Illinois Power Generating Company

Primary Ash Pond
FINAL CLOSURE PLAN

April 2022

Table of Contents

TABLES

ATTACHMENTS

1. INTRODUCTION

Illinois Power Generating Company (IPGC) is the owner of the coal-fired Newton Power Plant (NPP), also referred to as Newton Power Station (NPS), in Jasper County, Illinois.

This facility has a CCR unit called the Primary Ash Pond (PAP). This Closure Plan is for the PAP only. The PAP has an Illinois Environmental Protection Agency (IEPA) identification number of W0798070001-01.

1.1. Selected Closure Method

Section 845.720(b)(3): The final closure plan must identify the proposed selected closure method and must include the information required in subsection (a)(1) and the closure alternatives analysis specified in Section 845.710.

Based on the Closure Alternatives Analysis, closure with a final cover system has been identified as the most appropriate closure method, also known as Closure-in-Place (CIP, per Section 845.740). An alternatives analysis, provided in **Attachment A**, was prepared to evaluate CIP versus Closure by Removal (CBR, per Section 845.750) and CIP was the most appropriate closure method for the PAP.

1.2. Organization of Final Closure Plan

This Final Closure Plan is organized in the following manner:

- **Section 2** includes the Final Closure Plan, as required by Section 875.720(a)(1);
- **Section 3** includes a summary of amendments of the Closure Plan;
- **Section 4** includes a discussion of how the closure using a final cover system will comply with the performance and design requirements of Sections 845.720 and 845.750;
- **Section 5** includes additional information regarding the closure, and
- **Section 6** includes a Certification from a Qualified Professional Engineer;
- **Section 7** includes reference documents used in the development of this Final Closure Plan.

2. FINAL CLOSURE PLAN

<u>Section 845.720(a)(1):</u> Content of the Preliminary Closure Plan. The owner or operator of a new CCR surface impoundment or an existing CCR surface impoundment not required to close under Section 845.700 must prepare a preliminary written closure plan that describes the steps necessary to close the CCR surface impoundment at any point during the active life of the CCR surface impoundment consistent with recognized and generally accepted engineering practices.

This section includes the final closure plan for the PAP, as required by Section 845.720(a)(1). Specific requirements of the closure plan and the relevant regulatory citations are included in the following sections.

2.1. Narrative Closure Description

Section 845.720(a)(1)(A): A narrative description of how the CCR surface impoundment will be closed in accordance with this Part.

The PAP will be closed in place and covered with a final cover compliant with 40 C.F.R. § 257.102(d)(3) and Section 845.720(a)(1)(C). The PAP is an unlined CCR surface impoundment. Therefore, closing the PAP with a final cover system will result in a cap with lower permeability than the bottom of the pond.

Closure of the PAP with a final cover system will include the following tasks:

- Preparing the site for closure by establishing perimeter stormwater Best Management Practices (BMPs), as needed, at the construction limits of disturbance.
- Removing free liquids by solidifying waste, as needed, and removing liquid waste by removing liquids and pumping them to the adjacent Settling Pond for ultimate discharge at National Pollutant Discharge Elimination System (NPDES) Outfall 001.
- Consolidating waste to the North and East side of the pond as practical. Based on topography, it is estimated limited waste is located to the south, and that can be moved to the north side of the site.
- Removing existing outflow structures and culverts connecting the PAP to the adjacent Settling Pond.
    - Existing piping will be cut and capped below grade and the area backfilled and graded.
    - Aboveground pipes will be removed.
- Abandoning existing geotechnical piezometers that will not be utilized as post-closure

instrumentation. Abandonment will be performed in accordance with Illinois monitoring well regulations.

- Establishing a temporary dewatering and water management system within the PAP consisting of ditches and sumps to support passive (i.e., gravity) dewatering of CCR for stabilization and to collect contact stormwater during closure and maintain the PAP in an unwatered state. Contact stormwater, during construction, will be pumped to the Settling Pond for discharge at NDPES Outfall 001.

- Consolidating the PAP by excavating saturated CCR from the south and west side of the PAP and using it as fill within the north and east side of the PAP to establish minimum slopes. CCR will be placed in lifts and compacted to provide a subgrade suitable for construction of a final cover system. Dewatering will be performed as needed to support construction activity and fill placement, using the water management system.

    - Approximately 1,917,000-cy (2,600,000-tons) of ash will be consolidated from within the PAP. Material from Area 3 of the Newton Landfill 2, and coal pile material may be also moved from those areas and utilized as subgrade fill in the Ash Pond closure area.
    - Landfill 2 will be closed in place under its existing Permit No. 1997-233-LF.

- Removing the berm between the PAP and adjacent Settling Pond by lowering the grades to be consistent with the closure by removal grades. The Settling Pond will be removed, and the borrow area in the south side of the PAP will be used as a post-closure, non-CCR, stormwater management pond.

- Constructing a final cover system extending over the consolidated footprint of the PAP that contains CCR, and includes, from bottom to top:

    - A 40-mil linear low-density polyethylene (LLDPE) textured geomembrane, placed on a prepared subgrade with rocks no larger than one inch in diameter and other sharp objects removed prior to placement;

    - A geocomposite drainage layer, to convey stormwater that has percolated through the final cover soils to the perimeter stormwater drainage system;

        - Alternatively, the site may use a 50-mil LLDPE geomembrane material called “Microdrain” or “Supergrip” instead of a typical textured 40-mil LLDPE, that has built in drainage studs on the top side, allowing for use of an 8-oz. geotextile instead of the geocomposite listed above.

    - Based on a demonstration to be submitted to IEPA for approval pursuant to Section 845.750(c)(2), a final cover system will be installed including an alternative 1.5 ft thick protective layer (e.g., cover soil) to protect the geomembrane and 0.5 ft of topsoil capable of supporting vegetation, for a total cover soil thickness of 2 ft.

  - The final cover system grades will be approximately 2% over the majority of the PAP, although 25% (4 horizontal to 1 vertical [4H:1V]) grades will be used in limited areas, where needed to tie the final cover system into existing grades.
  - The final cover system will include an anchor trench for the geosynthetic materials along the entire perimeter of the consolidated material to secure the final cover system into existing grades. The anchor trench will be placed beyond the current limits of the waste to provide a continuous containment system and encapsulation for the retained CCR.
  - Existing groundwater monitoring wells in the closure area will be retained and modified by extending the wells through the final cover system, sealing the penetration with a pipe boot, and constructing a new surface completion on top of the final cover.
- Constructing a post-closure non-contact stormwater management system consisting of:
  - Stormwater channels leading from northeast to southwest to convey stormwater into the new stormwater pond; and
  - Drainage pipes, channels and downchutes where channels flow from the PAP final cover and lead into the stormwater pond, to reduce erosion.
- Establishing vegetation on the final cover system by:
  - Fertilizing the topsoil, as needed to support vegetation, based on agronomical soil tests;
  - Seeding the topsoil with a suitable grass seed for local climatic and soil conditions;
  - Providing temporary BMP measures such as mulch, erosion control blankets, silt fences, and/or straw wattles, as necessary to reduce the potential for soil erosion until vegetation is established; and
  - Restoring the site, after vegetation is established and the site is stabilized, by removing stormwater BMPs and temporary stabilization measures that are no longer needed.

Permit-level engineering drawings and material specifications for the closure are provided in **Attachment B**.

2.2. Decontamination of CCR Surface Impoundment

Section 845.720(a)(1)(B): If closure of the CCR surface impoundment will be *accomplished through removal of CCR from the CCR surface impoundment, a description of the procedures to remove the CCR and decontaminate the CCR surface impoundment in accordance with Section 845.740.*

The PAP will be closed-in-place and will not be closed by removal of CCR. However, the southwest portion of the pond is proposed to be consolidated to the northeast as part of this closure event (i.e. partial closure by removal). This portion will be completed in accordance with Section 845.740 as applicable to a 'partial CBR'.

In these areas, ash will be removed to approximately pre-pond topography. Up to 1 foot of subsoil may also be removed. The subsoils will be visually observed for signs of CCR staining. If subsoils with CCR staining are observed, they will be removed and disposed.

Section 845.740(b) does not apply to this project, as groundwater monitoring will continue per the groundwater monitoring plan for the site, which is primarily closed in place with a final cover system.

Section 845.740(c)(1) does not apply to this project, as material is not being transported off site.

Onsite dust controls, a public notice at the property entrance, and temporary control measures to prevent contamination of surface water, groundwater, soil and sediments shall be used throughout construction per Section 845.740. General housekeeping procedures shall be implemented to minimize the amount of time the CCR is exposed to precipitation and wind, and stormwater shall be managed under an NPDES permit and SWPPP.

A modification application to revise the current site NPDES permit will be submitted to include the new flows from unwatering and dewatering. This will be submitted prior to the Closure Construction Permit Application submittal. An NOI will be submitted as needed for coverage under the general NDPES permit for construction activities prior to commencing closure activities.

2.3. Final Cover System

Section 845.720(a)(1)(C): If closure of the CCR surface impoundment will be accomplished by leaving CCR in place, a description of the final cover system, designed in accordance with Section 845.750, and the methods and procedures to be used to install the final cover. The closure plan must also discuss how the final cover system will achieve the performance standards specified in Section 845.750.

A description of the final cover system design, methods and procedures used for installation, and how the final cover system will achieve the Section 845.750 performance standards is provided in **Section 4** of this Closure Plan.

2.4. Maximum CCR Inventory

Section 845.720(a)(1)(D): An estimate of the maximum inventory of CCR ever on-site over the active life of the CCR surface impoundment.

The maximum inventory of CCR ever on-site within the PAP is approximately 5,000,000 cubic yards. This inventory will increase by approximately 700,000 CY to approximately 5,700,000 CY through the closure process and consolidation of currently in place ash and soils on the south portion of the pond and utilizing it in the PAP as compacted subgrade fill.

2.5. Largest Surface Area Estimate

Section 845.720(a)(1)(E): An estimate of the largest area of the CCR surface impoundment ever requiring a final cover (see Section 845.750), at any time during the CCR surface impoundment's active life.

The largest surface area of the PAP, in plan view, is approximately 404 acres, as shown in the attached drawings. Final cover will be placed over an area of approximately 260.6 acres to extend completely across the surface area of the consolidated PAP waste and beyond the limits of CCR in plan view.

2.6. Closure Completion Schedule

Section 845.720(a)(1)(F): A schedule for completing all activities necessary to satisfy the closure criteria in this Section, including an estimate of the year in which all closure activities for the CCR surface impoundment will be completed. The schedule should provide sufficient information to describe the sequential steps that will be taken to close the CCR surface impoundment, including identification of major milestones such as coordinating with and obtaining necessary approvals and permits from other agencies, the dewatering and stabilization phases of CCR surface impoundment closure, or installation of the final cover system, and the estimated timeframes to complete each step or phase of CCR surface impoundment closure.

A milestone closure completion schedule has been prepared and is provided in **Table 1**. Key sequential phases and sub-tasks that will be completed as part of the closure will include:

- Agency Coordinating, Approvals, and Permitting
    - Approval of the closure Construction Permit Application by IEPA.

- Obtaining a modification to the existing NPDES permit to allow the disposal of water generated from unwatering and dewatering operations to Newton Lake via the existing NPDES-permitted Outfall 001 for the Site;

- Obtaining a construction permit from the Illinois Department of Natural Resources (IDNR), Office of Water Resources (OWR), Dam Safety Program (DSP) to allow the embankment and spillways of the PAP to be modified as part of closure;

- A coverage under the general NPDES permit for construction activities through IEPA, including construction stormwater controls and other BMPs such as silt fences and other measures; and

- A joint water pollution control construction and operating permit (WPC Permit).

- Final Design and Bidding
    - Completion of final design documents, including drawings and specifications.
    - Bidding and selection of a closure construction contractor.
- Dewater and Stabilize CCR, Install Final Cover System
    - Closure contractor mobilization and material procurement.
    - Installing stormwater BMPs around the construction area, per the Land Disturbance Permit.
    - Unwatering the PAP by pumping impounded water to the Polishing Pond.
    - Abandoning existing outfall structures and culverts.
    - Stabilizing the subgrade through dewatering and the placement of compacted CCR fill.
    - Constructing design final cover subgrades, including stormwater channel subgrades and modifications to the PAP perimeter berm.
    - Installing the final cover system geosynthetics and anchor trench.
    - Placing cover soil and topsoil over the geosynthetics.
- Site Restoration
    - Constructing riprap-lined letdown structures.

- Seeding and stabilizing the surface of the final cover system and other disturbed areas and allowing the vegetation to become established.
- Removing temporary stormwater BMPs and other temporary stabilization measures, after vegetation is established.
- Closure contractor demobilization from the site.

The closure construction project is expected to be completed by October 2028. Full vegetation will be established as soon as practical in the fall of 2028, with reseeding occurring as needed the following spring for establishment of a full stand of grass.

Table 1 – Closure Completion Milestone Schedule

Milestone	**Timeframe (Preliminary Estimates)**
Final Closure Plan Submittal	July 2022
Agency Coordination, Approvals, and Permitting • Obtain state permits, as needed, for dewatering, water discharge, land disturbance, and dam modifications.	16 to 24 months after Final Closure Plan Approval July 2022 to July 2024
Final Design and Bid Process • Complete final design of the closure and select a construction contractor.	6 to 12 months during Agency Coordination, Approvals, and Permitting July 2023 to July 2024
Dewater and Stabilize CCR, Install Final Cover System • Complete contractor mobilization, installation of stormwater BMPs, and unwatering of the PAP • Abandon outfall structures, stabilize the PAP, and complete grading and consolidation. • Install the final cover system and stormwater downchutes.	36 to 48 months after necessary permits are issued 12 months after final power plant shut down scheduled for September 17, 2027 July 2024 to July 2028
Site Restoration • Seed and stabilize the PAP. • Complete contractor demobilization.	2 to 3 months after the final cover system is complete May 2028 to September 2028
Timeframe to Complete Closure	Prior to October 17, 2028

Section 845.720(a)(1)(F) (Continued): When preparing the preliminary written closure plan, if the owner or operator of a CCR surface impoundment estimates that the time required to complete closure will exceed the timeframes specified in Section 845.760(a), the preliminary written closure plan must include the site-specific information, factors and considerations that would support any time extension sought under Section 845.760(b).

The time required to complete closure construction is not currently expected to exceed the timeframe specified in Section 845.760(a). Therefore, closure extensions for the PAP are not being sought at this time.

3. AMENDMENTS OF FINAL CLOSURE PLAN

Section 845.720(b)(4): If a final written closure plan revision is necessary after closure activities have started for a CCR surface impoundment, the owner or operator must submit a request to modify the construction permit within 60 days following the triggering event.

If revisions are required for this Final Closure Plan, the owner will submit a request to modify the construction permit within 60 days following the triggering event.

Table 2. CCR Final Closure Plan Revisions

Revision Number and Date	Pages or Section	Description of Revision	Professional Engineer Certifying Plan

4. CLOSURE WITH FINAL COVER SYSTEM

This section includes a description of the final closure with a final cover that will be completed for the PAP surface impoundment, including principal design and construction features, material specifications, and a discussion of how each feature is in accordance with the requirements of Section 845.750. Drawings showing each design feature and material specifications are provided in **Attachment B**.

4.1. Minimization of Post-Closure Infiltration and Releases

Section 845.750(a)(1): The owner or operator of a CCR surface impoundment must ensure that, at a minimum, the CCR surface impoundment is closed in a manner that will: Control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere.

Closure will, to the maximum extent feasible, minimize the post-closure infiltration of liquids into the retained CCR through the installation of a final cover system with the following design features and specifications:

- An LLDPE geomembrane low-permeability layer will placed on the prepared subgrade to control and minimize vertical infiltration into the surface impoundment. The geomembrane will be constructed on a subgrade that is free of sharp rocks or other debris and and will be protected from damage by installing a geocomposite drainage/cushion layer and a total of two feet of cover soil and topsoil over the top of the geomembrane. Alternatively, the geocomposite may be replaced with a geotextile cushion layer if used in conjunction with a microdrain style geomembrane for stormwater drainage.

- Surface stormwater will be routed from the top of the final cover by the construction of a free-draining post-closure stormwater management system including channels and letdown structures. The stormwater management system and sloped grade of the material will drain by gravity and preclude water impoundment on top of the final cover system, thereby minimizing post-closure infiltration into the CCR.

Releases of CCR leachate and/or contaminated run-off into the groundwater, surface waters, and/or atmosphere will be minimized, to the maximum extent feasible, as:

- The PAP is located on a relatively thick layer of clay estimated to be a low permeability material.

  - The final cover system will tie into the surrounding grades, by constructing a final cover anchor trench at or beyond the horizontal limits of the ash material.

  - This barrier will result in the CCR being physically isolated from the surrounding environment including the stormwater, surface water, and atmosphere and therefore minimizing the releases of CCR, leachate, or contaminated run-off into the ground, surface waters, and atmosphere.

- CCR leachate (e.g., pore water within the CCR) volumes will be minimized via the installation of the final cover system including a low-permeability geomembrane layer. The final cover system will minimize infiltration and therefore the amount of leachate within the CCR.
  - The PAP does not have a base liner or leachate collection system, however, its general location on the site's clays have shown through its groundwater monitoring system that leachate has not historically been migrating from the site.
  - Dewatering and unwatering efforts during construction are anticipated to remove pore water from within the CCR, followed by capping which will prevent 'recharge' from stormwater.

4.2. Preclusion of Future Impoundment

Section 845.750(a)(2): Preclude the probability of future impoundment of water, sediment, or slurry.

A final cover system will be installed on top of the PAP. All areas of the final cover system will be sloped to positively drain to the exterior of the PAP and preclude future impoundment of water, sediment, or slurry. This will include installing top deck slopes at approximately 2% grades, sideslopes at up to 25% (e.g., 4 horizontal to 1 vertical [4H:1V]) grades at the tie-in between the final cover system and existing grades, and stormwater channel grades at about 0.5% slopes. Stormwater channels will flow by gravity into the adjacent new stormwater pond via riprap-lined downchutes. Hydrologic and hydraulic calculations used to design the stormwater channels and other control features to preclude impoundment are provided in **Attachment C**.

4.3. Provisions for Preventing Instability, Sloughing and Movement

<u>Section 845.750(a)(3):</u> Include measures that provide for major slope stability to prevent the sloughing or movement of the final cover system during the closure and post-closure care period.

The perimeter berms of the PAP are constructed out of compacted fill materials and have been in place for over 40-years. The southwest berm of the PAP will be removed during closure for use as final cover soils and subgrade fill as needed. The northeast berm of the PAP also be mostly removed, and the final cover system will terminate into the remainder of the berm. The effects of these modifications have been evaluated by performing global slope stability analyses considering post- closure conditions. The resulting factors of safety exceed typical regulatory minimum values for static and seismic loading conditions. Slope stability analyses are provided in **Attachment D**.

Sloughing and movement of the final cover system will be minimized by constructing the final cover system at relatively flat slopes, including 2% over most of the final cover and 25% (4H:1V) at the edges of the final cover, as necessary to tie into existing grades. The potential for sloughing and movement of the final cover system has been evaluated by performing veneer stability analyses for the various interfaces within the final cover system. The resulting factors of safety exceed typical minimum values for static and seismic loading conditions. Veneer stability analyses are provided in **Attachment D**.

4.4. Minimize the Need for Further Maintenance

<u>Section 845.750(a)(4):</u> Minimize the need for further maintenance of the CCR surface impoundment.

Future maintenance needs will be minimized using the following design features:

- The final cover system will be installed at gentle 2% slopes over most of the final closure with 25% slopes in limited areas at the extents of the final cover, as needed to tie into existing grades.
    - These relatively flat slopes will minimize erosion of the final cover soils and thereby minimize maintenance needs by reducing stormwater flow velocities relative to steeper slopes.
    - The relatively flat slopes will also promote routine mowing of vegetation of the final cover system by allowing tractor-based mowing equipment to operate on the slopes with a reduced risk of equipment flip-over.

- The final cover, outside of stormwater channels, will be stabilized by placing topsoil, fertilizing the topsoil, establishing vegetation using suitable grass species.
    - The vegetation will minimize erosion of the final cover system by stabilizing the topsoil.
    - The use of fertilizer and selection of a suitable grass species will minimize maintenance required to repair areas of poor vegetation establishment.
- Stormwater channels will be stabilized with erosion control blankets and straw wattles. Erosion control blankets and riprap will be placed as needed to minimize post-closure erosion and associated maintenance for stormwater channels.
    - Calculations used to design the stormwater channel stabilization and riprap armoring were based on the 100-year, 24-hour, and 25-year, 24-hour storms. These calculations are provided in **Attachment C**.

4.5. Be Completed in Shortest Amount of Time

Section 845.750(a)(5): Be completed in the shortest amount of time consistent with recognized and generally accepted engineering practices.

Closure construction is expected to be completed within an amount of time that is consistent with recognized and generally accepted timeframes required to permit, design, bid, and construct a CCR impoundment final closure system, with a consideration of other permits form multiple agencies that are also required for the project. An estimated closure construction schedule is provided in **Section 2.6**. It should be noted that this schedule may change based on contractor, equipment, and material availability and actual weather conditions at the time at which closure occurs.

4.6. Drainage and Stabilization

Section 845.750(b)(1): Free liquids must be eliminated by removing liquid wastes or solidifying the remaining wastes and waste residues.

Section 845.750(b)(2): Remaining wastes must be stabilized sufficiently to support the final cover system.

Prior to installing the final cover system, free liquids will be eliminated by removing the liquid waste from the PAP. Engineering measures necessary to remove liquid waste that is readily separable under ambient temperature are pressure are being evaluated.

The removal of free liquids will result in the stabilization of the remaining CCR and will therefore allow the final cover to be placed on a stable subgrade

4.7. Final Cover System

<u>Section 845.750(c):</u> If a CCR surface impoundment is closed by leaving CCR in place, the owner or operator must install a final cover system that is designed to minimize infiltration and erosion, and, at a minimum, meets the requirements of this subsection (c) unless the owner or operator demonstrates that another construction technique or material provides equivalent or superior performance to the requirements of this subsection (c) and is approved by the Agency. The final cover system must consist of a low permeability layer and a final protective layer. The design of the final cover system must be included in the preliminary and final written closure plans required by Section 845.720 and the construction permit application for closure submitted to the Agency.

A final cover system has been designed consistent with the requirements of Section 845.720(c). The final cover will use a geomembrane as a low-permeability layer. The design of the final cover system is discussed within this section.

4.7.1. Low Permeability Layer - Geomembrane

<u>Section 845.750(c)(1)(B):</u> A geomembrane constructed in accordance with the following standards: i) The geosynthetic membrane must have a minimum thickness of 40 mil (0.04 inches) and, in terms of hydraulic flux, must be equivalent or superior to a three-foot layer of soil with a hydraulic conductivity of 1 x 10-7 cm/sec; ii) The geomembrane must have strength to withstand the normal stresses imposed by the waste stabilization process; and (iii) The geomembrane must be placed over a prepared base free from sharp objects and other materials that may cause damage.

The geomembrane will consist of a 40-mil linear low-density polyethylene (LLDPE) layer. Ramboll completed a Hydrologic Evaluation of Landfill Performance (HELP) [1] model to compare flux through the geomembrane cover to an equivalent cover system with 3 ft of 1×10^{-7} cm/sec clay, in order to demonstrate that the geomembrane final cover is superior to a soil-only cover. The HELP modeling estimated a total infiltration of 0.53 in of water per year (in/yr) for the geomembrane cover system, relative to 2.3 in/year for the cover system using 3 ft of 1×10^{-7} cm/sec clay [2]. Therefore, the geomembrane final cover system is superior to a cover system using 3 ft of 1×10^{-7} cm/sec clay, as infiltration is reduced by a factor of approximately 4.3.

Alternatively a 50-mil LLDPE Microdrain geomembrane material may be selected for this project. This material would be expected to meet or exceed the above discussed factor of 4.3.

The geomembrane will be installed on a prepared subgrade, after the underlying CCR has been stabilized. Therefore, additional normal stresses will not be imparted on the geomembrane due to the waste stabilization process.

The subgrade (e.g., base) for the geomembrane will be visually inspected and sharp objects such as rocks or debris that may damage the geomembrane will be removed, prior to deployment of the geomembrane.

4.7.2. Final Protective Layer

Section 845.750(c)(2): The final protective layer must meet the following requirements

A) Cover the entire low permeability layer;

B) Be at least three feet thick, be sufficient to protect the low permeability layer from freezing, and minimize root penetration of the low permeability layer;

C) Consist of soil material capable of supporting vegetation;

D) Be placed as soon as possible after placement of the low permeability layer; and

E) Be covered with vegetation to minimize wind and water erosion.

A final protective layer will be placed over and extend slightly beyond the entire geomembrane low-permeability layer in plan. Based on the demonstration to be submitted to IEPA for approval pursuant to Section 845.750(c)(2), the protective layer will include, from bottom to top, a nonwoven geotextile or geocomposite based on the geomembrane manufacturer selection, a 1.5-ft thick cover soil layer, and a 0.5-ft thick topsoil layer, for a total thickness of 2 ft.

The nonwoven geotextile (or geocomposite) and 1.5-ft thick cover soil layer will protect the geomembrane from root penetration. Geomembranes are not susceptible to freeze damage. The cushion layer and cover soil will be placed as soon as practical after the geomembrane has been deployed and both quality assurance and quality control testing has been performed on the geomembrane seams.

The 0.5-ft thick topsoil layer will be fertilized, as necessary to support appropriate grass species, in order to vegetate the final protective layer.

4.8. Certification

Section 845.750(c)(4): The owner or operator of the CCR surface impoundment must obtain and submit with its construction permit application for closure a written certification from a qualified professional engineer that the design of the final cover system meets the requirements of this section.

The undersigned qualified professional engineer registered in Illinois certifies that the design of the final cover system meets the requirements of Section 845.750.

Printed Name:

Signature *Date*

Registration Number:
Expiration Date:

Affix Seal

4.9. Uses of CCR in Closure

> Section 845.750(d): *This subsection specifies the allowable uses of CCR in the closure of CCR surface impoundments closing under Section 845.700. Notwithstanding the prohibition on further placement in Section 845.700, CCR may be placed in these surface impoundments, but only for purposes of grading and contouring in the design and construction of the final cover system, if: 1) The CCR placed was generated at the facility and is located at the facility at the time closure was initiated; 2) CCR is placed entirely above the elevation of CCR in the surface impoundment, following dewatering and stabilization (see subsection (b)); 3) The CCR is placed entirely within the perimeter berms of the CCR surface impoundment.*

Approximately 700,000 cubic yards of material are located within the pond, in the current landfill open cell, and coal pile that is anticipated to be moved and consolidated to the closure area. This material shall be used to reach slopes needed. Final grades may vary slightly based on field conditions in the pond, however minimum slopes shall be maintained. This waste material was generated onsite.

This bottom ash will be excavated from the south portion of the PAP and transported to the north portion of the PAP to be beneficially used as compacted subgrade fill below the final cover system. The ash will be placed on top of the existing subgrade (i.e., existing elevation of CCR in the surface impoundment) after dewatering of the PAP and used as a free-draining subgrade stabilization layer. CCR placement will only occur completely beneath the limits of the PAP final cover system. This is in accordance with the Section 845.750(d) criteria.

4.10. Final Cover System Slopes

Section 845.750(d)(4): *The final cover system is constructed with either: A) A slope not steeper than 5% grade after allowance for settlement; or B) At a steeper grade, if the Agency determines that the steeper slope is necessary, based on conditions at the site, to facilitate run-off and minimize erosion, and that side slopes are evaluated for erosion potential based on a stability analysis to evaluate possible erosion potential. The stability analysis, at a minimum, must evaluate the site geology; characterize soil shear strength; construct a slope stability model; establish groundwater and seepage conditions, if any; select loading conditions; locate critical failure surface; and iterate until minimum factor of safety is achieved.*

Final cover slopes will typically consist of 2% cross-slopes and 0.5% stormwater flowline slopes within the limits of final cover, which are generally less than 5%.

However, short lengths of 25% final cover slopes will be used in limited areas near the perimeter of the final cover, as needed to tie the final cover into the existing grades, as shown in the drawing package provided in **Attachment B**. Twenty five percent slopes will be utilized to allow most of the final cover, in area, to ultimately drain towards the southeast, and route stormwater into the new stormwater pond.

The stability of 25% final cover slopes has been evaluated both for the final cover system itself (e.g., veneer stability) and the global stability of the slope. These calculations included characterizing soil shear strength based on site geology, constructing slope stability models, establishing groundwater seepage conditions, selecting loading conditions, locating the critical failure surface, and iterating until minimum factors of safety were calculated. These calculations are provided in **Attachment D**. Resulting factors of safety exceed typical minimum factors of safety for both global and veneer stability.

5. ADDITIONAL INFORMATION

Both the lateral migration of groundwater and vertical infiltration of liquids, and releases of CCR, and leachate, and contaminated run-off into and out of the PAP will be controlled, minimized or eliminated, to the maximum extent feasible, under post-closure conditions.

- The PAP is unlined with underlying soils that are generally clays, as discussed in **Section 2.1**.
- Closure of the PAP will include constructing a final cover system that ties into the perimeter of the waste boundary, as discussed in **Section 4.**
- CCR within the PAP is separated from the uppermost aquifer by an estimated minimum of 14-ft of low permeability glacial tills [Ramboll, 2022].
- Groundwater levels beneath the PAP have been monitored using about 14 piezometers since 2015. During a review of data collected between 2015, and 2021 (a period of over five years), the normal groundwater elevation was typically El. 530 ft or lower, while Lake Newton surface water elevations were approximately El. 504.
- The lowest elevation of CCR within the PAP after closure will be approximately El. 485 ft, as shown in Sheet C-302 in **Attachment B**.

6. CERTIFICATION FROM A QUALIFIED PROFESSIONAL ENGINEER

Section 845.720(b)(S): The owner or operator of the CCR surface impoundment must obtain and submit with its construction permit application for closure a written certification from a qualified professional engineer that the final written closure plan meets the requirements of this Part.

I, ________________, 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 construction permit application has been prepared in accordance with the accepted practice of engineering and the requirements of Title 35, Subtitle G, Chapter I, Subchapter j, Section 845.720 of the Illinois Administrative Code.

Printed Name:

____

Signature *Date*

Registration Number:
Expiration Date:

Affix Seal

7. REFERENCES

[1] United States Environmental Protection Agency, "Walkthrough to Install and Operate the Hydrologic Evaluation of Landfill Performance (HELP) Model, Version 3.07," 2017.

[2] Ramboll, draft "Groundwater Modeling Report, Primary Ash Pond, Newton Power Plant, Newton, Illinois," April 2022.

Attachment A

Closure Alternatives Analysis

Closure Alternatives Analysis for the Primary Ash Pond at the Newton Power Plant Newton, Illinois

Draft—April 24, 2022

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www.gradientcorp.com
One Beacon Street, 17th Floor
Boston, MA 02108
617-395-5000

Table of Contents

Page

List of Tables

List of Figures

Abbreviations

AACE	Association for the Advancement of Cost Engineering
BMP	Best Management Practice
BCU	Bedrock Confining Unit
CAA	Closure Alternatives Analysis
CBR-Onsite	Closure-by-Removal with On-Site CCR Disposal
CBR-Offsite	Closure-by-Removal with Off-Site CCR Disposal
CCR	Coal Combustion Residual
CIP	Closure-in-Place
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CY	Cubic Yard
EJ	Environmental Justice
GHG	Greenhouse Gas
GWPS	Groundwater Protection Standards
HUC	Hydrologic Unit Code
IAC	Illinois Administrative Code
IDNR	Illinois Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
IPGC	Illinois Power Generating Company
LCU	Lower Confining Unit
LLDPE	Linear Low-Density Polyethylene
N_2O	Nitrous Oxide
NID	National Inventory of Dams
NO_x	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System
PAP	Primary Ash Pond
PM	Particulate Matter
PMP	Potential Migration Pathway
SFWA	State Fish and Wildlife Area
TMDL	Tr3TTotal Maximum Daily Load
TVA	Tennessee Valley Authority
UA	Uppermost Aquifer
UCU	Upper Confining Unit
UD	Upper Drift
US DOT	United States Department of Transportation
VOC	Volatile Organic Compound
WPC Permit	Water Pollution Control Construction and Operating Permit

Summary of Findings

Title 35, Part 845 of the Illinois Administrative Code (IAC; IEPA, 2021) requires the development of a Closure Alternatives Analysis (CAA) prior to undertaking closure activities at certain surface impoundments containing coal combustion residuals (CCRs) in the State of Illinois. Pursuant to requirements under IAC Section 845.710, this report presents a CAA for the Primary Ash Pond (PAP) located on Illinois Power Generating Company's (IPGC) Newton Power Plant property near the City of Newton, Illinois. The goal of a CAA is to holistically evaluate potential closure scenarios with respect to a wide range of factors, including the efficiency, reliability, and ease of implementation of the closure scenario; its potential positive and negative short- and long-term impacts on human health and the environment; and its ability to address concerns raised by residents (IAC Part 845; IEPA, 2021). Gradient evaluated three specific closure scenarios for the PAP: Closure-in-Place (CIP) with consolidation, Closure-by-Removal with On-Site CCR Disposal (CBR-Onsite), and Closure-by-Removal with Off-Site CCR Disposal (CBR-Offsite). The CIP scenario would entail consolidating CCR in the northern portion of the PAP, followed by capping with a new cover system consisting of a 40-mil linear low-density polyethylene (LLDPE) geomembrane layer, a geocomposite drainage layer, and 24 inches of vegetated soil.[1] The CBR-Onsite scenario would entail excavating the CCR from the PAP and transporting it to an on-Site landfill for disposal. The CBR-Offsite scenario would entail excavating the CCR from the PAP and transporting it to an off-Site landfill for disposal. IPGC will also continue to evaluate potential opportunities for beneficial re-use of CCR excavated from the PAP as an alternative to disposal.

IAC Section 845.710(c)(2) requires CAAs to "[i]dentify whether the facility has an onsite landfill with remaining capacity that can legally accept CCR, and, if not, whether constructing an onsite landfill is possible" (IEPA, 2021). There is an existing, permitted CCR landfill (Newton CCR Landfill Phase II) located immediately west of the PAP at the Newton Power Plant Site. However, this landfill is not actively being used to store waste and does not have sufficient capacity to contain all of the CCR that would be excavated from the PAP under the CBR-Onsite scenario. Additional landfill capacity would be required for the CBR-Onsite scenario and could be accomplished by reconstructing the current landfill cell, constructing additional sections of the landfill that have already been permitted, and either constructing an additional permitted expansion of the landfill or constructing a separate, additional on-Site landfill (Attachment B). A 25-acre area immediately adjacent to and east of the existing landfill is the most practical location for a potential landfill expansion.

Table S.1 summarizes the expected impacts of the CIP, CBR-Onsite, and CBR-Offsite closure scenarios with regard to each of the factors specified under IAC Section 845.710 (IEPA, 2021). Based on this evaluation and the additional details provided in Section 2 of this report, CIP has been identified as the most appropriate closure scenario for the PAP. Key benefits of the CIP scenario relative to the CBR-Onsite and CBR-Offsite scenarios include the more rapid re-development of the Site for use in utility-scale solar generation and battery energy storage and reduced impacts to workers, community members, and the environment during construction (*e.g.*, fewer constructed-related accidents, lower energy demands, less air pollution and greenhouse gas [GHG] emissions, less traffic-related impacts, and potentially lower impacts to environmental justice [EJ] communities). This conclusion is subject to change as additional data are collected and following the completion of an upcoming public meeting,

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[1] Alternatively, the final cover system for the PAP may use a 50-mil LLDPE geomembrane material called “Microspike” or “Supergrip," which has built-in drainage studs on the top (HDR, 2022).

which will be held in May 2022 pursuant to requirements under IAC Section 845.710(e). Following the public meeting, a final closure decision will be made based on the considerations identified in this report, the results of additional data that are collected, and any additional considerations that arise during the public meeting. The final closure recommendation will be provided in a Final Closure Plan, which will be submitted to the Illinois Environmental Protection Agency (IEPA) as described under IAC Section 845.720(b) (IEPA, 2021).

Table S.1 Comparison of Proposed Closure Scenarios

Evaluation Factor (Report Section; IAC Part 845 Section)	**Closure Scenario**		
	CIP	**CBR-Onsite**	**CBR-Offsite**
Closure Alternative Descriptions (Section 2.1, IAC Section 845.710(c))	The CIP scenario would entail consolidation of CCR in the northern portion of the PAP, followed by capping with a new cover system.	All CCR would be excavated from the PAP and transported *via* truck to the existing on-Site landfill for disposal. The on-Site landfill does not have sufficient capacity at present and would require expansion. This scenario meets the requirements of IAC Section 845.710(c)(2) (IEPA, 2021), which requires an assessment be included in the CAA of whether the Site has an on-Site landfill with available capacity or whether an on-Site landfill can be constructed.	All CCR would be excavated from the PAP and transported *via* truck to an off-Site landfill for disposal. Expansion of the off-Site landfill may be necessary in order to accept all of the CCR from the PAP.
Type and Degree of Long-Term Management, Including Monitoring, Operation, and Maintenance (Section 2.2.3, IAC Section 845.710(b)(1)(C))	Monitoring would be performed for 30 years post-closure or until GWPSs are achieved, whichever is longer. Additionally, the final cover system for the PAP would undergo 30 years of annual inspections, mowing, and maintenance.	Monitoring would be performed for 3 years post-closure or until GWPSs are achieved, whichever is longer.	Monitoring would be performed for 3 years post-closure or until GWPSs are achieved, whichever is longer.
Magnitude of Reduction of Existing Risks (Section 2.2.1, IAC Sections 845.710(b)(1)(A) and 845.710(b)(1)(F))	There are no current unacceptable risks to any human or ecological receptors associated with the PAP. Because there are no current risks, and dissolved constituent concentrations would be expected to decline post-closure, no risks to human or ecological receptors would be expected post-closure.	There are no current unacceptable risks to any human or ecological receptors associated with the PAP. Because there are no current risks, and dissolved constituent concentrations would be expected to decline post-closure, no risks to human or ecological receptors would be expected post-closure.	There are no current unacceptable risks to any human or ecological receptors associated with the PAP. Because there are no current risks, and dissolved constituent concentrations would be expected to decline post-closure, no risks to human or ecological receptors would be expected post-closure.
Likelihood of Future Releases of CCR (Section 2.2.2, IAC Sections 845.710(b)(1)(B) and 845.710(b)(1)(F))	During closure, there would be minimal risk of dike failure occurring at the PAP (*e.g.*, due to flooding or seismic activity) and minimal risk of dike overtopping during flood conditions. Post-closure, the risks of overtopping and dike failure would be even smaller than they are currently, due to the installation of a protective soil cover and new stormwater control structures. Dikes, final cover, and stormwater control features have been designed to withstand earthquakes and storm events.	During closure, there would be minimal risk of dike failure occurring at the PAP (*e.g.*, due to flooding or seismic activity) and minimal risk of dike overtopping during flood conditions. Following excavation, there would be no risk of CCR releases due to dike failure.	During closure, there would be minimal risk of dike failure occurring at the PAP (*e.g.*, due to flooding or seismic activity) and minimal risk of dike overtopping during flood conditions. Following excavation, there would be no risk of CCR releases due to dike failure.
Worker Risks (Section 2.2.4.1, IAC Sections 845.710(b)(1)(D) and 845.710(b)(1)(F))	An estimated 0.018 worker fatalities and 2.8 worker injuries would be expected to occur due to on-Site activities under this closure scenario. An additional 0.019 worker fatalities and 1.4 worker injuries would be expected to occur off-Site due to vehicle accidents during hauling, labor and equipment mobilization and demobilization, and material deliveries. In total, 0.037 worker fatalities and 4.3 worker injuries would be expected under this closure scenario. Overall, risks to workers would likely be highest under the CBR-Offsite scenario and lowest under the CIP scenario.	An estimated 0.032 worker fatalities and 5.0 worker injuries would be expected to occur due to on-Site activities under this closure scenario. An additional 0.032 worker fatalities and 2.5 worker injuries would be expected to occur off-Site due to vehicle accidents during hauling, labor and equipment mobilization and demobilization, and material deliveries. In total, 0.064 worker fatalities and 7.4 worker injuries would be expected under this closure scenario. Overall, risks to workers would likely be highest under the CBR-Offsite scenario and lowest under the CIP scenario.	An estimated 0.0097 worker fatalities and 1.5 worker injuries would be expected to occur due to on-Site activities under this closure scenario. An additional 0.26 worker fatalities and 15 worker injuries would be expected to occur off-Site due to vehicle accidents during hauling, labor and equipment mobilization and demobilization, and material deliveries. In total, 0.26 worker fatalities and 16 worker injuries would be expected under this closure scenario. Overall, risks to workers would likely be highest under the CBR-Offsite scenario and lowest under the CIP scenario.
Community Risks (Section 2.2.4.2, IAC Sections 845.710(b)(1)(D) and 845.710(b)(1)(F))			
▪ *Off-Site Impacts on Nearby Residents and EJ Communities*	Off-Site impacts on nearby residents (including accidents, traffic, noise, and air pollution) would be far less under this closure scenario than under the CBR-Offsite scenario because it does not require off-Site hauling (*i.e.*, off-Site transport of CCR or borrow soil). In total, an estimated 0.012 fatalities and 0.70 injuries would be expected to occur among community members due to off-Site activities under this scenario. No impacts to nearby EJ communities are anticipated under this closure scenario.	Off-Site impacts on nearby residents would be far less under this closure scenario than under the CBR-Offsite scenario because it does not require off-Site hauling (*i.e.*, off-Site transport of CCR or borrow soil). In total, an estimated 0.016 fatalities and 1.1 injuries would be expected to occur among community members due to off-Site activities under this scenario. No impacts to nearby EJ communities are anticipated under this closure scenario.	Off-Site impacts on nearby residents would be far greater under this scenario than under the CIP and CBR-Onsite scenarios, because this scenario requires significantly more off-Site vehicle and equipment travel miles. In total, an estimated 0.74 fatalities and 23 injuries would be expected to occur among community members due to off-Site activities under this scenario. With regard to traffic impacts, a haul truck would be likely to pass a location near the Site every 1.4 minutes on average during working hours for approximately 1,620 working days under this scenario. In addition, the transport of CCR to the off-Site landfill could potentially result in impacts to several EJ communities located along haul routes, including the EJ communities near Lawrenceville, IL, Vincennes, IN, and Terre Haute, IN.

Evaluation Factor (Report Section; IAC Part 845 Section)	**Closure Scenario**		
	CIP	**CBR-Onsite**	**CBR-Offsite**
▪ *Impacts on Scenic, Historical, and Recreational Value*	Due to (*e.g.*) noise and visual disturbances, construction activities may have short-term negative impacts on the recreational use of Newton Lake and the greater Newton Lake State Fish and Wildlife Area. Because the expected duration of construction activities is shorter under the CIP scenario than under the CBR-Onsite and CBR-Offsite scenarios, short-term impacts on the scenic and recreational value of natural areas near the Site would be less under this closure scenario than under the two CBR scenarios. There are no historical sites in the vicinity of the impoundment or the on-Site landfill. Thus, no impacts on historical sites would be expected under any closure scenario.	Due to (*e.g.*) noise and visual disturbances, construction activities may have short-term negative impacts on the recreational use of Newton Lake and the greater Newton Lake State Fish and Wildlife Area. Because the expected duration of construction activities is longer under the CBR-Onsite and CBR-Offsite scenarios than under the CIP scenario, short-term impacts on the scenic and recreational value of natural areas near the Site would be greater under these two closure scenarios than under the CIP scenario. There are no historical sites in the vicinity of the impoundment or the on-Site landfill. Thus, no impacts on historical sites would be expected under any closure scenario.	Due to (*e.g.*) noise and visual disturbances, construction activities may have short-term negative impacts on the recreational use of Newton Lake and the greater Newton Lake State Fish and Wildlife Area. Because the expected duration of construction activities is longer under the CBR-Onsite and CBR-Offsite scenarios than under the CIP scenario, short-term impacts on the scenic and recreational value of natural areas near the Site would be greater under these two closure scenarios than under the CIP scenario. There are no historical sites in the vicinity of the impoundment or the on-Site landfill. Thus, no impacts on historical sites would be expected under any closure scenario.
Environmental Risks (Section 2.2.4.3, IAC Sections 845.710(b)(1)(D) and 845.710(b)(1)(F))			
▪ *Impacts on Greenhouse Gas Emissions and Energy Consumption*	Total energy demands and GHG emissions would be far smaller under the CIP and CBR-Onsite scenarios than under the CBR-Offsite scenario, because the total on-Site and off-Site vehicle and equipment travel miles required under the CIP scenario (3,550,000 miles) and CBR-Onsite scenario (6,150,000 miles) are far smaller than those required under the CBR-Offsite scenario (67,700,000 miles). The CIP scenario would have an additional, unquantified carbon footprint due to the need to manufacture geomembranes for use in the final cover system. At the grid scale, construction of a solar facility at the Site would put energy back on the grid and reduce reliance on non-renewable energy sources. Re-development of the Site for solar would occur more rapidly under the CIP scenario than under the two CBR scenarios.	Total energy demands and GHG emissions would be far smaller under the CIP and CBR-Onsite scenarios than under the CBR-Offsite scenario, because the total on-Site and off-Site vehicle and equipment travel miles required under the CIP scenario (3,550,000 miles) and CBR-Onsite scenario (6,150,000 miles) are far smaller than those required under the CBR-Offsite scenario (67,700,000 miles). Because expansion of the existing on-Site landfill would be necessary in order to accept all of the CCR from the PAP, the CBR-Onsite scenario would have an additional, unquantified carbon footprint due to the need to manufacture geomembranes for use in the expanded landfill liner. At the grid scale, construction of a solar facility at the Site would put energy back on the grid and reduce reliance on non-renewable energy sources. Re-development of the Site for solar would occur more slowly under the two CBR scenarios than under the CIP scenario.	Total energy demands and GHG emissions would be far greater under the CBR-Offsite scenario than under the CIP and CBR-Onsite scenarios, because the total on-Site and off-Site vehicle and equipment travel miles required under the CBR-Offsite scenario (67,700,000 miles) are far greater than those required under the CIP scenario (3,550,000 miles) and the CBR-Onsite scenario (6,150,000 miles). If expansion of the off-Site landfill became necessary in order to accept all of the CCR from the PAP, then the CBR-Offsite scenario would have an additional, unquantified carbon footprint due to the need to manufacture geomembranes for use in the expanded landfill liner. At the grid scale, construction of a solar facility at the Site would put energy back on the grid and reduce reliance on non-renewable energy sources. Re-development of the Site for solar would occur more slowly under the two CBR scenarios than under the CIP scenario.
▪ *Impacts on Natural Resources and Habitat*	Construction activities may have short-term negative impacts on terrestrial and aquatic species located in the vicinity of the PAP, the borrow area, the on-Site landfill, and the off-Site landfill. Short-term impacts on natural resources and habitat would be smaller under the CIP scenario than under the CBR-Onsite and CBR-Offsite scenarios, because the overall duration of construction would be shorter under the CIP scenario than under the two CBR scenarios.	Construction activities may have short-term negative impacts on terrestrial and aquatic species located in the vicinity of the PAP, the borrow area, the on-Site landfill, and the off-Site landfill. Short-term impacts on natural resources and habitat would be greater under the CBR-Onsite and CBR-Offsite scenarios than under the CIP scenario, because the overall duration of construction would be longer under the two CBR scenarios than under the CIP scenario.	Construction activities may have short-term negative impacts on terrestrial and aquatic species located in the vicinity of the PAP, the borrow area, the on-Site landfill, and the off-Site landfill. Short-term impacts on natural resources and habitat would be greater under the CBR-Onsite and CBR-Offsite scenarios than under the CIP scenario, because the overall duration of construction would be longer under the two CBR scenarios than under the CIP scenario.

Evaluation Factor (Report Section; IAC Part 845 Section)	Closure Scenario CIP	 CBR-Onsite	 CBR-Offsite
Time Until Groundwater Protection Standards Are Achieved (Section 2.2.5, IAC Sections 845.710(b)(1)(E) and 845.710(d)(2 and 3))	Groundwater modeling was performed to evaluate future groundwater quality in the vicinity of the PAP under each of the proposed closure scenarios (Ramboll, 2022). Model predictions indicate that groundwater concentrations in monitoring wells within the UD/PMP and UA will achieve the GWPS in 20 years under the CIP scenario and 16 years under the CBR closure scenario (Ramboll, 2022). Model predictions also indicate that groundwater concentrations will remain above the GWPSs in the UCU for a period of more than 100 years for both the CIP and CBR scenarios. However, in both the CIP and CBR scenarios, the plume footprint continues to recede over time and remains within the property boundaries, indicating that both closure scenarios perform equivalently with regard to achieving the GWPSs (Ramboll, 2022).	Groundwater modeling was performed to evaluate future groundwater quality in the vicinity of the PAP under each of the proposed closure scenarios (Ramboll, 2022). Model predictions indicate that groundwater concentrations in monitoring wells within the UD/PMP and UA will achieve the GWPS in 20 years under the CIP scenario and 16 years under the CBR closure scenario (Ramboll, 2022). Model predictions also indicate that groundwater concentrations will remain above the GWPSs in the UCU for a period of more than 100 years for both the CIP and CBR scenarios. However, in both the CIP and CBR scenarios, the plume footprint continues to recede over time and remains within the property boundaries, indicating that both closure scenarios perform equivalently with regard to achieving the GWPSs (Ramboll, 2022).	Groundwater modeling was performed to evaluate future groundwater quality in the vicinity of the PAP under each of the proposed closure scenarios (Ramboll, 2022). Model predictions indicate that groundwater concentrations in monitoring wells within the UD/PMP and UA will achieve the GWPS in 20 years under the CIP scenario and 16 years under the CBR closure scenario (Ramboll, 2022). Model predictions also indicate that groundwater concentrations will remain above the GWPSs in the UCU for a period of more than 100 years for both the CIP and CBR scenarios. However, in both the CIP and CBR scenarios, the plume footprint continues to recede over time and remains within the property boundaries, indicating that both closure scenarios perform equivalently with regard to achieving the GWPSs (Ramboll, 2022).
Long-Term Reliability of the Engineering and Institutional Controls (Section 2.2.7; IAC Section 845.710(b)(1)(G))	CIP would be expected to be a reliable closure alternative over the long term.	CBR-Onsite would be expected to be a reliable closure alternative over the long term.	CBR-Offsite would be expected to be a reliable closure alternative over the long term.
Potential Need for Future Corrective Action (Section 2.2.8; IAC Section 845.710(b)(1)(H))	Corrective action is expected at the Site. An evaluation of potential corrective measures and corrective actions has not yet been completed, but will be conducted consistent with the requirements in IAC Section 845.660 and IAC Section 845.670.	Corrective action is expected at the Site. An evaluation of potential corrective measures and corrective actions has not yet been completed, but will be conducted consistent with the requirements in IAC Section 845.660 and IAC Section 845.670.	Corrective action is expected at the Site. An evaluation of potential corrective measures and corrective actions has not yet been completed, but will be conducted consistent with the requirements in IAC Section 845.660 and IAC Section 845.670.
Effectiveness of the Alternative in Controlling Future Releases (Section 2.3; IAC Section 845.710(b)(2)(A and B))	There are no current or future risks to any human or ecological receptors associated with the PAP. During closure, there would be minimal risk of dike failure occurring and minimal risk of dike overtopping during flood conditions. Post-closure, the risks of overtopping and dike failure would be even smaller than they are currently, due to the installation of a protective soil cover and new stormwater control structures. Dikes, final cover, and stormwater control features have been designed to withstand earthquakes and storm events.	There are no current or future risks to any human or ecological receptors associated with the PAP. During closure, there would be minimal risk of dike failure occurring and minimal risk of dike overtopping during flood conditions. Following excavation, there would be no risk of CCR releases due to dike failure.	There are no current or future risks to any human or ecological receptors associated with the PAP. During closure, there would be minimal risk of dike failure occurring and minimal risk of dike overtopping during flood conditions. Following excavation, there would be no risk of CCR releases due to dike failure.
Ease or Difficulty of Implementing the Alternative (Section 2.4, IAC Section 845.710(b)(3))			
▪ *Degree of Difficulty Associated with Construction*	CIP is a reliable and standard method for managing and closing waste impoundments. Dewatering saturated CCR to construct a stabilized final cover system subgrade may present challenges during closure; however, these challenges are common to most CCR surface impoundment closures and are commonly addressed *via* surface water management and dewatering techniques.	Relative to CIP, CBR-Onsite and CBR-Offsite pose additional implementation difficulties due to higher earthwork volumes and higher dewatering volumes, and longer construction schedules. The construction schedule for excavation may also be negatively impacted under the CBR-Onsite scenario, because the on-Site landfill would need to be expanded in order to receive all of the materials excavated from the impoundment.	Relative to CIP, CBR-Onsite and CBR-Offsite pose additional implementation difficulties due to higher earthwork volumes and higher dewatering volumes, and longer construction schedules. Hauling would be more difficult to implement under the CBR-Offsite scenario than under the CBR-Onsite scenario, due to the much longer haul distance required (75 miles *versus* 1 mile) and the need to use public roads for hauling. Because the CCR would be hauled on public roads, it would require haul trucks with a smaller capacity (16.5 cubic yards *versus* 34 cubic yards) and would also need to be dewatered to a greater extent than would be necessary under the CBR-Onsite scenario. Off-Site landfilling would additionally require the development of a disposal plan and could raise issues related to the co-disposal of CCR and other non-hazardous wastes. The off-Site landfill may need to be expanded to receive all of the CCR generated during excavation.
▪ *Expected Operational Reliability*	Operational reliability would be expected under all closure scenarios.	Operational reliability would be expected under all closure scenarios.	Operational reliability would be expected under all closure scenarios.

Evaluation Factor (Report Section; IAC Part 845 Section)	**Closure Scenario**		
	CIP	**CBR-Onsite**	**CBR-Offsite**
▪ *Need for Permits and Approvals*	Permits required under all closure scenarios would include a modification to the existing NPDES permit; a construction permit from the IDNR Dam Safety Program to allow the embankment and spillways of the PAP to be modified as part of closure; a construction stormwater permit through IEPA; and a joint water pollution control construction and operating permit (WPC permit).	Permits required under all closure scenarios would include a modification to the existing NPDES permit; a construction permit from the IDNR Dam Safety Program to allow the embankment and spillways of the PAP to be modified as part of closure; a construction stormwater permit through IEPA; and a joint water pollution control construction and operating permit (WPC permit). On-site landfill expansion would require permitting from IEPA Bureau of Land under Title 35 Sections 811 and 812 as well as local government approval.	Permits required under all closure scenarios would include a modification to the existing NPDES permit; a construction permit from the IDNR Dam Safety Program to allow the embankment and spillways of the PAP to be modified as part of closure; a construction stormwater permit through IEPA; and a WPC permit. Additional permits and approvals may be required under this scenario if the off-Site landfill must be expanded to receive all of the CCR from the PAP.
▪ *Availability of Equipment and Specialists*	CIP and CBR rely on common construction equipment and materials and typically do not require the use of specialists. However, global supply chains have been disrupted due to the COVID-19 pandemic, resulting in shortages in the availability of construction equipment and parts. There may be delays in construction under all scenarios if supply chain resilience does not improve by the time of construction. Due to smaller earthwork volumes and a lesser need for construction equipment under the CIP scenario than under the CBR scenarios, shortages may cause fewer challenges under the CIP scenario than under the CBR scenarios.	CIP and CBR rely on common construction equipment and materials and typically do not require the use of specialists. However, global supply chains have been disrupted due to the COVID-19 pandemic, resulting in shortages in the availability of construction equipment and parts. There may be delays in construction under all scenarios if supply chain resilience does not improve by the time of construction. Due to higher earthwork volumes and a greater need for construction equipment under the CBR scenarios than under the CIP scenario, shortages may cause greater challenges under the CBR scenarios than under the CIP scenario.	CIP and CBR rely on common construction equipment and materials and typically do not require the use of specialists. However, global supply chains have been disrupted due to the COVID-19 pandemic, resulting in shortages in the availability of construction equipment and parts. There may be delays in construction under all scenarios if supply chain resilience does not improve by the time of construction. Due to higher earthwork volumes and a greater need for construction equipment under the CBR scenarios than under the CIP scenario, shortages may cause greater challenges under the CBR scenarios than under the CIP scenario. The current shortage of truck drivers may be particularly impactful under the CBR-Offsite scenario, due to the large volumes of CCR to be hauled from the Site.
▪ *Available Capacity and Location of Treatment, Storage, and Disposal Services*	Under the CIP scenario, all of the CCR currently within the PAP would be stored within the existing footprint of the impoundment. Treatment would consist of unwatering the PAP at the start of construction, performing limited dewatering to stabilize the CCR subgrade, and managing stormwater inflow. Water from unwatering and dewatering of the PAP would be discharged in accordance with the NPDES permit for the facility.	The existing on-Site landfill at the Newton Power Plant Site does not have sufficient capacity to receive all of the CCR that is currently slated for landfilling under the CBR-Onsite scenario. Expansion of the on-Site landfill capacity would thus be necessary. The potential impacts of landfill expansion are included in the analysis as one aspect of the overall closure scenario. Water from unwatering and dewatering of the PAP would be discharged in accordance with the NPDES permit for the facility.	The capacity remaining at the preferred off-Site landfill (the Sycamore Ridge Landfill in Pimento, Indiana) is sufficient to receive all of the CCR in the PAP. However, due to the relatively short period over which CCR would be received at the landfill, vertical and/or lateral expansions may become necessary. Additionally, the landfill operators may need to develop a disposal plan to account for the increased volume of material that would be received and the unique CCR waste characteristics. Water from unwatering and dewatering of the PAP would be discharged in accordance with the NPDES permit for the facility.
Impact of Alternative on Waters of the State (Section 2.5, IAC Section 845.710(d)(4))	No current or future exceedances of any screening benchmarks for surface water would be expected under any closure scenario.	No current or future exceedances of any screening benchmarks for surface water would be expected under any closure scenario.	No current or future exceedances of any screening benchmarks for surface water would be expected under any closure scenario.
Potential Modes of Transportation Associated with CBR (Section 2.1; IAC Section 845.710(c)(1)	This factor is not relevant for CIP.	This factor is not relevant for CBR-Onsite.	IAC Section 845.710(c)(1) requires CBR alternatives to consider multiple methods for transporting CCR off-Site, including rail, barge, and trucks. HDR evaluated the feasibility of transporting CCR to the off-Site landfill *via* rail or barge and found that neither option is viable at this Site. Truck transport has been identified as the preferred option for transport of CCR to the off-Site landfill. The local availability and use of natural gas-powered trucks, or other low-polluting trucks, will be evaluated prior to the start of construction.

Evaluation Factor (Report Section; IAC Part 845 Section)	**Closure Scenario**		
	CIP	**CBR-Onsite**	**CBR-Offsite**
Concerns of Residents Associated with Alternatives (Section 2.6, IAC Section 845.710(b)(4))	Despite the preference for CBR that has been expressed by nonprofits representing community interests near the Site, CIP would effectively address residents' concerns regarding potential impacts to groundwater and surface water quality at the Site. Relative to CBR-Offsite, CIP and CBR-Onsite (which do not require any off-Site hauling) present far fewer risks to nearby residents and potentially EJ communities in the form of off-Site accidents, traffic-related impacts, noise, and air pollution. Moreover, under the CIP scenario, the Site could be more rapidly re-developed for use in utility-scale solar generation and battery energy storage.	Relative to CBR-Offsite, CIP and CBR-Onsite (which do not require any off-Site hauling) present far fewer risks to nearby residents and potentially EJ communities in the form of off-Site accidents, traffic-related impacts, noise, and air pollution. Moreover, under the CBR scenarios, the Site could take longer to re-develop for use in utility-scale solar generation and battery energy storage.	Relative to CIP and CBR-Onsite, CBR-Offsite (which requires substantial off-Site hauling) presents far greater risks to nearby residents and potentially EJ communities in the form of off-Site accidents, traffic-related impacts, noise, and air pollution. Moreover, under the CBR scenarios, the Site could take longer to re-develop for use in utility-scale solar generation and battery energy storage.
Class 4 Cost Estimate (Section 2.7, IAC Section 845.710(d)(1))	A Class 4 cost estimate will be prepared in the Final Closure Plan consistent with AACE classification standards.	A Class 4 cost estimate will be prepared in the Final Closure Plan consistent with AACE classification standards.	A Class 4 cost estimate will be prepared in the Final Closure Plan consistent with AACE classification standards.

Notes:

AACE = Association for the Advancement of Cost Engineering; CBR-Offsite = Closure-by-Removal with Off-Site CCR Disposal; CBR-Onsite = Closure-by-Removal with On-Site CCR Disposal; CCR = Coal Combustion Residual; CIP = Closure-in-Place; EJ = Environmental Justice; GHG = Greenhouse Gas; GWPS = groundwater protection standard; IAC = Illinois Administrative Code; IDNR = Illinois Department of Natural Resources; IEPA = Illinois Environmental Protection Agency; NPDES = National Pollutant Discharge Elimination System; PAP = Primary Ash Pond.

1 Introduction

1.1 Site Description and History

1.1.1 Site Location and History

Illinois Power Generating Company's (IPGC) Newton Power Plant is an electric power generating facility with coal-fired units located approximately seven miles southwest of the City of Newton, Illinois. The facility began operating in approximately 1977 and will be retired by the end of 2027 (Meeker, 2020; Ramboll, 2021).

1.1.2 CCR Impoundment

The Newton Power Plant produces and stores coal combustion residuals (CCRs) as part of its operations. The Primary Ash Pond (PAP; Vistra ID No. CCR Unit 501, Illinois Environmental Protection Agency [IEPA] ID No. W0798070001-01, and National Inventory of Dams [NID] ID No. IL50719), which is the only CCR-containing impoundment at this Site, is the subject of this report.

The PAP (Figure 1.1) is a 404-acre unlined surface impoundment constructed in 1977 for the management of bottom ash, fly ash, and other non-CCR waste generated by the facility (Ramboll, 2021). Decanted water from the PAP discharges into the Secondary Pond, a 9.3-acre non-CCR impoundment located immediately south of the PAP (Ramboll, 2021). The Secondary Pond, which is used to clarify process water, discharges to Newton Lake *via* a National Pollutant Discharge Elimination System (NPDES)-permitted outfall (AECOM, 2016a; Ramboll, 2021). After the Newton Power Plant is retired in 2027, the PAP will no longer receive sluiced ash. Final closure of the PAP is expected to be completed by the end of 2028 (HDR, 2022).

Figure 1.1 Site Location Map. Adapted from Ramboll (2021).

1.1.3 Surface Water Hydrology

The Secondary Pond, which receives decanted water from the PAP, is permitted to discharge to Newton Lake, the approximately 1,650-acre cooling pond for the facility (Figure 1.1, Ramboll, 2021). Newton Lake is a long water body that surrounds the PAP to the east, south, and west. It is located within the Weather Creek and Newton Lake Watersheds (Hydrologic Unit Codes [HUCs] 051201140504 and 051201140503, respectively), which lie within the larger Little Wabash River watershed (HUCs 05120114 and 05120115; Tetra Tech, 2008; US EPA, 2018). The southern boundary of the PAP is approximately 250 to 700 feet (ft) from the northern shore of Newton Lake (Ramboll, 2021).

Newton Lake (Assessment Unit ID IL_RCR) is listed on the 2018 Illinois Section 303(d) List as being impaired for fish consumption due to mercury. In addition, it is listed as being impaired for aesthetic quality due to Total Suspended Solids (IEPA, 2019a; US EPA, 2018). As of 2008, there is a Total Maximum Daily Load (TMDL) in place to address aesthetic quality impairments in Newton Lake due to an excess of Total Phosphorus (Tetra Tech, 2008).

In addition to Newton Lake, another unnamed 13.7-acre lake is located within 1,000 meters (3,281 feet) of the PAP. There are also several unnamed freshwater ponds located within 1,000 meters of the PAP that range in size from 0.3 acres to 6.2 acres (Figure 1.2; Ramboll, 2021).

Golder collected a total of 28 surface water samples from Newton Lake in the vicinity of the PAP in April and May of 2021 (Golder, 2021). These data are summarized in Gradient's Human Health and Ecological Risk Assessment for the Site, which is provided as Attachment A of this report.

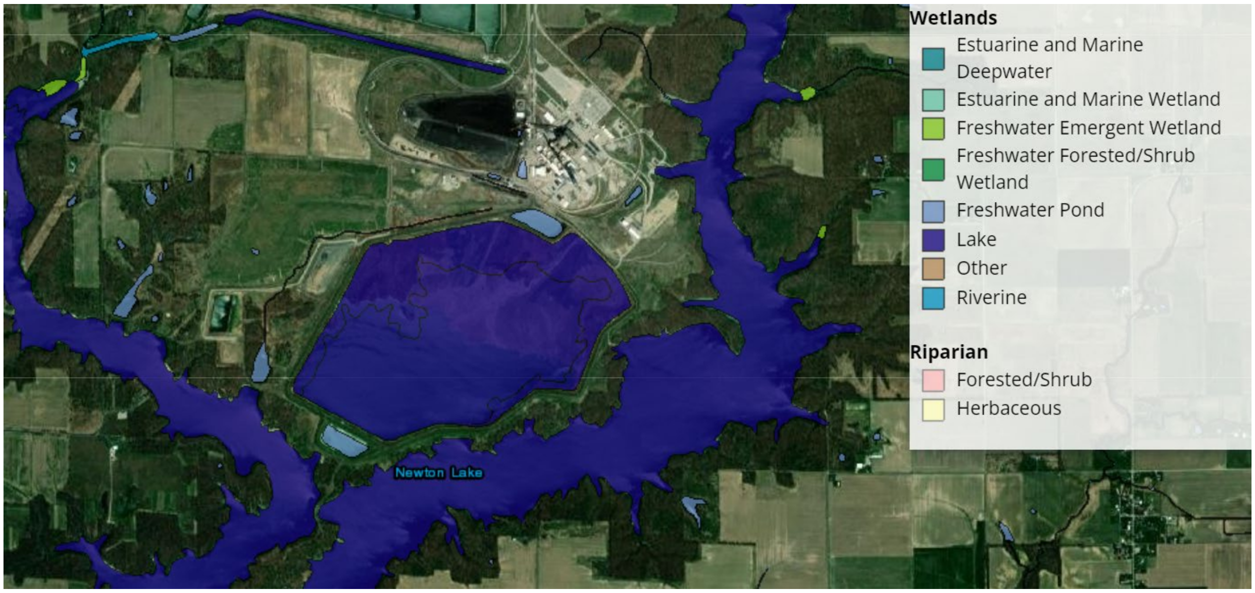

Figure 1.2 Wetlands and Surface Water Bodies in the Vicinity of the Newton Primary Ash Pond. Adapted from US FWS (2021).

1.1.4 Hydrogeology

The geology underlying the Site in the vicinity of the PAP primarily consists of unlithified deposits overlying a shale bedrock unit. The principal types of unlithified materials include the Peoria Silt /Sangman Soil, the Hagarstown Member, the Vandalia Till, the Mulberry Grove Member, and the Smithboro Till/Banner Formation (Ramboll, 2021). These unlithified deposits are underlain by a Pennsylvanian Age shale bedrock of the Mattoon Formation (Ramboll, 2021). Five distinct hydrostratigraphic units in the area are (listed from ground surface down): the Upper Drift (UD)/Potential Migration Pathway (PMP), the Upper Confining Unit (UCU), the Uppermost Aquifer (UA), the Lower Confining Unit (LCU), and the Bedrock Confining Unit (BCU) (Ramboll, 2021).The UD is composed of low permeability silts and clays of the Peoria Silt and Sangamon Soil and the sandier soils of the Hagarstown Member (*i.e.*, PMP). The Peoria Silt and Sangamon Soil range in thickness from 3 to 46 ft (Ramboll, 2021). The Hagarstown Member is generally 2 feet (ft) thick but is encountered at thicknesses up to about 6.9 ft in the vicinity of the Ash Pond (Ramboll, 2021). The UA is composed of a 3 to 17 ft thick Mulberry Grove Member, which consists of sand, silty- and clayey- sand, and gravel. The UA is sandwiched between two low-permeability confining units: (i) the UCU on top consisting of clay and silt of the Vandalia Till and (ii) the LCU on bottom consisting of silt and clay of the Smithboro Till Member and the Banner Formation (Ramboll, 2021). No wells are screened within the UCU, the LCU, or the underlying shale BCU.

Groundwater within the UA flows generally from the north towards the south and southwest. In the southern area of the PAP, groundwater flows toward a former drainage feature located west of the PAP (Ramboll, 2021). In the northern area of the PAP, groundwater from the UA may interact with surface water in Newton Lake, as evidenced by relatively higher groundwater head elevations compared to the Newton Lake water level. Groundwater within the UD/PMP may also interact with surface water in Newton Lake (Ramboll, 2021).

The "Hydrogeologic Site Characterization Report" prepared by Ramboll as part of the operating permit for the PAP includes an evaluation of groundwater data collected from PAP monitoring wells between 2015 and 2021 (Ramboll, 2021).

1.1.5 Site Vicinity

The Newton Power Plant Site is located in a predominantly agricultural area. The PAP is located south of the power plant and is bordered by Newton Lake to the west, south, and east (Ramboll, 2021. Scenic and recreational areas within a few miles of the Site include the Newton Lake State Fish and Wildlife Area (SFWA) and the Prairie Ridge State Natural Area / Jasper County Prairie Chicken Sanctuary (Ramboll, 2021. The Newton Lake SFWA, which includes Newton Lake and an additional 5,800 surrounding acres of timber, cropland, and open/non-cultivated land, is preserved by IDNR for fishing, hunting, and wildlife management. Approximately 540 acres of the western shoreline are also used for picnicking, hiking, biking, and horseback riding. The northeastern portion of the Newton Lake SFWA is dedicated to the preservation of the prairie chicken, a state-endangered species (IDNR, 2022). The Prairie Ridge State Natural Area / Jasper County Prairie Chicken Sanctuary, which is located east of Newton Lake, consists of several discontinuous tracts of land that are similarly dedicated to the preservation of the prairie chicken (IDNR, 2022).

Based on a review of the Illinois Department of Natural Resources (IDNR) Historic Preservation Division database and the Illinois State Archaeological Survey database, there are no historic sites located within 1,000 meters of the PAP (Ramboll, 2021).

1.2 IAC Part 845 Regulatory Review and Requirements

Title 35, Part 845 of the Illinois Administrative Code (IAC; IEPA, 2021) requires the development of a Closure Alternatives Analysis (CAA) prior to undertaking closure activities at certain CCR-containing surface impoundments in the State of Illinois. Section 2 of this report presents a CAA for the PAP pursuant to requirements under IAC Section 845.710. The goal of a CAA is to holistically evaluate each potential closure scenario with respect to a wide range of factors, including the efficiency, reliability, and ease of implementation of the closure scenario; its potential positive and negative short- and long-term impacts on human health and the environment; and its ability to address concerns raised by residents (IEPA, 2021). A CAA is a decision-making tool that is designed to aid in the selection of an optimal closure alternative for the impoundments at a site.

2 Closure Alternatives Analysis

2.1 Closure Alternative Descriptions (IAC Section 845.710(c))

This section of the report presents a CAA for the PAP pursuant to requirements under IAC Section 845.710 (IEPA, 2021). The three closure scenarios evaluated in this CAA are Closure-in-Place with consolidation (CIP), Closure-by-Removal with On-Site CCR Disposal (CBR-Onsite), and Closure-by-Removal with Off-Site CCR Disposal (CBR-Offsite). The CIP scenario would entail consolidation of CCR in the northern portion of the PAP, followed by capping with a new cover system. Under the CBR-Onsite scenario, the CCR would be excavated from the impoundment and hauled to an on-Site landfill. Under the CBR-Offsite scenario, the CCR would be excavated from the impoundment and hauled to an off-Site landfill. IPGC will also continue to evaluate potential opportunities for beneficial re-use of CCR excavated from the PAP as an alternative to disposal. In addition to the primary closure activities to be undertaken at the PAP, all three closure scenarios account for the eventual closure of the existing off-Site landfill (which currently contains uncapped waste) *via* capping.

IAC Section 845.710(c)(2) requires CAAs to, "[i]dentify whether the facility has an onsite landfill with remaining capacity that can legally accept CCR, and, if not, whether constructing an onsite landfill is possible" (IEPA, 2021). There is an existing, permitted CCR landfill (Newton CCR Landfill Phase II) located immediately west of the PAP at the Newton Power Plant Site. However, this landfill is not actively being used to store waste and does not have sufficient capacity to contain all of the CCR that would be excavated from the PAP under the CBR-Onsite scenario. Additional landfill capacity would be required for the CBR-Onsite scenario and could be accomplished by reconstructing the current landfill cell, constructing additional sections of the landfill that have already been permitted, and either constructing an additional permitted expansion of the landfill or constructing a separate, additional on-Site landfill (Attachment B). A 25-acre area immediately adjacent to and east of the existing landfill is the most practical location for a potential landfill expansion.

Sections 2.1.1, 2.1.2, and 2.1.3 provide detailed descriptions of the CIP, CBR-Onsite, and CBR-Offsite closure scenarios. These scenarios are based on the Closure Plan for the PAP (HDR, 2022) and additional closure documents and analyses provided to Gradient by HDR, which are attached to this report as Attachment B.

2.1.1 Closure-in-Place

Under the CIP scenario, the CCR in the PAP would be consolidated in the northern portion of the impoundment, then capped in place with a final cover system. This scenario includes the following work elements (HDR, 2022):

- Unwatering and dewatering of the impoundment *via* dewatering ditches and sumps. Water from unwatering and dewatering would be pumped to the adjacent Secondary Pond, which discharges to Newton Lake *via* a NPDES-permitted outfall. Dewatering and unwatering would begin as soon as practical with the completion of permitting and continue throughout the construction period.

- Consolidation of the CCR in the PAP by excavating CCR and approximately 1 foot of underlying soils from the southern and western portions of the PAP and using it as fill within the northern and eastern portions of the PAP in order to establish minimum slopes. CCR will be placed in lifts and compacted to provide a subgrade suitable for construction of a final cover system. In addition to CCR, materials within the existing on-Site landfill and/or coal pile may also be relocated and utilized as subgrade fill within the impoundment closure area.
- Removal of existing outflow structures and culverts connecting the PAP to the adjacent Secondary Pond.
- Removal of the berm between the PAP and the Secondary Pond, followed by removal of the Secondary Pond. Post-closure, an area in the southern portion of the PAP will be used as a stormwater management pond.
- Construction of an alternative cover system over the consolidated ash consisting of a 40-mil LLDPE geomembrane layer, a geocomposite drainage layer, and 24 inches of protective soil cover suitable for supporting vegetative growth.[2] An alternative cover performance demonstration will be submitted to IEPA for approval pursuant to Section 845.750(c)(2).
- Installation of stormwater control structures, including: (i) stormwater channels designed to convey stormwater into the new stormwater pond post-closure, and (ii) drainage pipes, channels, and downchutes designed to reduce erosion in places where channels flow from the PAP final cover and lead into the stormwater pond.
- Long-term (post-closure) monitoring and maintenance, including at least 30 years of groundwater monitoring at the impoundment, or until such time as groundwater protection standards (GWPSs) are achieved. Additionally, 30 years of post-closure care would be undertaken for the final cover system, including annual cap inspections, mowing, and maintenance.

Under this scenario, the existing on-Site landfill would also be closed *via* capping. The existing on-Site landfill is approximately 12 acres in size.

This CIP plan meets all closure requirements of IAC Part 845.750 (IEPA, 2021). Key closure elements that address the Part 845 closure requirements are summarized below. Further details are provided in the Closure Plan (HDR, 2022).

- An alternative cover system would be installed over the CCR that remains in the PAP. The cover, consisting of an LLDPE geomembrane layer and 24 inches of soil, as described above, would minimize vertical infiltration of precipitation into the basin [Part 845.750(a)(1)].
- The final cover system would be gently sloped to direct surface water away from the impoundment. Beyond the final cover system, channels would direct surface water away from the PAP to existing site drainages [Part 845.750(a)(2)].
- Free liquids would be removed from the PAP and managed in accordance with the NPDES permit for the facility [845.750(b)(1) and 845.750(b)(2)].
- Free liquids in the CCR would be eliminated by removing liquid wastes or solidifying the remaining wastes. Trenches would facilitate gravity drainage of liquid wastes in the CCR and direct the liquid wastes to sumps. Other engineering measures may be considered to facilitate removal of liquid wastes and stabilization of wastes. Sumps would be used to collect liquid wastes, which would be managed in accordance with the NPDES permit for the Site [845.750(b)(1) and 845.750(b)(2)].

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[2] Alternatively, the final cover system for the PAP may use a 50-mil LLDPE geomembrane material called "Microspike" or "Supergrip," which has built-in drainage studs on the top (HDR, 2022).

As an additional consideration, the PAP is located on a relatively thick layer of low-permeability clay, and the final cover system will tie into the surrounding grades. Post-closure, the CCR remaining in the PAP will therefore be physically isolated from the surrounding environment, including stormwater, surface water, and the atmosphere (HDR, 2022). Moreover, the CCR within the PAP will be located above the uppermost aquifer under normal conditions, and is also expected to be perennially above the uppermost aquifer level during higher-water conditions in Newton Lake. Post-closure, there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations, including the seasonal high-water table (HDR, 2022).

Under this scenario, approximately 1,920,000 CY of CCR will be relocated to the northern and eastern portions of the PAP (an assumed average travel distance of approximately 1 mile; Attachment B). Construction of the final cover systems for the impoundment and the on-Site landfill would require an additional 976,000 CY of clean soil, which would be sourced from within the footprint of the PAP, existing berms, and if needed, elsewhere on Site (an assumed average travel distance of approximately 1 mile; Attachment B). Borrow soil would be hauled around the Site using haul trucks with an assumed capacity of 34 CY.

Under the CIP scenario, the overall expected duration of closure activities (including closure of the impoundment and site restoration) is approximately 38 to 51 months (3.2 to 4.3 years). The total expected number of on-Site working days (excluding, *e.g.*, winter weather delays and weekends) is 720 days (Attachment B). Key parameters for the CIP scenario are shown in Table 2.1.

Table 2.1 Key Parameters for the Closure-in-Place Scenario

Parameter	Value
Surface Area of PAP	404 acres
Surface Area of Final Cover System	268acres
Surface Area of On-Site Landfill	12 acres
Volume of CCR to be Relocated	1,920,000 CY
Average Travel Distance for Relocation of CCR	1 mile
Required Volume of Borrow Soil	976,000 CY
Average Distance to On-Site Borrow Soil Location	1 mile
Duration of Construction Activities	3.2 to 4.3 years
Labor Hours	
Total On-Site Labor	245,000 hours
Total Off-Site Labor	4,000 hours
30% Contingency	74,600 hours
Total Labor Hours:	323,000 hours
Vehicle and Equipment Travel Miles	
Vehicles On-Site	79,000 miles
Equipment On-Site	720,000 miles
On-Site Haul Trucks (Unloaded + Loaded)	113,000 miles
Labor Mobilization	2,260,000 miles
Equipment Mobilization (Unloaded + Loaded)	66,200 miles
Off-Site Haul Trucks (Unloaded + Loaded)	0 miles
Material Deliveries (Unloaded + Loaded)	308,000 miles
Total On-Site Vehicle and Equipment Travel Miles:	912,000 miles
Total Off-Site Vehicle and Equipment Travel Miles:	2,640,000 miles
Total Vehicle and Equipment Travel Miles:	3,550,000 miles

Notes:
PAP = Primary Ash Pond.
Due to rounding, totals may not match the sum of the values.
Source: Attachment B, HDR (2022).

2.1.2 Closure-by-Removal with On-Site CCR Disposal

Under the CBR-Onsite scenario, all CCR would be excavated from the PAP and transported to an on-Site landfill for disposal. There is an existing, permitted CCR landfill at the Newton Power Plant Site, which is located approximately 1 mile from the PAP along Site roads (Attachment B). However, this landfill does not currently have sufficient capacity to contain all of the CCR that would be excavated from the PAP under the CBR-Onsite scenario (approximately 5,700,000 CY). The existing on-Site landfill would therefore need to be expanded under this scenario.

This scenario includes the following work elements (Attachment B):

- Expansion of the existing on-Site landfill. Landfill expansion would include the reconstruction of the current landfill cell, construction of the remaining permitted capacity for the landfill, and further expansion of the landfill into a 25-acre area located immediately to the east.
    - The landfill expansion area overlaps the footprint of the PAP, requiring phased closure of the PAP. CCR located within the landfill expansion area would be relocated to the existing permitted landfill prior to construction of the expansion.

  - The landfill expansion would also require relocation of an access road, a major drainageway, and possibly a monitoring well.
- Unwatering and dewatering of the impoundment by pumping water to the adjacent Secondary Pond, which discharges to Newton Lake *via* a NPDES-permitted outfall.
- Construction of stormwater control structures, including ditches and sumps, to convey runoff away from the impoundment.
- Excavation of CCR and approximately one foot of underlying soils from the impoundment and transport of these materials to the on-Site landfill.
- Backfilling of the impoundment as needed in order to promote positive drainage and prevent the impoundment of non-contact stormwater within the PAP post-closure.
- Site restoration, including the placement of six inches of topsoil along the side slopes and bottom of the PAP and revegetation with native grasses.
- Monitoring for 3 years post-closure or until such time as GWPSs are achieved, whichever is longer.

Under this scenario, the existing on-Site landfill would be closed *via* capping following the disposal of CCR from the impoundment. After expansion, the existing on-Site landfill would be approximately 66 acres in size.

Soil for expansion of the on-Site landfill, backfilling of the impoundment, site restoration, and on-Site landfill closure would be sourced from within the footprint of the PAP, existing berms, and if needed, elsewhere on Site (an assumed average travel distance of approximately 1 mile; Attachment B). In total, 562,000 CY of clean borrow soil would be required under this scenario. A haul truck capacity of 34 CY is assumed for the on-Site transport of borrow soil and CCR (Attachment B).

The overall expected duration of closure activities under this scenario (including closure of the impoundment, backfilling to maintain positive drainage, and site restoration) is approximately 70 to 110 months (5.8 to 9.2 years). The total expected number of on-Site working days (excluding, *e.g.*, winter weather delays and weekends) is 1,440 days (Attachment B). Key parameters for the CBR-Onsite scenario are shown in Table 2.2.

Table 2.2 Key Parameters for the Closure-by-Removal with On-Site CCR Disposal Scenario

Parameter	Value
Surface Area of PAP	404 acres
Surface Area of On-Site Landfill (After Expansion)	66 acres
Average Travel Distance to On-Site Landfill	1 mile
Hauled Volume of CCR	5,700,000 CY
Average Distance to On-Site Borrow Soil Location	1 mile
Hauled Volume of Borrow Soil	562,000 CY
Duration of Construction Activities	5.8 to 9.2 years
Labor Hours	
Total On-Site Labor	429,000 hours
Total Off-Site Labor	4,000 hours
30% Contingency	130,000 hours
Total Labor Hours:	563,000 hours
Vehicle and Equipment Travel Miles	
Vehicles On-Site	140,000 miles
Equipment On-Site	1,440,000 miles
On-Site Haul Trucks (Unloaded + Loaded)	335,000 miles
Labor Mobilization	3,940,000 miles
Equipment Mobilization (Unloaded + Loaded)	128,000 miles
Off-Site Haul Trucks (Unloaded + Loaded)	0 miles
Material Deliveries (Unloaded + Loaded)	164,000 miles
Total On-Site Vehicle and Equipment Travel:	1,910,000 miles
Total Off-Site Vehicle and Equipment Travel:	4,230,000 miles
Total Vehicle and Equipment Travel:	6,150,000 miles

Notes:
CCR = Coal Combustion Residual; PAP = Primary Ash Pond.
Due to rounding, totals may not match the sum of the values.
Source: Attachment B.

2.1.3 Closure-by-Removal with Off-Site CCR Disposal

Under the CBR-Offsite scenario, all CCR would be excavated from the PAP and transported to an off-Site landfill for disposal. The preferred landfill for off-Site disposal of CCR is the Sycamore Ridge Landfill in Pimento, Indiana (5621 East Cottom Drive), which is located approximately 75 miles from the Site (Attachment B). The Sycamore Ridge Landfill is the closest landfill to the Site with sufficient capacity to receive all of the material excavated from the PAP. Nonetheless, as described below in Section 2.4.5, it is possible that the Sycamore Ridge Landfill would have to be expanded during closure in order to accommodate the large amount of CCR to be received at the landfill and the relatively short time frame over which receipt of the CCR would occur.

IAC Section 845.710(c)(1) requires CBR alternatives to consider multiple methods for transporting CCR off-Site, including rail, barges, and trucks. HDR evaluated the feasibility of transporting CCR to the off-Site landfill *via* rail or barges and found that neither option is likely to be viable at this Site (Attachment B). Transporting CCR by rail would require modifications to the existing rail terminal on the Newton Power Plant property and the construction of a new rail terminal near the off-Site landfill. Modification of the existing on-Site rail terminal and construction of a new off-Site rail terminal would require coordination with the railroad and additional design and permitting, which could negatively impact the project schedule. Trucks would still be needed to haul CCR to and from the terminals, and additional CCR exposures could occur during the loading and unloading of CCR into trucks and rail cars. Moreover, because there is no direct rail route from the Site to the off-Site landfill, the transport of CCR to the off-Site landfill would require approximately 75 miles of rail transport (one-way) on tracks owned by 3 separate rail lines.

Barge transport is not a viable option for transporting CCR offsite, because the Newton Power Plant property is not located near a river that can accommodate barge traffic. In fact, the nearest terminal for barge traffic is approximately 125 miles away in St. Louis, Missouri. For these reasons, truck transport has been identified as the preferred option for transport of CCR to the off-Site landfill. Transport *via* truck would not require the construction of additional loading or unloading infrastructure and would not result in project delays due to permitting and coordination with other parties. The existing travel routes from the Site to the off-Site landfill are suitable for CCR transport *via* truck (Attachment B). The local availability and use of natural gas-powered trucks, or other low-polluting trucks, will be evaluated prior to the start of construction.

This scenario includes the following work elements (Attachment B):

- Unwatering and dewatering of the impoundment by pumping water to the adjacent Secondary Pond, which discharges to Newton Lake *via* a NPDES-permitted outfall.
- Construction of stormwater control structures, including ditches and sumps, to convey runoff away from the impoundment.
- Excavation of CCR and approximately one foot of underlying soils from the impoundment and transport of these materials to the off-Site landfill.
- Backfilling of the impoundment as needed in order to promote positive drainage and prevent the impoundment of non-contact stormwater within the PAP post-closure.
- Site restoration, including the placement of six inches of topsoil along the side slopes and bottom of the PAP and revegetation with native grasses.
- Monitoring for 3 years post-closure or until such time as GWPSs are achieved, whichever is longer.

Under this scenario, the existing on-Site landfill would also be closed *via* capping. The existing on-Site landfill is approximately 12 acres in size.

Soil for backfilling of the impoundment, site restoration, and on-Site landfill closure would be sourced from within the footprint of the PAP, existing berms, and if needed, elsewhere on Site (an assumed average travel distance of approximately 1 mile; Attachment B). In total, 68,000 CY of clean borrow soil would be required under this scenario. A haul truck capacity of 34 CY is assumed for the on-Site transport of borrow soil (Attachment B). CCR would be hauled to the off-Site landfill using haul trucks with a capacity of 16.5 CY, a smaller capacity than that of the haul trucks that would haul CCR to the on-Site landfill under the CBR-Onsite scenario (34 CY) due to restrictions placed on the size of trucks that can be used on public roadways.

The overall expected duration of closure activities under this scenario (including closure of the impoundment, backfilling to maintain positive drainage, and site restoration) is approximately 82 to 122 months (6.8 to 10 years). The total expected number of on-Site working days (excluding, *e.g.*, winter weather delays and weekends) is 1,620 days (Attachment B). Key parameters for the CBR-Offsite scenario are shown in Table 2.3.

Table 2.3 Key Parameters for the Closure-by-Removal with Off-Site CCR Disposal Scenario

Parameter	Value
Surface Area of PAP	404 acres
Surface Area of On-Site Landfill	12 acres
Average Travel Distance to Off-Site Landfill	75 miles
Hauled Volume of CCR	5,700,000 CY
Average Distance to On-Site Borrow Soil Location	1 mile
Hauled Volume of Borrow Soil	68,000 CY
Duration of Construction Activities	6.8 to 10 years
Labor Hours	
Total On-Site Labor	129,000 hours
Total Off-Site Labor	1,310,000 hours
30% Contingency	433,000 hours
Total Labor Hours:	1,880,000 hours
Vehicle and Equipment Travel Miles	
Vehicles On-Site	430,000 miles
Equipment On-Site	1,620,000 miles
On-Site Haul Trucks (Unloaded + Loaded)	0 miles
Labor Mobilization	13,100,000 miles
Equipment Mobilization (Unloaded + Loaded)	528,000 miles
Off-Site Haul Trucks (Unloaded + Loaded)	51,800,000 miles
Material Deliveries (Unloaded + Loaded)	128,000 miles
Total On-Site Vehicle and Equipment Travel:	2,050,000 miles
Total Off-Site Vehicle and Equipment Travel:	65,600,000 miles
Total Vehicle and Equipment Travel:	67,700,000 miles

Notes:
CCR = Coal Combustion Residual; PAP = Primary Ash Pond.
Due to rounding, totals may not match the sum of the values.
Source: Attachment B.

2.2 Long- and Short-Term Effectiveness of the Closure Alternative (IAC Section 845.710(b)(1))

2.2.1 Magnitude of Reduction of Existing Risks (IAC Section 845.710(b)(1)(A))

This section of the report addresses the potential risks to human and ecological receptors due to exposure to CCR-associated constituents in groundwater or surface water. Gradient has performed a Human Health and Ecological Risk Assessment for the Site (Attachment A of this report), which provides a detailed evaluation of the magnitude of existing risks to human and ecological receptors associated with the PAP. This report concluded that there are no current unacceptable risks to any human or ecological receptors associated with the PAP. Because there are no current risks to any human or ecological receptors, and dissolved constituent concentrations would be expected to decline post-closure, no post-closure risks would be expected under any closure scenario. Thus, there would be no current risk or future risk under any closure scenario, and the magnitude of reduction of existing risks would be the same under every closure scenarios.

2.2.2 Likelihood of Future Releases of CCR (IAC Section 845.710(b)(1)(B))

This section of the report quantifies the risk of future releases of CCR that may occur during dike failure and storm-related events.

Storm-Related Releases and Dike Failure During Flood Conditions

Based on the effective Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map for the Site, the PAP is located partially within the 100-year flood zone for Newton Lake (FEMA, 1985; Modeer, 2021). However, as required by IAC Section 845.340(c), "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." In addition, AECOM and Geosyntec evaluated the risk of flood overtopping occurring at the PAP and found that the impoundment can adequately manage flow during peak discharge from even a 1,000-year storm event, thus preventing overtopping (AECOM, 2016b; Geosyntec, 2021). Engineering analyses similarly show that the PAP dikes are expected to remain stable under static, seismic, and flood conditions (AECOM, 2016c; Geosyntec, 2021). Prior to closure (*i.e.*, under current conditions), the risk of floods or other storm-related events leading to dike failure or overtopping is therefore minimal. Post-closure, the risks of overtopping or dike failure occurring due to floods or other storm-related events would be even smaller than they are currently. Under the CIP scenario, a new cover system would be installed, which would include 24 inches of soil and a geomembrane liner, as well as new stormwater control structures. Relative to current conditions, this cover system would provide increased protection against berm and surface erosion, groundwater infiltration, and other adverse effects that could potentially trigger a dike slope failure event. Under the CBR-Onsite and CBR-Offsite scenarios, all of the CCR in the PAP would be excavated and relocated, eliminating the risk of a CCR release occurring post-closure. In summary, there is minimal current or future risk of sudden CCR releases occurring under any closure scenario either during or following closure.

Dike Failure Due to Seismicity

Sites in Illinois may be subject to seismic risks arising from the Wabash Valley Seismic Zone and the New Madrid Seismic Zone (IEMA, 2020). The Newton Power Plant property lies within approximately 40 miles of the Wabash Valley Fault System, and is therefore located within a seismic impact zone (Ramboll, 2021; Haley & Aldrich, Inc., 2018a). However, all structural components of the PAP have been designed to resist the maximum horizontal acceleration in lithified earth material for the Site. The PAP therefore meets the seismic safety requirements of 40 CFR Section 257.63(a) and IAC Section 845.330(a), and the overall risk of dike failure due to seismicity is expected to be low (Burns & McDonnell, 2021; Haley & Aldrich, Inc., 2018a). Additionally, the PAP does not lie within 200 feet of an active fault or fault damage zone at which displacement has occurred within the current geological epoch (*i.e.*, within the last ~11,650 years; Haley & Aldrich, Inc., 2018b). The nearest known faults are the Albion-Ridgeway and Mt. Carmel-New Harmony faults, which are located about 42 miles southeast of the PAP. These faults do not have known recent activity (Haley & Aldrich, Inc., 2018b). Overall, the risk of dike failure occurring during or following closure activities due to seismic activity is therefore expected to be low.

2.2.3 Type and Degree of Long-Term Management, Including Monitoring, Operation, and Maintenance (IAC Section 845.710(b)(1)(C))

The long-term operation and management plans for the PAP and the on-Site landfill under each closure scenario are described in Section 2.1 (Closure Alternatives Descriptions). In summary, under the CIP scenario, the PAP would undergo monitoring for 30 years post-closure, or until such time as GWPSs are achieved. Under the CBR-Onsite and CBR-Offsite scenarios, the PAP would undergo monitoring for 3 years post-closure, or until such time as GWPSs are achieved. The post-closure care plan for the CIP scenario would additionally include annual inspections, mowing, and maintenance of the final cover system.

2.2.4 Short-Term Risks to the Community or the Environment During Implementation of Closure (IAC Section 845.710(b)(1)(D))

2.2.4.1 Worker Risks

Best practices would be employed during construction in order to ensure worker safety and comply with all relevant regulations, permit requirements, and safety plans. However, it is impossible to completely eliminate the risk of accidents occurring during construction activities, both on- and off-Site. On-Site accidents include injuries and deaths arising from the use of heavy equipment and/or earthmoving operations during construction activities. Off-Site accidents include injuries and deaths due to vehicle accidents during labor and equipment mobilization/demobilization, material deliveries, and CCR hauling.

As shown in Tables 2.1 through 2.3, HDR estimates that the CIP scenario would require 245,000 on-Site labor hours (Attachment B). The CBR-Onsite scenario would require approximately 429,000 on-Site labor hours, and the CBR-Offsite scenario would require approximately 129,000 on-Site labor hours. The US Bureau of Labor Statistics (US DOL, 2020a,b) provides an estimate of the hourly fatality and injury rates for construction workers. Based on the accident rates reported by US Bureau of Labor Statistics and the on-Site labor hours reported in Attachment B, we estimate that approximately 2.8 worker injuries and 0.018 worker fatalities would occur on-Site under the CIP scenario; approximately 5.0 worker injuries and 0.032 worker fatalities would occur on-Site under the CBR-Onsite scenario; and approximately 1.5 worker injuries and 0.0097 worker fatalities would occur on-Site under the CBR-Offsite scenario (Table 2.4).

Table 2.4 Expected Number of On-Site Worker Accidents Under Each Closure Scenario

Closure Scenario	Injuries	Fatalities
CIP	2.8	0.018
CBR-Onsite	5.0	0.032
CBR-Offsite	1.5	0.0097

Notes:
CBR-Offsite = Closure-by-Removal with Off-Site CCR Disposal; CBR-Onsite = Closure-by-Removal with On-Site CCR Disposal; CIP = Closure-in-Place.

Off-Site, a far greater number of total vehicle and equipment travel miles would be required under the CBR-Offsite scenario than would be required under the CIP and CBR-Onsite scenarios (Tables 2.1 through 2.3). Under the CIP scenario, only 2,640,000 total off-Site vehicle and equipment travel miles would be required; under the CBR-Onsite scenario, 4,230,000 total off-Site vehicle and equipment travel miles would be required; and, under the CBR-Offsite scenario, 65,600,000 total off-Site vehicle and equipment travel miles would be required (Attachment B). The United States Department of

Transportation (US DOT, 2020) provides estimates of the expected number of fatalities and injuries "per vehicle mile driven" for drivers and passengers of large trucks and passenger vehicles. Table 2.5 shows the expected number of off-Site accidents under each closure scenario due to all categories of off-Site vehicle usage. For these calculations, it was assumed that labor mobilization/demobilization would rely upon passenger vehicles (cars or light trucks, including pickups, vans, and sport utility vehicles) and that hauling, equipment mobilization/demobilization, and material deliveries would rely upon large trucks. Based on US DOT's accident statistics and the mileage estimates in Attachment B, an estimated 1.4 worker injuries and 0.019 worker fatalities would be expected to occur due to off-Site activities under the CIP scenario; an estimated 2.5 worker injuries and 0.032 worker fatalities would be expected to occur due to off-Site activities under the CBR-Onsite scenario; and an estimated 15 worker injuries and 0.26 worker fatalities would be expected to occur due to off-Site activities under the CBR-Offsite scenario.

Table 2.5 Expected Number of Off-Site Worker Accidents Under Each Closure Scenario

Off-Site Vehicle Use Category	CIP		CBR-Onsite		CBR-Offsite	
	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities
Hauling	0	0	0	0	6.6	0.15
Labor Mobilization/Demobilization	1.4	0.018	2.4	0.031	8.1	0.10
Equipment Mobilization/Demobilization	0.0085	0.00019	0.016	0.00037	0.068	0.0015
Material Deliveries	0.039	0.00089	0.021	0.00048	0.016	0.00037
Total:	1.4	0.019	2.5	0.032	15	0.26

Notes:
CBR-Offsite = Closure-by-Removal with Off-Site CCR Disposal; CBR-Onsite = Closure-by-Removal with On-Site CCR Disposal; CIP = Closure-in-Place.

Overall, taking into account accidents occurring both on- and off-Site, 4.3 worker injuries and 0.037 worker fatalities would be expected under the CIP scenario; 7.4 worker injuries and 0.064 worker fatalities would be expected under the CBR-Onsite scenario; and 16 worker injuries and 0.26 worker fatalities would be expected under the CBR-Offsite scenario. Thus, overall risks to workers would be highest under the CBR-Offsite scenario and lowest under the CIP scenario. Differences in worker risks between the three scenarios would largely be driven by off-Site activities.

2.2.4.2 Community Risks

Accidents

Vehicle accidents that occur off-Site can result in injuries or fatalities among community members, as well as workers. Based on the accident statistics reported by US DOT (2020) and the off-Site travel mileages reported in Attachment B, off-Site vehicle accidents could result in an estimated 0.70 injuries and 0.012 fatalities among community members (*i.e.*, people involved in haul truck accidents that are neither haul truck drivers nor passengers, including pedestrians, drivers of other vehicles, *etc*.) under the CIP scenario (Table 2.6). Under the CBR-Onsite scenario, off-Site vehicle accidents could result in an estimated 1.1 community injuries and 0.016 community fatalities. Under the CBR-Offsite scenario, off-Site vehicle accidents could result in an estimated 23 community injuries and 0.74 community fatalities. Risks to community members arising from vehicle accidents are therefore much higher under the CBR-Offsite scenario than under the other two scenarios.

Table 2.6 Expected Number of Community Accidents Under Each Closure Scenario

Off-Site Vehicle Use Category	CIP		CBR-Onsite		CBR-Offsite	
	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities
Hauling	0	0	0	0	19	0.69
Labor Mobilization/Demobilization	0.56	0.0071	0.98	0.012	3.3	0.041
Equipment Mobilization/Demobilization	0.024	0.00088	0.047	0.0017	0.19	0.0070
Material Deliveries	0.11	0.0041	0.060	0.0022	0.047	0.0017
Total:	0.70	0.012	1.1	0.016	23	0.74

Notes:

CBR-Offsite = Closure-by-Removal with Off-Site CCR Disposal; CBR-Onsite = Closure-by-Removal with On-Site CCR Disposal; CIP = Closure-in-Place.

Traffic

Haul routes would be expected to use major arterial roads and highways wherever possible, which would reduce the incidence of traffic. However, the heavy use of local roads for construction operations may result in traffic near the Site and the off-Site landfill. Traffic could potentially cause travel delays on local roads and cause damage to local roadways. It could also cause delays in the re-development of the Site for use in utility-scale solar generation and battery energy storage.

Traffic may increase temporarily around the Site under all closure scenarios due to the daily arrival and departure of the workforce, equipment mobilization/demobilization, and material deliveries. However, these impacts would be expected to largely occur at the beginning or end of each work day (for the arrival/departure of the work force), at the beginning or end of the construction period (for equipment mobilization/demobilization), and at specific times throughout the construction period (for material deliveries). These impacts would therefore likely be less disruptive to community members than the constant and steady movement of haul trucks to and from the Site due to CCR hauling.

Off-Site CCR hauling would only be required under the CBR-Offsite scenario. Under this scenario, hauling-related construction activities would be expected to span approximately 1,620 working days and require approximately 345,000 truckloads (Attachment B). Assuming 10-hour working days, a haul truck would need to pass a given location near the Site once every 1.4 minutes on average for the duration of hauling-related activities under this closure scenario.

Noise

Construction generates a great deal of noise, both in the vicinity of the Site and along haul routes. In a closure impact analysis performed by the Tennessee Valley Authority (TVA, 2015), the authors found that "[T]ypical noise levels from construction equipment used for closure are expected to be 85 dBA or less when measured at 50 ft. These types of noise levels would diminish with distance…at a rate of approximately 6 dBA per each doubling of distance and therefore would be expected to attenuate to the recommended EPA noise guideline of 55 dBA at 1,500 ft." Because there are no residences or businesses within 1,500 feet of any of the construction areas on the Site (the impoundment, the on-Site borrow soil location, and the on-Site landfill), we do not anticipate that any residences or businesses would be adversely impacted by noise pollution at the Site under any closure scenario. However, recreators and wildlife on Newton Lake or within the greater Newton Lake SFWA, which lie within 1,500 feet of the PAP, could be temporarily impacted by construction noise under all scenarios. Noise impacts in the vicinity of the Site would likely be smaller under the CIP scenario than under the CBR-Onsite and CBR-Offsite scenarios, because the overall duration of construction would be shorter under the CIP scenario than under the two CBR scenarios (3.2 to 4.3 years for CIP *vs*. 5.8 to 9.2 years for CBR-Onsite *vs*. 6.8 to 10 years for CBR-Offsite).

In addition to impacts in the immediate vicinity of planned construction areas at the Site, local roads near the Site and the off-Site landfill may also experience noise pollution under the CBR-Offsite scenario due to high volumes of haul truck traffic. As described above (Traffic), the construction schedule for the CBR-Offsite scenario requires haul trucks to pass by a given location every 1.4 minutes on average for 10 hours each day over the course of approximately 1,620 working days. Dump trucks generate significant noise pollution, with noise levels of approximately 88 decibels or higher expected within a 50-foot radius of the truck (Exponent, 2018). This noise level is similar to the noise level of a gas-powered lawnmower or leaf blower (CDC, 2019). Decibel levels above 80 can damage hearing after 2 hours of exposure (CDC, 2019).

In addition to haul truck impacts, noise pollution may also arise under all closure scenarios due to the daily arrival and departure of the workforce, equipment mobilization/demobilization, and material deliveries. These impacts would be expected to largely occur at the beginning or end of each work day (for the arrival/departure of the work force), at the beginning or end of the construction period (for equipment mobilization/demobilization), and at specific times throughout the construction period (for material deliveries). These impacts would therefore likely be less disruptive to community members than the constant and steady movement of haul trucks to and from the Site. As such, off-Site noise impacts are likely to be greatest under the CBR-Offsite scenario (for which substantial off-Site hauling is required) and least under the CIP and CBR-Onsite scenarios (for which no off-Site hauling is required).

Air Quality

Construction can adversely impact air quality. Air pollution can occur both on-Site and off-Site (*e.g.*, along haul routes), potentially impacting workers as well as community members. With regard to construction activities, two categories of air pollution are of particular concern: equipment emissions and fugitive dust. The equipment emissions of greatest concern are those found in diesel exhaust. Most construction equipment is diesel-powered, including the dump trucks that would be used to haul material to and from the Site. Diesel exhaust contains numerous air pollutants, including nitrogen oxides (NO_x), particulate matter (PM), carbon monoxide (CO), and volatile organic compounds (VOCs; Hesterberg *et al.*, 2009; Mauderly and Garshick, 2009). Fugitive dust, another major air pollutant at construction sites, is generated by earthmoving operations and other soil- and CCR-handling activities. Along haul routes, an additional source of fugitive dust is road dust along unpaved dirt roads. Careful planning and the use of Best Management Practices (BMPs) such as wet suppression are used to minimize and control fugitive dust during construction activities; however, it is not possible to prevent dust generation entirely.

On-Site, emissions would be higher under the CBR-Onsite and CBR-Offsite scenarios than under the CIP scenario, due to the greater amount of on-Site vehicle and equipment travel miles required under these scenarios (912,000 total on-Site travel miles under the CIP scenario *versus* 1,910,000 total on-Site travel miles under the CBR-Onsite scenario *versus* 2,050,000 total on-Site travel miles under the CBR-Offsite scenario; Tables 2.1 through 2.3). Off-Site, emissions would be substantially higher under the CBR-Offsite scenario than under the CIP and CBR-Onsite scenarios, due to the demands of off-Site hauling (2,640,000 total off-Site travel miles under the CIP scenario *versus* 4,230,000 total off-Site travel miles under the CBR-Onsite scenario *versus* 65,600,000 total off-Site travel miles under the CBR-Offsite scenario).

Environmental Justice

The State of Illinois defines EJ communities to be those communities with a minority population above twice the state average and/or a total population below twice the state poverty rate (IEPA, 2019b).

IEPA's EJ Start mapper (IEPA, 2019b) uses income and demographics data collected by the U.S. Census Bureau to map all of the EJ communities throughout the state. In order to extend the boundaries of the EJ Start mapper into the neighboring state of Indiana (the location of the preferred off-Site landfill), Gradient used U.S. Census Bureau data reported in the national-level EJScreen tool (US EPA, 2020) to create a new EJ community mapping tool that was identical to EJ Start for communities in Illinois but also included EJ communities located in Indiana.

Gradient's analysis demonstrated that the outer perimeters of the 1-mile buffer zones for the two EJ communities located closest to the Site (the EJ community near Effingham, IL and the EJ community near Olney, IL) are both located approximately 15.5 miles from the Site (Figure 2.1). As described above (Noise), significant noise impacts due to construction are expected to be limited to potential receptors located within 1,500 ft (0.28 miles) of the Site. Similarly, the air quality impacts of construction are expected to be limited to potential receptors located within 1,000 ft (0.19 miles) of the Site (CARB, 2005; BAAQMD, 2017). Along heavily trafficked roadways, air quality impacts are expected to be limited to potential receptors located within 600 feet of the roadway (0.11 miles; US EPA, 2014). Thus, the EJ communities near Effingham and Olney are unlikely to be directly impacted by on-Site air emissions, noise pollution, or other negative impacts arising at the Site. However, they may be impacted by off-Site impacts, including CCR hauling (CBR-Offsite scenario only), labor and equipment mobilization/demobilization, and material deliveries. Off-Site impacts due to labor and equipment mobilization/demobilization and material deliveries would be expected to be diffuse (*i.e.,* to span a wide range of transport routes originating over a wide area). Additionally, these impacts would be expected to largely occur at the beginning or end of each work day (for the arrival/departure of the work force), at the beginning or end of the construction period (for equipment mobilization/demobilization), and at specific times throughout the construction period (for material deliveries). Hauling, in contrast, would rely on a single transport route that would be in continuous use throughout the entire excavation period. Off-Site hauling is therefore more likely to have a significant impact on EJ communities than other types of off-Site vehicle use.

Under the CBR-Offsite scenario, EJ communities located along the haul route to the off-Site landfill or near the off-Site landfill itself could potentially be negatively impacted throughout the excavation period by the air pollution, noise, traffic, and accidents generated by CCR-hauling activities. Figure 2.1 demonstrates that the off-Site landfill is not located within one mile of any EJ communities. However, based on the three major haul routes suggested by Google Maps (Google, 2022), transport of CCR to the off-Site landfill could potentially entail hauling CCR through the EJ communities near Lawrenceville, IL, Vincennes, IN, or Terre Haute, IN (Figure 2.1; IEPA, 2019b; US EPA, 2020).

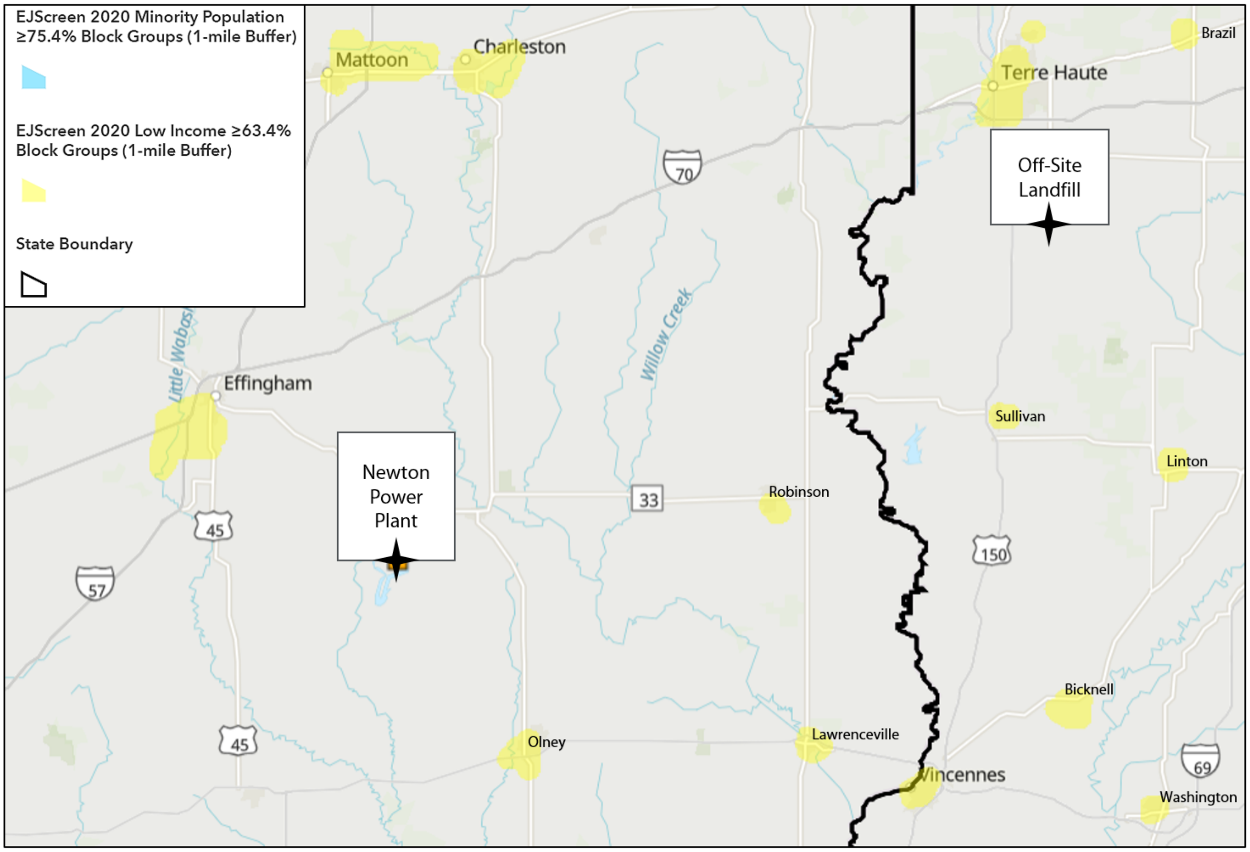

Figure 2.1 Environmental Justice Communities in the Vicinity of the Site and the Off-Site Landfill. Sources: IEPA (2019b) and US EPA (2020).

Scenic, Historical, and Recreational Value

During construction activities, negative impacts on scenic and recreational value may occur on Newton Lake and within the greater Newton Lake SFWA. Noise impacts were described above. In addition, construction activities at the PAP may be visible to recreators using Newton Lake and the Newton Lake SFWA, potentially interfering with enjoyment of the view. Negative impacts would not be expected to occur within any scenic, recreational, or conservation areas located further away from the Site, including the Prairie Ridge State Natural Area and Jasper County Prairie Chicken Sanctuary. Because the expected duration of construction activities is longer under the CBR-Onsite and CBR-Offsite scenarios than under the CIP scenario (3.2 to 4.3 years for CIP *vs*. 5.8 to 9.2 years for CBR-Onsite *vs*. 6.8 to 10 years for CBR-Offsite), short-term impacts on the scenic and recreational value of natural areas near the Site would be greater under these two closure scenarios than under the CIP scenario.

Based on a review of the IDNR Historic Preservation Division database and the Illinois State Archaeological Survey database, there are no historic sites located within 1,000 meters of the PAP or the on-Site landfill (Ramboll, 2021).

2.2.4.3 Environmental Risks

Greenhouse Gas Emissions

In addition to the air pollutants listed above in Section 2.2.4.2, construction equipment emits greenhouse gases (GHGs), including carbon dioxide (CO_2) and possibly nitrous oxide (N_2O). The potential impact of each closure scenario on GHG emissions is proportional to the potential impact of each closure scenario on other emissions from construction vehicles and equipment, as described above in Section 2.2.4.2. In summary, GHG emissions from construction equipment and vehicles would be far greater under the CBR-Offsite scenario than under the CIP and CBR-Onsite scenarios, because the total on-Site and off-Site vehicle and equipment travel miles required under the CBR-Offsite scenario (67,650,000 miles) is greater than those required under the CIP scenario (3,550,000 miles) and the CBR-Onsite scenario (6,150,000 miles; Tables 2.1 through 2.3).

We did not quantify the carbon footprint of the approximately 268 acres of geomembrane liner material required for the final PAP cover system under the CIP scenario. The carbon footprint of this geomembrane (*i.e.*, the fossil fuel emissions required to manufacture it) is an additional source of GHG emissions at the Site under the CIP scenario. Expansion of the on-Site landfill under the CBR-Onsite scenario and the potential expansion of the off-Site landfill under the CBR-Offsite scenario would have an additional, unquantified carbon footprint due to the manufacture of geomembranes used in the expanded landfill liners.

Energy Consumption

Energy consumption at a construction site is synonymous with fossil fuel consumption, because the energy to power construction vehicles and equipment comes from the burning of fossil fuels. Fossil fuel demands considered in this analysis include the burning of diesel fuel during construction activities and the carbon footprint of manufacturing geomembrane textiles. Because GHG emission impacts and energy consumption impacts both arise from the same sources at construction sites, the trends discussed above with respect to GHG emissions also apply to the evaluation of energy demands. Specifically, the energy demands of construction equipment and vehicles would be far greater under the CBR-Offsite scenario than under the CIP or CBR-Onsite scenarios. We did not quantify the energy demands of the geomembranes required for the construction of the final cover system under the CIP scenario, the geomembranes required for the expansion of the on-Site landfill under the CBR-Onsite scenario, or, potentially, the geomembranes required for expansion of the off-Site landfill under the CBR-Offsite scenario.

The Newton Power Plant Site is slated for re-development as a utility-scale solar power generating facility and battery energy storage facility. At the grid scale, solar generation would add energy back onto the grid and reduce reliance on non-renewable energy sources. In the short-term, closure activities at the Site may delay and obstruct these re-development efforts. The magnitude of expected delays will scale with the expected duration and intensity of construction activities during closure. Because the CIP scenario requires less construction activity than the two CBR scenarios and would be completed over a shorter time period, the CIP scenario would be expected to result in fewer delays to re-development – and, hence, the more rapid realization of grid-scale energy benefits – than the two CBR scenarios.

Natural Resources and Habitat

During closure, major construction activities such as the excavation of the impoundment, the excavation of the borrow area, the expansion of the on-Site landfill, and, potentially, the expansion of the off-Site landfill may require the destruction of some existing habitat atop portions of these construction areas, resulting in negative impacts to natural resources and habitat within the footprint of these areas. Construction may also have indirect negative impacts on the natural resources and habitat in the immediate vicinity of these locations by causing alarm and escape behavior in nearby wildlife (*e.g.*, due to noise disturbances). Finally, although erosion prevention and sediment control measures will be undertaken under all closure scenarios, it is possible that limited negative short-term impacts could occur to sensitive aquatic species in Newton Lake and the other minor surface water bodies located near the PAP (see Section 1.1.3) due to sediment runoff during construction. Short-term impacts on natural resources and habitat would be greater under the CBR-Onsite and CBR-Offsite scenarios than under the CIP scenario, because the overall duration of construction would be longer under the two CBR scenarios than under the CIP scenario (3.2 to 4.3 years for CIP *vs*. 5.8 to 9.2 years for CBR-Onsite *vs*. 6.8 to 10 years for CBR-Offsite).

In addition to the short-term negative habitat impacts caused by construction activities, closure may also result in long-term shifts in the habitat types overlying the major construction locations associated with closure. This assessment does not make any value judgments regarding the relative value of the habitat types currently overlying these locations and the habitat types that could potentially overlie these locations post-closure under the various closure scenarios.

According to the IDNR Natural Heritage Database, there are 18 endangered species and 7 threatened species within Jasper County (Ramboll, 2021). To our knowledge, however, no threatened or endangered species have been identified at the Site. Based on the information that is currently available, we do not expect construction activities to have negative impacts on any threatened or endangered species.

2.2.5 Time Until Groundwater Protection Standards Are Achieved (IAC Sections 845.710(b)(1)(E) and 845.710(d)(2 and 3))

The time horizon over which GWPSs would be exceeded at the Site is immaterial from a risk perspective, because there is no unacceptable risk associated with exceedances of a GWPS at the Site (see Section 2.2.1). Nonetheless, pursuant to requirements under IAC Section 845.710, this section of the text describes the time required to achieve GWPSs at the Site.

As described above in Section 1.1.4 (Hydrogeology), water and CCR-associated constituents from the PAP may migrate vertically downward until they reach the UD/PMP and the UA. Beneath the PAP, groundwater within the UA generally flows from the north towards the south/southwest, converging near a former drainage feature located along the western edge of the PAP (Ramboll, 2021). In the northern area of the PAP, groundwater from the UA may interact with surface water in Newton Lake, as evidenced by groundwater head elevations in this area that are higher than the surface water level in Newton Lake. Groundwater within the UD/PMP may also interact with surface water in Newton Lake.

At the Newton Site, seasonal variation in groundwater levels generally results in groundwater elevation fluctuations of less than one foot. Surface water elevations in Newton Lake similarly do not fluctuate significantly over time, since the lake elevation is controlled by a dam. As a result, groundwater flow directions at the Site are not generally affected by seasonal variabilities (Ramboll, 2021).

Groundwater modeling was performed to evaluate future groundwater quality in the vicinity of the PAP under each of the proposed closure alternatives (Ramboll, 2022). Model predictions indicate that groundwater concentrations in monitoring wells within the UD/PMP and UA will achieve the GWPS in 20 years under the CIP scenario and 16 years under the CBR closure scenario (Ramboll, 2022). The model-predicted four-year difference between the two scenarios is not significant. Furthermore, the four year difference to achieve the GWPS between the CIP and CBR scenarios is expected to be reduced, because the estimated duration of construction activities indicates that CBR will take a minimum of 2.6 to 4.9 years longer to implement than CIP (Section 2.1).

Model predictions also indicate that groundwater concentrations will remain above the GWPSs in the UCU for a period of more than 100 years for both the CIP and CBR scenarios. This is due to the retention of constituent mass within the thick, low conductivity layer which underlies the PAP. However, in both the CIP and CBR scenarios, the plume footprint continues to recede over time and remains within the property boundaries, indicating that both closure scenarios perform equivalently with regard to achieving the GWPSs (Ramboll, 2022).

2.2.6 Potential for Exposure of Humans and Environmental Receptors to Remaining Wastes, Considering the Potential Threat to Human Health and the Environment Associated with Excavation, Transportation, Re-disposal, Containment, or Changes in Groundwater Flow (IAC Section 845.710(b)(1)(F))

Section 2.2.1 evaluates potential risks to human and ecological receptors arising from the leaching of CCR-associated constituents into groundwater during closure activities and following closure of the PAP. Section 2.2.2 evaluates the potential for CCR releases to occur due to dike failure or overtopping during floods or other storm-related events. In summary, there is no current or future risk to any human or ecological receptors associated with the PAP. Additionally, there is minimal current or future risk of overtopping occurring at the embankments due to flood conditions at the Site. Dike failure due to, *e.g.*, seismic activity and storm-related events is also exceedingly unlikely.

Section 2.2.4 evaluates several potential risks to human health and the environment during closure activities, including risks of accidents occurring among workers; risks to nearby residents and EJ communities related to accidents, traffic-related impacts, noise, and air pollution; and risks to natural resources and wildlife. The findings from this section of the text are summarized in Table S.1 (Summary of Findings).

2.2.7 Long-Term Reliability of the Engineering and Institutional Controls (IAC Section 845.710(b)(1)(G))

Post-closure, there is minimal risk of engineering or institutional failures leading to sudden releases of CCR from the impoundment under the CIP scenario. There is no post-closure risk of engineering or institutional failures under the two CBR scenarios (see Section 2.2.2 above). Additionally, there are no current or future unacceptable risks to any human or ecological receptors under any closure scenario (see Section 2.2.1 above). Moreover, reliable engineering and institutional controls (*e.g.*, a bottom liner, a leachate management system, and groundwater monitoring) would be implemented at the on-Site and off-Site landfills under the CBR-Onsite and CBR-Offsite scenarios. All of the evaluated closure scenarios are therefore reliable with respect to long-term engineering and institutional controls.

2.2.8 Potential Need for Future Corrective Action Associated with the Closure (IAC Section 845.710(b)(1)(H))

Corrective action is expected at the Site. An evaluation of potential corrective measures and corrective actions has not yet been completed, but will be conducted consistent with the requirements in IAC Section 845.660 and IAC Section 845.670.

2.3 Effectiveness of the Closure Alternative in Controlling Future Releases (IAC Section 845.710(b)(2))

2.3.1 Extent to Which Containment Practices Will Reduce Further Releases (IAC Section 845.710(b)(2)(A))

The CCR in the PAP currently poses no unacceptable risks to human health or the environment (Section 2.2.1). Because current conditions do not present a risk to human health or the environment, and dissolved constituent concentrations would be expected to decline post-closure, there would also be no unacceptable risks to human health or the environment following closure, regardless of the closure scenario.

Section 2.2.2 discussed the potential for dike failure or overtopping to occur during or following closure activities, resulting in a sudden release of CCR. That analysis showed that there is minimal risk of sudden CCR releases occurring during or following closure under any closure scenario.

2.3.2 Extent to Which Treatment Technologies May Be Used (IAC Section 845.710(b)(2)(B))

Under all three closure scenarios, water generated during the dewatering and unwatering of the impoundment would be treated, if necessary, prior to disposal. Following treatment, water from unwatering and dewatering would be discharged to Newton Lake in accordance with the NPDES permit for the facility.

2.4 Ease or Difficulty of Implementing Closure Alternative (IAC Section 845.710(b)(3))

2.4.1 Degree of Difficulty Associated with Constructing the Closure Alternative

CIP using a final cover system is a reliable and standard method for managing and closing impoundments that relies on common construction activities. Dewatering saturated CCR to construct a stabilized final cover system subgrade can present challenges during closure; however, these challenges are common to most CCR surface impoundment closures and are commonly addressed *via* surface water management and dewatering techniques.

Excavation and landfilling of CCR is also a reliable and standard method for closing impoundments. However, relative to CIP, CBR-Onsite and CBR-Offsite pose additional implementation difficulties due to higher earthwork volumes and higher dewatering volumes, and longer construction schedules. Relative to the CBR-Onsite scenario, hauling would be far more difficult to implement under the CBR-Offsite scenario due to the longer haul distance required for off-Site disposal than for on-Site disposal (approximately 75 miles *versus* 1 mile) and the need to haul the CCR over public roads. Hauling over public roads rather than private roads would require the use of lower-volume haul trucks (16.5 CY *versus* 34 CY), which would increase the number of trucks and trips required for CCR excavation and transport. Additionally, because the CBR-Offsite scenario would involve hauling CCR off-Site (*i.e.*, intrastate travel), a higher level of dewatering would be required under this scenario compared to the CBR-Onsite scenario. As described in Section 2.2.4.2 ("Community Risks"), off-Site hauling may also have detrimental community impacts due to vehicle accidents, traffic-related impacts, noise, and air pollution.

In addition to off-Site hauling, off-Site landfilling under the CBR-Offsite scenario may pose particular challenges. A disposal plan would need to be developed between IPGC and the owner/operator of the third-party landfill in order to outline acceptable waste conditions upon delivery, daily waste production rates, and the expected duration of the project. Off-Site landfilling may additionally raise issues related to the co-disposal of CCR and other non-hazardous wastes and may require additional permitting. Finally, the construction schedule for excavation may be negatively impacted if, during the course of closure, it is determined that the off-Site landfill must be expanded in order to receive all of the materials excavated from the PAP.

2.4.2 Expected Operational Reliability of the Closure Alternative

There is no post-closure risk of operational failures leading to sudden releases of CCR from the impoundment under the two CBR scenarios. There is minimal post-closure risk of sudden CCR releases occurring under the CIP scenario, because: (i) the final cover system will be constructed and maintained in accordance with all relevant state and federal safety regulations, and (ii) the dikes, final cover, and stormwater control features have all been designed to withstand earthquakes and storm events (see Section 2.2.2 above). Moreover, appropriate operational controls are expected to be implemented at the on-Site and off-Site landfills under the CBR-Onsite and CBR-Offsite scenarios. As such, operational reliability would be expected under all closure scenarios.

2.4.3 Need to Coordinate with and Obtain Necessary Approvals and Permits from Other Agencies

Permits and approvals would be needed under all closure scenarios. Components of the three closure scenarios that would be expected to require a permit include:

- A modification to the existing NPDES permit through IEPA to allow the disposal of water generated from unwatering and dewatering operations to Newton Lake *via* the existing NPDES-permitted outfall for the Site;
- A construction permit from the Illinois Department of Natural Resources, Office of Water Resources, Dam Safety Program to allow the embankment and spillways of the PAP to be modified as part of closure;
- A construction stormwater permit through IEPA, including construction stormwater controls and other BMPs such as silt fences and other measures; and
- A joint water pollution control construction and operating permit (WPC permit).

As discussed below in Section 2.4.5, the existing on-Site landfill would require expansion under the CBR-Onsite scenario in order to accommodate all of the material excavated from the PAP. Expansion of the onsite landfill would require permitting from the IEPA Bureau of Land, under Title 35 Section 811 and 812, and approval from local government. Under the CBR-Offsite scenario, it may similarly be necessary to expand the off-Site landfill. Additional permitting may be required under this scenario for transport of the CCR and to expand the off-Site landfill. It may also be necessary to modify the operating plan for the off-Site landfill in order to accommodate the increased rate of filling of the landfill and the likely need for additional equipment and personnel to manage the receipt and disposal of the CCR.

2.4.4 Availability of Necessary Equipment and Specialists

CIP, CBR-Onsite, and CBR-Offsite are reliable and standard methods for managing waste that rely on common construction equipment and materials and typically do not require the use of specialists, outside of typical construction labor and equipment operators. However, global supply chains have been disrupted due to the COVID-19 pandemic, resulting in shortages in the availability of construction equipment and parts. There may be some shortages in construction equipment under all scenarios, if supply chain resilience does not improve by the time of construction. Alternatively, extended downtime may be required for equipment repairs and maintenance. A national shortage of truck drivers has also developed during the COVID-19 pandemic. Due to higher earthwork volumes and a longer construction schedule under the CBR-Onsite and CBR-Offsite scenarios than under the CIP scenario, shortages in construction equipment may cause greater challenges under these scenarios than under the CIP scenario. The current shortage of truck drivers may be particularly impactful under the CBR-Offsite scenario, due to the large volume of CCR to be hauled from the Site. If sufficient trucks and truck drivers are not available, the construction schedule at the impoundment may lengthen based on hauling-related delays.

The availability of critical materials such as metal, wood, and electronic chips has also been impacted by the COVID-19 pandemic. However, soil materials and geomembrane liner materials have generally been available during 2021 and early 2022 for landfill development and closure projects.

2.4.5 Available Capacity and Location of Needed Treatment, Storage, and Disposal Services

Under the CIP scenario, all of the CCR currently within the PAP would be stored within the existing footprint of the PAP. Treatment would consist of unwatering the PAP at the start of construction, performing limited dewatering to stabilize the CCR subgrade, and managing stormwater inflow. Water from unwatering and dewatering of the PAP would be discharged in accordance with the NPDES permit for the facility. Under the two CBR scenarios, water treatment would similarly consist of unwatering and dewatering the PAP at the start of construction and discharging water from unwatering/dewatering in accordance with the NPDES permit for the facility. Due to the need for dewatering prior to CCR hauling, a higher volume of water would be expected to be generated during dewatering under the two CBR scenarios than under the CIP scenario.

Under the CBR-Onsite and CBR-Offsite scenarios, 5.7 million CY of CCR would be excavated from the PAP and require disposal. The existing landfill on the Newton Power Plant property does not have sufficient capacity to receive all of the CCR that is currently slated for landfilling under the CBR-Onsite scenario. Expansion of the on-Site landfill would thus be necessary. The steps required for on-Site landfill expansion were described above in Section 2.1.2. Under the CBR-Offsite scenario, CCR would be sent to the Sycamore Ridge Landfill in Pimento, Indiana, which is located approximately 75 miles from the Site (Attachment B). The Sycamore Ridge Landfill has approximately 10 million CY of remaining capacity, and should therefore be able to accept all of the material excavated from the PAP without expansion (Attachment B). However, closure of the PAP would increase the annual waste receipt rate at the off-Site landfill. Due to the short time frame over which CCR would be received at the landfill, vertical and/or lateral expansions may become necessary. Additionally, the landfill operators may need to develop a disposal plan to account for the increased volume of material that would be received and the unique CCR waste characteristics. Elements of this disposal plan might include increasing daily operational capacity and procedures, expediting planned airspace construction, and potentially expediting landfill expansion.

2.5 Impact of Closure Alternative on Waters of the State (IAC Section 845.710(d)(4))

As demonstrated in Gradient's Human Health and Ecological Risk Assessment (Attachment A), both modeled and measured surface water concentrations in Newton Lake are below relevant human health and ecological screening benchmarks. Surface water concentrations of CCR-associated constituents would be expected to decline over time under all closure scenarios. Thus, no current or future exceedances of any human health or ecological screening benchmarks would be anticipated under any closure scenario.

The lined landfills that would receive the CCR excavated from the impoundment under the CBR-Onsite and CBR-Offsite scenarios would be managed to ensure that no surface water impacts would occur in the vicinity of the landfill. In summary, no impacts on any waters of the state would be expected under any closure scenario.

2.6 Concerns of Residents Associated with Closure Alternatives (IAC Section 845.710(b)(4))

Several nonprofits representing community interests near the Site have raised concerns regarding the potential impacts of the PAP on groundwater and surface water quality, including Earthjustice, the Prairie Rivers Network, and the Sierra Club (Earthjustice *et al*., 2018; Sierra Club and CIHCA, 2014). These parties generally prefer CBR to CIP, citing fears that allowing CCR to remain in place "allows the widespread groundwater contamination to continue indefinitely" (Earthjustice *et al*., 2018). However, it is not the case that closing the PAP *via* CIP rather than CBR would result in undue risks to groundwater and surface water post-closure. As described in Sections 2.2.1 and 2.2.2, no current or future unacceptable risks to human or ecological receptors are associated with the PAP under any scenario. There is also minimal risk of future CCR releases occurring under any scenario. Furthermore, groundwater modeling conducted at the Site demonstrated that both closure scenarios perform equivalently with regard to achieving the GWPSs (Ramboll, 2022). All three closure scenarios are therefore responsive to residents' concerns regarding impacts to groundwater and surface water quality. Additionally, the CIP and CBR-Onsite scenarios have several advantages over the CBR-Offsite scenario with regard to likely community concerns. Specifically, because the CIP and CBR-Onsite scenarios do not require any off-Site hauling, they present fewer risks to workers, nearby residents, and potentially EJ communities than the CBR-Offsite scenario during construction in the form of off-Site accidents, traffic-related impacts, noise, and air pollution (Section 2.2.4 above). Closure would also be achieved more rapidly under the CIP scenario than under the CBR-Onsite and CBR-Offsite scenarios, due to the shorter duration of construction activities. Finally, the Site can be more rapidly re-developed for use in utility-scale solar generation and battery energy storage under the CIP scenario than under the CBR-Onsite and CBR-Offsite scenarios. Re-development of the Site for use in solar generation and battery energy storage would bring new jobs to the community and contribute positively to Illinois's growing renewable energy portfolio.

2.7 Class 4 Cost Estimate (IAC Section 845.710(d)(1))

A Class 4 cost estimate will be prepared in the Final Closure Plan consistent with the Advancement of Cost Engineering (AACE) Classification Standard (or a comparable classification practice as provided in the AACE Classification Standard), as required by IAC Section 845.710 (IEPA, 2021).

2.8 Summary

Table S.1 (Summary of Findings) summarizes the expected impacts of the CIP, CBR-Onsite, and CBR-Offsite closure scenarios with regard to each of the factors specified under IAC Section 845.710 (IEPA, 2021). Based on this evaluation and the details provided in Section 2 above, CIP has been identified as the most appropriate closure scenario for the PAP. Key benefits of the CIP scenario relative to the CBR-Onsite and CBR-Offsite scenarios include more rapid re-development of the Site for use in utility-scale solar generation and battery energy storage and reduced impacts to workers, community members, and the environment during construction (*e.g.*, fewer constructed-related accidents, lower energy demands, less air pollution and GHG emissions, less traffic-related impacts, and potentially lower impacts to EJ communities). These conclusions are subject to change as additional data are collected and following the completion of an upcoming public meeting, which will be held in May 2022 pursuant to requirements under IAC Section 845.710(e). Following the public meeting, a final closure decision will be made based on the considerations identified in this report, the results of additional data that are collected, and any additional considerations that arise during the public meeting. The final closure recommendation will be provided in a Final Closure Plan, which will be submitted to IEPA as described under IAC Section 845.720(b) (IEPA, 2021).

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Attachment A

Human Health and Ecological Risk Assessment

Human Health and Ecological Risk Assessment
Primary Ash Pond
Newton Power Plant
Newton, Illinois

April 24, 2022

GRADIENT

www.gradientcorp.com
One Beacon Street, 17th Floor
Boston, MA 02108
617-395-5000

Table of Contents

List of Tables

List of Figures

Abbreviations

ADI	Acceptable Daily Intake
BCF	Bioconcentration Factor
BCG	Biota Concentration Guide
BCU	Bedrock Confining Unit
CAA	Closure Alternatives Assessment
CCR	Coal Combustion Residual
CEM	Conceptual Exposure Model
COI	Constituent of Interest
COPC	Constituent of Potential Concern
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
ESV	Ecological Screening Value
GWPS	Groundwater Protection Standard
GWQS	Groundwater Quality Standards
HTC	Human Threshold Criteria
IAC	Illinois Administrative Code
IDNR	Illinois Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
ILWATER	Illinois Water and Related Wells
IPGC	Illinois Power Generating Company
ISGS	Illinois State Geological Survey
LCU	Lower Confining Unit
LF 1	Phase 1 Landfill
LF 2	Phase 2 Landfill
MCL	Maximum Contaminant Level
NPDES	National Pollutant Discharge Elimination System
NPP	Newton Power Plant
NRWQC	National Recommended Water Quality Criteria
ORNL RAIS	Oak Ridge National Laboratory's Risk Assessment Information System
PAP	Primary Ash Pond
PMP	Potential Migration Pathway
PRG	Preliminary Remediation Goal
RfD	Reference Dose
RME	Reasonable Maximum Exposure
RSL	Regional Screening Level
SWQS	Surface Water Quality Standards
TEC	Threshold Effect Concentration
UA	Uppermost Aquifer
UCU	Upper Confining Unit
UD	Upper Drift
US DOE	United States Department of Energy
US EPA	United States Environmental Protection Agency

1 Introduction

Illinois Power Generating Company's (IPGC) Newton Power Plant (NPP, or "the Site") is an electric power generating facility with coal-fired units located approximately seven miles southwest of the city of Newton, Illinois. The facility began operating in approximately 1977 and will be retired by the end of 2027 (Meeker, 2020; Ramboll, 2021). The NPP has one surface impoundment for storage of coal combustion residuals (CCR), known as the Primary Ash Pond (PAP), that was constructed in 1977 and covers approximately 404 acres (Ramboll, 2021). Closure of the PAP (Illinois Environmental Protection Agency [IEPA] ID No. W0798070001-01), which is the subject of this report, is planned to commence by the end of 2022.

This report presents the results of an evaluation that characterizes potential risk to human and ecological receptors that may be exposed to CCR constituents in environmental media originating from the PAP. This risk evaluation was performed to support the Closure Alternatives Assessment (CAA) for the PAP in accordance with requirements in Title 35 Part 845 of the Illinois Administrative Code (IAC) (IEPA, 2021). Human and ecological risks were evaluated for Site-specific constituents of interest (COIs). The conceptual site model (CSM) assumed that Site-related COIs in groundwater may migrate to the adjacent Newton Lake and affect surface water and sediment in the vicinity of the Site.

Consistent with United States Environmental Protection Agency (US EPA) guidance (US EPA, 1989), this report used a tiered approach to evaluate potential risks, which included the following steps:

1. Identify complete exposure pathways and develop a conceptual exposure model (CEM).
2. Identify Site-related COIs: Constituents detected in groundwater were considered COIs if their maximum detected concentration over the period from 2015 to 2021 exceeded a groundwater protection standard (GWPS) identified in Part 845.600 (IEPA, 2021), or a relevant surface water quality standard (IEPA, 2019; US EPA Region IV, 2018).
3. Perform screening-level risk analysis: Compare maximum measured or modeled COI concentrations in surface water and sediment to conservative, health-protective benchmarks in order to determine constituents of potential concern (COPCs).
4. Perform refined risk analysis: If COPCs are identified, perform a refined analysis to evaluate potential risks associated with the COPCs.
5. Formulate risk conclusions and discuss any associated uncertainties.

This assessment relies on a conservative (*i.e.*, health-protective) approach and is consistent with the risk approaches outlined in US EPA guidance. Specifically, we considered evaluation criteria detailed in IEPA guidance documents (*e.g.*, IEPA, 2013, 2019), incorporating principles and assumptions consistent with the Federal CCR Rule (US EPA, 2015a) and US EPA's "Human and Ecological Risk Assessment of Coal Combustion Residuals" (US EPA, 2014).

Based on the evaluation presented in this report, no unacceptable risks to human and ecological receptors resulting from CCR exposures associated with the PAP were identified. Specific risk assessment results include the following:

- No unacceptable risks were identified for recreators boating in Newton Lake adjacent to the Site.

- No unacceptable risks were identified for recreators exposed to sediment in Newton Lake adjacent to the Site.
- No unacceptable risks were identified for anglers consuming locally caught fish.
- No unacceptable risks were identified for ecological receptors exposed to surface water or sediment.
- No bioaccumulative ecological risks were identified.

It should be noted that this evaluation incorporates a number of conservative assumptions that tend to overestimate exposure and risk. Moreover, it should be noted that because current conditions do not present a risk to human health or the environment, there will also be no unacceptable risk to human health or the environment for future conditions when the PAP is closed. For all future closure scenarios, potential releases of CCR-related constituents will decline over time and consequently potential exposures to CCR-related constituents in the environment will also decline.

2 Site Overview

2.1 Site Description

The NPP is located in Jasper County Illinois, approximately seven miles southwest of the city of Newton. The PAP is located south of the power plant in a predominantly agricultural area. The PAP is surrounded by Newton Lake on the west, south, and east (Figure 2.1) (Ramboll, 2021). Three CCR units are present on the NPP property, including the PAP and two landfills; the Phase 1 Landfill (LF 1) is located northwest and west of the PAP, and the Phase 2 Landfill (LF 2) is located west of the PAP. The PAP is the subject of this report (Ramboll, 2021). The PAP discharges into a secondary pond located immediately south of the PAP, which then discharges to Newton Lake under a National Pollutant Discharge Elimination System (NPDES) permit (No. IL0049191) (Ramboll, 2021).

Newton Lake was formed by the construction of a dam in 1975 (US National Dams, 2022), and is used as a cooling water supply for the NPP (IDNR, 2019). Water is drawn from the eastern arm near the power plant and thermal effluent is released at two locations in the western arm via NPDES permitted outfalls (IEPA, 2016).

Figure 2.1 Site Location Map. Source: Ramboll, 2021.

2.2 Geology/Hydrogeology

The geology underlying the Site in the vicinity of the PAP primarily consists of unlithified deposits overlying a shale bedrock unit. The principal types of unlithified materials include the Peoria Silt /Sangman Soil, the Hagarstown Member, the Vandalia Till, the Mulberry Grove Member, and the Smithboro Till/Banner Formation (Ramboll, 2021). These unlithified deposits are underlain by a Pennsylvanian Age shale bedrock of the Mattoon Formation (Ramboll, 2021). Five distinct hydrostratigraphic units in the area are (listed from ground surface down): the Upper Drift (UD)/Potential Migration Pathway (PMP), the Upper Confining Unit (UCU), the Uppermost Aquifer (UA), the Lower Confining Unit (LCU), and the Bedrock Confining Unit (BCU) (Ramboll, 2021).

The UD is composed of low permeability silts and clays of the Peoria Silt and Sangamon Soil and the sandier soils of the Hagarstown Member (*i.e.*, PMP). The Hagarstown Member is generally 2 feet (ft) thick but is encountered at thicknesses up to about 6.9 ft in the vicinity of the Ash Pond (Ramboll, 2021). The UD/PMP has a geometric mean horizontal hydraulic conductivity of 3.1 x 10^{-3} cm/s (Ramboll, 2021). The UA is composed of a 3 to 17 ft thick Mulberry Grove Member, which consists of sand, silty- and clayey-sand, and gravel. The UA has a geometric mean horizontal hydraulic conductivity of 6.8 x 10^{-3} cm/s (Ramboll, 2021). The UA is sandwiched between two low-permeability confining units: (i) the UCU on top consisting of clay and silt of the Vandalia Till and (ii) the LCU on bottom consisting of silt and clay of the Smithboro Till Member and the Banner Formation (Ramboll, 2021). No wells are screened within the UCU, the LCU, or the underlying shale BCU. Field hydraulic conductivity tests were not performed in any of these confining units (Ramboll, 2021).

Groundwater within the UA flows generally from the north towards the south and southwest. In the southern area of the PAP, groundwater flows toward a former drainage feature located west of the PAP (Ramboll, 2021). In the northern area of the PAP, groundwater from the UA may interact with surface water in Newton Lake, as evidenced by relatively higher groundwater head elevations compared to the Newton Lake water level. Groundwater velocities in the UA range from 0.04 to 1.9 ft/day. Horizontal hydraulic gradients calculated for the UA range from 0.0025 to 0.0071 ft/ft (Ramboll, 2021). Groundwater within the UD/PMP may also flow into Newton Lake; however, flow velocity or hydraulic gradient have not been calculated or measured within the PMP (Ramboll, 2021).

2.3 Conceptual Site Model

A CSM describes sources of contamination, the hydrogeological units, and the physical processes that control the transport of water and solutes. In this case, the CSM describes how groundwater underlying the PAP migrates and interacts with surface water and sediment in the adjacent Newton Lake. The CSM was developed using available hydrogeologic data specific to the PAP (Ramboll, 2021), including information on groundwater flow and surface water characteristics.

CCR-related constituents may migrate vertically downward beneath the PAP and into groundwater; these constituents may subsequently migrate with groundwater in the UA and the PMP and flow into the eastern arm of Newton Lake. CCR-related constituents from the PAP may migrate vertically downward through the UD/PMP and the UCU into the UA (Ramboll, 2021). The north to south groundwater flow within the UA is mostly in the horizontal direction because the UA is underlain by two low-permeability confining units (*i.e.*, LCU and BCU) that inhibit vertical flow (Ramboll, 2021). A component of the CCR-related constituents from the PMP may also flow into Newton Lake, particularly on the eastern portion of the PAP where groundwater and surface water interact. After groundwater flows into the lake, dissolved constituents in groundwater may partition between sediments and surface water.

2.4 Groundwater Monitoring

A total of 29 wells have been used to monitor the groundwater quality near and downgradient of the PAP. Of these, 23 wells are screened in the UA, and 6 wells are screened in the UD (Table 2.1). The analyses presented in this report relied on all available data from the 29 wells collected between 2015 and 2021, which is the period subsequent to the promulgation of the Federal CCR Rule. Groundwater samples were analyzed for a suite of total metals, specified in Illinois CCR Rule Part 845.600 (IEPA, 2021).[1] A summary of the groundwater data used in this risk evaluation is presented in Table 2.2. The PAP well locations are shown in Figure 2.2. Note that there are additional wells in the vicinity of the PAP (shown in Figure 2.1) that were not used in this risk analysis, because they were screened in the CCR and are not reflective of groundwater conditions. The use of groundwater data in this risk evaluation does not imply that detected constituents are associated with the PAP or that they have been identified as potential groundwater exceedances.

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[1] Samples were analyzed for a longer list of inorganic constituents and general water quality parameters (chloride, fluoride, sulfate, and total dissolved solids), but these constituents were not evaluated in the risk evaluation.

Figure 2.2 Monitoring Well Locations. Source: Ramboll, 2021, Figure 3-1.

Table 2.1 Groundwater Monitoring Wells Related to Newton Primary Ash Pond

Well	Hydrogeologic Unit	Date Constructed	Screen Top Depth (ft bgs)	Screen Bottom Depth (ft bgs)	Well Depth (ft bgs)
APW02	UD	06/19/2010	9.70	19.70	20.00
APW03	UD	06/18/2010	9.70	19.70	20.00
APW04	UD	06/19/2010	7.70	17.70	18.00
APW05	UA	10/22/2015	62.64	67.44	67.84
APW05S	UD	01/19/2021	10.00	20.00	20.00
APW06	UA	10/21/2015	67.67	72.48	72.88
APW07	UA	11/05/2015	77.89	82.70	83.10
APW08	UA	10/28/2015	71.40	81.06	81.53
APW09	UA	11/03/2015	56.66	61.46	61.85
APW10	UA	11/06/2015	40.74	45.54	45.94
APW11	UA	01/23/2021	60.00	65.00	65.00
APW12	UD	02/21/2021	20.00	30.00	30.00
APW13	UA	01/22/2021	58.50	63.50	63.50
APW14	UA	01/23/2021	50.00	55.00	55.00
APW15	UA	01/22/2021	98.00	103.00	103.00
APW16	UA	01/20/2021	80.50	85.50	85.50
APW17	UA	01/22/2021	87.00	92.00	92.00
APW18	UA	01/21/2021	75.00	80.00	80.00
G48MG	UA	10/20/2015	71.80	76.65	77.06
G202	UA	10/16/1996	64.00	74.00	74.00
G203	UA	11/15/1996	62.50	72.50	72.50
G208	UA	10/13/2011	74.93	94.71	94.80
G217S	UD	08/26/1997	9.00	19.00	19.00
G217D	UA	12/09/2014	--	--	69.30
G222	UA	10/25/2011	64.57	79.24	79.30
G223	UA	10/11/2011	79.09	88.75	89.10
G224	UA	10/05/2011	63.51	73.17	73.50
R202	UA	--	--	--	--
R217D	UA	09/26/2017	60.10	65.03	65.24

Notes:
-- = Data Unavailable.
bgs = Below Ground Surface; ft = Feet; UA = Uppermost Aquifer; UD = Upper Drift.
Source: Ramboll, 2021.

Table 2.2 Groundwater Data Summary

Constituent	Samples with Constituent Detected	Samples Analyzed	Minimum Detected Value	Maximum Detected Value	Maximum Laboratory Detection Limit
Total Metals (mg/L)					
Antimony	2	225	0.0035	0.0036	0.003
Arsenic	204	225	0.001	0.13	0.001
Barium	225	225	0.0075	1.5	0.001
Beryllium	3	225	0.0025	0.0033	0.001
Boron	358	358	0.023	0.66	0.02
Cadmium	4	225	0.0012	0.0034	0.001
Chromium	39	225	0.004	0.09	0.004
Cobalt	37	225	0.002	0.036	0.002
Lead	59	225	0.001	0.065	0.001
Lithium	106	225	0.01	0.3	0.02
Mercury	14	225	0.0002	0.002	0.0002
Molybdenum	195	225	0.0011	0.045	0.001
Selenium	9	225	0.001	0.006	0.001
Thallium	5	225	0.0011	0.0036	0.001
Radionuclides (pCi/L)					
Radium-226+228	225	225	0.0127	15.2	1.85
Other (mg/L, unless otherwise noted)					
Chloride	372	372	8	550	500
Fluoride	316	360	0.258	8.16	6.25
Sulfate	331	370	1	3200	500
Total Dissolved Solids	482	482	300	5500	34

Notes:
pCi/L = PicoCuries Per Liter.

2.5 Surface Water Monitoring

Golder collected a total of 28 surface water samples from Newton Lake in the vicinity of the PAP in April and May, 2021 (Golder Associates Inc., 2021). The sample locations are shown in Figure 2.3, and the sampling results are summarized in Table 2.3.

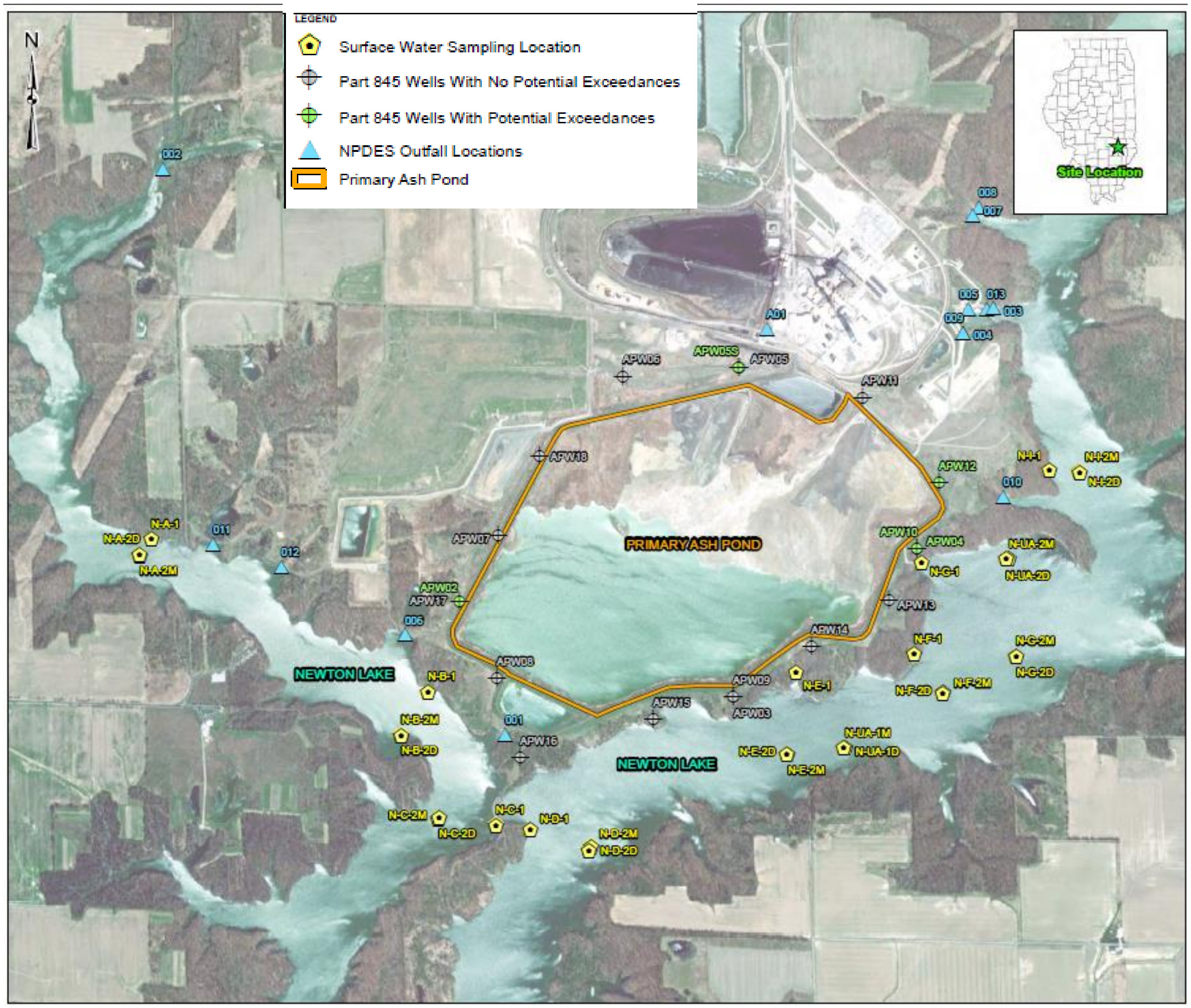

Figure 2.3 Surface Water Sampling Locations. Source: Golder Associates Inc., 2021.

Table 2.3 Surface Water Data Summary

Constituent	Samples with Constituent Detected	Samples Analyzed	Minimum Detected Value	Maximum Detected Value	Maximum Laboratory Detection Limit
Total Metals (mg/L)					
Antimony	0	28			0.003
Arsenic	28	28	0.0018	0.0042	0.001
Barium	28	28	0.052	0.64	0.001
Beryllium	0	28			0.001
Boron	28	28	0.11	0.14	0.01
Cadmium	0	28			0.001
Calcium	28	28	19	22	0.2
Chromium	1	28	0.0067	0.0067	0.004
Cobalt	0	28			0.002
Iron	28	28	0.027	1.2	0.01
Lead	0	28			0.001
Lithium	0	28			0.02
Magnesium	28	28	5.0	5.8	0.1
Manganese	28	28	0.044	0.69	0.001
Mercury	0	28			0.0002
Molybdenum	28	28	0.0046	0.0062	0.001
Potassium	28	28	5.6	10	0.1
Selenium	0	28			0.001
Sodium	28	28	19	22	0.1
Thallium	0	28			0.001
Radionuclides (pCi/L)					
Radium-226+228	28	28	0.012	2.1	1.09
Other (mg/L)					
Chloride	28	28	8.5	9.6	1
Fluoride	28	28	0.35	0.51	0.25
Sulfate	28	28	35	95	25
Total Dissolved Solids	28	28	170	240	34

Notes:

COI = Constituent of Interest; pCi/L = PicoCuries Per Liter.

Surface water was analyzed for both total and dissolved metals; only total metals are reported here because they generally have higher concentrations than dissolved metals. However, the maximum dissolved concentrations for boron, manganese, and molybdenum are slightly higher (up to a factor of two) than the maximum total concentrations, but boron, manganese, and molybdenum have not been identified as COIs.

3 Risk Evaluation

3.1 Risk Evaluation Process

A risk evaluation was conducted to determine whether constituents present in groundwater underlying and downgradient of the PAP have the potential to pose adverse health effects to human and ecological receptors. The risk evaluation is consistent with the principles of risk assessment established by US EPA and has considered evaluation criteria detailed in Illinois guidance documents (*e.g.*, IEPA, 2013, 2019).

The general risk evaluation approach is summarized in Figure 3.1 and discussed below.

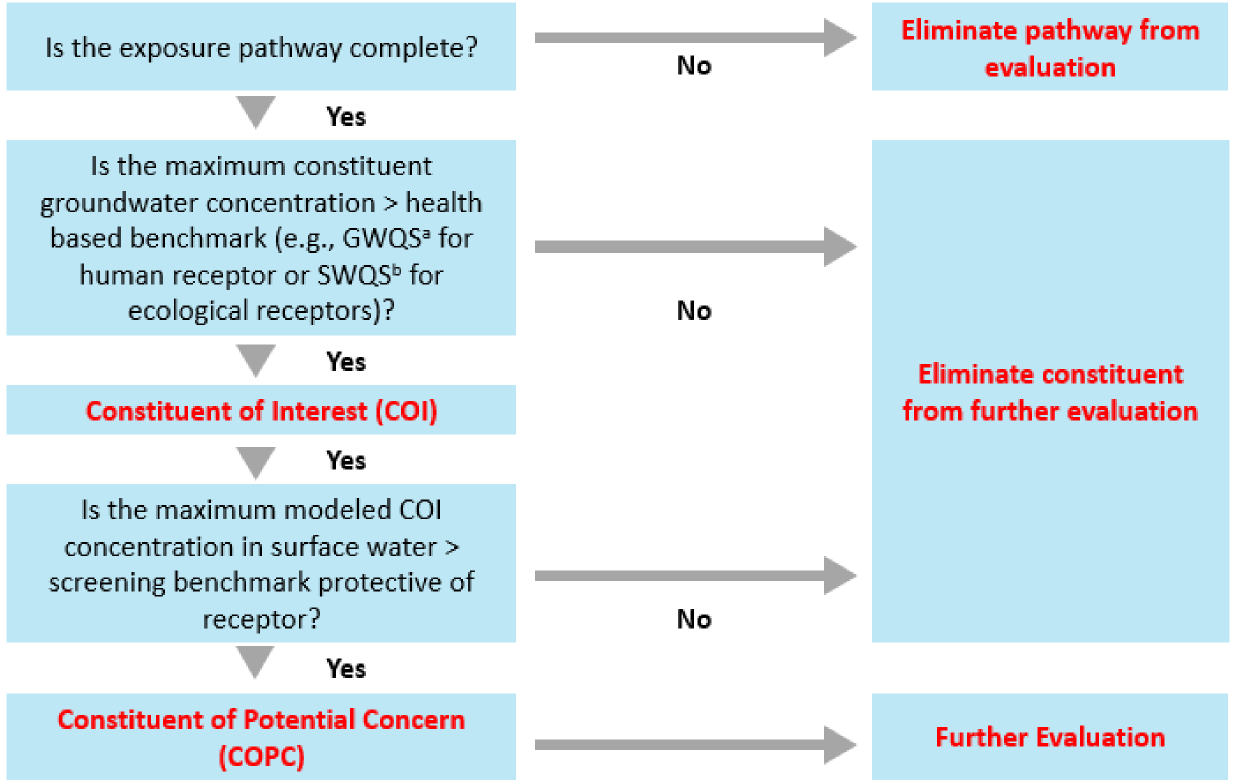

Figure 3.1 Overview of Risk Evaluation Methodology. IEPA = Illinois Environmental Protection Agency; GWQS = IEPA Groundwater Quality Standards; SWQS = IEPA Surface Water Quality Standards. (a) The IEPA Part 845 Groundwater Protection Standards (GWPS) were used to identify COIs. (b) IEPA SWQS protective of chronic exposures to aquatic organisms were used to identify ecological COIs. In the absence of an SWQS, US EPA Region IV Ecological Screening Values (ESVs) were used.

The first step in the risk evaluation was to develop the CEMs and identify complete exposure pathways. All potential receptors and exposure pathways based on groundwater use and surface water use in the vicinity of the Site were considered. Exposure pathways that are incomplete were excluded from the evaluation.

Groundwater data were used to identify COIs. COIs were identified as constituents with maximum concentrations in groundwater in excess of groundwater quality standards (GWQS)[2] for human receptors and surface water quality standards (SWQS) for ecological receptors. Based on the CSM (Section 2.2), some groundwater underlying the PAP has the potential to interact with surface water in Newton Lake. Therefore, potential PAP-related constituents in groundwater may potentially flow toward and into surface water in Newton Lake.

Surface water samples have been collected from Newton Lake adjacent to the Site; however, sediment samples have not been collected from the lake. Gradient modeled the potential migration of COIs from groundwater to surface water and sediment to evaluate potential risks to receptors (see Section 3.3.3).

Gradient modeled the COI concentrations in surface water and sediment based on the groundwater data from the PAP-related wells. The measured and modeled COI concentrations in surface water and sediment were compared to conservative, generic risk-based screening benchmarks for human health and ecological receptors. These generic screening benchmarks rely on default assumptions with limited consideration of site-specific characteristics. Human health benchmarks are receptor-specific values calculated for each pathway and environmental medium that are designed to be protective of human health. Ecological benchmarks are medium-specific values designed to be protective of all potential ecological receptors exposed to surface water. Ecological and human health screening benchmarks are inherently conservative because they are intended to screen out chemicals that are of no concern with a high level of confidence. Therefore, a measured or modeled COI concentration exceeding a screening benchmark does not indicate an unacceptable risk, but only that further risk evaluation is warranted. COIs with maximum concentrations exceeding a conservative screening benchmark are identified as COPCs requiring further evaluation.

As described in more detail below, this evaluation relied on the screening assessment to demonstrate that constituents present in groundwater underlying the PAP do not pose an unacceptable human health or ecological risk. That is, after the screening step, no COPCs were identified and further assessment was not warranted.

3.2 Human and Ecological Conceptual Exposure Models

A CEM provides an overview of the receptors and exposure pathways requiring risk evaluation. The CEM describes the source of the contamination, the mechanism that may lead to a release of contamination, the environmental media to which a receptor may be exposed, the route of exposure (exposure pathway), and the types of receptors that may be exposed to these environmental media.

3.2.1 Human Conceptual Exposure Model

The human CEM for the Site depicts the relationships between the off-Site environmental media potentially impacted by constituents in groundwater and human receptors that could be exposed to these media. Figure 3.2 presents a human CEM for the Site. It considers a human receptor who could be exposed to COIs hypothetically released from the PAP into groundwater, surface water, sediment, and fish. The following human receptors and exposure pathways were evaluated for inclusion in the Site-specific CEM.

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[2] As discussed further in Section 3.3.2, GWQS are protective of human health and not necessarily of ecological receptors. While ecological receptors are not exposed to groundwater, groundwater can potentially enter into the adjacent surface water and impact ecological receptors. Therefore, two sets of COIs were identified: one for humans and another for ecological receptors.

- Residents – exposure to groundwater/surface water as drinking water;
- Residents – exposure to groundwater/surface water used for irrigation;
- Recreators in the lake adjacent to the Site:
  - Boaters – exposure to surface water and sediment while boating;
  - Swimmers – exposure to surface water and sediment while swimming;
  - Anglers – exposure to surface water and sediment and consumption of locally caught fish.

All of these exposure pathways were considered to be complete, except for residential exposure to groundwater or surface water used for drinking water or irrigation, and swimming. Section 3.2.1.1 explains why the residential drinking water and irrigation pathways are incomplete, and Section 3.2.1.2 provides additional description of the recreational exposures. While a recreator's potential exposure to surface water in Newton Lake was evaluated, swimming does not occur in Newton Lake, because it is owned by IPGC and used as a cooling reservoir (IDNR, 2022).

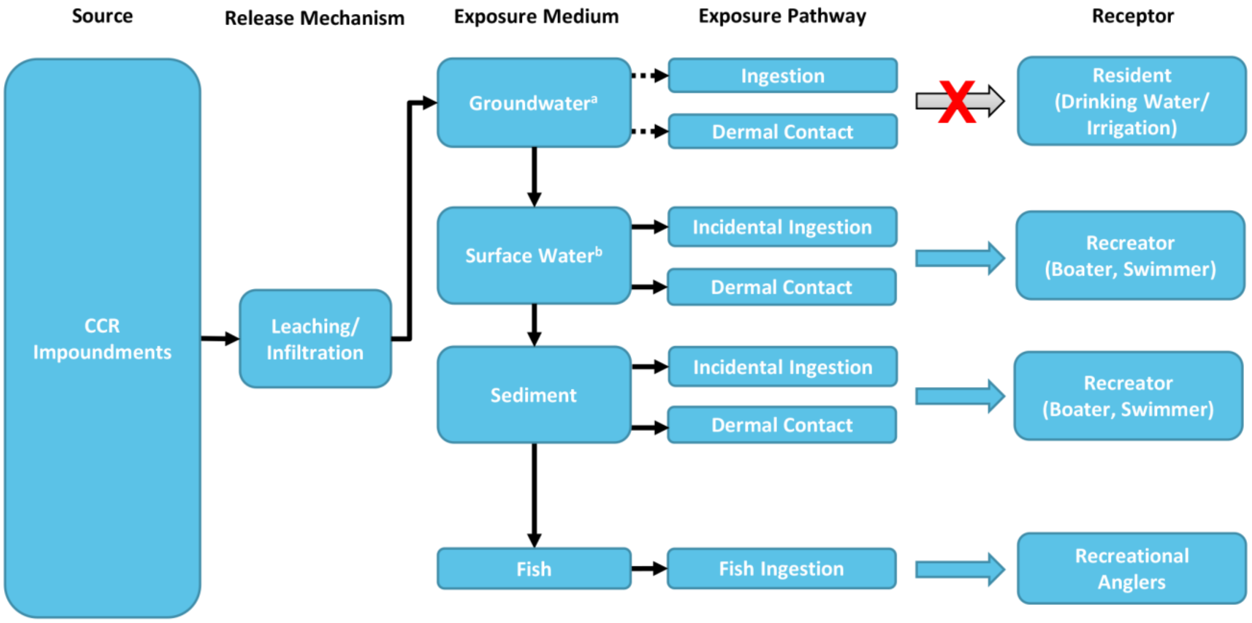

Figure 3.2 Human Conceptual Exposure Model. CCR = Coal Combustion Residual. Dashed line/Red X = Incomplete or insignificant exposure pathway. (a) Groundwater in the vicinity of the Site is not used as a drinking water or irrigation source. (b) Surface water is not used as a drinking water source.

3.2.1.1 Groundwater or Surface Water as a Drinking Water/Irrigation Source

Groundwater as a source of drinking water and/or irrigation water is not a complete exposure pathway for CCR-related constituents originating from the PAP. Specifically, shallow groundwater from the UA and the PMP in the vicinity of the PAP is not used as a source of drinking water, and no potable wells were identified downgradient of the PAP. A summary of the evidence supporting the conclusion that there are no residential uses of the shallow groundwater and Newton Lake surface water as a source of drinking water is presented below:

- **No potential groundwater receptors are in the vicinity of the PAP**. Relying on state databases, Ramboll completed a potable water well survey in 2021 (Ramboll, 2021). Two wells[3] were identified within a 1,000-meter radius of the PAP boundary during a comprehensive search of the Illinois State Geological Survey's (ISGS) Illinois Water and Related Wells (ILWATER) Map (ISGS, 2020) (Figure 3.3). Both wells are listed as dry/abandoned and are not currently in use as a source of drinking water (Ramboll, 2021).
- **There is no off-Site migration of CCR-related constituents in groundwater**. Newton Lake is intersected by both the UA and the PMP; thus, groundwater from the UA and the PMP may interact with surface water in the lake in some areas. The two water wells that are identified within a 1,000 m radius of the PAP are located on the southeast side of Newton Lake, *i.e.*, the opposite side of the lake from the PAP. Thus, Newton Lake separates the wells from the PAP (Figure 3.3). CCR-constituents in groundwater within the UA and the PMP are not expected to flow underneath or bypass Newton Lake.
- **Newton Lake adjacent to the PAP is not used as a public water supply.** Newton Lake is a cooling water pond owned and maintained by IPGC. IPGC restricts the use of the pond as a source of drinking water. Therefore, the human exposure pathway of surface water ingestion (as potable water) adjacent to the PAP was not evaluated further.
- **The PAP has a limited hydraulic connection to underlying groundwater**. The LCU and the shale BCU underlying the shallow aquifers (*i.e.*, the UA and the PMP) form a hydraulic barrier between the PAP and deeper groundwater resources. Due to the very low hydraulic conductivity of these confining units, downward migration of shallow groundwater is expected to be limited. Therefore, the likelihood of PAP-related impacts to deep groundwater is minimal.

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[3] These are well numbers 120790038600 and 120790043600 (Ramboll, 2021).

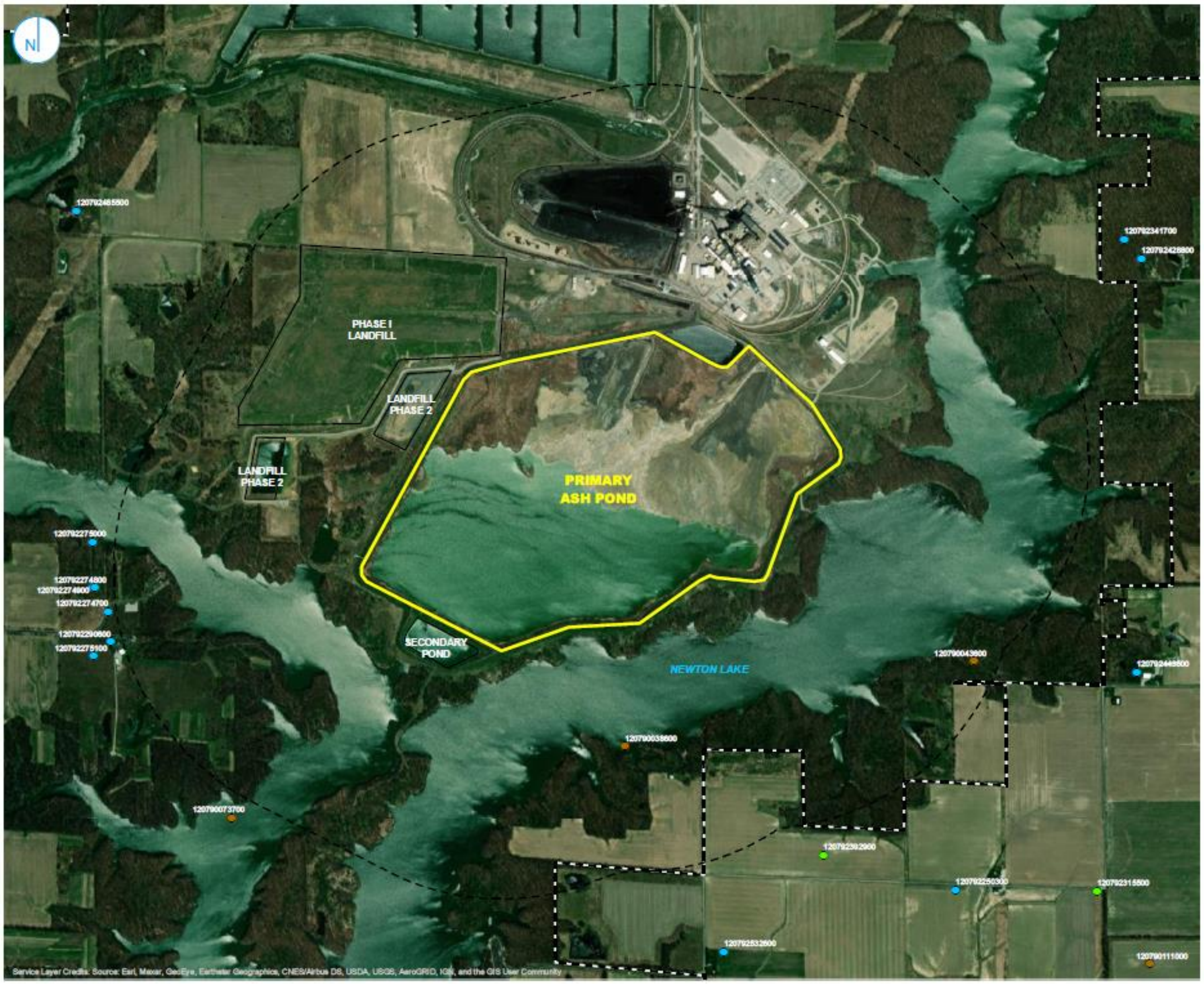

Figure 3.3 Water Wells Within 1,000 meters of the Primary Ash Pond. Source: Ramboll, 2021, Figure B-1.

3.2.1.2 Recreational Exposures

Newton Lake is located adjacent to the Site and is owned by IPGC. A portion of the NPP property along the lake has been leased to the Illinois Department of Natural Resources (IDNR) for use as a State Fish and Wildlife Area; thus, the lake is used for recreational fishing (IDNR, 2019). Recreational exposure to surface water and sediment may occur during activities such as boating or fishing in the lake. Recreational anglers may also consume locally caught fish from Newton Lake. Swimming does not occur in Newton Lake because it is owned by IPGC and used as a cooling reservoir (IDNR, 2022).

3.2.2 Ecological Conceptual Exposure Model

The ecological CEM for the Site depicts the relationships between off-Site environmental media (surface water and sediment) potentially impacted by COIs in groundwater and ecological receptors that may be exposed to these media. The ecological risk evaluation considered both direct toxicity as well as secondary toxicity *via* bioaccumulation. Figure 3.4 presents the ecological CEM for the Site. The following ecological receptor groups and exposure pathways were considered:

- **Ecological Receptors Exposed to Surface Water:**
  - Aquatic plants, amphibians, reptiles, and fish.
- **Ecological Receptors Exposed to Sediment:**
  - Benthic invertebrates (*e.g.*, insects, crayfish, mussels).
- **Ecological Receptors Exposed to Bioaccumulative COIs:**
  - Higher trophic-level wildlife (avian and mammalian) *via* direct exposures (surface water and sediment exposure) and secondary exposures through the consumption of prey (*e.g.*, plants, invertebrates, small mammals, fish).

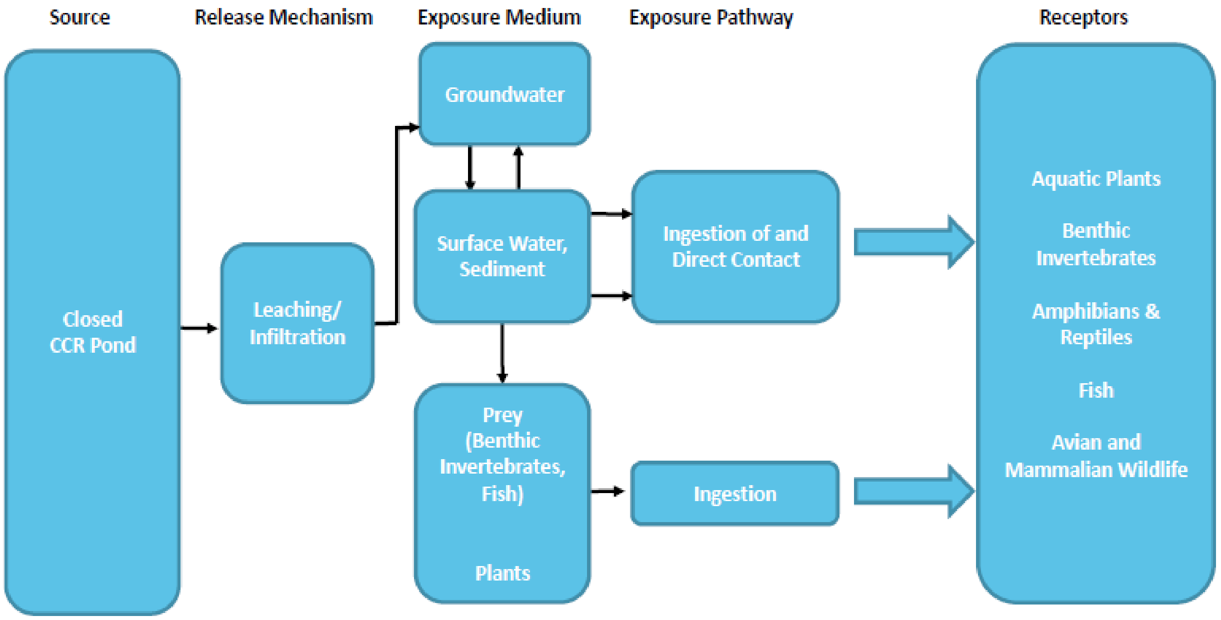

Figure 3.4 Ecological Conceptual Exposure Model. CCR = Coal Combustion Residual.

3.3 Identification of Constituents of Interest

Risks were evaluated for COIs. A constituent was considered a COI if the maximum detected constituent concentration in groundwater exceeded a health-based benchmark. According to US EPA risk assessment guidance (US EPA, 1989), this screening step is designed to reduce the number of constituents carried through the risk evaluation that are anticipated to have a minimal contribution to the overall risk. Identified COIs are the constituents that are most likely to pose a risk concern in the surface water adjacent to the Site.

3.3.1 Human Health Constituents of Interest

For the human health risk evaluation, COIs were conservatively identified as constituents with maximum concentrations in groundwater above the GWPS listed in the Illinois CCR Rule Part 845.600 (IEPA, 2021). Gradient used the maximum detected concentrations from groundwater samples collected from all of the PAP-associated wells, regardless of hydrostratigraphic unit. The use of groundwater data in this risk evaluation does not imply that detected constituents are associated with the PAP or that they have been identified as potential groundwater exceedances. Using this approach, 7 COIs (arsenic, cobalt, lead, lithium, thallium, radium-226+228, and fluoride) were identified for the human health risk evaluation *via* the surface water pathway (Table 3.1).

The water quality parameters that exceeded the GWPS included chloride, sulfate, and total dissolved solids; however, these constituents were not included in the risk evaluation because the GWPS is based on aesthetic quality and there is an absence of studies regarding toxicity to human health. The US EPA secondary maximum contaminant levels (MCLs) for chloride, sulfate, and total dissolved solids are based on aesthetic quality. The secondary MCLs for chloride and sulfate (250 mg/L) are based on salty taste (US EPA, 2021a). The secondary MCL for total dissolved solids (500 mg/L) is based on hardness, deposits, colored water, staining, and salty taste (US EPA, 2021a). Given that these parameters are not likely to pose a human health risk concern in the event of exposure, they were not considered to be human health COIs.

Table 3.1 Human Health Constituents of Interest

Constituents[a]	**Maximum Concentration**	**GWPS**[b]	**Human Health COI**[c]
Total Metals (mg/L)			
Antimony	0.0036	0.0060	No
Arsenic	0.13	0.010	Yes
Barium	1.5	2.0	No
Beryllium	0.0033	0.0040	No
Boron	0.66	2.0	No
Cadmium	0.0034	0.0050	No
Chromium	0.090	0.10	No
Cobalt	0.036	0.0060	Yes
Lead	0.065	0.0075	Yes
Lithium	0.30	0.040	Yes
Mercury	0.0020	0.0020	No
Molybdenum	0.045	0.10	No
Selenium	0.0060	0.050	No
Thallium	0.0036	0.0020	Yes
Radionuclides (pCi/L)			
Radium-226+228	15	5.0	Yes
Other (mg/L)			
Chloride	550	200	No[d]
Fluoride	8.2	4.0	Yes
Sulfate	3,200	400	No[d]
Total Dissolved Solids	5,500	1,200	No[e]

Notes:
COI = Constituent of Interest; GWPS = Groundwater Protection Standard; MCL = Maximum Contaminant Level; pCi/L = PicoCuries Per Liter.
Shaded = Compound identified as a COI.
(a) The constituents are those listed in the IL Part 845.600 GWPS (IEPA, 2021).
(b) The IL Part 845.600 GWPS (IEPA, 2021) were used to identify COIs.
(c) COIs are constituents for which the maximum concentration exceeds the groundwater standard.
(d) This constituent is not likely to pose a human health risk concern due to the absence of studies regarding toxicity to human health. Therefore, this constituent is not considered a COI.
(e) Total dissolved solids are not considered a COI because the MCL is based on aesthetic quality.

3.3.2 Ecological Constituents of Interest

The Illinois GWPS, as defined in IEPA's guidance, were developed to protect human health but not necessarily ecological receptors. While ecological receptors are not exposed to groundwater, groundwater can potentially migrate into the adjacent surface water and impact ecological receptors. Therefore, to identify ecological COIs, the maximum concentrations of constituents detected in groundwater were compared to ecological surface water benchmarks protective of aquatic life.

The surface water screening benchmarks for freshwater organisms were obtained from the following hierarchy of sources:

- IEPA (2019) SWQS. IEPA SWQS are health-protective benchmarks for aquatic life exposed to surface water on a long-term basis (*i.e.*, chronic exposure). The SWQS for several metals are hardness dependent (cadmium, chromium, copper, lead, manganese, nickel, and zinc). Screening benchmarks for these constituents were calculated assuming US EPA's default hardness of 100 mg/L (US EPA, 2022).[4]
- US EPA Region IV (2018) surface water Ecological Screening Values (ESVs) for hazardous waste sites.

Benchmarks from the United States Department of Energy's (US DOE) guidance document ("A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota") were used for radium (US DOE, 2019). US DOE presents benchmarks for radium-226 and radium-228 (4 and 3 picoCuries per liter [pCi/L], respectively). Given that radium concentrations are expressed as total radium (radium-226+228, *i.e.*, the sum of radium-226 and radium-228), Gradient used the lower of the two benchmarks (3 pCi/L for radium-228) to evaluate total radium concentrations.

Consistent with the human health risk evaluation, Gradient used the maximum detected concentrations from groundwater samples collected from all of the PAP-associated wells, (regardless of hydrostratigraphic unit) without considering spatial or temporal representativeness for ecological receptor exposures. The use of the maximum constituent concentrations in this evaluation is designed to conservatively identify COIs that warrant further investigation. Cadmium, cobalt, lead, mercury, radium-226+228, chloride, and fluoride were identified as COIs for ecological receptors (Table 3.2).

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[4] Hardness data are not available for Newton Lake adjacent to the Site, therefore, the US EPA (2022) default hardness of 100 mg/L was used. Use of a higher hardness value would result in less stringent screening values, thus, use of the US EPA default hardness is conservative.

Table 3.2 Ecological Constituents of Interest

Constituents[a]	Maximum Groundwater Concentration	Ecological Benchmark[b]	Basis	Ecological COI[c]
Total Metals (mg/L)				
Antimony	0.0036	0.19	US EPA R4 ESV	No
Arsenic	0.13	0.19	IEPA SWQC	No
Barium	1.5	5.0	IEPA SWQC	No
Beryllium	0.0033	0.064	US EPA R4 ESV	No
Boron	0.66	7.6	IEPA SWQC	No
Cadmium	0.0034	0.0011	IEPA SWQC	Yes
Chromium	0.09	0.21	IEPA SWQC	No
Cobalt	0.036	0.019	US EPA R4 ESV	Yes
Lead	0.065	0.020	IEPA SWQC	Yes
Lithium	0.3	0.44	US EPA R4 ESV	No
Mercury	0.002	0.0011	IEPA SWQC	Yes
Molybdenum	0.045	7.2	US EPA R4 ESV	No
Selenium	0.006	1.0	IEPA SWQC	No
Thallium	0.0036	0.0060	US EPA R4 ESV	No
Radionuclides (pCi/L)				
Radium-226+228	15.2	3.0	US DOE	Yes
Other (mg/L, unless otherwise noted)				
Chloride	550	500	IEPA SWQC	Yes
Fluoride	8.16	4.0	IEPA SWQC	Yes
Sulfate	3200	NA	NA	No
Total Dissolved Solids	5500	NA	NA	No

Notes:

COI = Constituent of Interest; DOE = Department of Energy; GWPS = Groundwater Protection Standard; IEPA SWQS = Illinois Environmental Protection Agency Surface Water Quality Standards; NA = Not Available; PAP = Primary Ash Pond; pCi/L = PicoCuries Per Liter; US EPA R4 ESV = US Environmental Protection Agency Region IV Ecological Screening Value.

Shaded = Compound identified as a COI.

(a) The constituents are those listed in the IL Part 845.600 GWPS (IEPA, 2021) that were detected in at least one groundwater sample from the 28 wells related to the Newton PAP.

(b) Ecological benchmarks are from the hierarchy of sources discussed in Section 3.3.2: IEPA SWQS (IEPA, 2019); US EPA R4 "Ecological Risk Assessment Supplemental Guidance" (US EPA Region IV, 2018); and US DOE's guidance document "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota" (US DOE, 2019).

(c) Constituents with maximum detected concentrations exceeding a benchmark protective of surface water exposure are considered ecological COIs.

3.3.3 Surface Water and Sediment Modeling

Surface water sampling has been conducted in Newton Lake adjacent to the Site. To estimate the potential contribution to surface water (and sediment) from groundwater specifically associated with the PAP, Gradient modeled concentrations in Newton Lake surface water and sediment from groundwater flowing into the lake for the detected human and ecological COIs. This is because the constituents detected in groundwater above an ecological or health-based benchmark are most likely to pose a risk concern in the adjacent surface water. Gradient modeled human health and ecological COI concentrations in the surface water and sediment using a mass balance calculation based on the surface water and groundwater mixing. The model assumes a well-mixed groundwater-surface water location. The maximum detected concentrations in groundwater (regardless of well location) from 2015 to 2021 were conservatively used to model COI concentrations in surface water and sediment. The groundwater data were measured as total metals. Use of the total metal concentration for these COIs may overestimate surface water concentrations because dissolved concentrations, which are lower than total concentrations, represent the mobile fractions of constituents that could likely flow into and mix with surface water.

The modeling approach does not account for geochemical transformations that may occur during groundwater mixing with surface water. Gradient assumed that predicted surface water concentrations were influenced only by the physical mixing of groundwater as it enters the surface water and were not further influenced by the geochemical reactions in the water and sediment, such as precipitation. In addition, the model only predicts surface water and sediment concentrations as a result of the potential migration of COI concentrations in PAP-related groundwater and does not account for background concentrations in surface water or sediment.

For this evaluation, Gradient adapted a simplified and conservative form of US EPA's indirect exposure assessment methodology (US EPA, 1998) that was used in US EPA's coal combustion waste risk assessment (US EPA, 2014). The model is a mass balance calculation based on surface water and groundwater mixing and the concept that the dissolved and sorbed concentrations can be related through an equilibrium partitioning coefficient (K_d). The model assumes a well-mixed groundwater-surface water location, with partitioning among total suspended solids, dissolved water column, sediment pore water, and solid sediments.

Sorption to soil and sediment is highly dependent on the surrounding geochemical conditions. To be conservative, we ignored the natural attenuation capacity of soil and sediment and estimated the surface water concentration based only on the physical mixing of groundwater and surface water (*i.e.*, dilution) at the point where groundwater flows into surface water.

The aquifer and surface water properties used to estimate the volume of groundwater flowing into Newton Lake and surface water concentrations are presented in Table 3.3. The COI concentrations in sediment were modeled using the COI-specific sediment-to-water partitioning coefficients and the sediment properties presented in Table 3.4. In the absence of Site-specific information for Newton Lake, Gradient used default assumptions (*e.g.*, depth of the upper benthic layer and bed sediment porosity) to model sediment concentrations. The modeled surface water and sediment concentrations are presented in Table 3.5. These modeled concentrations reflect conservative contributions from groundwater. A description of the modeling and the detailed results are presented in Appendix A.

Table 3.3 Groundwater and Surface Water Properties Used in Modeling

Parameter	Unit	Values	Notes/Source
Groundwater			
COI Concentration	mg/L	Constituent specific	Maximum detected concentration in groundwater.
Cross Section Area for the Uppermost Aquifer[a]	m^2	18,330	The sum of the maximum thicknesses of the PMP and the UA (*i.e.*, approximately 7.3 m) multiplied by the length of the ash pond intersecting Newton Lake (*i.e.*, about 2,500 m) (Ramboll, 2021).
Hydraulic Gradient	m/m	0.0048	The average hydraulic gradient determined for the UA was used (Ramboll, 2021).
Hydraulic Conductivity of the Uppermost Aquifer	cm/s	0.00495	Average of the geometric mean horizontal hydraulic conductivities measured for the PMP (3×10^{-3} cm/s) and the UA (6.8×10^{-3} cm/s).
Surface Water			
Surface Water Flow Rate	L/yr	3.37×10^{13}	An overflow dam located in the south portion of the lake (between the two lake arms) regulates water discharge out of the lake. The total discharge rate through the dam is 59,450 cubic feet per second [cfs] (US National Dams, 2022). This flow is assumed to be representative of the sum of discharges from the eastern and western arms of the Lake. A flow rate of 37,701 cfs was determined for the eastern arm adjacent to the PAP based on watershed ratio analysis (Archfield & Vogel, 2010; Gianfagna *et al*., 2015) using the USGS StreamStats application (USGS, 2022).
Total Suspended Solids	mg/L	6	Representative average river concentration (Hanson Professional Services, Inc., 2019).
Depth of the Water Column	m	5.08	Depth of Newton Lake near the power plant (Ramboll, 2021).
Suspended Sediment to Water Partition Coefficient	mg/L	Constituent specific	Values based on US EPA (2014).

Notes:

cfs = Cubic Feet per Second; COI = Constituent of Interest; L/yr = Liter Per Year; m^2 = Square Meter; PAP = Primary Ash Pond; PMP = Primary Migration Pathway; UA = Uppermost Aquifer; US EPA = United States Environmental Protection Agency.

(a) Cross-sectional area represents the area through which groundwater flows from the UA into Newton Lake (*i.e.*, the area where groundwater intersects Newton Lake).

Table 3.4 Sediment Properties Used in Modeling

Parameter	Unit	Value	Notes/Source
Sediment			
Depth of Upper Benthic Layer	m	0.03	Default (US EPA, 2014)
Depth of Water Body	m	5.11	Depth of water column (5.08 m, depth of Newton Lake near the power plant (Ramboll, 2021) plus depth of upper benthic layer (0.03 m) (US EPA, 2014)
Bed Sediment Particle Concentration	g/cm^3	1	Default (US EPA, 2014)
Bed Sediment Porosity	-	0.6	Default (US EPA, 2014)
TSS Mass per Unit Area	kg/m^2	0.030	Depth of water column × TSS × conversion factors (10^{-6} kg/mg and 1,000 L/m^3)
Sediment Mass per Unit Area	kg/m^2	30	Depth of upper benthic layer × bed sediment particulate concentration × conversion factors (0.001 kg/g, 10^6 cm^3/m^3)
Sediment to Water Partition Coefficients	mg/L	Constituent specific	Values based on US EPA (2014)

Notes:
TSS = Total Suspended Solids; US EPA = United States Environmental Protection Agency.

Table 3.5 Surface Water and Sediment Modeling Results

COI	Groundwater Concentration (mg/L or pCi/L)	Mass Discharge Rate (mg/year or pCi/year)	Total Water Column Concentration (mg/L or pCi/L)	Concentration Sorbed to Bottom Sediments (mg/kg or pCi/kg)
Total Metals				
Arsenic	0.13	1.8E+07	5.3E-07	1.3E-04
Cadmium	0.0034	4.7E+05	1.4E-08	1.9E-05
Cobalt	0.036	4.9E+06	1.5E-07	1.3E-04
Lead	0.065	8.9E+06	2.7E-07	2.7E-03
Lithium	0.30	4.1E+07	1.2E-06	(a)
Mercury	0.0020	2.7E+05	8.2E-09	3.0E-04
Thallium	0.0036	4.9E+05	1.5E-08	2.7E-07
Radionuclides				
Radium-226+228	15	2.1E+09	6.2E-05	4.4E-01
Other				
Chloride	550	7.6E+10	2.3E-03	(a)
Fluoride	8.2	1.1E+09	3.4E-05	5.3E-03
Sulfate	3,200	4.4E+11	1.3E-02	(a)

Notes:
COI = Constituent of Concern; K_d = Equilibrium Partition Coefficient; pCi/L = PicoCuries Per Liter; pCi/kg = PicoCuries Per Kilogram.
(a) Lithium, chloride, and sulfate do not readily sorb to soil or sediment particles; a K_d value of 0 was used for the modeling.

3.4 Human Health Risk Evaluation

The section below presents the results of the human health risk evaluation for recreators (boaters and anglers) in Newton Lake adjacent to the Site. Risks were assessed using the maximum measured or modeled COIs in surface water.

3.4.1 Recreators Exposed to Surface Water

Screening Exposures: Recreators could be exposed to surface water *via* incidental ingestion and dermal contact while boating. In addition, anglers could consume fish caught in Newton Lake. The maximum measured or modeled COI concentrations in surface water were used as conservative upper-end estimates of the COI concentrations to which a recreator might be exposed directly (incidental ingestion of COIs in surface water while boating) and indirectly (consumption of locally caught fish exposed to COIs in surface water).

Screening Benchmarks: Illinois surface water criteria (IEPA, 2019), known as human threshold criteria (HTC), are based on incidental exposure through contact or ingestion of small volumes of water while swimming or during other recreational activities, as well as the consumption of fish. The HTC values were calculated from the following equation (IEPA, 2019):

$$\mathrm{HTC} = \frac{\mathrm{ADI}}{\mathrm{W} + (\mathrm{F} \times \mathrm{BCF})}$$

where:

HTC = Human health protection criterion in milligrams per liter (mg/L)
ADI = Acceptable daily intake (mg/day)
W = Water consumption rate (L/day)
F = Fish consumption rate (kg/day)
BCF = Bioconcentration factor (L/kg-tissue)

Illinois defines the acceptable daily intake (ADI) as the "maximum amount of a substance which, if ingested daily for a lifetime, results in no adverse effects to humans" (IEPA, 2019). US EPA defines its chronic reference dose (RfD) as an "estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure for a chronic duration (up to a lifetime) to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime" (US EPA, 2011a). Illinois lists methods to derive an ADI from the primary literature (IEPA, 2019). In accordance with Illinois guidance, Gradient derived an ADI by multiplying the MCL by the default water ingestion rate of 2 L/day (IEPA, 2019). In the absence of an MCL, Gradient applied the RfD used by US EPA to derive its Regional Screening Levels (RSLs) (US EPA, 2021b) as a conservative estimate of the ADI. The RfDs are given in mg/kg-day, while the ADIs are given in mg/day; thus, Gradient multiplied the RfD by a standard body weight of 70 kg to obtain the ADI in mg/day. The calculation of the HTC values is shown in Appendix B, Table B.1.

Gradient used bioconcentration factors (BCFs) from a hierarchy of sources. The primary BCFs were those that US EPA used to calculate the National Recommended Water Quality Criteria (NRWQC) for human health (US EPA, 2002). Other sources included BCFs used in the US EPA coal combustion ash risk assessment (US EPA, 2014) and BCFs reported by Oak Ridge National Laboratory's Risk Assessment

Information System (ORNL RAIS) (ORNL, 2020).[5] Lithium did not have a BCF value available from any authoritative source; therefore, the water quality criterion for lithium was calculated assuming a BCF of 1. This is a conservative assumption, as lithium does not readily bioaccumulate in the aquatic environment (ECHA, 2020a,b; ATSDR, 2010).

Illinois recommends a fish consumption rate of 0.020 kg/day (20 g/day) for an adult weighing 70 kg (IEPA, 2019). Illinois recommends a water consumption rate of 0.01 L/day for "incidental exposure through contact or ingestion of small volumes of water while swimming or during other recreational activities" (IEPA, 2019). Appendix B, Table B.1 presents the calculated HTC for fish and water and for fish consumption only.

The HTC for fish consumption for radium-226+228 was calculated as follows:

$$\mathrm{HTC} = \frac{\mathrm{TCR}}{(\mathrm{SF} \times \mathrm{BAF} \times \mathrm{F})}$$

where:

HTC = Human health protection criterion in picoCuries per liter (pCi/L)
TCR = Target cancer risk ($1\text{x}10^{-5}$)
SF = Food ingestion slope factor (risk/pCi)
BAF = Bioaccumulation factor (L/kg-tissue)
F = Fish consumption rate (kg/day)

The food ingestion slope factor (lifetime excess total cancer risk per unit exposure, in risk/pCi) used to calculate the HTC was the highest value of those for radium-226 (Ra-226), radium-228 (Ra-228), and "Ra-228+D" (US EPA, 2001). According to US EPA (2001), "+D" indicates that "the risks from associated short-lived radioactive decay products (*i.e.*, those decay products with radioactive half-lives less than or equal to 6 months) are also included."

Screening Risk Evaluation: The maximum modeled and measured COI concentrations in surface water were compared to the calculated Illinois HTC values (Table 3.6). All surface water concentrations were below their respective benchmarks. The HTC values are protective of recreational exposure *via* water and/or fish ingestion and do not account for dermal exposures to COIs in surface water while boating. However, given that the measured and modeled COI surface water concentrations are orders of magnitude below HTC protective of water and/or fish ingestion, dermal exposures to COIs are not expected to be a risk concern. Moreover, the dermal uptake of metals is considered to be minimal and only a small proportion of ingestion exposures. Thus, none of the COIs evaluated would be expected to pose an unacceptable risk to recreators exposed to surface water while boating and anglers consuming fish caught in Newton Lake.

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[5] Although recommended by US EPA (2015b), US EPA EpiSuite 4.1 (US EPA, 2019) was not used as a source of BCFs because inorganic compounds are outside the estimation domain of the program.

Table 3.6 Risk Evaluation for Recreators (Boaters and Anglers)

COI	Maximum SW Concentration		HTC for Water and Fish	HTC for Water Only	HTC for Fish Only	COPC	
	Modeled	Measured[a]				Based on Modeled Concentrations	Based on Measured Concentrations
Total Metals (mg/L)							
Arsenic	5.3E-07	4.2E-03	0.022	2.0	0.023	No	No
Cobalt	1.5E-07	ND	0.0035	2.1	0.0035	No	NA
Lead	2.7E-07	ND	0.015	0.015	0.015	No	NA
Lithium	1.2E-06	ND	4.7	14	7.0	No	NA
Thallium	1.5E-08	ND	0.0017	0.40	0.0017	No	NA
Radionuclides (pCi/L)							
Radium-226+228	6.2E-05	2.1E+00	1,000	1,000	87,413	No	No
Other (mg/L)							
Fluoride	3.4E-05	5.1E-01	143	800	174	No	No

Notes:
COI = Constituent of Interest; COPC = Constituent of Potential Concern; HTC = Human Threshold Criteria; NA = Not Applicable; ND = Not Determined; pCi/L = PicoCuries Per Liter; SW = Surface Water.
(a) Measured concentrations are listed only for the constituents identified as COIs. Measured surface water concentrations may be different from modeled concentrations because measured data include the effects of background and other industrial sources. Modeled concentrations only represent the potential effect on surface water quality resulting from the measured groundwater concentrations.

3.4.2 Recreators Exposed to Sediment

Recreational exposure to sediment may occur during boating activity in Newton Lake; exposure to sediment may occur through incidental ingestion and dermal contact.

Screening Exposures: COIs in impacted groundwater flowing into the river can sorb to sediments. In the absence of sediment data, sediment concentrations were modeled using maximum detected groundwater concentrations.

Screening Benchmarks: There are no established recreator RSLs that are protective of recreational exposures to sediment (US EPA, 2021c). Therefore, benchmarks that are protective of recreational exposures to sediment *via* incidental ingestion and dermal contact were calculated using US EPA's RSL guidance (US EPA, 2021c). These benchmarks were calculated using the recommended assumptions (*i.e.*, oral bioavailability, body weights, averaging time) and toxicity reference values (*i.e.*, RfD and cancer slope factor [CSF]). Recreators were assumed to be exposed to sediment while recreating 60 days a year (or two weekend days per week for 30 weeks a year, from April to October). The exposure duration was assumed for a child 6 years of age and an adult 20 years of age, per US EPA guidance (Stalcup, 2014). The daily recommended residential soil ingestion rates of 200 mg/day for a child and 100 mg/day for an adult are based on an all-day exposure to residential soils (Stalcup, 2014; US EPA, 2011b). Since recreational exposures to sediment are assumed to occur for less than four hours per day, one-third of the daily residential soil ingestion (67 mg/day for a child and 33 mg/day for an adult) was used as a conservative assumption. For dermal exposures, recreators were assumed to be exposed to sediment on their lower legs and feet (1,026 cm^2 for the child and 3,026 cm^2 for the adult, based on the age-weighted surface areas reported in US EPA, 2011b). While other body parts may be exposed to sediment, the contact time will likely be very short, as the sediment would wash off in the surface water. Gradient used US EPA's recommended adherence factor of 0.2 mg/cm^2 based on child exposure to wet soil (US EPA, 2004; Stalcup, 2014), which was used in the US EPA RSL User's Guide for a child recreator exposed to soil or sediment

(US EPA, 2021c). The sediment screening benchmarks were calculated based on a target hazard quotient of 1, or a target cancer risk of $1x10^{-5}$. Appendix B, Table B.2 presents the calculation of screening benchmarks protective of recreational exposures to sediment. A recreator sediment screening benchmark for radium-226+228 was based on soil Preliminary Remediation Goals (PRGs) calculated for radium-226 and radium-228 using US EPA's PRG calculator (US EPA, 2020). The lower of the two values was used as the recreator sediment screening benchmark for radium-226+228 (Appendix B, Table B.3).

Screening Risk Evaluation: The modeled sediment concentrations were well below the recreational sediment screening benchmarks (Table 3.7). Therefore, exposure to sediment is not expected to pose an unacceptable risk to recreators while boating.

Table 3.7 Risk Evaluation for Recreators Exposed to Sediment

COI	Modeled Sediment Concentration (mg/kg)	Recreator Sediment Screening Benchmark (mg/kg)	COPC
Total Metals (mg/kg)			
Arsenic	1.3E-04	6.8E+01	No
Cobalt	1.3E-04	4.1E+02	No
Lead	2.7E-03	4.0E+02	No
Lithium	(a)	2.7E+03	NA
Thallium	2.7E-07	1.4E+01	No
Radionuclides (pCi/kg)			
Radium-226+228	4.4E-01	7.9E+03	No
Other (mg/kg)			
Fluoride	5.3E-03	5.5E+04	No

Notes:
COI = Constituent of Interest; COPC = Constituent of Potential Concern; K_d = Equilibrium Partition Coefficient; NA = Not Applicable; pCi/kg = PicoCuries Per Kilogram.
(a) Lithium does not readily sorb to soil or sediment particles; a K_d value of 0 was used for the modeling.

3.5 Ecological Risk Evaluation

Based on the ecological CEM (Figure 3.4), ecological receptors could be exposed to surface water and dietary items (*i.e.*, prey and plants) potentially impacted by identified COIs (cadmium, cobalt, lead, mercury, radium-226+228, chloride, and fluoride).

3.5.1 Ecological Receptors Exposed to Surface Water

Screening Exposures: The ecological evaluation considered aquatic communities in Newton Lake potentially impacted by identified ecological COIs. Measured and modeled surface water concentrations were compared to risk-based ecological screening benchmarks.

Screening Benchmarks: Surface water screening benchmarks protective of aquatic life were obtained from the following hierarchy of sources:

- IEPA SWQS (IEPA, 2019), regulatory standards that are intended to protect aquatic life exposed to surface water on a long-term basis (*i.e.*, chronic exposure). For cadmium, the surface water benchmark is hardness dependent and calculated using a default hardness of 100 mg/L (US EPA, 2022)[6];

- US EPA Region IV (2018) surface water ESVs for hazardous waste sites; and
- US DOE benchmarks from the guidance document, "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota" (US DOE, 2019).

Risk Evaluation: The maximum measured and modeled COI concentrations in surface water were compared to the benchmarks protective of aquatic life (Table 3.8). The measured and modeled surface water concentrations for the COIs were below their respective benchmarks. Thus, none of the COIs evaluated are expected to pose an unacceptable risk to aquatic life in Newton Lake.

Table 3.8 Risk Evaluation of Ecological Receptors Exposed to Surface Water

COI	Maximum Surface Water Concentration		Ecological Freshwater Benchmark	Basis	COPC	
	Modeled	Measured			Based on Modeled Concentrations	Based on Measured Concentrations
Total Metals (mg/L)						
Cadmium	1.4E-08	ND	0.0011	IEPA SWQC	No	NA
Cobalt	1.5E-07	ND	0.019	US EPA R4 ESV	No	NA
Lead	2.7E-07	ND	0.020	IEPA SWQC	No	NA
Mercury	8.2E-09	ND	0.0011	IEPA SWQC	No	NA
Radionuclides (pCi/L)						
Radium-226+228	6.2E-05	2.1	3.0	US DOE	No	No
Other (mg/L)						
Chloride	2.3E-03	9.6	500	IEPA SWQC	No	No
Fluoride	3.4E-05	0.51	4.0	IEPA SWQC	No	No

Notes:

COI = Constituent of Interest; COPC = Constituent of Potential Concern; IEPA SWQC = Illinois Environmental Protection Agency Surface Water Quality Standard; NA = Not Applicable; ND = Not Detected; pCi/L = PicoCuries Per Liter; US DOE = United States Department of Energy; US EPA R4 ESV = United States Environmental Protection Agency Region IV Ecological Screening Value.

3.5.2 Ecological Receptors Exposed to Sediment

Screening Exposures: COIs in impacted groundwater discharging into Newton Lake can sorb to sediments *via* chemical partitioning. In the absence of sediment data, sediment concentrations were modeled using maximum detected groundwater concentrations. Therefore, the modeled COI sediment concentrations reflect the potential maximum Site-related sediment concentration originating from groundwater.

Screening Benchmarks: Sediment screening benchmarks were obtained from US EPA Region IV (2018). The majority of the sediment ESVs are based on threshold effect concentrations (TECs) from MacDonald *et al.* (2000), which provide consensus values that identify concentrations below which harmful effects on sediment-dwelling organisms are unlikely to be observed. In the absence of an ESV for radium-226+228, a sediment screening value of 90,000 pCi/kg was used, based on the biota concentration guide (BCG) for radium-228 (US DOE, 2019).[7] Chloride and fluoride are not expected to sorb to sediment; therefore, risk

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[6] Conservatisms associated with using a default hardness value are discussed in Section 3.6.

[7] The biota concentration guide (BCG) for sediment is 90 pCi/g for Ra-228 and 100 pCi/g for Ra-226; the lower of the two values was used for Ra-226+228, and converted to pCi/kg (US DOE, 2019).

to ecological receptors exposed to sediment was not evaluated for these constituents. The benchmarks used in this evaluation are listed in Table 3.9.

Screening Risk Results: The maximum modeled COI sediment concentrations were below their respective sediment screening benchmarks (Table 3.9). The modeled sediment concentrations attributed to potential contributions from Site groundwater for all COIs were less than 1% of the sediment screening benchmark. Therefore, the modeled sediment concentrations attributed to potential contributions from Site groundwater are not expected to significantly contribute to ecological exposures in Newton Lake adjacent to the Site.

Table 3.9 Risk Evaluation of Ecological Receptors Exposed to Sediment

COI	Modeled Sediment Concentration	ESV[a]	COPC	% of Benchmark
Total Metals (mg/kg)				
Cadmium	1.9E-05	0.99	No	0.0019%
Cobalt	1.3E-04	50	No	0.0003%
Lead	2.7E-03	35.8	No	0.0074%
Mercury	3.0E-04	0.18	No	0.16%
Radionuclides (pCi/kg)				
Radium-226+228	4.4E-01	90,000[b]	No	0.0005%
Other (mg/kg)				
Chloride	-	-	-	-
Fluoride	5.3E-03	NA	-	-

Notes:
COI = Constituent of Interest; COPC = Constituent of Potential Concern; ESV = Ecological Screening Value; NA = Not available; pCi/kg = PicoCuries Per Kilogram; US DOE = United States Department of Energy; US EPA = United States Environmental Protection Agency.
(a) ESV from US EPA Region IV (2018).
(b) ESV from US DOE (2019); value converted from 90 pCi/g to 90,000 pCi/kg.

3.5.3 Ecological Receptors Exposed to Bioaccumulative Constituents of Interest

Screening Exposures: COIs with bioaccumulative properties can impact higher-trophic-level wildlife exposed to these COIs *via* direct exposures (surface water and sediment exposure) and secondary exposures through the consumption of dietary items (*e.g.*, plants, invertebrates, small mammals, and fish).

Screening Benchmark: US EPA Region IV (2018) guidance and IEPA SWQS (IEPA, 2019) guidance were used to identify constituents with potential bioaccumulative effects.

Risk Evaluation: With the exception of mercury, the ecological COIs (cadmium, cobalt, lead, radium-226+228, chloride, and fluoride) were not identified as having potential bioaccumulative effects. Therefore, these COIs are not considered to pose an ecological risk *via* bioaccumulation. IEPA (2019) identifies mercury as the only metal with bioaccumulative properties. US EPA Region IV (2018) also identifies mercury (including methyl mercury) as having potential bioaccumulative effects.[8]

The modeled mercury concentration in surface water (8.2×10^{-9} mg/L) was below the mercury surface water ESV for wildlife (1.3×10^{-6} mg/L), and the modeled mercury concentration in sediment (3.0×10^{-4} mg/kg) was below the sediment ESV for wildlife (0.18 mg/kg) (US EPA Region IV, 2018). Both the

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[8] US EPA Region IV (2018) identifies selenium as having potential bioaccumulative effects. Although selenium was detected in groundwater, it was not considered an ecological COI.

modeled surface water and sediment concentrations were below benchmarks protective of receptors accounting for bioacccumulative properties. Therefore, in addition to not posing an ecological risk from direct toxicity, mercury does not pose a risk from bioaccumulation exposures.

3.6 Uncertainties and Conservatisms

A number of uncertainties and their potential impact on the risk evaluation are discussed below. Wherever possible, conservative assumptions were used in an effort to minimize uncertainties and overestimate rather than underestimate risks.

Exposure Estimates:

- The risk evaluation included the IL Part 845.600 constituents detected in groundwater samples (above GWPS) collected from wells associated with the PAP. However, it is possible that not all of the detected constituents are related specifically to the PAP.
- The human health and ecological risk characterizations were based on the maximum measured or modeled COI concentrations, rather than on averages. Thus, the variability in exposure concentrations was not considered. Assuming continuous exposure to the maximum concentration overestimates human and ecological exposures, given that receptors are mobile and concentrations change over time. For example, US EPA guidance states that risks should be estimated using average exposure concentrations as represented by the 95% upper confidence limit on the mean (US EPA, 1992). Given that exposure estimates based on the maximum concentrations did not exceed risk benchmarks, Gradient has greater confidence that there is no risk concern.
- Only constituents detected in groundwater were used to identify COIs and model COI concentrations in surface water and sediment. For the constituents that were not detected in PAP groundwater, the detection limits were below the IL Part 845.600 GWPS and thus do not require further evaluation.
- COI concentrations in surface water were modeled using the maximum detected total COI concentrations in groundwater. Modeling surface water concentrations using total metal concentrations may overestimate surface water concentrations because dissolved concentrations, which are lower than total concentrations, represent the mobile fractions of constituents that could likely flow into and mix with surface water.
- The COIs identified in this evaluation also occur naturally in the environment. Contributions to exposure from natural or other non-AP-related sources were not considered in the evaluation of modeled concentrations; only exposure contributions potentially attributable to Site groundwater mixing with surface water were evaluated. While not quantified, exposures from potential PAP-related groundwater contributions are likely to represent only a small fraction of the overall human and ecological exposure to COIs that also have natural or non-AP-related sources.
- Screening benchmarks for human health were developed using exposure inputs based on US EPA's recommended values for reasonable maximum exposure (RME) assessments (Stalcup, 2014). RME is defined as "the highest exposure that is reasonably expected to occur at a site but that is still within the range of possible exposures" (US EPA, 2004). US EPA states the "intent of the RME is to estimate a conservative exposure case (*i.e.*, well above the average case) that is still within the range of possible exposures" (US EPA, 1989). US EPA also notes that this high-end exposure "is the highest dose estimated to be experienced by some individuals, commonly stated as approximately equal to the 90th percentile exposure category for individuals" (US EPA, 2015c). Thus, most individuals will have lower exposures than those presented in this risk assessment.

Toxicity Benchmarks:

- Screening-level ecological benchmarks were compiled from IEPA and US EPA guidance and designed to be protective of the majority of Site conditions, leaving the option for Site-specific refinement. In some cases, these benchmarks may not be representative of the Site-specific conditions or receptors found at the Site, or may not accurately reflect concentration-response relationships encountered at the Site. For example, the ecological benchmark for cadmium is hardness dependent. However, hardness data are not available for Newton Lake; therefore, Gradient relied on US EPA's default hardness of 100 mg/L. Use of a higher hardness value would increase the cadmium SWQS because benchmarks become less stringent with higher levels of hardness. Regardless of the hardness, the maximum modeled cadmium concentration is orders of magnitude below the SWQS.
- In addition, for the ecological evaluation, Gradient conservatively assumed all constituents to be 100% bioavailable. Modeled COI concentrations in surface water are considered total COI concentrations. In addition, the measured surface water data used in this report represent total concentrations. US EPA recommends using dissolved metals as a measure of exposure to ecological receptors because it represents the bioavailable fraction of metal in water (US EPA, 1993). Therefore, the modeled surface water COI concentrations may be an overestimation of exposure concentrations to ecological receptors.
- In general, it is important to appreciate that the human health toxicity factors used in this risk evaluation are developed to account for uncertainties, such that safe exposure levels used as benchmarks are often many times lower (even orders of magnitude lower) than the levels that cause effects that have been observed in human or animal studies. For example, toxicity factors incorporate a 10-fold safety factor to protect sensitive subpopulations. This means that a risk exceedance does not necessarily equate to actual harm.

4 Summary and Conclusions

A screening-level risk evaluation was performed for Site-related constituents in groundwater at the NPP in Newton, Illinois. The CSM developed for the Site indicates that groundwater beneath the PAP flows into Newton Lake adjacent to the Site and may potentially impact surface water and sediment.

CEMs were developed for human and ecological receptors. The complete exposure pathways for humans include recreators (boaters) in Newton Lake who are exposed to surface water and sediment, and anglers who consume locally caught fish. Based on the local hydrogeology, residential exposure to groundwater used for drinking water or irrigation is not a complete pathway and was not evaluated. The complete exposure pathways for ecological receptors include aquatic life (including aquatic and marsh plants, amphibians, reptiles, and fish) exposed to surface water; benthic invertebrates exposed to sediment; and avian and mammalian wildlife exposed to bioaccumulative COIs in surface water, sediment, and dietary items.

Groundwater data collected from 2015 to 2021 were used to estimate exposures. Surface water data collected from Newton Lake were also evaluated. For groundwater constituents retained as COIs, surface water and sediment concentrations were modeled using the maximum detected groundwater concentration. Surface water and sediment exposure estimates were screened against benchmarks protective of human health and ecological receptors for this risk evaluation.

For recreators exposed to surface water, all COIs were below the conservative risk-based screening benchmarks. Therefore, none of the COIs evaluated in surface water are expected to pose an unacceptable risk to recreators in Newton Lake adjacent to the Site.

For recreators exposed to sediment *via* incidental ingestion and dermal contact, the modeled sediment concentrations were below health-protective sediment benchmarks. Therefore, the modeled sediment concentrations are not expected to pose an unacceptable risk to recreators exposed to sediment in Newton Lake adjacent to the Site.

For anglers consuming locally caught fish, the modeled concentrations of all COIs in surface water (as well as the measured data) were below conservative benchmarks protective of fish consumption. Therefore, none of the COIs evaluated are expected to pose an unacceptable risk to recreators consuming fish caught in Newton Lake.

Ecological receptors exposed to surface water include aquatic and marsh plants, amphibians, reptiles, and fish. The risk evaluation showed that none of the modeled or measured COIs in surface water exceeded protective screening benchmarks. Ecological receptors exposed to sediment include benthic invertebrates. The modeled sediment COIs did not exceed the conservative screening benchmarks; therefore, none of the COIs evaluated in sediment are expected to pose an unacceptable risk to ecological receptors.

Ecological receptors were also evaluated for exposure to bioaccumulative COIs. This evaluation considered higher-trophic-level wildlife with direct exposure to surface water and sediment and secondary exposure through the consumption of dietary items (*e.g.*, plants, invertebrates, small mammals, fish). Mercury was the only ecological COI identified as having potential bioaccumulative effects. However, the modeled concentrations did not exceed benchmarks protective of bioaccumulative effects. Therefore, mercury is not considered to pose an ecological risk *via* bioaccumulation. Overall, this evaluation demonstrated that none of the COIs evaluated are expected to pose an unacceptable risk to ecological receptors.

It should be noted that this evaluation incorporates a number of conservative assumptions that tend to overestimate exposure and risk. The risk evaluation was based on the maximum detected COI concentration; however, US EPA guidance states that risks should be based on a representative average concentration such as the 95% upper confidence limit on the mean; thus, using the maximum concentration tends to overestimate exposure. Although the COIs identified in this evaluation also occur naturally in the environment, the contributions to exposure from natural background sources and nearby industry were not considered; thus, CCR-related exposures were likely overestimated. Exposure estimates assumed 100% metal bioavailability, which likely results in overestimates of exposure and risks. Exposure estimates were based on inputs to evaluate the "reasonable maximum exposure"; thus, most individuals will have lower exposures than those estimated in this risk assessment.

Finally, it should be noted that because current conditions do not present a risk to human health or the environment, there will also be no unacceptable risk to human health or the environment for future conditions when the PAP is closed. For all future closure scenarios, potential releases of CCR-related constituents will decline over time and, consequently, potential exposures to CCR-related constituents in the environment will also decline.

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Appendix A

Surface Water and Sediment Modeling

Gradient modeled concentrations in river surface water and sediment based on available groundwater data. First, Gradient estimated the flow rate of constituents of interest (COIs) that may flow into Newton Lake *via* groundwater. Then, Gradient adapted United States Environmental Protection Agency's (US EPA's) indirect exposure assessment methodology (US EPA, 1998) in order to model surface water and sediment water concentrations in Newton Lake.

Model Overview

Groundwater flow into Newton Lake is represented by a one-dimensional steady-state model. In this model, the groundwater plume migrates horizontally in the Uppermost Aquifer (UA) and the potential migration pathway (PMP) prior to discharging into Newton Lake. The groundwater flow entering the lake is the flow going through a cross-sectional area with a length equal to the length of the lake adjacent to the Primary Ash Pond (PAP) with potential CCR-related impacts and a height equal to the maximum saturated thicknesses of the UA and the PMP. This is a conservative assumption because groundwater elevation data indicate that only groundwater on the eastern side of the PAP has potential to interact with surface water in the lake. It was assumed that groundwater flowing through the shallow water bearing zones (*i.e.*, the UA and the PMP) may flow into Newton Lake. The length of the groundwater discharge zone was estimated using Google Earth Pro (Google LLC, 2022).

Groundwater flow into Newton Lake mixes with the surface water in the lake. The COIs entering the lake *via* groundwater can dissolve into the water column, sorb to suspended sediments, or sorb to benthic sediments. Using US EPA's indirect exposure assessment methodology (US EPA, 1998), the model evaluates the surface water and sediment concentrations at a location downstream of the groundwater discharge, assuming a well-mixed water column.

Groundwater Discharge Rate

The groundwater discharge rate was evaluated using conservative assumptions. Gradient conservatively assumed that the groundwater concentrations were uniformly equal to the maximum detected concentration for each individual COI. Gradient ignored adsorption by subsurface soil and assumed that groundwater flowing through the shallow aquifers was discharged into the lake.

For each groundwater unit, the groundwater flow rate into the river was derived using Darcy's Law:

$$Q = KiA$$

where:

Q = Groundwater flow rate (m^3/s)
K = Hydraulic conductivity (m/s)
i = Hydraulic gradient (m/m)
A = Cross-sectional area (m^2)

For each COI, the mass discharge rate into the lake was then calculated by:

$$m_c = C_c \times Q \times CF$$

where:

m_c = Mass discharge rate of the COI (mg/year)
C_c = Maximum groundwater concentration of the COI (mg/L)
Q = Groundwater flow rate (m^3/s)

CF = Conversion factors: 1,000 L/m^3; 31,557,600 s/year

The values of the aquifer parameters used for these calculations are provided in Table A.1. The calculated mass discharge rates were then used as inputs for the surface water and sediment partitioning model.

The cross-sectional area for the shallow aquifers was 18,330 m^2. The length of the discharge zone was estimated to be approximately 2,500 m. The height of the discharge zone was assumed to be the sum of the maximum thicknesses of the PMP and the UA (*i.e.*, approximately 7.3 m) (Ramboll, 2021).

The hydraulic gradient was 0.0048 m/m, based on the average horizontal hydraulic gradient determined for the UA (Ramboll, 2021). Hydraulic gradient was not measured in the PMP.

The hydraulic conductivity was 0.00495 cm/s, based on the average of the geometric mean horizontal hydraulic conductivities measured for the PMP (3 x 10^{-3} cm/s) and the UA (6.8 x 10^{-3} cm/s) (Ramboll, 2021).

Surface Water and Sediment Concentration

Groundwater that flows into the lake will be diluted in the surface water flow. Constituents transported by groundwater into the surface water migrate into the water column and the bed sediments. The surface water model Gradient used to estimate the surface water and sediment concentrations is a steady-state model described in US EPA's indirect exposure assessment methodology (US EPA, 1998), and also used in US EPA's "Human and Ecological Risk Assessment of Coal Combustion Residuals" (US EPA, 2014). This model describes the partitioning of constituents between surface water, suspended sediments, and benthic sediments based on equilibrium partition coefficients. It estimates the concentrations of constituents in surface water, suspended sediments, and benthic sediments at steady-state equilibrium at a theoretical location downstream of the discharge point after complete mixing of the water column. In the analysis, Gradient used the partitioning coefficients given in Table J-1 of the US EPA CCR Risk Assessment for all COIs (US EPA, 2014). These coefficients are presented in Table A.2.

To be conservative, Gradient assumed that the constituents were not affected by dissipation or degradation once they entered the water body. The total water body concentration of the COI was calculated as (US EPA, 1998):

$$C_{wtot} = \frac{m_c}{V_f \times f_{water}}$$

where:

C_{wtot} = Total water body concentration of the constituent (mg/L)
m_c = Mass discharge rate of the COI (mg/year)
V_f = Water body annual flow (L/year)
f_{water} = Fraction of COI in the water column (unitless)

Newton Lake was formed by damming and is used as a cooling water supply for Newton Power Plant (NPP) (US National Dams, 2022). Water is drawn from the eastern arm near the power plant and thermal effluent is released at two locations in the western arm *via* NPDES permitted outfalls (IEPA, 2016). A small overflow dam located in the south portion of the lake (between the two lake arms) regulates water discharge out of the lake. The total discharge rate of 59,450 cubic feet per second (cfs) through the overflow dam (US National Dams. 2022) is assumed to be representative of the sum of discharges from the eastern and western arms of the Newton Lake. A flow rate of 37,701 cfs was determined for the eastern arm based on watershed ratio analysis (Archfield & Vogel, 2010; Gianfagna *et al.*, 2015) using the USGS StreamStats application (USGS, 2022). The surface water parameters are presented in Table A.3.

The fraction of COIs in the water column was calculated for each COI using the sediment/water and suspended solids/water partition coefficients (US EPA, 2014, Table J-1). The fraction of COIs in the water column is defined as (US EPA, 2014):

$$f_{water} = \frac{(1 + [K_{dsw} \times TSS \times 0.000001]) \times \frac{d_w}{d_z}}{\left([1 + (K_{dsw} \times TSS \times 0.000001)]\ \times \frac{d_w}{d_z}\right) + ([bsp + K_{dbs} \times bsc] \times \frac{d_b}{d_z})}$$

where:

K_{dsw} = Suspended sediment-water partition coefficient (mL/g)
K_{dbs} = Sediment-water partition coefficient (mL/g)
TSS = Total suspended solids in the surface water body (mg/L), set equal to the representative average river concentration of 6 mg/L (Hanson Professional Services, Inc., 2019)
0.000001 = Units conversion factor
d_w = Depth of the water column (m). The depth of the water column was estimated as 5.08 m, based on the geologic cross-section in Ramboll (2021 Figure 2-7).
.
d_b = Depth of the upper benthic layer (m), set equal to 0.03 m (US EPA, 2014)
$d_z = d_w + d_b$ = Depth of the water body (m) = 5.11 m
bsp = Bed sediment porosity (unitless), set equal to 0.6 (US EPA, 2014)
bsc = Bed sediment particle concentration (g/cm^3), set equal to 1.0 g/cm^3 (US EPA, 2014)

The fraction of COIs dissolved in the water column (f_d) is calculated as (US EPA 2014):

$$f_d = \frac{1}{1 + K_{dsw} \times TSS \times 0.000001}$$

The values of the fraction of COIs in the water column and other calculated parameters are presented in Table A.4.

The total water column concentration (C_{wcTot}) of the COIs, comprising both the dissolved and suspended sediment phases, is then calculated as (US EPA, 2014):

$$C_{wcTot} = C_{wtot} \times f_{water} \times \frac{d_z}{d_w}$$

Finally, the dissolved water column concentration (C_{dw}) for the COIs is calculated as (US EPA, 2014):

$$C_{dw} = f_d \times C_{wcTot}$$

The dissolved water column concentration was then used to calculate the concentration of COIs sorbed to suspended solids in the water column (US EPA, 1998):

$$C_{sw} = C_{dw} \times K_{dsw}$$

where:

C_{sw} = Concentration sorbed to suspended solids (mg/kg)
C_{dw} = Concentration dissolved in the water column (mg/L)
K_{dsw} = Suspended solids/water partition coefficient (mL/g)

In the same way, using the total water body concentration and the fraction of COIs in the benthic sediments, the model derives the total concentration in benthic sediments (US EPA, 2014, Table J-1-12):

$$C_{bstot} = f_{benth} \times C_{wtot} \times \frac{d_z}{d_b}$$

where:

C_{bstot} = Total concentration in bed sediment (mg/L or g/m^3)
C_{wtot} = Total water body concentration of the constituent (mg/L)
f_{benth} = Fraction of contaminant in benthic sediments (unitless)
d_b = Depth of the upper benthic layer (m)
$d_z = d_w + d_b$ = Depth of the water body (m)

This value can be used to calculate dry weight sediment concentration as follows:

$$C_{sed-dw} = \frac{C_{bstot}}{bsc}$$

where:

C_{sed-dw} = Dry weight sediment concentration (mg/kg)
C_{bstot} = Total sediment concentration (mg/L)
bsc = Bed sediment bulk density (default value of 1 g/cm^3 from US EPA, 2014)

The total sediment concentration is composed of the concentration dissolved in the bed sediment pore water (equal to the concentration dissolved in the water column) and the concentration sorbed to benthic sediments (US EPA, 1998).

The concentration sorbed to benthic sediments was calculated from (US EPA, 1998):

$$C_{sb} = C_{dbs} \times K_{dbs}$$

where:

C_{sb} = Concentration sorbed to bottom sediments (mg/kg)

C_{dbs} = Concentration dissolved in the sediment pore water (mg/L)
K_{dbs} = Sediments/water partition coefficient (mL/kg)

For each COI, the modeled total water column concentration, the modeled dry weight sediment concentration, and the modeled concentration sorbed to sediment are presented in Table A.5.

Table A.1 Parameters Used to Estimate Groundwater Discharge to Surface Water

Groundwater Unit	Parameter	Name	Value	Unit
Uppermost Aquifer and Potential Migration Pathway	A	Cross-Sectional Area[a]	18,330	m^2
Uppermost Aquifer and Potential Migration Pathway	i	Hydraulic Gradient[b]	0.0048	m/m
Uppermost Aquifer and Potential Migration Pathway	K	Hydraulic Conductivity[c]	0.00495	cm/s

Notes:

Source: Hydraulic gradient and hydraulic conductivity values from Ramboll (2021).

Cross-sectional area was estimated from Ramboll (2021).

(a) The sum of the maximum thicknesses of the PMP and the UA (i.e., approximately 7.3 m) multiplied by the length of the ash pond intersecting Newton lake (*i.e.*, about 2,500 m).

(b) Hydraulic gradient measurements are not available for the PMP. The average hydraulic gradient determined for the UA was used.

(c) Average of the geometric mean horizontal hydraulic conductivities measured for the PMP (3×10^{-3} cm/s) and the UA (6.8×10^{-3} cm/s).

Table A.2 Partition Coefficients

Constituent	Sediment-Water, Mean, K_{dbs}		Suspended Sediment-Water, Mean, K_{dsw}	
	Value (log_{10}) (mL/g)	Value (mL/g)	Value (log_{10}) (mL/g)	Value (mL/g)
Metals				
Arsenic	2.4	2.51E+02	3.9	7.94E+03
Cadmium	3.3	2.00E+03	4.9	7.94E+04
Cobalt	3.1	1.26E+03	4.8	6.31E+04
Lead	4.6	3.98E+04	5.7	5.01E+05
Lithium	-	-	-	-
Mercury	4.9	7.94E+04	5.3	2.00E+05
Thallium	1.3	2.00E+01	4.1	1.26E+04
Radionuclides				
Radium-226+228	-	7.40E+03	-	7.40E+03
Other				
Chloride	-	-	-	-
Fluoride	2.2	1.58E+02	2.2	1.58E+02
Sulfate	-	-	-	-

Notes:

Source: US EPA (2014).

Lithium, chloride, and sulfate do not readily sorb to soils and sediments. Consequently, sediment concentrations were not modeled for these constituents (K_d was assumed to be 0).

Table A.3 Surface Water Parameters

Parameter	Name	Value	Unit
TSS	Total Suspended Solids	6	mg/L
V_{fx}	Surface Water Flow Rate	3.37×10^{13}	L/yr
d_b	Depth of Upper Benthic Layer (default)	0.03	m
d_w	Depth of Water Column	5.08	m
d_z	Depth of Water Body	5.11	m
bsc	Bed Sediment Bulk Density (default)	1	g/cm^3
bsp	Bed Sediment Porosity (default)	0.6	-
M_{TSS}	TSS Mass per Unit Area[a]	0.0305	kg/m^2
M_S	Sediment Mass per Unit Area[b]	30	kg/m^2

Notes:
Source of default values: US EPA (2014).
(a) Determined by multiplying total suspended solids, TSS by the depth of water column, d_w.
(b) Determined by multiplying depth of upper benthic layer, d_b, with sediment bed particle concentration of 1 g/cc.

Table A.4 Calculated Parameters

COI	Fraction of Constituent in the Water Column f_{water}	Fraction of Constituent in the Benthic Sediments $f_{benthic}$	Fraction of Constituent Dissolved in the Water Column $f_{dissolved}$
Arsenic	0.413	0.587	0.955
Cadmium	0.111	0.889	0.677
Cobalt	0.156	0.844	0.725
Lead	0.017	0.983	0.250
Lithium	0.996	0.004	
Mercury	0.005	0.995	0.455
Thallium	0.899	0.101	0.930
Radionuclides			
Radium-226+228	0.023	0.977	0.957
Other			
Fluoride	0.516	0.484	0.999

Note:
COI = Constituent of Interest.

Table A.5 Surface Water and Sediment Modeling Results

Contaminant	Groundwater Concentration (mg/L or pCi/L)	Mass Discharge Rate (mg/year or pCi/year)	Total Water Column Concentration (mg/L or pCi/L)	Concentration Sorbed to Bottom Sediments (mg/kg or pCi/kg)
Total Metals				
Arsenic	1.30E-01	1.79E+07	5.34E-07	1.28E-04
Cadmium	3.40E-03	4.67E+05	1.40E-08	1.89E-05
Cobalt	3.60E-02	4.95E+06	1.48E-07	1.35E-04
Lead	6.50E-02	8.93E+06	2.67E-07	2.65E-03
Lithium	3.00E-01	4.12E+07	1.23E-06	(a)
Mercury	2.00E-03	2.75E+05	8.21E-09	2.97E-04
Thallium	3.60E-03	4.95E+05	1.48E-08	2.74E-07
Radionuclides				
Radium-226+228	1.52E+01	2.09E+09	6.24E-05	4.42E-01
Other				
Chloride	5.50E+02	7.56E+10	2.26E-03	(a)
Fluoride	8.16E+00	1.12E+09	3.35E-05	5.31E-03
Sulfate	3.20E+03	4.40E+11	1.31E-02	(a)

Notes:

pCi/kg = PicoCuries Per Kilogram; pCi/L = PicoCuries Per Liter.

(a) Lithium, chloride, and sulfate do not readily sorb to soil or sediment particles; a K_d value of 0 was used for the modeling.

Appendix B

Screening Benchmarks

Table B.1 Calculated Water Quality Standards Protective of Incidental Ingestion and Fish Consumption

Human Health COI	BCF[a] (L/kg-tissue)	Basis	MCL (mg/L)	RfD (mg/kg-day)	ADI[b] (mg/day)	Human Threshold Criteria		
						Water & Fish (mg/L)	Water Only (mg/L)	Fish Only (mg/L)
Arsenic	44	NRWQC (2002)	0.010	0.00030	0.020	0.022	2.0	0.023
Cobalt	300	ORNL (2018)	NC	0.00030	0.021	0.0035	2.1	0.0035
Fluoride	2.3	US EPA (2014)	4.0	0.040	8.0	143	800	174
Lead	46	US EPA (2014)	0.015	NC	0.030	0.015	0.015	0.015
Lithium	1	(c)	NC	0.002	0.14	4.7	14	7.0
Thallium	116	NRWQC (2002)	0.0020	0.000010	0.0040	0.0017	0.40	0.0017

Human Health COI	BAF (L/kg-tissue)		MCL (pCi/L)	ADI (pCi/day)	Food Ingestion Slope Factor[d] (risk/pCi)	Human Threshold Criteria		
	SW-Fish	Basis				Water & Fish (pCi/L)	Water Only (pCi/L)	Fish Only (pCi/L)
Radium-226+228	4.0	ORNL (2018)	5	10	1.43E-09	1,000	1,000	87,413

Notes:

ADI = Acceptable Daily Intake; BAF = Bioaccumulation Factor; BCF = Bioconcentration Factor; MCL = Maximum Contaminant Level; NC = No Criterion Available; NRWQC = National Recommended Water Quality Criteria; ORNL = Oak Ridge National Laboratory; pCi = picocurie; Ra = Radium; RAIS = Risk Assessment Information System; RfD = Reference Dose; US EPA = United States Environmental Protection Agency.

(a) BCFs from the following hierarchy of sources:

NRWQC (US EPA, 2002). National Recommended Water Quality Criteria: 2002. Human Health Criteria Calculation Matrix.

US EPA (2014). Human and Ecological Risk Assessment of Coal Combustion Residuals.

ORNL RAIS (ORNL, 2018). Risk Assessment Information System (RAIS) Toxicity Values and Chemical Parameters.

(b) ADI based on the MCL is calculated as the MCL (mg/L) multiplied by a water ingestion rate of 2 L/day. In the absence of an MCL, the ADI was calculated as the RfD (mg/kg-day) multiplied by the body weight (70 kg).

(c) BCF of 1 was used as a conservative assumption, due to lack of published BCF.

(d) Food ingestion slope factors for Ra-226+D and Ra-228+D were compared and the higher factor (Ra-228+D) was selected. The "+D" indicates that the risks from "associated short-lived radioactive decay products are also included" (US EPA, 2001).

Equations from IEPA (2019):

Consumption of Water and Fish

$$\text{HTC} = \frac{\text{ADI}}{\text{W} + (\text{F} \times \text{BCF})}$$

Incidental Consumption of Water Only

$$\text{HTC} = \frac{\text{ADI}}{\text{W}}$$

Consumption of Fish Only

$$\text{HTC} = \frac{\text{ADI}}{\text{F} \times \text{BCF}}$$

Where:

Human Threshold Criteria (HTC)	Chemical-specific	mg/L
Acceptable Daily Intake (ADI)	Chemical-specific	mg/day
Fish Consumption Rate (F)	0.02	kg/day
Bioconcentration Factor (BCF)/ Bioaccumulation Factor (BAF)	Chemical-specific	L/kg-tissue
Water Consumption Rate (W)	0.01	L/day
Body Weight	70	kg
Target Cancer Risk (TCR)	1.0E-05	

Radium-226+228

$$\text{HTC} = \frac{\text{TCR}}{(\text{SF} \times \text{BAF} \times \text{F})}$$

Table B.2 Recreator Exposure to Sediment

COI	Relative Bioavailability (unitless)	Dermal Absorption Fraction (unitless)	Cancer				Cancer SL (mg/kg)	Non-Cancer								Recreator RSL Sediment (mg/kg)	Basis[a]
			TRV		Child + Adult			TRV		Child		Adult		Child	Adult		
			CSF (mg/kg-day)$^{-1}$	Dermal CSF (mg/kg-day)$^{-1}$	Incidental Ingestion SL (mg/kg)	Dermal Contact SL (mg/kg)		RfD (mg/kg-day)	Dermal RfD (mg/kg-day)	Incidental Ingestion SL (mg/kg)	Dermal Contact SL (mg/kg)	Incidental Ingestion SL (mg/kg)	Dermal Contact SL (mg/kg)	Non-Cancer SL (mg/kg)			
Total Metals																	
Arsenic	1	3.0E-02	1.5E+00	1.5E+00	8.1E+01	4.1E+02	6.8E+01	3.0E-04	3.0E-04	4.1E+02	4.4E+03	4.4E+03	8.0E+03	3.8E+02	2.8E+03	6.8E+01	c
Cobalt	1	NA	NC	NC	NC	NC	NC	3.0E-04	3.0E-04	4.1E+02	NA	4.4E+03	NA	4.1E+02	4.4E+03	4.1E+02	nc
Lead	1	NA	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	4.0E+02	L
Lithium	1	NA	NC	NC	NC	NC	NC	2.0E-03	2.0E-03	2.7E+03	NA	2.9E+04	NA	2.7E+03	2.9E+04	2.7E+03	nc
Thallium	1	NA	NC	NC	NC	NC	NC	1.0E-05	1.0E-05	1.4E+01	NA	1.5E+02	NA	1.4E+01	1.5E+02	1.4E+01	nc
Other																	
Fluoride	1	NA	NC	NC	NC	NC	NC	4.0E-02	4.0E-02	5.5E+04	NA	5.8E+05	NA	5.5E+04	5.8E+05	5.48E+04	nc
Radionuclides																**Total Soil PRG (pCi/kg)**	
Radium-226+228																7.9E+03	

Notes:

ABS = Dermal Absorption Fraction; COI = Constituent of Interest; CSF = Cancer Slope Factor; NC = No Criterion Available; pCi = PicoCurie; PRG = Preliminary Remediation Goal; RfD = Reference Dose; RSL = Regional Screening Level; SL = Screening Level; TRV = Toxicity Reference Value; US EPA = United States Environmental Protection Agency.

(a) Screening benchmark defined as the lower of the Screening Levels for cancer and non-cancer. The basis of the benchmark presented as c = based on cancer endpoint, nc = based on non-cancer endpoint, or L = based on blood lead levels.

Equations for Screening Benchmark and Screening Levels:

$$\text{Screening Benchmark} = \frac{1}{\frac{1}{SL_{ing}} + \frac{1}{SL_{derm}}}$$

$$\text{Non-cancer } SL_{ing} = \frac{THQ * RfD}{Intake} \qquad \text{Cancer } SL_{ing} = \frac{TR}{Intake * CSF}$$

$$\text{Non-cancer } SL_{derm} = \frac{THQ * RfD}{Intake * ABS} \qquad \text{Cancer } SL_{derm} = \frac{TR}{Intake * ABS * CSF}$$

Where:

Target Risk (TR)	1E-05	
Target Hazard Quotient (THQ)	1	
Reference Dose (RfD)	Chemical-specific	mg/kg-day
Dermal Absorption Fraction (ABS)	Chemical-specific	
Cancer Slope Factor (CSF)	Chemical-specific	mg/kg
Incidental Ingestions Screening Level (SL_{ing})	Chemical-specific	mg/kg
Dermal Contact Screening Level (SL_{derm})	Chemical-specific	mg/kg

Sediment – Ingestion (Chemical)

		Non-Cancer		Cancer		
Intake Factor (IF) = $\frac{IR \times EF \times ED \times CF}{BW \times AT}$ =		7.3E-07	6.8E-08	6.3E-08	2.0E-08	Basis
		Child	Adult	Child	Adult	
IR	Ingestion Rate (mg/day)	67	33	67	33	One-third of US EPA residential soil ingestion rate (Professional Judgment)
EF	Sediment Exposure Frequency (days/year)	60	60	60	60	2 days/week between April and October when air temperature > 70°F (Professional Judgment)
ED	Exposure Duration (years)	6	20	6	20	Default value for Resident (US EPA, 2021b)
CF	Conversion Factor (kg/mg)	0.000001	0.000001	0.000001	0.000001	
BW	Body Weight (kg)	15	80	15	80	Default value for Resident (US EPA, 2021b)
AT	Averaging Time (days)	2,190	7,300	25,550	25,550	Default value for Resident (US EPA, 2021b)

Sediment – Dermal Contact (Chemical)

		Non-Cancer		Cancer		
Intake Factor (IF) = $\frac{SA \times AF \times EF \times ED \times CF}{BW \times AT}$ =		2.2E-06	1.2E-06	1.9E-07	3.6E-07	Basis
		Child	Adult	Child	Adult	
SA	Surface Area Exposed to Sediment (cm^2/day)	1,026	3,026	1,026	3,026	Age weighted SA for lower legs and feet (US EPA, 2011b)
AF	Sediment Skin Adherence Factor (mg/cm^2)	0.2	0.2	0.2	0.2	Age weighted AF for children exposed to sediment (US EPA, 2011b)
EF	Sediment Exposure Frequency (days/year)	60	60	60	60	2 days/week between April and October when air temperature > 70°F (Professional Judgment)
ED	Exposure Duration (years)	6	20	6	20	Default value for Resident (US EPA, 2021b)
CF	Conversion Factor (kg/mg)	0.000001	0.000001	0.000001	0.000001	
BW	Body Weight (kg)	15	80	15	80	Default value for Resident (US EPA, 2021b)
AT	Averaging Time (days)	2,190	7,300	25,550	25,550	Default value for Resident (US EPA, 2021b)

Table B.3.1 Recreator PRGs for Soil, input values

Variable	Recreator Soil Default Value	Form-input Value
A (PEF Dispersion Constant)	16.2302	16.8653
B (PEF Dispersion Constant)	18.7762	18.7848
City (Climate Zone)	Default	Chicago, IL (7)
C (PEF Dispersion Constant)	216.108	215.0624
Cover layer thickness for GSF (gamma shielding factor) cm	0 cm	0 cm
$CF_{rec\text{-}fowl}$ (fowl contaminated fraction) unitless	1	1
$CF_{rec\text{-}game}$ (game contaminated fraction) unitless	1	1
ED_{rec} (exposure duration - recreator) yr		26
EF_{rec} (exposure frequency - recreator) day/yr		60
$f_{p\text{-}fowl}$ (fowl on-site fraction) unitless	1	1
$f_{p\text{-}game}$ (land game on-site fraction) unitless	1	1
$f_{s\text{-}fowl}$ (fraction of year fowl is on site) unitless	1	1
$f_{s\text{-}game}$ (fraction of year land game is on site) unitless	1	1
$MLF_{pasture}$ (pasture plant mass loading factor) unitless	0.25	0.25
t_{rec} (time - recreator) yr		26
TR (target risk) unitless	0.000001	0.000001
F(x) (function dependent on U_m/U_t) unitless	0.194	0.182
PEF (particulate emission factor) m^3/kg	1,359,344,438	1,560,521,177
Q/C_{wind} (g/m^2-s per kg/m^3)	93.77	98.431
A_s (acres)	0.5	0.5
Site area for ACF (area correction factor) m^2	1,000,000 m^2	1,000 m^2
ED_{rec} (exposure duration - recreator) yr		26
$ED_{rec\text{-}a}$ (exposure duration - recreator adult) yr		20
$ED_{resc\text{-}c}$ (exposure duration - recreator child) yr		6
EF_{rec} (exposure frequency - recreator) day/yr		60
$EF_{rec\text{-}a}$ (exposure frequency - recreator adult) day/yr		60
$EF_{rec\text{-}c}$ (exposure frequency - recreator child) day/yr		60
ET_{rec} (exposure time - recreator) hr/day		8
$ET_{rec\text{-}a}$ (exposure time - recreator) hr/day		8
$ET_{rec\text{-}c}$ (exposure time - recreator) hr/day		8
$IFA_{rec\text{-}adj}$ (age-adjusted inhalation rate - recreator) m^3		9,200
$IFS_{rec\text{-}adj}$ (age-adjusted soil intake rate - recreator) mg		63,720
$IRA_{rec\text{-}a}$ (inhalation rate - recreator adult) m^3/day	20	20
$IRA_{rec\text{-}c}$ (inhalation rate - recreator child) m^3/day	10	10
$IRS_{rec\text{-}a}$ (soil intake rate - recreator adult) mg/day	100	33
$IRS_{rec\text{-}c}$ (soil intake rate - recreator child) mg/day	200	67
t_{rec} (time - recreator) yr		26
TR (target risk) unitless	0.000001	0.000001
U_m (mean annual wind speed) m/s	4.69	4.65
U_t (equivalent threshold value)	11.32	11.32
V (fraction of vegetative cover) unitless	0.5	0.5

Notes:

IL = Illinois; PRG = Preliminary Remediation Goal; yr = year.

Table B.3.2 Recreator PRGs for Soil, Ra-226

Isotope	ICRP Lung Absorption Type	Soil Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Half-life (yr)	1,000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Particulate Emission Factor (m^3/kg)	Dry Soil-to-plant transfer factor (pCi/g-fresh plant per pCi/g-dry soil)	Beef Transfer Factor (pCi/kg per pCi/d)	Poultry Transfer Factor (pCi/kg per pCi/d)	Ingestion PRG TR=1.0E-06 (pCi/g)	Inhalation PRG TR=1.0E-06 (pCi/g)	External Exposure PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (mg/kg)	Total PRG TR=1.0E-06 (pCi/kg)
Ra-226	S	6.77E-10	2.82E-08	2.50E-08	5.14E-10	4.33E-04	1.60E+03	6.85E-01	1.00E+00	1.56E+09	1.95E-02	1.70E-03	-	2.32E+01	6.02E+03	4.10E+01	1.48E+01	1.50E-05	1.48E+04

Notes:

d = Day; ICRP = International Commission on Radiological Protection; Ra = Radium; S = Slow; pCi = Picocurie; PRG = Preliminary Remediation Goal; TR = Target Risk; yr = Year.

Table B.3.3 Recreator PRGs for Soil, Ra-228

Isotope	ICRP Lung Absorption Type	Soil Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Half-life (yr)	1,000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor	Particulate Emission Factor (m^3/kg)	Dry Soil-to-plant transfer factor (pCi/g-fresh plant per pCi/g-dry soil)	Beef Transfer Factor (pCi/kg per pCi/d)	Poultry Transfer Factor (pCi/kg per pCi/d)	Ingestion PRG TR=1.0E-06 (pCi/g)	Inhalation PRG TR=1.0E-06 (pCi/g)	External Exposure PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (mg/kg)	Total PRG TR=1.0E-06 (pCi/kg)
Ra-228	S	1.98E-09	4.37E-08	3.43E-11	1.42E-09	1.21E-01	5.75E+00	1.00E+00	1.00E+00	1.56E+09	1.95E-02	1.70E-03	-	7.93E+00	3.89E+03	2.04E+04	7.91E+00	2.90E-08	7.91E+03

Notes:

d = Day; ICRP = International Commission on Radiological Protection; Ra= Radium; S = Slow; pCi = Picocurie; PRG = Preliminary Remediation Goal; TR = Target Risk; yr = Year.

Attachment B

Supporting Information for the Closure Alternatives Analysis – Primary Ash Pond at the Newton Power Plant

Illinois Power Generating Company
CLOSURE ALTERNATIVES ANALYSIS SUPPORTING INFORMATION REPORT

Newton Power Plant
Primary Ash Pond

April 2022

Table of Contents

FIGURES

TABLES

1. INTRODUCTION AND BACKGROUND

Illinois Power Generating Company (IPGC) is the owner of the coal-fired Newton Power Plant (NPP), located in Jasper County, Illinois. Newton is an active power plant and will remain active until 2027, at which time electricity production will cease and it will become inactive. This power plant has a surface impoundment called the Primary Ash Pond. Closure of the Primary Ash Pond (PAP) will take place in phases and upon shut down of the power plant in 2027, with final closure complete in fall of 2028.

This supplemental information was developed for the closure alternatives analysis as required in accordance with 35 Illinois Administrative Code (IAC) 845, Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments (Part 845). Closure of the PAP will be performed under the relevant Illinois Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments (Part 845) [1] and the United States Environmental Protection Agency (USEPA) CCR Rule [2].

Part 845 requires a Closure Alternatives Analysis (CAA) to be completed, pursuant to the requirements of Section 845.710, to support the Closure Plan prepared pursuant to Section 845.720. The CAA for the Newton PAP will be performed by Gradient Corporation (Gradient). HDR has prepared this Closure Alternatives Analysis Supporting Information Report (Report) to provide information requested by Gradient to support their preparation of the CAA.

1.1. Report Contents

The following information is contained within this report:

- **Section 1** includes the Introduction and Background;
- **Section 2** includes information related to closure-by-removal (CBR) including:
    - A feasibility evaluation of CBR using an onsite landfill (CBR-Onsite);
    - An evaluation of potential offsite landfills to receive the CCR for CBR-Offsite; and
    - A feasibility evaluation of CCR transportation for CBR-Offsite using over-the-road trucks, rail, and barging.
- **Section 3** includes an overview of the planned construction for closure-in-place (CIP), CBR-Onsite, and CBR-Offsite;
- **Section 4** includes a project schedule for CIP, CBR-Onsite and CBR-Offsite; and
- **Section 5** includes estimates for construction material quantities, cost, labor, vehicle miles, and equipment miles, for CIP, CBR-Onsite, and CBR-Offsite.
- **Section 5** includes references for information used in this report.

2. CLOSURE-BY-REMOVAL INFORMATION

Section 845.710(c)(1) of the IAC requires the evaluation of complete removal of CCR (e.g., CBR), and Section 845.710(c)(2) requires the CAA to identify if the Power Plant has an existing onsite landfill that can accept the CCR, or if constructing a new onsite landfill is feasible. Additionally, Section 845.710(c)(1) requires the evaluation of multiple modes of transportation of CCR, including rail, barge, and truck. This section includes evaluation of onsite landfill options, potential offsite landfills, and potential methods for transporting CCR to offsite landfills.

2.1. Potential CBR - Onsite Landfill Options

2.1.1. Existing Newton CCR Landfill

An existing CCR landfill, the Newton CCR Landfill Phase II, is currently open at the site, but is not actively used to store CCR. The current landfill cell (Area 3) is approximately 7.2-acres in size, however, this cell would require reconstruction prior to use.

Cell Area 1 is 7.2-acres
\+ Cell Area 2 is 4.5-acres
\+ Cell Area 3 is 7.2-acres (unused, assumed rebuild required)
18.9-acres constructed in total

There are about 34 permitted landfill acres remaining to construct (including a rebuild of Area 3), resulting in about 3.2-million cubic yards of permitted capacity remaining. The current landfill is adjacent to a historic closed landfill to the north that does not have additional permitted capacity.

The PAP contains approximately 5.7-million cubic yards of CCR. Therefore, disposal of the CCR in an onsite landfill would require a permitted landfill expansion or permitted new landfill on-site.

2.1.2. Feasibility of New Onsite Landfill Construction

The NPP site boundary was evaluated for suitable areas for the construction of an onsite landfill. Three primary options were identified, as shown in **Figure 1**. The feasibility of constructing a new landfill or landfill expansion in each area is described below:

- The Option 1 area is approximately 28-acres in size and is located immediately north of the existing landfill. This expansion would require removal of a portion of the final cover system on the historic landfill to the north, and installation of an overliner system over the historic landfill.
  - The leachate drainage system of the current landfill would require re-evaluation and reconstruction to facilitate an expansion to the north. Existing site infrastructure would require re-routing.

    - The national wetlands inventory mapper indicates possible presence of wetlands in the area and to the south. This represents a potential impact to a protected area.
    - This area is not in the 100-year floodplain, per the Jasper County FIRM, panel number 170990-0125-B.
    - Therefore, constructing a landfill within the Option 1 area is considered less preferred, due to impacts to the existing site infrastructure and potential impacts to adjacent protected areas.
- The Option 2 area is approximately 25-acres in size and is located east of the existing landfill.
    - Option 2 overlaps with the existing PAP. This area would require phased closure of the pond where waste was first moved from the pond and into the existing permitted landfill, and then the landfill would be expanded into the clean closed footprint to hold the remaining waste.
    - This area would require relocation of the site access road and possible relocation of a monitoring well.
    - This area is not in the 100-year floodplain, per the Jasper County FIRM, panel number 170990-0125-B. However, it would require rerouting a major site drainageway.
    - Based on a review of the national wetlands inventory mapper and current site conditions, this area is not anticipated to impact potential wetlands.
    - Therefore, with phasing considerations taken into account, the Option 2 Area represents potentially the most practical option for onsite landfilling, because it expands an existing landfill, thus requiring less acreage for volume required, and is not anticipated to be in a protected area or buffer zone.
- The Option 3 area is approximately 33-acres in size and is located to the north of the existing closed landfill.
    - Option 3 represents the option of a new onsite landfill, rather than expanding the existing landfill. With this option, a greater area is needed and requires use of an area currently used for farming. An estimated 33-acres, with 4:1 sideslopes and 50-ft in height would be required.
    - This area represents an increased haul distance from the current PAP, adding time to the total project.
    - This area is not in the 100-year floodplain, per the Jasper County FIRM, panel number 170990-0125-B.
    - Based on a review of the national wetlands inventory mapper and current site conditions,

this area is not anticipated to impact potential wetlands.

  - Therefore, constructing a landfill in the Option 3 area is not preferred, due to use of land that has agricultural value, increased haul distance, and increased landfill footprint.

In summary, the areas available for potentially constructing a landfill within the site boundary each have challenges and potential limitations. The option considered potentially feasible above is the Option 2 Area – which is evaluated further on the attached tables.

2.2. Potential CBR-Offsite Receiving Landfills

Potential offsite landfills suitable for disposing of the approximately 5.7-million cubic yards of CCR within the PAP were evaluated using IEPA's online Illinois Disposal Capacity Report [3], and Indiana's Solid Waste Reporting website [4]. The closest landfills to the site, by road miles, were determined to be:

- Sanitation Service's Landfill 33, Ltd., located in Effingham, IL, (21-miles);
- Republic Services Sumner Landfill, located in Sumner, IL, (46-miles);
- Republic Services Sycamore Ridge Landfill, located in Pimento, Indiana, (75-miles).

Sycamore Ridge Landfill is the landfill evaluated in the supporting information tables due to its estimated potential to have sufficient capacity for the volume of CCR to be removed. This landfill is the furthest distance of the identified sites at about 75-miles. No landfills have not yet been contacted, as of the date of this report, to confirm that they would be willing and able to accept the CCR. Information on the landfills is provided in **Table 1** and the location of each landfill relative to the site is provided in **Figure 2**.

2.3. Potential CBR-Offsite Transportation Methods

Section 845.710(c)(1) requires CBR to consider multiple methods for transporting removed CCR, including using rail, barge, and trucks. An evaluation of each method is included within this section.

2.3.1. Transportation by Rail

The power plant does currently have an established rail terminal, although modifications would be required in order for it to be used to load and transport CCR material. Modifications would increase the project schedule due to the need to coordinate with the railroad, complete design and permitting, and construct the loading area. CCR would still need to be hauled by truck to the loading area and loaded into rail cars, resulting in additional CCR handling and potential exposure to the surrounding environment.

A direct rail route to Sumner Landfill does not exist. A direct route to Landfill 33 does exist, however, an existing terminal suitable for unloading CCR is not present at the landfill. The amount of permitted airspace remaining at both of the Illinois landfills is not sufficient for the total volume of waste from the PAP, and therefore not practical for development of rail lines or terminals.

Sycamore Ridge Landfill is located adjacent to an existing rail line, however, an existing terminal suitable for unloading CCR is not present at the landfill. A rail unloading terminal would need to be constructed which would increase the project schedule due to the need to coordinate with the railroad, complete design and permitting, and construct the terminal. CCR would still need to be hauled from the rail terminal to the active area of the landfill, resulting in additional CCR handling and potential exposure to the surrounding environment.

Hauling CCR to Sycamore Ridge Landfill in Indiana would require approximately 75-miles (one-way) of hauling by rail on tracks owned by three separate rail lines (CSX, Indiana Rail Road Company, and PVTX), as shown on **Figure 2**. The ability of CCR to be hauled over multiple lines and transferred from line to line is currently unknown.

Therefore, transporting CCR by rail is unlikely to be a viable option for PAP CBR, due to the need to design, permit, and construct additional loading and unloading infrastructure, resulting in corresponding project schedule delays, and the distance and number of rail lines over which the CCR would need to be transported.

2.3.2. Transportation by Barge

The Newton Power Plant is not near rivers that accommodate barge traffic. It is estimated the nearest terminal for barge traffic is in St. Louis, approximately 125-miles away. This requires more trucking than the option to haul directly to a landfill, as well as installation of unloading infrastructure and additional hauling after the barge. Therefore, this option is not considered feasible.

2.3.3. Transportation by Truck

The PAP is located approximately eight miles from IL-33, which is suitable for receiving on-road truck hauling traffic. North 500th Street routinely receives truck traffic associated with the power plant. Potential travel routes between the PAP and landfills are shown on **Figure 2**, although actual travel routes may vary.

Transporting CCR by truck will not require the construction of additional loading or unloading infrastructure at either the receiving landfills or PAP. CCR would be loaded into trucks using heavy equipment at the PAP. CCR will then be unloaded at the receiving landfill by the truck directly. Since no construction is required, project delays related to coordination with other entities, design, and permitting are unlikely to occur. Therefore, transporting CCR by truck is a viable option for the PAP.

3. CLOSURE DESCRIPTION NARRATIVES

Section 845.720(a)(1)(A) requires a narrative description of CCR impoundment closures to be prepared. Narrative descriptions have been prepared for CIP, CBR-Onsite, and CBR-Offsite and are included within this section.

3.1. Closure in Place

A narrative description of how the PAP will be closed in place is provided in Section 2.1 of the PAP Closure Plan.

3.2. CBR-Onsite

A narrative description of CBR-Onsite of the PAP is as follows:

- The PAP will be unwatered by pumping free surface water to the adjacent Settling Pond for ultimate discharge at NPDES Outfall 001.

- A temporary water management system will be constructed within the PAP, including ditches and sumps. The system will maintain the PAP in an unwatered state by collecting contact stormwater during closure construction. Unwatering flows will be pumped to the Settling Pond for ultimate discharge at NDPES Outfall 001.

- CCR will be removed from the PAP using mass mechanical excavation techniques. Much of the CCR will be saturated or nearly saturated, so mass excavation will include the use of dewatering seepage trenches or other forms of passive dewatering (i.e., rim ditching or windrowing) to moisture-condition the CCR prior to handling. Dewatering flows will be pumped to the Settling Pond for ultimate discharge at NPDES Outfall 001.

- CCR will be loaded into dump trucks and hauled to the existing landfill, which will be expanded as the project progresses.

- The PAP outlet structure will be removed and disposed of at the offsite receiving landfill. Soil backfill will be placed at the previous outlet structure location.

- The PAP bottom and side- slopes will be decontaminated by removing approximately one foot of soil beneath the side-slope and bottom grades. The soils will be disposed of in the offsite receiving landfill.

- Once CBR is complete, the former PAP will be backfilled as needed to drain towards the south, in order to allow stormwater to gravity flow and preclude the impoundment of water. Backfill materials would include clean soil material excavated from the soil perimeter berm.

- The PAP will be restored by placing six inches of topsoil on the bottom and side slopes of the PAP and establishing vegetation. Stormwater best management practices (BMPs) such as erosion control blankets and straw wattles will be used, as needed to reduce erosion during vegetation establishment.

- After vegetation is established, BMPs will be removed, and closure construction will be considered completed.

3.3. CBR-Offsite

A narrative description of CBR-Offsite of the PAP is as follows:

- The PAP will be unwatered by pumping free surface water to the adjacent Settling Pond for ultimate discharge at NPDES Outfall 001.
- A temporary water management system will be constructed within the PAP, including ditches and sumps. The system will maintain the PAP in an unwatered state by collecting contact stormwater during closure construction. Unwatering flows will be pumped to the Settling Pond for ultimate discharge at NDPES Outfall 001.
- CCR will be removed from the PAP using mass mechanical excavation techniques. Much of the CCR will be saturated or nearly saturated, so mass excavation will include the use of dewatering seepage trenches or other forms of passive dewatering (i.e., rim ditching or windrowing) to moisture-condition the CCR prior to handling. Dewatering flows will be pumped to the Settling Pond for ultimate discharge at NPDES Outfall 001.
- CCR will be loaded into on-road dump trucks and hauled to the offsite receiving landfill.
- The PAP outlet structure will be removed and disposed of at the offsite receiving landfill. Soil backfill will be placed at the previous outlet structure location.
- The PAP bottom and side- slopes will be decontaminated by removing approximately one foot of soil beneath the side-slope and bottom grades. The soils will be disposed of in the offsite receiving landfill.
- Once CBR is complete, the former PAP will be backfilled as needed to drain towards the south, in order to allow stormwater to gravity flow and preclude the impoundment of water. Backfill materials would include clean soil material excavated from the soil perimeter berm.
- The PAP will be restored by placing six inches of topsoil on the bottom and side slopes of the PAP and establishing vegetation. Stormwater best management practices (BMPs) such as erosion control blankets and straw wattles will be used, as needed to reduce erosion during vegetation establishment.
- After vegetation is established, BMPs will be removed, and closure construction will be considered completed.

4. CONSTRUCTION SCHEDULES

Section 845.720(a)(1)(F) requires a schedule including all activities necessary to complete closure to be prepared. Schedules have been prepared for CIP, CBR-Onsite, and CBR-Offsite and are included within this section. Schedules were prepared using estimates of task durations based on HDR’s experience, typical weather conditions at the site, and expected construction rates relative to estimated construction quantities.

4.1. CIP

The proposed closure completion schedule for CIP is provided in Section 2.6 of the PAP Closure Plan.

4.2. CBR-Onsite

The proposed closure construction schedule for CBR-Onsite is provided in **Table 2**.

4.3. CBR-Offsite

The proposed closure construction schedule for CBR-Offsite is provided in **Table 2**.

5. MATERIAL, QUANTITY, COST, LABOR, AND MILEAGE ESTIMATES

5.1. Quantity and Cost Estimates

Section 845.710(d)(1) requires a cost estimate to be prepared in accordance with the Class 4 standards of the Association for the Advancement of Cost Engineering (AACE) [5]. Cost estimates for both CIP, CBR-Onsite, and CBR-Offsite were prepared in accordance with the AACE Class 4 standards, utilizing the following approach:

- Major construction components and line-items were identified, in accordance with the narrative closure description (**Section 3**).
- Construction quantities were estimated based on volume estimates, area estimates, and proposed construction schedules (**Section 4**).
- Unit costs were estimated for each construction line-item utilizing RSMeans Heavy Construction Cost Data [6] (RS Means). For line-items where RSMeans data was not available, unit costs were estimated based on recent industry pricing observed by HDR on projects of similar size, scope, and complexity.
    - RSMeans unit costs were developed assuming Union labor for Effingham, Illinois (located approximately 23 miles from the PAP), for 2022.
- Soil fill was assumed to come from onsite borrow sources located within 4,000-ft of the construction on average. Soil borrow is currently planned to be obtained from within the pond area, existing berms, and if needed, elsewhere on site.
- A contingency of 30% was applied for the construction cost estimate total, based on the level of design and quantity estimate prepared as part of this Report.

5.2. Labor and Mileage Estimates

In addition to construction cost and quantity estimates, Gradient also utilized HDR's estimates of construction labor hours, equipment usage, haul truck mileage, daily labor mobilization vehicle mileage, material delivery mileage, and onsite vehicle mobilization mileage. These estimates were prepared using the following approach:

- For line items where RSMeans [6] was utilized to develop the costs, the corresponding RSMeans crew size, equipment description, and daily output were utilized to estimate the total number of man-hours and equipment hours.
- For line items where RSMeans data was unavailable, the crew size, equipment description, and daily output were estimated based on recent industry pricing observed by HDR on projects of similar size, scope, and complexity.

- Daily labor mobilization miles were estimated assuming an average one-way commute of 35 miles for each individual working onsite. The number of working days were estimated from the construction schedules (**Section 4**).
- Estimates of haul truck mileage were based on the assumed round-trip haul distance and dump truck size. All dump trucks were assumed to be filled to capacity.
- Estimates of material delivery miles were prepared based on HDR's experience.

5.3. Results

The detailed labor and mileage estimates are provided in **Tables 3a** and **3b**, respectively.

The detailed labor and mileage estimates are provided in **Tables 4a** and **4b**, respectively.

The detailed labor and mileage estimates are provided in **Tables 5a** and **5b**, respectively.

6. REFERENCES

[1] Illinois Environmental Protection Agency, "35 Ill. Adm. Code Part 845, Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments," Springfield, IL, 2021.

[2] United Stated Environmental Protection Agency, "40 CFR Parts 257 and 261, Hazardous and Solid Waste Management System, Disposal of Coal Combustion Residuals from Electric Utilities, Final Rule, 2015," 2015.

[3] Illinois Environmental Protection Agency, "Illinois Landfill Disposal Capacity Report," August 2021.

[4] Indiana Department of Environmental Management, “Solid Waste Reporting - 2020,” accessed March 10, 2022.

[5] AACE International, "Recommended Practice 18R-97: Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Process Industries," 2020.

[6] RSMeans, "Heavy Construction Costs with RSMeans Data," Gordian, 2022.

Figures

Source: Google Earth Imagery, 2022.
Note: Areas and boundaries are approximate/conceptual, for estimating purposes only.

DRAFT

HDR

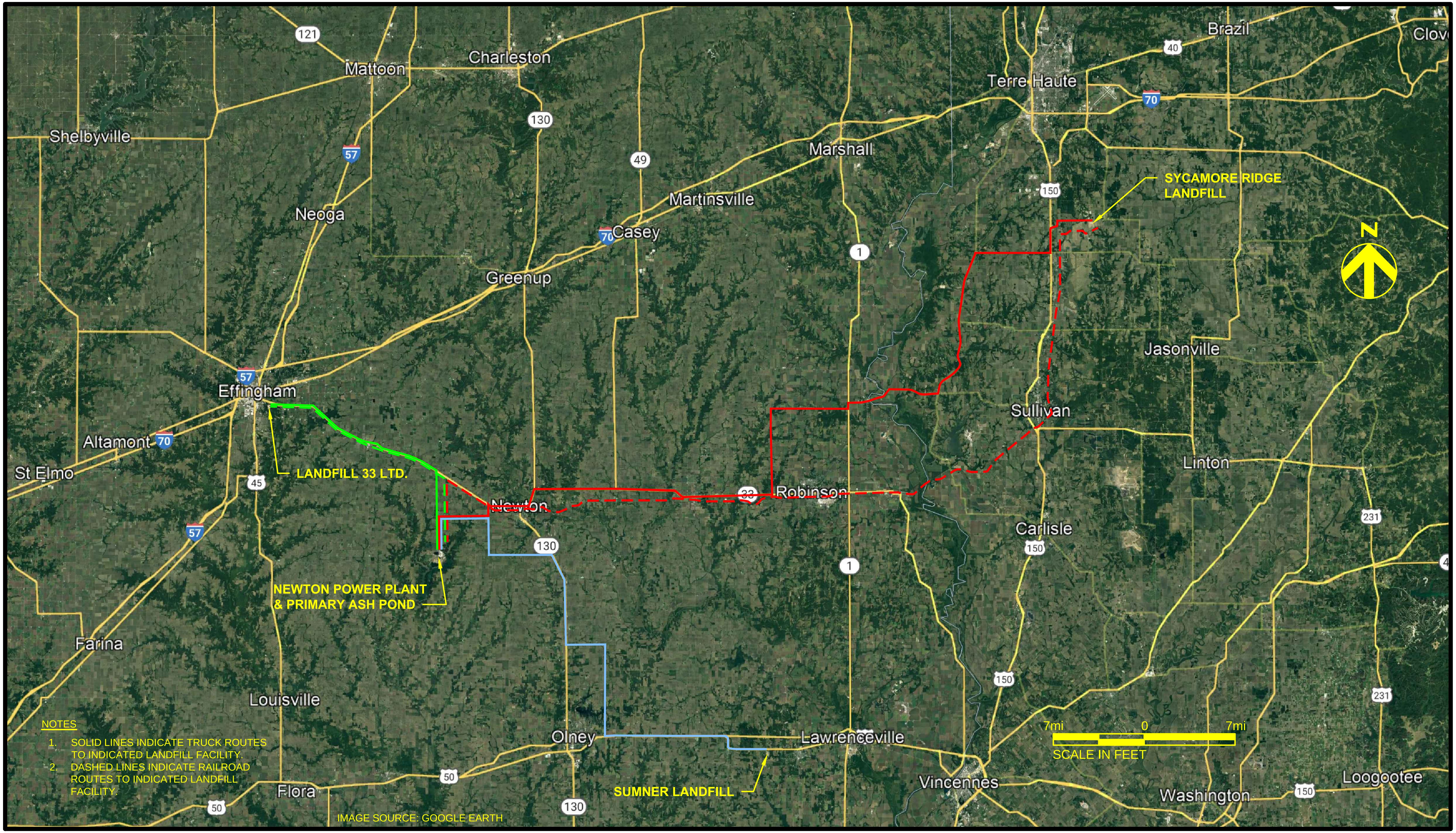
IPGC NEWTON POWER PLANT
PRIMARY ASH POND CLOSURE
NEWTON, ILLINOIS

ONSITE LANDFILL -POTENTIAL AREA OPTIONS

DATE
4.6.2022

FIGURE
1

C:\pwworking\central01\d2372207_Fig 1 - Alternate Landfill Map.dwg, Layout1, 3/14/2022 4:10:04 PM, MBICKFORD



NOTES
1. SOLID LINES INDICATE TRUCK ROUTES TO INDICATED LANDFILL FACILITY.
2. DASHED LINES INDICATE RAILROAD ROUTES TO INDICATED LANDFILL FACILITY.

IMAGE SOURCE: GOOGLE EARTH

DRAFT

HDR

IPGC NEWTON POWER PLANT
PRIMARY ASH POND CLOSURE
NEWTON, ILLINOIS

ALTERNATIVE LANDFILL PROXIMITY MAP

DATE
MARCH 2022

FIGURE
1

Tables

Table 1: Offsite Landfill Information

Landfill Name:	Owner:	Location:	One-way Distance From Site:	5-yr Average Disposal Volume (CY):	Remaining Site Capacity (CY)
Sycamore Ridge Landfill	Republic Services, Inc.	Pimento, IN	75 miles	524,173 (tons)(1)	10,000,000 (2)
Landfill 33 Ltd. (3)	Sanitation Service, Inc.	Effingham, IL	21 miles	111,290	527,135
Sumner Landfill, Inc. (3)	Republic Services, Inc.	Sumner, IL	46 miles	93,890	2,807,604

1 Estimated - remaining permitted footprint
2 IDEM: Managing Waste: Solid Waste Reporting
3 Landfill Capacity Report - Landfill Capacity (illinois.gov)

Table 2: Closure Schedule

Milestone	Timeframe		
	Closure in Place	**Closure by Removal - On-site**	**Closure by Removal Off-Site**
Agency Coordination, Approvals, Permitting Obtain state permits, as needed, for dewatering/unwatering, water discharge, land disturbance, and outlet modifications	16 to 24 months after final Closure Plan Approval	8 to 12 months after final Closure Plan Approval	12 to 18 months after final Closure Plan Approval
Final Design and Bid Process* Complete final design of the closure and select a construction contractor	6 to 12 months during Agency Coordination, Approvals, and Permitting	6 to 12 months during Agency Coordination, Approvals, and Permitting	6 to 12 months during Agency Coordination, Approvals, and Permitting
Close CCR Unit Complete Contractor mobilization, installation of stormwater control measures for construction Complete dewatering and unwatering Complete Mass Excavation of CCR and decontamination of Ash Pond Install final cover system (closure in place only) Winter weather delays are assumed between November and March of each construction year	36 to 48 months after necessary permits are issued	60 to 96 months after necessary permits are issued	72 to 108 months after necessary permits are issued
Slope to drain -backfill soil to maintain positive drainage	Concurrent with above item	6 to 8 months after final plant shutdown	6 to 8 months after final plant shutdown
Site Restoration Seed and stabilize the Ash Pond Complete Contractor demobilization	2-3 months after grading is complete	4 to 6 months after grading is complete	4 to 6 months after grading is complete
Timeframe to Complete Closure	**54 to 75 months**	**78 to 122 months**	**94 to 140 months**

*Assume final design and bidding is concurrent with final approvals and permitting

Table 3a: Material Quantity and Cost Estimate - Closure in Place

Item No.	Item	Crew	Worker Type	Workers (#)	Equipment Type	Equipment (#)	Daily Output	Labor Hours	Equipment Hours	Units	Quantity
1	**Pre-Construction**										
	Mobilization and Demobilization									LS	1
2	**Site Preparation**										
	Site Preparation: Clearing and Grubbing	B7	Operator x 1 Laborer x 5	6	Brush Chipper x 1 Crawler Loader x 1 Chainsaws x 2	4	1	3,000	2,000	AC	50
	Construction Soil Erosion and Sediment Controls	B62	Operator x 1 Laborer x 2	3	Skid Steer x 1	1	650	2,308	769	LF	50,000
	Construction Facilities - Office Trailer	-	-	-	-	-	-	-	-	LS	1
	Construction Facilities - Storage Trailers (2)	-	-	-	-	-	-	-	-	LS	2
	Construction Facilities - Portable Toilets (4)	-	-	-	-	-	-	-	-	MO	36
	Dust Control	B59	Truck Driver x 1	1	Water Truck x 1	1	1	4,800	4,800	DAY	480
	Haul Road Maintenance	B86A	Operator x 1	1	Grader x 1	1	1	1,440	1,440	DAY	144
3	**Dewatering, Unwatering, and Stormwater Management**										
	Unwatering, Dewatering, and Stormwater Management for the Primary Ash Pond	B10K	Operator x 1 Laborer x 0.5	1.5	Pump x 1	1	1	21,900	14,600	DAY	1460
	Water Management (additives, sampling)	-	-	-	-	-	-	-	-	DAY	1460
	Unwatering, Dewatering, and Stormwater Management for Lake Jake and Settling Pond	B10K	Operator x 1 Laborer x 0.5	1.5	Pump x 1	1	1	2,700	1,800	DAY	180
	Outlet structure modification and temporary drainage features	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	0.05	300	200	LS	1
	Dewatering Sumps Installation	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	1	6,000	4,000	EA	400
4	**Closure**										
	Excavation of Ash Material										
	Excavation of ash material	B14J	Operator x 1 Laborer x 0.5	1.5	Front End Loader x 1	1	3,800.00	7,570	5,047	CY	1,917,700
	Hauling material to northern portion of site	B34F	Truck Driver x 1	1	Dump Truck x 1	1	528.00	36,320	36,320	CY	1,917,700
	Spreading of Material	B10B	Operator x 1 Laborer x 0.5	1.5	Dozer x 1	1	1,000.00	28,766	19,177	CY	1,917,700
	Compaction of Material	B10Y	Operator x 1 Laborer x 0.5	1.5	Vibratory Roller x 1	1	2,300.00	12,507	8,338	CY	1,917,700
	Fine grading of ash surface OR clean closed area	B11L	Operator x 1 Laborer x 1	2	Grader x 1	1	1.84	4,394	2,197	AC	404
	Piezometer and Monitoring Well Extensions	C18	Laborer x 1.125	1.125	Concrete Cart x 1	1	1.00	45	40	EA	4
	Material Conditioning (drying, stabilizing)	-	-	-	-	-	-	-	-	CY	1,917,700
	Offsite Disposal Fee	-	-	-	-	-	-	-	-	CY	0
5	**Onsite Landfill and Pond Capping**										
	Clay layer, 1.5-ft (onsite landfill closure)										
	Excavation and Loading of Material	B14J	Operator x 1 Laborer x 0.5	1.5	Front End Loader x 1	1	3,800	186	124	CY	47,110
	Hauling Material	B34F	Truck Driver x 1	1	Dump Truck x 1	1	528	892	892	CY	47,110
	Spreading of Material	B10B	Operator x 1 Laborer x 0.5	1.5	Dozer x 1	1	1,000	707	471	CY	47,110
	Compacting Material	B10D	Operator x 1 Laborer x 0.5	1.5	Dozer x 1 Compactor x 1	1	2,000	353	236	CY	47,110
	Finish grading material	B11L	Operator x 1 Laborer x 1	2	Grader x 1	1	1.84	3,040	1,520	AC	280
	Geomembrane, 40-mil LLDPE	HDR1	Operator x 2 Laborer x 10	12	Skid Steer x 1 Forklift x 1	5	2	16,770	6,988	AC	280
	Geotextile, 8-oz.	HDR1	Operator x 2 Laborer x 10	12	Skid Steer x 1 Forklift x 1	5	2	16,770	6,988	AC	280
	Anchor Trench	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	250	810	540	LF	13,500
	Temporary Anchor Trench	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	250	379	253	LF	6,320
	Drainage Pipes on Geomembrane	HDR1	Operator x 2 Laborer x 10	12	Skid Steer x 1 Forklift x 1	5	7,500	590	246	LF	36,893
	Placement of Protective Cover Soil (onsite source)										
	Excavation and Loading of Material	B14J	Operator x 1 Laborer x 0.5	1.5	Front End Loader x 1	1	3,800.00	2,750	1,833	CY	696,682
	Hauling Material	B34F	Truck Driver x 1	1	Dump Truck x 1	1	528.00	13,195	13,195	CY	696,682
	Spreading of Material	B10B	Operator x 1 Laborer x 0.5	1.5	Dozer x 1	1	1,000.00	10,450	6,967	CY	696,682
	Finish grading material	B11L	Operator x 1 Laborer x 1	2	Grader x 1	1	1.84	3,040	1,520	AC	280
	Placement of Vegetative Soil (onsite source)										
	Excavation and Loading of Material	B14J	Operator x 1 Laborer x 0.5	1.5	Front End Loader x 1	1	3,800.00	917	611	CY	232,227
	Hauling Material	B34F	Truck Driver x 1	1	Dump Truck x 1	1	528.00	4,398	4,398	CY	232,227
	Spreading of Material	B10B	Operator x 1 Laborer x 0.5	1.5	Dozer x 1	1	1,000.00	3,483	2,322	CY	232,227
	Finish grading material	B11L	Operator x 1 Laborer x 1	2	Grader x 1	1	1.84	3,040	1,520	AC	280
	Installation of drainage channels									*LF*	*15,884*
	Erosion Control Blanket	2 Clab	Laborer x 2	2	-	0	1000	1,765	0	SY	88,244
	Installation of drainage letdowns									*LF*	*5,028*
	Riprap	B30	Operator x 1 Truck Driver x 2	3	Excavator x 1 Dump Trucks x 2	3	100	2,682	2,682	SY	8,939
	Geotextile, 10 oz.	B62	Operator x 1 Laborer x 2	3	Skid Steer x 1	1	2,500	107	36	SY	8,939
6	**Stormwater and Perimeter**										
	Removal of Outlet Structure	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	0.10	150	100	LS	1
	Removal of Outlet Pipe	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	0.20	75	50	LS	1
	Installation of permanent stormwater culverts, riprap aprons, an	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	0.10	150	100	LS	1
	Establish Access Roads									*LF*	*13,500*
	Gravel	B32	Operator x 3 Laborer x 1	4	Grader x 1 Roller x 1 Dozer x 1	3	5,000	360	270	SY	45,000
	Geotextile, 10 oz.	B62	Operator x 1 Laborer x 2	3	Skid Steer x 1	1	2,500	540	180	SY	45,000
	Seed, fertilize, and maintain vegetated surfaces										
	Seeding	B66	Operator x 1	1	Loader-Backhoe x 1	1	1.5	**3,000**	3,000	AC	450
	Fertilizing	B66	Operator x 1	1	Loader-Backhoe x 1	1	3	1,500	1,500	AC	450
	Mulch (select areas/steep slopes)	B66	Operator x 1	1	Loader-Backhoe x 1	1	140,000	124	124	SF	1,742,400
	Repair initial erosion	B66	Operator x 1	1	Loader-Backhoe x 1	1	1	400	400	AC	40
7	**Engineering and Construction Support**										
	Final Closure Design, Local Permitting Support, and Bid Support	HDR2	Engineering Staff x 4	4	-	0	0.01	4,000	0	LS	1
	Engineering Support and CQA during Construction	HDR3	CQA Staff x 1 Engineering Staff x 1	2	Truck x 1	1	0.001	20,000	10,000	LS	1

	Labor Hours:	Equipment Hours:
	248,673	**169,793**
Contingency (30%)	**323,275**	**220,730**

Notes:

1. RS Means used as reference - adjusted based on project size, location, type.
2. Grey crews were established based on HDR relevant project experience.

Table 3b: Labor, Equipment, and Mileage Estimate - Closure in Place - Totals

Item	Quantity	Assumptions
Labor Total Hours	323,275	10-hr days
Duration of Onsite Construction in Days	720	Working days, 9 months per year for 4 yrs, 20-working days per month average
Average Daily Crew Size	45	Crew Members
Daily Labor Mobilization Miles	2,262,925	Average of 70 miles round trip per day
Vehicles Miles Onsite	79,040	2 mile round trip from gate to parking 5 miles per day for CQA tech and Construction Supervisor 10% Contingency for site visitors (client and engineering support)
Equipment Mobilization Miles - Unloaded	33,110	Average of 300 miles one way for equipment hauling Average 1 load of equipment 2,000 Equipment working hours
Equipment Mobilization Miles - Loaded	33,110	Average of 300 miles one way for equipment hauling Average 1 load of equipment per working week
Daily Equipment Miles Onsite	720,000	Average of ~20 crew members running equipment Assume 50 miles per piece of equipment (average 5 mph, 10-hrs per day)
Onsite Haul Truck Miles - Unloaded	56,403	34 CY Haul Truck 1-mile route out
Onsite Haul Truck Miles - Loaded	56,403	34 CY Haul Truck 1-mile route back
Offsite Haul Truck Miles - Unloaded	0	16.5 CY Dump Truck 75 mile trip
Offsite Haul Truck Miles - Loaded	0	16.5 CY Dump Truck 75 mile trip
Material Delivery Miles - Unloaded	154,080	Assume geosynthetic source ~850-miles from site (possibly South Carolina) 60 extra trips for piping, seed, fertilizer, mulch, straw wattles, and concrete - source 1000 miles away average
Material Delivery Miles - Loaded	154,080	Assume geosynthetic source ~850-miles from site (possibly South Carolina) 60 extra trips for piping, seed, fertilizer, mulch, straw wattles, and concrete - source 1000 miles away average
Estimated Total	**3,549,150**	**miles**

Table 4a: Material Quantity and Cost Estimate - Onsite Landfill

Item No.	Item	Crew	Worker Type	Workers (#)	Equipment Type	Equipment (#)	Daily Output	Labor Hours	Equipment Hours	Units	Quantity
1	**Pre-Construction**										
	Mobilization and Demobilization									LS	1
2	**Site Preparation**										
	Site Preparation: Clearing and Grubbing	B7	Operator x 1 Laborer x 5	6	Brush Chipper x 1 Crawler Loader x 1 Chainsaws x 2	4	1	3,000	2,000	AC	50
	Construction Soil Erosion and Sediment Controls	B62	Operator x 1 Laborer x 2	3	Skid Steer x 1	1	650	2,308	769	LF	50,000
	Construction Facilities - Office Trailer	-	-	-	-	-	-	-	-	LS	1
	Construction Facilities - Storage Trailers (2)	-	-	-	-	-	-	-	-	LS	2
	Construction Facilities - Portable Toilets (4)	-	-	-	-	-	-	-	-	MO	36
	Dust Control	B59	Truck Driver x 1	1	Water Truck x 1	1	1	4,800	4,800	DAY	480
	Haul Road Maintenance	B86A	Operator x 1	1	Grader x 1	1	1	1,440	1,440	DAY	144
3	**Dewatering, Unwatering, and Stormwater Management**										
	Unwatering, Dewatering, and Stormwater Management for the Primary Ash Pond	B10K	Operator x 1 Laborer x 0.5	1.5	Pump x 1	1	1	43,800	29,200	DAY	2920
	Water Management (additives, sampling)	-	-	-	-	-	-	-	-	DAY	2920
	Unwatering, Dewatering, and Stormwater Management for Lake Jake and Settling Pond	B10K	Operator x 1 Laborer x 0.5	1.5	Pump x 1	1	1	2,700	1,800	DAY	180
	Outlet structure modification and temporary drainage features	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	0.05	300	200	LS	1
	Dewatering Sumps Installation	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	1	6,000	4,000	EA	400
4	**Closure**										
	Excavation of Ash Material										
	Excavation of ash material	B14J	Operator x 1 Laborer x 0.5	1.5	Front End Loader x 1	1	3,800.00	22,500	15,000	CY	5,700,000
	Hauling material to onsite landfill area	B34F	Truck Driver x 1	1	Dump Truck x 1	1	528.00	107,955	107,955	CY	5,700,000
	Spreading of Material	B10B	Operator x 1 Laborer x 0.5	1.5	Dozer x 1	1	1,000.00	85,500	57,000	CY	5,700,000
	Compaction of Material	B10Y	Operator x 1 Laborer x 0.5	1.5	Vibratory Roller x 1	1	2,300.00	37,174	24,783	CY	5,700,000
	Fine grading of ash surface OR clean closed area	B11L	Operator x 1 Laborer x 1	2	Grader x 1	1	1.84	4,394	2,197	AC	404
	Piezometer and Monitoring Well Extensions	C18	Laborer x 1.125	1.125	Concrete Cart x 1	1	1.00	45	40	EA	4
	Material Conditioning (drying, stabilizing)	-	-	-	-	-	-	-	-	CY	5,700,000
	Offsite Disposal Fee	-	-	-	-	-	-	-	-	CY	0
5	**Onsite Landfill Closure**										
	Landfill Bottom liner system (clay, 60-mil HDPE, drainage layer)										
	Mass Excavation	B14J	Operator x 1	1.5	Front End Loader x 1	1	3,800	3,947	2,632	CY	1,000,000
	Mas Excavation - Hauling	B34F	Truck Driver x 1	1	Dump Truck x 1	1	528	18,939	18,939	CY	1,000,000
	Clay layer, 2-ft (bottom liner - onsite landfill)										
	Excavation and Loading of Material	B14J	Operator x 1 Laborer x 0.5	1.5	Front End Loader x 1	1	3,800	708	472	CY	179,467
	Hauling Material	B34F	Truck Driver x 1	1	Dump Truck x 1	1	528	3,399	3,399	CY	179,467
	Spreading of Material	B10B	Operator x 1 Laborer x 0.5	1.5	Dozer x 1	1	1,000	2,692	1,795	CY	179,467
	Compacting Material	B10D	Operator x 1 Laborer x 0.5	1.5	Dozer x 1 Compactor x 1	1	2,000	1,346	897	CY	179,467
	Finish grading material	B11L	Operator x 1 Laborer x 1	2	Grader x 1	1	1.84	587	294	AC	54
	Geomembrane, 60-mil HDPE	HDR2	Operator x 2 Laborer x 10	12	Skid Steer x 1 Forklift x 1	5	2	3,240	1,350	AC	54
	Geotextile, 8-oz.	HDR2	Operator x 2 Laborer x 10	12	Skid Steer x 1 Forklift x 1	5	2	3,240	1,350	AC	54
	Anchor Trench (bottom liner)	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	250	180	120	LF	3,000
	Drainage Layer (bottom liner)										
	Purchase Material	-	-	-	-	-	-	-	-	CY	89,734
	Hauling Material	B34C	Truck Driver x 1	1	16.5-CY Truck x 1	1	99	9,064	9,064	CY	89,734
	Spreading of Material	B10B	Operator x 1 Laborer x 0.5	1.5	Dozer x 1	1	1,000	1,346	897	CY	89,734
	Capping										
	Clay layer, 1.5-ft (onsite landfill closure)										
	Excavation and Loading of Material	B14J	Operator x 1 Laborer x 0.5	1.5	Front End Loader x 1	1	3,800	646	431	CY	163,764
	Hauling Material	B34F	Truck Driver x 1	1	Dump Truck x 1	1	528	3,102	3,102	CY	163,764
	Spreading of Material	B10B	Operator x 1 Laborer x 0.5	1.5	Dozer x 1	1	1,000	2,456	1,638	CY	163,764
	Compacting Material	B10D	Operator x 1 Laborer x 0.5	1.5	Dozer x 1 Compactor x 1	1	2,000	1,228	819	CY	163,764
	Finish grading material	B11L	Operator x 1 Laborer x 1	2	Grader x 1	1	1.84	715	357	AC	66
	Geomembrane, 40-mil LLDPE	HDR1	Operator x 2 Laborer x 10	12	Skid Steer x 1 Forklift x 1	5	2	3,942	1,643	AC	66
	Geotextile, 8-oz.	HDR1	Operator x 2 Laborer x 10	12	Skid Steer x 1 Forklift x 1	5	2	3,942	1,643	AC	66
	Anchor Trench	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	250	-	-	LF	-
	Temporary Anchor Trench	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	250	-	-	LF	-
	Drainage Pipes on Geomembrane	HDR1	Operator x 2 Laborer x 10	12	Skid Steer x 1 Forklift x 1	5	7,500	315	131	LF	19,710
	Placement of Protective Cover Soil (onsite source)										
	Excavation and Loading of Material	B14J	Operator x 1 Laborer x 0.5	1.5	Front End Loader x 1	1	3,800.00	646	431	CY	163,764
	Hauling Material	B34F	Truck Driver x 1	1	Dump Truck x 1	1	528.00	3,102	3,102	CY	163,764
	Spreading of Material	B10B	Operator x 1 Laborer x 0.5	1.5	Dozer x 1	1	1,000.00	2,456	1,638	CY	163,764
	Finish grading material	B11L	Operator x 1 Laborer x 1	2	Grader x 1	1	1.84	715	357	AC	66
	Placement of Vegetative Soil (onsite source)										
	Excavation and Loading of Material	B14J	Operator x 1 Laborer x 0.5	1.5	Front End Loader x 1	1	3,800.00	215	144	CY	54,588
	Hauling Material	B34F	Truck Driver x 1	1	Dump Truck x 1	1	528.00	1,034	1,034	CY	54,588
	Spreading of Material	B10B	Operator x 1 Laborer x 0.5	1.5	Dozer x 1	1	1,000.00	819	546	CY	54,588
	Finish grading material	B11L	Operator x 1 Laborer x 1	2	Grader x 1	1	1.84	715	357	AC	66
	Installation of drainage channels									*LF*	*19,710*
	Erosion Control Blanket	2 Clab	Laborer x 2	2	-	0	1000	2,190	0	SY	109,500
	Installation of drainage letdowns									*LF*	*6,570*
	Riprap	B30	Operator x 1 Truck Driver x 2	3	Excavator x 1 Dump Trucks x 2	3	100	3,504	3,504	SY	11,680
	Geotextile, 10 oz.	B62	Operator x 1 Laborer x 2	3	Skid Steer x 1	1	2,500	140	47	SY	11,680
6	**Stormwater and Perimeter**										
	Removal of Outlet Structure	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	0.10	150	100	LS	1
	Removal of Outlet Pipe	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	0.20	75	50	LS	1
	Installation of permanent stormwater culverts, riprap aprons, an	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	0.10	150	100	LS	1
	Establish Access Roads									*LF*	*13,500*
	Gravel	B32	Operator x 3 Laborer x 1	4	Grader x 1 Roller x 1 Dozer x 1	3	5,000	360	270	SY	45,000
	Geotextile, 10 oz.	B62	Operator x 1 Laborer x 2	3	Skid Steer x 1	1	2,500	540	180	SY	45,000
	Seed, fertilize, and maintain vegetated surfaces										
	Seeding	B66	Operator x 1	1	Loader-Backhoe x 1	1	1.5	3,000	3,000	AC	450
	Fertilizing	B66	Operator x 1	1	Loader-Backhoe x 1	1	3	1,500	1,500	AC	450
	Mulch (select areas/steep slopes)	B66	Operator x 1	1	Loader-Backhoe x 1	1	140,000	124	124	SF	1,742,400
	Repair initial erosion	B66	Operator x 1	1	Loader-Backhoe x 1	1	1	410	410	AC	41
7	**Engineering and Construction Support**										
	Final Closure Design, Local Permitting Support, and Bid Support	HDR2	Engineering Staff x 4	4	-	0	0.01	4,000	0	LS	1
	Engineering Support and CQA during Construction	HDR3	CQA Staff x 1 Engineering Staff x 1	2	Truck x 1	1	0.001	20,000	10,000	LS	1

	Labor Hours:	**Equipment Hours:**
	432,797	**329,049**
Contingency (30%)	**562,636**	**427,763**

Notes:

1. RS Means used as reference - adjusted based on project size, location, type.
2. Grey crews were established based on HDR relevant project experience.

Table 4b: Labor, Equipment, and Mileage Estimate - Closure by Removal -Onsite Landfill- Totals

Item	Quantity	Assumptions
Labor Total Hours	562,636	10-hr days
Duration of Onsite Construction in Days	1,440	Working days, 9 months per year for 8 yrs, 20-working days per month average
Average Daily Crew Size	39	Crew Members
Daily Labor Mobilization Miles	3,938,451	Average of 70 miles round trip per day
Vehicles Miles Onsite	139,620	2 mile round trip from gate to parking 5 miles per day for CQA tech and Construction Supervisor 10% Contingency for site visitors (client and engineering support)
Equipment Mobilization Miles - Unloaded	64,164	Average of 300 miles one way for equipment hauling Average 1 load of equipment 2,000 Equipment working hours
Equipment Mobilization Miles - Loaded	64,164	Average of 300 miles one way for equipment hauling Average 1 load of equipment per working week
Daily Equipment Miles Onsite	1,440,000	Average of ~20 crew members running equipment Assume 50 miles per piece of equipment (average 5 mph, 10-hrs per day)
Onsite Haul Truck Miles - Unloaded	167,647	34 CY Haul Truck 4000 ft cycle
Onsite Haul Truck Miles - Loaded	167,647	34 CY Haul Truck 4000 ft cycle
Offsite Haul Truck Miles - Unloaded	0	16.5 CY Dump Truck 75 mile trip
Offsite Haul Truck Miles - Loaded	0	16.5 CY Dump Truck 75 mile trip
Material Delivery Miles - Unloaded	82,115	Assume geosynthetic source ~850-miles from site (possibly South Carolina) 60 extra trips for piping, seed, fertilizer, mulch, straw wattles, and concrete - source 1000 miles away average
Material Delivery Miles - Loaded	82,115	Assume geosynthetic source ~850-miles from site (possibly South Carolina) 60 extra trips for piping, seed, fertilizer, mulch, straw wattles, and concrete - source 1000 miles away average
Estimated Total	**6,145,923**	**miles**

Table 5a: Material Quantity and Cost Estimate - Offsite Landfill

Item No.	Item	Crew	Worker Type	Workers (#)	Equipment Type	Equipment (#)	Daily Output	Labor Hours	Equipment Hours	Units	Quantity
1	**Pre-Construction**										
	Mobilization and Demobilization									LS	1
2	**Site Preparation**										
	Site Preparation: Clearing and Grubbing	B7	Operator x 1 Laborer x 5	6	Brush Chipper x 1 Crawler Loader x 1 Chainsaws x 2	4	1	3,000	2,000	AC	50
	Construction Soil Erosion and Sediment Controls	B62	Operator x 1 Laborer x 2	3	Skid Steer x 1	1	650	2,308	769	LF	50,000
	Construction Facilities - Office Trailer	-	-	-	-	-	-	-	-	LS	1
	Construction Facilities - Storage Trailers (2)	-	-	-	-	-	-	-	-	LS	2
	Construction Facilities - Portable Toilets (4)	-	-	-	-	-	-	-	-	MO	36
	Dust Control	B59	Truck Driver x 1	1	Water Truck x 1	1	1	4,800	4,800	DAY	480
	Haul Road Maintenance	B86A	Operator x 1	1	Grader x 1	1	1	1,440	1,440	DAY	144
3	**Dewatering, Unwatering, and Stormwater Management**										
	Unwatering, Dewatering, and Stormwater Management for the Primary Ash Pond	B10K	Operator x 1 Laborer x 0.5	1.5	Pump x 1	1	1	49,275	32,850	DAY	3285
	Water Management (additives, sampling)	-	-	-	-	-	-	-	-	DAY	3285
	Unwatering, Dewatering, and Stormwater Management for Lake Jake and Settling Pond	B10K	Operator x 1 Laborer x 0.5	1.5	Pump x 1	1	1	2,700	1,800	DAY	180
	Outlet structure modification and temporary drainage features	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	0.05	300	200	LS	1
	Dewatering Sumps Installation	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	1	6,000	4,000	EA	400
4	**Closure**										
	Excavation of Ash Material										
	Excavation of ash material	B14J	Operator x 1 Laborer x 0.5	1.5	Front End Loader x 1	1	3,800.00	22,500	15,000	CY	5,700,000
	Hauling material offsite	B34C	Truck Driver x 1	1	Haul Truck x 1	1	48	1,187,500	1,187,500	CY	5,700,000
	Spreading of Material	B10B	Operator x 1 Laborer x 0.5	1.5	Dozer x 1	1	1,000.00	85,500	57,000	CY	5,700,000
	Compaction of Material	B10Y	Operator x 1 Laborer x 0.5	1.5	Vibratory Roller x 1	1	2,300.00	37,174	24,783	CY	5,700,000
	Fine grading of ash surface OR clean closed area	B11L	Operator x 1 Laborer x 1	2	Grader x 1	1	1.84	4,394	2,197	AC	404
	Piezometer and Monitoring Well Extensions	C18	Laborer x 1.125	1.125	Concrete Cart x 1	1	1.00	0	0	EA	0
	Material Conditioning (drying, stabilizing)	-	-	-	-	-	-	-	-	CY	5,700,000
	Offsite Disposal Fee	-	-	-	-	-	-	-	-	CY	5,700,000
5	**Onsite Landfill Closure**										
	Clay layer, 1.5-ft (onsite landfill closure)										
	Excavation and Loading of Material	B14J	Operator x 1 Laborer x 0.5	1.5	Front End Loader x 1	1	3,800	115	77	CY	29,163
	Hauling Material	B34F	Truck Driver x 1	1	Dump Truck x 1	1	528	552	552	CY	29,163
	Spreading of Material	B10B	Operator x 1 Laborer x 0.5	1.5	Dozer x 1	1	1,000	437	292	CY	29,163
	Compacting Material	B10D	Operator x 1 Laborer x 0.5	1.5	Dozer x 1 Compactor x 1	1	2,000	219	146	CY	29,163
	Finish grading material	B11L	Operator x 1 Laborer x 1	2	Grader x 1	1	1.84	127	64	AC	12
	Geomembrane, 40-mil LLDPE	HDR1	Operator x 2 Laborer x 10	12	Skid Steer x 1 Forklift x 1	5	2	702	293	AC	12
	Geotextile, 8-oz.	HDR1	Operator x 2 Laborer x 10	12	Skid Steer x 1 Forklift x 1	5	2	702	293	AC	12
	Anchor Trench	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	250	0	0	LF	
	Temporary Anchor Trench	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	250	0	0	LF	
	Drainage Pipes on Geomembrane	HDR1	Operator x 2 Laborer x 10	12	Skid Steer x 1 Forklift x 1	5	7,500	56	23	LF	3,510
	Placement of Protective Cover Soil (onsite source)										
	Excavation and Loading of Material	B14J	Operator x 1 Laborer x 0.5	1.5	Front End Loader x 1	1	3,800.00	115	77	CY	29,163
	Hauling Material	B34F	Truck Driver x 1	1	Dump Truck x 1	1	528.00	552	552	CY	29,163
	Spreading of Material	B10B	Operator x 1 Laborer x 0.5	1.5	Dozer x 1	1	1,000.00	437	292	CY	29,163
	Finish grading material	B11L	Operator x 1 Laborer x 1	2	Grader x 1	1	1.84	127	64	AC	12
	Placement of Vegetative Soil (onsite source)										
	Excavation and Loading of Material	B14J	Operator x 1 Laborer x 0.5	1.5	Front End Loader x 1	1	3,800.00	38	26	CY	9,721
	Hauling Material	B34F	Truck Driver x 1	1	Dump Truck x 1	1	528.00	184	184	CY	9,721
	Spreading of Material	B10B	Operator x 1	1.5	Dozer x 1	1	1,000.00	146	97	CY	9,721
	Finish grading material	B11L	Operator x 1 Laborer x 1	2	Grader x 1	1	1.84	127	64	AC	12
	Installation of drainage channels									*LF*	*3,510*
	Erosion Control Blanket	2 Clab	Laborer x 2	2	-	0	1000	390	0	SY	19,500
	Installation of drainage letdowns									*LF*	*1,170*
	Riprap	B30	Operator x 1 Truck Driver x 2	3	Excavator x 1 Dump Trucks x 2	3	100	624	624	SY	2,080
	Geotextile, 10 oz.	B62	Operator x 1 Laborer x 2	3	Skid Steer x 1	1	2,500	25	8	SY	2,080
6	**Stormwater and Perimeter**										
	Removal of Outlet Structure	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	0.10	150	100	LS	1
	Removal of Outlet Pipe	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	0.20	75	50	LS	1
	Installation of permanent stormwater culverts, riprap aprons, an	B14A	Operator x 1 Laborer x 0.5	1.5	Excavator x 1	1	0.10	150	100	LS	1
	Establish Access Roads									*LF*	*13,500*
	Gravel	B32	Operator x 3 Laborer x 1	4	Grader x 1 Roller x 1 Dozer x 1	3	5,000	360	270	SY	45,000
	Geotextile, 10 oz.	B62	Operator x 1 Laborer x 2	3	Skid Steer x 1	1	2,500	540	180	SY	45,000
	Seed, fertilize, and maintain vegetated surfaces										
	Seeding	B66	Operator x 1	1	Loader-Backhoe x 1	1	1.5	3,000	3,000	AC	450
	Fertilizing	B66	Operator x 1	1	Loader-Backhoe x 1	1	3	1,500	1,500	AC	450
	Mulch (select areas/steep slopes)	B66	Operator x 1	1	Loader-Backhoe x 1	1	140,000	124	124	SF	1,742,400
	Repair initial erosion	B66	Operator x 1	1	Loader-Backhoe x 1	1	1	410	410	AC	41
7	**Engineering and Construction Support**										
	Final Closure Design, Local Permitting Support, and Bid Support	HDR2	Engineering Staff x 4	4	-	0	0.01	4,000	0	LS	1
	Engineering Support and CQA during Construction	HDR3	CQA Staff x 1 Engineering Staff x 1	2	Truck x 1	1	0.001	20,000	10,000	LS	1

	Labor Hours:	**Equipment Hours:**
	1,442,878	**1,353,799**
Contingency (30%)	**1,875,741**	**1,759,939**

Notes:

1. RS Means used as reference - adjusted based on project size, location, type.
2. Grey crews were established based on HDR relevant project experience.

Table 5b: Labor, Equipment, and Mileage Estimate - Closure by Removal -Offsite Landfill- Totals

Item	Quantity	Assumptions
Labor Total Hours	1,875,741	10-hr days
Duration of Onsite Construction in Days	1,620	Working days, 9 months per year for 9 yrs, 20-working days per month average
Average Daily Crew Size	116	Crew Members
Daily Labor Mobilization Miles	13,130,188	Average of 70 miles round trip per day
Vehicles Miles Onsite	430,483	2 mile round trip from gate to parking 5 miles per day for CQA tech and Construction Supervisor 10% Contingency for site visitors (client and engineering support)
Equipment Mobilization Miles - Unloaded	263,991	Average of 300 miles one way for equipment hauling Average 1 load of equipment 2,000 Equipment working hours
Equipment Mobilization Miles - Loaded	263,991	Average of 300 miles one way for equipment hauling Average 1 load of equipment per working week
Daily Equipment Miles Onsite	1,620,000	Average of ~20 crew members running equipment Assume 50 miles per piece of equipment (average 5 mph, 10-hrs per day)
Onsite Haul Truck Miles - Unloaded	0	34 CY Haul Truck 4000 ft cycle
Onsite Haul Truck Miles - Loaded	0	34 CY Haul Truck 4000 ft cycle
Offsite Haul Truck Miles - Unloaded	25,909,091	16.5 CY Dump Truck 75 mile trip
Offsite Haul Truck Miles - Loaded	25,909,091	16.5 CY Dump Truck 75 mile trip
Material Delivery Miles - Unloaded	63,938	Assume geosynthetic source ~850-miles from site (possibly South Carolina) 60 extra trips for piping, seed, fertilizer, mulch, straw wattles, and concrete - source 1000 miles away average
Material Delivery Miles - Loaded	63,938	Assume geosynthetic source ~850-miles from site (possibly South Carolina) 60 extra trips for piping, seed, fertilizer, mulch, straw wattles, and concrete - source 1000 miles away average
Estimated Total	**67,654,711**	**miles**

Attachment B

Final Closure Plans and Material Specifications

Closure Drawings For

IPGC Newton Power Station

Primary Ash Pond Closure

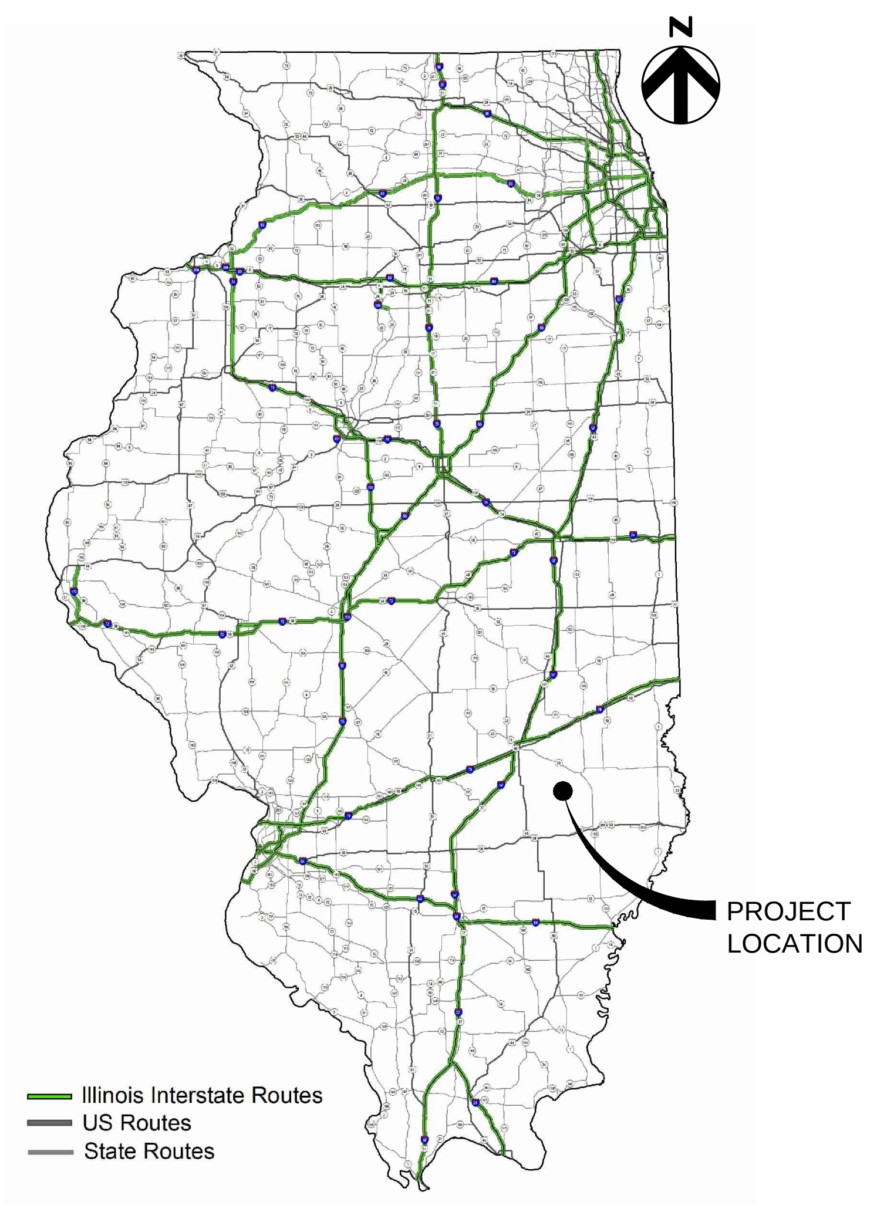
Construction Permit Application

Project No.
10296144

Jasper County, IL
April 2022

DRAFT 4.20.22

INDEX OF DRAWINGS



STATE MAP
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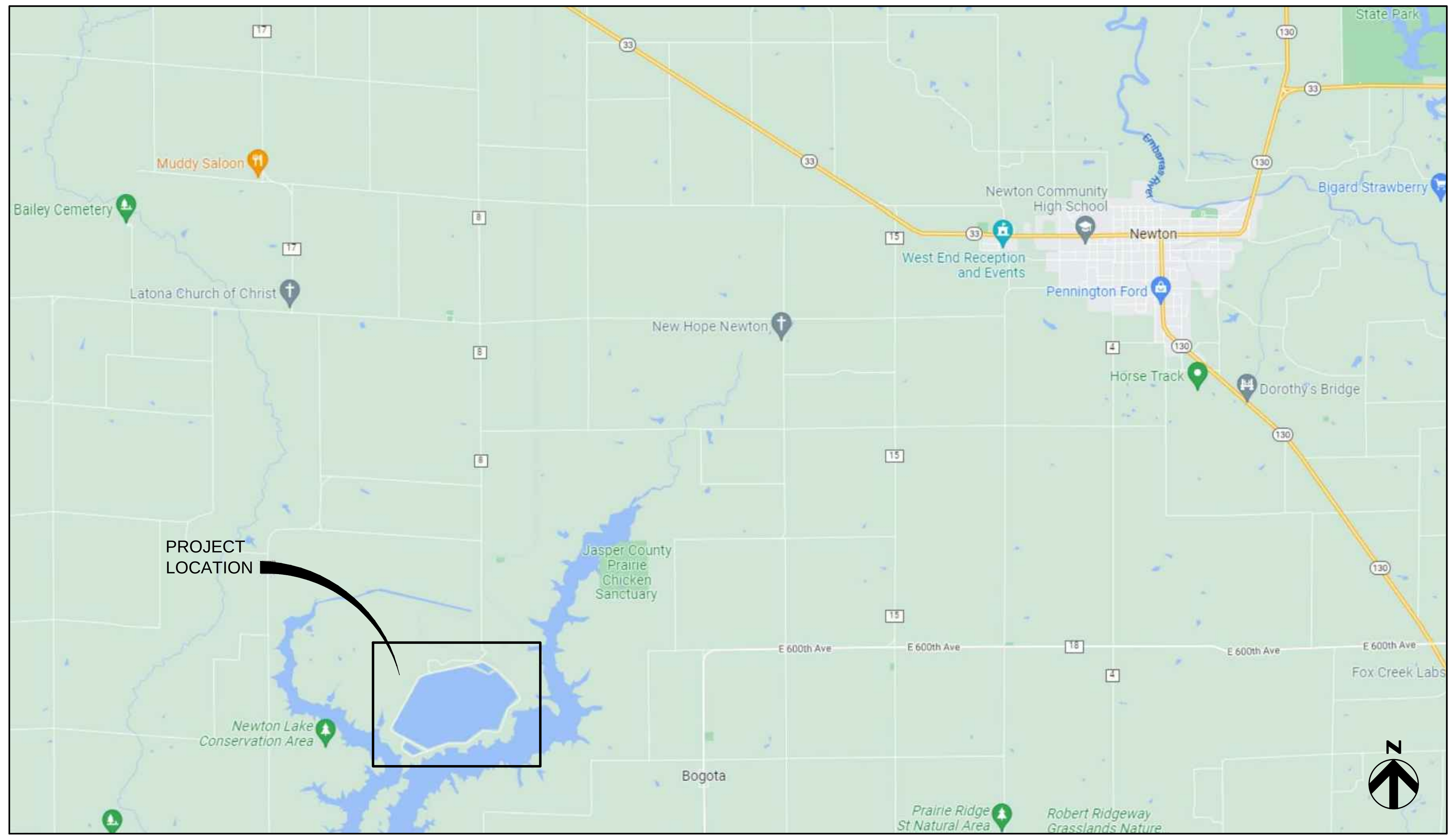
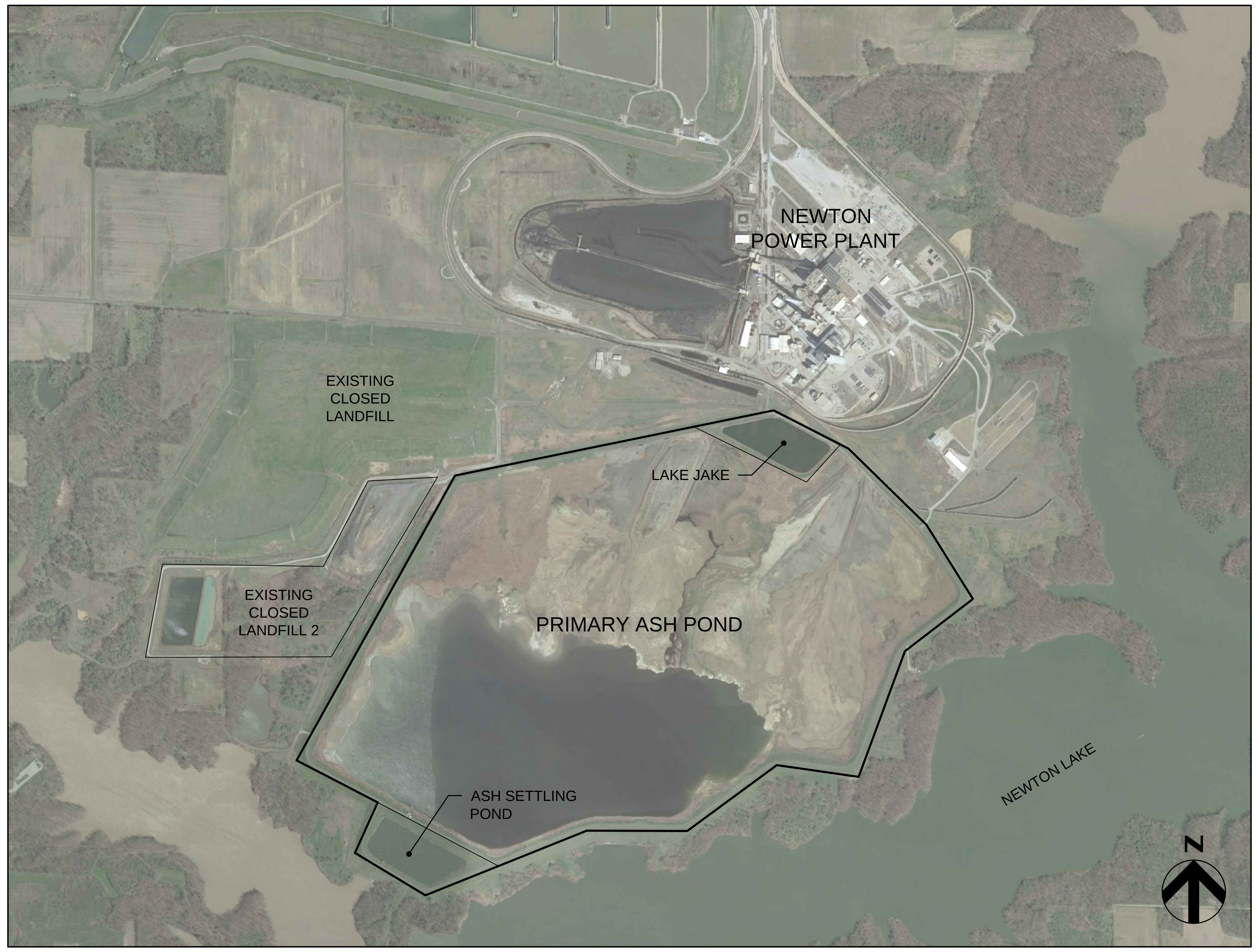
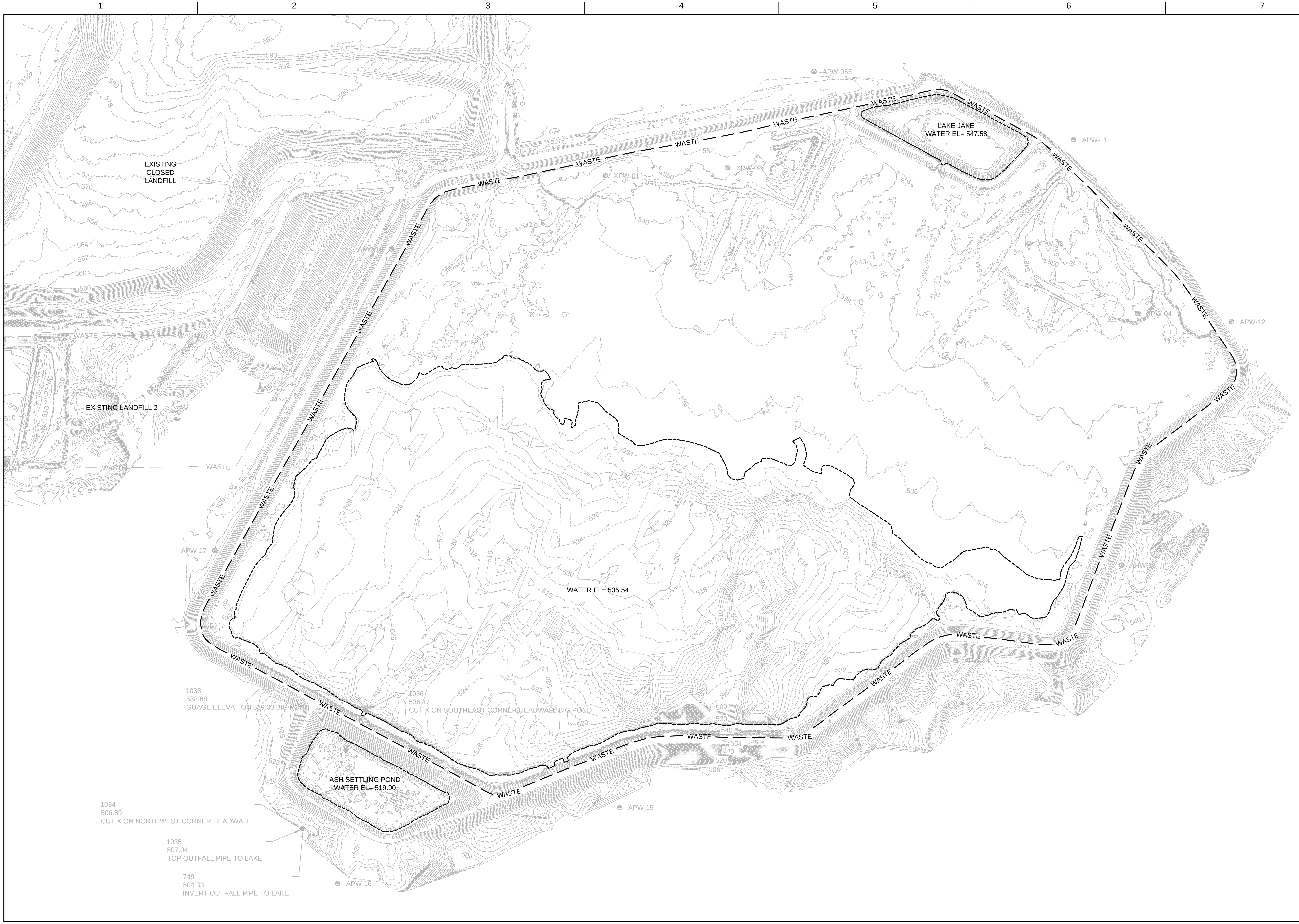


PROJECT LOCATION MAP
SCALE: 1" = 6000'



PROJECT SITE MAP
SCALE: 1" = 1000'



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LEGEND

— — — — WASTE —	ESTIMATED ASH POND BOUNDARY
— — — — WASTE —	EXISTING LANDFILL BOUNDARY
- - - - - - - - - -	LIMITS OF BATHYMETRIC SURVEY
——— 550 ———	EXISTING MAJOR CONTOUR
– – – – – – – – – –	EXISTING MINOR CONTOUR
ⓦ	EXISTING GROUNDWATER WELL

NOTES

1. EXISTING GRADES REPRESENT EXISTING TOPOGRAPHIC AND BATHYMETRIC SURVEY PROVIDED BY INGENAE DATE DECEMBER 2, 2020 AND DECEMBER 14, 2020 RESPECTIVELY.
2. SOLID WASTE BOUNDARY ESTIMATED FROM INTERIOR EDGE OF CONTAINMENT BERM.

ISSUE	DATE	DESCRIPTION
A	04/20/2022	ISSUED FOR REVIEW

PROJECT MANAGER	M. ROBERTS
CIVIL	G. WILLIAMS
CIVIL	K. KINLEY
DRAWN BY	M. BICKFORD
PROJECT NUMBER	10296144

DRAFT

ILLINOIS POWER GENERATING COMPANY
NEWTON POWER PLANT
PRIMARY ASH POND CLOSURE

PHASE 1 - DEWATERING
EXISTING CONDITIONS PLAN

0 1" 2"

FILENAME 00C101.DWG

SCALE 1" = 300'

SHEET
00C101

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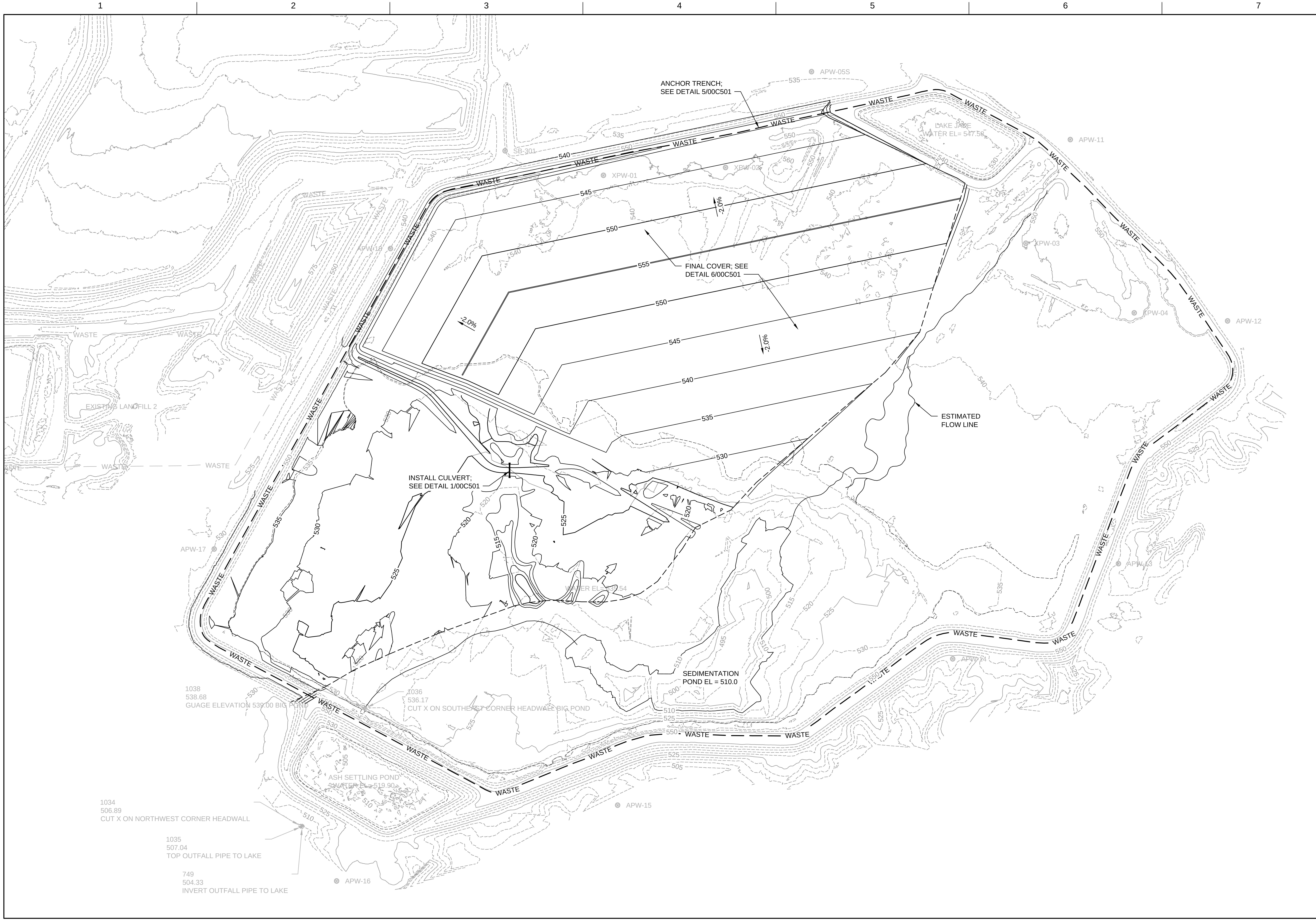

N

LEGEND

— — WASTE —	ESTIMATED ASH POND BOUNDARY
— — WASTE —	EXISTING LANDFILL BOUNDARY
- - - - - -	LIMITS OF BATHYMETRIC SURVEY
—— 550 ——	EXISTING MAJOR CONTOUR
- - - - - -	EXISTING MINOR CONTOUR
—— 550 ——	PROPOSED MAJOR CONTOUR
————	PROPOSED MINOR CONTOUR
— — — —	PHASE BOUNDARY
Ⓦ	EXISTING GROUNDWATER WELL

NOTES

1. EXISTING GRADES REPRESENT EXISTING TOPOGRAPHIC AND BATHYMETRIC SURVEY PROVIDED BY INGENAE DATE DECEMBER 2, 2020 AND DECEMBER 14, 2020 RESPECTIVELY.
2. SOLID WASTE BOUNDARY ESTIMATED FROM INTERIOR EDGE OF CONTAINMENT BERM.
3. PROPOSED GRADES REPRESENT ANTICIPATED TOP OF FINAL POND CLOSURE ELEVATIONS.
4. CLOSURE BY REMOVAL GRADES ESTIMATED BASED ON HISTORIC TOPOGRAPHY AND MAY VARY BASED ON FIELD CONDITIONS.
5. PHASED CLOSURE TOTAL AREA MAY VARY BASED ON DEWATERING PROGRESS AND WASTE ENCOUNTERED.

WEST CLOSURE EARTHWORK	
CUT	535,000 CY
CLOSURE FILL	1,465,400 CY
ROAD FILL	12,400 CY
NET	942,800 CY [FILL]

D
C
B
A

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HDR

ISSUE	DATE	DESCRIPTION
A	04/20/2022	ISSUED FOR REVIEW

PROJECT MANAGER	M. ROBERTS
CIVIL	G. WILLIAMS
CIVIL	K. KINLEY
DRAWN BY	M. BICKFORD
PROJECT NUMBER	10296144

DRAFT

ILLINOIS POWER GENERATING COMPANY
NEWTON POWER PLANT
PRIMARY ASH POND CLOSURE

PHASE 2 - CLOSURE
WEST ASH POND CLOSURE GRADING

0 1" 2"

FILENAME 00C102.DWG
SCALE 1" = 300'

SHEET
00C102

LEGEND

— — WASTE — —	ESTIMATED ASH POND BOUNDARY
— — WASTE — —	EXISTING LANDFILL BOUNDARY
- - - - - -	LIMITS OF BATHYMETRIC SURVEY
——— 550 ———	EXISTING MAJOR CONTOUR
- - - - - -	EXISTING MINOR CONTOUR
——— 550 ———	PROPOSED MAJOR CONTOUR
———————	PROPOSED MINOR CONTOUR
— — — — —	PHASE BOUNDARY
⊗	EXISTING GROUNDWATER WELL
—·—·—·—	FINAL COVER DRAIN PIPE
—·—>—·—>	DRAINAGE CHANNEL WITH DRAIN PIPE; SEE DETAIL 3/00C501
—>>——>>	LETDOWN STRUCTURE WITH DRAIN PIPE; SEE DETAIL 2/00C501
🟩	ESTIMATED PHASE 3 CLOSURE-IN-PLACE (CIP); SEE DETAIL 6/00C501
🟩	ESTIMATED PHASE 3 CLOSURE-BY-REMOVAL (CBR)

NOTES

1. EXISTING GRADES REPRESENT EXISTING TOPOGRAPHIC AND BATHYMETRIC SURVEY PROVIDED BY INGENAE DATE DECEMBER 2, 2020 AND DECEMBER 14, 2020 RESPECTIVELY.
2. SOLID WASTE BOUNDARY ESTIMATED FROM INTERIOR EDGE OF CONTAINMENT BERM.
3. PROPOSED GRADES REPRESENT ANTICIPATED TOP OF FINAL POND CLOSURE ELEVATIONS.
4. CLOSURE BY REMOVAL GRADES ESTIMATED BASED ON HISTORIC TOPOGRAPHY AND MAY VARY BASED ON FIELD CONDITIONS.
5. PHASED CLOSURE TOTAL AREA MAY VARY BASED ON DEWATERING PROGRESS AND WASTE ENCOUNTERED.
6. POND GRADES MAY VARY IN ORDER TO FIND SUITABLE SOILS.

EAST POND EARTHWORK	
CUT	366,700 CY
CLOSURE FILL	1,008,900 CY
ROAD FILL	3,500 CY
NET	645,700 CY [FILL]
FINAL CLOSURE STORMWATER POND EXCAVATION	
CUT	642,300 CY
WEST CLOSURE IMPROVEMENTS	
CAPPED CLOSURE	135.5 AC
CLEAN CLOSURE	88.4 AC
ACCESS ROAD SURFACE	6,100 LF
DRAINAGE CHANNEL	11,200 LF
LETDOWN STRUCTURE	1,950 LF
4" DRAIN PIPE	20,600 LF

ISSUE	DATE	DESCRIPTION
A	04/20/2022	ISSUED FOR REVIEW

PROJECT MANAGER	M. ROBERTS
CIVIL	G. WILLIAMS
CIVIL	K. KINLEY
DRAWN BY	M. BICKFORD
PROJECT NUMBER	10296144

DRAFT

ILLINOIS POWER GENERATING COMPANY
NEWTON POWER PLANT
PRIMARY ASH POND CLOSURE

PHASE 3 - CLOSURE
EAST ASH POND CLOSURE GRADING

0 1" 2"

FILENAME 00C103.DWG
SCALE 1" = 300'

SHEET
00C103

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LEGEND

— — — WASTE —	ESTIMATED ASH POND BOUNDARY
— — — WASTE —	EXISTING LANDFILL BOUNDARY
—— 550 ——	EXISTING MAJOR CONTOUR
- - - - - - -	EXISTING MINOR CONTOUR
—— 550 ——	PROPOSED MAJOR CONTOUR
————	PROPOSED MINOR CONTOUR
— — — — — —	PHASE BOUNDARY
Ⓦ	EXISTING GROUNDWATER WELL
—··—··—··—	FINAL COVER DRAIN PIPE
══ > ══ > ══	DRAINAGE CHANNEL WITH DRAIN PIPE; SEE DETAIL 3/00C501
══ >> ══ >> ══	LETDOWN STRUCTURE WITH DRAIN PIPE; SEE DETAIL 2/00C501
🟩	ESTIMATED PHASE 4 CLOSURE-IN-PLACE (CIP); SEE DETAIL 6/00C501
🟩	ESTIMATED PHASE 4 CLOSURE-BY-REMOVAL (CBR)
▢	PREVIOUS CLOSURE AREA

NOTES

1. EXISTING GRADES REPRESENT EXISTING TOPOGRAPHIC AND BATHYMETRIC SURVEY PROVIDED BY INGENAE DATE DECEMBER 2, 2020 AND DECEMBER 14, 2020 RESPECTIVELY.
2. SOLID WASTE BOUNDARY ESTIMATED FROM INTERIOR EDGE OF CONTAINMENT BERM.
3. PROPOSED GRADES REPRESENT ANTICIPATED TOP OF FINAL POND CLOSURE ELEVATIONS.
4. CLOSURE BY REMOVAL GRADES ESTIMATED BASED ON HISTORIC TOPOGRAPHY AND MAY VARY BASED ON FIELD CONDITIONS.
5. PHASED CLOSURE TOTAL AREA MAY VARY BASED ON DEWATERING PROGRESS AND WASTE ENCOUNTERED.
6. POND GRADES MAY VARY IN ORDER TO FIND SUITABLE SOILS.

REMAINING POND EARTHWORK	
CUT	787,700 CY
CLOSURE FILL	326,200 CY
ROAD FILL	128,400 CY
NET	333,100 CY [CUT]
FINAL CLOSURE STORMWATER POND EXCAVATION	
CUT	129,200 CY
EAST CLOSURE IMPROVEMENTS	
CAPPED CLOSURE	74.7 AC
CLEAN CLOSURE	21.5 AC
ACCESS ROAD SURFACE	5,200 LF
DRAINAGE CHANNEL	4,700 LF
LETDOWN STRUCTURE	350 LF
4" DRAIN PIPE	6,500 LF

ISSUE	DATE	DESCRIPTION
A	04/20/2022	ISSUED FOR REVIEW

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CIVIL	G. WILLIAMS
CIVIL	K. KINLEY
DRAWN BY	M. BICKFORD
PROJECT NUMBER	10296144

DRAFT

ILLINOIS POWER GENERATING COMPANY
NEWTON POWER PLANT
PRIMARY ASH POND CLOSURE

PHASE 4 - CLOSURE
REMAINING ASH POND CLOSURE GRADING

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SHEET 00C104

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N

LEGEND

- — — — WASTE — ESTIMATED ASH POND BOUNDARY
- — — — WASTE — EXISTING LANDFILL BOUNDARY
- —— 550 —— EXISTING MAJOR CONTOUR
- - - - - - EXISTING MINOR CONTOUR
- —— 550 —— PROPOSED MAJOR CONTOUR
- ———— PROPOSED MINOR CONTOUR
- ———— PHASE BOUNDARY
- Ⓦ EXISTING GROUNDWATER WELL
- —··—··— FINAL COVER DRAIN PIPE
- —— > —— > —— DRAINAGE CHANNEL WITH DRAIN PIPE; SEE DETAIL 3/00C501
- —— >> —— >> —— LETDOWN STRUCTURE WITH DRAIN PIPE; SEE DETAIL 2/00C501
- 🟩 ESTIMATED PHASE 5 CLOSURE-IN-PLACE (CIP); SEE DETAIL 6/00C501
- 🟩 ESTIMATED PHASE 5 CLOSURE-BY-REMOVAL (CBR)
- ⬜ PREVIOUS CLOSURE AREA

NOTES

1. EXISTING GRADES REPRESENT EXISTING TOPOGRAPHIC AND BATHYMETRIC SURVEY PROVIDED BY INGENAE DATE DECEMBER 2, 2020 AND DECEMBER 14, 2020 RESPECTIVELY.
2. SOLID WASTE BOUNDARY ESTIMATED FROM INTERIOR EDGE OF CONTAINMENT BERM.
3. PROPOSED GRADES REPRESENT ANTICIPATED TOP OF FINAL POND CLOSURE ELEVATIONS.
4. CLOSURE BY REMOVAL GRADES ESTIMATED BASED ON HISTORIC TOPOGRAPHY AND MAY VARY BASED ON FIELD CONDITIONS.
5. PHASED CLOSURE TOTAL AREA MAY VARY BASED ON DEWATERING PROGRESS AND WASTE ENCOUNTERED.
6. POND GRADES MAY VARY IN ORDER TO FIND SUITABLE SOILS.

FINAL CLOSURE STORMWATER POND EXCAVATION	
CUT	628,667 CY
REMAINING CLOSURE IMPROVEMENTS	
CAPPED CLOSURE	50.4 AC
CLEAN CLOSURE	80.9 AC
ACCESS ROAD SURFACE	2,650 LF
DRAINAGE CHANNEL	3,500 LF
LETDOWN STRUCTURE	2,850 LF
4" DRAIN PIPE	9,850 LF

ISSUE	DATE	DESCRIPTION
A	04/20/2022	ISSUED FOR REVIEW

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CIVIL	G. WILLIAMS
CIVIL	K. KINLEY
DRAWN BY	M. BICKFORD
PROJECT NUMBER	10296144

DRAFT

ILLINOIS POWER GENERATING COMPANY
NEWTON POWER PLANT
PRIMARY ASH POND CLOSURE

PHASE 5 - CLOSURE
REMAINING ASH POND CLOSURE CAPPING

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SCALE	1" = 300'

SHEET
00C105

A	04/20/2022	ISSUED FOR REVIEW
ISSUE	**DATE**	**DESCRIPTION**

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CIVIL	G. WILLIAMS
CIVIL	K. KINLEY
DRAWN BY	M. BICKFORD
PROJECT NUMBER	10296144

DRAFT

ILLINOIS POWER GENERATING COMPANY
NEWTON POWER PLANT
PRIMARY ASH POND CLOSURE

FINAL CLOSURE CONDITIONS

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SCALE 1" = 300'

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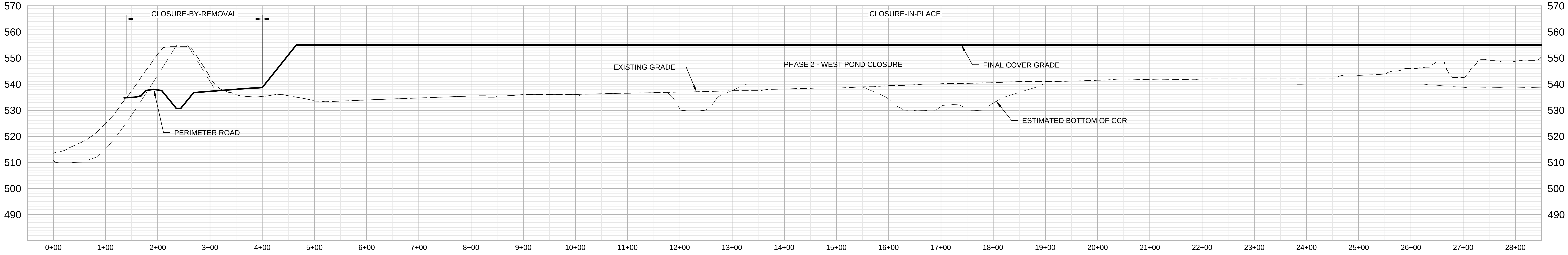
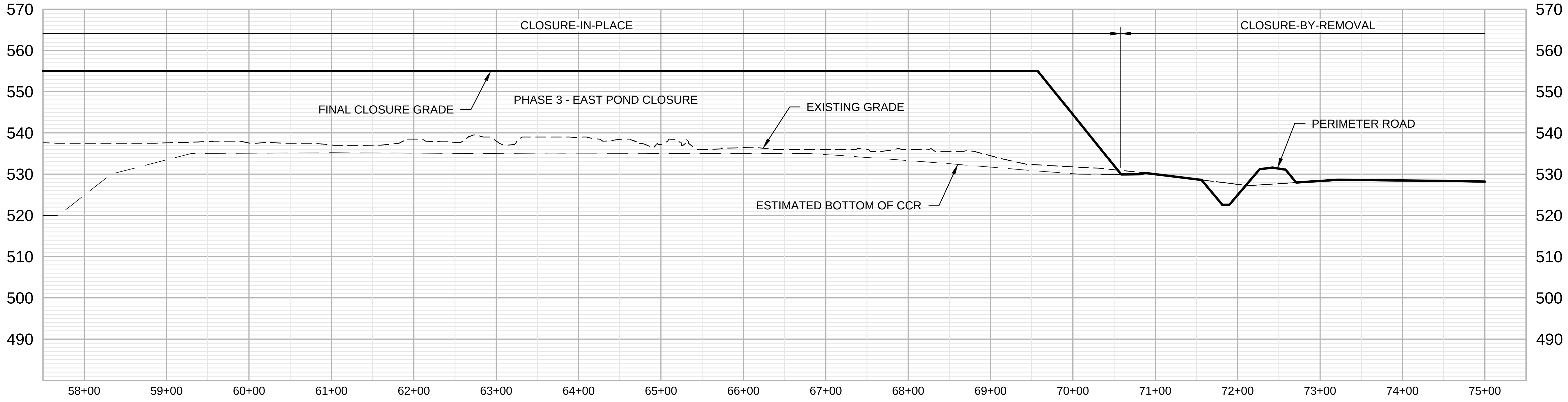


A-A
00C106
SECTION A-A
HORIZ: 1" = 100' | VERT: 1" = 20'

A-A
00C106
SECTION A-A (cont.)
HORIZ: 1" = 100' | VERT: 1" = 20'



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SECTION A-A (cont.)
HORIZ: 1" = 100' | VERT: 1" = 20'

ISSUE	DATE	DESCRIPTION
A	04/20/2022	ISSUED FOR REVIEW

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CIVIL G. WILLIAMS
CIVIL K. KINLEY
DRAWN BY M. BICKFORD
PROJECT NUMBER 10296144

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ILLINOIS POWER GENERATING COMPANY
NEWTON POWER PLANT
PRIMARY ASH POND CLOSURE

CROSS SECTIONS

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SCALE AS NOTED

SHEET
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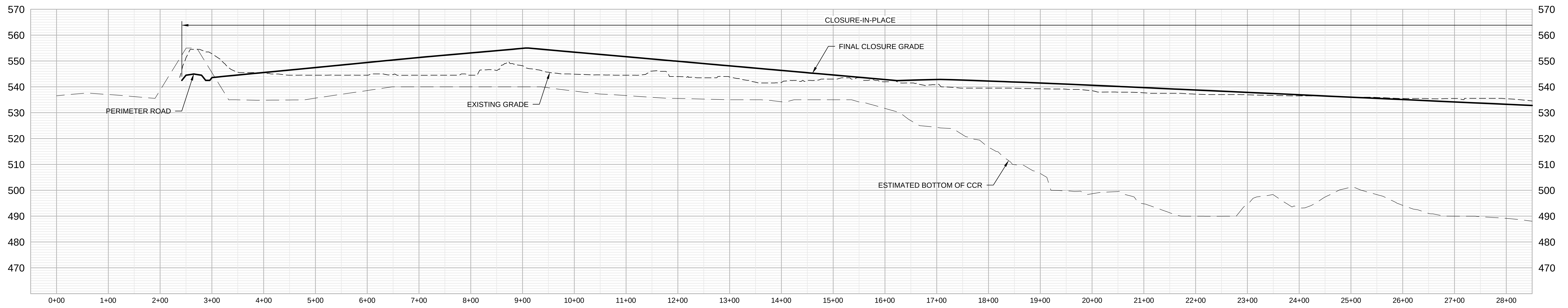

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00C106
SECTION B-B
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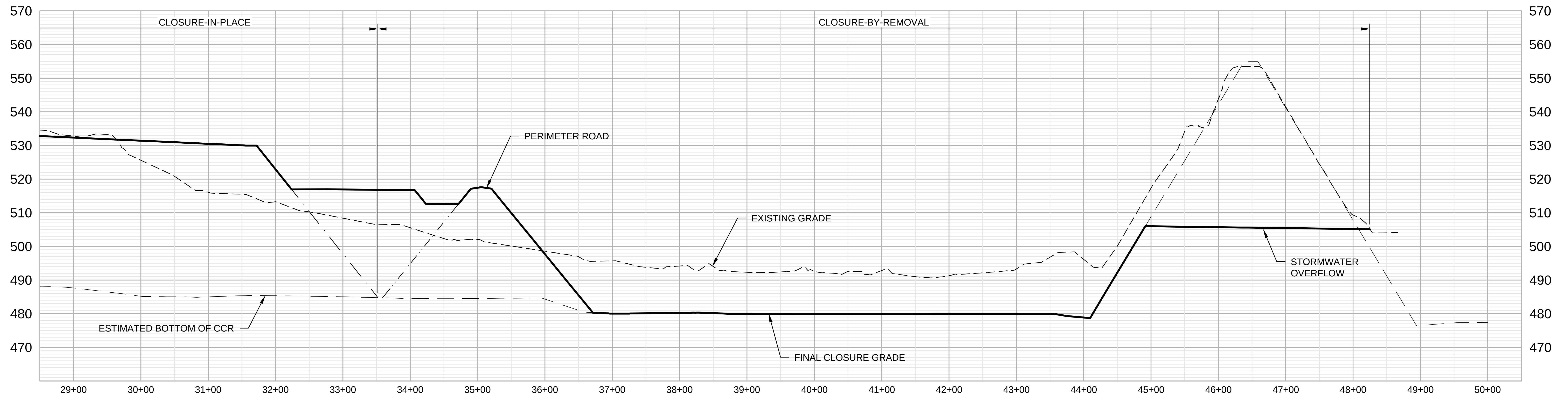

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00C106
SECTION B-B (cont.)
HORIZ: 1" = 100' | VERT: 1" = 20'

HDR

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A	04/20/2022	ISSUED FOR REVIEW

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PROJECT NUMBER	10296144

DRAFT

ILLINOIS POWER GENERATING COMPANY
NEWTON POWER PLANT
PRIMARY ASH POND CLOSURE

CROSS SECTIONS

0 1" 2"

FILENAME 00C302.DWG
SCALE AS NOTED

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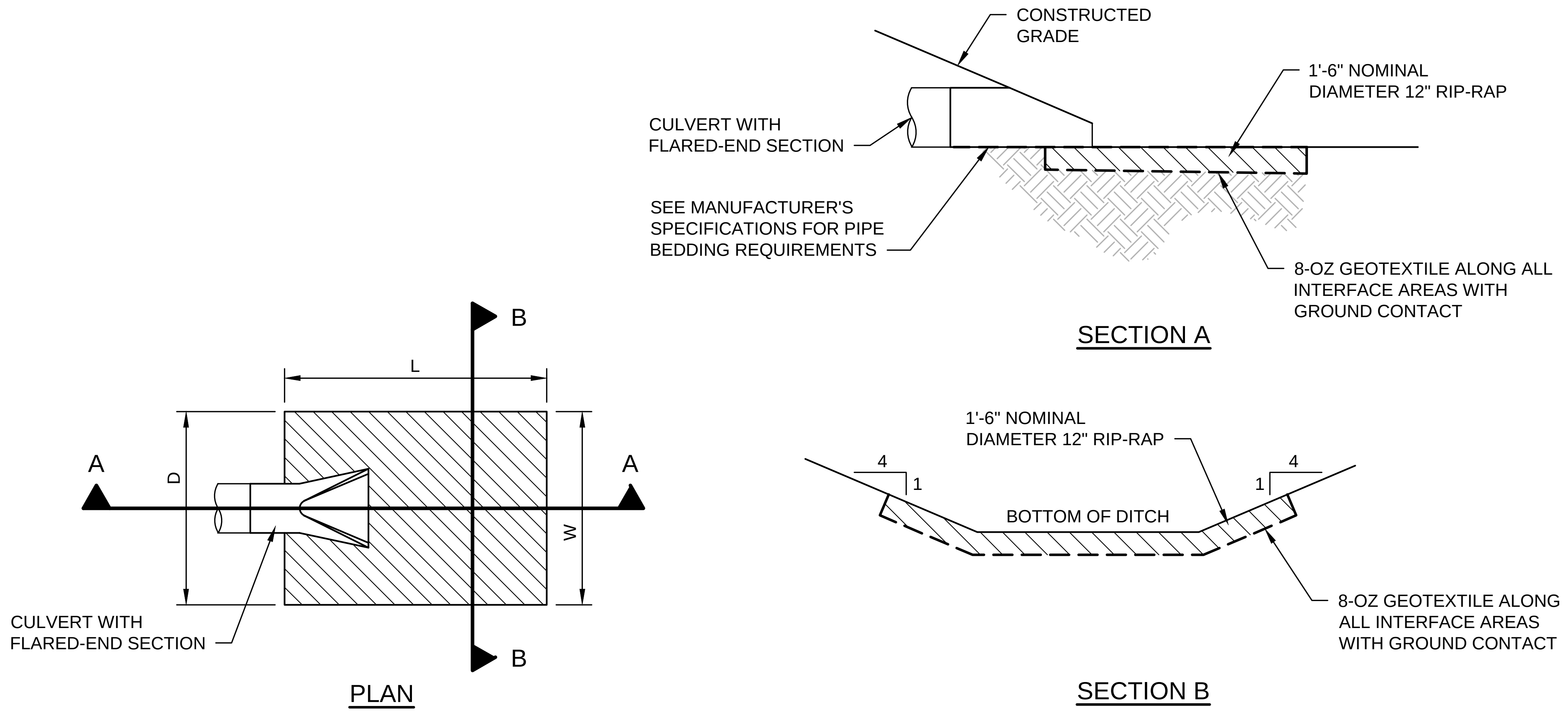

1 FLARED-END SECTION AND REVETMENT STONE APRON
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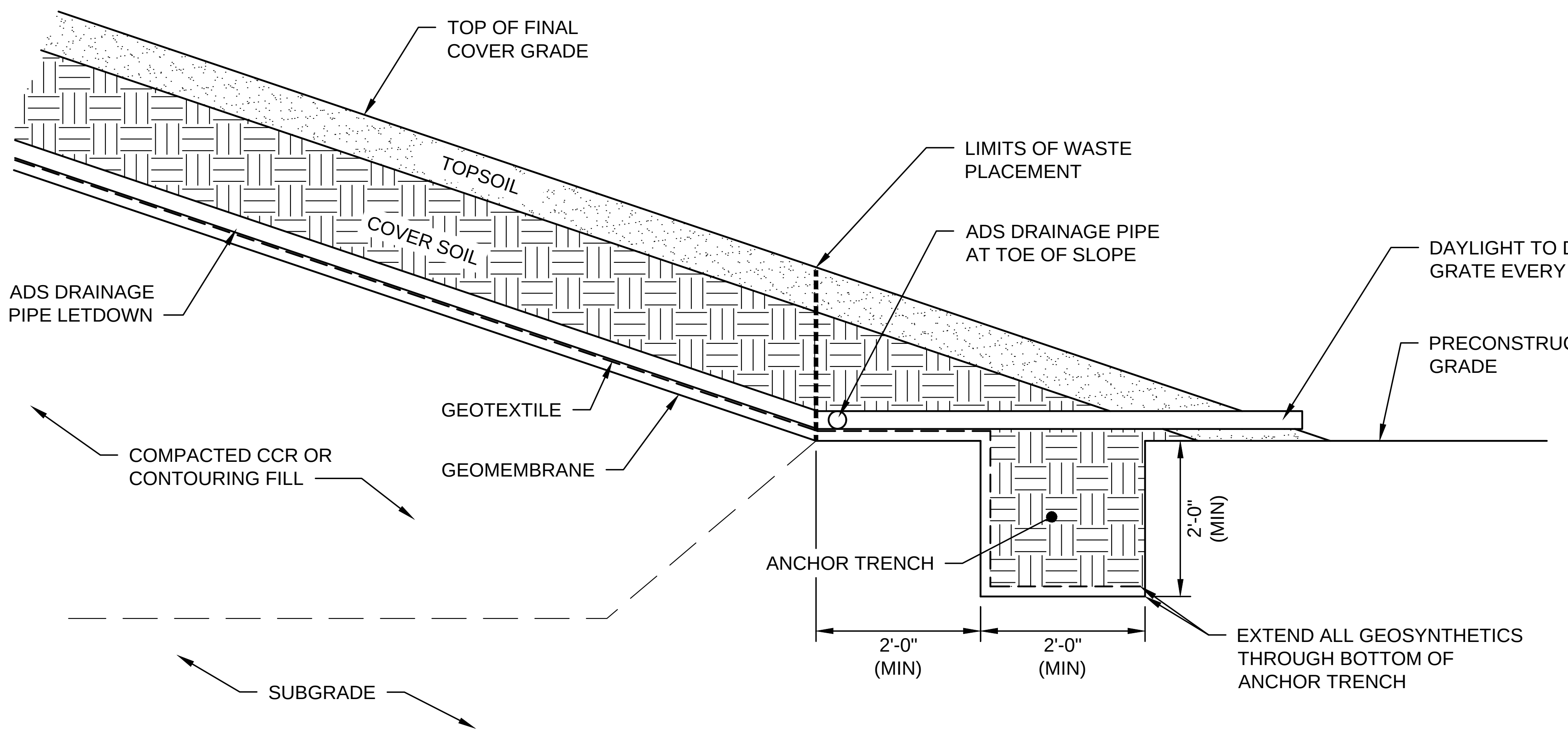

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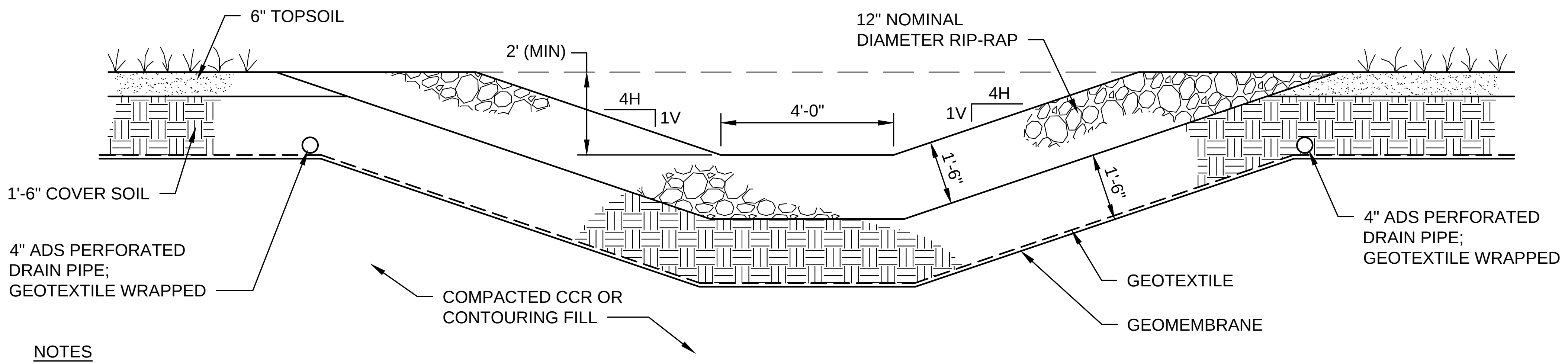
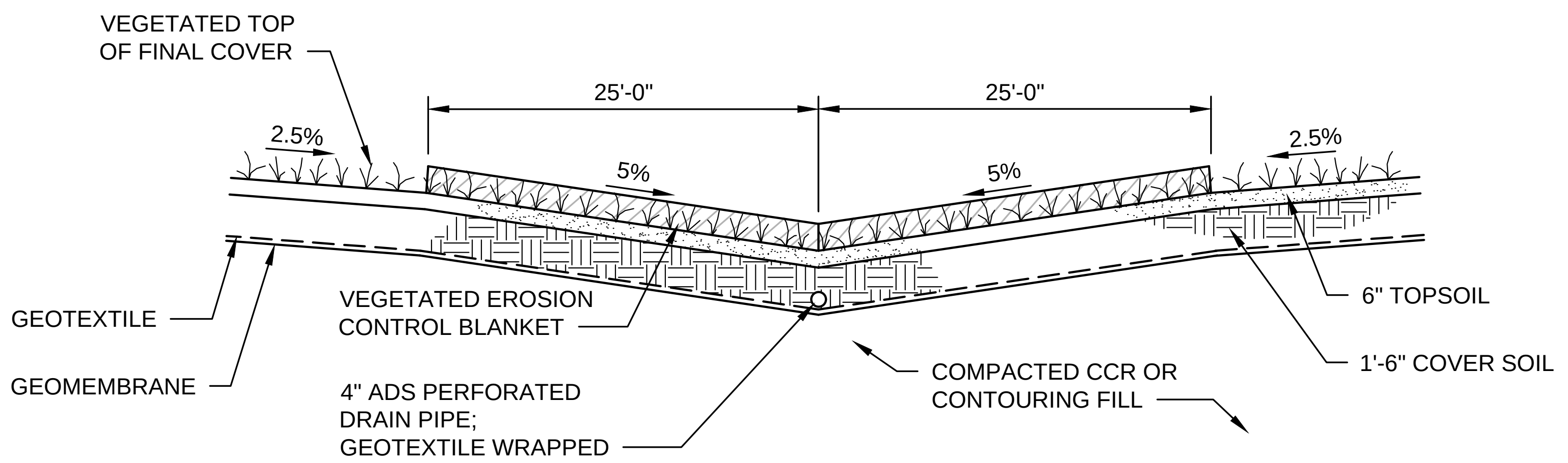


NOTES
1. CENTRAL LETDOWN STRUCTURE DRAINAGE CHANNEL TO BE INSTALLED WITH A 12-FOOT WIDE BOTTOM AND 3-FOOT DEPTH.

2 LETDOWN STRUCTURE
00C103 NO SCALE



3 DRAINAGE CHANNEL
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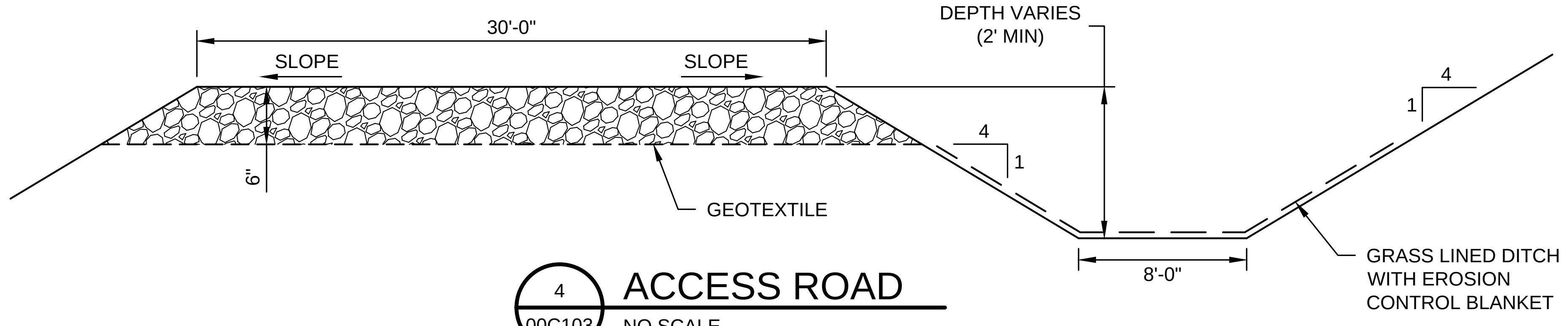

4 ACCESS ROAD
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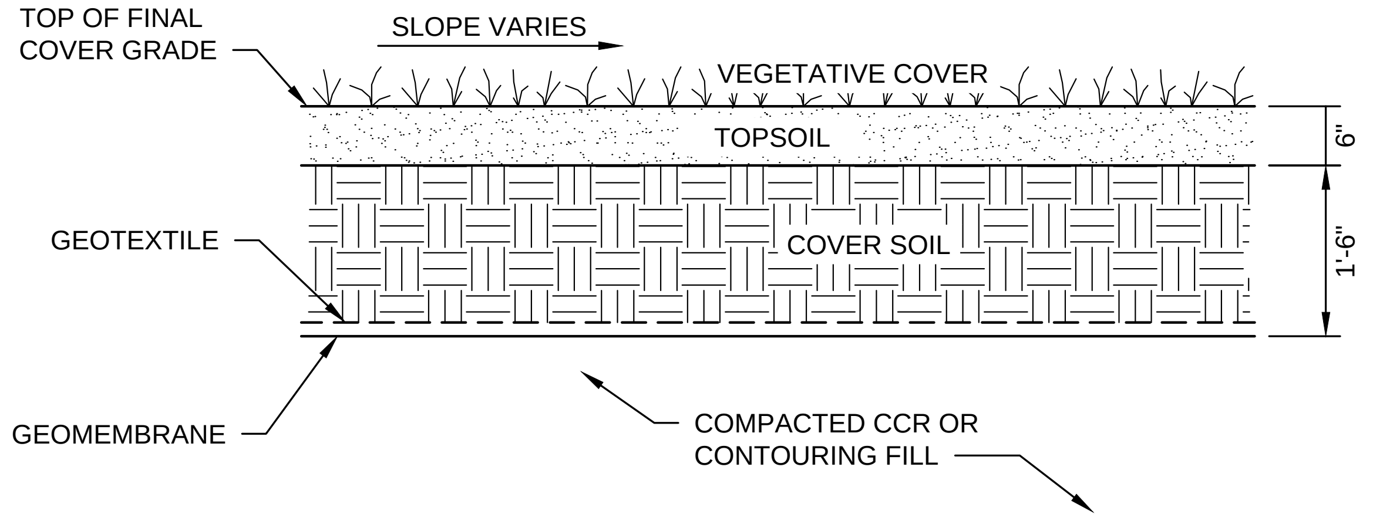
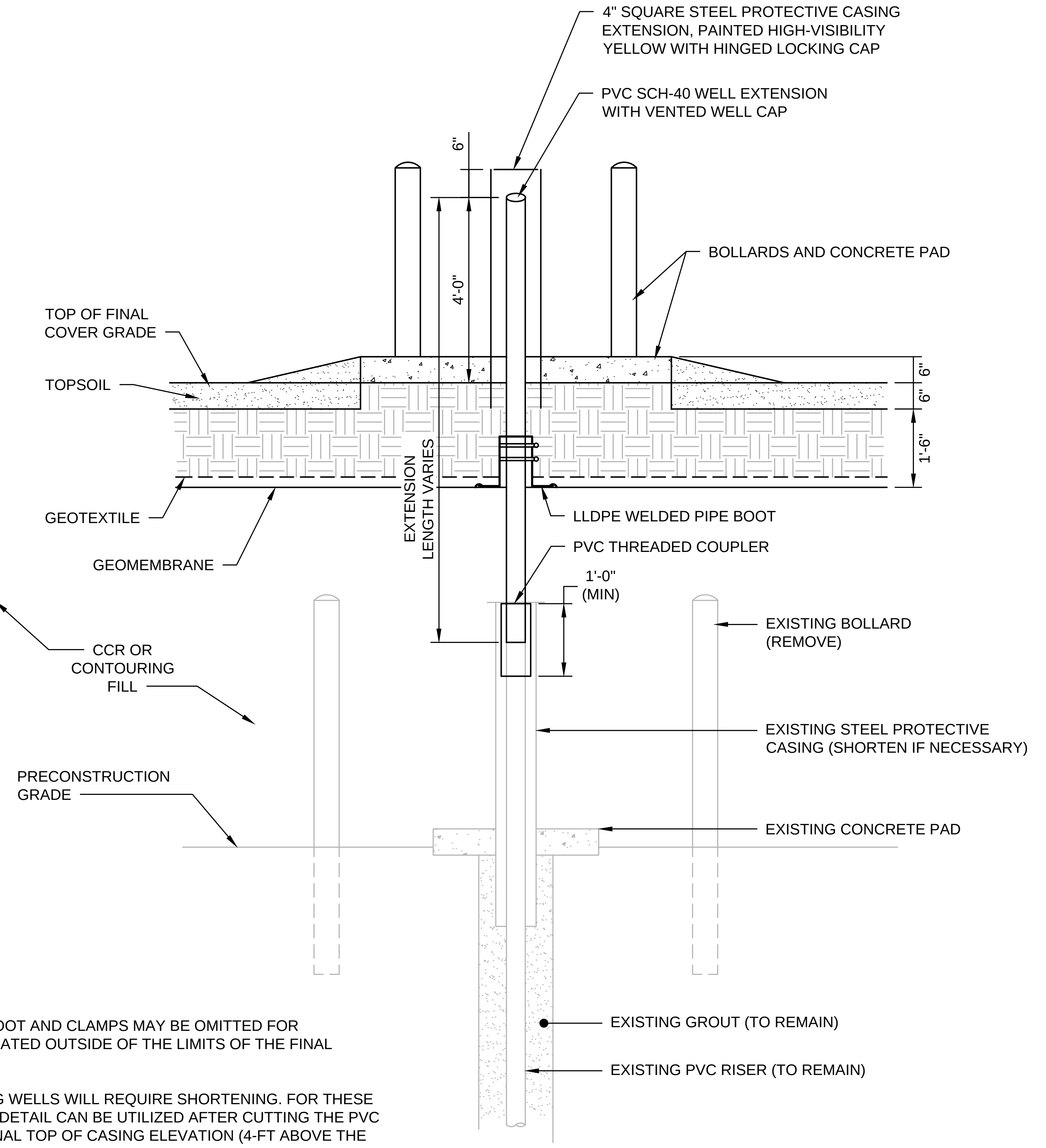


6 FINAL COVER
00C103 NO SCALE

NOTES
1. THE FINAL COVER IS DESIGNED WITH A 50-MIL LLDPE MICRODRAIN GEOMEMBRANE MATERIAL WITH DRAINAGE STUDS INSTALLED UPWARDS ND TEXTURED SIDE INSTALLED DOWNWARDS OVERLAIN WITH 8-OZ. GEOTEXTILE.
2. OPTIONALLY, THE MICRODRAIN GEOMEMBRANE AND GEOTEXTILE MAY BE REPLACED WITH A TEXTURED 40-MIL LLDPE GEOMEMBRANE OVERLAIN WITH A GEOCOMPOSITE DRAINAGE LAYER. ENGINEER TO VERIFY GEOCOMPOSITE MATERIAL MEETS DESIGN REQUIREMENTS FOR DRAINAGE.



NOTES
1. THE LLDPE PIPE BOOT AND CLAMPS MAY BE OMITTED FOR PIEZOMETERS LOCATED OUTSIDE OF THE LIMITS OF THE FINAL COVER SYSTEM.
2. SOME MONITORING WELLS WILL REQUIRE SHORTENING. FOR THESE WELLS, THE SAME DETAIL CAN BE UTILIZED AFTER CUTTING THE PVC CASING TO THE FINAL TOP OF CASING ELEVATION (4-FT ABOVE THE FINAL COVER ELEVATION) AFTER THE GRADE AROUND THE WELL IS LOWERED.
3. FOR MONITORING WELLS LOCATED IN AN ACTIVE SITE ROADWAY, THE ABOVE-GRADE PROTECTIVE CASING, BOLLARDS, AND CONCRETE PAD MAY BE SUBSTITUTED WITH A FLUSH MOUNT CASING AND A CONCRETE PAD AT LEAST 3-FT IN DIAMETER AND 4-INCHES IN THICKNESS. ALL OTHER DETAILS ARE TO REMAIN THE SAME.

7 MONITORING WELL EXTENSION
00C103 NO SCALE

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A	04/20/2022	ISSUED FOR REVIEW

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CIVIL	G. WILLIAMS
CIVIL	K. KINLEY
DRAWN BY	M. BICKFORD
PROJECT NUMBER	10296144

DRAFT

ILLINOIS POWER GENERATING COMPANY
NEWTON POWER PLANT
PRIMARY ASH POND CLOSURE

DETAILS

0 1" 2"

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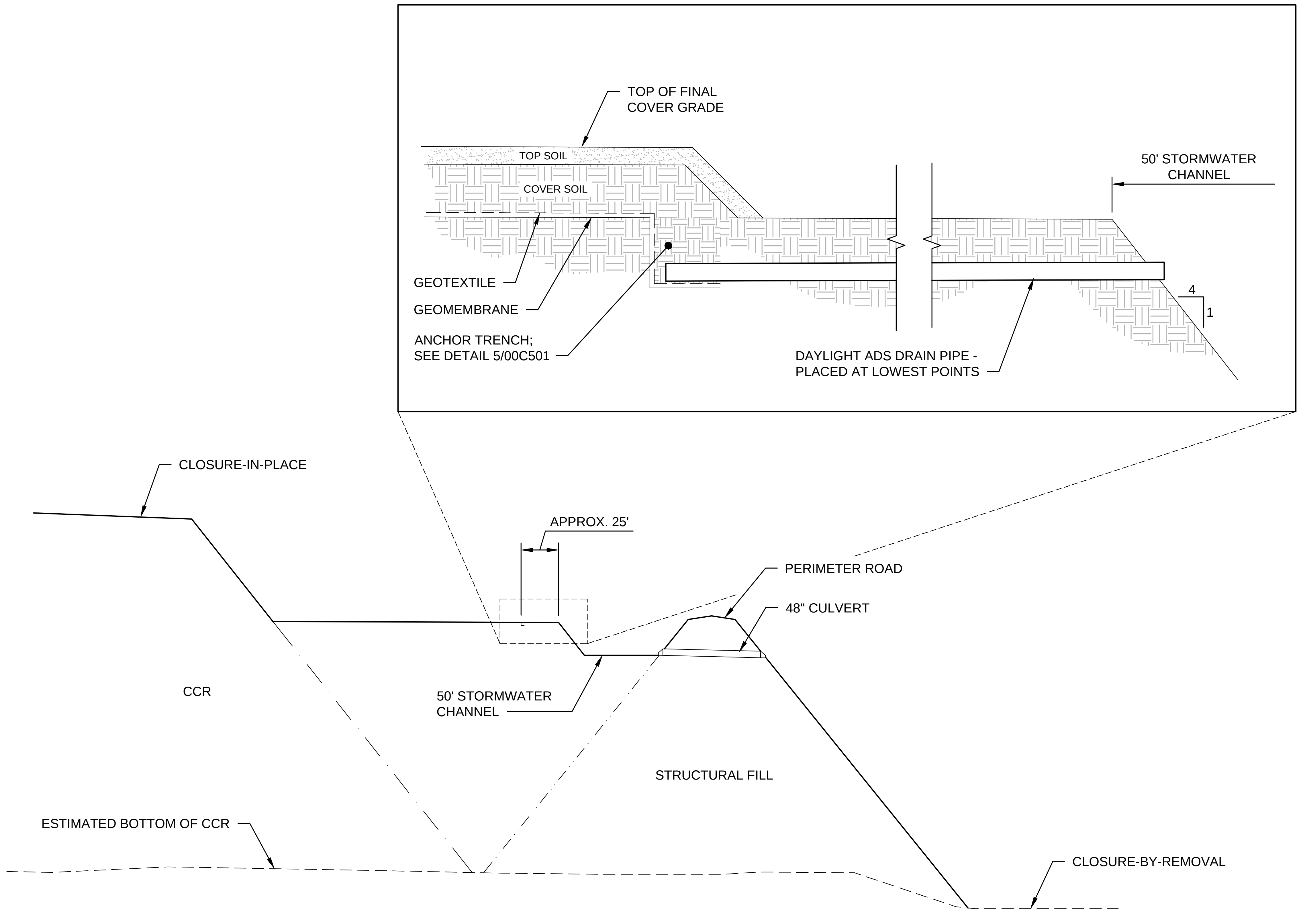

1
00C105

SOUTH PERIMETER ROAD STORMWATER CHANNEL ANCHOR TRENCH

NO SCALE

ISSUE	DATE	DESCRIPTION
A	04/20/2022	ISSUED FOR REVIEW

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CIVIL	K. KINLEY
DRAWN BY	M. BICKFORD
PROJECT NUMBER	10296144

DRAFT

ILLINOIS POWER GENERATING COMPANY
NEWTON POWER PLANT
PRIMARY ASH POND CLOSURE

DETAILS

0 1" 2"

FILENAME 00C502.DWG
SCALE AS NOTED

SHEET
00C502

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Attachment C

Hydrologic and Hydraulic Design of Stormwater Management System

Illinois Power Generating Company
HYDROLOGIC AND HYDRAULIC DESIGN OF STORMWATER MANAGEMENT SYSTEM

Newton Power Plant
Primary Ash Pond

April 2022

Table of Contents

FIGURES

APPENDICES

1. PURPOSE

This calculation package provides documentation of the hydrologic and hydraulic calculations of the cover design for final closure of the approximately 400-acre Illinois Power Generating Company (IPGC) Newton Power Station Primary Ash Pond closure area. The analysis evaluates whether the proposed drainage features are adequate to manage 25-year and 100-year, 24-hour storm events. This analysis was completed to satisfy Illinois Administrative Code Part 845.510 and in support of the Closure Plan requirements detailed in IAC Section 845.750(a) to design a final cover with stormwater features promoting drainage away from the closure area and minimizing the need for future maintenance of the CCR surface impoundment.

2. ASSUMPTIONS AND DATA INPUT

The proposed drainage features were designed to convey both 25-year and 100-year, 24-hour storm events. AutoCAD Civil 3D Hydroflow Hydrographs Extension was used for the hydrologic analysis. The model estimated peak runoff rate for each subcatchment based on precipitation volumes derived from NOAA Atlas 14 data. AutoCAD Civil 3D Hydroflow Express Extension was used to confirm that proposed culverts would be sufficient to handle peak flows from 25-year and 100-year, 24-hour storm event. The following presents a summary of the assumptions and inputs used in the stormwater model.

2.1 Hydrology Inputs

Summary of Site Data

The existing surface grades for the Newton Ash Landfill are based on a topographic and bathymetric survey provided by IngenAE, LLC, dated December 2, 2020, and December 14, 2020. The proposed grades used for the hydrologic and hydraulic evaluation represent anticipated conditions and may be further modified during the design process, or due to field conditions at the time of construction.

Rainfall Depth and Distribution

Rainfall depths are based on the National Oceanic and Atmospheric Administration's (NOAA) Precipitation Frequency Data Server (PFDS). Precipitation estimates for the site location were input into the Hydrographs model for the 25-, and 100-year, 24-hour storm events. The NOAA PFDS outputs for the site location are included in **Appendix A**.

The Type II SCS storm distribution was used to evaluate the high rainfall intensity portion of the storm as a critical flood risk analysis. The SCS is considered a conservative model and is therefore considered adequate for design purposes. The following storm events were used to size the proposed stormwater features:

- Type II SCS 25-year, 24-hour event is 5.26 inches (Design)
- Type II SCS 100-year, 24-hour event is 6.58 inches (Convey Safely)

Curve Number (CN)

Curve numbers (CN) were estimated using Table 2-2 in the TR-55 manual embedded in the Hydrographs model. The curve numbers assumed soil conditions in the immediate vicinity of the landfill were generally type C, based on a review of the United States Department of Agriculture's (USDA) Web Soil Survey as shown on the map print out in **Appendix A**. The final cover will include, from bottom to top, a geomembrane, geotextile, 1.5-ft of cover soil, 0.5-feet of topsoil, and established vegetation. The selected SCS curve number for the site was based on the following parameters:

- Open spaces, lawns, and parks
- Condition – Good
- Hydrologic Soil Group – C
- CN = 74

Subcatchments

The Newton basin design is comprised of seven (7) areas which stormwater drainage was analyzed. These approximate areas are indicated on Figure 1 and comprised as follows:

- Western Channel Area – 69-acres
- Eastern Channel Area – 61-acres
- Central Channel Area – 73-acres
- West Central Channel Area – 39-acres
- East Central Area – 14 Acres
- Inside Perimeter Road Area – 29-acres
- Storage and Outlet Area 144-acres of which 35-acresis wetted pond

The total approximate 400-acres is comprised of approximately 255-acres of cover, 144-acres of closure by removal, and 30-acres of ancillary areas. The areas were subdivided based on the grading plan and proposed drainage features, including drainage channels and letdowns to the perimeter ditch. Dividing the area into multiple subcatchments allows for a refined model that provides detailed information on stormwater flow over the site. The drainage map and associated subcatchment parameters are shown in **Figure 1**.

2.2 Hydraulic Inputs and Results

The following section summarizes the design assumptions and hydraulic parameters used to perform the hydraulic analysis.

Perimeter Ditches

The location and slope of the perimeter ditches were based on the permit application grading plans, approximated as 30% design. Perimeter drainage ditches were calculated as west and east channels and represent the interior ditch of the perimeter roadway. These perimeter drainage ditches originate at the north end of the construction and route stormwater toward the south. Initially the ditches are two (2) feet deep but increase depth as the flow continues south. Both ditches are minimally, 8-ft wide, 2-ft deep with 4:1 sideslopes. Channels were modeled at a minimum section of 2 ft of depth and a nominal 4-ft of depth and found to be sufficient to convey the 100-year, 24-hour storm event in both cases.

Drainage Channels

Areas of final cover have a 2% slope. The drainage terraces are designed as V-ditches with sideslopes of 5%, a longitudinal slope of about 0.5%, and a maximum flow depth of 1.25-ft. According to Manning's n for channels, a roughness coefficient of 0.022 was used for a clean, straight channel without rifts or deep pools.

Letdowns

The letdown structures were designed as trapezoidal structures with 1.5-feet of 12-inch diameter riprap. The riprap overlays a geomembrane, geotextile, and 1.5-feet of cover soil. The base of each letdown is 4-feet wide with 3:1 side slopes. The Manning's n used for the letdown structures was 0.026. The longitudinal slope of the letdowns varied based on location.

Central Drainageway

Much like the letdowns described above, the central drainage way consists of a trapezoidal channel with 1.5 feet of 12-inch diameter riprap. The central drainageway flows at 1% slopes, is 3 feet deep and 12 feet wide. This profile is similar to the letdowns across the side but increased in size to accommodate the larger drainage area and flow.

Culverts

Culverts for the work will be installed to route stormwater under the perimeter roadway and into the borrow area pond. The culverts will be category 2 or 3 reinforced concrete pipes with appropriate bedding, and inlet and outlet protections. It may be advantageous to install headwalls to manage the pipe inlets and outlets. Pipes will be 48" and laid at 2 percent slope.

Outlet Weir

The overall drainage path for the project culminates at an area of ponded water and outlet weir. The weir is designed to be 150 feet wide, with 4:1 sideslopes and approximately a 0.2% slope. The outlet weir is intended to convey stormwater originating from the development area out to the neighboring Lake Newton. The elevation of the outfall is such that no back flow from the Lake is expected into the project area.

3. CALCULATION OUTPUTS

This calculation package is intended to compute and model various stormwater features of the site as described in the previous section. This section indicates the anticipated flow and performance of the individual drainage features.

Perimeter Ditches

The West Drainage Channel consists of 68.65-acres where a calculated flow of 199.78-cfs is expected from the 100-year, 24-hour storm event. This results in approximately 2.6-feet of flow depth, at a velocity slightly above 4 feet per second. During establishment of vegetation, it would be advantageous to utilize an erosion control matting.

The East Drainage Channel consists of 61.34-acres where a calculated flow of 178.51-cfs is expected from the 100-year, 24-hour storm event. This results in approximately 2.64-feet of flow depth, at a velocity of 3.65 feet per second. During establishment of vegetation, it would be advantageous to utilize an erosion control matting.

Drainage Channels

The design drainage terrace was indicated by the largest drainage area flowing to a terrace. This area was measured at about 12-acres, resulting in approximately 35 cubic feet per second for a 100-year, 24-hour storm event. The drainage terrace can successfully manage this flow with over 5 inches of freeboard remaining at a velocity of 2.60 feet per second.

Letdowns

The letdown structures carry various flows around the project site with minimal flows being appropriately managed through short, robust riprap letdowns.

Central Drainageway

The central drainageway consists of 72.85-acres where a calculated flow of 211-cfs is expected from the 100-year, 24-hour storm event. This results in approximately 2.14 feet of flow depth, at a velocity of 4.8 feet per second.

Culverts

The culverts will convey approximately 285-acres of runoff resulting in 827-cfs from a 100-year, 24-hour storm event. Multiple culverts are to be installed to lessen the size of necessary culvert but also to provide redundancy to the system. The 48-inch RCP culvert flowing approximately full results is 217.5-cfs at the design slope and length. Installing four total pipes, two at each location as shown on the plans, will provide a free flow scenario to limit potential of holding water within the consolidation area. Flow out of each pipe will result in the potential for highly erosive velocities. Protections of the inlet and outlet areas should be further designed prior to construction.

Outlet Weir

The outlet weir provides conveyance for the entire project area. The weir will discharge all 428.5-acres of runoff. The runoff is calculated to be 1194-cfs from the 100-year, 24-hour storm event. The weir is 150-feet wide with a 0.2 percent slope. This equates to a flow depth of 1.78 feet at a velocity of 4.27 feet per second. The tailwater condition should be even or approximately even. Final design should confirm this condition.

Figures

Drainage Mapping

HDR

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	M. ROBERTS
CIVIL	G. WILLIAMS
CIVIL	K. KINLEY
DRAWN BY	M. BICKFORD
PROJECT NUMBER	10296144

DRAFT

ILLINOIS POWER GENERATING COMPANY
NEWTON POWER PLANT
PRIMARY ASH POND CLOSURE

FINAL CLOSURE CONDITIONS

0 1" 2"

FILENAME 00C106.DWG
SCALE 1" = 300'

SHEET
00C106

DRAFT

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	M. ROBERTS
CIVIL	G. WILLIAMS
CIVIL	K. KINLEY
DRAWN BY	M. BICKFORD
PROJECT NUMBER	10296144

ILLINOIS POWER GENERATING COMPANY
NEWTON POWER PLANT
PRIMARY ASH POND CLOSURE

FINAL CLOSURE CONDITIONS

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FILENAME 00C106.DWG
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SHEET
00C106

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Appendix A

NOAA Rainfall and WebSoil Survey Reports

NOAA Atlas 14, Volume 2, Version 3
Location name: Newton, Illinois, USA*
Latitude: 38.9287°, Longitude: -88.2879°
Elevation: 533.87 ft**
* source: ESRI Maps
** source: USGS

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	0.402 (0.364-0.445)	0.477 (0.433-0.528)	0.563 (0.510-0.623)	0.632 (0.571-0.699)	0.719 (0.646-0.793)	0.787 (0.705-0.868)	0.853 (0.761-0.939)	0.920 (0.818-1.01)	1.01 (0.891-1.11)	1.08 (0.944-1.18)
10-min	0.625 (0.565-0.691)	0.745 (0.676-0.825)	0.875 (0.792-0.968)	0.976 (0.882-1.08)	1.10 (0.989-1.21)	1.19 (1.07-1.32)	1.28 (1.15-1.41)	1.37 (1.22-1.51)	1.49 (1.31-1.63)	1.57 (1.38-1.72)
15-min	0.766 (0.693-0.847)	0.910 (0.826-1.01)	1.07 (0.973-1.19)	1.20 (1.09-1.33)	1.36 (1.22-1.50)	1.48 (1.32-1.63)	1.59 (1.42-1.76)	1.71 (1.52-1.88)	1.85 (1.64-2.04)	1.96 (1.72-2.15)
30-min	1.01 (0.916-1.12)	1.22 (1.11-1.35)	1.47 (1.33-1.63)	1.67 (1.51-1.84)	1.92 (1.73-2.12)	2.11 (1.89-2.33)	2.30 (2.05-2.54)	2.49 (2.22-2.74)	2.75 (2.42-3.02)	2.94 (2.58-3.22)
60-min	1.24 (1.12-1.37)	1.50 (1.36-1.66)	1.85 (1.67-2.04)	2.12 (1.92-2.34)	2.49 (2.24-2.74)	2.78 (2.49-3.07)	3.08 (2.75-3.39)	3.38 (3.01-3.72)	3.80 (3.35-4.17)	4.12 (3.62-4.53)
2-hr	1.49 (1.35-1.66)	1.80 (1.63-2.00)	2.24 (2.02-2.48)	2.57 (2.32-2.85)	3.04 (2.73-3.35)	3.41 (3.05-3.76)	3.79 (3.38-4.17)	4.18 (3.72-4.60)	4.72 (4.16-5.18)	5.14 (4.52-5.65)
3-hr	1.58 (1.43-1.77)	1.91 (1.73-2.13)	2.37 (2.14-2.64)	2.74 (2.47-3.05)	3.25 (2.91-3.60)	3.66 (3.27-4.05)	4.09 (3.64-4.53)	4.55 (4.03-5.03)	5.18 (4.55-5.71)	5.68 (4.95-6.26)
6-hr	1.89 (1.70-2.11)	2.27 (2.05-2.54)	2.80 (2.53-3.13)	3.24 (2.91-3.61)	3.84 (3.43-4.27)	4.33 (3.86-4.81)	4.84 (4.29-5.37)	5.38 (4.74-5.96)	6.12 (5.36-6.78)	6.72 (5.83-7.45)
12-hr	2.22 (2.02-2.44)	2.67 (2.43-2.94)	3.28 (2.98-3.60)	3.77 (3.42-4.14)	4.44 (4.01-4.87)	4.98 (4.49-5.46)	5.55 (4.97-6.07)	6.14 (5.48-6.71)	6.95 (6.15-7.59)	7.59 (6.67-8.29)
24-hr	2.64 (2.47-2.84)	3.17 (2.96-3.41)	3.89 (3.63-4.18)	4.47 (4.16-4.80)	5.26 (4.88-5.65)	5.91 (5.45-6.34)	6.58 (6.04-7.06)	7.28 (6.63-7.81)	8.24 (7.44-8.88)	9.01 (8.06-9.72)
2-day	3.09 (2.89-3.33)	3.70 (3.46-3.99)	4.52 (4.22-4.87)	5.17 (4.81-5.57)	6.05 (5.61-6.51)	6.75 (6.23-7.26)	7.46 (6.85-8.04)	8.19 (7.48-8.84)	9.18 (8.32-9.94)	9.96 (8.96-10.8)
3-day	3.30 (3.10-3.53)	3.95 (3.71-4.22)	4.81 (4.52-5.15)	5.50 (5.15-5.87)	6.42 (5.99-6.86)	7.15 (6.65-7.65)	7.90 (7.30-8.46)	8.66 (7.96-9.30)	9.69 (8.83-10.4)	10.5 (9.49-11.4)
4-day	3.51 (3.31-3.73)	4.20 (3.96-4.46)	5.11 (4.82-5.42)	5.82 (5.48-6.18)	6.79 (6.37-7.21)	7.56 (7.06-8.04)	8.34 (7.75-8.88)	9.13 (8.43-9.75)	10.2 (9.34-11.0)	11.0 (10.0-11.9)
7-day	4.09 (3.87-4.34)	4.90 (4.63-5.20)	5.93 (5.60-6.29)	6.72 (6.33-7.12)	7.74 (7.28-8.21)	8.53 (8.00-9.06)	9.32 (8.70-9.91)	10.1 (9.38-10.8)	11.1 (10.3-11.9)	11.9 (10.9-12.8)
10-day	4.65 (4.39-4.94)	5.55 (5.25-5.89)	6.68 (6.30-7.09)	7.52 (7.09-7.99)	8.63 (8.11-9.15)	9.47 (8.87-10.1)	10.3 (9.61-10.9)	11.1 (10.3-11.8)	12.2 (11.2-13.0)	13.0 (11.9-13.9)
20-day	6.42 (6.08-6.78)	7.62 (7.22-8.06)	9.05 (8.57-9.58)	10.1 (9.57-10.7)	11.5 (10.9-12.2)	12.6 (11.8-13.3)	13.6 (12.7-14.4)	14.6 (13.6-15.5)	15.8 (14.7-16.9)	16.8 (15.5-17.9)
30-day	7.87 (7.49-8.28)	9.29 (8.85-9.78)	10.9 (10.3-11.4)	12.0 (11.4-12.7)	13.5 (12.8-14.2)	14.6 (13.9-15.4)	15.7 (14.8-16.6)	16.7 (15.7-17.7)	18.0 (16.8-19.1)	19.0 (17.6-20.2)
45-day	9.81 (9.35-10.3)	11.6 (11.0-12.1)	13.4 (12.8-14.1)	14.7 (14.0-15.5)	16.5 (15.6-17.3)	17.7 (16.8-18.6)	18.9 (17.9-19.9)	20.1 (18.9-21.2)	21.5 (20.2-22.7)	22.5 (21.0-23.9)
60-day	11.6 (11.1-12.2)	13.7 (13.0-14.3)	15.7 (15.0-16.5)	17.3 (16.4-18.0)	19.1 (18.2-20.0)	20.5 (19.5-21.5)	21.8 (20.7-22.9)	23.1 (21.8-24.2)	24.6 (23.1-25.9)	25.6 (24.0-27.1)

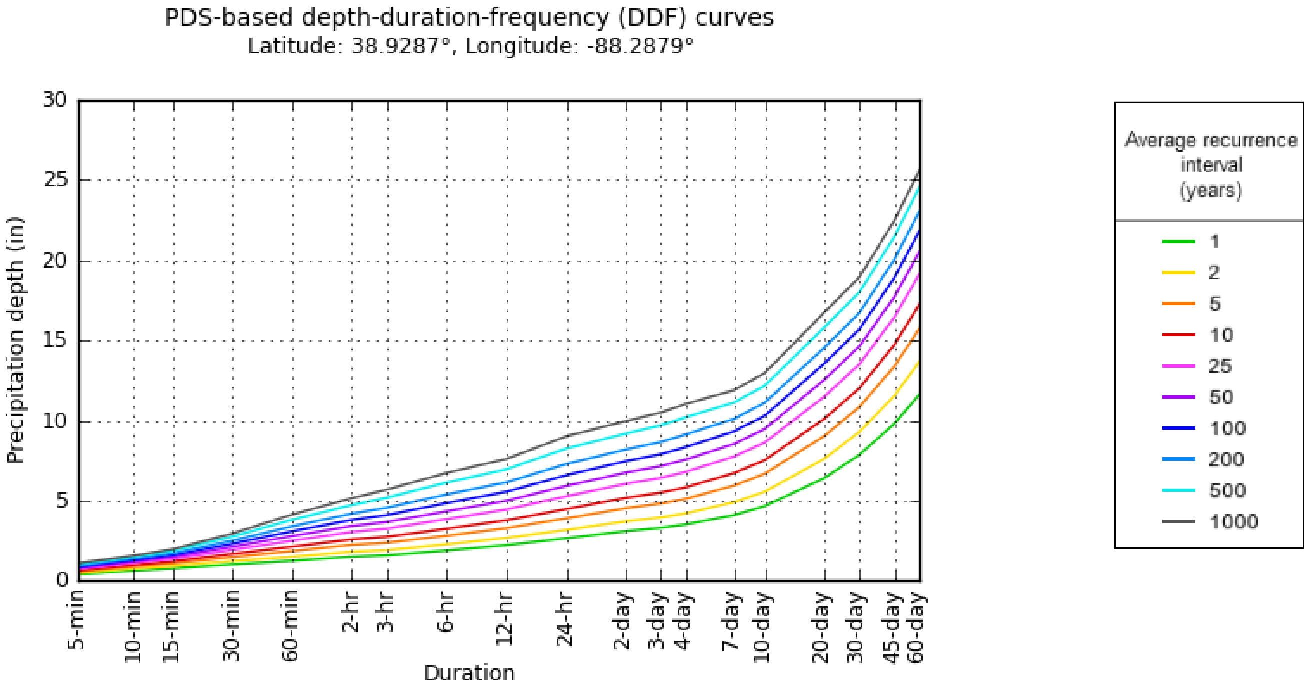
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

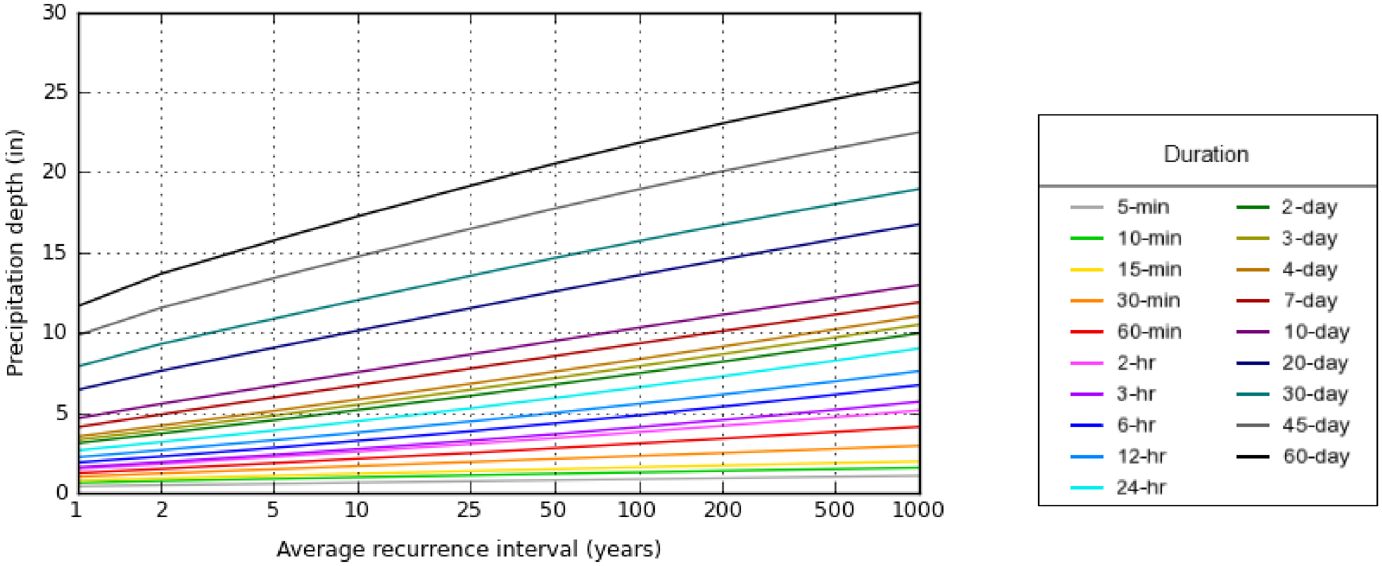
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper 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.

Back to Top

PF graphical





NOAA Atlas 14, Volume 2, Version 3

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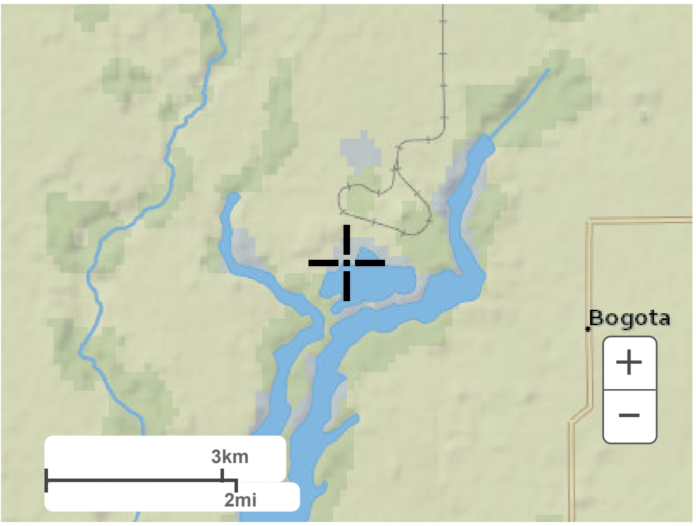
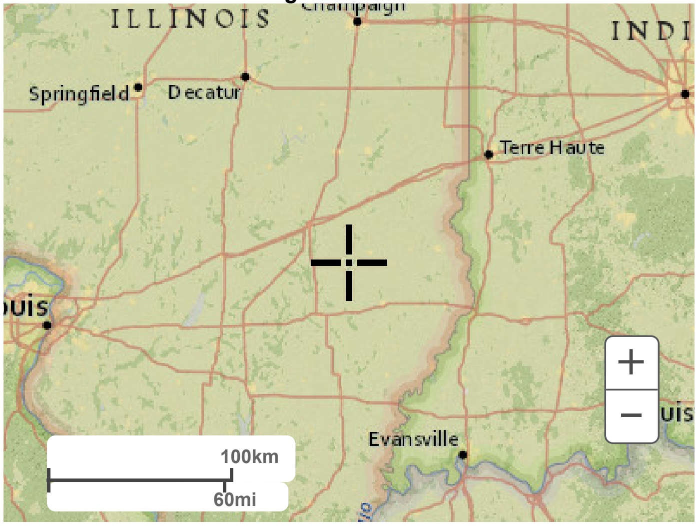
Back to Top

Maps & aerials

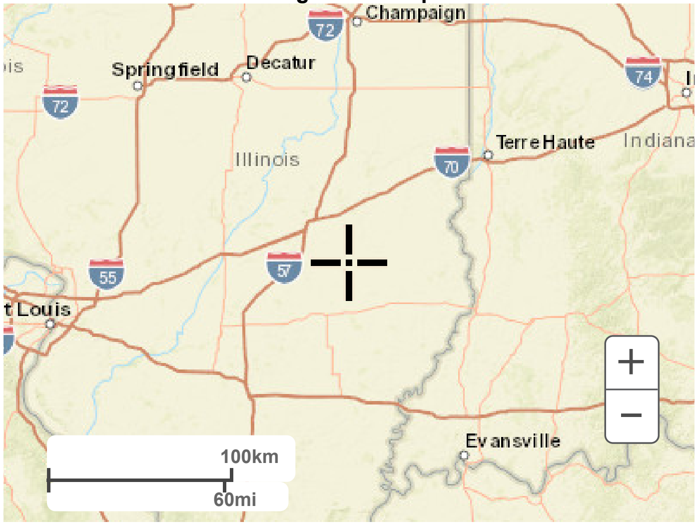
Small scale terrain



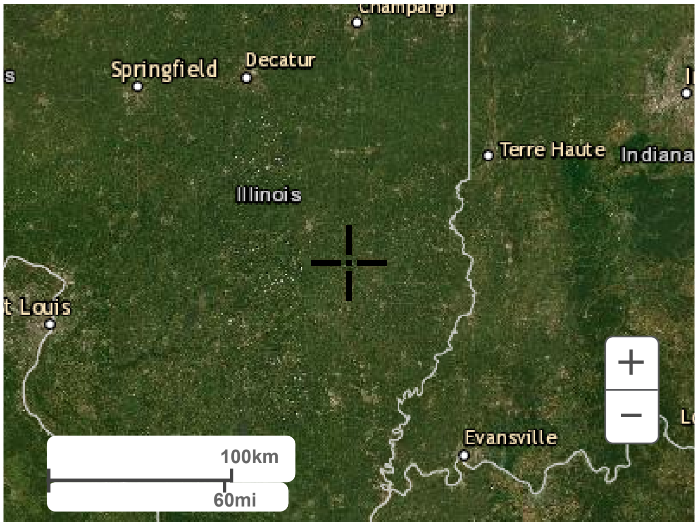
Large scale terrain



Large scale map



Large scale aerial



Back to Top

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

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A product of the National
Cooperative Soil Survey,
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States Department of
Agriculture and other
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agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for

Jasper County, Illinois

April 19, 2022

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

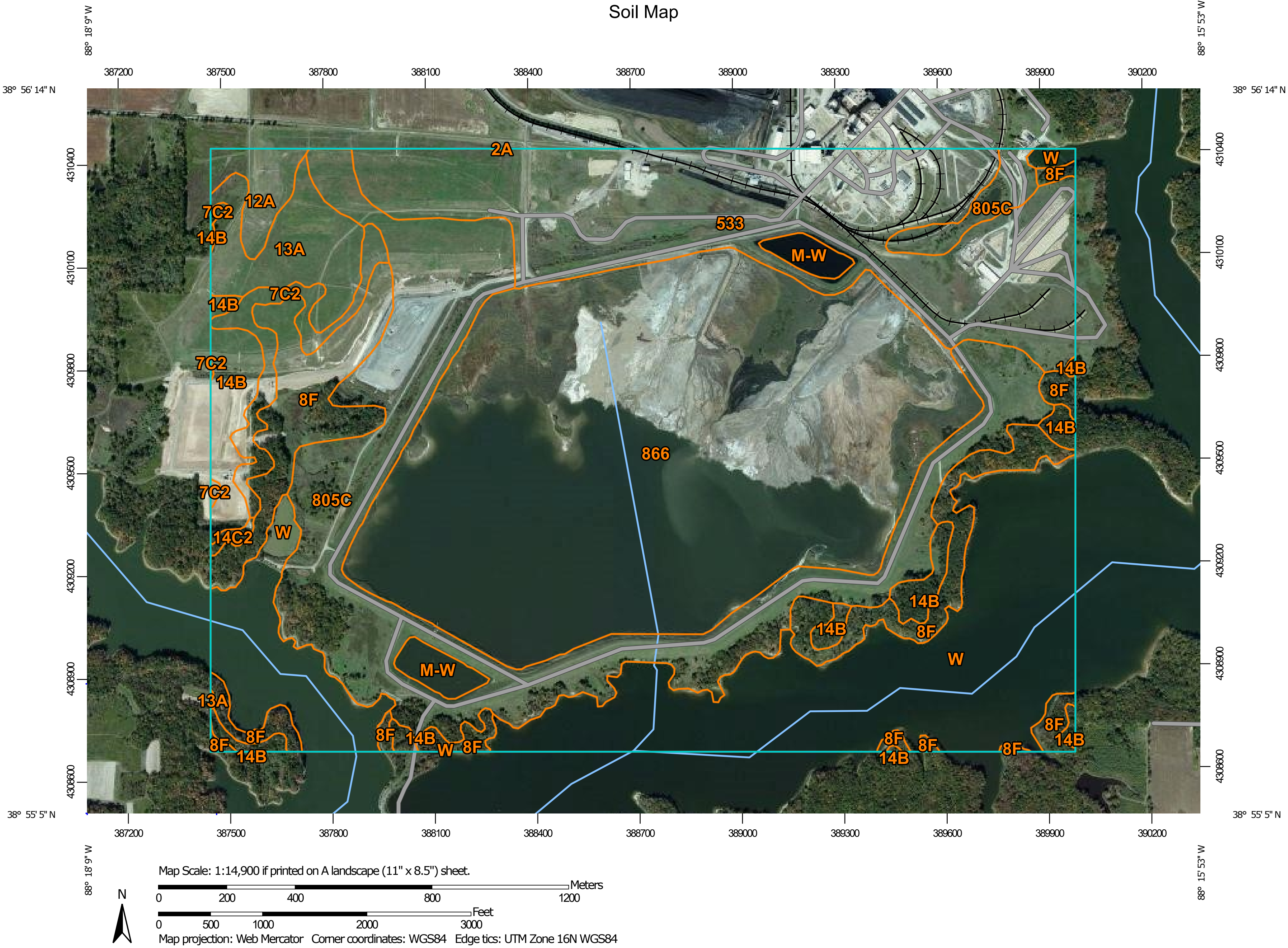
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map



Map Scale: 1:14,900 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Jasper County, Illinois
Survey Area Data: Version 18, Aug 31, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 16, 2011—Oct 15, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
2A	Cisne silt loam, 0 to 2 percent slopes	0.0	0.0%
7C2	Atlas silt loam, 5 to 10 percent slopes, eroded	17.6	1.6%
8F	Hickory silt loam, 18 to 35 percent slopes	76.7	6.9%
12A	Wynoose silt loam, 0 to 2 percent slopes	11.5	1.0%
13A	Bluford silt loam, 0 to 2 percent slopes	29.4	2.7%
14B	Ava silt loam, 2 to 5 percent slopes	31.9	2.9%
14C2	Ava silt loam, 5 to 10 percent slopes, eroded	1.3	0.1%
533	Urban land	178.2	16.1%
805C	Orthents, clayey, sloping	186.5	16.9%
866	Dumps, slurry	375.5	33.9%
M-W	Miscellaneous water	11.5	1.0%
W	Water	186.5	16.9%
Totals for Area of Interest		**1,106.7**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Jasper County, Illinois

2A—Cisne silt loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2rkjg
Elevation: 360 to 840 feet
Mean annual precipitation: 35 to 42 inches
Mean annual air temperature: 53 to 57 degrees F
Frost-free period: 175 to 195 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Cisne and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cisne

Setting

Landform: Ground moraines
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty loess over silty drift

Typical profile

Ap - 0 to 8 inches: silt loam
E - 8 to 17 inches: silt loam
Bt1 - 17 to 37 inches: silty clay loam
2Bt2 - 37 to 60 inches: silty clay loam
2C - 60 to 77 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 12 to 19 inches to abrupt textural change
Drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.02 to 0.20 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Ecological site: R113XY903IL - Wet Upland Prairie (silky dogwood/big bluestem - switchgrass) (Cornus obliqua/Andropogon gerardii - Panicum virgatum)
Hydric soil rating: Yes

Minor Components

Huey

Percent of map unit: 10 percent
Landform: Depressions
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Talf
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: F114BY502IN - Wet Till Upland Forest
Hydric soil rating: Yes

7C2—Atlas silt loam, 5 to 10 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2tp1z
Elevation: 330 to 840 feet
Mean annual precipitation: 38 to 46 inches
Mean annual air temperature: 54 to 58 degrees F
Frost-free period: 180 to 195 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Atlas, eroded, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Atlas, Eroded

Setting

Landform: Till plains
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loess over paleosol formed in till

Typical profile

Ap - 0 to 7 inches: silt loam
2Btg1 - 7 to 29 inches: silty clay loam
2Btg2 - 29 to 79 inches: silty clay loam

Properties and qualities

Slope: 5 to 10 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)
Depth to water table: About 6 to 18 inches

Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water supply, 0 to 60 inches: Moderate (about 8.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Ecological site: F114BY502IN - Wet Till Upland Forest
Hydric soil rating: No

Minor Components

Ava, eroded

Percent of map unit: 10 percent
Landform: Hillslopes, ridges
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Convex
Across-slope shape: Linear, convex
Ecological site: F113XY910IL - Fragic Backslope Woodland (post oak - black oak/aromatic sumac/little bluestem - tick trefoil) (Quercus stellata - Quercus velutina/Rhus aromatica/Schizachyrium scoparium - Desmodium spp.)
Hydric soil rating: No

8F—Hickory silt loam, 18 to 35 percent slopes

Map Unit Setting

National map unit symbol: 2yb19
Elevation: 370 to 680 feet
Mean annual precipitation: 39 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 185 to 195 days
Farmland classification: Not prime farmland

Map Unit Composition

Hickory and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hickory

Setting

Landform: Ground moraines
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear

Across-slope shape: Linear
Parent material: Loamy till

Typical profile

A - 0 to 4 inches: silt loam
E - 4 to 12 inches: loam
Bt1 - 12 to 26 inches: clay loam
Bt2 - 26 to 46 inches: clay loam
Bt3 - 46 to 60 inches: clay loam

Properties and qualities

Slope: 18 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: F113XY911IL - Loamy Till Backslope Forest (white oak - hickory/flowering dogwood/common blue wood aster) (Quercus alba - Carya spp./Cornus florida/Symphyotrichum cordifolium)
Hydric soil rating: No

Minor Components

Ava

Percent of map unit: 5 percent
Landform: Ridges
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: F113XY910IL - Fragic Backslope Woodland (post oak - black oak/aromatic sumac/little bluestem - tick trefoil) (Quercus stellata - Quercus velutina/Rhus aromatica/Schizachyrium scoparium - Desmodium spp.)
Hydric soil rating: No

Atlas, eroded

Percent of map unit: 3 percent
Landform: Ground moraines
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: F114BY502IN - Wet Till Upland Forest
Hydric soil rating: No

Belknap, frequently flooded

Percent of map unit: 2 percent
Landform: Flood plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F113XY919IL - Wet Silty Floodplain Forest (common hackberry - green ash/roughleaf dogwood/Canadian woodnettle) (Celtis occidentalis - Fraxinus pennsylvanica /Cornus drummondii /Laportea canadensis)
Hydric soil rating: No

12A—Wynoose silt loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2t959
Elevation: 360 to 840 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 53 to 58 degrees F
Frost-free period: 175 to 195 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Wynoose and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wynoose

Setting

Landform: Ground moraines
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess over mixed loess and drift over sangamon age paleosol till

Typical profile

Ap - 0 to 7 inches: silt loam
Eg - 7 to 19 inches: silt loam
Btg - 19 to 36 inches: silty clay
2Btg - 36 to 66 inches: silty clay loam
3Btgb - 66 to 79 inches: silty clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 13 to 24 inches to abrupt textural change
Drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.02 to 0.20 in/hr)

Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 12.0
Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Ecological site: F113XY905IL - Wet Upland Woodland (pin oak - swamp white oak/green hawthorn /sweet woodreed) (Quercus palustris - Quercus bicolor/ Crataegus viridis /Cinna arundinacea)
Hydric soil rating: Yes

Minor Components

Bluford

Percent of map unit: 10 percent
Landform: Ground moraines
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F113XY905IL - Wet Upland Woodland (pin oak - swamp white oak/ green hawthorn /sweet woodreed) (Quercus palustris - Quercus bicolor/ Crataegus viridis /Cinna arundinacea)
Hydric soil rating: No

13A—Bluford silt loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2t95c
Elevation: 360 to 840 feet
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 53 to 58 degrees F
Frost-free period: 175 to 195 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Bluford and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bluford

Setting

Landform: Ground moraines
Landform position (two-dimensional): Summit

Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess over mixed loess and drift

Typical profile

Ap - 0 to 7 inches: silt loam
E - 7 to 19 inches: silt loam
Btg - 19 to 35 inches: silty clay
2Btgx - 35 to 42 inches: silty clay loam
2Btg - 42 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 10 to 24 inches to abrupt textural change; 24 to 48 inches to fragipan
Drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Ecological site: F113XY905IL - Wet Upland Woodland (pin oak - swamp white oak/green hawthorn /sweet woodreed) (Quercus palustris - Quercus bicolor/ Crataegus viridis /Cinna arundinacea)
Hydric soil rating: No

Minor Components

Wynoose

Percent of map unit: 10 percent
Landform: Ground moraines
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F113XY905IL - Wet Upland Woodland (pin oak - swamp white oak/ green hawthorn /sweet woodreed) (Quercus palustris - Quercus bicolor/ Crataegus viridis /Cinna arundinacea)
Hydric soil rating: Yes

14B—Ava silt loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2t95h
Elevation: 360 to 840 feet
Mean annual precipitation: 38 to 46 inches
Mean annual air temperature: 54 to 58 degrees F
Frost-free period: 180 to 195 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Ava and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ava

Setting

Landform: Ridges
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess over mixed loess and drift over till

Typical profile

Ap - 0 to 6 inches: silt loam
E - 6 to 14 inches: silt loam
Bt - 14 to 34 inches: silty clay loam
2Btx - 34 to 50 inches: silty clay loam
3Btb - 50 to 79 inches: loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: 25 to 40 inches to fragipan
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.02 to 0.06 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water supply, 0 to 60 inches: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C

Ecological site: F113XY910IL - Fragic Backslope Woodland (post oak - black oak/ aromatic sumac/little bluestem - tick trefoil) (Quercus stellata - Quercus velutina/Rhus aromatica/Schizachyrium scoparium - Desmodium spp.)
Hydric soil rating: No

Minor Components

Bluford

Percent of map unit: 10 percent
Landform: Ground moraines
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F113XY905IL - Wet Upland Woodland (pin oak - swamp white oak/ green hawthorn /sweet woodreed) (Quercus palustris - Quercus bicolor/ Crataegus viridis /Cinna arundinacea)
Hydric soil rating: No

14C2—Ava silt loam, 5 to 10 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2t95l
Elevation: 360 to 840 feet
Mean annual precipitation: 38 to 46 inches
Mean annual air temperature: 54 to 58 degrees F
Frost-free period: 180 to 195 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Ava, eroded, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ava, Eroded

Setting

Landform: Hillslopes, ridges
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Loess over mixed loess and drift over till

Typical profile

Ap - 0 to 9 inches: silt loam
Bt and E - 9 to 28 inches: silty clay loam
Btx - 28 to 36 inches: silty clay loam
2Btx - 36 to 64 inches: silt loam
3Btb - 64 to 78 inches: silt loam

Properties and qualities

Slope: 5 to 10 percent
Depth to restrictive feature: 25 to 40 inches to fragipan
Drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water supply, 0 to 60 inches: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: F113XY910IL - Fragic Backslope Woodland (post oak - black oak/aromatic sumac/little bluestem - tick trefoil) (Quercus stellata - Quercus velutina/Rhus aromatica/Schizachyrium scoparium - Desmodium spp.)
Hydric soil rating: No

Minor Components

Bluford, eroded

Percent of map unit: 10 percent
Landform: Ground moraines
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: F113XY905IL - Wet Upland Woodland (pin oak - swamp white oak/green hawthorn /sweet woodreed) (Quercus palustris - Quercus bicolor/Crataegus viridis /Cinna arundinacea)
Hydric soil rating: No

533—Urban land

Map Unit Setting

National map unit symbol: 1q78h
Elevation: 510 to 980 feet
Mean annual precipitation: 28 to 40 inches
Mean annual air temperature: 45 to 54 degrees F
Frost-free period: 140 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 90 percent

Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Down-slope shape: Linear
Across-slope shape: Linear

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Orthents, loamy, nearly level

Percent of map unit: 4 percent
Landform: Lake plains, ground moraines
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Orthents, clayey, nearly level

Percent of map unit: 4 percent
Landform: Ground moraines, lake plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Orthents, loamy-skeletal, nearly level

Percent of map unit: 2 percent
Landform: Lake plains, ground moraines
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

805C—Orthents, clayey, sloping

Map Unit Setting

National map unit symbol: y5ns
Elevation: 360 to 840 feet
Mean annual precipitation: 35 to 42 inches
Mean annual air temperature: 53 to 57 degrees F
Frost-free period: 175 to 195 days

Farmland classification: Not prime farmland

Map Unit Composition

Orthents, clayey, and similar soils: 90 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Orthents, Clayey

Setting

Parent material: Earthy cut and fill

Typical profile

H1 - 0 to 4 inches: silty clay loam
H2 - 4 to 60 inches: silty clay loam

Properties and qualities

Slope: 1 to 16 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.02 to 0.20 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Hydric soil rating: Unranked

Minor Components

Wynoose

Percent of map unit: 3 percent
Landform: Till plains
Ecological site: F113XY905IL - Wet Upland Woodland (pin oak - swamp white oak/ green hawthorn /sweet woodreed) (Quercus palustris - Quercus bicolor/ Crataegus viridis /Cinna arundinacea)
Hydric soil rating: Yes

866—Dumps, slurry

Map Unit Setting

National map unit symbol: y5nt
Mean annual precipitation: 35 to 46 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 195 days

Farmland classification: Not prime farmland

Map Unit Composition

Dumps, slurry: 90 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dumps, Slurry

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8

Hydric soil rating: No

M-W—Miscellaneous water

Map Unit Setting

National map unit symbol: 1qg37

Frost-free period: 175 to 195 days

Farmland classification: Not prime farmland

Map Unit Composition

Miscellaneous water: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Miscellaneous Water

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8w

Hydric soil rating: Unranked

W—Water

Map Unit Composition

Water: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Water

Setting

Landform: Channels, perenial streams, drainageways, lakes, oxbows, rivers

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8w

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Appendix B

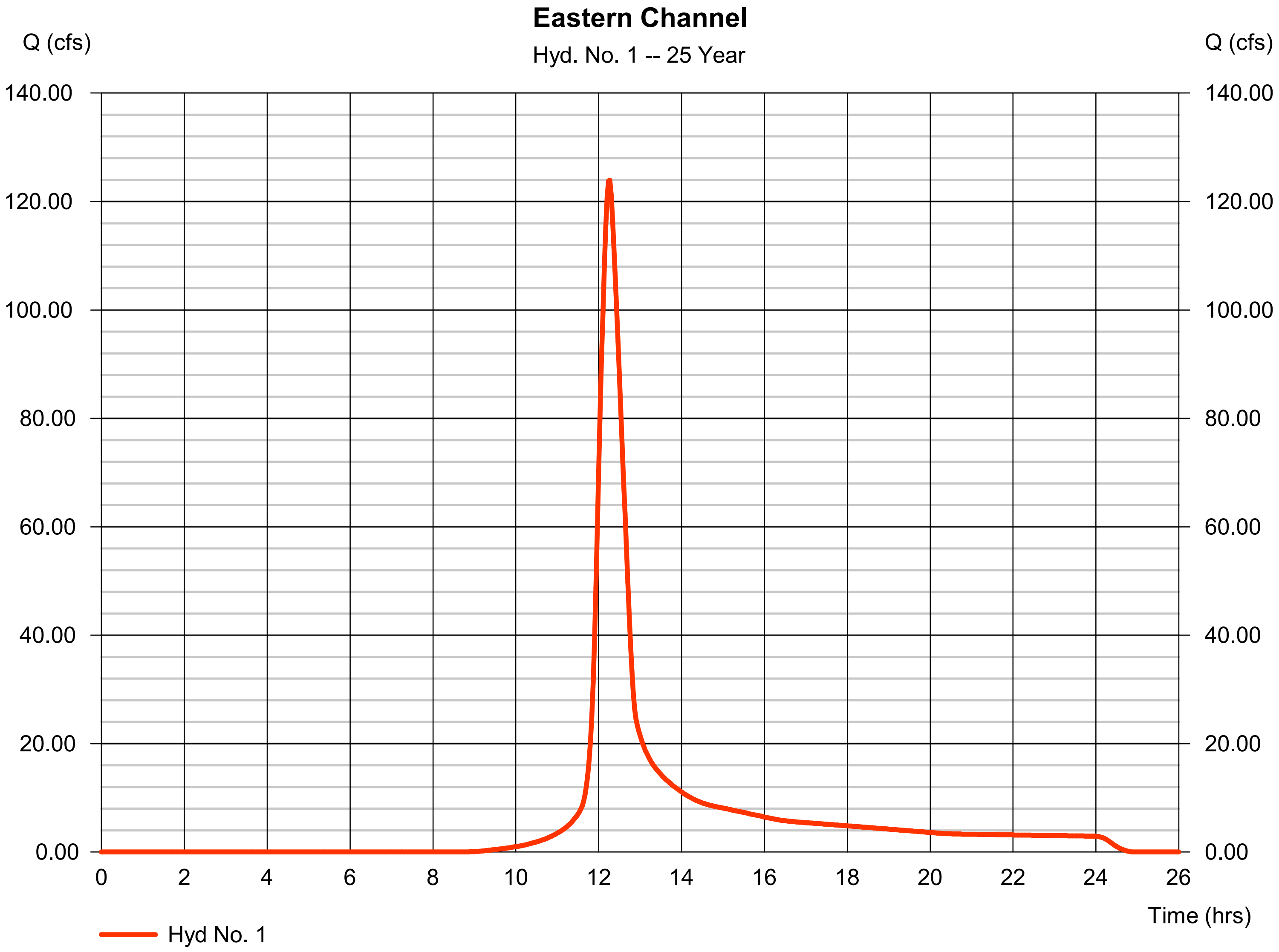
Hydroflow Hydrograph Output

Hydrograph Report

Hyd. No. 1

Eastern Channel

Hydrograph type	= SCS Runoff	Peak discharge	= 123.93 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.27 hrs
Time interval	= 2 min	Hyd. volume	= 566,480 cuft
Drainage area	= 61.340 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.50 min
Total precip.	= 5.26 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



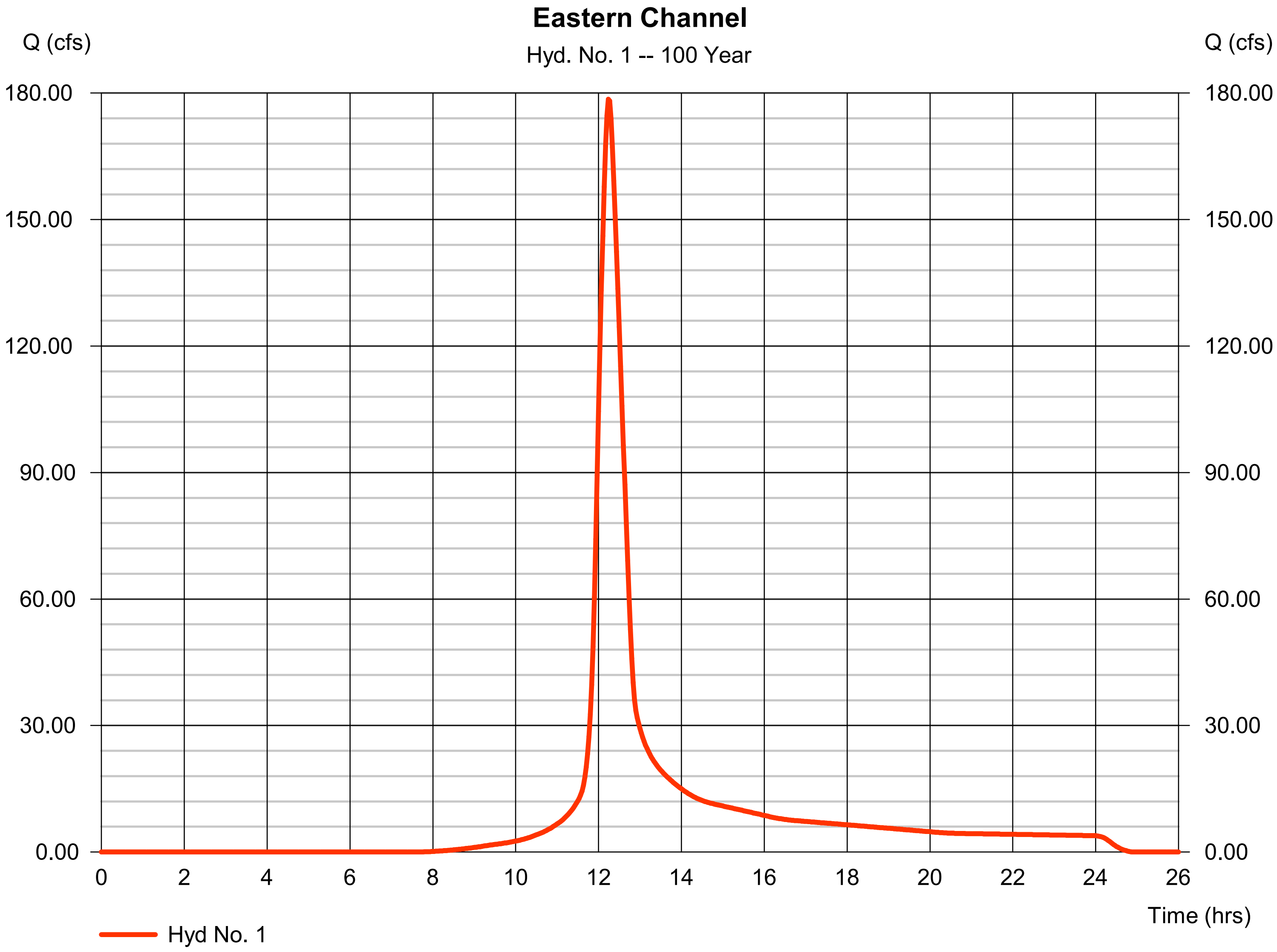
Hydrograph Report

Hyd. No. 1

Eastern Channel

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 61.340 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 6.58 in
Storm duration = 24 hrs

Peak discharge = 178.51 cfs
Time to peak = 12.23 hrs
Hyd. volume = 809,728 cuft
Curve number = 74
Hydraulic length = 0 ft
Time of conc. (Tc) = 34.50 min
Distribution = Type II
Shape factor = 484

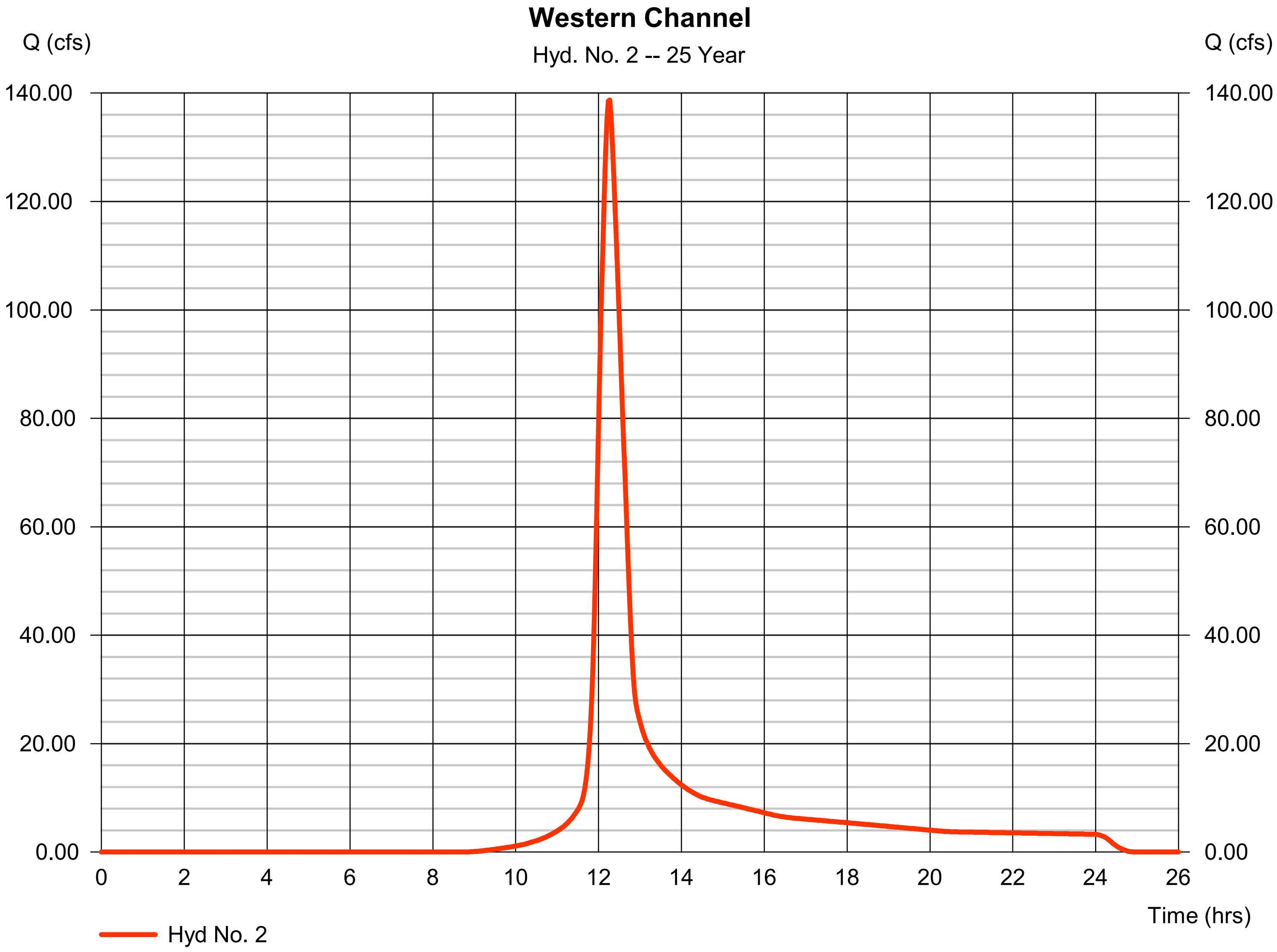


Hydrograph Report

Hyd. No. 2

Western Channel

Hydrograph type	= SCS Runoff	Peak discharge	= 138.69 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.27 hrs
Time interval	= 2 min	Hyd. volume	= 633,988 cuft
Drainage area	= 68.650 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.50 min
Total precip.	= 5.26 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hyd. No. 2

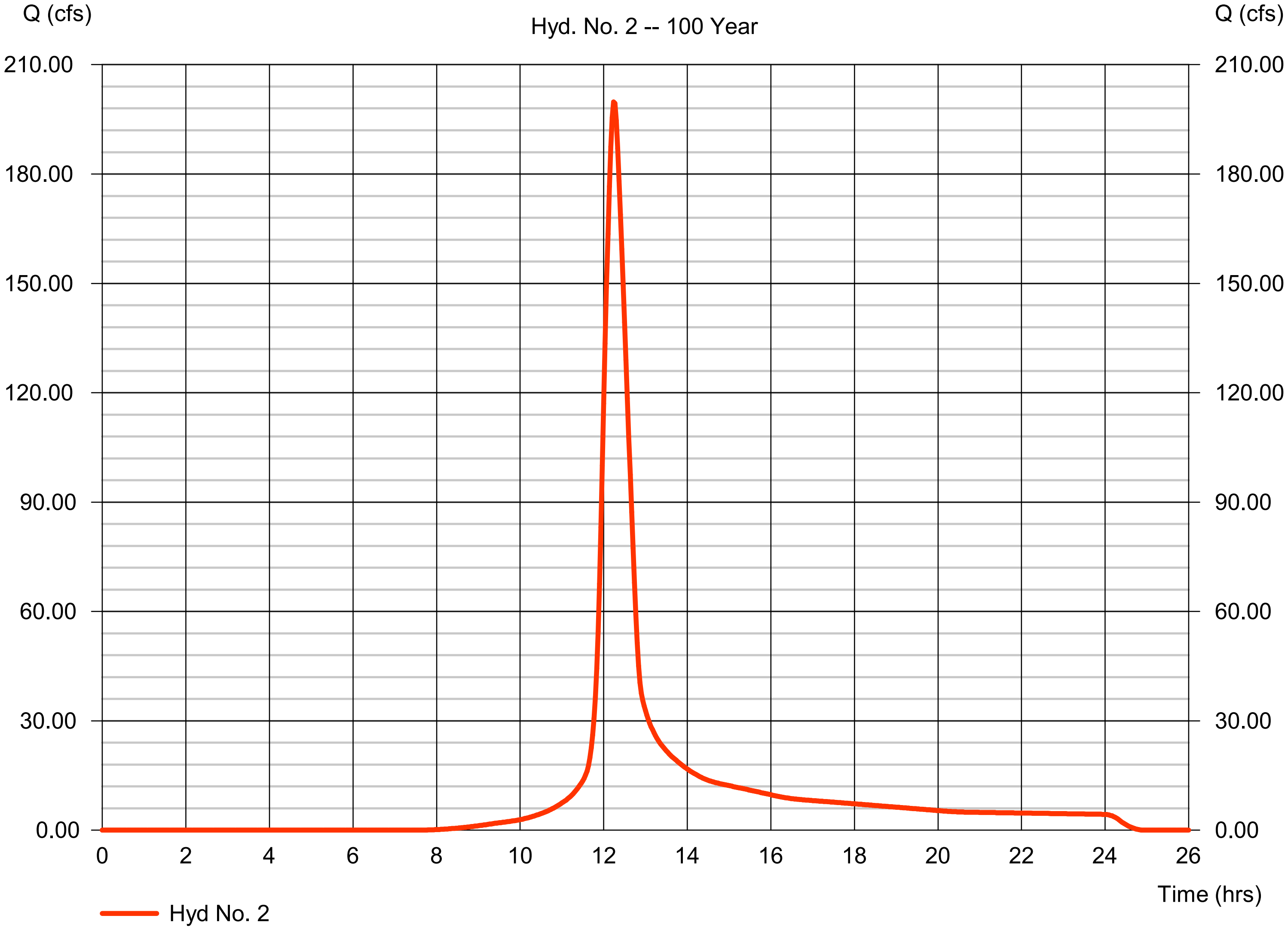
Western Channel

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 68.650 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 6.58 in
Storm duration = 24 hrs

Peak discharge = 199.78 cfs
Time to peak = 12.23 hrs
Hyd. volume = 906,225 cuft
Curve number = 74
Hydraulic length = 0 ft
Time of conc. (Tc) = 34.50 min
Distribution = Type II
Shape factor = 484

Western Channel

Hyd. No. 2 -- 100 Year

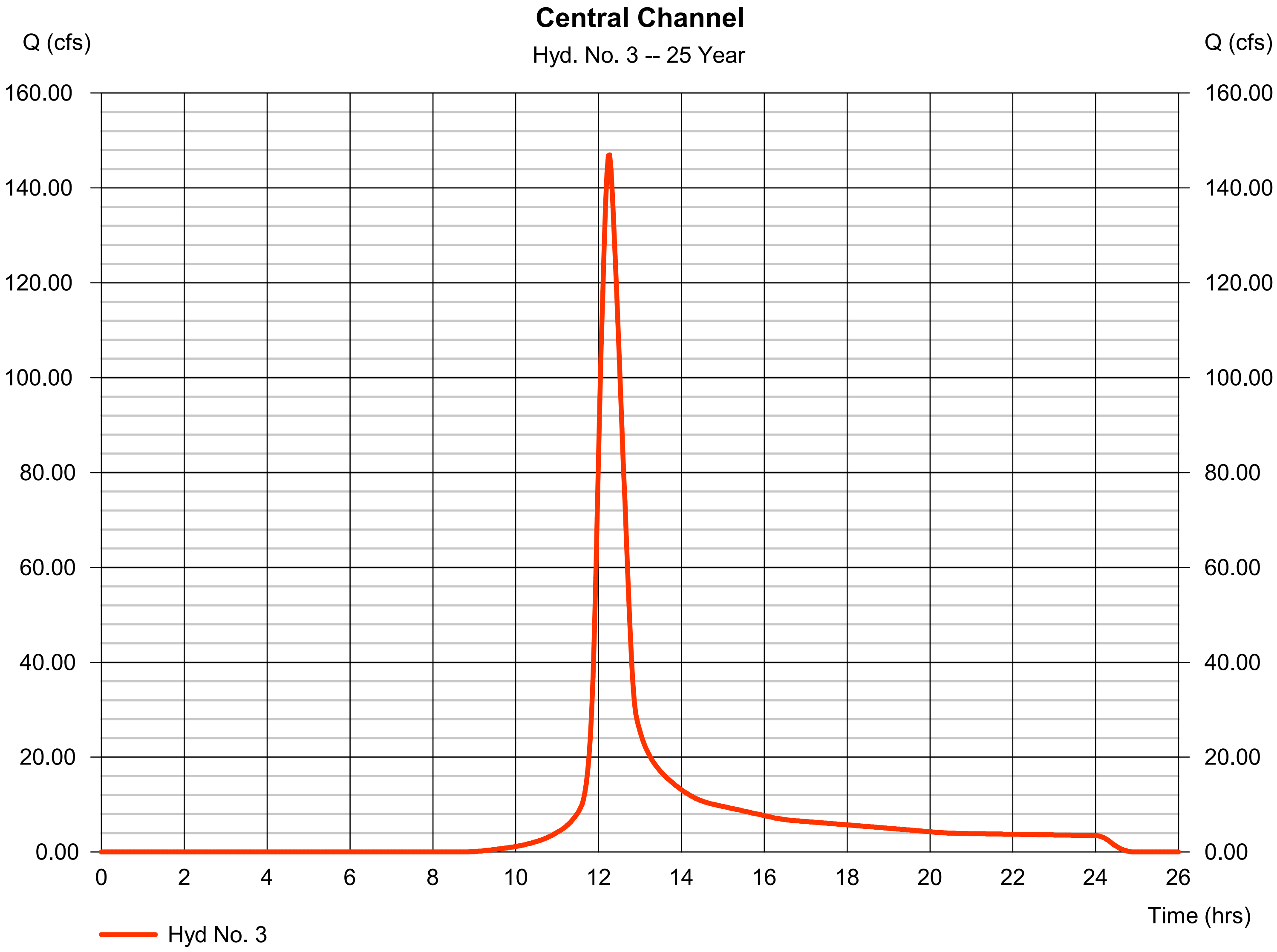


Hydrograph Report

Hyd. No. 3

Central Channel

Hydrograph type	= SCS Runoff	Peak discharge	= 146.98 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.27 hrs
Time interval	= 2 min	Hyd. volume	= 671,851 cuft
Drainage area	= 72.750 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.50 min
Total precip.	= 5.26 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

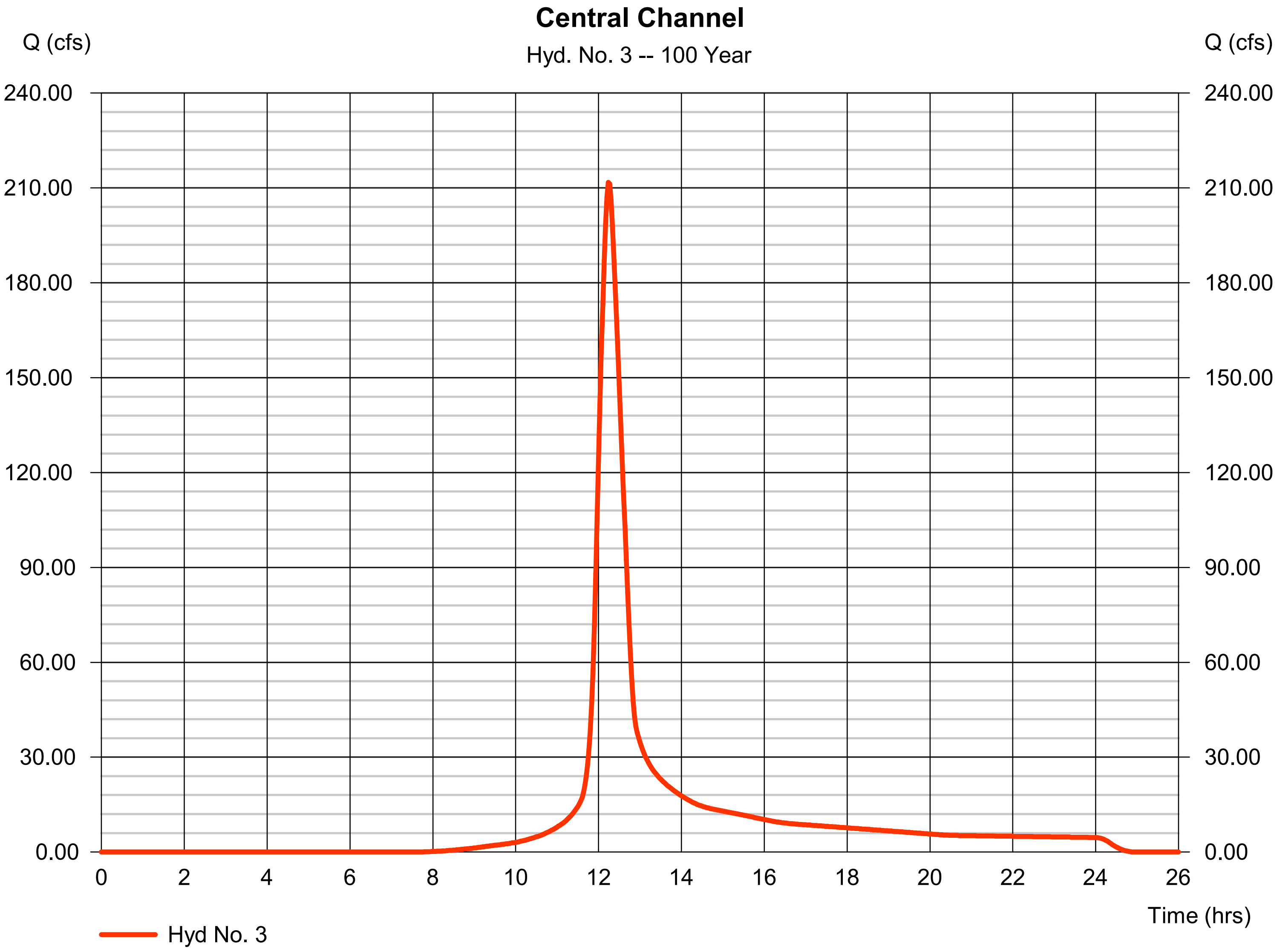


Hydrograph Report

Hyd. No. 3

Central Channel

Hydrograph type	= SCS Runoff	Peak discharge	= 211.72 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 960,347 cuft
Drainage area	= 72.750 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.50 min
Total precip.	= 6.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



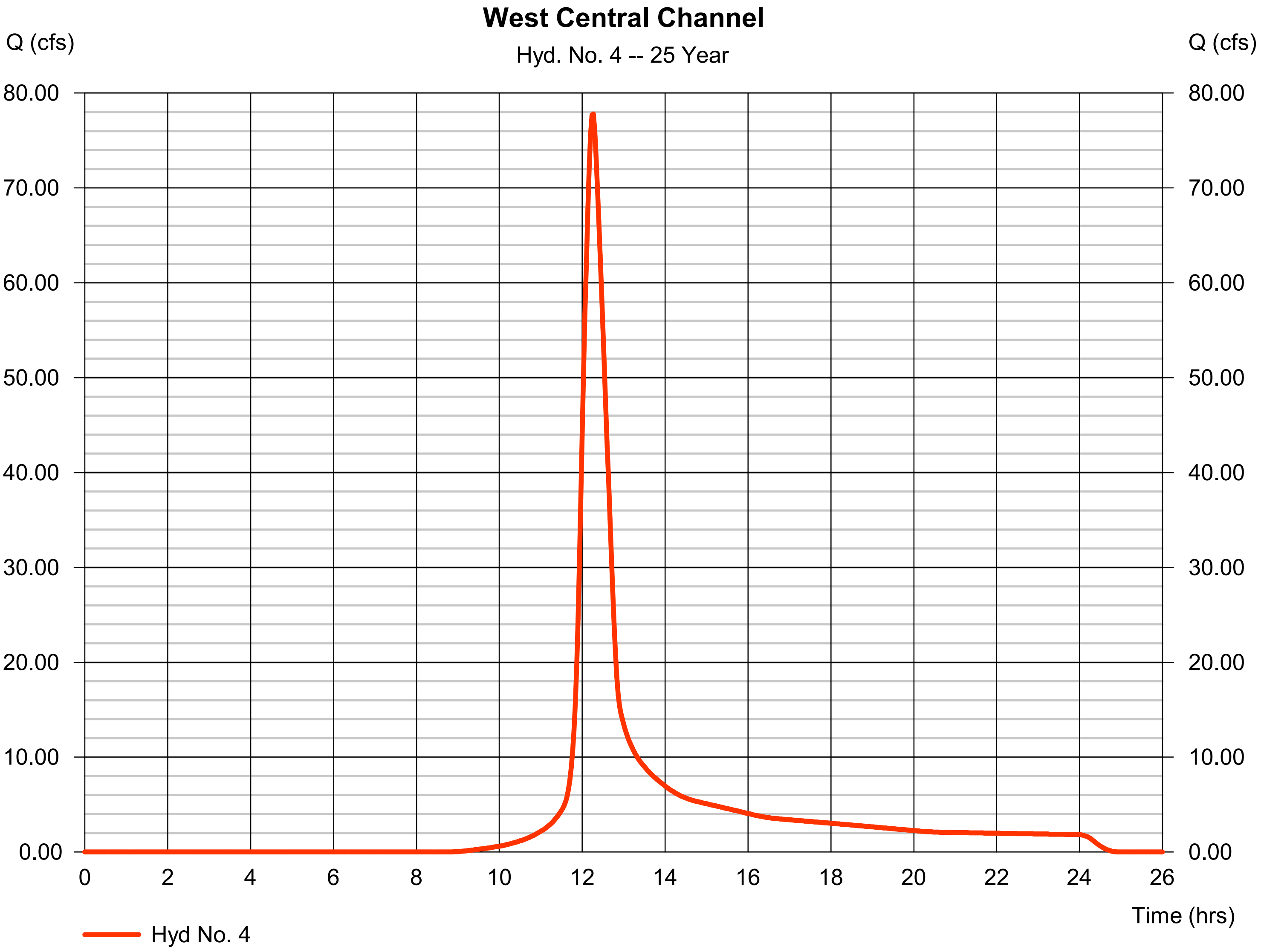
Hydrograph Report

Hyd. No. 4

West Central Channel

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 2 min
Drainage area = 38.510 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 5.26 in
Storm duration = 24 hrs

Peak discharge = 77.80 cfs
Time to peak = 12.27 hrs
Hyd. volume = 355,643 cuft
Curve number = 74
Hydraulic length = 0 ft
Time of conc. (Tc) = 34.50 min
Distribution = Type II
Shape factor = 484



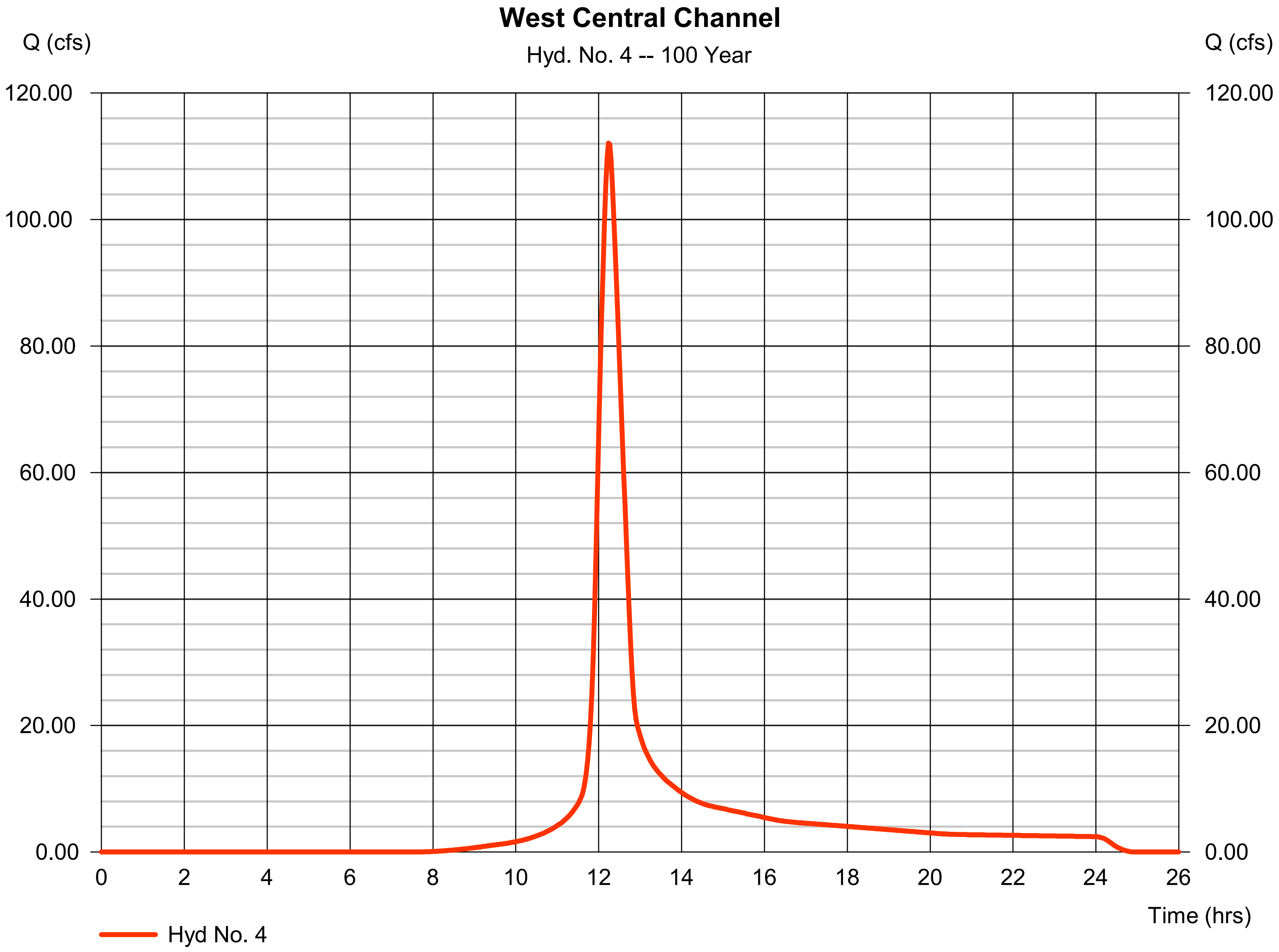
Hydrograph Report

Hyd. No. 4

West Central Channel

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 38.510 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 6.58 in
Storm duration = 24 hrs

Peak discharge = 112.07 cfs
Time to peak = 12.23 hrs
Hyd. volume = 508,357 cuft
Curve number = 74
Hydraulic length = 0 ft
Time of conc. (Tc) = 34.50 min
Distribution = Type II
Shape factor = 484

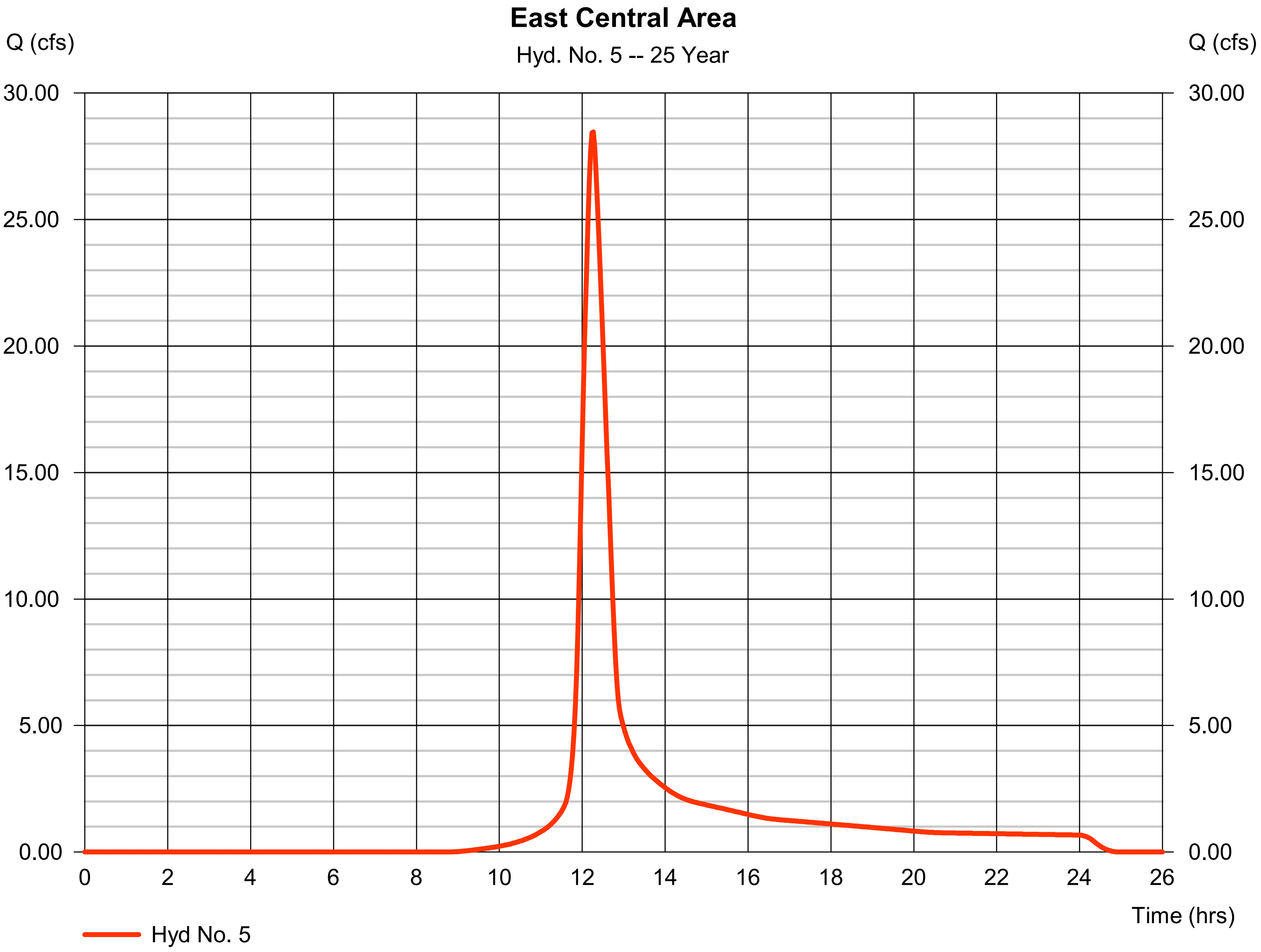


Hydrograph Report

Hyd. No. 5

East Central Area

Hydrograph type	= SCS Runoff	Peak discharge	= 28.47 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.27 hrs
Time interval	= 2 min	Hyd. volume	= 130,122 cuft
Drainage area	= 14.090 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.50 min
Total precip.	= 5.26 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

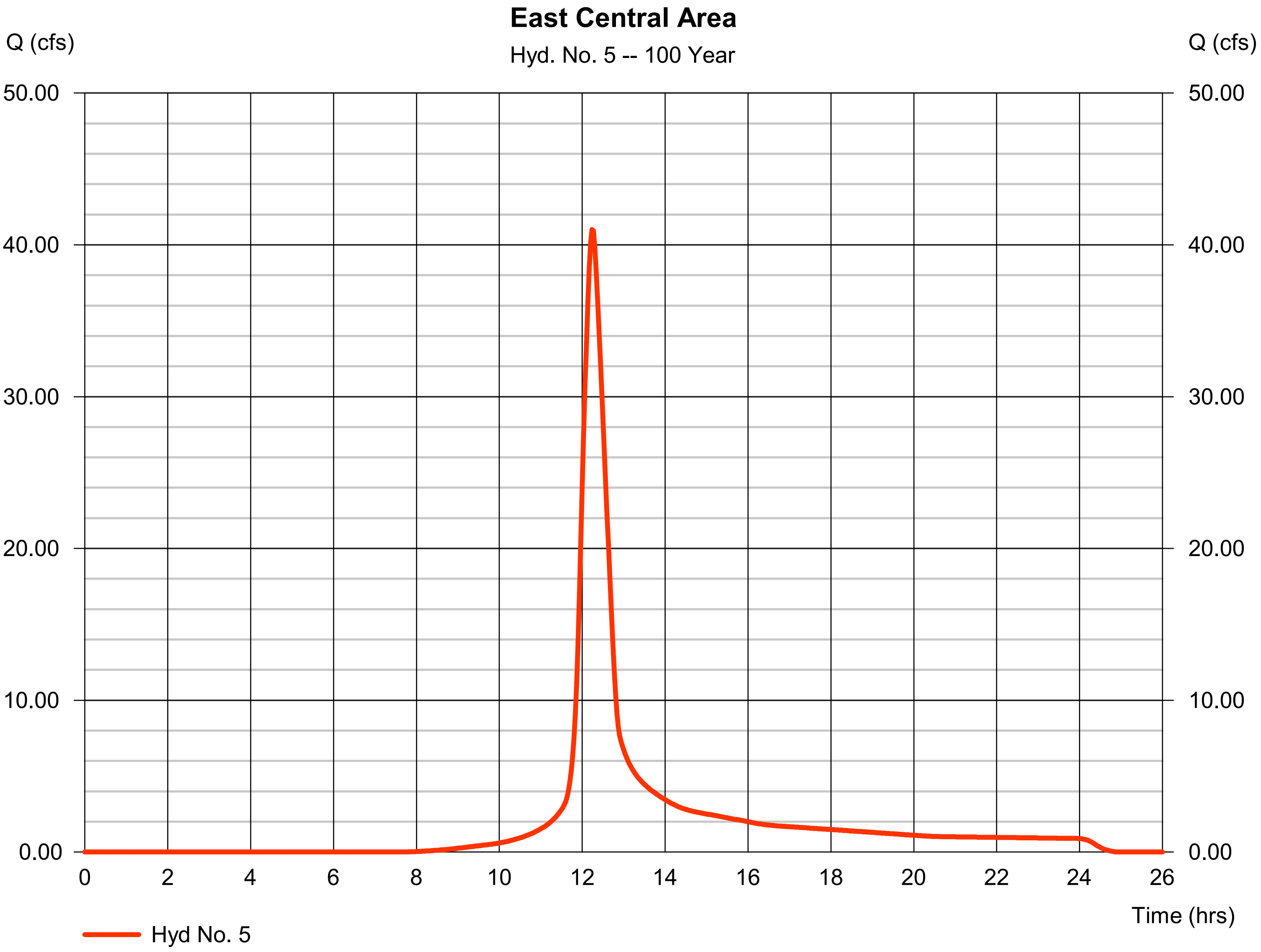


Hydrograph Report

Hyd. No. 5

East Central Area

Hydrograph type	= SCS Runoff	Peak discharge	= 41.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 185,997 cuft
Drainage area	= 14.090 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.50 min
Total precip.	= 6.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

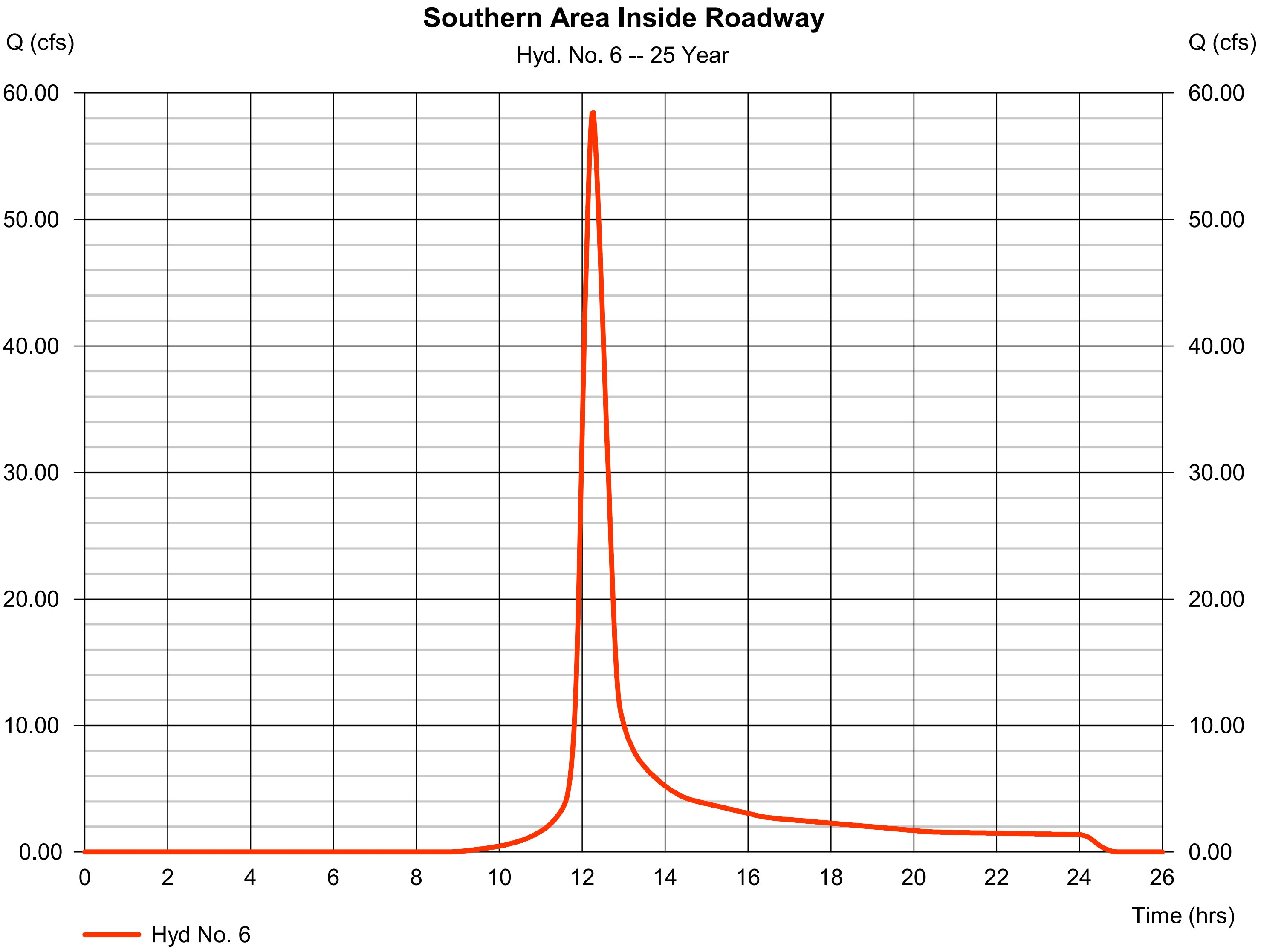


Hydrograph Report

Hyd. No. 6

Southern Area Inside Roadway

Hydrograph type	= SCS Runoff	Peak discharge	= 58.47 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.27 hrs
Time interval	= 2 min	Hyd. volume	= 267,263 cuft
Drainage area	= 28.940 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.50 min
Total precip.	= 5.26 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

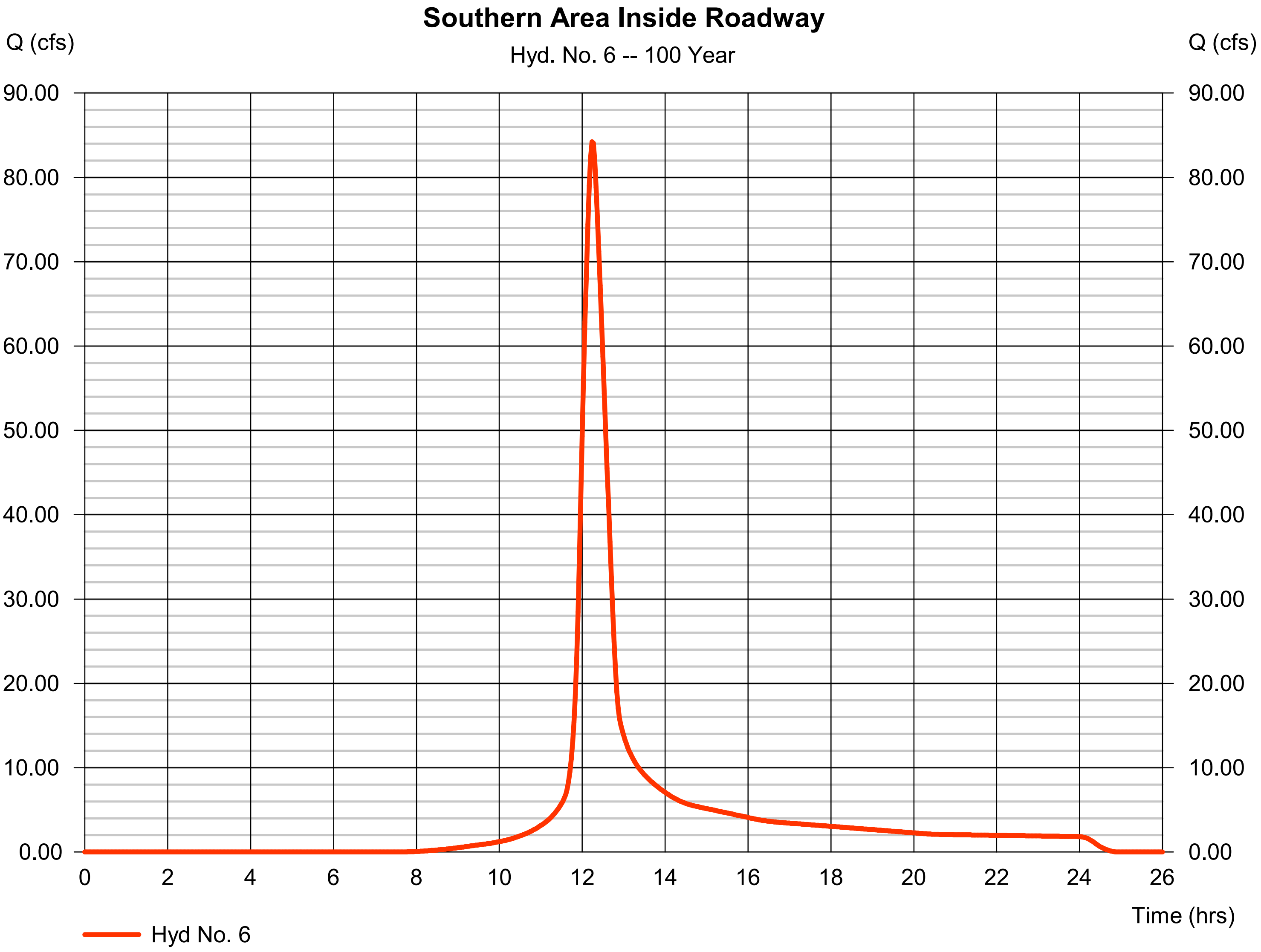


Hydrograph Report

Hyd. No. 6

Southern Area Inside Roadway

Hydrograph type	= SCS Runoff	Peak discharge	= 84.22 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 382,027 cuft
Drainage area	= 28.940 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.50 min
Total precip.	= 6.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

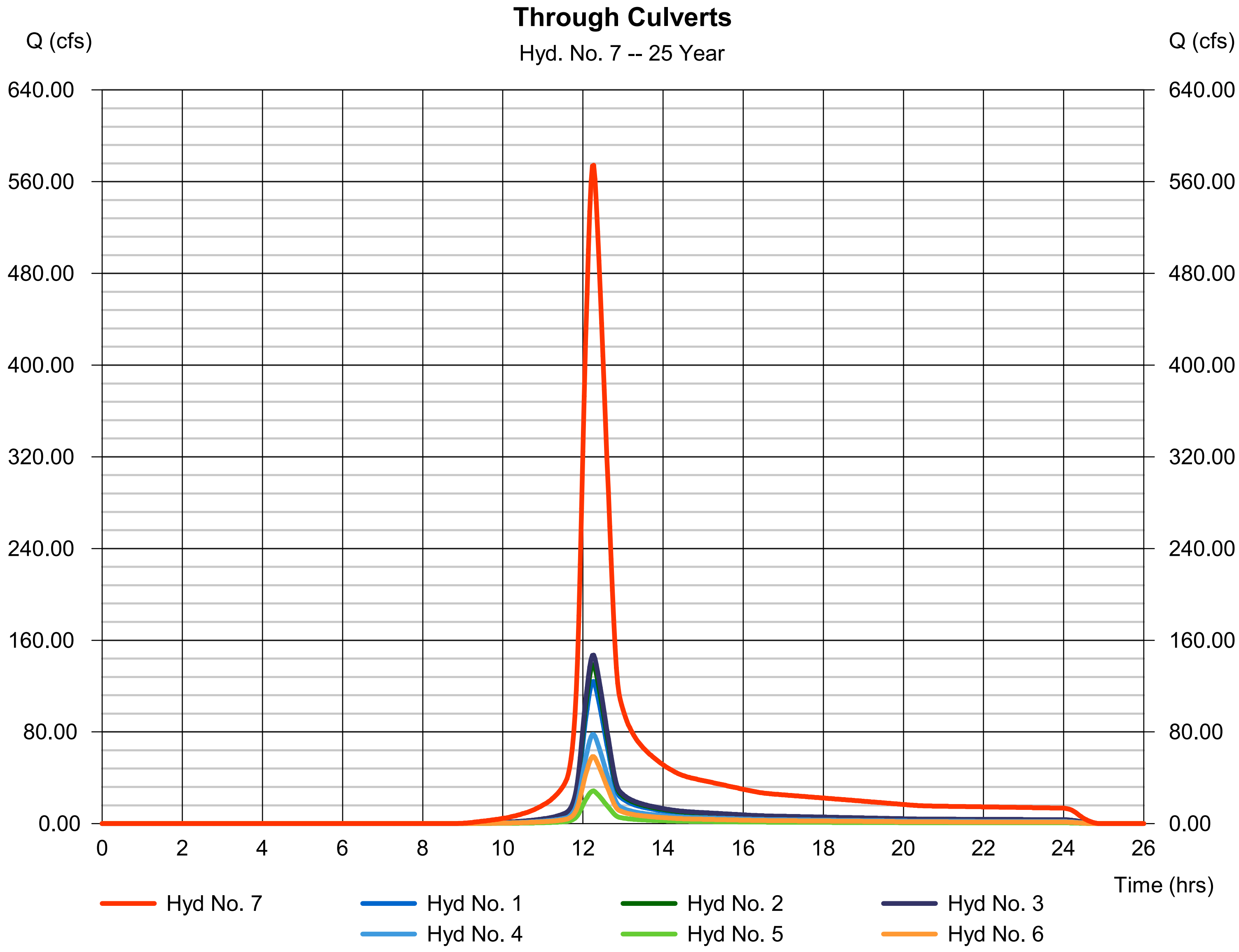


Hydrograph Report

Hyd. No. 7

Through Culverts

Hydrograph type	= Combine	Peak discharge	= 574.33 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.27 hrs
Time interval	= 2 min	Hyd. volume	= 2,625,349 cuft
Inflow hyds.	= 1, 2, 3, 4, 5, 6	Contrib. drain. area	= 284.280 ac



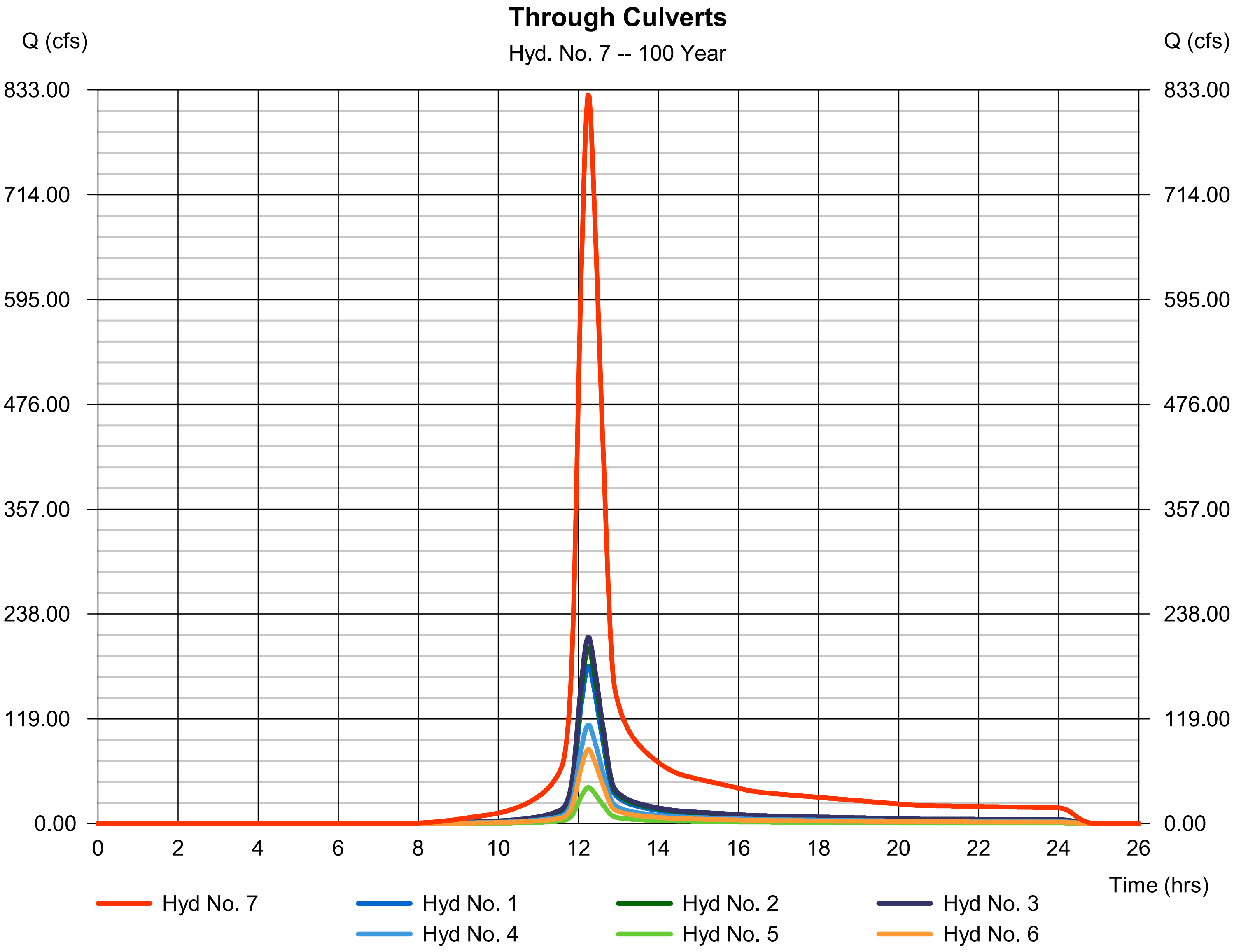
Hydrograph Report

Hyd. No. 7

Through Culverts

Hydrograph type = Combine
Storm frequency = 100 yrs
Time interval = 2 min
Inflow hyds. = 1, 2, 3, 4, 5, 6

Peak discharge = 827.31 cfs
Time to peak = 12.23 hrs
Hyd. volume = 3,752,680 cuft
Contrib. drain. area = 284.280 ac



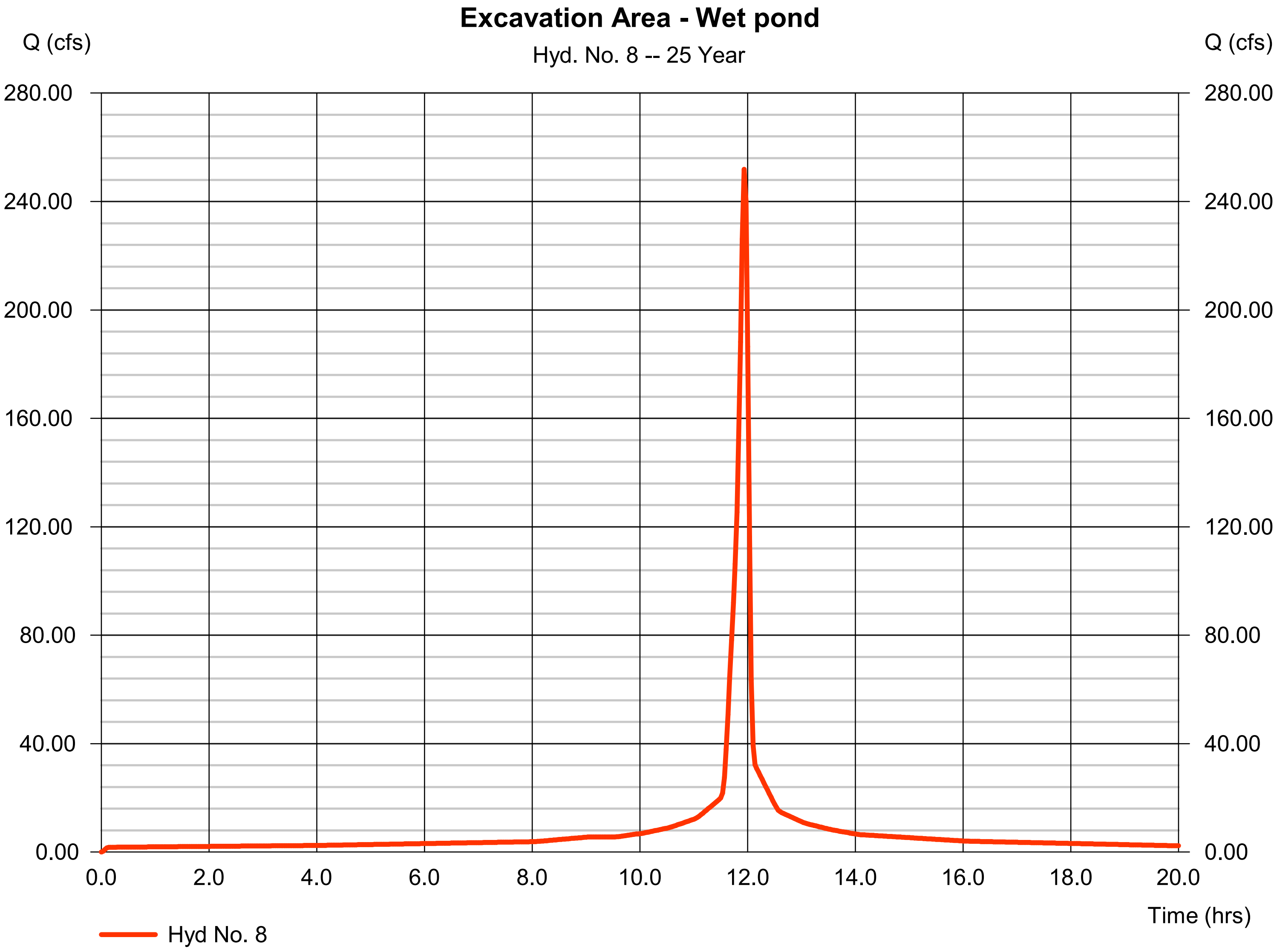
Hydrograph Report

Hyd. No. 8

Excavation Area - Wet pond

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 2 min
Drainage area = 35.050 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 5.26 in
Storm duration = 24 hrs

Peak discharge = 251.91 cfs
Time to peak = 11.93 hrs
Hyd. volume = 627,410 cuft
Curve number = 100
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type II
Shape factor = 484

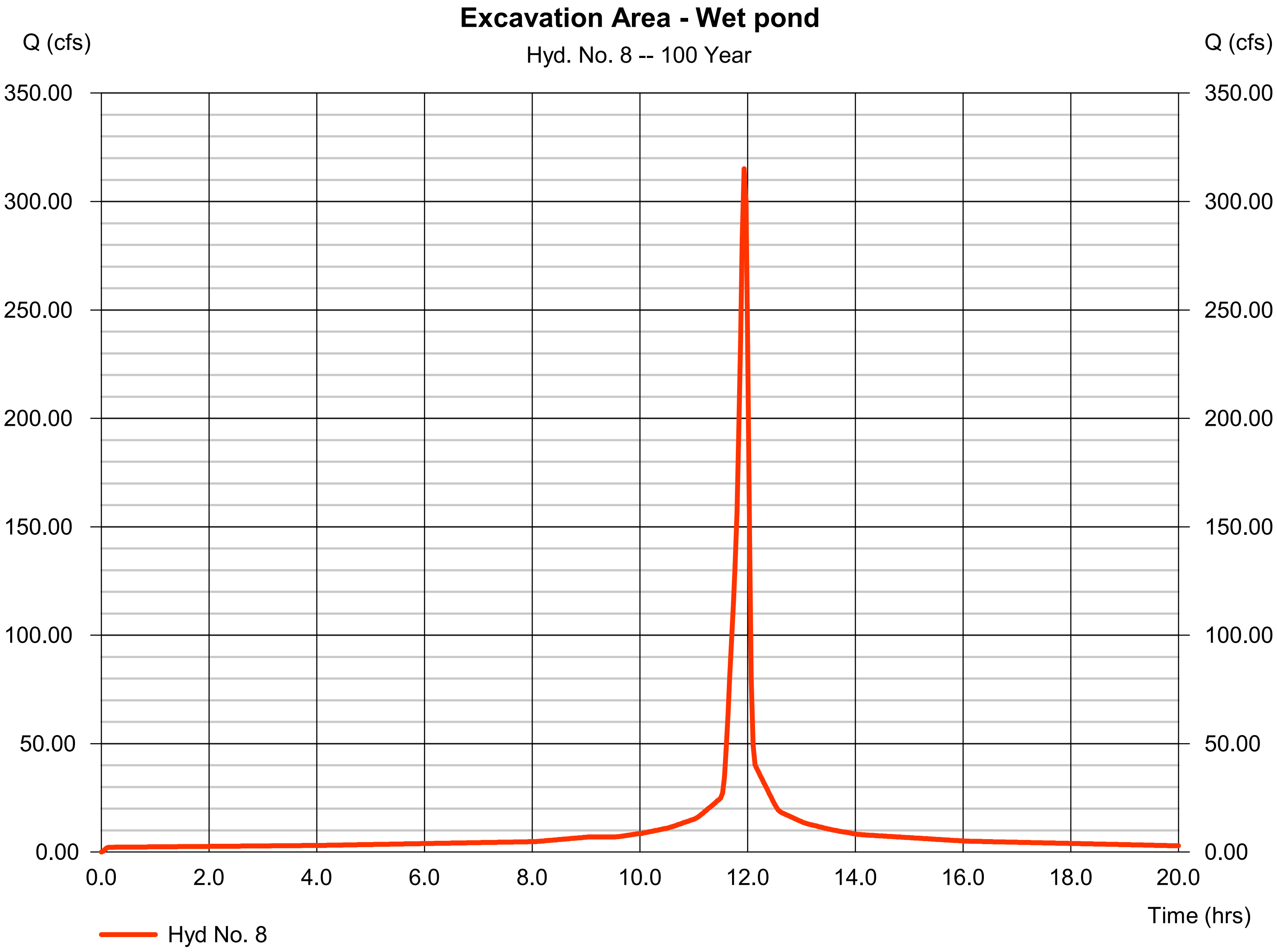


Hydrograph Report

Hyd. No. 8

Excavation Area - Wet pond

Hydrograph type	= SCS Runoff	Peak discharge	= 315.13 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 784,859 cuft
Drainage area	= 35.050 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

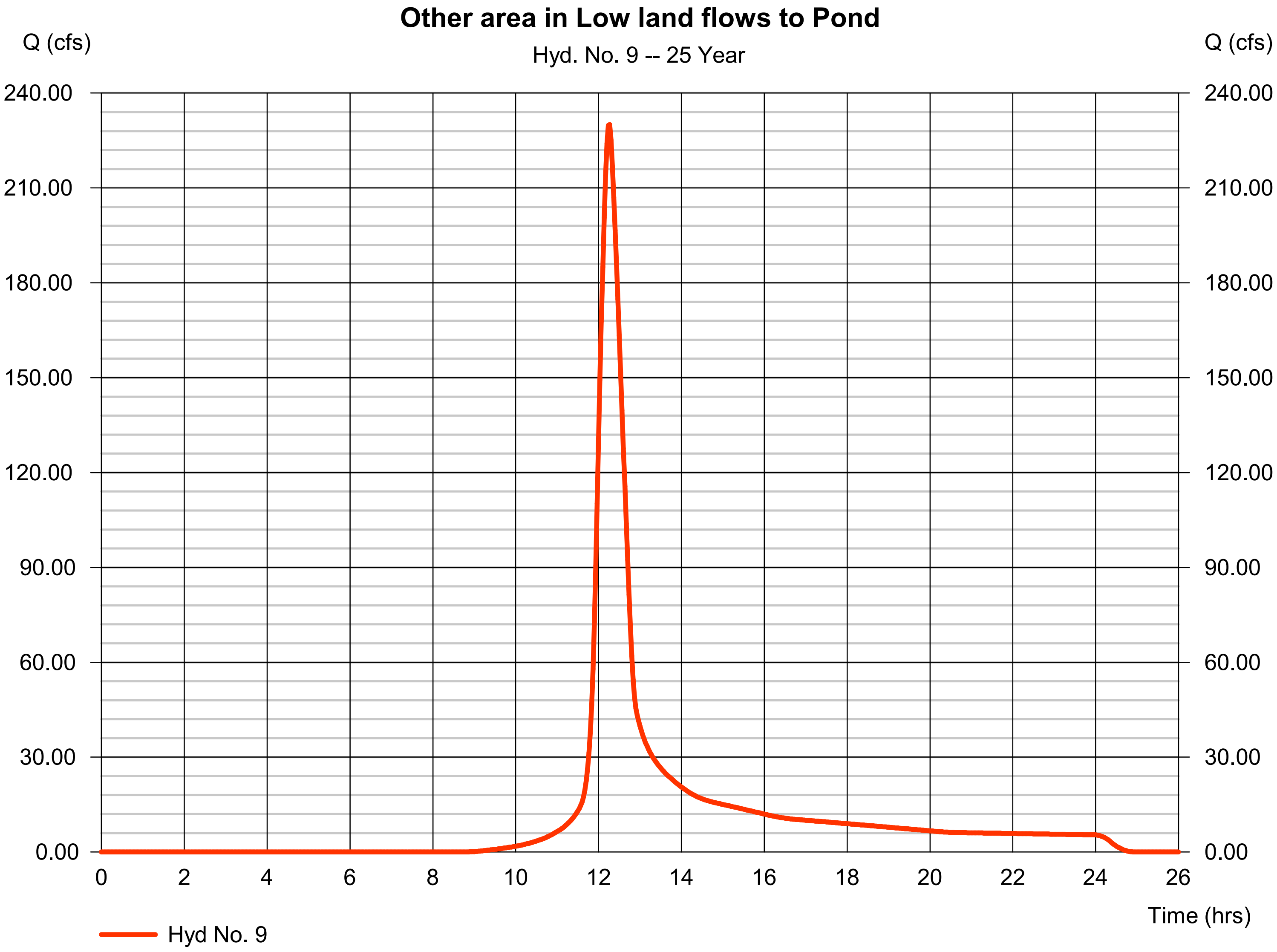


Hydrograph Report

Hyd. No. 9

Other area in Low land flows to Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 230.07 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.27 hrs
Time interval	= 2 min	Hyd. volume	= 1,051,690 cuft
Drainage area	= 113.880 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.50 min
Total precip.	= 5.26 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

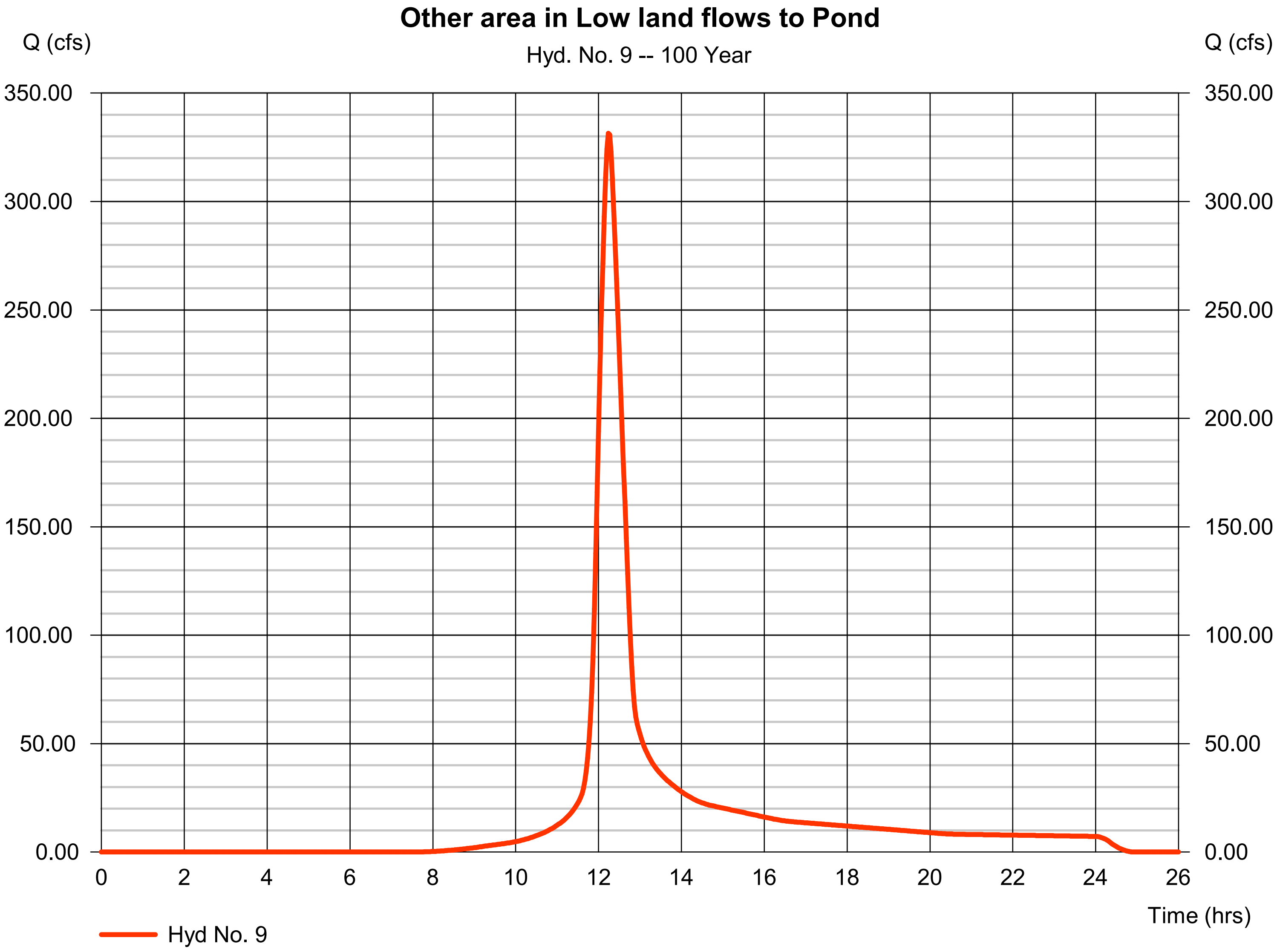


Hydrograph Report

Hyd. No. 9

Other area in Low land flows to Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 331.41 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 1,503,291 cuft
Drainage area	= 113.880 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.50 min
Total precip.	= 6.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

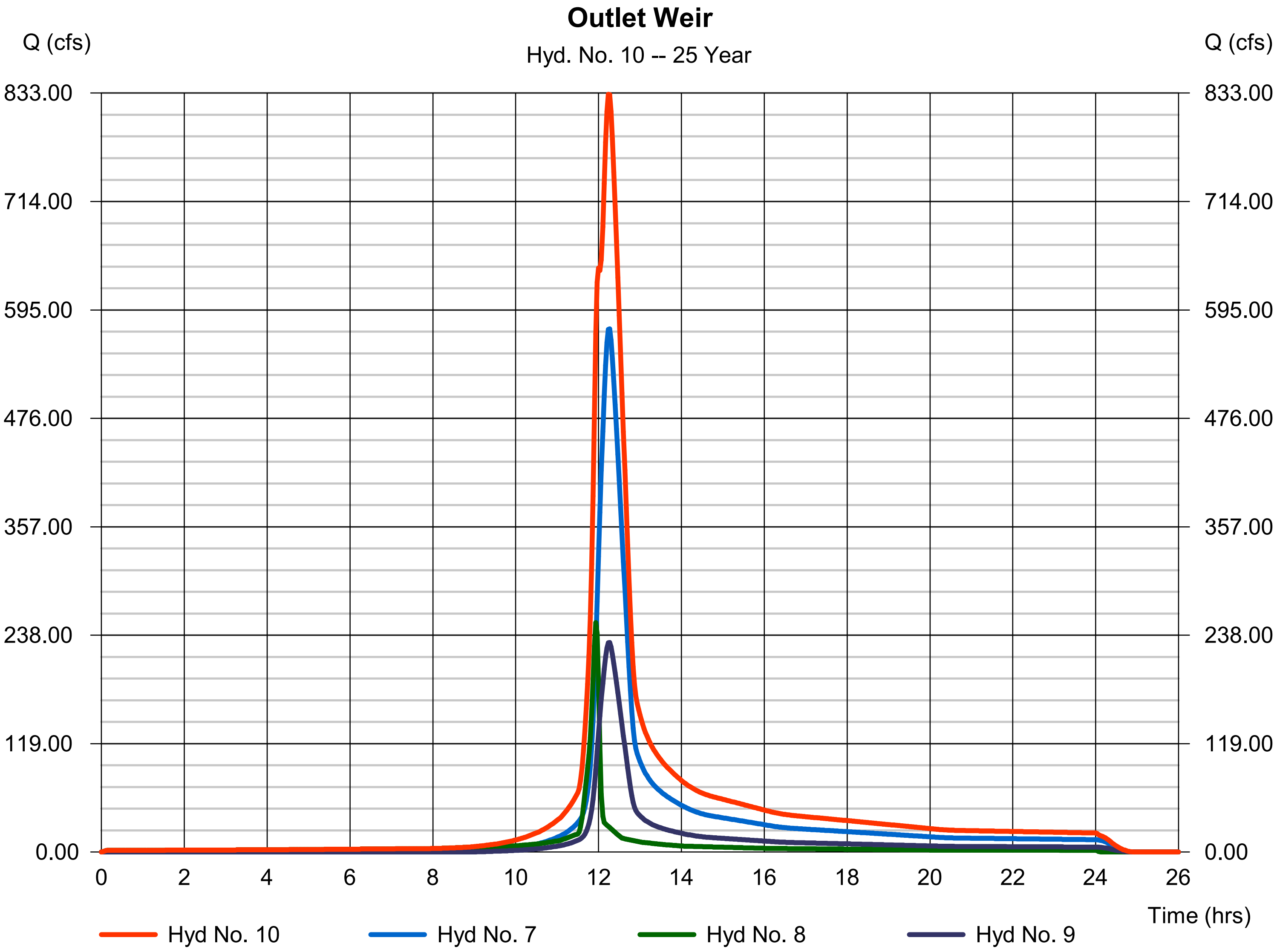


Hydrograph Report

Hyd. No. 10

Outlet Weir

Hydrograph type	= Combine	Peak discharge	= 831.51 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 4,304,447 cuft
Inflow hyds.	= 7, 8, 9	Contrib. drain. area	= 148.930 ac

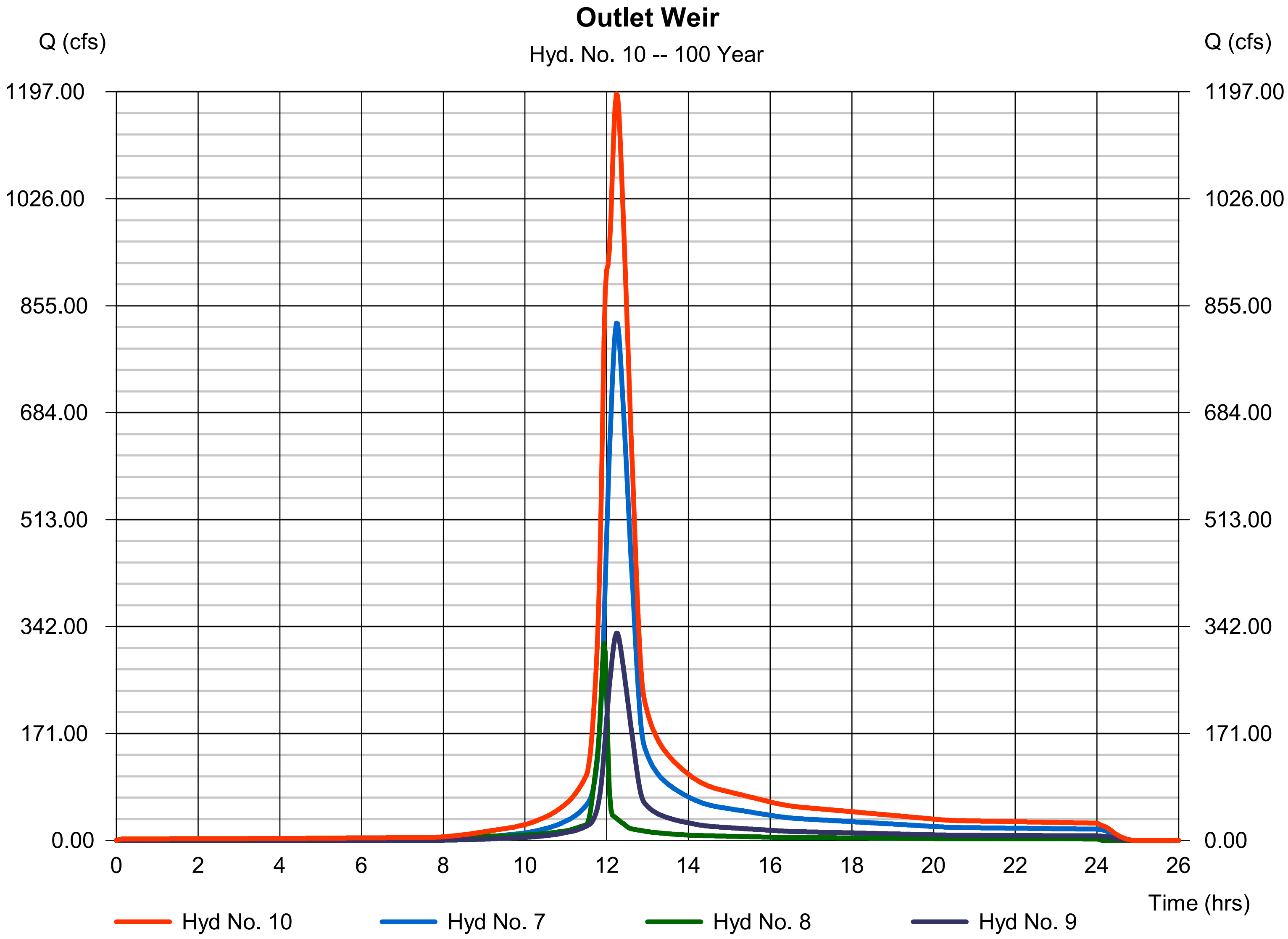


Hydrograph Report

Hyd. No. 10

Outlet Weir

Hydrograph type	= Combine	Peak discharge	= 1193.98 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 6,040,827 cuft
Inflow hyds.	= 7, 8, 9	Contrib. drain. area	= 148.930 ac

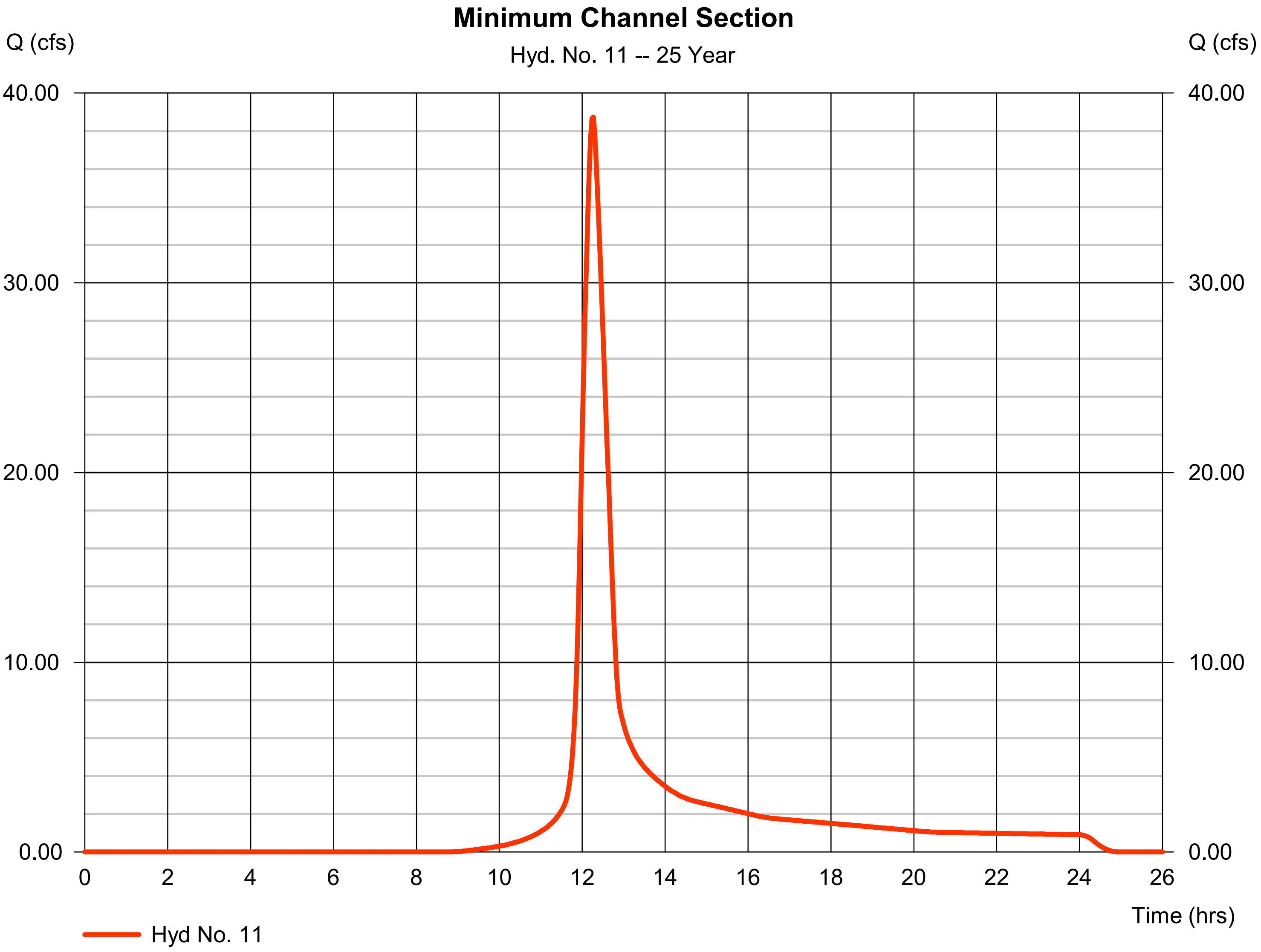


Hydrograph Report

Hyd. No. 11

Minimum Channel Section

Hydrograph type	= SCS Runoff	Peak discharge	= 38.73 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.27 hrs
Time interval	= 2 min	Hyd. volume	= 177,036 cuft
Drainage area	= 19.170 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.50 min
Total precip.	= 5.26 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

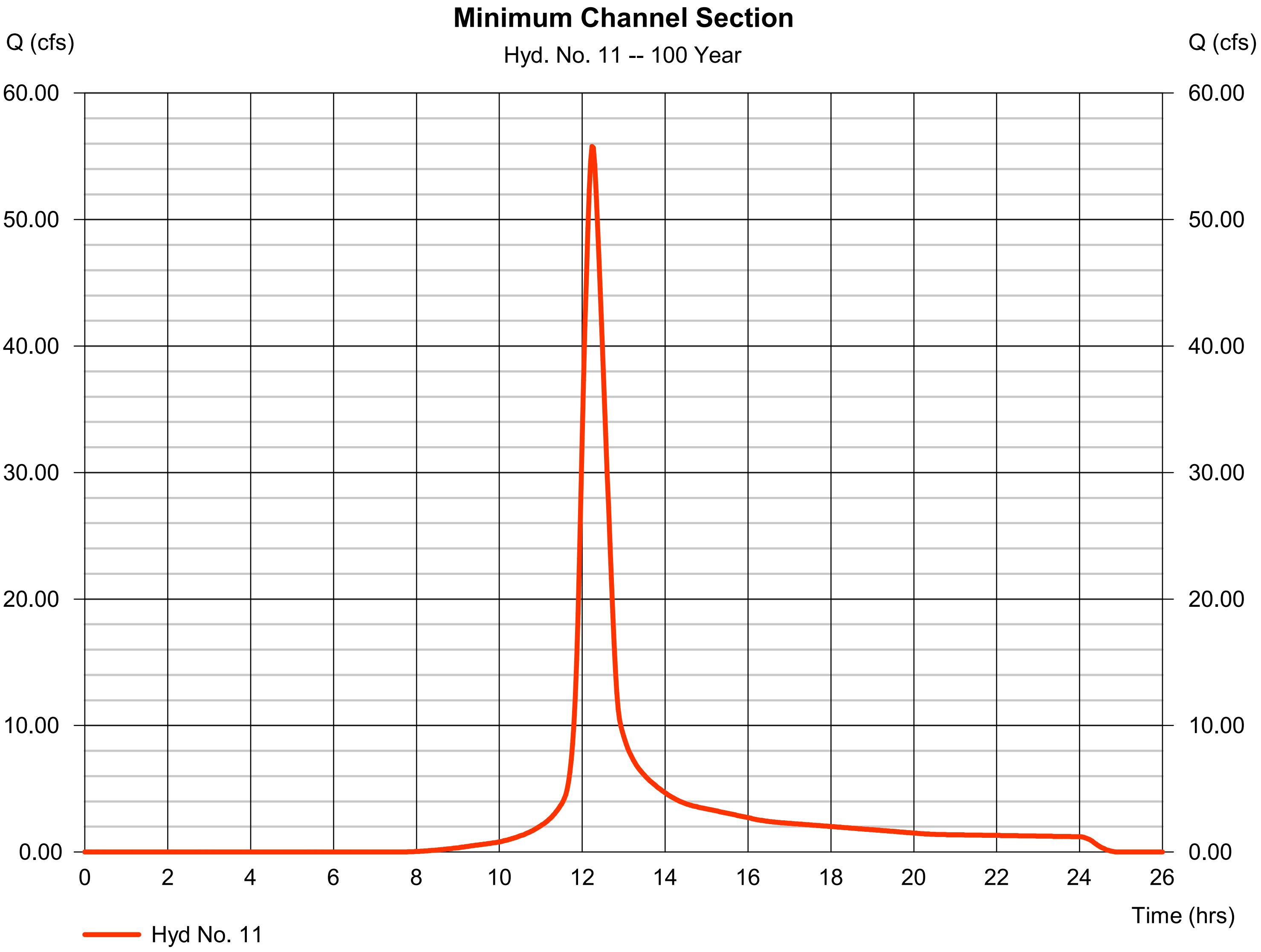


Hydrograph Report

Hyd. No. 11

Minimum Channel Section

Hydrograph type	= SCS Runoff	Peak discharge	= 55.79 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 253,056 cuft
Drainage area	= 19.170 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.50 min
Total precip.	= 6.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Appendix C

Hydroflow Express Output

Channel Report

East Channel Lower Reach

Trapezoidal

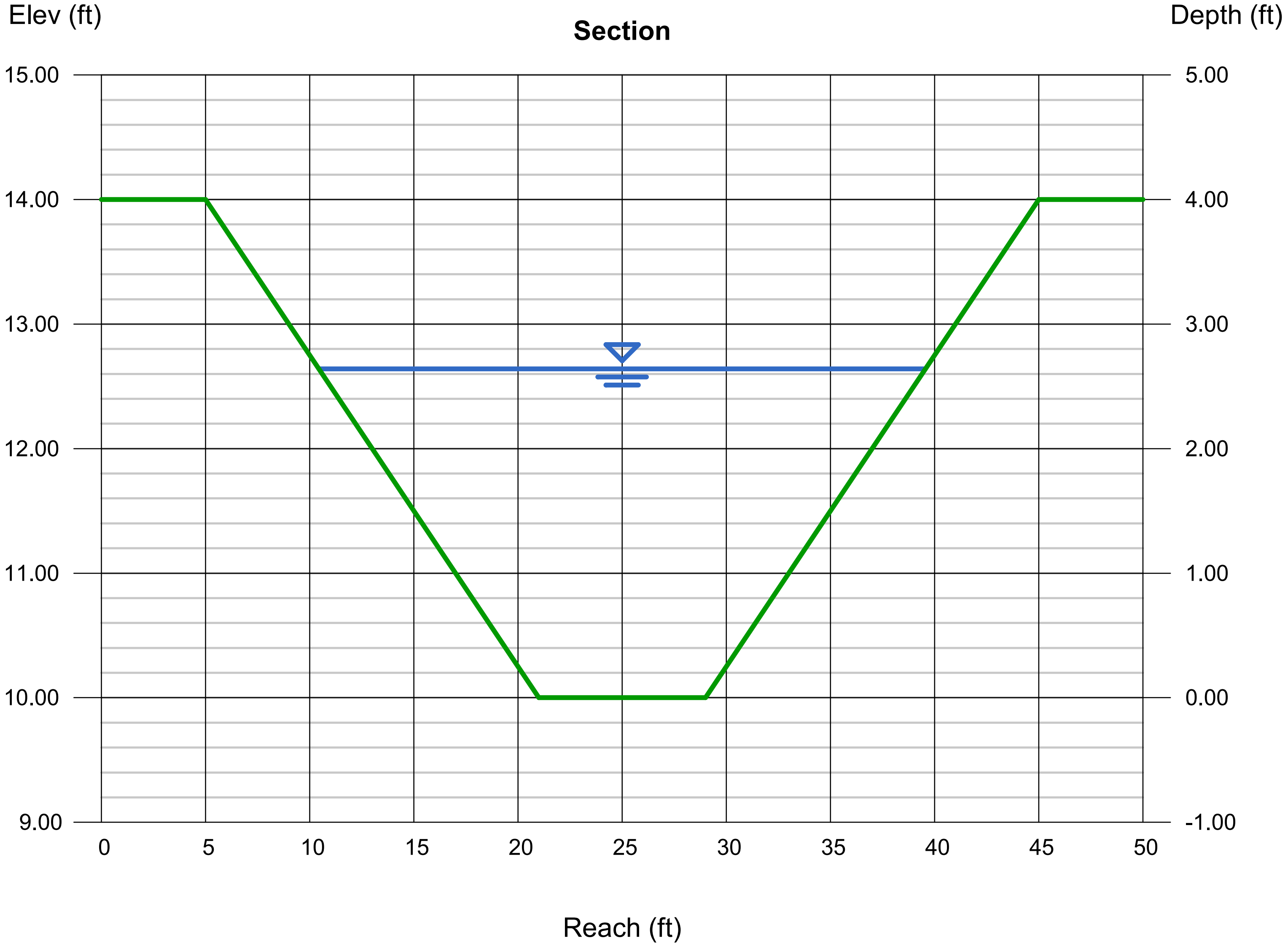
Bottom Width (ft)	= 8.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 10.00
Slope (%)	= 0.15
N-Value	= 0.022

Calculations

Compute by:	Known Q
Known Q (cfs)	= 178.63

Highlighted

Depth (ft)	= 2.64
Q (cfs)	= 178.63
Area (sqft)	= 49.00
Velocity (ft/s)	= 3.65
Wetted Perim (ft)	= 29.77
Crit Depth, Yc (ft)	= 1.84
Top Width (ft)	= 29.12
EGL (ft)	= 2.85



Channel Report

West Channel

Trapezoidal

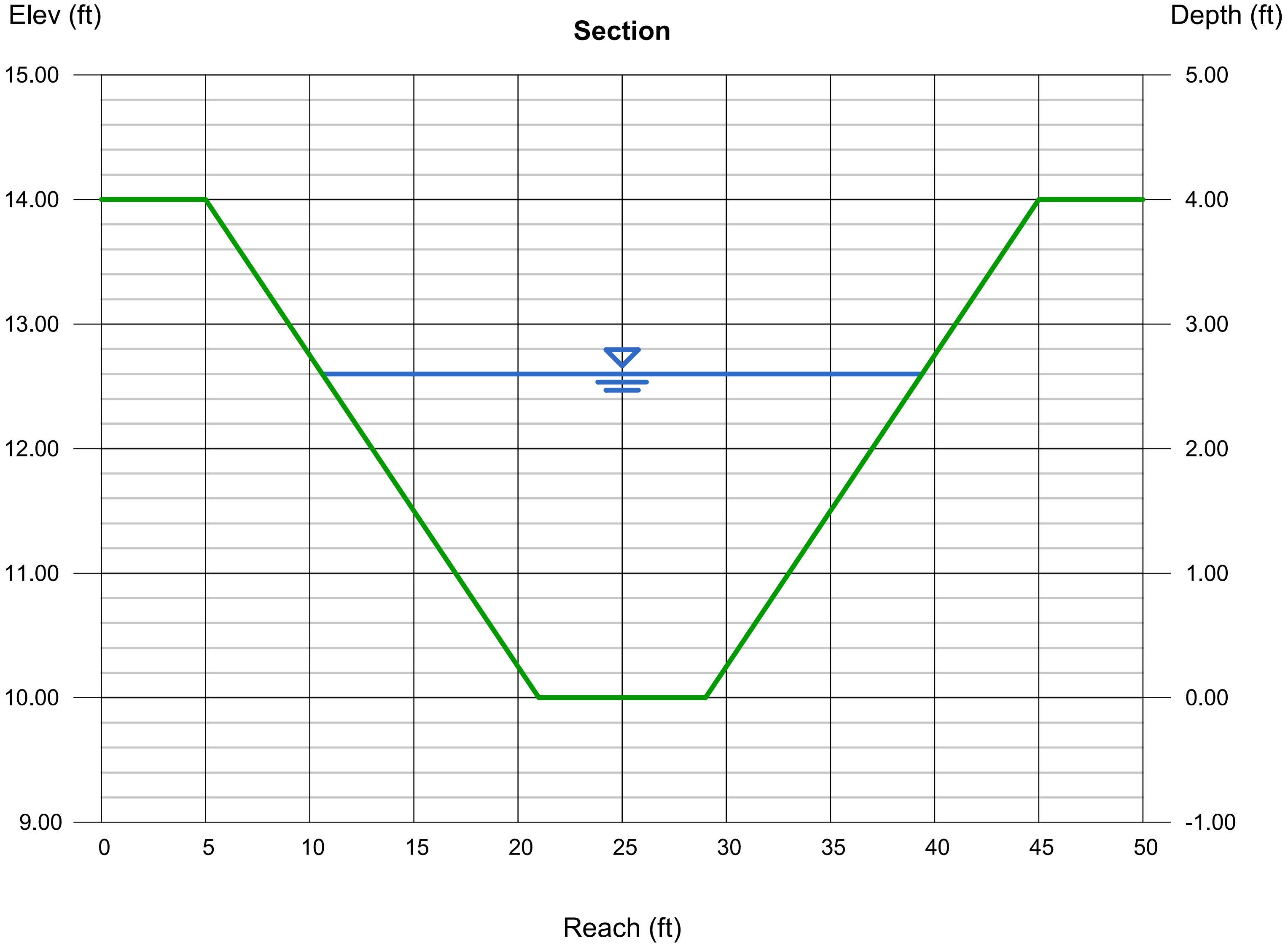
Bottom Width (ft)	= 8.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 10.00
Slope (%)	= 0.20
N-Value	= 0.022

Calculations

Compute by:	Known Q
Known Q (cfs)	= 199.60

Highlighted

Depth (ft)	= 2.60
Q (cfs)	= 199.60
Area (sqft)	= 47.84
Velocity (ft/s)	= 4.17
Wetted Perim (ft)	= 29.44
Crit Depth, Yc (ft)	= 1.95
Top Width (ft)	= 28.80
EGL (ft)	= 2.87



Channel Report

Central Drainageway

Trapezoidal

Bottom Width (ft) = 12.00

Side Slopes (z:1) = 3.00, 3.00

Total Depth (ft) = 3.00

Invert Elev (ft) = 10.00

Slope (%) = 1.00

N-Value = 0.026

Calculations

Compute by: Known Q

Known Q (cfs) = 212.00

Highlighted

Depth (ft) = 1.78

Q (cfs) = 212.00

Area (sqft) = 30.87

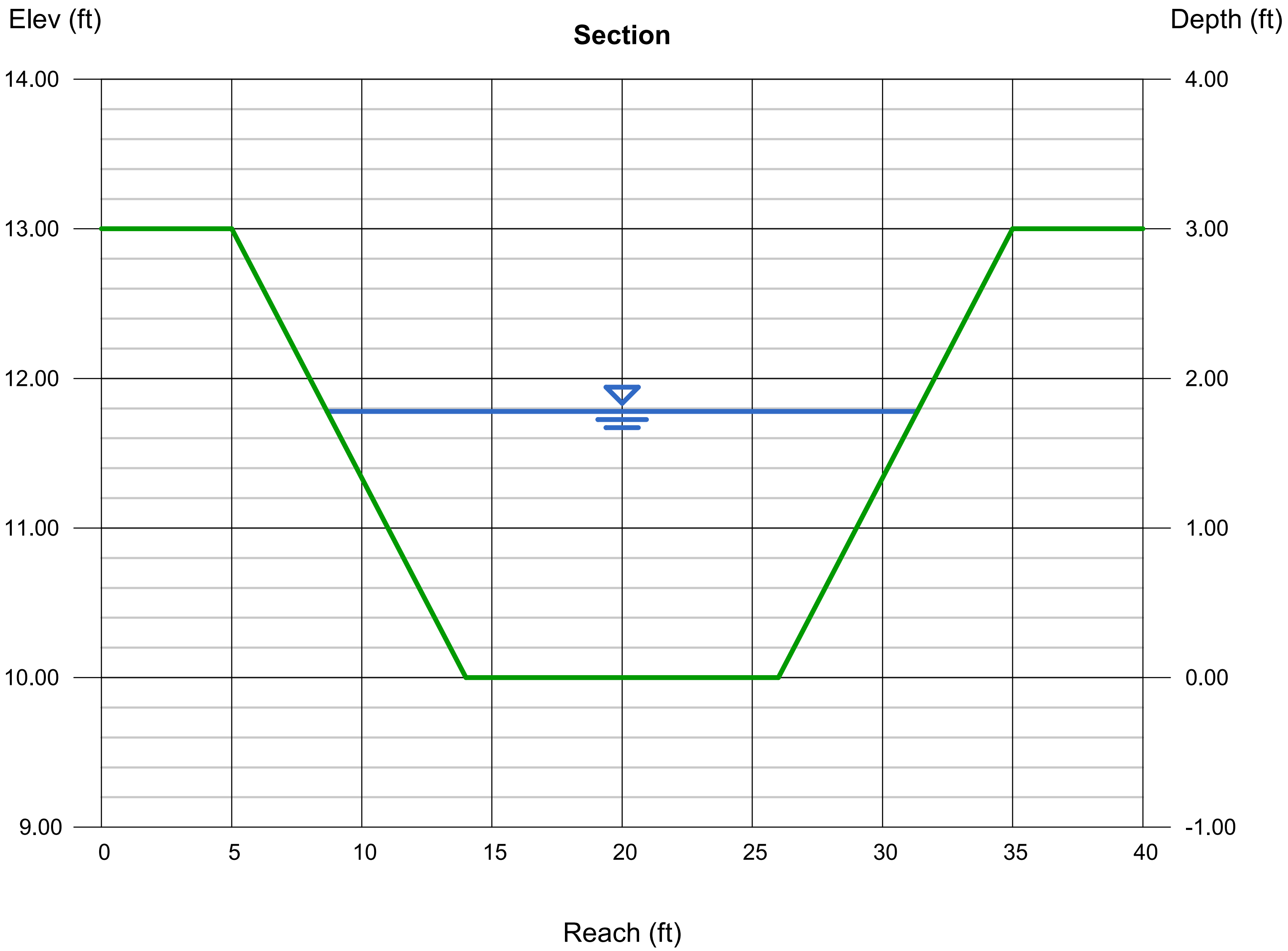
Velocity (ft/s) = 6.87

Wetted Perim (ft) = 23.26

Crit Depth, Yc (ft) = 1.82

Top Width (ft) = 22.68

EGL (ft) = 2.51



Channel Report

Culvert Under Perimeter Road x4

Circular

Diameter (ft) = 4.00

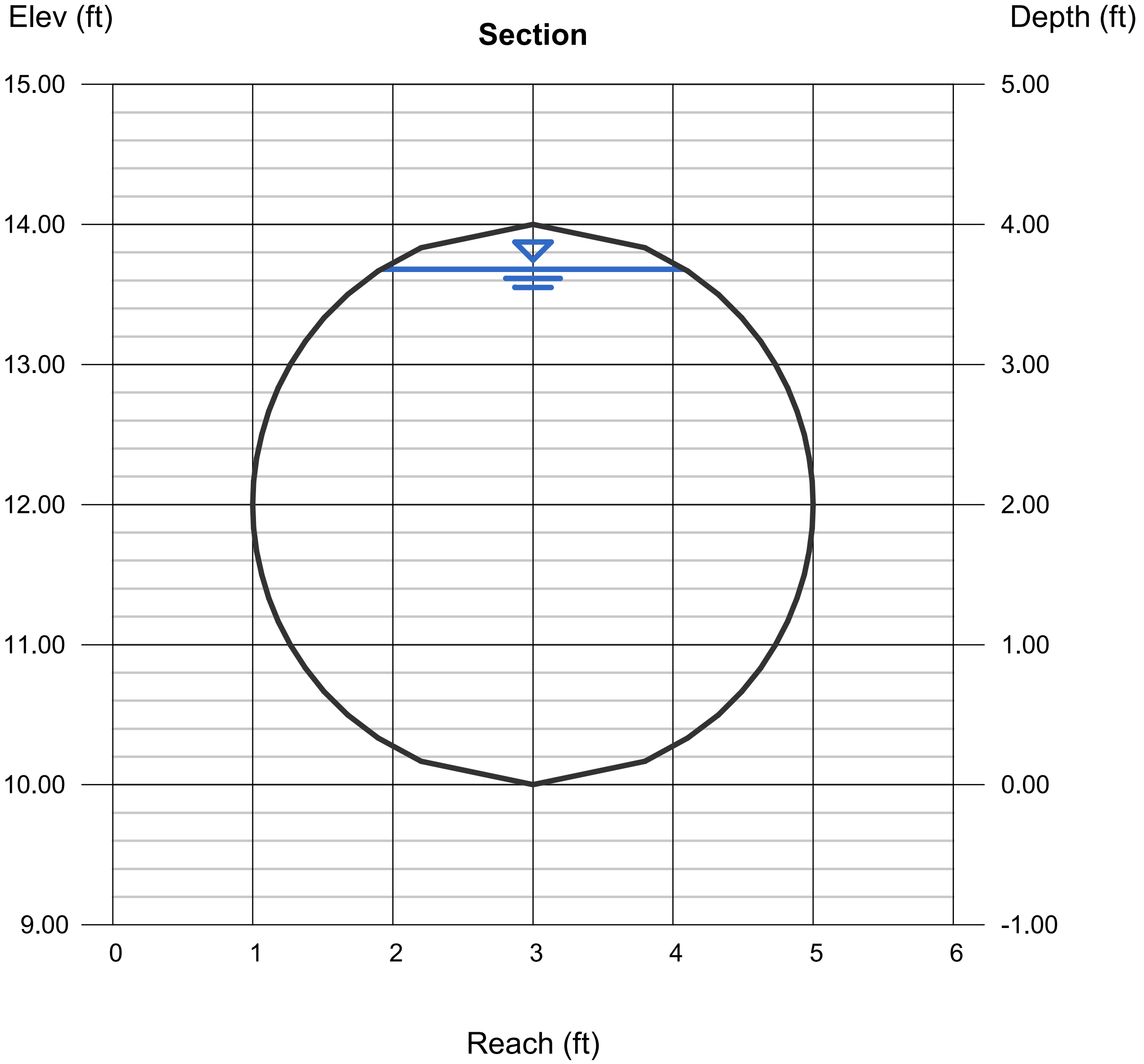
Invert Elev (ft) = 10.00
Slope (%) = 2.00
N-Value = 0.013

Calculations

Compute by: Q vs Depth
No. Increments = 25

Highlighted

Depth (ft) = 3.68
Q (cfs) = 218.07
Area (sqft) = 12.10
Velocity (ft/s) = 18.02
Wetted Perim (ft) = 10.28
Crit Depth, Yc (ft) = 3.89
Top Width (ft) = 2.16
EGL (ft) = 8.73



Channel Report

Outlet Weir

Trapezoidal

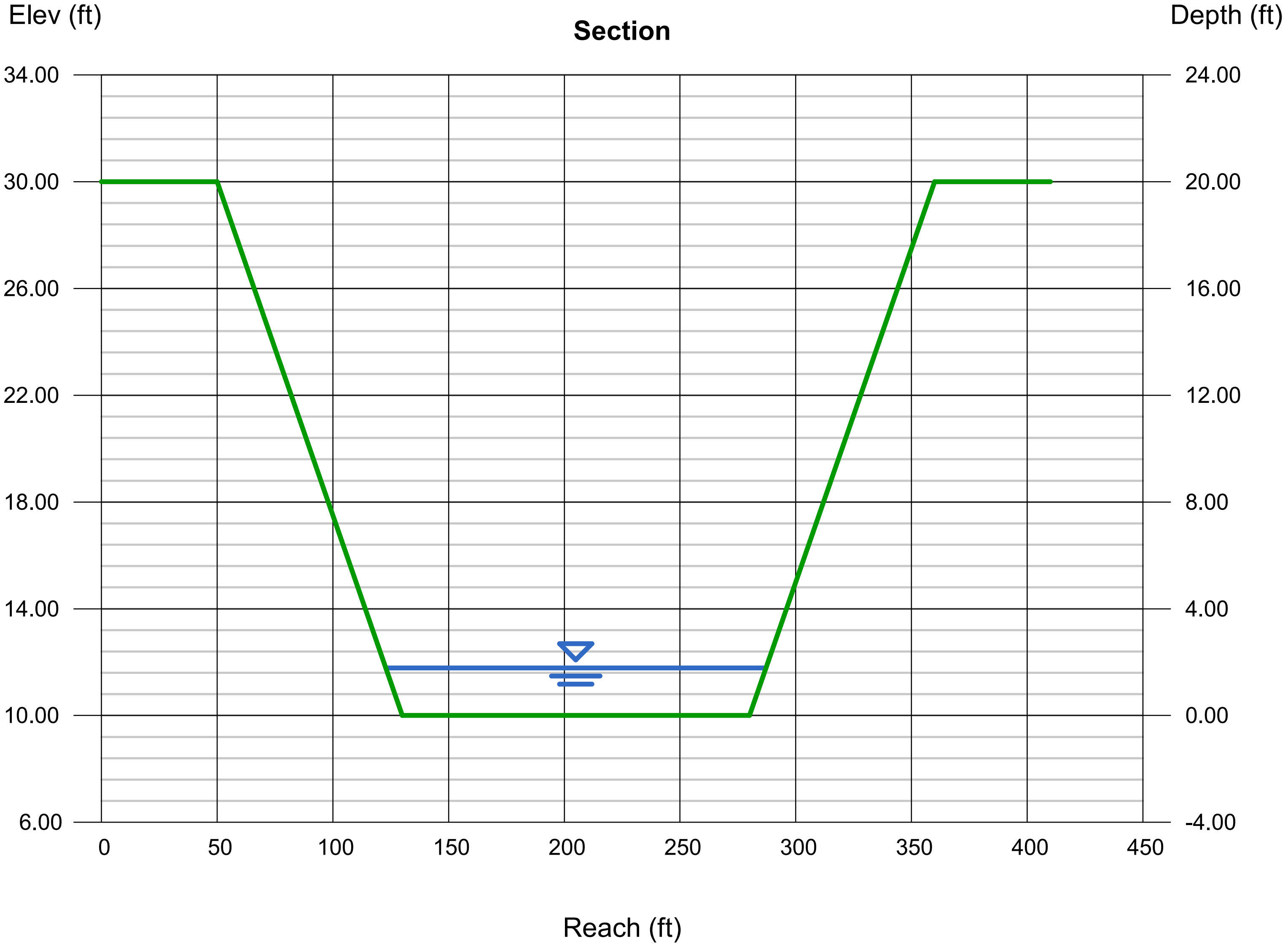
Bottom Width (ft)	= 150.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 20.00
Invert Elev (ft)	= 10.00
Slope (%)	= 0.20
N-Value	= 0.022

Calculations

Compute by:	Known Q
Known Q (cfs)	= 1194.00

Highlighted

Depth (ft)	= 1.78
Q (cfs)	= 1,194
Area (sqft)	= 279.67
Velocity (ft/s)	= 4.27
Wetted Perim (ft)	= 164.68
Crit Depth, Yc (ft)	= 1.24
Top Width (ft)	= 164.24
EGL (ft)	= 2.06



Channel Report

East Channel Minimum Section

Trapezoidal

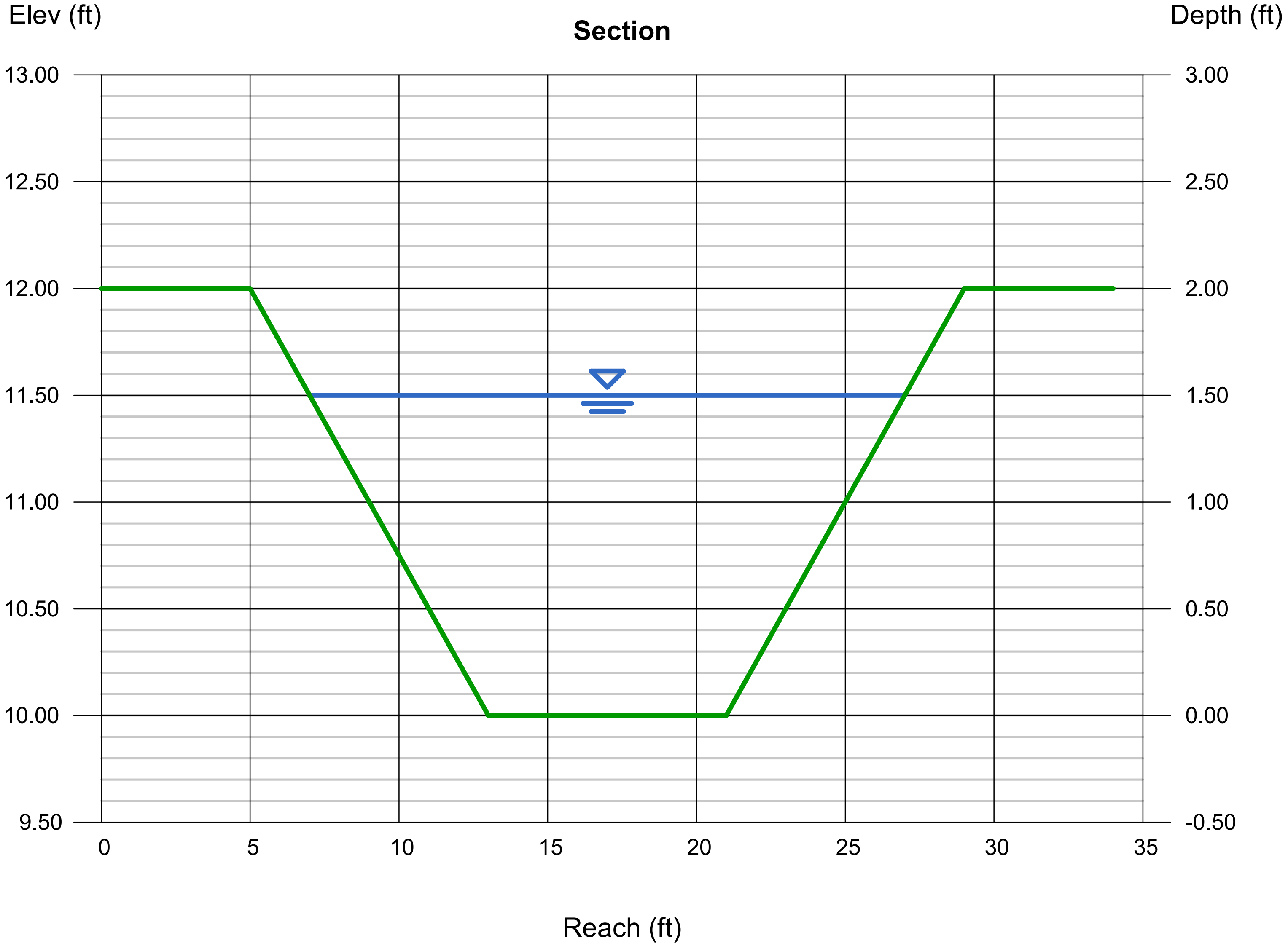
Bottom Width (ft)	= 8.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 10.00
Slope (%)	= 0.15
N-Value	= 0.022

Calculations

Compute by:	Known Q
Known Q (cfs)	= 56.00

Highlighted

Depth (ft)	= 1.50
Q (cfs)	= 56.00
Area (sqft)	= 21.00
Velocity (ft/s)	= 2.67
Wetted Perim (ft)	= 20.37
Crit Depth, Yc (ft)	= 0.98
Top Width (ft)	= 20.00
EGL (ft)	= 1.61



Attachment D

Geotechnical Design of Slopes and Final Cover System

Slope Stability Report for IPGC Newton Primary Ash Pond Closure

Newton, Illinois

Draft April 2022

Certification

	I hereby certify that these engineering documents were prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Illinois. Date My license renewal date is Pages or sheets covered by this seal: All pages.

Table of Contents

Figures

Attachments

References

1. Slope/W Version v11.14.1.3, build 212549 x64_n6; GeoStudio 2019, Geo-Slope International, Ltd.
2. Global Stability Evaluation for Newton Power Station, Primary Ash Pond, Newton, Illinois, January 4, 2011.
3. Geotechnical Engineering Properties of Fly Ash and Bottom Ash.
4. U.S. Geological Survey – Earthquake Hazards Program

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1 Purpose

The purpose of this report is to evaluate the global slope stability for the IPGC Newton Power Station Primary Ash Pond Closure slopes. These calculations focus on the stability of the existing base grades, placed ash, and final cover system, assuming typical material properties based on static and seismic conditions.

The global slope stability through the ash fill final closure slope for the following scenarios were evaluated:

- Run A – A northeast-southwest section through the south side slope in order to evaluate the slope stability of the ash fill on a 4H:1V slope. **Figure 2, Section A-A**.
- Run B – A northeast-southwest section through the south side slope in order to evaluate the slope stability of the ash fill on a 4H:1V slope and seismic impact. **Figure 3, Section A-A**.
- Run C – A northeast-southwest section through the south side slope in order to evaluate the sliding block slope stability of the ash fill on a 4H:1V slope. **Figure 4, Section A-A**.
- Run D – A northeast-southwest section through the south side slope in order to evaluate the sliding block slope stability of the ash fill on a 4H:1V slope and seismic impact. **Figure 5, Section A-A**.
- Run E – A northeast-southwest section through the south side slope in order to evaluate the slope stability of the ash fill on a 4H:1V slope. **Figure 6, Section B-B**.
- Run F – A northeast-southwest section through the south side slope in order to evaluate the slope stability of the ash fill on a 4H:1V slope and seismic impact. **Figure 7, Section B-B**.
- Run G – A northeast-southwest section through the south side slope in order to evaluate the sliding block slope stability of the ash fill on a 4H:1V slope. **Figure 8, Section B-B**.
- Run H – A northeast-southwest section through the south side slope in order to evaluate the sliding block slope stability of the ash fill on a 4H:1V slope and seismic impact. **Figure 9, Section B-B**.

2 Approach

Two-dimensional limit equilibrium methods were used to evaluate slope stability for the static condition. Per the historical permit documentation, the site was determined to be in a seismic impact zone.

Per the Illinois Department of Natural Resources, the seismic hazard analysis should use bedrock peak ground accelerations with a 2% probability of exceedance (PE) in 50 years (mean return time of 2,500 years). The National Seismic Hazards Mapping Project (NSHMP) interactive deaggregations model (2014 edition) was used to obtain the probabilistic bedrock accelerations at the site. The NSHMP model considers ground motion from many sources surrounding the site location with the assumption that the site condition is rock with an average shear wave velocity of 2,500 ft/s. Bedrock spectral response acceleration 0.2286 g were obtained from the NSHMP model (**Attachment B**). The seismic coefficient for the seismic slope stability runs was determined via the United States Army Corps of Engineers 'Rationalizing the Seismic Coefficient Method Report', published in July 1984, which states: "carry out a conventional pseudostatic stability analysis using a seismic coefficient equal to one-half the predicted peak bedrock acceleration". This method yields a seismic coefficient of 0.115 g based on a peak bedrock acceleration of 0.2286 g.

The base computer program Slope/W was used to run Morgenstern-Price analysis type circular arc surfaces and sliding block surfaces. Search techniques within Slope/W were used to find the critical slip surface producing the minimum factor of safety for each analysis. The location of the critical slip surface is a function of the site geometry (slope angle and height), material stratigraphy, physical properties of the soil and fly ash, external loads; weight of soil and/or waste above the slip surface and groundwater conditions.

3 Material Properties and Sections

3.1 Slope Stability

The materials were grouped into four (4) basic types similar to the Global Stability Evaluation Report, attached as Appendix B. See Table 1 below. For this analysis, an internal angle of friction of 25-degrees for the fly ash was used based on typical results for dry fly ash. Each scenario is based on long-term properties, to be conservative.

In addition, final cover veneer slope stability analysis was conducted to evaluate the stability of the final cover soil over the final cover membrane system. Final cover veneer results are provided in **Attachment A.**

Table 1: Material Characteristics

Material/Description	**Moist Unit Weight (PCF)**	**Cohesion (PSF)**	**Friction Angle (DEG)**
Embankment Fill	125	50	25
Existing Silty-Clay/Clay	120	50	30
Fly Ash	112	0	25
Final Cover System	125	50	25

Notes (Basis):

1. Embankment Fill and Existing Silty-Clay/Clay characteristics are based on the Global Stability Evaluation Report.
2. Fly ash characteristics are based on industry standard values for dry fly ash.
3. Final cover system is based on average values.

4 Stability Analysis Results and Conclusions

4.1 Ash Fill Scenarios

The table below summarizes results from the stability analyses for the slopes:

Run	**Case**	**Slope**	**Condition**	**Slip Surface**	**Factor of Safety**
Final Cover Ash Fill Slope – Cross Section A-A					
A	Ash Fill Slope – Final Cover **(Figure 2)**	4H:1V	Long Term	Circular	1.971
B	Ash Fill Slope – Final Cover **(Figure 3)**	4H:1V	Long Term	Circular - Seismic	1.321
C	Ash Fill Slope – Final Cover **(Figure 4)**	4H:1V	Long Term	Sliding Block	1.892
D	Ash Fill Slope – Final Cover **(Figure 5)**	4H:1V	Long Term	Sliding Block - Seismic	1.272
Final Cover Ash Fill Slope – Cross Section B-B					
E	Ash Fill Slope – Final Cover **(Figure 4)**	4H:1V	Long Term	Circular	2.402
F	Ash Fill Slope – Final Cover **(Figure 4)**	4H:1V	Long Term	Circular - Seismic	1.629
G	Ash Fill Slope – Final Cover **(Figure 5)**	4H:1V	Long Term	Sliding Block	2.436
H	Ash Fill Slope – Final Cover **(Figure 5)**	4H:1V	Long Term	Sliding Block - Seismic	1.621
Final Cover Veneer Stability					
-	Final Cover Veneer – Static	4H:1V	Long Term	Veneer	2.11
-	Final Cover Veneer – Seismic	4H:1V	Long Term	Veneer	1.12

4.2 Conclusions

Illinois Department of Natural Resources recommends a minimum factor of safety of 1.5 for long-term stability. During an extreme event, such as an earthquake, a factor of safety of 1.0 or more is recommended. Based on the results of our analyses, the embankment slopes have satisfactory factors of safety for global stability and veneer stability.

This model was generated using typical material properties. Results are based on design assumptions as stated and HDR is not responsible for deviations from the operational/design assumptions.

The outputs from the computer results of stability analyses are attached to this report with the **Figures** section.

Figures

Plans, Cross Sections, and Slope Stability Output

PROJECT MANAGER M. ROBERTS
CIVIL G. WILLIAMS
CIVIL K. KINLEY
DRAWN BY M. BICKFORD
PROJECT NUMBER 10296144

ISSUE	**DATE**	**DESCRIPTION**

DRAFT

ILLINOIS POWER GENERATING COMPANY
NEWTON POWER PLANT
PRIMARY ASH POND CLOSURE

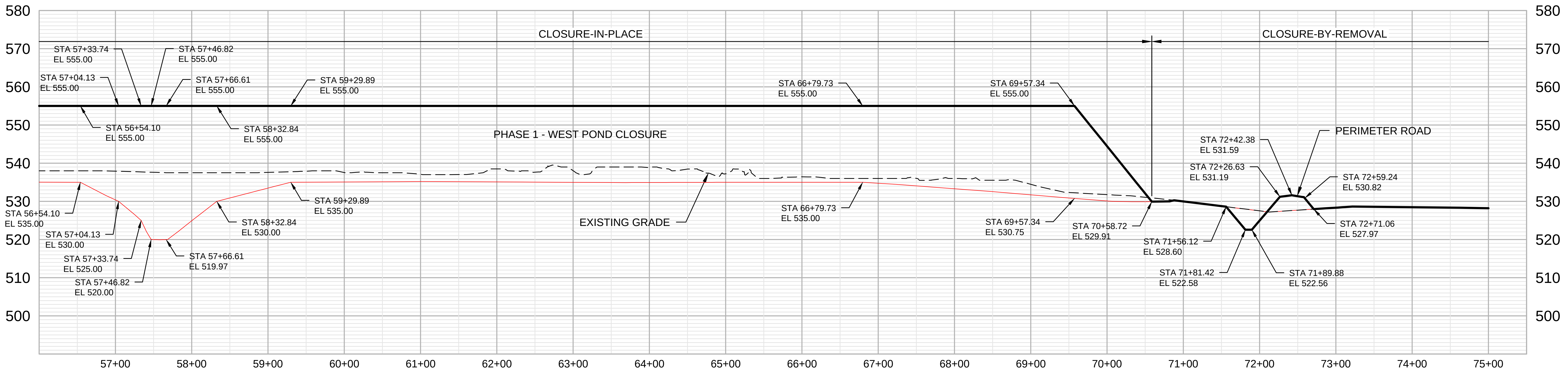
FINAL CLOSURE CONDITIONS

0 1" 2"

FILENAME 00C106.DWG
SCALE 1" = 300'

SHEET
00C106

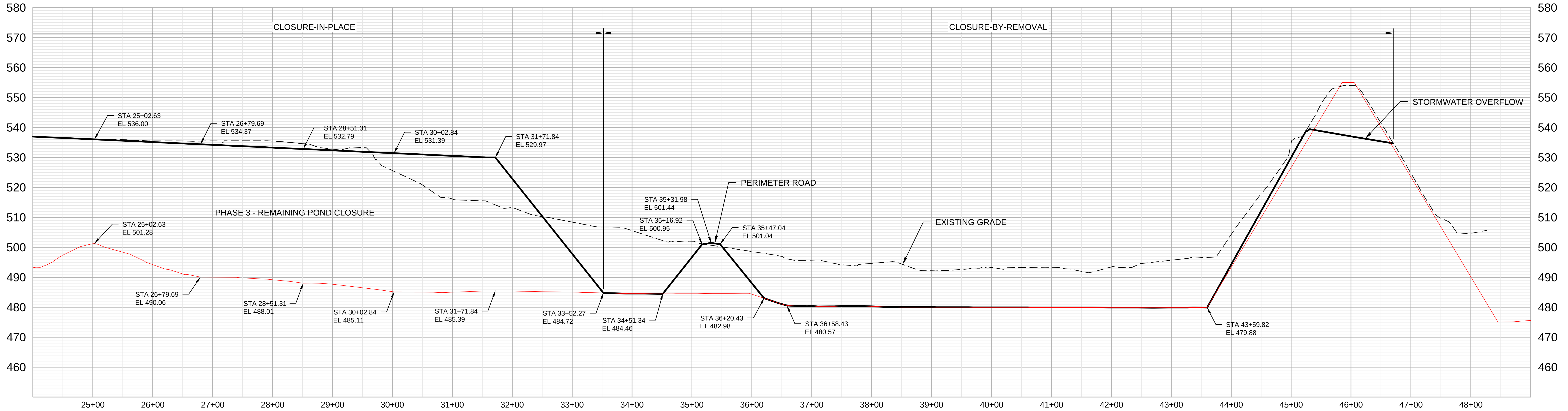
c:\pwworking\central01\d2372207\00C106.dwg, Layout1, 4/7/2022 11:07:15 AM, MBICKFORD



A-A
00C106

SECTION A-A

HORIZ: 1" = 100' | VERT: 1" = 20'



B-B
00C106

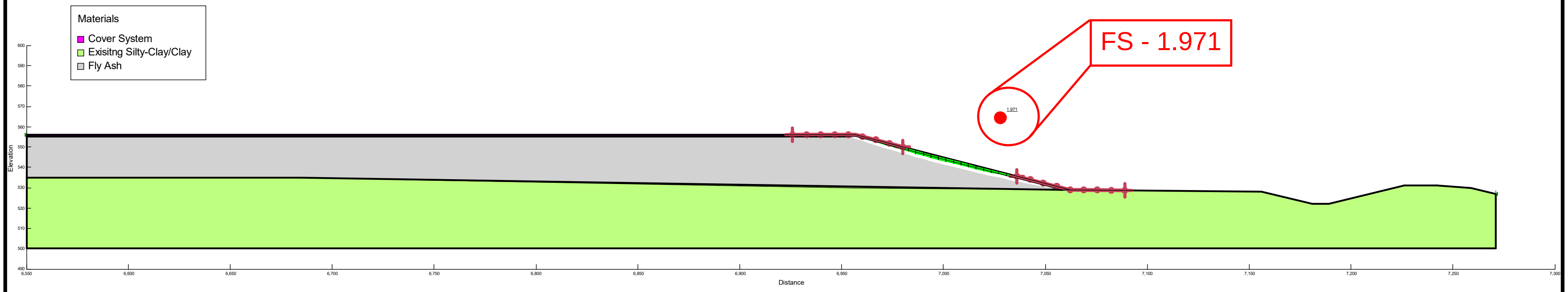
SECTION B-B (cont.)

HORIZ: 1" = 100' | VERT: 1" = 20'

DRAFT

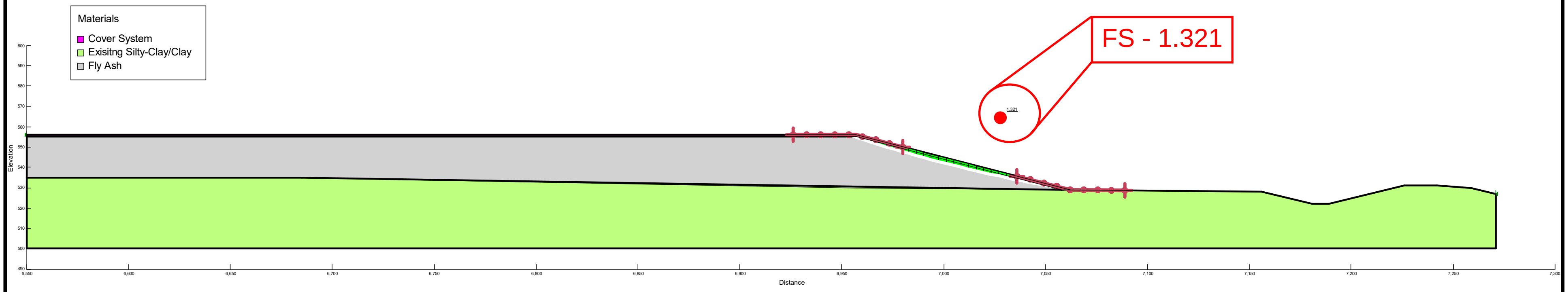
Figure 1
Closure Cross Sections

C:\pwworking\central01\d2372192\99C-GP01-01.dwg, Layout2, 3/29/2022 1:24:08 PM, MBICKFORD



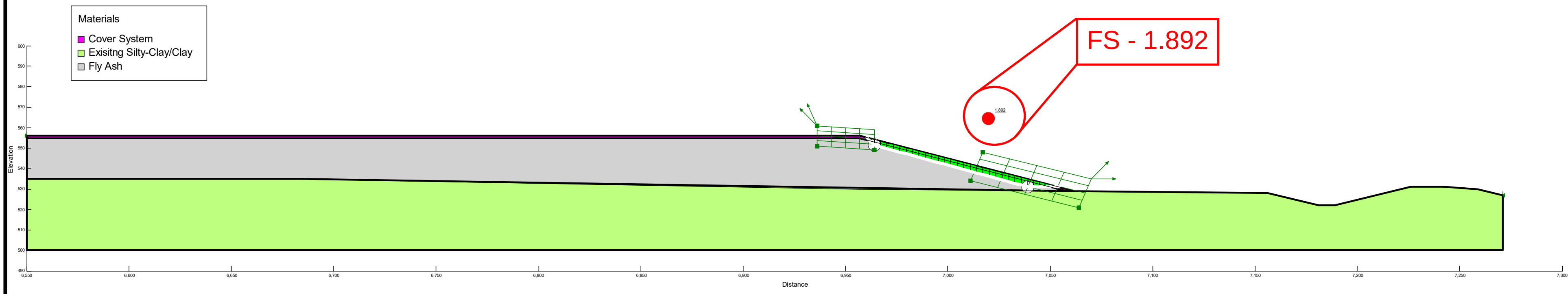
DRAFT

SLOPE/W Analysis	Figure 2
AA Slope Circular.gsz	
04/07/2022	1:917



DRAFT

SLOPE/W Analysis	Figure 3
AA Slope Circular - Seismic.gsz	
04/14/2022	1:917

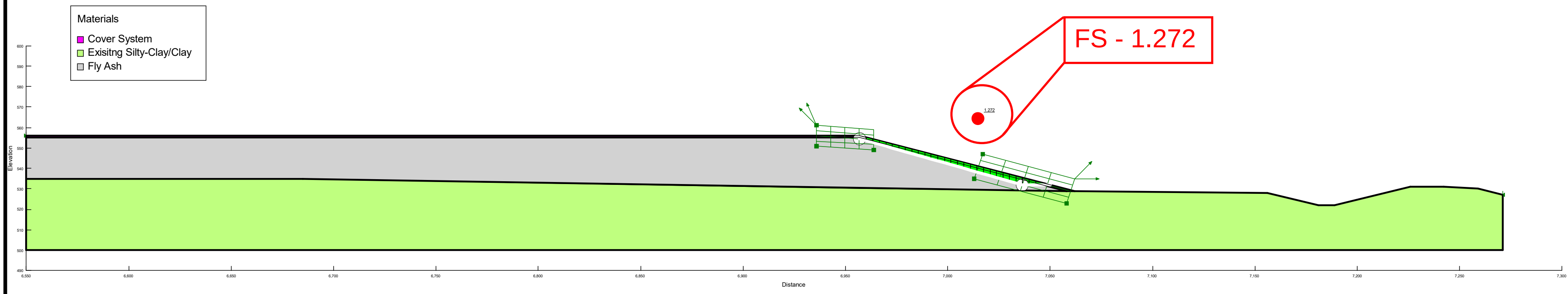


DRAFT

SLOPE/W Analysis
Figure 4

AA Slope - Sliding Block.gsz

04/14/2022
1:917



DRAFT

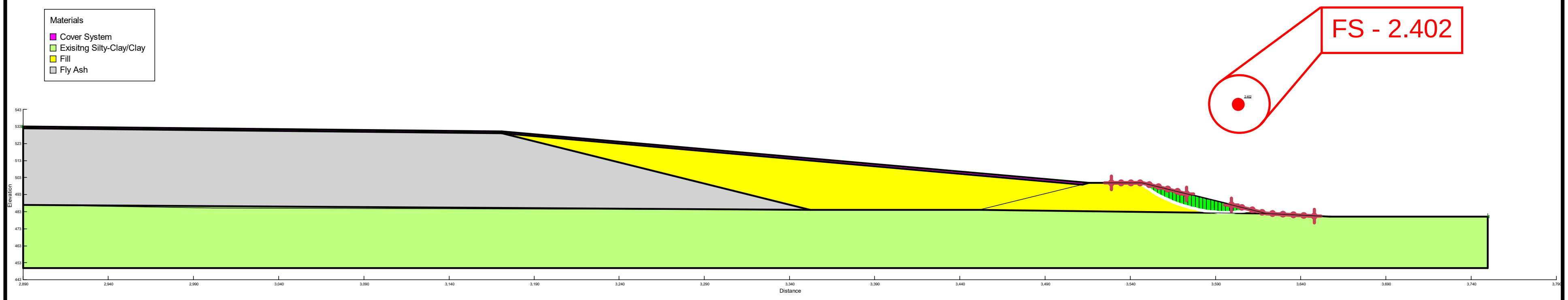
SLOPE/W Analysis

Figure 5

AA Slope - Sliding Block - Seismic.gsz

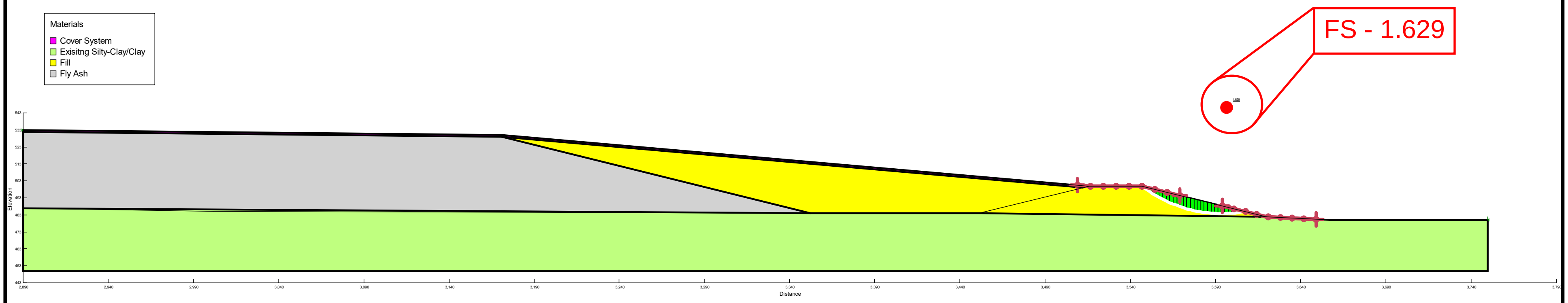
04/14/2022

1:917



DRAFT

SLOPE/W Analysis	Figure 6
BB Slope Circular.gsz	
04/14/2022	1:1,097



DRAFT

SLOPE/W Analysis	Figure 7
BB Slope Circular - Seismic.gsz	
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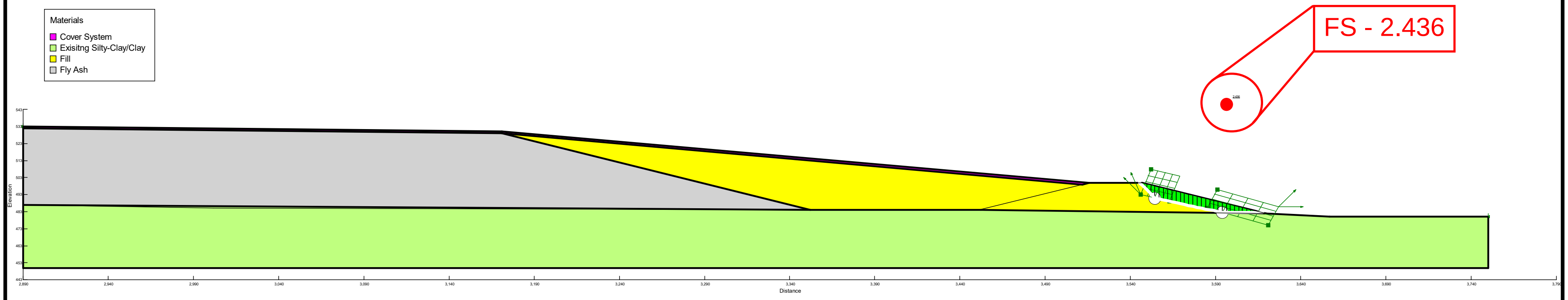

DRAFT

SLOPE/W Analysis	Figure 8
BB Slope-Sliding Block.gsz	
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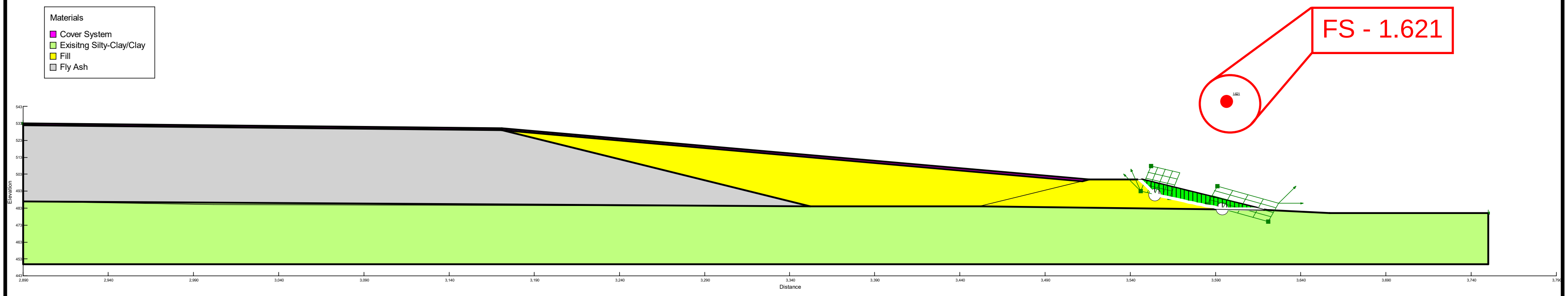


DRAFT

SLOPE/W Analysis	Figure 9
BB Slope-Sliding Block - Seismic.gsz	
04/14/2022	1:1,097

Attachment A

Final Cover Veneer Stability

DRAFT

Project: IPGC Newton Power Station – Primary Ash Pond Closure
Project Number: 10296144
Date: April-22
Calculation: G. Shafer

Objective: Evaluate the stability of the cover veneer against sliding

Reference: Matasovic, N. (1991), "Selection of Method for Seismic Slope Stability Analysis", Proc. 2nd International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamaics, St. Louis, Vol. 2, pp 1057-1062

Requirements: FSmin (Static) = 1.5; Fsmin (Dynamic) = 1.0 (If Applicable)

Analysis: Infinite Slope (Matasovic, 1991); See eqjua

0.115	**Ks**	Seismic coefficient - See next page 0.5*max horizontal accel
125	**gc**	Unit wight of protective cover materials (pcf)
62.4	**gw**	Unit weight of water (pcf)
	c	Cohesion/adhesion along assumed failure surface (psf)
	F	Interface friction angle along assumed failure surface (degrees)
2	**Zc**	Depth of protective cover (depth to failure surface) (ft)
1.95	**dw**	Depth to seepage surface (assumed parallel to slope (ft)
14	**b**	Slope angle of protective cover (degrees); 4H:1V

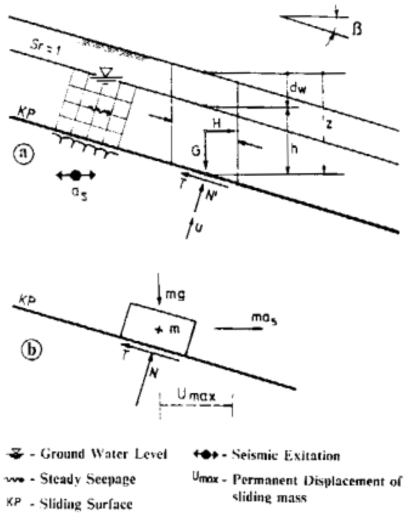


Fig. 2 Model of an infinite slope

Based on the above assumptions, the principles of limit equilibrium and the notation introduced in Figure 2, the following expression for the factor of safety, F_s, has been derived (Matasovic, 1989):

$$F_s = \frac{c/(\gamma\, z \cos^2 ß) + \tan \Phi[1 - \gamma_w(z-d_w)/(\gamma\, z)] - k_s \tan ß \tan \Phi}{k_s + \tan ß} \qquad (1)$$

where γ, γ_w, c and Φ are the unit weight of slope material, the unit weight of water, cohesion and the angle of internal friction respectively.

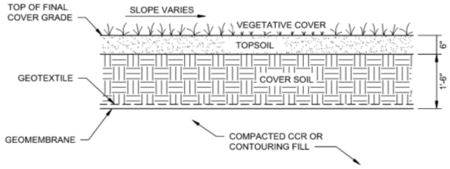
Calculate Static FS Against Sliding

Soil Conditions at Interface	Interface Friction Angle (F)*	Cohesion/Adhesion (psf)	Resisting Force	Driving Force	F.S.	Normal Load	Interface Shear Strength
	28.0	0.0	0.408	0.364	1.12	125	66
			0.000	0.364	0.00	125	0
			0.000	0.364	0.00	125	0
			0.000	0.364	0.00	125	0
			0.000	0.364	0.00	125	0
			0.000	0.364	0.00	125	0
			0.000	0.364	0.00	125	0
			0.000	0.364	0.00	125	0
			0.000	0.364	0.00	125	0
			0.000	0.364	0.00	125	0

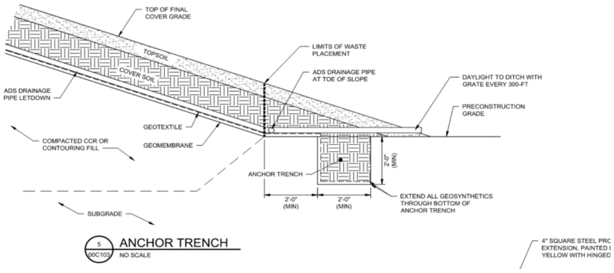
Iteration

	26.0	0.0	0.37	0.36	1.03	125	61
	27.0	0.0	0.39	0.36	1.07	125	64
	28.0	0.0	0.41	0.36	1.12	125	66
	29.0	0.0	0.43	0.36	1.17	125	69
	30.0	0.0	0.44	0.36	1.22	125	72

Sketches:
*Note: the geomembrane includes a microspike which acts as a drainage composite with the addition of the geotextile shown below.



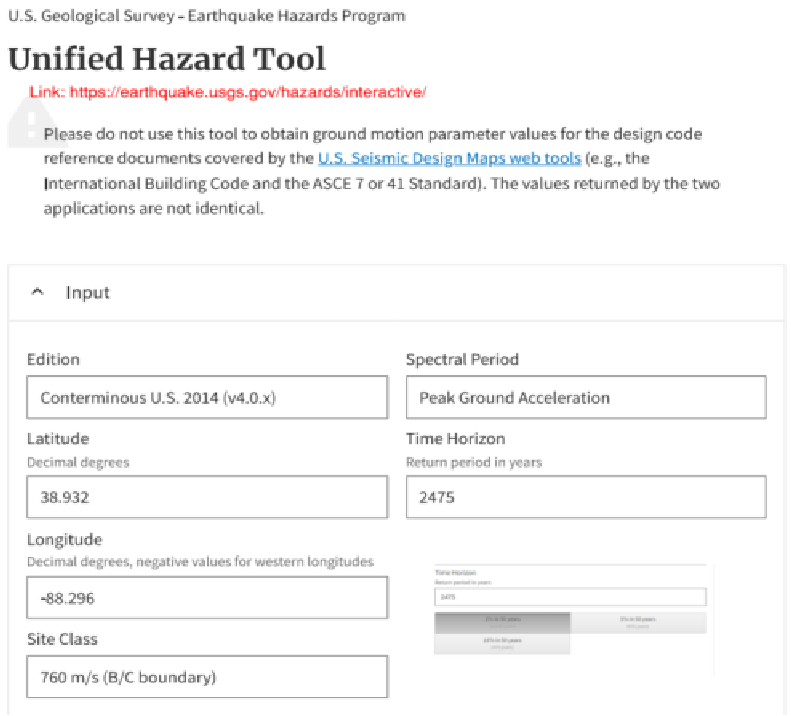
6 00C103 FINAL COVER
NO SCALE



***Conclusion:**
The proposed configuration is stable using 28 degrees as an assumed value for interface friction.
Prior to construction, the interface friction value should be confirmed with on-site site specific and geosynthetics.

Link: [Unified Hazard Tool (usgs.gov)]
Result: 0.2274 Use half for coefficient in analysis.

Ref: Rationalizing the Seismic Coefficient Method, Hynes-Griffin, Franklin USACE
Link: [MP GL-84-13, Rationalizing the Seismic Coefficient Method (dren.mil)]



U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Link: https://earthquake.usgs.gov/hazards/interactive/

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition: Conterminous U.S. 2014 (v4.0.x)

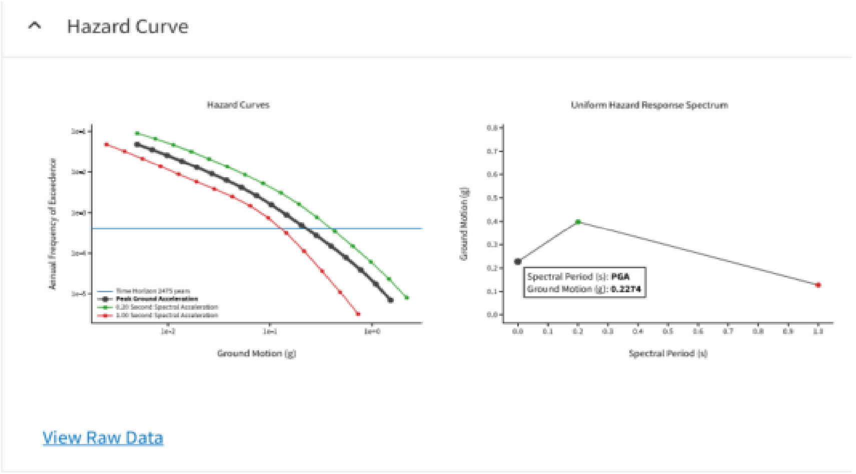
Spectral Period: Peak Ground Acceleration

Latitude (Decimal degrees): 38.932

Time Horizon (Return period in years): 2475

Longitude (Decimal degrees, negative values for western longitudes): -88.296

Site Class: 760 m/s (B/C boundary)



Hazard Curve

Spectral Period (s): **PGA**
Ground Motion (g): **0.2274**

DRAFT

Project: IPGC Newton Power Station – Primary Ash Pond Closure
Project Number: 10296144
Date: April-22
Calculation: G. Shafer

Objective: Evaluate the stability of the cover veneer against sliding

Reference: Matasovic, N. (1991), "Selection of Method for Seismic Slope Stability Analysis", Proc. 2nd International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamaics, St. Louis, Vol. 2, pp 1057-1062

Requirements: FSmin (Static) = 1.5; Fsmin (Dynamic) = 1.0 (If Applicable)

Analysis: Infinite Slope (Matasovic, 1991); See eqjua

		Seismic coefficient (= peak horizontal acceleration) (= 0 for static stability)
0	**Ks**	Static
125	**gc**	Unit wight of protective cover materials (pcf)
62.4	**gw**	Unit weight of water (pcf)
	c	Cohesion/adhesion along assumed failure surface (psf)
	F	Interface friction angle along assumed failure surface (degrees)
2	**Zc**	Depth of protective cover (depth to failure surface) (ft)
1.95	**dw**	Depth to seepage surface (assumed parallel to slope (ft)
14	**b**	Slope angle of protective cover (degrees); 4H:1V

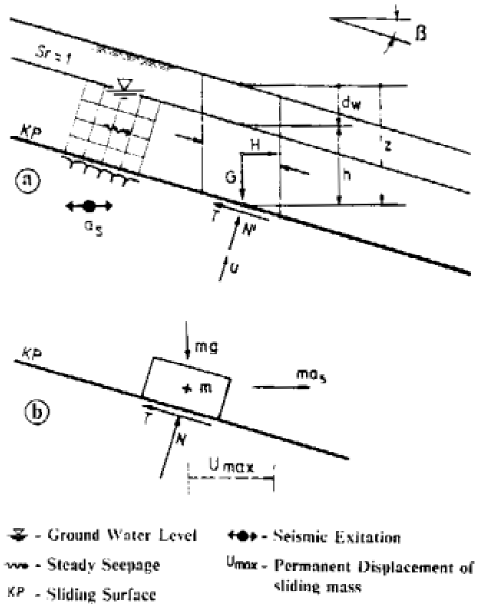


Fig. 2 Model of an infinite slope

Based on the above assumptions, the principles of limit equilibrium and the notation introduced in Figure 2, the following expression for the factor of safety, F_s, has been derived (Matasovic, 1989):

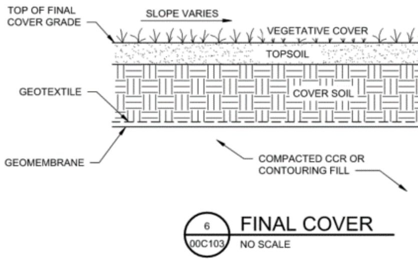
$$F_s = \frac{c/(\gamma\, z \cos^2 \beta) + \tan \Phi [1 - \gamma_w (z-d_w)/(\gamma\, z)] - k_s \tan \beta \tan \Phi}{k_s + \tan \beta} \qquad (1)$$

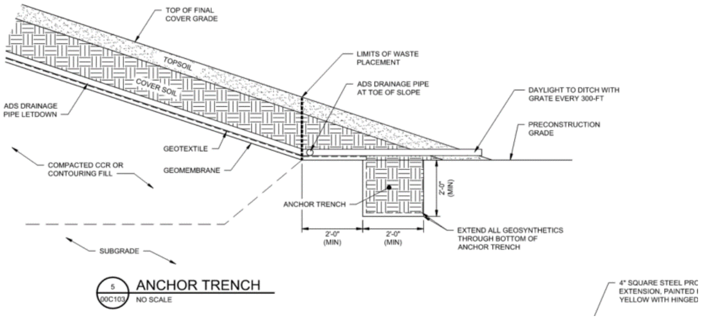
where γ, γ_w, c and Φ are the unit weight of slope material, the unit weight of water, cohesion and the angle of internal friction respectively.

Calculate Static FS Against Sliding

Soil Conditions at Interface	Interface Friction Angle (F)*	Cohesion/Adhesion (psf)	Resisting Force	Driving Force	F.S.	Normal Load	Interface Shear Strength
	28.0	0.0	0.525	0.249	2.11	125	66
			0.000	0.249	0.00	125	0
			0.000	0.249	0.00	125	0
			0.000	0.249	0.00	125	0
			0.000	0.249	0.00	125	0
			0.000	0.249	0.00	125	0
			0.000	0.249	0.00	125	0
			0.000	0.249	0.00	125	0
			0.000	0.249	0.00	125	0
			0.000	0.249	0.00	125	0
Iteration							
	26.0	0.0	0.48	0.25	1.93	125	61
	27.0	0.0	0.50	0.25	2.02	125	64
	28.0	0.0	0.53	0.25	2.11	125	66
	29.0	0.0	0.55	0.25	2.20	125	69
	30.0	0.0	0.57	0.25	2.29	125	72
	31.0	0.0	0.59	0.25	2.38	125	75

Sketches:
*Note: the geomembrane includes a microspike which acts as a drainage composite with the addition of the geotextile shown below.





***Conclusion:**
The proposed configuration is stable using 28 degrees as an assumed value for interface friction. Prior to construction, the interface friction value should be confirmed with on-site site specific and geosynthetics.

Attachment B

Reference Information

-Soil Characteristics Data

-Seismic Support Data

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Conterminous U.S. 2014 (v4.0.x)

Latitude

Decimal degrees

38.933

Longitude

Decimal degrees, negative values for western longitudes

-88.279

Site Class

760 m/s (B/C boundary)

Spectral Period

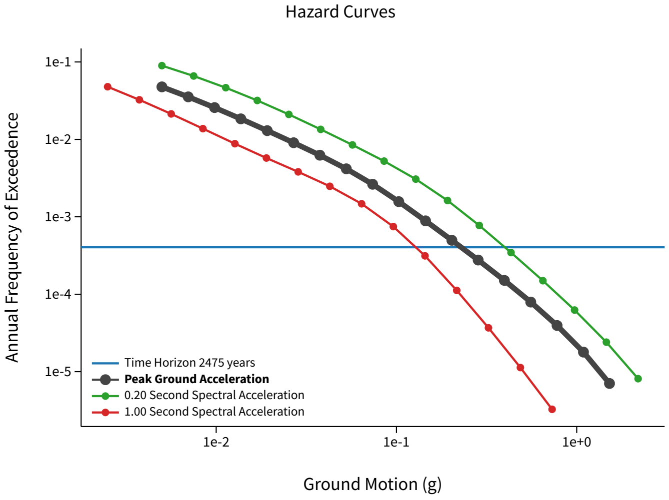
Peak Ground Acceleration

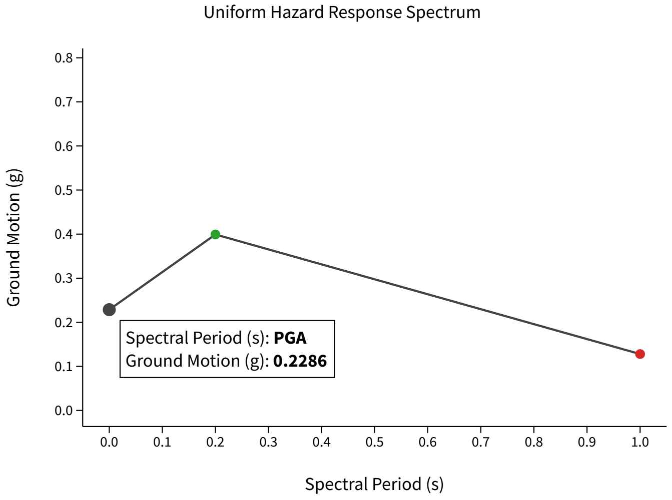
Time Horizon

Return period in years

2475

Hazard Curve


Hazard Curves


Uniform Hazard Response Spectrum

View Raw Data

GLOBAL STABILITY EVALUATION
NEWTON POWER STATION
PRIMARY ASH POND
NEWTON, ILLINOIS

Prepared for:

AMEREN ENERGY RESOURCES
St. Louis, Missouri

Prepared by:

GEOTECHNOLOGY, INC.
St. Louis, Missouri

Geotechnology Project No. J017150.01

January 4, 2011

GEOTECHNOLOGY INC
FROM THE GROUND UP

January 4, 2011 J017150.01

Mr. Gerald R. Ryckman, C.P.M.
Ameren Energy Resources
One Ameren Plaza
1901 Chouteau Avenue
St. Louis, Missouri 63166-6146

GLOBAL STABILITY EVALUATION
NEWTON POWER STATION
PRIMARY ASH POND
NEWTON, ILLINOIS

Dear Mr. Ryckman:

Presented in this report are the results of an embankment stability evaluation conducted for the referenced project. This exploration was conducted in general accordance with our May 21, 2010 revised proposal. This report includes our project understanding, observed site conditions, conclusions and/or recommendations, and support data as given in the Table of Contents.

It has been our pleasure to provide these services to you, and we would welcome the opportunity to provide other services during the course of the project. Please contact us if you need further information or clarification about this document.

Very truly yours,

GEOTECHNOLOGY, INC.

STATE OF ILLINOIS
SENTHIL B. KUMAR
No. 062-054233
REGISTERED
PROFESSIONAL ENGINEER

Senthil

Senthil Kumar, P.E.
Senior Engineer
Geotechnical Group

Dale M. Smith

Dale M. Smith, P.E.
Collinsville Branch Manager

SK/DMS/JAB:sk/jsj

Copies submitted: (3) hard copies
(1) pdf format on CD

Dale M. Smith
Exp. 11/30/11

J017150.01

GLOBAL STABILITY EVALUATION
NEWTON POWER STATION
PRIMARY ASH POND
NEWTON, ILLINOIS

TABLE OF CONTENTS

ILLUSTRATIONS

APPENDICES

J017150.01

GLOBAL STABILITY EVALUATION
NEWTON POWER STATION
PRIMARY ASH POND
NEWTON, ILLINOIS

SECTION I - PROJECT DATA

AUTHORIZATION

The services documented in this report were provided in accordance with the terms, conditions and scope of services described in Geotechnology's May 21, 2010 revised proposal numbered P017237.01A. The project was authorized by issuance of Ameren Purchase Order No. 496284, dated June 14, 2010.

PURPOSE AND SCOPE OF SERVICES

The purpose of our services was to perform a stability analysis of the ash pond embankment. Briefly, services consisted of site reconnaissance, drilling five borings, installing two piezometers, laboratory testing, engineering analyses and preparation of this report. Important information prepared by The Association of Engineering Firms Practicing in the Geosciences (ASFE) for studies of the type is included in Appendix A for your review.

PROJECT AND SITE DESCRIPTION

We understand that the coal-ash waste materials from the power generating process at the Ameren Newton Power Plant are stored in the primary ash pond located south of the plant. The site location and general topography of the area as per U.S.G.S. map of the vicinity are shown on Plate 1. We understand that the ash pond was constructed circa 1974. Based on data provided by Ameren, the ash pond is contained by an approximately 17,000-foot long embankment. The ash pond is bordered to the south by Newton Lake. We understand that the normal pool level of Newton Lake is El 505[1]. At the time of our investigation, water was ponding along the inbound slope of the embankment at El 534. The slope of the embankment in the vicinity of our exploration was approximately 1V:3H (Vertical:Horizontal) and 40 feet wide at the top, which was at approximately El 555. The slope is generally covered with grass and weeds. An approximately 20-foot wide gravel access road is present on top of the embankment.

---

[1] All elevations herein refer to the mean sea level (msl) datum in feet.

SECTION II - FIELD EXPLORATION AND LABORATORY TESTING

FIELD EXPLORATION

The field exploration consisted of drilling five borings, designated as Borings B-1 through -5, at approximately the locations shown on Plate 2. The borings were located in the field by Geotechnology by measuring distances from existing site features at a representative section for height and steepness. Subsequently, the boring locations and the selected section of the embankment were surveyed by Milano & Grunloh Engineers LLC, and the location coordinates and elevations were provided to Geotechnology. Also, the surveyors obtained spot elevations along the crest of the embankment. These section details and spot elevations are included in Appendix E.

The borings were drilled to auger refusal or predetermined depths of 25 to 55 feet using a CME 750 rotary drill rig equipped with hollow stem augers. Standard Penetration Tests (SPT's) were performed using an automatic hammer. Split-spoon samples and relatively undisturbed Shelby tube samples were obtained at the depths indicated on the boring logs presented in Appendix B. An explanation of the terms and symbols used on the borings is provided in Appendix B.

At the completion of drilling, all borings except the borings where piezometers were installed were backfilled with a cement-bentonite grout or bentonite chips. Grout was pumped through a grout pipe inserted to the bottom of the boring, with grout backfilling bore holes from the bottom up. Grout was pumped until visible at the surface prior to withdrawing the grout pipe. A continuous positive head of grout was maintained during removal of the grout pipe.

A staff scientist from Geotechnology provided technical direction during field exploration, observed drilling and sampling, assisted in obtaining samples and prepared descriptive logs of the material encountered. The boring logs represent conditions observed at the time of exploration, and have been edited to incorporate results of the laboratory tests as appropriate.

Unless noted on the logs, the lines designating the changes between various strata represent approximate boundaries. The transition between materials may be gradual or may occur between recovered samples. The stratification given on the logs, or described herein, is for use by Geotechnology in its analyses and should not be used as the basis of design or construction cost estimates without realizing that there can be variation from that shown or described.

The logs and related information depict subsurface conditions only at the specific locations and times where sampling was conducted. The passage of time may result in changes in conditions, interpreted to exist, at or between the locations where sampling was conducted.

LABORATORY TESTING

Laboratory testing was performed to estimate pertinent engineering and index properties of the soil. Moisture contents were determined for cohesive soil samples, and Atterberg limits tests were accomplished on selected samples. Consolidated-undrained triaxial, unconfined compression and percent passing #200 sieve tests were performed on representative samples. Laboratory test results are presented in Appendices B and C.

SECTION III - SUBSURFACE CONDITIONS

STRATIGRAPHY

Fill is present in all borings drilled along the embankment (Borings B-1, -2 and -5). Fill consists of silty clay and clay with a trace of sand and gravel and extends to depths of 22 to 37 feet. Representative samples of the fill had unit dry densities in the range of 104 to 121 pounds per cubic foot (pcf). Moisture content percentages ranged from the mid teens to the lower twenties. SPT N-values in the embankment fill varied from 8 to 16 blows per foot (bpf).

Below the fill, and at the surface in Borings B- 3 and -4, an alluvial deposit of interbedded soft to very stiff, silty clay and clay is present. The thickness of the cohesive stratum varies between 8 and 25 feet. A representative sample had a unit dry density of 105 pcf. Moisture contents ranged from the upper single digits to upper teens. Below the silty clay/clay stratum hard, sandy clay, clay or silty clay is present. This stratum extends to the depths of exploration or auger refusal.

Auger refusal was encountered in Borings B-1 and -5 at depths of 57.5 and 47.5 feet, respectively. Auger refusal may represent either a hard soil layer or bedrock. Since rock coring was not performed, the character of these materials could not be determined.

GROUNDWATER

Groundwater was observed in the crest and toe borings while drilling at depths of 33 to 34, and 2 to 5 feet, respectively. Groundwater levels shown on the boring logs may not have stabilized before backfilling, which is typical in less permeable cohesive soil. Consequently, the indicated groundwater levels may not represent present or future levels.

Open-standpipe piezometers were installed in Borings B-2 and -3 to permit subsequent measurement of the groundwater levels. The piezometers consist of 2-inch diameter PVC pipe, with a 10-foot length of screen placed within the boring. The annular space within the screened interval was backfilled with sand, sealed above the screen with bentonite pellets, and the remainder backfilled with cement-bentonite grout or bentonite pellets. A protective steel well casing was placed over the riser pipe. Details of the piezometer installation at each of the borings are presented on the Piezometer construction diagrams in Appendix D. Groundwater was observed in Piezometers B-2 and -3 at depths of 26 feet and 1 foot, approximately 90 days after completion of drilling. Groundwater levels may vary significantly over time due to the effects of seasonal variation in precipitation, recharge, the level of Newton Lake or other factors not evident at the time of exploration.

SECTION IV –GLOBAL STABILITY EVALUATION

As part of the embankment evaluation, slope stability analyses were performed. A current topographic plan of the site was not available. However, the project surveyor provided the latitude, longitude and the surface elevation of the boring locations and points along the representative section. This information was used to develop the slope profile for the analyses. Results of the analyses are discussed in subsequent sections.

SLOPE STABILITY ANALYSIS

Slope stability analysis consists of comparing the driving forces within a cross-section of slope to the resisting forces and determining the factor of safety. Gravity forces tend to move the slope downwards (driving force), while resisting forces derived from the soil shear strength tend to keep the slope in place. When the driving force acting on the slope is greater than the resisting force, sliding can occur. The factor of safety of the slope is the ratio of the restraining force divided by the driving force. Generally, when the factor of safety is 1 or less, the slope is considered to be unstable. The accepted standard in local practice and consistent with Illinois Department of Natural Resources (IDNR) dam safety requirement is to have a factor of safety of 1.5 for long term static stability of a slope, and 1.0 for pseudo-static conditions (seismic loading).

Slope stability analyses were performed for a representative section of the embankment along the south perimeter of the primary ash pond. The location of the cross-section of the embankment analyzed is represented by Section A-A, and is shown on Plate 2. Soil properties used in the stability analysis were selected based on laboratory test results and Geotechnology’s experience with similar materials. In our analyses the pond was assumed to be filled with fly ash. The soil properties used in the models are summarized in the following table:

SOIL PROPERTIES			
Soil Type	**Density (pcf)**	**Cohesion (psf)**	**Friction Angle (°)**
Embankment Fill	125	50	25
Silty Clay/Clay	120	50	30
Hard, Silty/Sandy Clay	120	50	30
Fly Ash	112	0	0

Geotechnology performed stability analysis for deep seated, global failure of the embankment. The cross-section of the embankment analyzed is shown on the attached Plate 3. Since the embankment has been in place for more than 35 years, long-term stability of the embankment was analyzed (i.e. effective stress conditions). Based on the piezometer data and the level of ponding groundwater to the north, a groundwater table for the analysis of the ash pond embankment was established as shown on Plate 3. A pseudo-static seismic analysis was performed on the selected embankment section using a horizontal acceleration of 0.18g, which corresponds to a seismic event with a mean return time of 2,500 years (Plate 4). Details of the methodology used in determining the horizontal acceleration is given in a subsequent section. The Morgenstern-Price procedure was used to compute factors of safety. The computer program SLOPE/W was used to perform the computations. The calculated factors of safety are given in the following table.

SLOPE STABILITY ANALYSIS RESULTS			
Analysis Condition	**Calculated Factor of Safety**	**Target Factor of Safety**[a]	**Reference Plate No.**
Existing Conditions, Steady State Seepage	1.8	1.5	3
Partially Saturated Slope, Steady State Seepage	1.5	1.5	4
Slope with Seismic Forces Mean Return Time 2,500 Years	1.1	1.0	5
Partially Saturated Slope Slope with Seismic Forces Mean Return Time 2,500 Years	0.9	1.0	6

[a] **"Procedural Guidelines for Preparation of Technical Data to be included in Application for Permits for Construction and Maintenance of Dams" issued by Illinois Department of Natural Resources.**

IDNR recommends a minimum factor of safety of 1.5 for long-term stability. During an extreme event, such as an earthquake, a factor of safety of 1.0 or more is recommended. Based on the results of our analyses, the embankment slopes have satisfactory factors of safety for global stability. Exception is the seismic event occurring when the slope is partially saturated (Plate 6).

SEISMICITY

The site is located in a region of the country that has a significant seismic risk due to the presence of the New Madrid Seismic Zone (NMSZ) in southeastern Missouri and the Wabash Valley Seismic Zone (WVSZ) in southeastern Illinois and southwestern Indiana. The NMSZ is the site of three of the largest magnitude earthquake events (estimated surface-wave magnitudes greater than or equal to 8.0) to strike North America in recorded history (December 1811 through February 1812). Researchers predict that the WVSZ is capable of producing large earthquakes similar in magnitude to the 1811-1812 NMSZ earthquakes.

Per the previously referenced Illinois Department of Natural Resources procedural guidelines for application of dam construction permit, the seismic hazard analysis should use bedrock peak ground accelerations with a 2% probability of exceedence (PE) in 50 years (mean return time of 2,500 years). The National Seismic Hazards Mapping Project (NSHMP) interactive deaggregations models (2002 edition) were used to obtain the probabilistic bedrock accelerations at the site. The NSHMP models consider ground motion from many sources surrounding the site location with the assumption that the site condition is rock with an average shear wave velocity of 2,500 ft/s. Bedrock spectral response acceleration at short periods (S_s), and at 1-second periods (S_1) of 0.58 g and 0.17 g, respectively, were obtained from the NSHMP models.

A detailed site-specific seismic hazard analysis was beyond our scope of services. The guidelines established by the International Building Code, 2006 edition (IBC 2006) were used to propagate the bedrock acceleration to the ground surface. Based on the boring data and Section 1613.5.6 of the IBC 2006, we calculated that the underlying soil profile within the upper 100 feet could be defined as Site Class C (Very Dense Soil and Soft Rock). Using Site Class C and guidelines in Section 1802 of IBC 2006, we were able to calculate an approximate surficial horizontal peak ground acceleration of 0.18g, which was used in the pseudo-static slope stability analysis.

SECTION V - LIMITATIONS OF REPORT

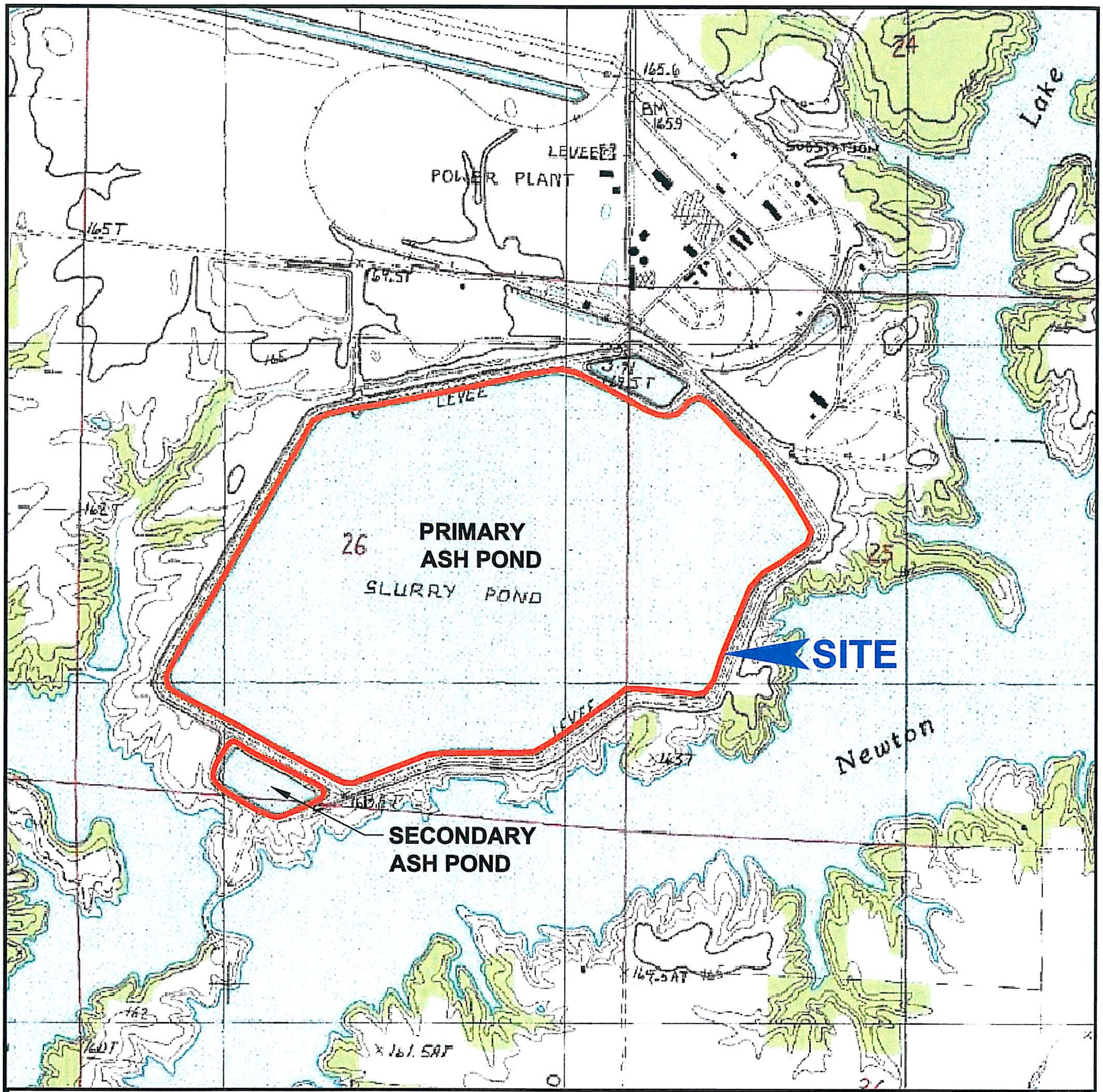
This report has been prepared on behalf of and for the exclusive use of the client for specific application to the named project as described herein. If this report is provided to prospective contractors, the client should make it clear that the information is provided for factual data only and not as a warranty of subsurface conditions included in this report. Unanticipated soil or rock conditions may require the expenditure of additional funds to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs.

Geotechnology has attempted to conduct the services reported herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions. The recommendations and conclusions contained in this report are professional opinions. No other representation, expressed or implied, is included or intended.

Unless specifically stated in our proposal or this report, the scope of our services for this phase of the project did not include any environmental assessment or investigation for the presence or absence of wetlands or hazardous or toxic material in the soil, surface water, groundwater or air, on or below or around this site. Any statements in this report or on the boring logs regarding odors noted or unusual or suspicious items or conditions observed are strictly for the information of our client.

The analyses, conclusions, and recommendations contained in this report are based on the data obtained from the subsurface exploration. The field exploration methods used indicate subsurface conditions only at the specific locations where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Discrete sampling cannot be relied on to accurately reflect natural variations in stratigraphy that may exist between sample locations and/or intervals. Unless specifically noted, the scope of our services did not include an assessment of the effects of flooding and natural erosion of adjacent creeks or rivers on the project site.

The conclusions or recommendations presented in this report should not be used if the nature, design, or location of the facilities is changed or if there is a substantial lapse in time between the submittal of this report and the start of work at the site. If changes are contemplated, Geotechnology must review them to assess their impact on findings, conclusions, and/or design recommendations given in this report. Geotechnology will not be responsible for any claims, damages, or liability associated with any other party’s interpretations of the subsurface data or reuse of the subsurface data or engineering analyses in this report without our express written authorization.



NOTES

Plan adapted from a 7.5 minute U.S.G.S. map for Jasper County, Illinois Quadrangle, last revised in 1985.

0 2,000 4,000

SCALE IN FEET

LEGEND

🟥 Approximate Location of Ash Pond

N

Drawn By: SLC	Ck'd By:	App'vd By:
Date: 11-10-10	Date: 12/21/10	Date: 1/4/11

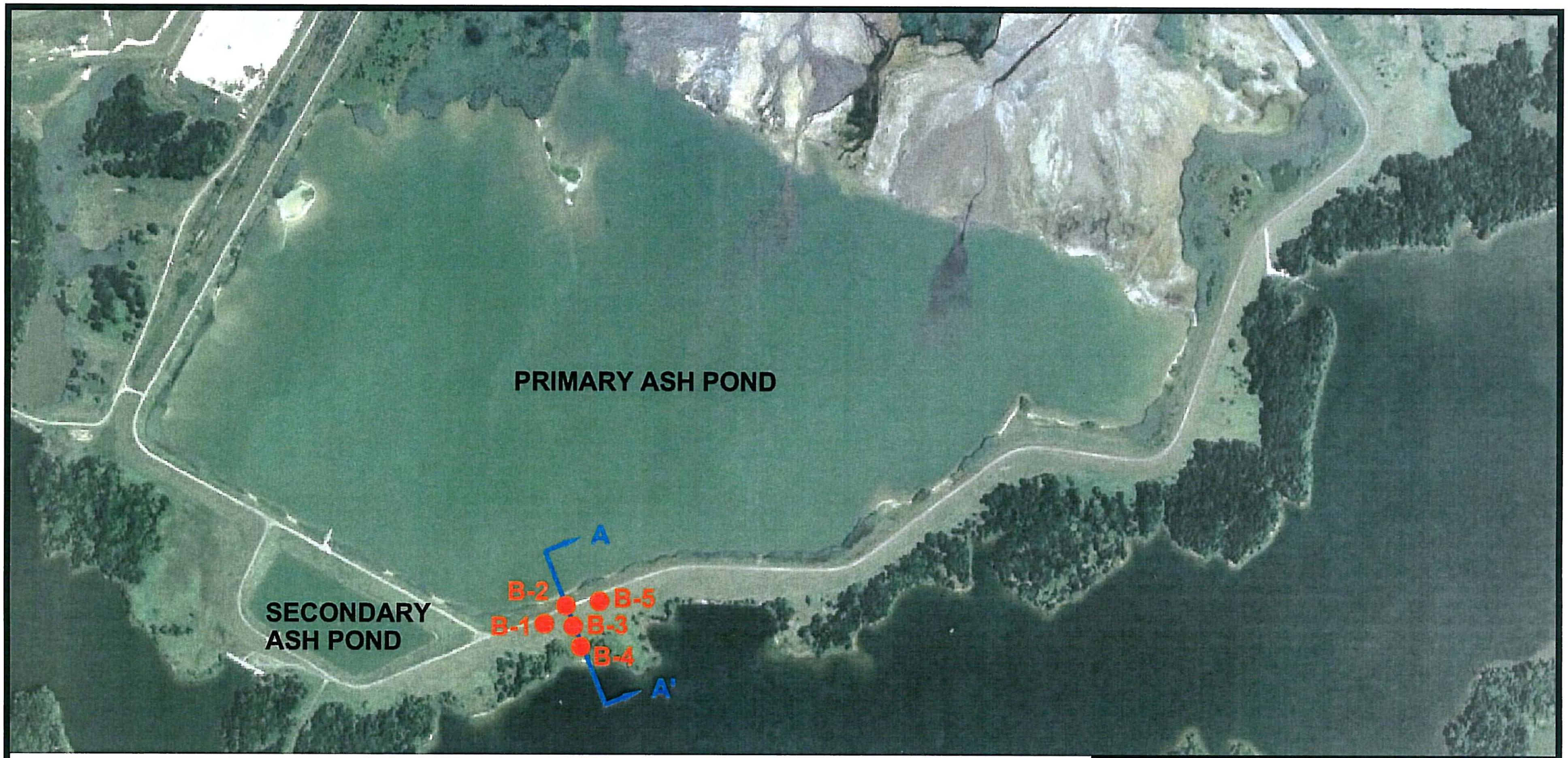
GEOTECHNOLOGY INC
FROM THE GROUND UP

Newton Power Station
Newton, Illinois

SITE LOCATION AND TOPOGRAPHY

Project Number
J017150.01

PLATE 1



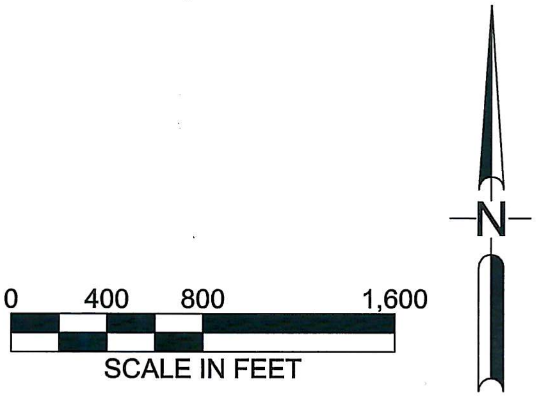
NOTES

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

LEGEND

● Boring Location

▬ Slope Stability Cross Section



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Date: 11-10-10	Date: 12/21/10	Date: 1/4/11

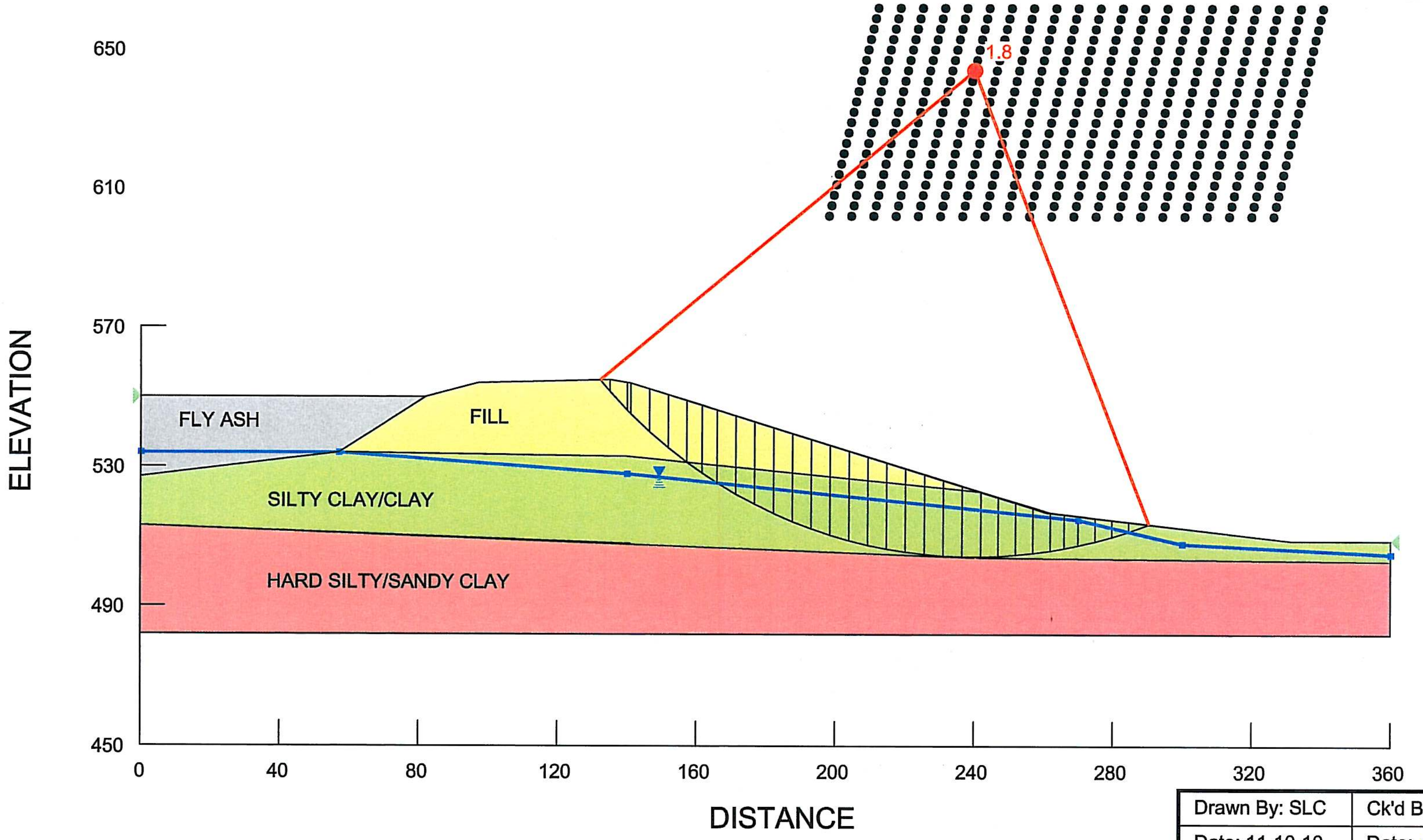
GEOTECHNOLOGY INC
FROM THE GROUND UP

Newton Power Station
Newton, Illinois

AERIAL PHOTOGRAPH OF SITE AND BORING LOCATIONS

Project Number
J017150.01

PLATE 2



NOTE

See plate 2 for location of cross section.

Material	Density (pcf)	Cohesion (psf)	Friction Angle (deg)
Fill	125	50	25
Silty Clay/Clay	120	50	30
Hard, Silty/Sandy Clay	120	50	30
Fly Ash	112	0	0

Drawn By: SLC	Ck'd By: SLC	App'vd By: DW
Date: 11-10-10	Date: 12/21/10	Date: 1/4/11

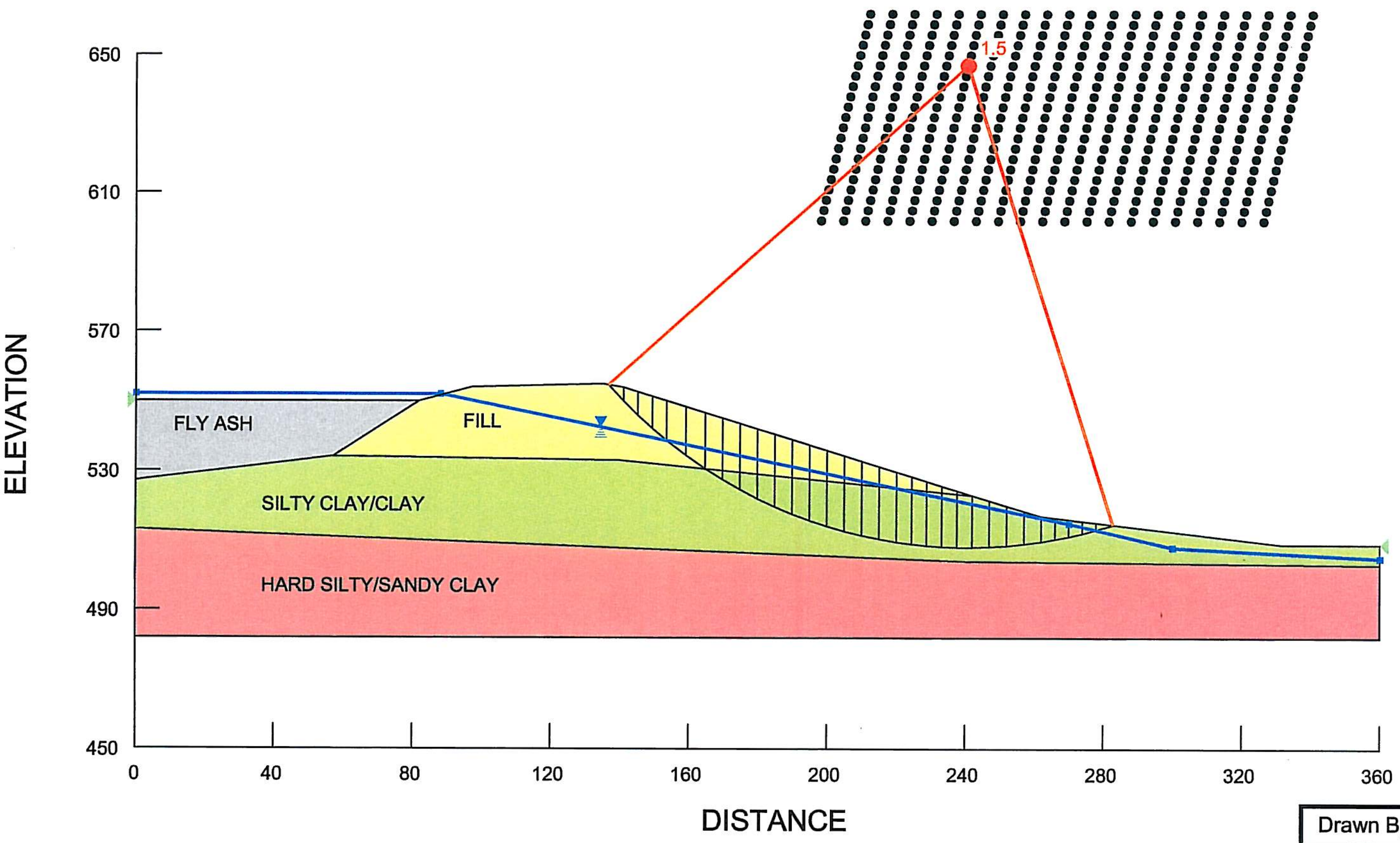
GEOTECHNOLOGY INC
FROM THE GROUND UP

Newton Power Station
Newton, Illinois

SLOPE STABILITY CROSS SECTION A-A'
STEADY STATE SEEPAGE

Project Number
J017150.01

PLATE 3



NOTES

1. See plate 2 for location of cross section.

2. Analysis is a parametric study of piezometric surface for a corresponding FOS=1.5. The piezometric surface shown does not represent observed conditions but represents an upper limit below which the FOS is equal to or greater than the target FOS 1.5.

Material	Density (pcf)	Cohesion (psf)	Friction Angle (deg)
Fill	125	50	25
Silty Clay/Clay	120	50	30
Hard, Silty/Sandy Clay	120	50	30
Fly Ash	112	0	0

Drawn By: SLC	Ck'd By: Slc	App'vd By: DM
Date: 11-10-10	Date: 12/21/10	Date: 1/4/11

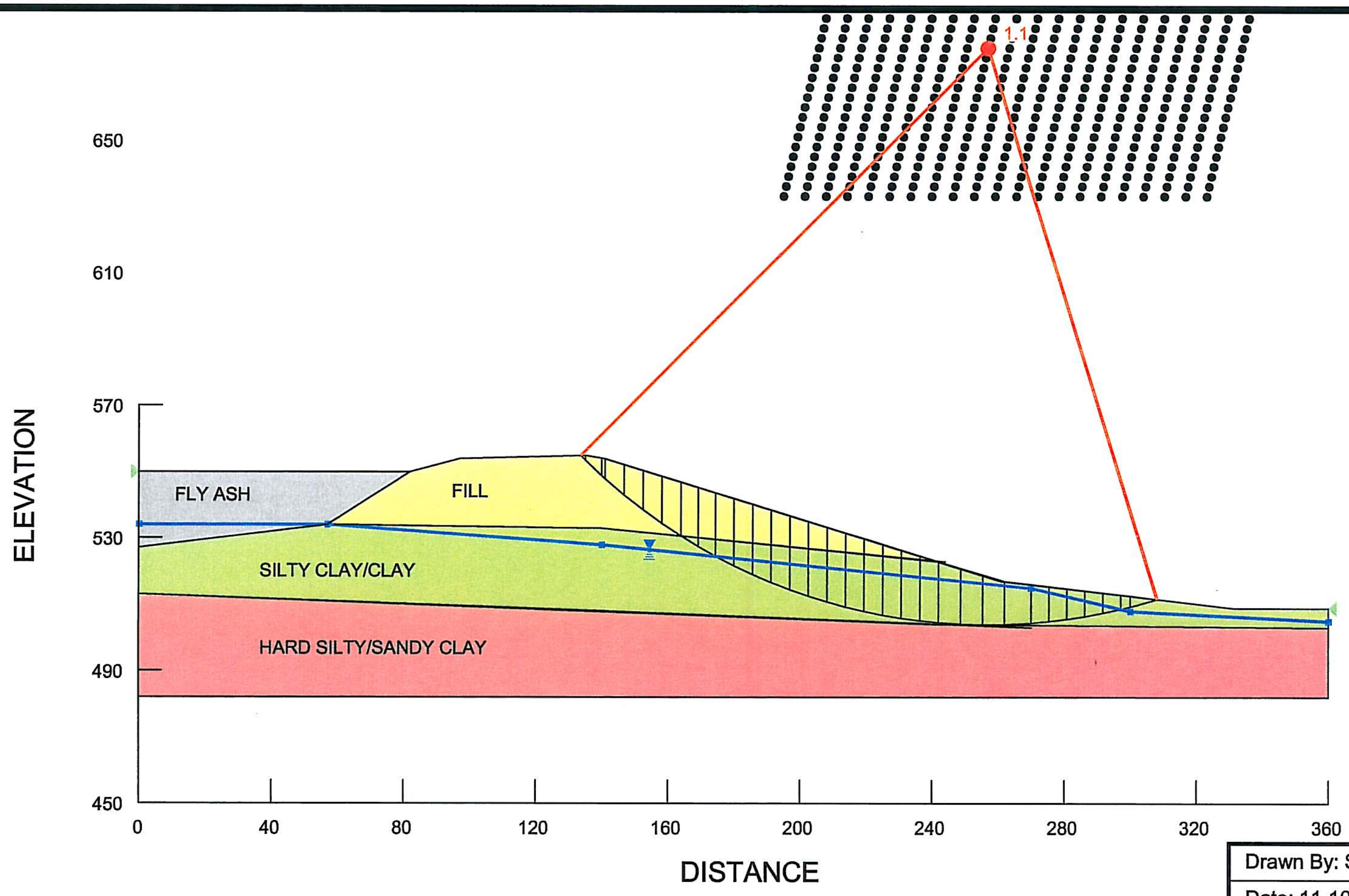
GEOTECHNOLOGY INC
FROM THE GROUND UP

Newton Power Station
Newton, Illinois

SLOPE STABILITY CROSS SECTION A-A'
STEADY STATE SEEPAGE
SATURATED SLOPE

Project Number
J017150.01

PLATE 4



NOTE
See plate 2 for location of cross section.

Material	Density (pcf)	Cohesion (psf)	Friction Angle (deg)
Fill	125	50	25
Silty Clay/Clay	120	50	30
Hard, Silty/Sandy Clay	120	50	30
Fly Ash	112	0	0

Drawn By: SLC	Ck'd By: SLC	App'vd By:
Date: 11-10-10	Date: 12/21/10	Date: 1/6/11

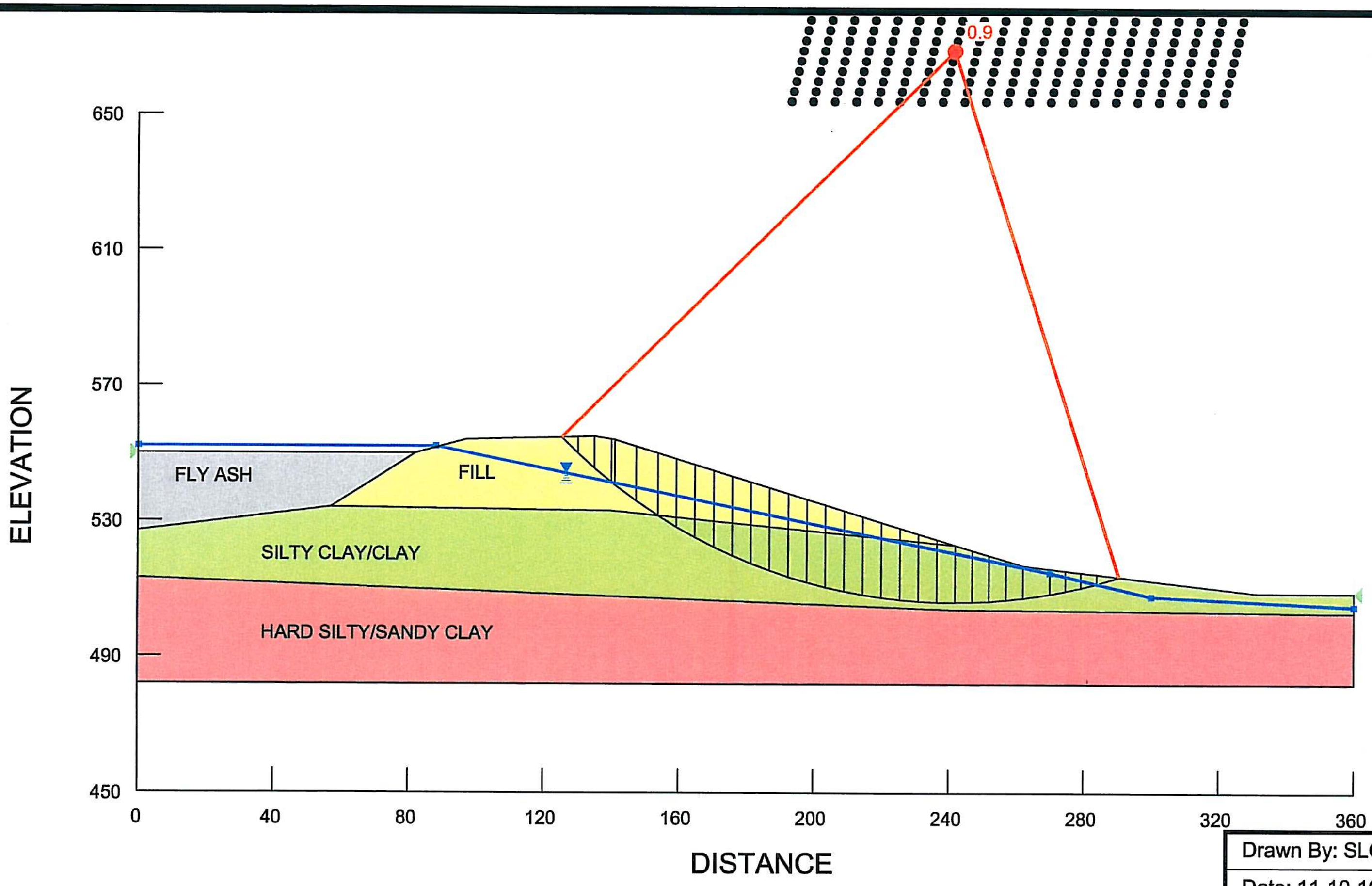
GEOTECHNOLOGY INC
FROM THE GROUND UP

Newton Power Station
Newton, Illinois

SLOPE STABILITY CROSS SECTION A-A'
SEISMIC ANALYSIS
(MEAN RETURN TIME 2,500 YEARS)

Project Number
J017150.01

PLATE 5



NOTE

See plate 2 for location of cross section.

Material	Density (pcf)	Cohesion (psf)	Friction Angle (deg)
Fill	125	50	25
Silty Clay/Clay	120	50	30
Hard, Silty/Sandy Clay	120	50	30
Fly Ash	112	0	0

Drawn By: SLC	Ck'd By: Sec	App'vd By: DM
Date: 11-10-10	Date: 12/21/10	Date: 1/4/11

GEOTECHNOLOGY INC
FROM THE GROUND UP

Newton Power Station
Newton, Illinois

SLOPE STABILITY CROSS SECTION A-A'
SEISMIC ANALYSIS
PARTIALLY SATURATED SLOPE
(MEAN RETURN TIME 2,500 YEARS)

Project Number
J017150.01

PLATE 6

APPENDIX A

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

Important Information about Your
Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
THE BEST PEOPLE ON EARTH

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

APPENDIX B

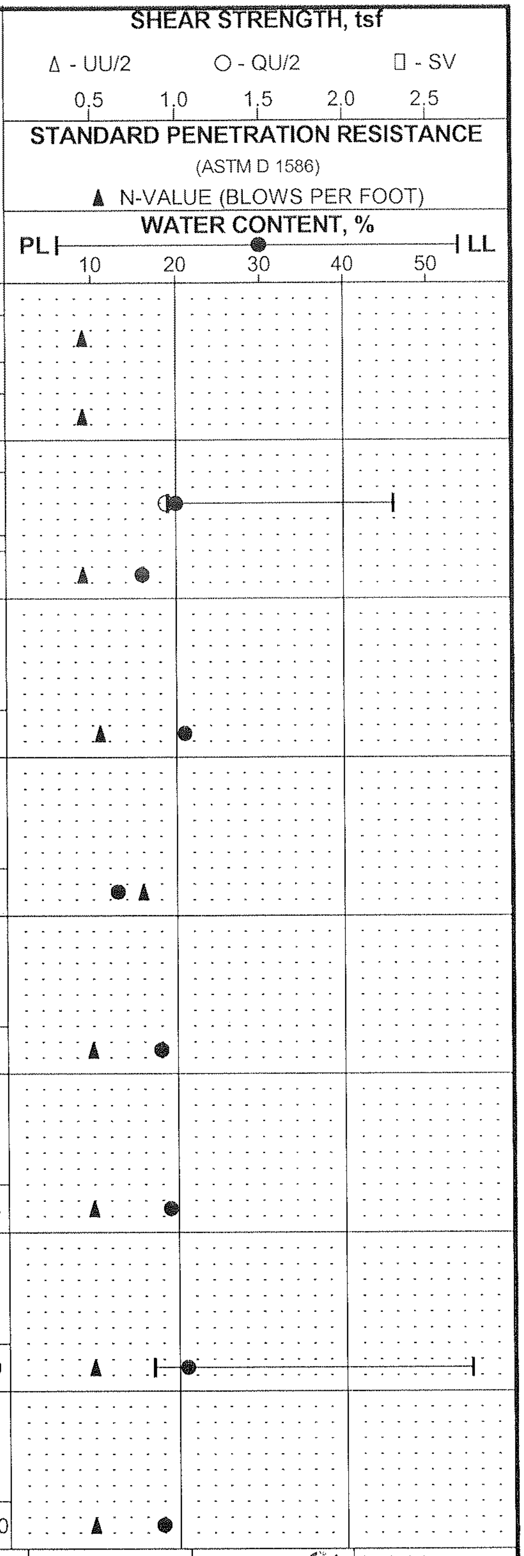
DETAILED LOGS OF BORINGS
BORING LOG: TERMS AND SYMBOLS

Surface Elevation: 554.1

Datum msl

Completion Date: 6/15/10

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	FILL: brown, silty clay, trace sand and gravel	▨	3-4-5	SS1
	FILL: brown clay	▨	2-3-6	SS2
5	FILL: brown and gray, silty clay	▨	107	ST3
		▨	2-3-6	SS4
10				
	FILL: brown clay	▨	2-4-7	SS5
15				
	FILL: brown, silty clay, trace sand	▨	2-8-8	SS6
20				
	FILL: brown clay	▨	2-4-6	SS7
25				
	Stiff, brown and gray CLAY - (CH)	▨	2-4-6	SS8
30				
	⊻	▨	2-4-6	SS9
35				
	trace gravel	▨	4-4-6	SS10



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 33 FEET ⊻

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM __ FEET

MVU DRILLER KCR LOGGER

CME 750X DRILL RIG

HAMMER TYPE Auto

REMARKS: Datum: IL State Plane Coordinates, East Zone. N: 821256.011' E: 997512.963'

Drawn by: KA	Checked by: SM	App'vd. by: DW
Date: 6/23/10	Date: 1/3/11	Date: 1/4/11

GEOTECHNOLOGY INC
FROM THE GROUND UP

Newton Power Station
Newton, Illinois

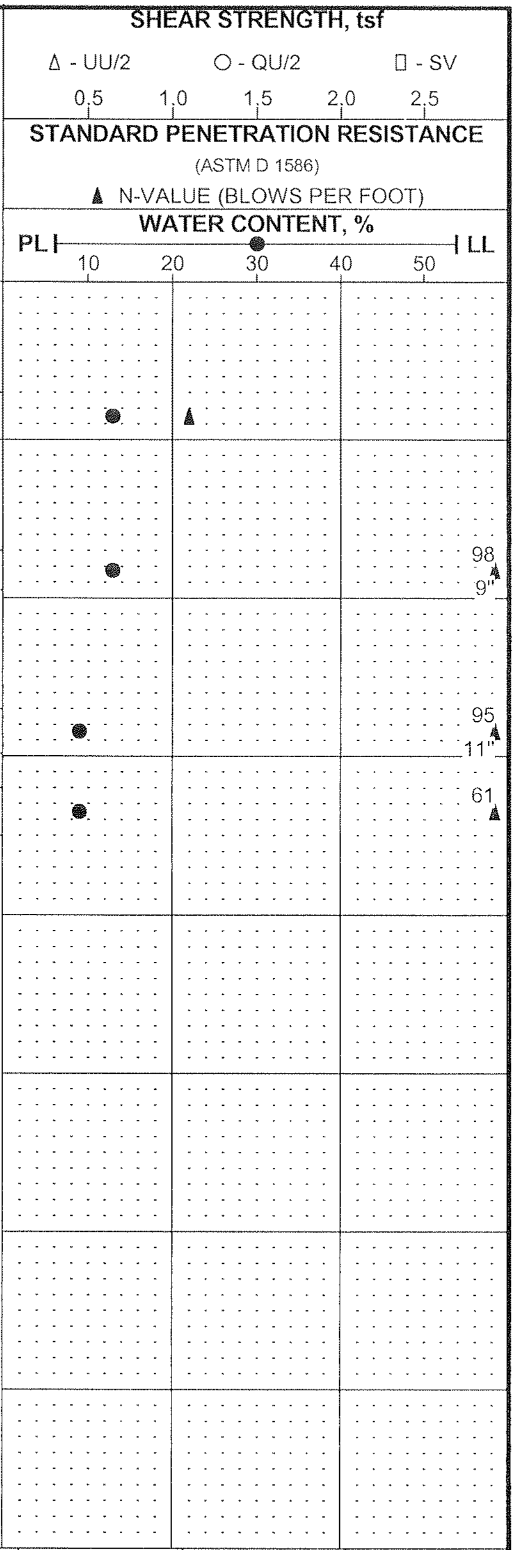
LOG OF BORING: B-1

Project No. J017150.01

Surface Elevation: 554.1 Completion Date: 6/15/10

Datum msl

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Stiff, brown and gray CLAY - (CH) *(continued)*			
	Very stiff, brown, silty CLAY, trace gravel - CL			
45			4-7-15	SS11
	Hard, brown, sandy CLAY - CL			
	43.2 percent passing the No. 200 sieve.			
50			26-48 -50/3"	SS12
55			27-45 -50/5"	SS13
			13-24-37	SS14
	Auger refusal at 57.5 feet.			
60				
65				
70				
75				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 33 FEET ⊻

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
MVU DRILLER KCR LOGGER
CME 750X DRILL RIG
HAMMER TYPE Auto

REMARKS: Datum: IL State Plane Coordinates, East Zone. N: 821256.011' E: 997512.963'

Drawn by: KA	Checked by:	App'vd. by:
Date: 6/23/10	Date: 1/3/11	Date: 1/4/11

GEOTECHNOLOGY INC
FROM THE GROUND UP

Newton Power Station
Newton, Illinois

CONTINUATION OF
LOG OF BORING: B-1

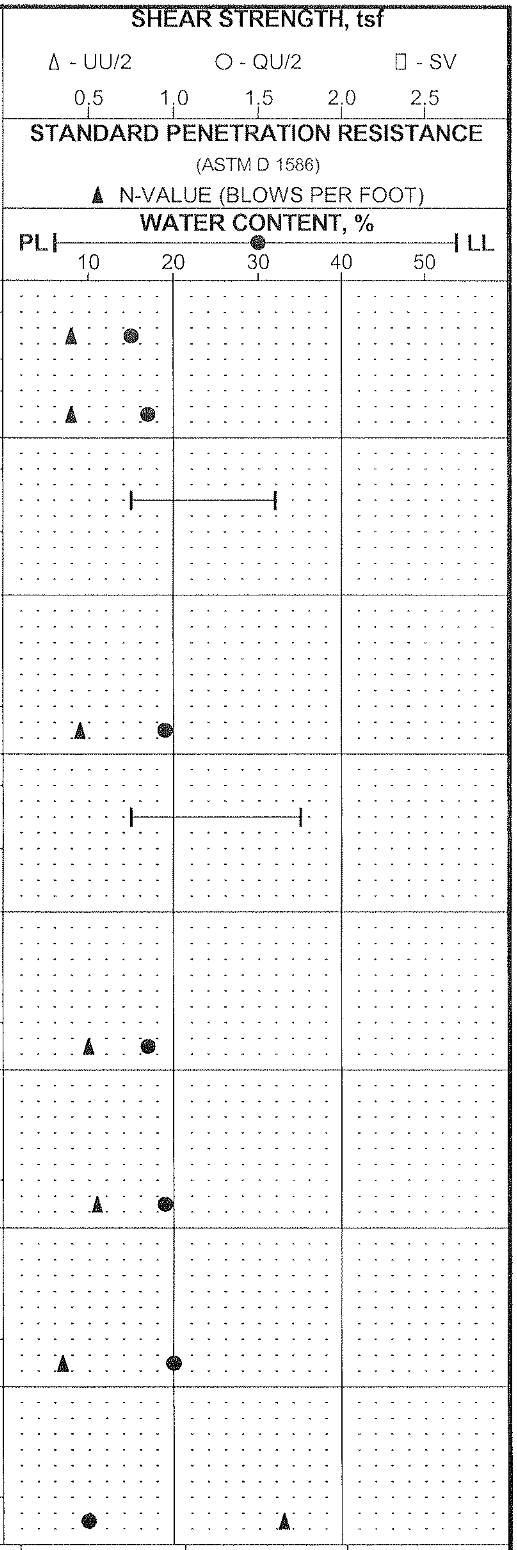
Project No. J017150.01

Surface Elevation: 554.6

Datum msl

Completion Date: 6/16/10

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	FILL: brown, silty clay, interbedded with occasional clay	▩		
			2-4-4	SS1
			2-4-4	SS2
5				
			117	ST3
			117	ST4
10				
			2-4-5	SS5
15				
			107	ST6
			104	ST7
20				
	Stiff, brown, silty CLAY - CL	▨		
			2-5-5	SS8
25				
	Stiff, brown CLAY, trace gravel - CH	▨		
			2-5-6	SS9
30				
	Medium stiff to hard, brown, silty CLAY, trace sand - CL ⊻	▨		
	68.8 percent passing the No. 200 sieve.		1-3-4	SS10
35				
			9-14-19	SS11



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 33 FEET ⊻

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM __ FEET

MVU DRILLER KCR LOGGER

CME 750X DRILL RIG

HAMMER TYPE Auto

REMARKS: Datum: IL State Plane Coordinates, East Zone. N: 821332.544' E: 997697.278'

Drawn by: KA	Checked by: SJE	App'vd. by: DMV
Date: 6/23/10	Date: 1/3/11	Date: 1/4/11

GEOTECHNOLOGY INC
FROM THE GROUND UP

Newton Power Station
Newton, Illinois

LOG OF BORING: B-2

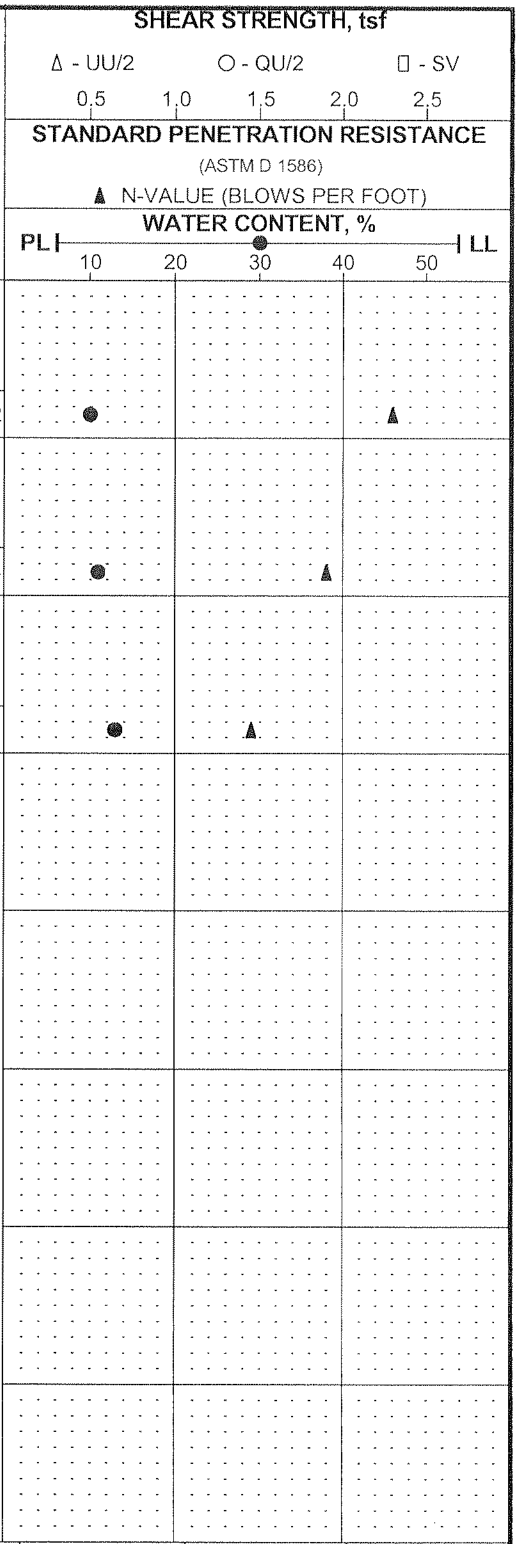
Project No. J017150.01

Surface Elevation: 554.6

Datum msl

Completion Date: 6/16/10

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium stiff to hard, brown, silty CLAY, trace sand - CL *(continued)*	▨		
45			10-17-29	SS12
	Hard to very stiff, brown CLAY with sand and gravel - CH	▨		
50			11-16-22	SS13
			8-13-16	SS14
55	Boring terminated at 55 feet.			
60				
65				
70				
75				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 33 FEET ⊻

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM __ FEET
MVU DRILLER KCR LOGGER
CME 750X DRILL RIG
HAMMER TYPE Auto

REMARKS: Datum: IL State Plane Coordinates, East Zone. N: 821332.544' E: 997697.278'

Drawn by: KA	Checked by:	App'vd. by:
Date: 6/23/10	Date: 1/3/11	Date: 1/4/11

GEOTECHNOLOGY INC
FROM THE GROUND UP

Newton Power Station
Newton, Illinois

CONTINUATION OF
LOG OF BORING: B-2

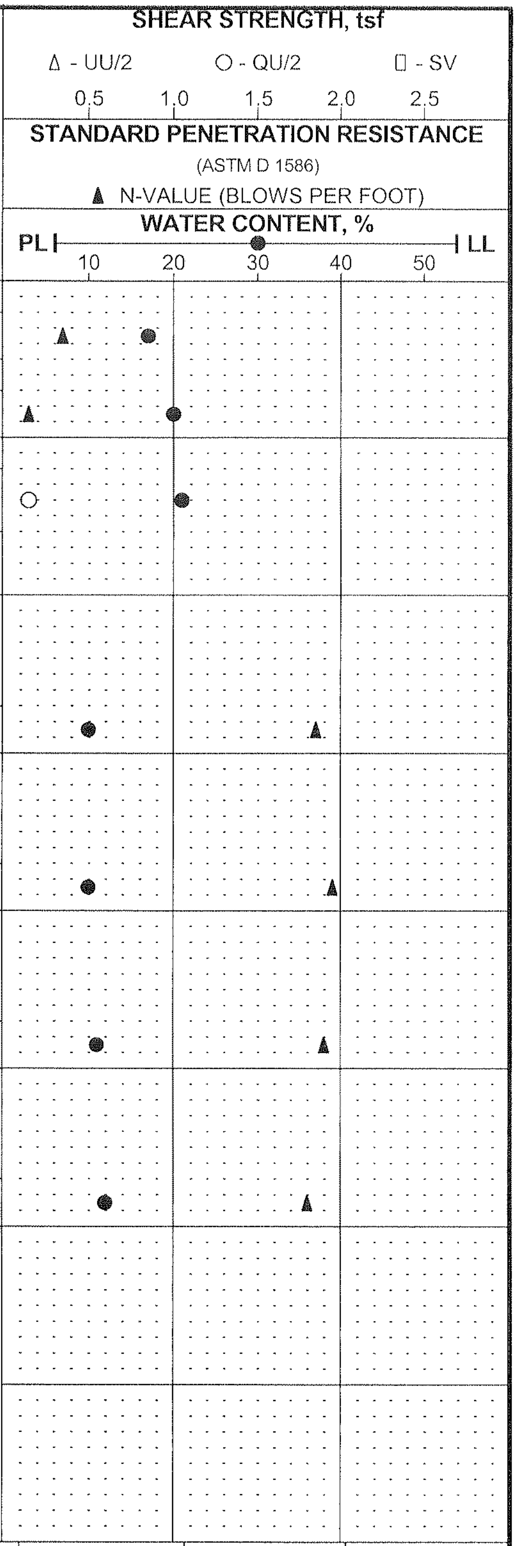
Project No. J017150.01

Surface Elevation: 515.0

Datum msl

Completion Date: 6/17/10

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
0	Medium stiff to soft, brown, silty CLAY - CL	▨		
		▨	3-3-4	SS1
5	∇	▨	1-1-2	SS2
		▨	105	ST3
10		▨		ST4
	Hard, brown to gray silty CLAY - CL	▨		
15		▨	7-16-21	SS5
20		▨	9-16-23	SS6
25		▨	12-15-23	SS7
30		▨	8-14-22	SS9
30	Boring terminated at 30 feet.			
35				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J017150.01 - AMEREN-NEWTON.GPJ GTINC 0638301.GPJ 12/13/10

GROUNDWATER DATA

ENCOUNTERED AT 5 FEET ∇

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM __ FEET
MVU DRILLER KCR LOGGER
CME 750X DRILL RIG
HAMMER TYPE Auto

REMARKS: Datum: IL State Plane Coordinates, East Zone. N: 821206.705' E: 997735.386'

Drawn by: KA	Checked by: Sn	App'vd. by: DW
Date: 6/23/10	Date: 1/3/11	Date: 1/4/11

GEOTECHNOLOGY INC
FROM THE GROUND UP

Newton Power Station
Newton, Illinois

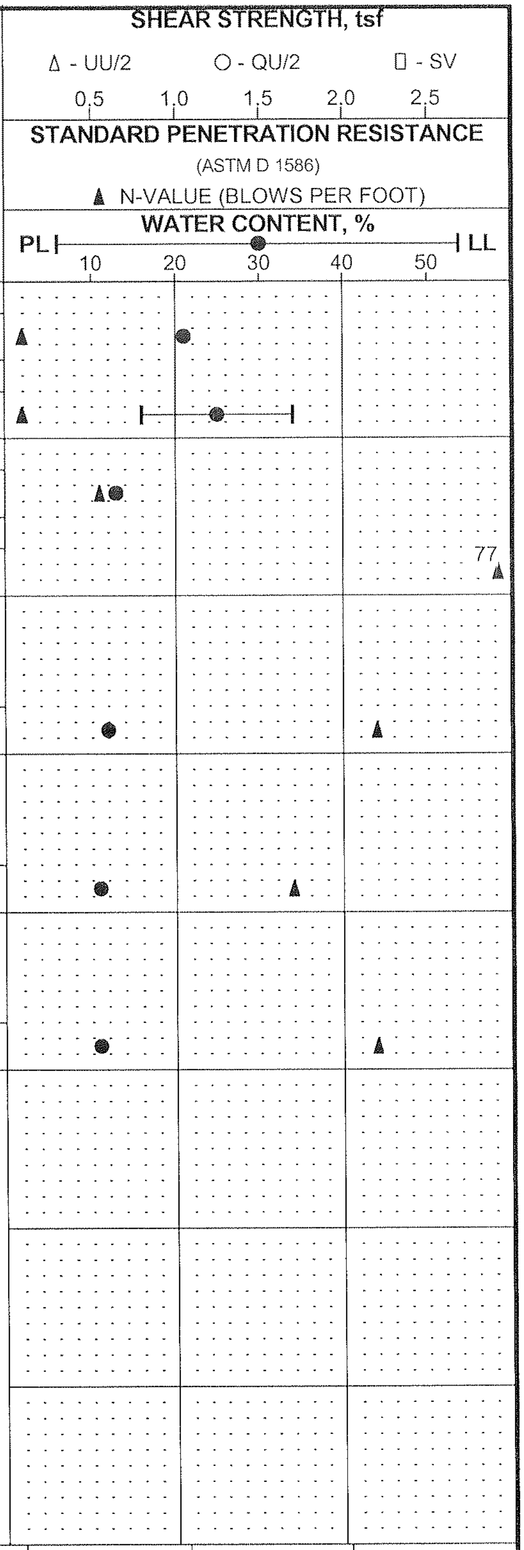
LOG OF BORING: B-3

Project No. J017150.01

Surface Elevation: 510.9 Completion Date: 6/18/10

Datum msl

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Soft, brown, silty CLAY - (CL)	▨		
	▽	▨	2-1-1	SS1
		▨	1-1-1	SS2
5	Stiff, brown and gray CLAY - CH	▨	1-3-8	SS3
	Hard, brown and gray, silty CLAY - CL	▨	25-24-53	SS4
10		▨		
		▨	11-24-20	SS5
15		▨		
		▨	8-14-20	SS6
20		▨		
		▨	12-17-27	SS7
25	Boring terminated at 25 feet.			
30				
35				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J017150.01 - AMEREN-NEWTON.GPJ GTINC 0638301.GPJ 12/16/10

GROUNDWATER DATA

ENCOUNTERED AT 2 FEET ▽

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM ___ FEET
MVU DRILLER KCR LOGGER
CME 750X DRILL RIG
HAMMER TYPE Auto

REMARKS: Datum: IL State Plane Coordinates, East Zone. N: 821177.029' E: 997745.742'

Drawn by: KA	Checked by:	App'vd. by:
Date: 6/23/10	Date: 1/3/11	Date: 1/4/11

GEOTECHNOLOGY INC
FROM THE GROUND UP

Newton Power Station
Newton, Illinois

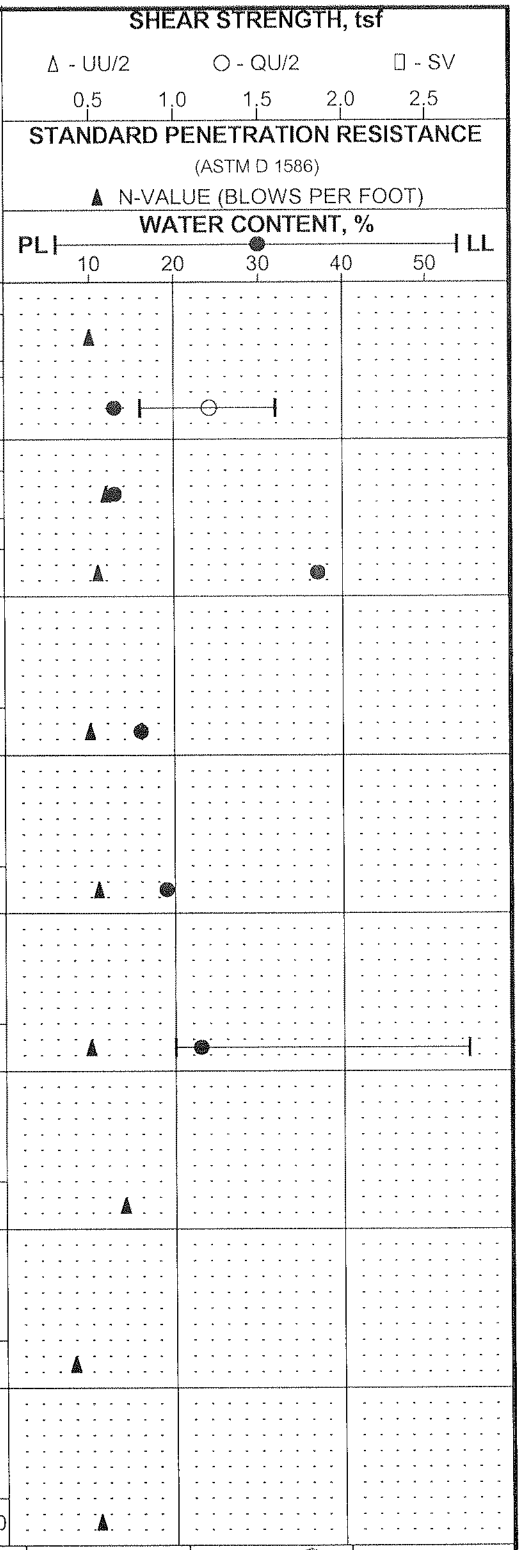
LOG OF BORING: B-4

Project No. J017150.01

Surface Elevation: 554.0 Completion Date: 6/17/10

Datum msl

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	FILL: brown, silty clay			
			4-6-4	SS1
			121	ST2
5				
	trace sand		3-5-7	SS3
	FILL: brown and gray, clay			
	trace gravel		3-5-6	SS4
10				
			2-4-6	SS5
15				
			2-4-7	SS6
20				
			2-4-6	SS7
25				
	trace sand and gravel		4-7-7	SS8
30				
	FILL: brown, silty clay			
	⊻		3-3-5	SS9
35				
	Stiff to hard, brown, silty CLAY - CL			
			2-5-6	SS10



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J017150.01 - AMEREN-NEWTON.GPJ GTINC 0638301.GPJ 12/[illegible]

GROUNDWATER DATA

ENCOUNTERED AT 34 FEET ⊻

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM __ FEET

MVU DRILLER KCR LOGGER

CME 750X DRILL RIG

HAMMER TYPE Auto

REMARKS: Datum: IL State Plane Coordinates, East Zone. N: 821405.69' E: 997881.328'

Drawn by: KA	Checked by: SK	App'vd. by: DMS
Date: 6/23/10	Date: 1/3/11	Date: 1/4/11

GEOTECHNOLOGY INC
FROM THE GROUND UP

Newton Power Station
Newton, Illinois

LOG OF BORING: B-5

Project No. J017150.01

Surface Elevation: 554.0

Datum msl

Completion Date: 6/17/10

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Stiff to hard, brown, silty CLAY - CL *(continued)*	▨		
45		▨	7-14-24	SS11
	Hard, brown, sandy CLAY - CL	▨	44-50/2"	SS12
	Sampler and auger refusal at 47.5 feet.			
50				
55				
60				
65				
70				
75				

SHEAR STRENGTH, tsf

Δ - UU/2 ○ - QU/2 ▯ - SV

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

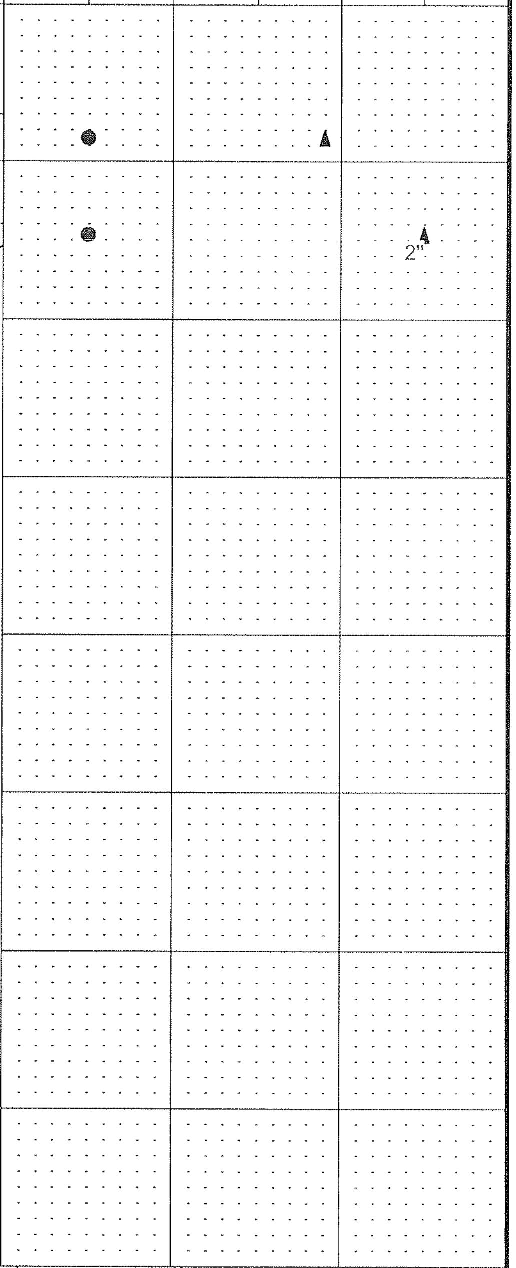
(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL ├──●──┤ LL

10 20 30 40 50



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J017150.01 - AMEREN-NEWTON.GPJ GTINC 0638301.GPJ 12/13/10

GROUNDWATER DATA

ENCOUNTERED AT 34 FEET ∇

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM ___ FEET

MVU DRILLER KCR LOGGER

CME 750X DRILL RIG

HAMMER TYPE Auto

REMARKS: Datum: IL State Plane Coordinates, East Zone. N: 821405.69' E: 997881.328'

Drawn by: KA	Checked by: Sd	App'vd. by: DW
Date: 6/23/10	Date: 1/3/11	Date: 1/4/11

GEOTECHNOLOGY INC

FROM THE GROUND UP

Newton Power Station
Newton, Illinois

CONTINUATION OF
LOG OF BORING: B-5

Project No. J017150.01

BORING LOG: TERMS AND SYMBOLS

GENERAL NOTES

1. *Information on each boring log is a compilation of subsurface conditions based on soil or rock classifications obtained from the field as well as from laboratory testing of samples. The strata lines on the logs may be approximate or the transition between the strata may be gradual rather than distinct. Water level measurements refer only to those ob - served at the times and places indicated, and may vary with time, geologic condition or construction activity.*
2. *Relative composition and Unified Soil Classification designations are based on visual estimates and are approximate only. If laboratory tests were performed to classify the soil, the unified designation is show in parenthesis.*
3. *Value given in Unit Dry Weight/SPT Column is either a unit dry weight in pounds per cubic foot, if adjacent to a ST sample designation, or blows per 6-inch increment if adjacent to a SS sample designation.*

ABBREVIATIONS

UU/2	*Shear Strength from Unconsolidated – Undrained Triaxial Test (ASTM D2850)*
QU/2	*Shear Strength from Unconfined Compression Test (ASTM D2166)*
SV	*Shear Strength from Field Vane (ASTM D2573)*
PL	*Plastic Limit (ASTM D4318)*
LL	*Liquid Limit (ASTM D4318)*

LEGEND

CS	Continuous Sampler
GB	Grab Sample Taken From Auger Cuttings Or Wash Water Return
NX 100 42	NX Rock Core with Percent Recovery/R.Q.D. Given In Adjacent Column
PST	Three Inch Diameter Piston Tube Sample
SS	Split Spoon Sample (Standard Penetration Test)
ST	Three Inch Diameter Shelby Tube Sample
*	Sample Not Recovered
SV	Field Vane Test

SPLIT – BARREL SAMPLER DRIVING RECORD

Blow Per Foot (N-Value)	*Description*
25	*25 blows drove sampler 12 inches after initial 6 inches of seating.*
75/10”	*75 blows drove sampler 10 inches after initial 6 inches of seating.*
50/S3”	*50 blows drove sampler 3 inches during initial 6 inch seating interval.*

NOTES:
1. *To avoid damage to sampling tools, driving is limited to 50 blows during any six inch interval.*
2. *N-Value (Blow Count) is the standard penetration resistance based on the total number of blows, using a 140-lb hammer with 30-inch free fall, required to drive a split spoon the last two of three, 6-inch drive increments. (Example: 4/7/9, N = 7 + 9 = 16). Values are shown as a summation on grid plot and may be shown as 4/7/9 in Unit Dry Weight – SPT column.*

RELATIVE COMPOSITION

Trace…………………...0-10 %
With/Some…………...11-35 %
Soil modifier such……. > 35 %
As silty, clayey, sandy, etc.

DENSITY OF GRANULAR SOILS

Descriptive Term:	***N—Value***
Very Loose	*0 - 4*
Loose	*5 - 10*
Medium Dense	*11 - 30*
Dense	*31 - 50*
Very Dense	*> 50*

STRENGTH OF COHESIVE SOILS

Consistency	**Undrained Shear Strength Tons Per Sq. Ft.**	**Field Test**	**Approximate N-Value Range**
Very Soft	*less than 0.12*	*Thumb will penetrate soil more than 1”*	*0 - 1*
Soft	*13 to 0.25*	*Thumb will penetrate soil about 1”*	*2 - 4*
Medium Stiff	*0.26 to 0.50*	*Thumb will penetrate soil about ¼”*	*5 – 8*
Stiff	*0.51 to 1.00*	*Thumb hardly indents soil*	*9 – 15*
Very Stiff	*1.01 to 2.00*	*Thumb will not indent soil, but readily indented with thumbnail*	*16 – 30*
Hard	*greater than 2.00*	*Thumbnail will not indent soil*	*> 30*

SOIL GRAIN SIZE

U.S. STANDARD SIEVE

12” 3” ¾“ 4 10 40 200

BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		

300 76.2 19.1 4.76 2.00 0.42 0.074 0.002

SOIL GRAIN SIZE IN MILLIMETERS

SOIL STRUCTURE

Calcareous *– Having appreciable quantities of carbonate.*

Fissured *– Containing shrinkage or relief cracks, often filled with sand or silt; usually more or less vertical.*

Slickensided *– Having planes of weakness that appear slick and glossy. The degree of slickensidedness depends upon the spacing of slickensides and the ease of breaking along those planes.*

Layer *-- Inclusion greater than 3 inches thick.*

Seam *– Inclusion 1/8 inch to 3 inches thick extending through the sample*

Parting *– Inclusion less than 1/8 inch thick.*

Pocket *– Inclusion of material of different texture that is smaller than the diameter of the sample.*

Interlayered *– Soil samples composed of alternating layers of different soil types.*

Intermixed *– Soil samples composed of pockets of different soil types and a layered or laminated structure is not evident.*

Laminated *– Soil sample composed of alternating partings or seams of different soil type.*

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
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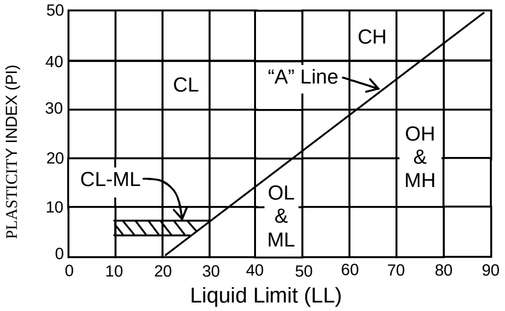
UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			SYMBOL	DESCRIPTION
Coarse-Grained Soils (More than 50% Larger than No 200 Sieve Size)	Gravel and Gravelly Soils	Clean Gravels Little or no Fines	GW	Well-Graded Gravel, Gravel-Sand Mixture
			GP	Poorly –Graded Gravel, Gravel-Sand Mixture
		Gravels with Appreciable Fines	GM	Silty Gravel, Gravel-Sand-Silt Mixture
			GC	Clayey-Gravel, Gravel-Sand-Clay Mixture
	Sand and Sandy Soils	Clean Sands Little or no Fines	SW	Well-Graded Sand, Gravelly Sand
			SP	Poorly Graded Sand, Gravelly Sand
		Sands with Appreciable Fines	SM	Silty Sand, Sand-Silt Mixture
			SC	Clayey Sand, Sand-Clay Mixture
Fine-Grained Soils (More than 50% Smaller than No 200 Sieve Size)	Silts and Clays	Liquid Limit Less Than 50	ML	Silt, Clayey Silt, Silty or Clayey Very Fine Sand, Slight Plasticity
			CL	Clay, Sandy Clay, Silty Clay, Low to Medium Plasticity
			OL	Organic Silts, or Silty Clays of Low Plasticity
	Silts and Clays	Liquid Limit More Than 50	MH	Silt, Fine Sandy or Silt Soil with High Plasticity
			CH	Clay, High Plasticity
			OH	Organic Clay of Medium to High Plasticity
	Highly Organic Soils		PT	Peat, Humus, Swamp Soil

PLASTICITY CHART



RELATIVE PLASTICITY

Nonplastic	Cannot Roll Into Ball
Trace Plasticity	Barely Roll Into Ball
Medium Plastic	Can be Rolled Into Ball
Highly Plastic	No Rupture by Kneading

VISUAL DESCRIPTION CRITERIA*

TABLE 1: CRITERIA FOR DESCRIBING ANGULARITY OF COARSE-GRAINED PARTICLES

Description	***Criteria***
Angular	*Particles have sharp edges and relatively plane sides with unpolished surfaces*
Subangular	*Particles are similar to angular description but have rounded edges*
Subrounded	*Particles have nearly plane sides but have well-rounded corners and edges*
Rounded	*Particles have smoothly curved sides and no edges*

TABLE 2: CRITERIA FOR DESCRIBING PARTICLE SHAPE

Description	***Criteria***
Flat	*Particles with width/thickness X3*
Elongated	*Particles with length/width X3*
Flat and Elongated	*Particles meet criteria for both flat and elongated*

TABLE 3: CRITERIA FOR DESCRIBING MOISTURE CONDITION

Description	***Criteria***
Dry	*Absence of moisture, dusty, dry to the touch*
Moist	*Damp, but no visible water*
Wet	*Visible free water, usually soil is below the water table*

TABLE 4: CRITERIA FOR DESCRIBING REACTION WITH HCL

Description	***Criteria***
None	*No visible reaction*
Weak	*Some reaction, with bubbles forming slowly*
Strong	*Violent reaction, with bubbles forming rapidly*

TABLE 6: CRITERIA FOR DESCRIBING CEMENTATION

Description	***Criteria***
Weak	*Crumbles or breaks with handling or little finger pressure*
Moderate	*Crumbles or breaks with considerable finger pressure*
Strong	*Will not crumble or break with finger pressure*

**NOTES: 1. Tables adapted from ASTM D2488 "Description and identification of Soils" (Visual-Manual Procedure)*
2. Tables 5, 7 and 11 incorporated into other information on this plate.

TABLE 8: CRITERIA FOR DESCRIBING DRY STRENGTH

Description	***Criteria***
None	*The dry specimen crumbles into powder with mere pressure of handling*
Low	*The dry specimen crumbles into powder with some finger pressure*
Medium	*The dry specimen breaks into pieces or crumbles with considerable finger pressure*
High	*The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface.*
Very High	*The dry specimen cannot be broken between the thumb and a hard surface*

TABLE 9: CRITERIA FOR DESCRIBING DILATANCY

Description	***Criteria***
None	*No visible change in the specimen*
Slow	*Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.*
Rapid	*Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.*

TABLE 10: CRITERIA FOR DESCRIBING TOUGHNESS

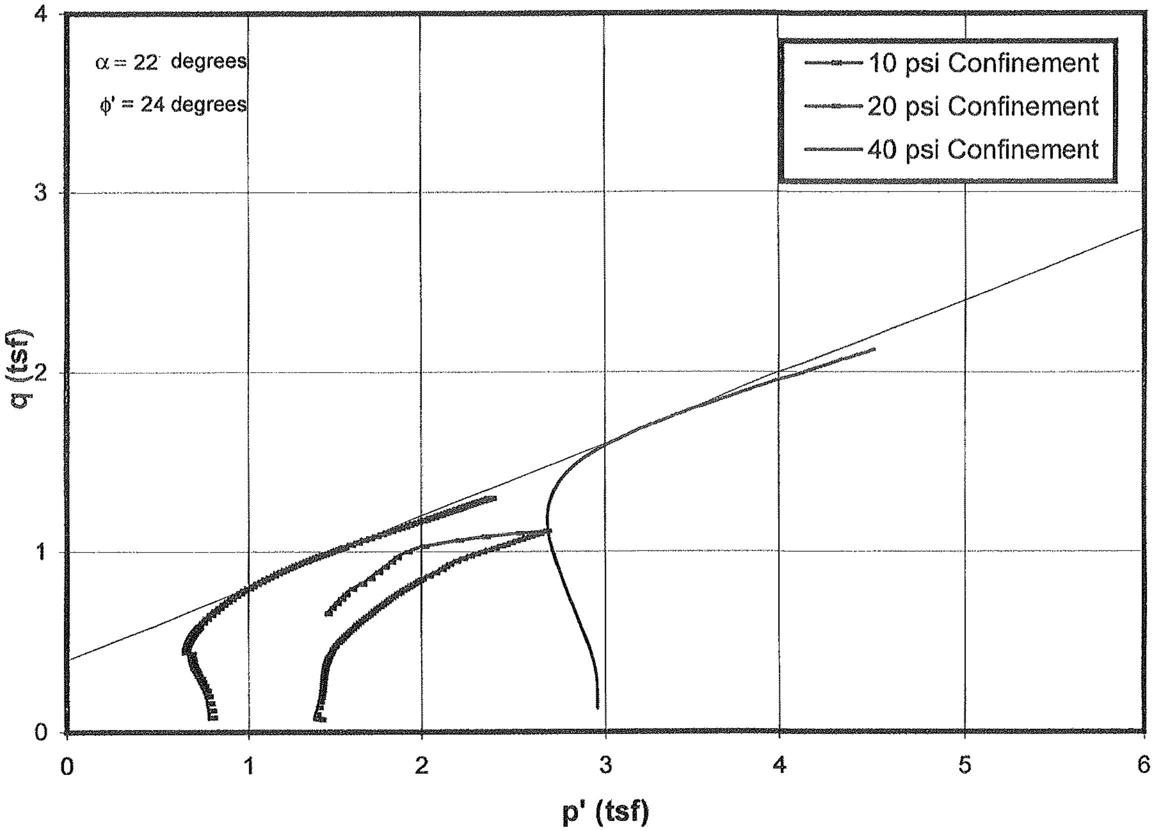
Description	***Criteria***
Low	*Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft.*
Medium	*Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness*
High	*Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness*

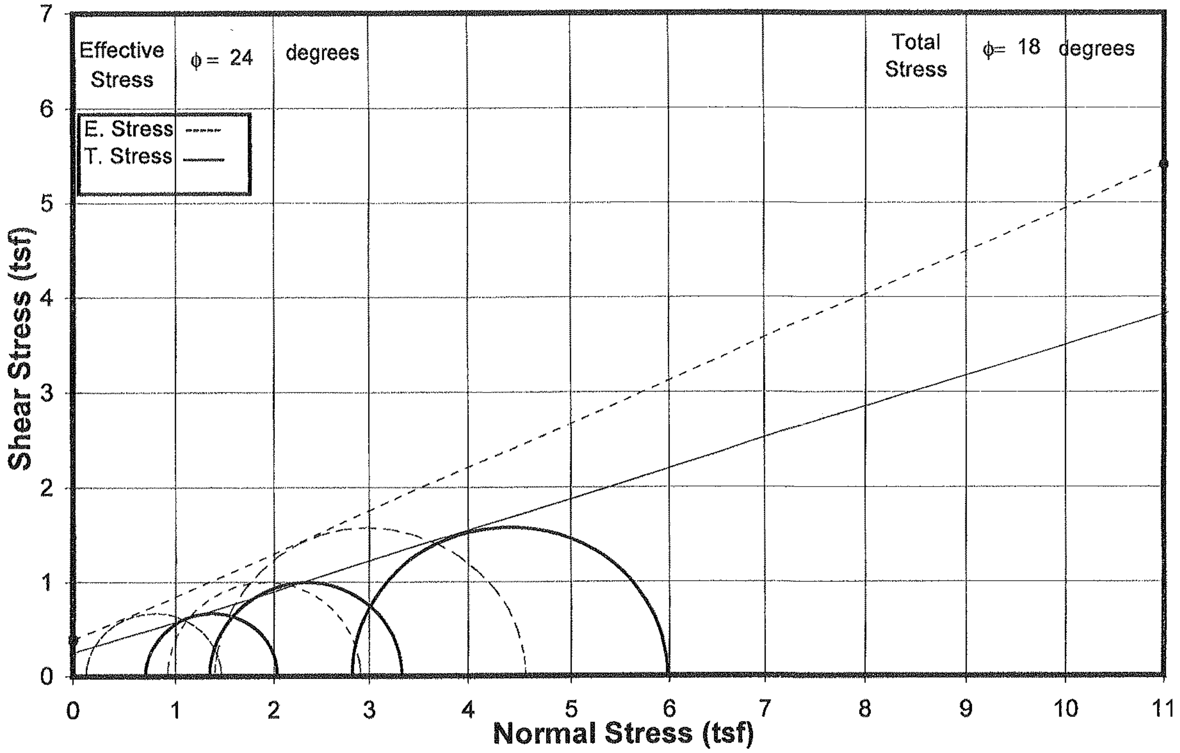
TABLE 12: IDENTIFICATION OF INORGANIC FINE-GRAINED SOILS FROM MANUAL TESTS

Soil Symbol	***Dry Strength***	***Dilatancy***	***Toughness***
ML	*None to low*	*Slow to rapid*	*Low or thread cannot be formed*
CL	*Medium to high*	*None to slow*	*Medium*
MH	*Low to medium*	*None to slow*	*Low to medium*
CH	*High to very high*	*none*	*High*

APPENDIX C

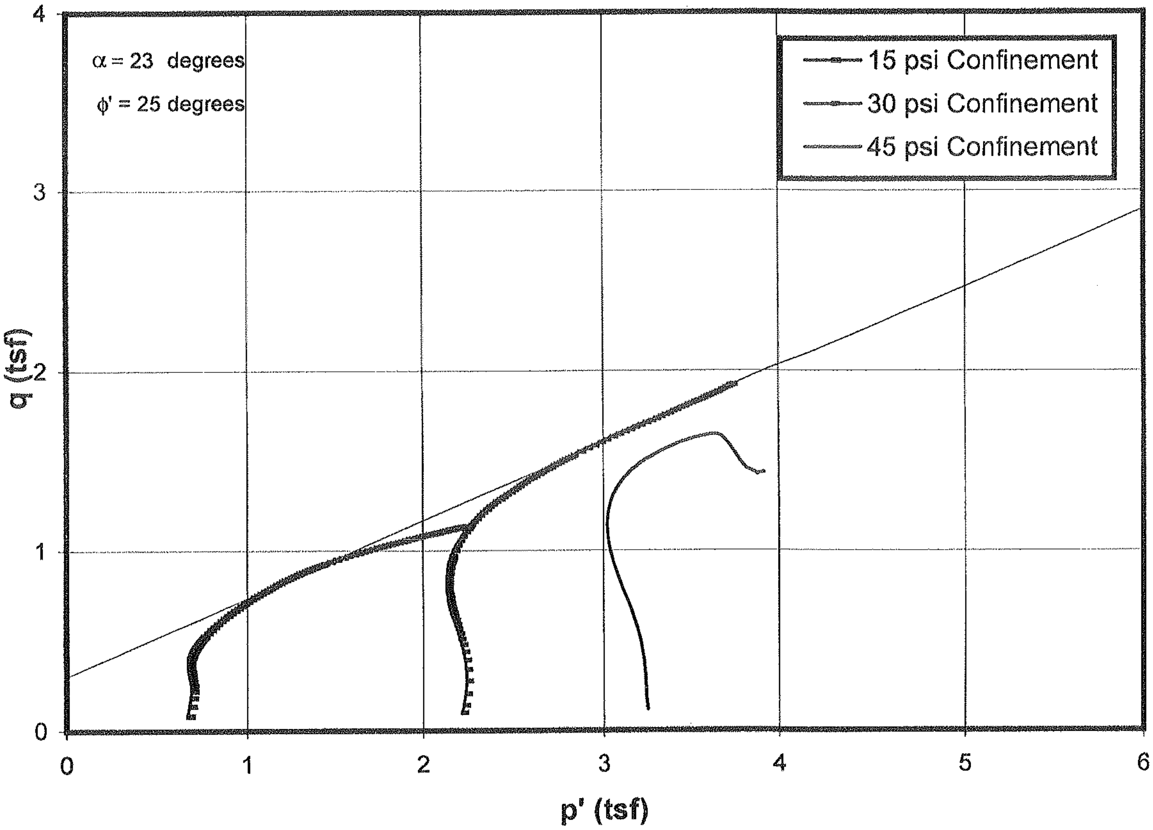
LABORATORY TEST DATA

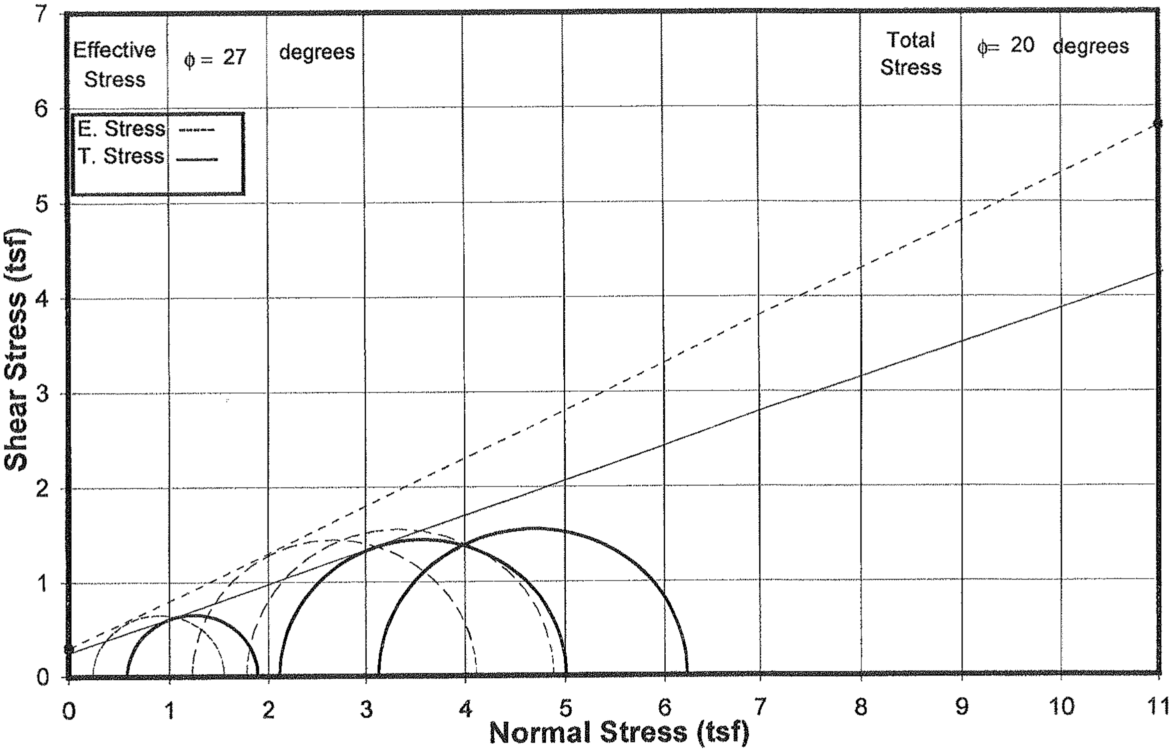




CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

ASTM D 4767
Project No.: J017150.01
Boring: B-2
Sample: ST-3, ST-4, ST-4 - Depth: 6, 8, 8



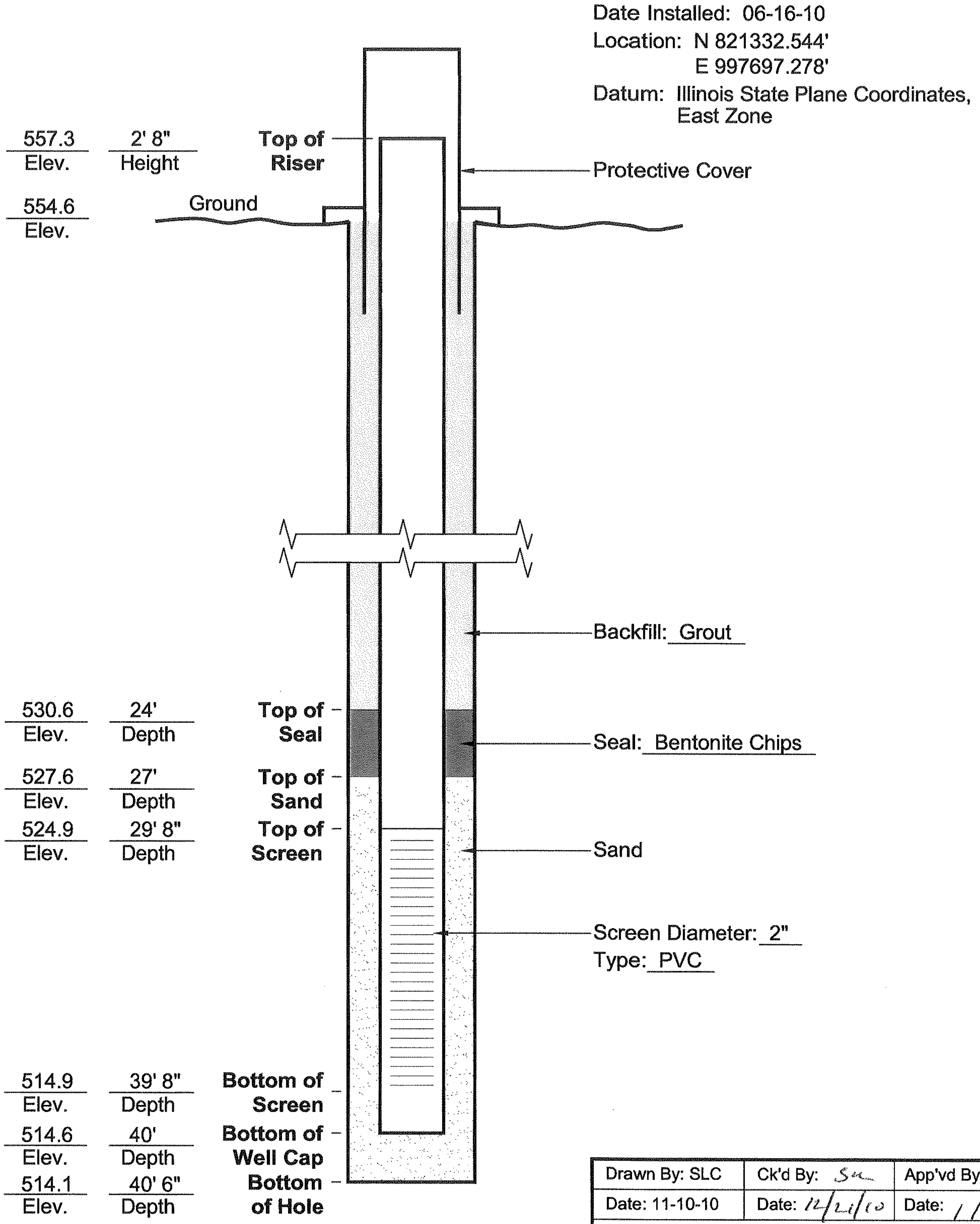


CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

ASTM D 4767
Project No.: J017150.01
Boring: B-2
Sample: ST-6, ST-7, ST-7 - Depth: 16, 18, 18

APPENDIX D

PIEZOMETER INSTALLATION DETAILS



Drawn By: SLC	Ck'd By: Sm	App'vd By: DW
Date: 11-10-10	Date: 12/21/10	Date: 1/10/11

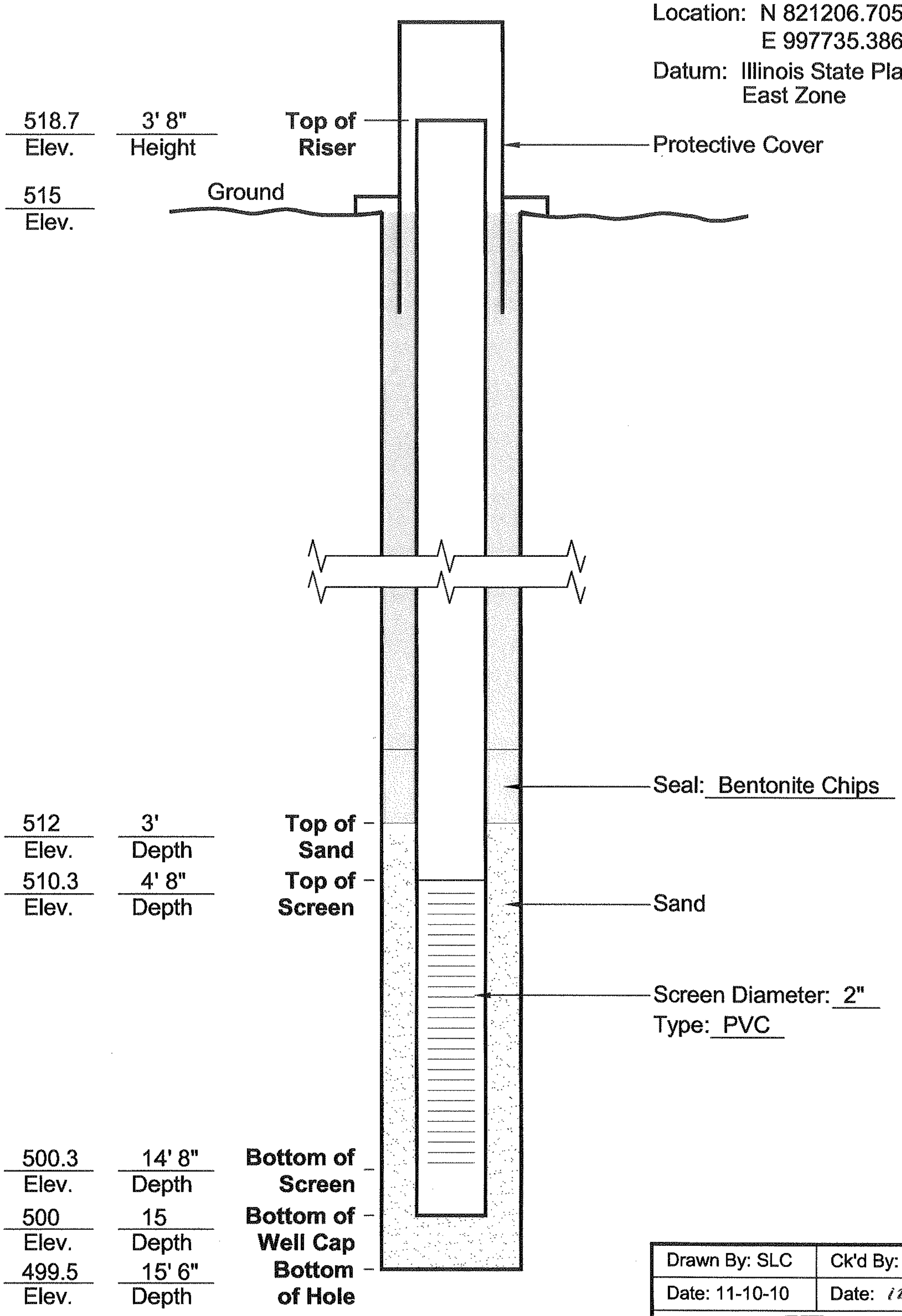
GEOTECHNOLOGY INC
FROM THE GROUND UP

Newton Power Station
Newton, Illinois

PIEZOMETER CONSTRUCTION DIAGRAM

Project Number J017150.01	B-2

Date Installed: 06-17-10
Location: N 821206.705'
E 997735.386'
Datum: Illinois State Plane Coordinates,
East Zone



Drawn By: SLC	Ck'd By:	App'vd By:
Date: 11-10-10	Date: 12/21/10	Date: 1/4/11

GEOTECHNOLOGY INC
FROM THE GROUND UP

Newton Power Station
Newton, Illinois

PEIZOMETER CONSTRUCTION DIAGRAM

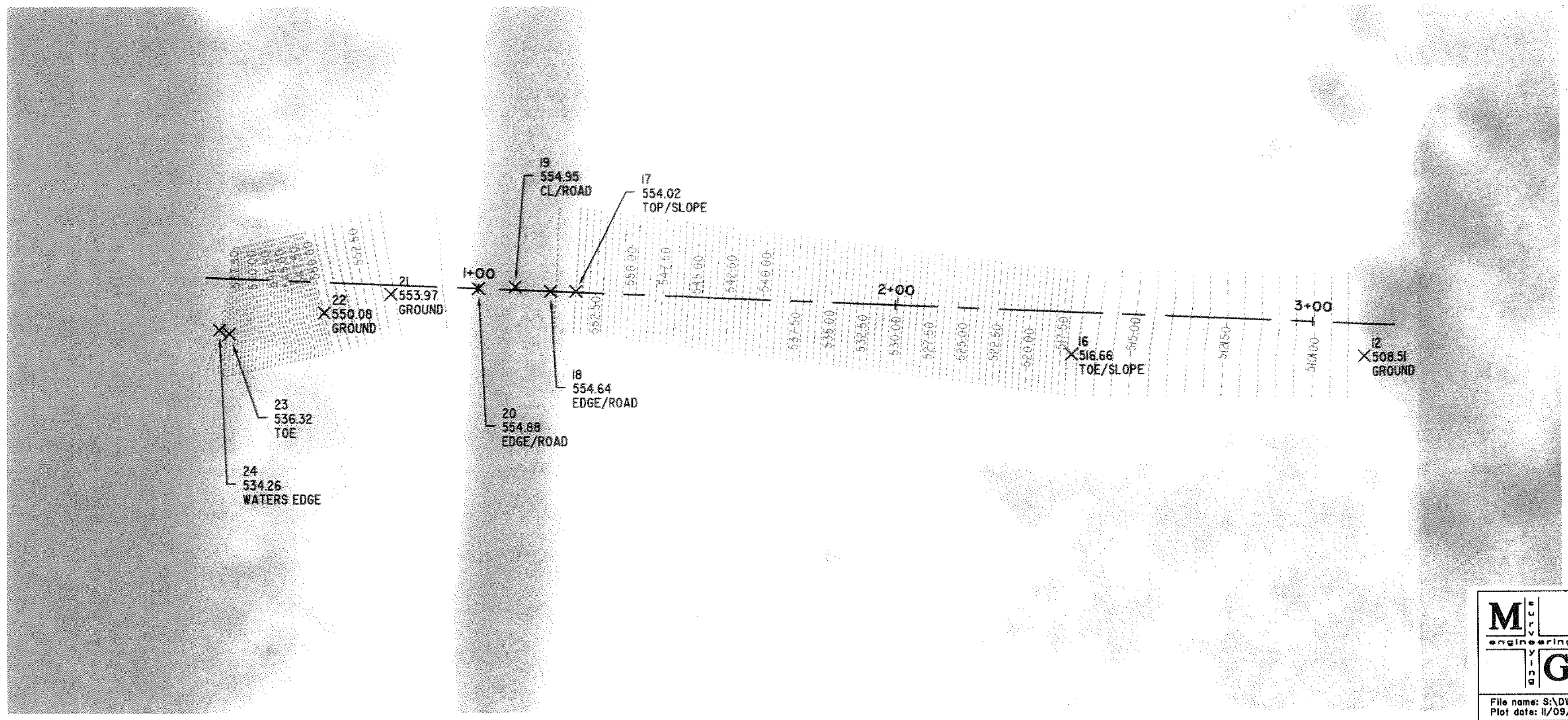
Project Number
J017150.01

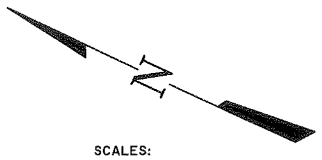
B-3

APPENDIX E

SURVEY DATA

Point	Station	Offset	Elevation	Description
12	3+12.97	7.724'	508.511'	GROUND
16	2+42.81	10.140'	516.664'	TOE/SLOPE
17	1+23.30	−0.246'	554.015'	TOP/SLOPE
18	1+17.28	0.000'	554.641'	EDGE/ROAD
19	1+08.75	−0.738'	554.950'	CL/ROAD
20	1+00.00	0.000'	554.879'	EDGE/ROAD
21	0+79.42	2.185'	553.969'	GROUND
22	0+63.83	7.278'	550.079'	GROUND
23	0+41.20	13.241'	536.323'	TOE
24	0+38.67	12.423'	534.256'	WATERS EDGE



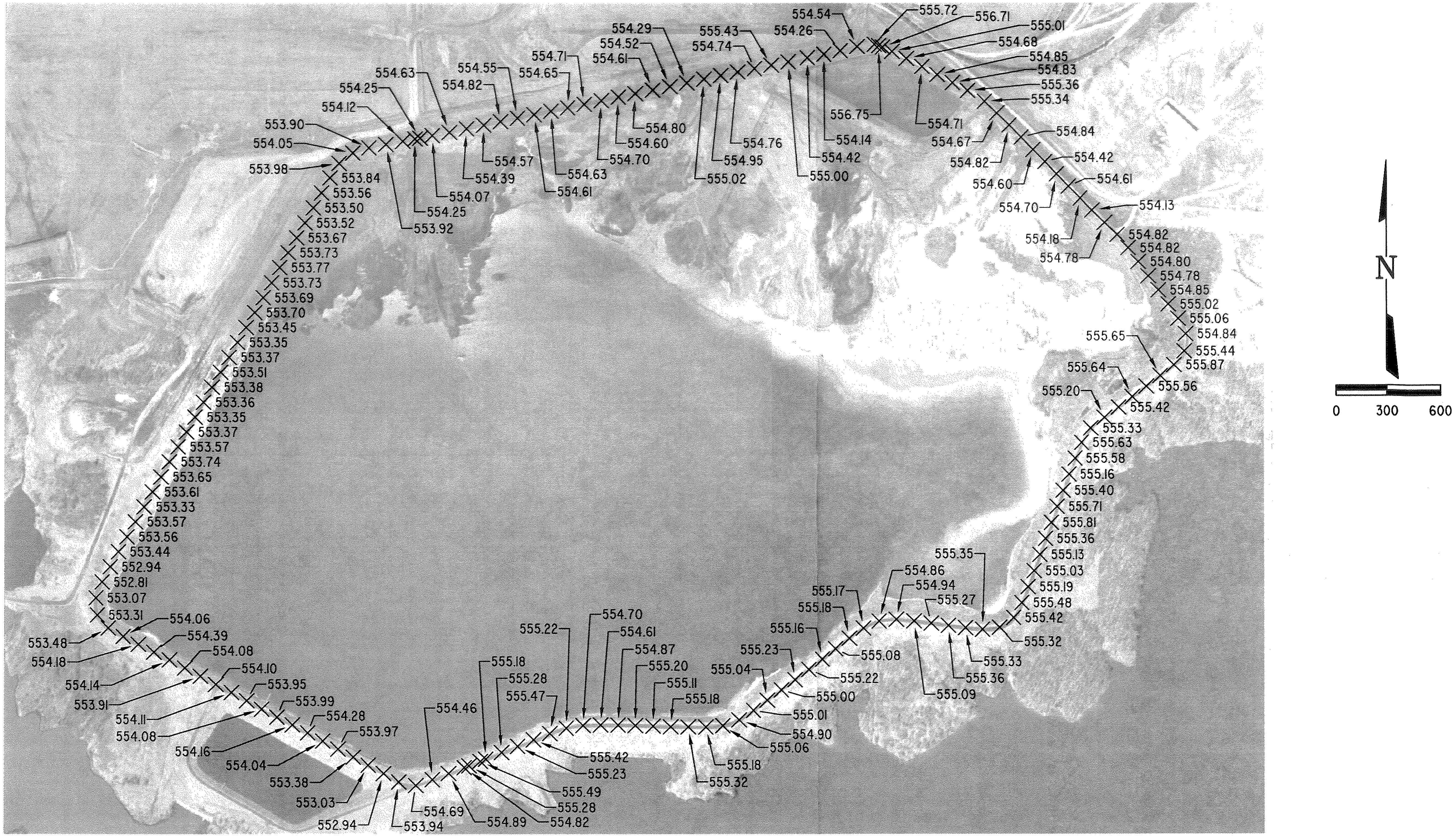


SCALES:
1" =20' HOR
1" =5' VER

MILANO & GRUNLOH ENGINEERS, LLC
114 WEST WASHINGTON
P.O. BOX 897
EFFINGHAM, ILLINOIS 62401
Phone: (217) 347-7262
(800) 677-2714
Fax #: (217) 342-3433
Web Address: www.mgengineers.com
Design Firm #: 184-003108

File name: S:\DWG\10\10165bg5\dwg\Section.dwg
Plot date: 11/09/10 at 16:10
F.B. 628

AMEREN-CIPS
NEWTON FACILITY
CROSS SECTION



MILANO & GRUNLOH ENGINEERS, LLC
114 WEST WASHINGTON
P.O. BOX 897
EFFINGHAM, ILLINOIS 62401
Phone: (217) 347-7262
(800) 677-2714
Fax #: (217) 342-3433
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