAB) Pond[1] at the Duck Creek Power Plant (DCPP), also referred to as Duck Creek Power Station (DUC) 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 certification for the existing CCR surface impoundment, completed in 2016 and subsequently posted on the Illinois Power Resources Generating, LLC (IPRG) CCR Website ( [2]) be updated on a five-year basis. The BAB is an incised CCR surface impoundment, as defined by 40 CFR §257.53. Per §257.73(b); the requirements of §287.73(a)(2) (hazard potential classification), §257.73(a)(3) (emergency action plan), §257.73(2) (structural stability assessment) and §257.73(e) (safety factor assessment) are not applicable to incised CCR surface impoundments.

The initial certification reports developed in 2016 were independently reviewed by Geosyntec ( [2], [3]). Additionally, field observations, interviews with plant staff, and evaluations were performed to compare conditions in 2021 at the BAB relative to the 2016 initial certifications. These tasks determined that the BAB meets all requirements for the Inflow Design Flood Control System Plan. **Table 1** provides a summary of the initial 2016 certifications and the updated 2021 periodic certifications.

[1] The BAB Pond is also referred to as ID Number W05780100001-03, BAB Pond by the Illinois Environmental Protection Agency (IEPA); CCR unit ID 205 by IPRG, and IL50716 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 BAB Pond or the BABP.

## Table 1 – Periodic Certification Summary

| | | | 2016 Initial Certification | | 2021 Periodic Certification | |
|---|---|---|---|---|---|---|
| | CCR Rule Reference | Requirement Summary | Requirement Met? | Comments | Requirement Met? | Comments |
| **Hazard Potential Classification** | | | | | | |
| 3 | §257.73(a)(2) | Document hazard potential classification | Not Applicable | The BAB is an incised CCR surface impoundment [3] and the requirement to perform a hazard potential classification does not apply under the criteria presented in §257.73(a)(2).. | | |
| **Emergency Action Plan** | | | | | | |
| 4 | §257.73(a)(3)(iv) | Prepare written Emergency Action Plan | Not Applicable | The BAB is an incised CCR surface impoundment [3] and the requirement to prepare an emergency action plan does not apply under the criteria presented in §257.73(a)(3). | | |
| **History of Construction** | | | | | | |
| 5 | §257.73(c)(1) | Compile a history of construction | Not Applicable | The BAB is an incised CCR surface impoundment [3] and the requirement to prepare an emergency action plan does not apply under the criteria presented in §257.73(c). | | |
| **Structural Stability Assessment** | | | | | | |
| 6 | §257.73(d)(1)(i) | Stable foundations and abutments | Not Applicable | The BAB is an incised CCR surface impoundment [3] and the requirement to prepare a structural stability assessment does not apply under the criteria presented in §257.73(d). | | |
| | §257.73(d)(1)(ii) | Adequate slope protection | | | | |
| | §257.73(d)(1)(iii) | Sufficiency of dike compaction | | | | |
| | §257.73(d)(1)(iv) | Presence and condition of slope vegetation | | | | |
| | §257.73(d)(1)(v)(A) and (B) | Adequacy of spillway design and management | | | | |
| | §257.73(d)(1)(vi) | Structural integrity of hydraulic structures | | | | |
| | §257.73(d)(1)(vii) | Stability of downstream slopes inundated by water body. | | | | |
| **Safety Factor Assessment** | | | | | | |
| 7 | §257.73(e)(1)(i) | Maximum storage pool safety factor must be at least 1.50 | Not Applicable | The BAB is an incised CCR surface impoundment [3] and the requirement to prepare a structural stability assessment does not apply under the criteria presented in §257.73(e). | | |
| | §257.73(e)(1)(ii) | Maximum surcharge pool safety factor must be at least 1.40 | | | | |
| | §257.73(e)(1)(iii) | Seismic safety factor must be at least 1.00 | | | | |
| | §257.73(e)(1)(iv) | For dike construction of soils that have susceptible to liquefaction, safety factor must be at least 1.20 | | | | |
| **Inflow Design Flood Control System Plan** | | | | | | |
| 8 | §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 25-year, 24-hour, Inflow Design Flood [2]. | Yes | Existing IDF reviewed and assessed to be conservative due to a lower normal pool elevation in 2021 due to process water flows no longer being sluiced into the BAB. |
| | §257.82(b) | Discharge from CCR Unit | Yes | Discharge from the CCR Unit is routed through a NPDES-permitted outfall during both normal and 100-year, 24-hour Inflow Design Flood conditions, after performing updated hydrologic and hydraulic analyses [2]. | Yes | |

# SECTION 1

## INTRODUCTION AND BACKGROUND

This Periodic United States Environmental Protection Agency (USEPA) Coal Combustion Residual (CCR) Rule [1] Certification Report was prepared by Geosyntec Consultants (Geosyntec) for Dynegy Midwest Generation, LLC (Dynegy) to document the periodic certification of the Bottom Ash Basin (BAB) at the Duck Creek Power Plant (DUC), located at 17751 North Cilco Road in Canton, Illinois 61520. The location of DUC is provided in **Figure 1**, and a site plan showing the location of the BAB 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 (from AECOM, 2016)**

## 1.1 BAB Description

The DUC power plant was retired in December of 2019. Prior to retirement, two active CCR surface impoundments – the BAB and the GMF Pond – and one CCR landfill – were used for managing CCRs generated at DUC. This certification report only pertains to the BAB. The BAB is an incised CCR surface impoundment; per §257.73, a hazard potential classification is not required for incised CCR surface impoundments [3].

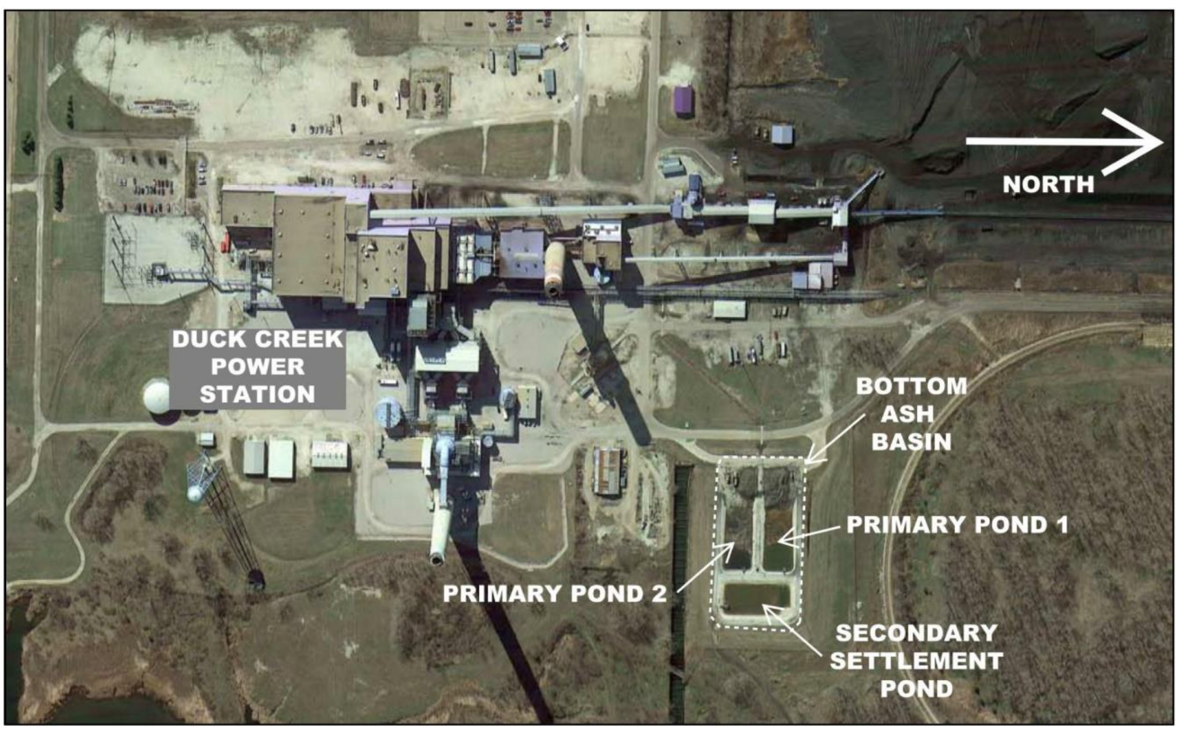


**Figure 3 – Bottom Ash Basin Area Plan (from AECOM, 2016)**

The BAB, which is sub-divided into Primary Pond 1, Primary Pond 2, and the Secondary Settlement Pond, as shown in **Figure 3**, served as the wet bottom ash impoundment basin. Within the BAB, Primary Ponds 1 and 2 are essentially identical in design and construction and received sluiced bottom ash from DUC. Prior to retirement of DUC, the Secondary Settlement Pond sub-basin operated as a polishing pond before discharging water into the plant's discharge channel, which led to the Duck Creek Reservoir and a NPDES-permitted outfall. The BAB consists of incised trapezoidal basins that were constructed in 2009. Primary Pond 1 and Primary Pond 2 operated alternatively which each sub-basin operating for approximately one week at a time. While one sub-basin was receiving bottom ash, the other sub-basin was dewatered and the ash was removed [3].

Sluiced bottom ash entered the BAB through Trewana precast modular trenches. Overflow water from the Primary Pond sub-basins flows into the Secondary Settlement Pond sub-basin through a stop-log weir. Outflow from the BAB was transmitted from the Secondary Settlement Pond through a stop-log structure into a 12-in. diameter corrugated high-density polyethylene (HDPE) pipe which flows by gravity into the discharge channel [3].

The BAB is lined with, from bottom to top, a 60-mil geomembrane, 12-in of compacted clay, and an 8-in. thick reinforced concrete slab. The interior side slopes of the BAB were graded at a 7% slope and were constructed to sidewall heights ranging from 5.7 to 9 ft (basin sidewalls below current existing grade) [3].

As formerly operated, the maximum operating pool of the BAB Primary Ponds 1 and 2 was El. 577.3 ft[2], and the normal pool elevation of the Secondary Settlement Pond was 573.5 ft. The pool elevation in each sub-basin is controlled by the stop log overflow weirs. Most CCR was removed from the BAB after closure; Primary Ponds 1 and 2 were observed by Geosyntec to be dry in May of 2020 and a nominal amount of impounded water was observed in the Secondary Settlement Pond. Only small amounts of CCR were observed to be present adjacent to the outfall structures in Primary Ponds 1 and 2. The BAB is approximately 1.9 acres in size and the perimeter (i.e. crest) length is approximately 1,100 ft. The minimum crest elevation of the BAB is 579.0 ft for Primary Pond 1 and Primary Pond 2 and 578.0 ft for the Secondary Settlement Pond.

The initial certification for the BAB Inflow Design Flood Control System Plan (§257.82) was completed by AECOM in 2016 and subsequently posted to IPRG's CCR Website [2]. Additional documentation for the initial certification included a detailed operating record report containing calculations and other information prepared for the inflow design flood control system plan by AECOM [3]. This operating record report was not posted to IPRG's CCR Website.

---

[2] All elevations are in the North American Vertical Datum of 1988 (NAVD88), unless otherwise noted.

## 1.2 Report Objectives

These following objectives are associated with this report:

- Compare site conditions from 2015/2016, when the initial certifications were developed, to site conditions in 2021, when data for the periodic certification was obtained, and evaluate if updates are required to the §257.82 Inflow Design Flood Control System Plan ( [2], [3]).

- Independently review the Inflow Design Flood Control System Plan ( [2], [3]) reports to determine if updates may be required based on technical considerations.

- Confirm that the BAB meets all of the requirements associated with §257.82, or, if the BAB does not meet all requirements, provide recommendations for compliance with these sections of the CCR Rule [1].

# SECTION 2

# COMPARISION OF INITIAL AND PEROIDIC SITE CONDITIONS

## 2.1 Overview

This section describes the comparison of conditions at the BAB between the start of the initial CCR certification program in 2015 and 2016 (initial conditions) and subsequent collection of periodic certification site data in 2021 (periodic conditions).

## 2.2 Review of Annual Inspection Reports

Annual onsite inspections for the BAB were performed between 2016 and 2020 ( [4], [5], [6], [7], [8]) and were certified by a licensed professional engineer in accordance with §257.83(b). Each inspection report provided 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.
- 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 BAB between 2015 and 2020. No signs of instability, structural weakness, or changes which may have affected the operation or stability of the BAB were noted in the annual inspection reports.

## 2.3 Comparison of Initial to Periodic Site Visits

An initial site visit to the BAB was conducted by AECOM in 2015 and documented with a Site Visit Summary and corresponding photographs [9]. 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 outlet structures or other appurtenances, limits of CCR, maintenance programs, and repairs). The stie visit included walking the perimeter of the BAB visually observing conditions, recording field notes, and collecting photographs. The site visit is documented in a field observation form and photographic log provided in **Appendix A**. A summary of significant findings from the periodic site visit is provided below:

- The DUC power plant was retired in December of 2019 and process water is no longer discharged to the BAB. No impounded water was observed in Primary Ponds 1 and 2, while a small amount of water (i.e., approximately one foot or less) was observed in the Polishing Pond.

- Most CCR was removed from the BAB, except for minor amounts of CCR located adjacent to the spillway structures in Primary Ponds 1 and 2.

- With the DUC power plant retirement, cooling water is no longer being discharged to the channel leading to the Duck Creek cooling pond. If discharge from the BAB were to occur it would be routed into the cooling channel.

## 2.4 Interview with Power Plant Staff

An interview with Mr. Daryl Johnson and Mr. Brandon Potter of the DUC power plant was conducted by Mr. Lucas P. Carr, P.E. of Geosyntec on May 27, 2021. Mr. Johnson, at the time of the interview, had been employed at DUC for 8 years and was responsible for environmental compliance and completed weekly CCR impoundment inspections on some years, including the BAB, in addition to managing vegetation maintenance. Mr. Potter, at the time of the interview, had been employed at DUC for 10 years and assisted in the inspection and operation of the various CCR impoundments, including the BAB. The interview included a discussion of included a discussion of potential changes that that may have occurred at the BAB since development of the initial certifications ( [2], [3])

- Were any construction projects completed for the BAB since 2015, and, if so, are design drawings and/or details available?
  - No construction projects were completed.
- Were there any changes to the purpose of the BAB since 2015?
  - No changes, outside of the plant being closed in December of 2019 and the cessation of CCR disposal activities and process inflows.
- Were there any changes to the to the instrumentation program and/or physical instruments for the BAB since 2015?
  - The BAB does not have instrumentation.

- Have area-capacity curves for the BAB been prepared since 2015?
    - No known area capacity curves have been developed.
- Were there any changes to spillways and/or diversion features for the BAB completed since 2015?
    - No changes have occurred.
- Were there any changes to construction specifications, surveillance, maintenance, and repair procedures for the BAB since 2015?
    - No changes have occurred.

# SECTION 3

# INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN - §257.82

## 3.1 Overview of Initial IDF

The Initial Inflow Design Flood Control System Plan (Initial IDF) was prepared by AECOM in 2016 ( [2], [3]), following the requirements of §257.82. The Initial IDF included the following information:

- A hydraulic and hydrologic analysis, performed for the 25-year design flood event because the BAB is an incised CCR surface impoundment, which corresponded to 5.25 inches of rainfall over a 24-hour period.

- The Initial IDF utilized a HydroCAD Version 10 model to evaluate spillway flows and pool level increases during the design flood, with a starting water surface elevation (SWSE) of 577.3 ft in Primary Ponds 1 and 2 and 573.5 ft in the Secondary Settlement Pond sub-basin.

The Initial IDF concluded that the BAB met the requirements of §257.82, as the peak water surface estimated by the HydroCAD model was El. 577.8 ft in Primary Pond 1, 577.7 ft in Primary Pond 21, and 574.2 ft in the Secondary Settlement Pond, relative to a minimum crest elevations of 579.0 ft from Primary Ponds 1 and 2 and 578.0 ft for the Secondary Settlement Pond. Therefore, overtopping was not expected.

The Initial IDF also evaluated the potential for discharge from the CCR unit and determined that discharge in violation of the existing NDPES permit for the BAB was not expected, as all discharge from the BAB during both normal and inflow design flood conditions was expected to be routed through the existing spillway and discharge channel to a NDPES-permitted outfall associated with the DUC Cooling Pond.

## 3.2 Review of Initial IDF

Geosyntec performed a review of the Initial IDF ( [2], [3]) 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 CCR Rule [1] requirements.

- Reviewing the rainfall depth and distribution for appropriateness.

- Performing a high-level review of the inputs to the hydrologic modeling.

- Reviewing the hydrologic model parameters for spill parameters, starting pool elevation, and storage vs. the reference data.
- Reviewing the overall Initial IDF vs. the applicable requirements of the CCR Rule [1].

The review noted that the BAB is currently not receiving process flows and does not retain a normal pool, due to the DUC power plant being retired. The review also noted that the discharge of the BAB outfall into the DUC cooling discharge channel was considered a free-discharge in the initial IDF hydrologic model; however the discharge channel is not currently active (see **Section 3.3**). Therefore, the review determined that the assumptions within the IDF are conservative, and no significant technical issues were noted within the technical review. However, a detailed review (e.g., check) of the calculations was not performed.

### 3.3 Summary of Site Changes Affecting the Initial IDF

The DUC power plant was retired in December of 2019. Retirement includes the cessation of process water pumping into the BAB and cooling water into the cooling discharge channel, in addition to reduced water levels in Primary Ponds 1 and 2 and the Secondary Settlement Pond. Most of the impounded CCR was removed from the BAB at the time of closure. However, these changes result in the Initial IDF ( [2], [3]) being conservative, as the existing pool elevations are below the starting water surface elevations (SWSEs) of 577.3 ft for Primary Ponds 1 and 2 and 573.5 ft for the Secondary Settlement Pond.

### 3.4 Updated IDF

Geosyntec does not recommend updating the Initial IDF ( [2], [3]) at this time. Although several changes at the site have occurred, these changes are expected to reduce the peak water surface elevation (PWSE) during the IDF, rather than increase it. Therefore, the PWSE within the Initial IDF ( [2], [3]) should be considered conservative.

# SECTION 4

# CONCLUSIONS

The BAB at DUC was evaluated relative to the USEPA CCR Rule periodic assessment requirements for Inflow design flood control system planning (§257.82). Based on these evaluations presented herein the referenced requirements are satisfied for inflow design flood control system planning.

## SECTION 5

## CERTIFICATION STATEMENT

CCR Unit: Illinois Power Resources Generation, LLC; Duck Creek Power Plant, BAB 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 inflow design flood control system planning, dated October 2021, were conducted in accordance with the requirements of 40 CFR §257.82.

*Lucas P. Carr*

10/11/2021

*Date*

LICENSED PROFESSIONAL ENGINEER
LUCAS PHILIP CARR
062066694
STATE OF ILLINOIS
Exp. 11/30/2021

# SECTION 6

# 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] AECOM, "CCR Ruel Report: Initial Inflwo Design Flood Control System Plan for Bottom Ash Basin at Duck Creek Power Station," St. Louis, MO, October 2016.

[3] AECOM, "CCR Certification Report: Initial Structural Stability Assessment, Initial Safety Factor Assessment, and Initial Inflow Design Flood Control System Plan for Bottom Ash Basin at Duck Creek Power Station," St. Louis, MO, October 2016.

[4] J. Knutelski and J. Campbell, "Annual CCR Surface Impoundment Inspection Report (per 40 CFR 257.83(b)(2)), Duck Creek Power Station, Bottom Ash Basin," January 18, 2017.

[5] J. Knutelski and J. Campbell, "Annual CCR Surface Impoundment Inspection Report (per 40 CFR 257.83(b)(2)), Duck Creek Power Station, Bottom Ash Basin," February 7, 2018.

[6] J. Knutelski, "Annual Inspection by a Qualified Professional Engineer, 40 CFR §257.83(b), Duck Creek Power Station, Bottom Ash Basin," January 10, 2019.

[7] J. Knutelski, "Annual Inspection by a Qualified Professional Engineer, 40 CFR §257.83(b), Duck Creek Power Station, Bottom Ash Basin," January 8, 2020.

[8] J. Knutelski, "Annual Inspection by a Qualified Professional Engineer, 40 CFR §257.83(b), Duck Creek Power Station, Bottom Ash Basin," January 6, 2021.

[9] AECOM, "CCR Unit Initial Site Visit Summary, Dynegy CCR Compliance Program, Duck Creek Bottom Ash Basin," June 23, 2015.

# ATTACHMENTS

# Attachment A

# BAB Site Visit Photolog

# GEOSYNTEC CONSULTANTS
## Photographic Record

| | |
|---|---|
| **Site Owner:** Illinois Power Resources Generating | **Project Number:** GLP8027 |
| **CCR Unit:** Bottom Ash Basin (BAB) | **Site:** Duck Creek Power Station |

**Photo:** 01

**Date:** 05/27/2021

**Direction Facing:** E

**Comments:** BAB north basin. Note lack of CCR.

**Photo:** 02

**Date:** 05/27/2021

**Direction Facing:** E

**Comments:** BAB south basin. Note lack of CCR.

## GEOSYNTEC CONSULTANTS
**Photographic Record**

| | |
|---|---|
| **Site Owner:** Illinois Power Resources Generating | **Project Number:** GLP8027 |
| **CCR Unit:** Bottom Ash Basin (BAB) | **Site:** Duck Creek Power Station |

**Photo:** 03

**Date:** 05/27/2021

**Direction Facing:** E

**Comments:** BAB polishing pond. Note lack of CCR.

**Photo:** 04

**Date:** 05/27/2021

**Direction Facing:** E

**Comments:** BAB polishing pond. Note lack of CCR.

| **GEOSYNTEC CONSULTANTS**<br>**Photographic Record** | |
|---|---|
| **Site Owner:** Illinois Power Resources Generating | **Project Number:** GLP8027 |
| **CCR Unit:** Bottom Ash Basin (BAB) | **Site:** Duck Creek Power Station |

| | |
|---|---|
| **Photo:** 05<br>**Date:** 05/27/2021<br>**Direction Facing:** Down<br>**Comments:** BAB north basin spillway inlet. |  |
| **Photo:** 06<br>**Date:** 05/27/2021<br>**Direction Facing:** Down<br>**Comments:** BAB south basin spillway inlet. |  |

| **GEOSYNTEC CONSULTANTS**<br>**Photographic Record** | |
|---|---|
| **Site Owner:** Illinois Power Resources Generating | **Project Number:** GLP8027 |
| **CCR Unit:** Bottom Ash Basin (BAB) | **Site:** Duck Creek Power Station |

| | |
|---|---|
| **Photo:** 07 |  |
| **Date:** 05/27/2021 | |
| **Direction Facing:** Down | |
| **Comments:** BAB polishing pond outfall inlet. | |

October 2021