Intended for
Dynegy Midwest Generation, LLC
13498 E 800th St
Hennepin, IL 61327

Date
March 7, 2025

Project No.
1940110241-006

CORRECTIVE ACTION GROUNDWATER MONITORING PLAN

HENNEPIN POWER PLANT, WEST ASH POND SYSTEM, IEPA ID NO. W1550100002-01 AND W1550100002-03

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Project name	**Hennepin Power Plant West Ash Pond System**
Project no.	**1940110241-006**
Recipient	**Dynegy Midwest Generation, LLC**
Document type	**Corrective Action Groundwater Monitoring Plan**
Revision	**DRAFT**
Date	**March 7, 2025**

Ramboll
234 W. Florida Street
Fifth Floor
Milwaukee, WI 53204
USA

T 414-837-3607
F 414-837-3608
https://ramboll.com

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ACRONYMS AND ABBREVIATIONS

35 I.A.C.	Title 35 of the Illinois Administrative Code
ASD	Alternative Source Demonstration
CCR	coal combustion residuals
COC	constituent of concern
cm/s	Centimeters per second
CSM	conceptual site model
DMG	Dynegy Midwest Generation, LLC
E001	Event 1
GMP	Groundwater Monitoring Plan
GWPS	groundwater protection standard
HCR	Hydrogeologic Site Characterization Report
HPP	Hennepin Power Plant
ID	identification
IEPA	Illinois Environmental Protection Agency
NID	National Inventory of Dams
No.	Number
OWAP	Old West Polishing Pond
OWPP	Old West Ash Pond
Ramboll	Ramboll Americas Engineering Solutions, Inc.
RL	reporting limit
SI	surface impoundment
StAP	Statistical Analysis Plan
TDS	total dissolved solids
UA	uppermost aquifer
USEPA	United States Environmental Protection Agency
WAPS	West Ash Pond System

1. INTRODUCTION

1.1 Overview

In accordance with requirements of Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845: Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments, Ramboll Americas Engineering Solutions, Inc. (Ramboll) has prepared this Corrective Action Groundwater Monitoring Plan (GMP) on behalf of Hennepin Power Plant (HPP), operated by Dynegy Midwest Generation, LLC (DMG). This GMP will apply specifically to the coal combustion residuals (CCR) Unit referred to as the West Ash Pond System (WAPS), CCR identification (ID) number (No.) 804, Illinois Environmental Protection Agency (IEPA) ID No. W1550100002-01 and W1550100002-03, and National Inventory of Dams (NID) No. IL50698. WAPS is comprised of two sub-units including the Old West Ash Pond (OWAP) and the Old West Polishing Pond (OWPP). Both sub-units were originally constructed as a single unit with a single perimeter dike and subsequently internally divided into sub-units as part of operational practices. This document and all past engineering and hydrogeological studies consider the WAPS as a single CCR unit. The WAPS is a closed, unlined CCR SI that was previously used to manage CCR and non-CCR waste streams at the HPP.

This Corrective Action GMP includes 35 I.A.C. § 845 content requirements specific to 35 I.A.C. § 845.630 (*Groundwater Monitoring System*), 35 I.A.C. § 845.640 (*Groundwater Sampling and Analysis*), 35 I.A.C. § 845.650 (Groundwater Monitoring Program), and 35 I.A.C. § 845.680 (*Implementation of the Corrective Action Plan*) for the WAPS at the HPP.

A checklist in **Table 1-1** provides references to sections, tables, and figures within this document that meet the specific requirements of 35 I.A.C. § 845.630, 35 I.A.C. § 845.640, 35 I.A.C. § 845.650, and 35 I.A.C. § 845.680.

This Corrective Action GMP is included as Appendix B.1 to the Construction Permit Application for the HPP WAPS. The Corrective Action Plan proposes a continuous containment system which includes a deep cutoff wall combined with previously implemented source control (*i.e.,* closure) as the selected remedy for the WAPS. As described in the Corrective Action Plan, the proposed remedy meets the performance standards of 35 I.A.C. § 845.670(d) and addresses all current and potential future releases from the WAPS. Likewise, this Corrective Action GMP establishes how data will be collected, documented, and evaluated to assess remedy effectiveness for all currently documented and potential future releases from the WAPS[1] per the process outlined in **Figure 1-1**.

Adaptive site management strategies are an integral part of corrective action groundwater monitoring. The adaptive site management approach consistent with National Research Council, Interstate Technology & Regulatory Council and United States Environmental Protection Agency (USEPA) methodologies will allow timely incorporation of new site information throughout corrective action to ensure the achievement of the groundwater protection standard (GWPS). The adaptive site management approach expedites progress toward meeting the GWPS while acknowledging uncertainties, such as the persistence of current groundwater flow directions and potential related changes in geochemical conditions. The structured decision-making process

[1] The presence of exceedances at the waste boundary will continue to be evaluated under the Operating permit GMP previously submitted to IEPA [4].

proposed in this Corrective Action GMP includes specific metrics used to evaluate remedy progress, criteria which would trigger adaptive management evaluation, and options for those management actions.

1.2 Site Location and Background

The HPP is an approximately 504-acre property consisting of 19 parcels positioned adjacent to the Illinois River, including a retired coal-fired power plant, CCR landfill and SIs, and farmland. The HPP is located in the northwest quarter of Section 26, Township 33 North, Range 2 West, Putnam County, Illinois and approximately 3 miles north-northeast of the Village of Hennepin (**Figure 1-2**).

The HPP construction history includes construction of Unit 1 in 1953 and Unit 2 in 1969, with capacities of 70 megawatts (MW) and 210 MW, respectively. The plant initially burned high-sulfur Illinois coal and switched to sub-bituminous Powder River Basin coal in 1999 [1]. The HPP ceased operations in 2019 when the power plant was retired.

The WAPS is one of three CCR units at the HPP regulated under 35 I.A.C. § 845. The other two CCR units regulated under 35 I.A.C. § 845 (Ash Pond Number [No.] 2 and No. 4 multi-unit [AP2/AP4] and the East Ash Pond) are located adjacent to each other and the Landfill, east of the HPP. The WAPS is located west of the HPP. Areas surrounding the WAPS include agricultural land, with scattered groupings or rows of trees to the southeast, and low-lying floodplains of the Donnelley Wildlife Management Area to the southwest and west. The WAPS and surrounding properties are shown on **Figure 1-3**.

1.3 Conceptual Site Model

Significant site investigation has been completed at the HPP to characterize the geology, hydrogeology, and groundwater quality. Based on extensive investigation and monitoring, the WAPS has been well characterized and detailed in the Hydrogeologic Site Characterization Report (HCR) [2] included in the Operating Permit Application[2] and the Nature and Extent Report [3][3]. A conceptual site model (CSM) has been developed and is discussed below.

The WAPS is characterized by two hydrostratigraphic units. The units, listed from surface downward, are summarized as follows:

- **Uppermost Aquifer (UA)**: Includes the Cahokia Alluvium which consists of fine-grained river deposits comprised of silts and clays (upper UA), fine-medium sands (middle UA), and highly permeable glacial outwash sands and gravels of the Henry Formation (lower UA). The UA contains variable amounts of cobbles and boulders within a sand and gravel matrix. Both the prevalence and size of the cobbles and boulders increase with depth.
- **Bedrock Confining Unit**: Comprised of interbedded layers of shales with thin limestone, sandstone, and coal beds. Representative hydraulic conductivity for shale ranges from 5×10^{-6} to 5×10^{-10} centimeters per second (cm/s) and this unit defines the lower boundary

[2] The HCR was previously included as Attachment H of the Hennepin Power Plant Old West Ash Pond No. 1 and No. 3 and Old West Polishing Pond Operating Permit Application, submitted to IEPA on October 25, 2021.

[3] The Nature and Extent Report was previously submitted to IEPA [3] and is provided with updates as Appendix D of the Corrective Action Alternatives Assessment (CAAA). The CAAA serves as Appendix A to the Corrective Action Plan to which this report is attached.

of the UA. Borings along the perimeter of the nearby East Ash Pond System confirm the presence of shale bedrock between elevations ranging from 399.2 to 410.2 feet [2].

The direction of groundwater flow and hydraulic gradient within the UA varies with the elevation of the Illinois River. During normal river stage the direction of groundwater flow is most often toward the river, but comparison of groundwater and river elevation data indicate reversals in this flow direction during times of high river elevations. The relative duration of these events is short, which leads to the determination of a predominant groundwater flow direction toward the river Flow directions are generally consistent between seasons. Groundwater elevations and contours for the May 30, 2023 groundwater monitoring event (Event 1 [E001]) are presented in **Figure 1-4**.

1.4 Groundwater Quality

Groundwater monitoring in accordance with the proposed Operating GMP and sampling methodologies provided in the operating permit application for groundwater compliance at the WAPS began in the second quarter of 2023 [4]. The proposed compliance monitoring wells yield groundwater samples that represent the quality of downgradient groundwater at the CCR boundary (as required in 35 I.A.C. § 845.630(a)(2)).

The E001 quarterly groundwater monitoring event was completed on June 1, 2023. In accordance with 35 I.A.C. § 845.610(b)(3)(C), and the statistical analysis plan submitted with the operating permit application (Appendix A of the Groundwater Monitoring Plan) constituent concentrations observed at compliance wells were evaluated for compliance the GWPSs summarized in 35 I.A.C. § 845.600 to determine exceedances[4] of the GWPS. The statistical determination identified the following GWPS exceedances at compliance groundwater monitoring wells [5]:

- Arsenic at wells 21R and 51
- Boron at wells 21R, 22, 23, and 35
- Cadmium at well 22
- Sulfate at wells 23 and 35

Pursuant to 35 I.A.C. § 845.650(e), an Alternative Source Demonstration (ASD) presented evidence demonstrating that sources other than the WAPS were the cause of the cadmium GWPS exceedance at well 22 [6], and the ASD was subsequently approved by the IEPA [7].

Subsequent compliance sampling events (following E001) were evaluated for exceedances of the GWPS as described in 35 I.A.C. § 845.600 [8, 9, 10, 11, 12, 13]. Exceedances identified during the subsequent events were consistent with those listed above. In addition to the exceedances listed above, the following exceedances were identified:

- Lithium at well 22
- Total dissolved solids (TDS) at well 35

[4] Throughout this document, "exceedance" or "exceedances" is intended to refer only to potential exceedances of proposed applicable background statistics or GWPSs as described in the proposed groundwater monitoring program, which was submitted to the IEPA on October 25, 2021 as part of DMG's operating permit application for the HPP WAPS. That operating permit application, including the proposed groundwater monitoring program, remains under review by the IEPA and, therefore, DMG has not identified any actual exceedances.

In accordance with 35 I.A.C. § 845.660, a Corrective Measures Assessment was developed to address current and potential future GWPS exceedances originating from the WAPS, exclusive of the cadmium exceedance addressed in the ASD, and was submitted to IEPA on May 8, 2024 [14]. The 35 I.A.C. § 845.650 groundwater monitoring requirements will continue to ensure that there will be timely detection of changes in groundwater quality during the stay. The selected remedy will meet the performance standards of 35 I.A.C. § 845.670(d) and once implemented and completed, the selected remedy presented in the Corrective Action Plan will attain the GWPSs.

1.5 Supplemental Site Investigation

A limited investigation was conducted in 2024 in accordance with 35 I.A.C. § 845.650 to assess the hydraulic conductivity of the bedrock in preparation for design of the proposed bedrock cutoff wall. Three borings were advanced along the perimeter of the HPP WAPS through unconsolidated materials and into competent bedrock. Soil lithology was logged continuously from borings completed at these locations, and packer testing was conducted on select intervals from each boring to evaluate ranges in bedrock hydraulic conductivities. During the bedrock investigation, one aquifer solids sample was collected to further assess nature, degree, and extent of arsenic groundwater impacts downgradient of the HEN WAPS [15].

2. CORRECTIVE ACTION GROUNDWATER MONITORING PLAN

This Corrective Action GMP is being provided to propose a groundwater monitoring program specific to the WAPS that will comply with 35 I.A.C. § 845.680. The Corrective Action GMP will monitor and evaluate groundwater quality specifically to document the effectiveness of the corrective action remedy. The groundwater monitoring program will include sampling and analysis procedures that are consistent and that provide an accurate representation of groundwater quality.

2.1 Corrective Action Groundwater Monitoring Program and Parameters

2.1.1 35 I.A.C. § 845 Corrective Action Groundwater Monitoring

The proposed 35 I.A.C. § 845 corrective action monitoring well network will consist of eight wells to document the effectiveness of the corrective action remedy and ultimately demonstrate compliance with GWPSs (**Figure 2-1**). The wells included in the corrective action monitoring well network include select compliance monitoring wells from the Operating GMP network (*e.g.*, those with previously reported exceedances of the GWPS) (**Section 1.4**).

As appropriate to meet the corrective action monitoring objectives and evaluate the effectiveness of the corrective action remedy (as described in **Section 3**), the corrective action monitoring program involves assigning each well to a monitoring category or purpose (**Table 2-1**). These monitoring categories include:

- **Inside Plume**: monitoring wells installed at the CCR boundary with GWPS exceedances.
- **Plume Definition**: wells located along the lateral or vertical boundary of the plume.

A summary of the well locations and associated purpose as it relates to the above categories is presented in **Table 2-1** and **Figure 2-1**. Monitoring well depths and construction details are listed in **Table 2-2**, and boring logs and monitoring well construction forms are provided in **Appendix A**. Groundwater samples will be collected and analyzed for the laboratory and field parameters in **Table 2-3**. Laboratory parameters include major ions for evaluating groundwater chemistry and constituents of concern (COCs) (*i.e.*, reported exceedances in accordance with the Operating GMP) the Corrective Action is intended to address. Sampling to evaluate corrective action effectiveness will begin the quarter after the corrective action remedy is implemented and commissioned.

2.2 Sampling Schedule

All wells in the corrective action GMP network, as presented in **Table 2-1**, will be sampled quarterly to provide a complete picture of corrective action effectiveness. Groundwater elevations will be determined at the time of sample collection from each well. Sampling will end in accordance with 35 I.A.C. § 845.680(c), when compliance with the GWPS has been demonstrated "at all points within the plume of contamination that lies beyond the waste boundary […] for a period of three consecutive years" (details in **Section 3.3**).

Consistent with 35 I.A.C. § 845.650(b)(4), quarterly sampling may be reduced to a semiannual frequency with IEPA approval after completion of five years of monitoring. A request for reduced sampling frequency will include a demonstration that corrective action monitoring effectiveness

will not be compromised; sufficient data has been collected to evaluate ongoing remedy effectiveness; and existing data show trends consistent with anticipated remedy performance (details in **Section 3.1**).

2.3 Groundwater Sample Collection

Groundwater sampling procedures have been developed and the collection of groundwater samples is being implemented to meet the requirements of 35 I.A.C. § 845.640. In addition to groundwater well samples, quality assurance samples will be collected as described in **Section 2.5** (**Table 2-3**). Groundwater samples will be collected and analyzed in accordance with the Multi-Site Sampling and Analysis Plan [16].

2.4 Laboratory Analysis

Laboratory analysis will be performed consistent with the requirements of 35 I.A.C. § 845.640(j) by a state-certified laboratory using methods approved by IEPA and USEPA. Laboratory methods may be modified based on laboratory equipment availability or procedures, but the Reporting Limit (RL) for all parameters analyzed, regardless of method, will be lower than the applicable groundwater quality standard [17]. Concentrations lower than the RL will be reported as less than the RL.

2.5 Quality Assurance Program

Consistent with the requirements of 35 I.A.C. § 845.640(a)(5), the sampling and analysis program includes procedures and techniques for quality assurance/quality control (QA/QC). Additional quality assurance samples to be collected will include the following:

- Field duplicates will be collected at a frequency of one per group of ten or fewer investigative water samples.
- One equipment blank sample will be collected and analyzed for each day of sampling. If dedicated sampling equipment is used, then equipment blank samples will not be collected.
- The duplicate and equipment blank quality assurance samples will be supplemented by the laboratory QA/QC program, which typically includes:
  - Regular generation of instrument calibration curves to assure instrument reliability
  - Laboratory control samples and/or quality control check standards that have been spiked, and analyses to monitor the performance of the analytical method
  - Matrix spike/matrix spike duplicate analyses to determine percent recoveries and relative percent differences for each of the parameters detected
  - Analysis of replicate samples to check the precision of the instrumentation and/or methodology employed for all analytical methods
  - Analysis of method blanks to assure that the system is free of contamination

Water quality meters used to measure pH and turbidity will be calibrated according to manufacturer's specifications. At a minimum, it is recommended that calibration of pH occur daily prior to sampling and checked for accuracy at the end of each day. Unusual or suspect pH measurements during sampling events will be flagged, evaluated, and additional calibration may be performed throughout the sampling events. Turbidity meters will be checked daily, prior to

and following sampling. Unusual measurements or erratic meter performance will be flagged and evaluated for overall effects on the data prior to reporting.

2.6 Groundwater Monitoring Well Maintenance Plan

Consistent with the requirements of 35 I.A.C. § 845.630(e)(2), maintenance will be performed according to the Multi-Site Sampling and Analysis Plan [16] as needed to assure that the monitoring wells provide representative groundwater samples. Monitoring wells will be inspected during each groundwater sampling event; inspections will consist of the following:

- Visual inspection, clearing of vegetation, replacement of markers, and painting of protective casings as needed to assure that monitoring wells are clearly marked and accessible
- Visual inspection and repair or replacement of well aprons as needed to assure that they are intact, drain water away from the well, and have not heaved
- Visual inspection and repair or replacement of protective casings as needed to assure that they are undamaged, and that locks are present and functional
- Checks to assure that well caps are intact and vented, unless in flood-prone areas in which case caps will not be vented
- Routine measurement of monitoring well depths to determine the degree of siltation within the wells. Wells will be redeveloped as needed to remove siltation from the screened interval if it impedes flow of water into the well
- Checks to assure that wells are clear of internal obstructions, and flow freely

If wells are damaged or become otherwise inoperable, they will be replaced by wells screened at the same elevation and as close to the original well as possible (ideally within 10 feet) and notification will be provided to IEPA. If a replacement well cannot be installed within approximately 10 feet of the original well location, notification will be sent to IEPA and a monitoring well will be installed as close as possible to the original monitoring well and given a new well identification number. Any well replacement activities will also be documented in the Annual Groundwater Monitoring and Corrective Action Report.

2.7 Statistical Analysis

A Multi-Site Statistical Analysis Plan (StAP) [18], has been developed to summarize the statistical procedures that will be used to evaluate the groundwater results.

2.8 Data Reporting

Groundwater monitoring and analysis completed in accordance with 35 I.A.C. § 845 under an approved monitoring program will be reported to IEPA annually by January 31 as required by I.A.C. § 845.550, for data collected the preceding year. The Annual Groundwater Monitoring and Correct Action Report will include the status of the groundwater monitoring and Corrective Action Plan for the WAPS in addition to other requirements detailed in 35 I.A.C. § 845.610(e).

2.9 Compliance with Applicable Groundwater Protection Standards

As provided in 35 I.A.C. § 845.680(c)(2), corrective action is considered complete when compliance with the GWPS has been achieved by demonstrating that concentration of constituents listed in 35 I.A.C. § 845.600 have not exceeded the GWPSs for a period of three

consecutive years, using the statistical procedures and performance standards in 35 I.A.C. § 845.640(f) and (g).

Attainment of GWPSs and conclusion of corrective action monitoring is discussed below in **Section 3.3**.

If a new exceedance is determined during monitoring under the Operating GMP, the Corrective Action groundwater monitoring program will be evaluated for monitoring of additional locations and/or constituents using the adaptive site management methods presented herein.

3. EFFECTIVENESS OF THE CORRECTIVE ACTION REMEDY

The methods for evaluating the effectiveness of the corrective action remedy described in this section are based on the following guidance documents:

- "Methods for Evaluating the Attainment of Cleanup Standards Volume 2: Groundwater," Office of Policy, Planning, and Evaluation, 1992 [18].
- "Groundwater Remedy Completion Strategy: Moving Forward with the End in Mind," Office of Solid Waste and Emergency Response, 2014 [19].
- "Adaptive Site Management – A Framework for Implementing Adaptive Management at Contaminated Sediment Superfund Sites," USEPA, Office of Superfund Remediation and Technology Innovation, 2022 [20].
- "Environmental Cleanup Best Management Practices: Effective Use of the Project Life Cycle Conceptual Site Model," USEPA Office of Solid Waste and Emergency Response, 2011 [21].

Evaluation of corrective action remedy effectiveness will occur in three phases (**Figure 3-1**): remedy progress evaluation, stability evaluation, and attainment evaluation [18].

1. Remedy progress evaluation occurs after implementation of corrective actions to assesses if the remedy is functioning as anticipated.
2. The stability evaluation, which assesses if a new post-treatment steady state in the groundwater has been reached.
3. Attainment evaluation occurs after a new steady state has been achieved and assesses if COC concentrations are below the GWPS.

COCs are parameters with exceedances of the GWPS to be addressed by the Corrective Action Plan. Corrective action monitoring at HEN WAPS includes the following COC parameters:

- Arsenic, boron, lithium, sulfate, and TDS

The effectiveness of the remedy at each phase is evaluated using performance metrics designed to assess the goals of that phase. Performance metrics answer questions designed to evaluate multiple aspects of remedy effectiveness with the ultimate goal of holistically guiding management decisions [19]. These metrics may be evaluated using qualitative (subject to expert judgement) or quantitative (numerical outcomes) methods.

This section details the goals and performance metrics of each phase of remedy evaluation. Within each phase, the well groups described in **Section 2.1** have distinct applicable metrics and/or potential management actions consistent with the role of that well group within the corrective action monitoring framework. The remedy evaluation metrics documented here are specific to wells within the Corrective Action monitoring program.

3.1 Remedy Progress Evaluation

The goal of remedy process evaluation is to determine if a groundwater remedy is on track to achieve cleanup standards within the proposed time frame and to inform adaptive management decisions if performance metrics are not achieved. Evaluation of remedy progress includes evaluating the response of COCs in individual monitoring wells and in the plume as a whole. Remedy progress is evaluated using performance metrics as described below. **Table 3-1** details

the questions used to assess remedy progress and metrics which would trigger additional evaluation of adaptive site management options. **Figure 3-2** presents an outline of the decision-making process regarding adaptive management actions (the first step of which is assessing remedy progress per **Table 3-1**).

Documentation of remedy progress metrics will be provided in the Annual Groundwater Monitoring and Corrective Action Report (**Section 2.8**) beginning after the second year of data collection: a minimum of eight data points is required to complete meaningful statistical analysis required for evaluation of the remedy progress metrics, which will be available after two years of quarterly sampling. Per USEPA guidance [19], a thorough review of corrective action progress and remedy effectiveness will be conducted every five years. A Five-Year Annual Groundwater Monitoring and Corrective Action Report will evaluate the comprehensive data set and, if triggered by the results of the remedy progress evaluation metrics (**Table 3-1**), evaluate whether adaptive management actions are needed (**Figure 3-2**). The five-year time frame allows adaptive management decisions to be based on a robust data sufficient to complete meaningful statistical analysis while remaining responsive to changing site conditions [19]. The remedy progress evaluation metrics and triggers for additional evaluation are described below.

3.1.1 Comparison to Groundwater Protection Standard

The plume wells in this monitoring plan were defined based on exceedances of the GWPS. The question posed to evaluate whether exceedances of the GWPS occur, and associated method of evaluation is (**Table 3-1**):

- Are COC concentrations greater than the GWPS? – Compare data points or summary statistics to site-specific GWPS values.

COC concentrations below the GWPS in plume wells may indicate that remedial actions are approaching completion and that moving to the next phase of remedy effectiveness evaluation may be warranted (see **Section 3.2**). Persistence of COC concentrations above the GWPS in Plume Definition wells may indicate that the plume is no longer properly delineated. Therefore, the trigger criterion for further evaluation is a central tendency measure of the last eight data points exceeding the GWPS.

3.1.2 Agreement with Groundwater Model

A groundwater flow and transport model[5] was used to compare the anticipated time to reach the GWPS for the different corrective actions considered at the WAPS.

The question posed to evaluate agreement of corrective action remedy progress with the groundwater model results is provided in **Table 3-1** and summarized below:

- Are concentrations of COCs at individual wells consistent with modeling expectations? – Evaluate if the observed results track with the predicted results in general direction and magnitude using expert professional judgement.

Only plume and Plume Definition wells included in the flow and transport model are evaluated according to this metric. Trigger criteria for additional adaptive site management evaluation include monitoring results failing to follow the general magnitude and direction of groundwater

[5] The Groundwater Modeling Technical Memorandum is included as an attachment to the Corrective Actions Alternative Analysis presented as part of the Corrective Action Plan.

model results at one or more locations. It is acceptable to conclude that if no further adaptive site management evaluation is triggered if future observations do not precisely match modeled results on an individual well basis if the direction of remedy progress is adequate.

3.1.3 Trend Analysis

Evaluation of COC trends in wells both within and outside of the plume is a major component of remedy progress evaluations [18, 19]. Decreasing COC concentrations within the groundwater plume provides critical support for remedy effectiveness evaluations. Changing concentrations in wells defining the plume may indicate unanticipated plume migration or a need for better Plume Definition. Both short-term and long-term trends are important to evaluate remedy performance [18]. All trend analyses are performed in accordance with the Multi-Site StAP [18] and the USEPA Unified Guidance for groundwater statistics [22].

The questions posed to evaluate if COC concentrations are decreasing in Inside Plume wells and the associated methods for evaluation are provided in **Table 3-1** and summarized as follows:

- Are average plume COC concentrations decreasing? – Evaluate trend based on quarterly average of COC concentrations of Inside Plume wells, both for the last eight sampling events and since corrective action was initiated.

The questions posed to evaluate if COC concentrations are changing in Inside Plume wells and Plume Definition wells and the associated methods for evaluation are provided in **Table 3-1** and summarized below:

- Are concentrations of COCs at individual wells changing? – Evaluate trend of COC concentrations, both for the last eight sampling events and since corrective action was initiated.

The goal of the corrective action is to reduce COC concentrations in the groundwater. Therefore, trigger criteria have been established for the two types of corrective action monitoring wells as follows:

- Inside Plume well triggers for adaptive site management evaluation are based on no decreasing trend in COC concentrations (short-term or long-term).
- Plume Definition well triggers are based on increasing COC concentrations, which may indicate improper delineation of the plume. Therefore, the trigger criterion for adaptive site management evaluation at Plume Definition wells is increasing short- or long-term trend.

3.1.4 Adaptive Management Actions

The goal of adaptive management actions is to understand why performance metrics are not met and, if the remedy is found to be unsuccessful in meeting remediation goals, drive supplemental corrective actions or, in extreme cases, re-evaluation of remedy selection. This section describes in greater detail the steps in the flow chart presented in **Figure 3-2** (adapted from Figure 2 in [19]).

As the remedy progress evaluation metrics are evaluated annually, failure to meet the metrics (as described in **Table 3-1**) leads to further action. If the data available at the time of the Five-Year Review are anticipated to be inadequate for determining the need for adaptive site management actions, additional data may be collected before the Five-Year Review including collecting samples from additional wells or measuring additional parameters.

If the remedy progress is not found to be adequate during the Five-Year Review, the most critical question is whether or not the remedy is likely to achieve the GWPS in a reasonable time frame. This may be evaluated using methods such as regression analysis or analysis of groundwater flow. If the remedy progress is not judged to be adequate but the remedy is likely to achieve the GWPS in a reasonable time frame, the CSM or the groundwater model may require updating to reflect evolving field conditions[6]. Additional data collected may also suggest ways to optimize the monitoring network or performance metrics [19].

If the remedy does not appear likely to achieve the GWPS in a reasonable time frame, it may be due to changing hydrogeochemical dynamics within the plume or an additional source of COCs not accounted for in the CSM. If available data suggests either occurrence, the Five-Year Review will describe additional activities planned to investigate if the existing remedy is still a viable option for attaining the GWPS. If the remedy is still viable, an update to the CSM and groundwater model is likely required [20, 22] and will be conducted after additional investigation is completed.

If the remedy does not appear likely to achieve the GWPS in a reasonable time frame, the plume is appropriately delineated, there is no alternative source of COCs not accounted for in the CSM, and the plume is appropriately delineated; or if the investigation into the hydrogeochemical changes or alternative source of COCs determines that the remedial action is no longer solely viable as a corrective action, an evaluation of additional remedial actions will be initiated.

If the remedy progress evaluation metrics indicate that concentrations across the monitoring network are below the GWPS, the remedy progress phase may be considered complete, and the monitoring program may move to the Stability Evaluation phase (see **Section 3.2**).

3.2 Stability Evaluation

Evaluation of groundwater stability reflects the idea that implementation of a remedy will, by necessity, cause changes to the physical and chemical environment of the groundwater. In order to evaluate ultimate effectiveness of the remedy, it is critical to evaluate if a new stable equilibrium has been reached after final closure has been implemented. Stability is achieved when groundwater elevations are stable (accounting for seasonal variability); average COC concentrations are stable across all wells; and COC concentrations are stable at each well.

Trends in groundwater elevation and COC concentrations at each plume well will be evaluated using the most recent eight data points (*i.e.*, two years of data when sampling quarterly) according to methods presented in the Multi-Site StAP [18]. This metric is met for a plume well when there is no statistically significant trend for three consecutive years.

Plume COC concentrations will be evaluated for trend using the most recent eight data points, with the average concentration across plume wells per sampling event considered as one data point, according to methods presented in the Multi-Site StAP [18]. This metric is met when there is no statistically significant trend in groundwater elevation or COC concentrations.

[6] As stated in Section 1.4.1 of the Corrective Action Plan, "Estimated times to reach GWPS will be periodically reviewed and updated based on observed corrective action performance via an adaptive site management strategy."

3.3 Attainment Evaluation and Conclusion of Corrective Action Monitoring

The ultimate goal of groundwater corrective action is to attain compliance with the GWPS for each COC in Inside Plume wells. After stability has been achieved per the metrics discussed in **Section 3.2**, attainment evaluation will begin. Per 35 I.A.C. § 845.680(c), corrective action is considered complete when compliance with the GWPS has been demonstrated "at all points within the plume of contamination that lies beyond the waste boundary […] for a period of three consecutive years". Attainment of the GWPS will be evaluated in accordance with the Multi-Site StAP [18]. Corrective Action monitoring is considered complete for the site when COCs in the corrective action monitoring well network do not exceed the GWPS for three years.

4. REFERENCES

[1] Science and Technology Management, Inc. , "Investigation of Site Closure Options at Illinois Power Company's Hennepin East Ash Impoundment. Report No. STMI/135/96-02," Brookfield, Wisconsin, June 1996.

[2] Natural Resource Technology, Inc., Hydrogeologic Site Characterization Report. Hennepin West Ash Pond System. Hennepin, IL. Dynegy Midwest Generation, LLC., December 20, 2017.

[3] Ramboll Americas Engineering Solutions, Inc., Nature and Extent Report, Hennepin Power Plant, West Ash Pond System, IEPA ID NO. W1550100002-01 AND W1550100002-03, May 8, 2024.

[4] Ramboll Americas Engineering Solutions, Inc., Addendum to the Groundwater Monitoring Plan, Hennepin Power Plant, West Ash Pond System, Hennepin, Illinois, Dynegy Midwest Generation, LLC., October 25, 2021.

[5] Ramboll Americas Engineering Solutions, Inc., 35 I.A.C. § 845.610(B)(3)(D) Groundwater Monitoring Data and Detected Exceedances, 2023 Quarter 2, West Ash Pond System, Hennepin Power Plant, Hennepin, Illinois., September 11, 2023.

[6] Ramboll Americas Engineering Solutions, Inc., 35 I.A.C. § 845.650(E): Alternative Source Demonstration, West Ash Pond System, Hennepin Power Plant, Hennepin, IL, IEPA ID: W1550100002-01 and W1550100002-03, November 11, 2023.

[7] Illinois Environmental Protection Agency (IEPA), "Letter from Michael Summers (IEPA) to Phil Morris (Dynegy Midwest Generation, LLC), Re: Hennepin Power Plant West Ash Pond System; W1550100002-01 & 03, Alternative Source Demonstration (ASD) Submittal.," December 11, 2023.

[8] Ramboll Americas Engineering Solutions, Inc., 35 I.A.C. § 845.610(B)(3)(D) Groundwater Monitoring Data and Detected Exceedances, 2023 Quarter 3, West Ash Pond System, Hennepin Power Plant, Hennepin, Illinois., January 15, 2024.

[9] Ramboll Americas Engineering Solutions, Inc., "35 I.A.C. § 845.610(B)(3)(D) Groundwater Monitoring Data and Detected Exceedances, 2023 Quarter 4, West Ash Pond System, Hennepin Power Plant, Hennepin, Illinois," March 4, 2024.

[10] Ramboll Americas Engineering Solutions, Inc., "35 I.A.C. § 845.610(B)(3)(D) Groundwater Monitoring Data and Detected Exceedances, 2024 Quarter 1, West Ash Pond System, Hennepin Power Plant, Hennepin, Illinois," April 22, 2024.

[11] Ramboll Americas Engineering Solutions, Inc., "35 I.A.C. § 845.610(B)(3)(D) Groundwater Monitoring Data and Detected Exceedances, 2024 Quarter 2, West Ash Pond System, Hennepin Power Plant, Hennepin, Illinois," August 30, 2024.

[12] Ramboll Americas Engineering Solutions, Inc, "35 I.A.C. § 845.610(B)(3)(D) Groundwater Monitoring Data and Detected Exceedances, 2024 Quarter 3, West Ash Pond System, Hennepin Power Plant, Hennepin, Illinois," November 5, 2024.

[13] Ramboll Americas Engineering Solutions, Inc., "35 I.A.C. § 845.610(B)(3)(D) Groundwater Monitoring Data and Detected Exceedances, 2024 Quarter 4, West Ash Pond System, Hennepin Power Plant, Hennepin, Illinois," January 10, 2025.

[14] Ramboll Americas Engineering Solutions, Inc., 35 I.A.C. § 845 Corrective Measures Assessment, Hennepin Power Plant, West Ash Pond System, IEPA ID: W1550100002-01 And W1550100002-03, May 8, 2024.

[15] Ramboll Americas Engineering Solutions, Inc., "Addendum to the Nature and Extent Report, Hennepin Power Plant, West Ash Pond System, IEPA ID NO. W1550100002-01 and W1550100002-03," March 7, 2025.

[16] Ramboll Americas Engineering Solutions, Inc., "Multi-Site Sampling and Analysis Plan, Revision 1," December 28, 2022. [Online]. Available: https://www.luminant.com/documents/ccr/il-ccr/Hennepin/2023/Multi-Site%20Sampling%20Analysis%20Plan-Hennepin-W1550100002%E2%80%9001,03,04,05,07.pdf.

[17] Ramboll Americas Engineering Solutions, Inc., "Multi-Site Quality Assurance Project Plan, Revision 1," December 28, 2022. [Online]. Available: https://www.luminant.com/documents/ccr/il-ccr/Hennepin/2023/Multi-site%20Quality%20Assurance%20Project%20Plan-Hennepin-W1550100002%E2%80%9001,03,04,05,07.pdf.

[18] United States Environmental Protection Agency, "Methods for Evaluating the Attainment of Cleanup Standards Volume 2: Groundwater," Office of Policy, Planning, and Evaluation, 1992.

[19] United States Environmental Protection Agency, "Groundwater Remedy Completion Strategy: Moving Forward with the End in Mind," Office of Solid Waste and Emergency Response, 2014.

[20] United States Environmental Protection Agency, "Adaptive Site Management - A Framework for Implementing Adaptive Management at Contaminated Sediment Superfund Sites.," Office of Superfund Remediation and Technology Innovation, 2022.

[21] United States Environmental Protection Agency, "Environmental Cleanup Best Management Practices: Effective Use of the Project Life Cycle Conceptual Site Model," Office of Solid Waste and Emergency Response, 2011.

[22] United States Environmental Protection Agency, "Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance," Office of Resource Conservation and Recovery, 2009.

[23] Ramboll Americas Engineering Solutions, Inc., "35 I.A.C. § 845 Multi-Site Statistical Analysis Plan," 2025. [Online]. Available: Placeholder for URL.

TABLES

Table 1-1. 35 I.A.C. § 845 Requirements Checklist
Corrective Action Groundwater Monitoring Plan
Hennepin Power Plant
West Ash Pond System
Hennepin, IL

35 I.A.C. § 845 Reference	35 I.A.C. § 845 Components	Location of Information in Corrective Action GMP
845.630	**Groundwater Monitoring Systems**	
845.630(a)(2)	Potential contaminant pathways must be monitored.	NA
845.630(a) 845.630(b) 845.630(c)	At least two upgradient wells and four downgradient wells (min. 1 and 3, but requires additional documentation)	Section 2.1 Figure 2-1
845.630(a) 845.630(b) 845.630(c)	Downgradient Well Density	Figure 2-1
845.630(a)(2)	Downgradient wells at waste boundary	Figure 2-1
845.640	**Groundwater Sampling and Analysis Requirements**	
845.640(a)	Consistent sampling and analysis procedures	Section 2 Tables 2-1 and 2-3
845.640(b)	Methods are appropriate	Section 2 Tables 2-1 and 2-3
845.640(c)	Groundwater elevations must be measured in each well prior to purging, each time groundwater is sampled.	Section 2.2
845.640 (d)(e)(f)(g)(h)	Establishment of background and application of statistical methods	Section 2.7
845.640(i)	Analyze total recoverable metals	Sections 2.1 and Section 2.4
845.640(j)	Analyze groundwater samples using a certified laboratory	Section 2.4

Table 1-1. 35 I.A.C. § 845 Requirements Checklist
Corrective Action Groundwater Monitoring Plan
Hennepin Power Plant
West Ash Pond System
Hennepin, IL

35 I.A.C. § 845 Reference	35 I.A.C. § 845 Components	Location of Information in Corrective Action GMP
845.650	**Groundwater Monitoring Program**	
845.650(a)	Must include monitoring for all constituents with a groundwater protection standard in Section 845.600(a), calcium, and turbidity	Section 2.1
845.650(b)(c)	Groundwater Monitoring Frequency	Sections 2.1
845.650(d)(e)	Exceedances of the groundwater protection standard	Section 3.1.1
NA	Staff gauge/ piezometer to monitor head of neighboring surface water body	Section 1.3 Figure 1-4
845.680	**Implementation of the Corrective Action Plan**	
845.680(a)(1)(a)	Establish and implement a corrective action groundwater monitoring program that meets requirements of 845.650	Sections 2.3 and 3 Tables 2-1 and 3-1 Figure 2-1
845.680(a)(1)(b)	Document the effectiveness of the corrective action remedy	Section 3
845.680(a)(1)(c)	Demonstrate compliance with the groundwater protection standard under Subsection [845.680] (c)	Sections 3.11

Table 1-1. 35 I.A.C. § 845 Requirements Checklist
Corrective Action Groundwater Monitoring Plan
Hennepin Power Plant
West Ash Pond System
Hennepin, IL

35 I.A.C. § 845 Reference	35 I.A.C. § 845 Components	Location of Information in Corrective Action GMP
845.680(c)(1)	Demonstrate compliance with the groundwater protection standards established by 845.600 has been achieved at all points within the plume of contamination that lies beyond the waste boundary	Section 3
845.680(c)(2)	Demonstrate that concentrations of constituents listed in 845.600 have not exceeded the groundwater protection standards for a period of three consecutive years using statistical procedures and performance standards in 845.640(f) and (g)	Section 3

[O: CJC 08/17/21; C: LDC 08/30/21; U: MKC 07/16/24]

Notes:
GMP = Groundwater Monitoring Plan
NA = Not Applicable

Table 2-1. Summary of Monitoring Well Locations and Purpose
Corrective Action Groundwater Monitoring Plan
Hennepin Power Plant
West Ash Pond System
Hennepin, IL

Well ID	Monitored Unit	Corrective Action Monitoring Well System	
		Inside Plume	Plume Definition
21R	UA	X	
22	UA	X	
22D	UA		X
23	UA	X	
27	UA		X
35	UA	X	
50	UA		X
51	UA	X	

[O: JRK 11/26/2024; C: CJC 12/10/2024]

Notes:
UA = uppermost aquifer

Table 2-2. Monitoring Well Locations and Construction Details
Corrective Action Groundwater Monitoring Plan
Hennepin Power Plant
West Ash Pond System
Hennepin, IL

Location	HSU	Date Constructed	Top of PVC Elevation (ft)	Measuring Point Elevation (ft)	Measuring Point Description	Ground Elevation (ft)	Screen Top Depth (ft bgs)	Screen Bottom Depth (ft bgs)	Screen Top Elevation (ft)	Screen Bottom Elevation (ft)	Well Depth (ft bgs)	Bottom of Boring Elevation (ft)	Screen Length (ft)	Screen Diameter (inches)	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
21R	UA	02/06/2020	452.05	452.05	Top of PVC	449.37	37.6	47.6	411.77	401.77	50.0	399.4	10	2	41.299866	-89.328914
22	UA	12/09/1982	464.45	464.45	Top of PVC	461.46	24.4	34.4	437.06	427.06	34.6	426.9	10	2	41.302032	-89.321512
22D	UA	08/07/2019	465.43	465.43	Top of PVC	461.83	49.7	59.7	412.16	402.16	59.7	401.8	10	2	41.302017	-89.321572
23	UA	12/10/1982	463.39	463.39	Top of PVC	460.88	34.0	44.0	426.88	416.88	45.2	415.7	10	2	41.300881	-89.325376
27	UA	09/11/1995	450.58	450.58	Top of PVC	448.21	30.0	35.0	418.21	413.21	36.3	412.0	5	2	41.296911	-89.328898
35	UA	09/08/1999	454.83	454.83	Top of PVC	451.51	8.0	18.0	443.51	433.51	17.6	433.9	10	2	41.29916	-89.324145
50	UA	08/07/2019	463.94	463.94	Top of PVC	460.59	19.6	29.6	440.99	430.99	29.6	430.6	10	2	41.302243	-89.320647
51	UA	02/04/2020	464.80	464.80	Top of PVC	461.50	56.0	66.0	405.50	395.50	66.3	394.5	10	2	41.300639	-89.326953

Notes:
All elevation data are presented relative to the North American Vertical Datum 1988 (NAVD88), GEOID 12A
bgs = below ground surface
ft = foot or feet
HSU = Hydrostratigraphic Unit
PVC = polyvinyl chloride
UA = uppermost aquifer

Table 2-3. Sampling and Analysis Summary
Corrective Action Groundwater Monitoring Plan
Hennepin Power Plant
West Ash Pond System
Hennepin, IL

Parameter	Analytical Method [1]	Number of Samples	Field Duplicates [2]	Field Blanks [3]	Equipment Blanks [3]	MS/MSD [4]	Total	Container Type	Minimum Volume [5]	Preservation (Cool to 6 °C for all samples)	Sample Hold Time from Collection Date
Corrective Action Parameter(s)[6]											
Arsenic	6020 [7]	8	1	0	0	1	10	plastic	600 mL	HNO_3 to pH<2	6 months
Boron	6020 [7]	8	1	0	0	1	10	plastic	600 mL	HNO_3 to pH<2	6 months
Lithium	EPA 200.7	8	1	0	0	1	10	plastic	600 mL	HNO_3 to pH<2	6 months
Sulfate	9056A, 9251 or EPA 300	8	1	0	0	1	10	plastic	50 mL	Cool to 6 °C	28 days
Total Dissolved Solids	SM 2540 C	8	1	0	0	1	10	plastic	200 mL	Cool to 6 °C	7 days
Inorganic Parameters											
Alkalinity, bicarbonate	SM 2320 B	8	1	0	0	1	10	plastic	500 mL	Cool to 6 °C	14 days
Alkalinity, carbonate	SM 2320 B	8	1	0	0	1	10	plastic	500 mL	Cool to 6 °C	14 days
Chloride	9056A, 9251 or EPA 300	8	1	0	0	1	10	plastic	100 mL	Cool to 6 °C	28 days
Fluoride	9056A, 9251 or EPA 300	8	1	0	0	1	10	plastic	300 mL	Cool to 6 °C	28 days
Magnesium	6020 [7]	8	1	0	0	1	10	plastic	600 mL	HNO_3 to pH<2	6 months
Sodium	6020 [7]	8	1	0	0	1	10	plastic	600 mL	HNO_3 to pH<2	6 months
Potassium	6020 [7]	8	1	0	0	1	10	plastic	600 mL	HNO_3 to pH<2	6 months
Field Parameters											
pH	SM 4500-H+ B	8	NA	NA	NA	NA	8	flow-through cell	NA	none	immediately
Dissolved Oxygen [8]	SM 4500-O/405.1	8	NA	NA	NA	NA	8	flow-through cell	NA	none	immediately
Temperature [8]	SM 2550	8	NA	NA	NA	NA	8	flow-through cell	NA	none	immediately
Oxidation/Reduction Potential [8]	SM 2580 B	8	NA	NA	NA	NA	8	flow-through cell	NA	none	immediately
Specific Conductance [8]	SM 2510 B	8	NA	NA	NA	NA	8	flow-through cell	NA	none	immediately
Turbidity [9]	SM 2130 B	8	NA	NA	NA	NA	8	flow-through cell or hand-held turbidity meter	NA	none	immediately

[O: JRK 11/26/2024; C: CJC 12/10/2024]

Notes:
[1] Analytical method numbers are from SW-846 unless otherwise indicated. Analytical methods may be updated with more recent versions as appropriate.
[2] Field duplicates will be collected at a frequency of one per group of 10 or fewer investigative water samples. Field duplicates will not be collected for radium analysis.
[3] Field blanks will be collected at the discretion of the project manager; Equipment blanks will be collected at a rate of 1 per sampling event if non-dedicated equipment is used.
[4] Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples will be collected at a frequency of one per group of 20 or fewer investigative water samples per CCR unit/multi-unit. Additional volume to be determined by laboratory.
[5] Sample volume is estimated and will be determined by the laboratory.
[6] Determined by reported exceedances under the Operating Groundwater Monitoring Plan
[7] Metals may be analyzed via USEPA methods 6010 or 6020 depending on laboratory instrument availability.
[8] Parameter collected for quality assurance and quality control for field sampling purposes only; not required to be collected or reported under 35 IAC § 845; collection of parameter may be discontinued without notification.
[9] If turbidity exceeds 10 NTU, a duplicate sample filtered through a 0.45 micron filter may be collected for metals analysis in addition to the unfiltered sample. Both samples would be submitted for analysis.
< = less than
°C = degrees Celsius
HNO_3 = nitric acid
mL = milliliter
NA = not applicable
NTU = nephelometric turbidity unit

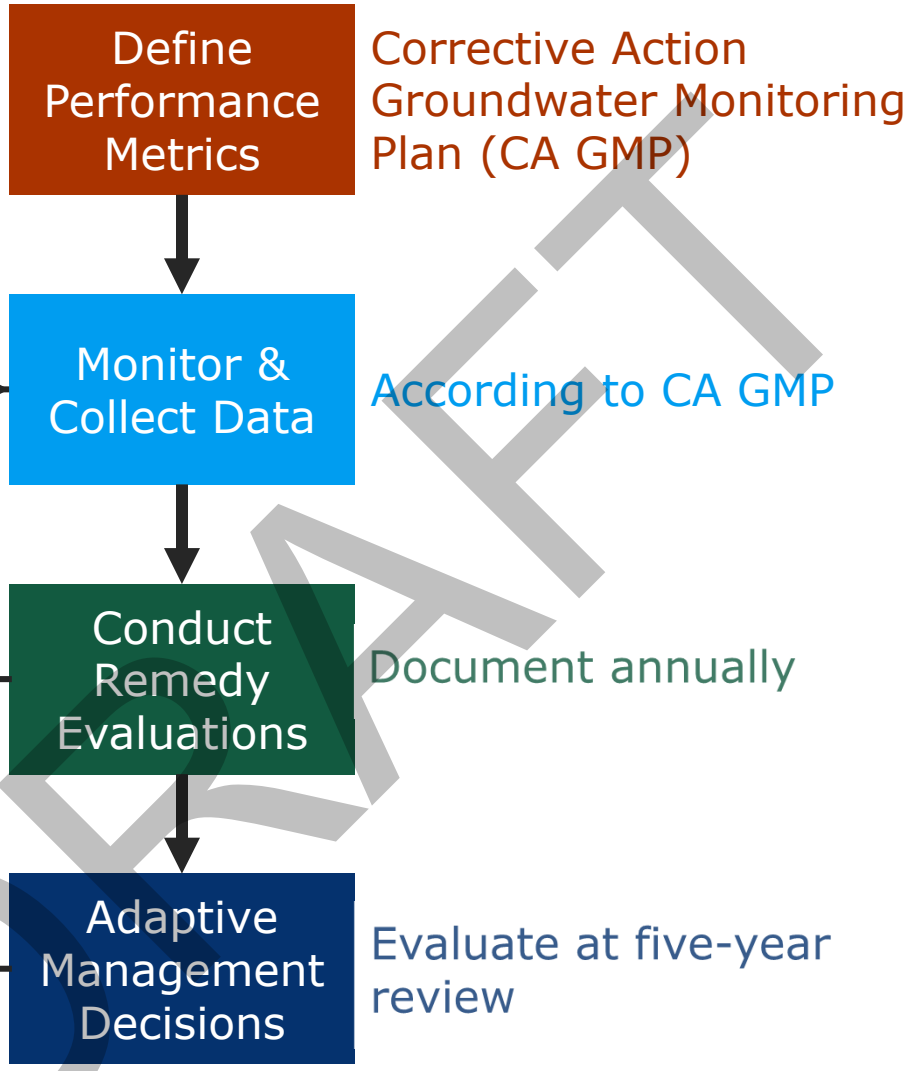
Table 3-1. Adaptive Site Management Metrics and Trigger Criteria
Corrective Action Groundwater Monitoring Plan
Hennepin Power Plant
West Ash Pond System
Hennepin, IL

QUESTION	Are COC concentrations greater than the GWPS?		Are concentrations of COCs at individual wells consistent with modeling expectations?[a]		Are the average COC concentrations decreasing?	Are concentrations of COCs at individual wells changing?	Adaptive Site Management Outcome
EVALUATION[b]	Compare data points or summary statistics to site-specific GWPS		Do the observed results track with the predicted results in general direction and magnitude? (Professional judgement)		Evaluate trend on quarterly average of well concentrations, both for last 8 data points and since corrective action initiated or closure completed	Evaluate trend of COCs at each well, both for last 8 data points and since corrective action initiated	
Inside Plume	Central tendency concentration of last eight data points above the GWPS	**AND**	Results inconsistent with model	**AND MORE THAN ONE OF**	Neither trend decreasing	Neither trend decreasing	**Additional Evaluation Triggered (See Figure 3-2)**
Lateral/Vertical Plume Definition	Central tendency concentration of last eight data points above the GWPS		Results inconsistent with model		--	Either trend increasing	

[O: CJC 10/23/2024; C: AOC 10/30/2024]

Notes:
a. Only applies to wells included in the flow and transport model
b. To be documented in Annual Monitoring and Corrective Action Reports
-- = No relevant trigger criteria
COC = constituent of concern
GWPS = groundwater protection standard

FIGURES



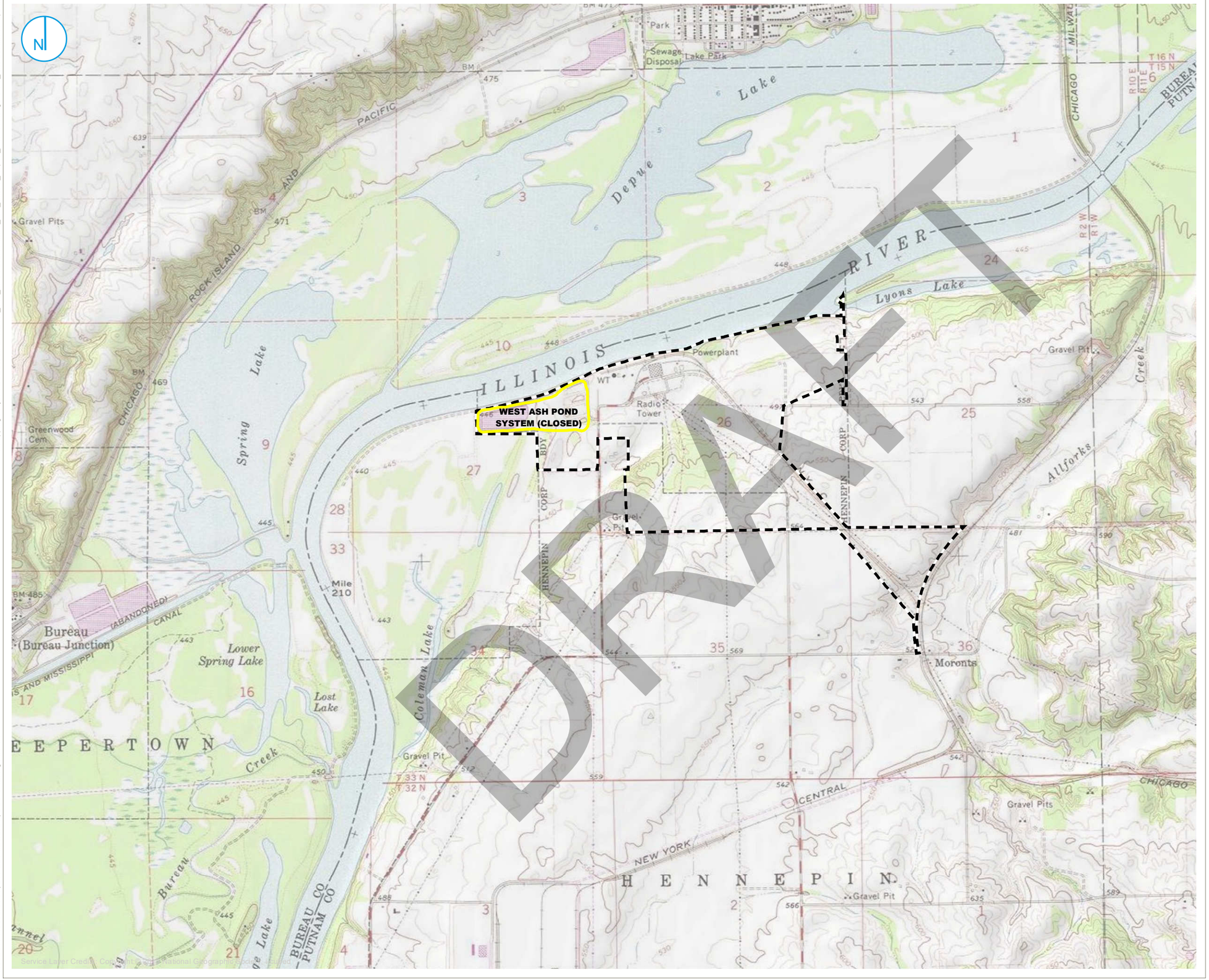
RAMBOLL

DRAFTED BY: AO | 11/27/2024

CORRECTIVE ACTION MONITORING OUTLINE

CORRECTIVE ACTION GROUNDWATER MONITORING PLAN
HENNEPIN POWER PLANT
WEST ASH POND SYSTEM
HENNEPIN, ILLINOIS

Figure 1-1



REGULATED UNIT (SUBJECT UNIT)

PROPERTY BOUNDARY

0 1,000 2,000 Feet

SITE LOCATION MAP

CORRECTIVE ACTION
GROUNDWATER MONITORING REPORT
WEST ASH POND SYSTEM
HENNEPIN POWER PLANT
HENNEPIN, ILLINOIS

FIGURE 1-2

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

PROJECT: 169000XXXX | DATED: 4/23/2024 | DESIGNER: galammo

Y:\Mapping\Projects\22\2285\MXD\Nature_and_Extent\HEN\Nature_and_Extent_Report_Hen\West\Figure 1-1_Site Location Map.mxd

MONITORING WELL
REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
LIMITS OF FINAL COVER
PROPERTY BOUNDARY

0 200 400
Feet

SITE MAP

CORRECTIVE ACTION
GROUNDWATER MONITORING REPORT
WEST ASH POND SYSTEM
HENNEPIN POWER PLANT
HENNEPIN, ILLINOIS

FIGURE 1-3

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

Y:\Mapping\Projects\22\12285\MXD\GMP\Hennepin\OWAP_804\845_CorrectiveAction\HEN_804_845CA.aprx\Figure 1-3. Site Map

PROJECT: 169000XXXX | DATED: 12/10/2024 | DESIGNER: GALARNMC

- COMPLIANCE MONITORING WELL
- BACKGROUND MONITORING WELL
- MONITORING WELL
- GROUNDWATER ELEVATION CONTOUR (1 FT CONTOUR INTERVAL, NAVD88)
- INFERRED GROUNDWATER ELEVATION CONTOUR
- GROUNDWATER FLOW DIRECTION
- REGULATED UNIT (SUBJECT UNIT)
- LIMITS OF FINAL COVER
- PROPERTY BOUNDARY

NOTES:

1.ELEVATIONS IN PARENTHESES WERE NOT USED FOR CONTOURING.

2. ELEVATION CONTOURS SHOWN IN FEET, NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

*ILLINOIS RIVER ELEVATION OBTAINED FROM STAFF GAGE SG02, LOCATED AT THE HENNEPIN POWER PLANT

0 200 400 Feet

UPPERMOST AQUIFER POTENTIOMETRIC SURFACE MAP MAY 30, 2023 (E001)

CORRECTIVE ACTION
GROUNDWATER MONITORING REPORT
WEST ASH POND SYSTEM
HENNEPIN POWER PLANT
HENNEPIN, ILLINOIS

FIGURE 1-4

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

MONITORING WELL
REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
LIMITS OF FINAL COVER
PROPERTY BOUNDARY
XXX CORRECTIVE ACTION - INSIDE PLUME: DOWNGRADIENT OF CUTOFF WALL
XXX CORRECTIVE ACTION - LATERAL/VERTICAL PLUME DEFINITION

0 200 400 Feet

PROPOSED 35 I.A.C. § 845 CORRECTIVE ACTION MONITORING WELL LOCATION MAP

CORRECTIVE ACTION
GROUNDWATER MONITORING REPORT
WEST ASH POND SYSTEM
HENNEPIN POWER PLANT
HENNEPIN, ILLINOIS

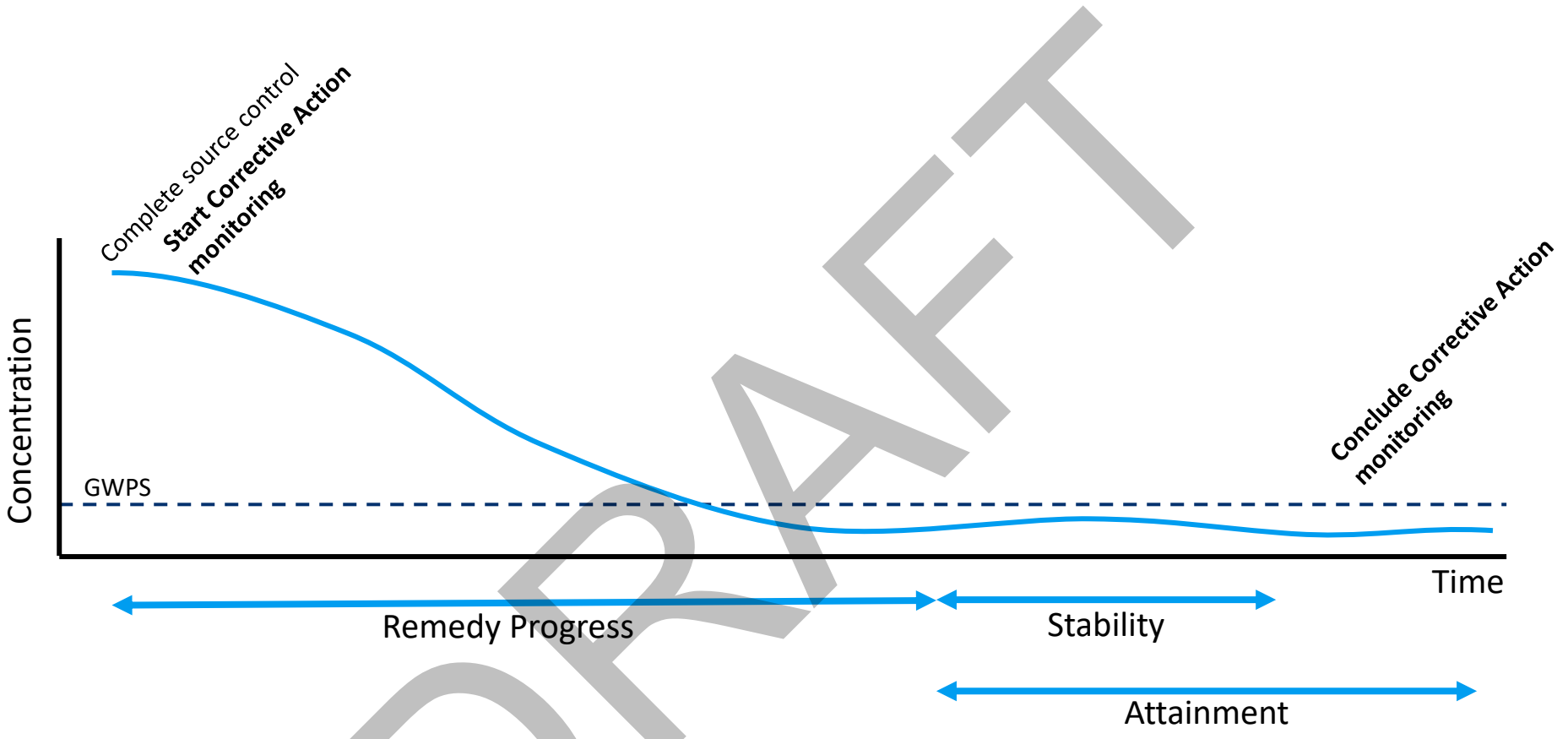
FIGURE 2-1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

Y:\Mapping\Projects\222285\MXD\GMP\Hennepin\OWAP_8041845_CorrectiveAction\HEN_804_845CA.aprx\Figure 2-1. Proposed 845 CA Monitoring Well Location Map

PROJECT: 169000XXXX | DATED: 12/11/2024 | DESIGNER: GALARNMC



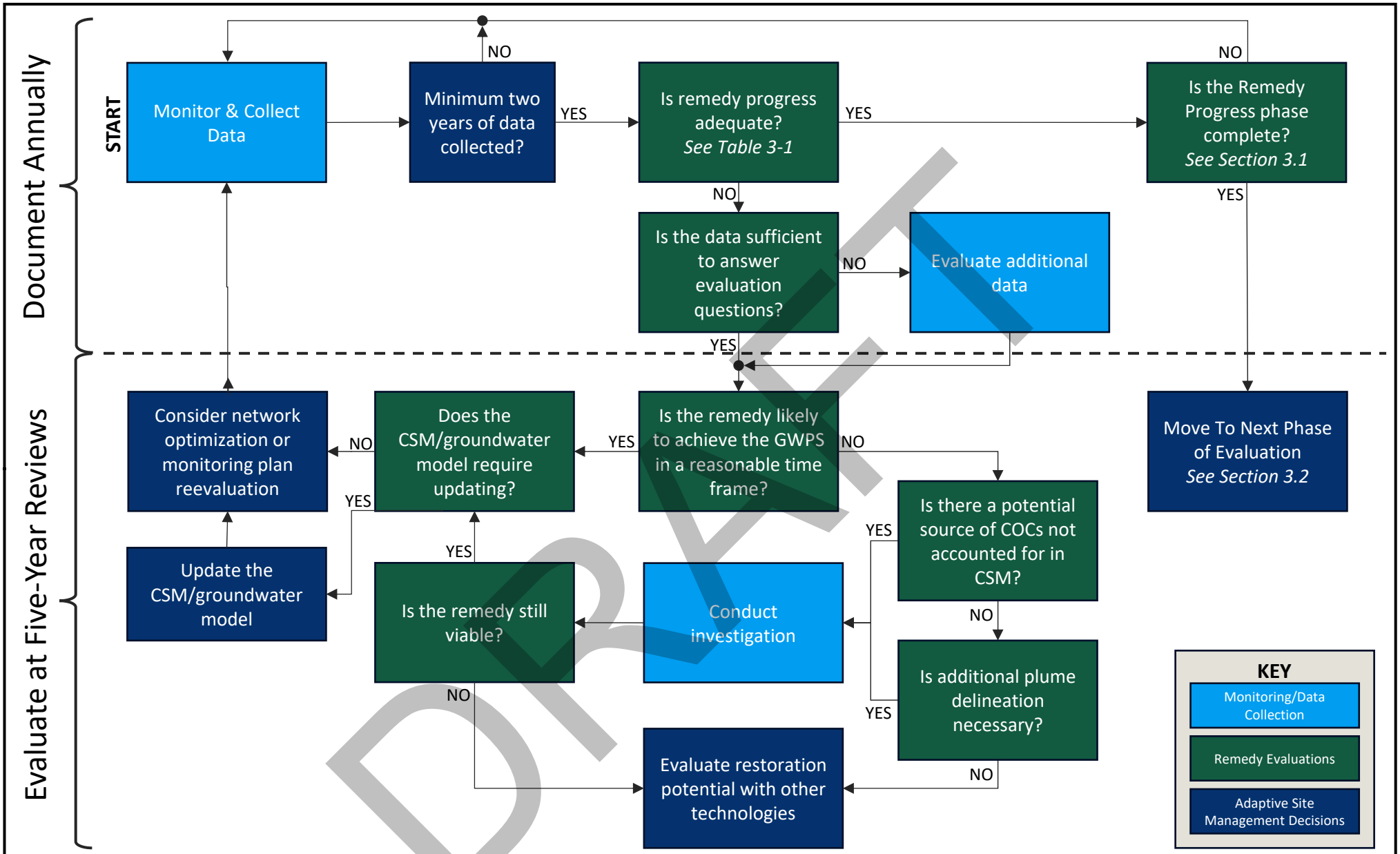
RAMBOLL

DRAFTED BY: AO | 11/27/2024

CORRECTIVE ACTION MONITORING TIMELINE

CORRECTIVE ACTION GROUNDWATER MONITORING PLAN
HENNEPIN POWER PLANT
WEST ASH POND SYSTEM
HENNEPIN, ILLINOIS

Figure 3-1



Adapted from Figure 2 in USEPA (2014) *"Groundwater Remedy Completion Strategy: Moving Forward with the End in Mind,"* Office of Solid Waste and Emergency Response. 9200.2-144. May. https://semspub.epa.gov/work/HQ/100000021.pdf

RAMBOLL

DRAFTED BY: AO | 11/27/2024

ADAPTIVE SITE MANAGEMENT FLOW CHART

CORRECTIVE ACTION GROUNDWATER MONITORING PLAN
HENNEPIN POWER PLANT
WEST ASH POND SYSTEM
HENNEPIN, ILLINOIS

Figure 3-2

APPENDICES

Geosyntec consultants

1 McBride and Sons Center Dr
Suite 202
Chesterfield, MO 63005

GS FORM: WELL BORE 01/04

BOREHOLE LOG

BORING	**MW-21R**	**SHEET**	**1 OF 2**
START DRILL DATE	February 5, 2020	**ELEVATION DATA:**	
FINISH DRILL DATE	February 5, 2020	**GROUND SURF. (Ft)**	449.37
LOCATION	PUTNAM COUNTY, HENNEPIN IL	**TOP OF CASING (Ft)**	452.05
PROJECT	HENNEPIN POWER STATION	**DATUM**	NAVD 1988
NUMBER	CHE8400		

DEPTH (ft-bgs)	DESCRIPTION 1) Unit/Formation, Mem. 2) USCS Name 3) Color 4) Moisture 5) Percent Grain Size 6) Plasticity 7) Density/Consistency 8) Structure 9) Other (Mineralization, Discoloration, Odor, etc.)	GRAPHIC LOG	WELL LOG	GROUNDWATER OR STRUCTURE	ELEVATION (ft)	SAMPLE NO.	TYPE	BLOW COUNT	N-Value	RECOVERY (%)	COMMENTS 1) Rig Behavior 2) Air Monitoring
0	Red brown, sandy gravel, GP, fill material					01		3 4 3 3	7	9/24	
						02		10 4 4 3	8	12/24	
	@ 4 ft wet				445			8			
5						03		4 4 3	8	8/24	
	@ 7.2 ft Dark gray, fly ash, ML, non-plastic, non-cohesive					04		1 0 0 1	0	12/24	
	@ 8 ft damp, medium soft					05		1 1 2 2	3	18/24	
10					440						
						06		1 1 1 1	2	14/24	
	No recovery					07		0 1 1 2	2	0/24	
	No recovery										
15					435	08		0 1 1 2	2	24/24	
	Gray/brown, silty clay, CL, medium plasticity, medium soft					09		0 1 2 2	3	24/24	
	Dark gray/black, diatomaceous, silty clay, CL, medium plasticity				430	10		0 0 1 2	1	24/24	
20	Dark gray, clay, CH, high plasticity, cohesive, medium soft, damp					11		0 0 2 2	2	24/24	
	Dark gray, silty clay, CL, medium low plasticity, medium soft, damp					12		0 1 1 2	2	20/24	
	@ 24 ft medium plasticity				425						
25						13		0 1 1 2	2	24/24	
						14		1 1 1 2	2	24/24	
	@ 28 ft diatomaceous							2 2 2 2			
30					420	15		2	4	24/24	

CONTRACTOR TSC
EQUIPMENT CME 75
DRILL MTHD HOLLOWSTEM AUGER
DIAMETER 6-inch
LOGGER C. CHRISTENSON
REVIEWER L. CARR

NORTHING 1688527.77
EASTING 2526767.44
COORDINATE SYSTEM: STATE PLANE ILLINOIS WEST

NOTES:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Geosyntec consultants

1 McBride and Sons Center Dr
Suite 202
Chesterfield, MO 63005

GS FORM: WELL BORE 01/04

BOREHOLE LOG

BORING	**MW-21R**	**SHEET**	**2 OF 2**
START DRILL DATE	February 5, 2020	**ELEVATION DATA:**	
FINISH DRILL DATE	February 5, 2020	**GROUND SURF. (Ft)**	449.37
LOCATION	PUTNAM COUNTY, HENNEPIN IL	**TOP OF CASING (Ft)**	452.05
PROJECT	HENNEPIN POWER STATION	**DATUM**	NAVD 1988
NUMBER	CHE8400		

DEPTH (ft-bgs)	DESCRIPTION 1) Unit/Formation, Mem. 6) Plasticity 2) USCS Name 7) Density/Consistency 3) Color 8) Structure 4) Moisture 9) Other (Mineralization, Discoloration, Odor, etc.) 5) Percent Grain Size	GRAPHIC LOG	WELL LOG	GROUNDWATER OR STRUCTURE	ELEVATION (ft)	SAMPLE NO.	TYPE	BLOW COUNT	N-Value	RECOVERY (%)	COMMENTS 1) Rig Behavior 2) Air Monitoring
	@ 31 ft fine sand lenses					16		0 1 1 2	2	24/24	
	Dark gray, diatomaceous silt with few clay, MH, soft, damp, low plasticity					17		1 1 1 2	2	24/24	
35	Dark gray, diatomaceous, silty clay, CL, medium plasticity, medium soft, damp				415	18		1 1 2 2	3	24/24	
	Dark gray, diatomaceous, silt with few clay and trace sand, MH, soft, damp, low plasticity					19		0 0 1 1	1	24/24	
	Dark gray, diatomaceous, silt with some clay, MH, medium-low plasticity, soft, damp				410	20		2 2 2 2	4	24/24	
40	Dark gray, silty sand, SM, wet					21		0 0 1 2	1	8/24	
	@ 41.5 ft, Dark Gray silty clay, CL, medium plasticity										
	Gray medium to fine sand, SP, with silty clay layer (CL), wet					22		2 3 4 4	7	24/24	
	@ 44 ft with trace clay and coarse sand				405						
45						23		3 5 3 5	8	24/24	
	Gray, fine sand, SP, with few coarse sand and some silt, medium soft, wet					24		6 9 10 12	19	24/24	
	Dark gray, silty clay, CL, medium plasticity, medium soft, damp				400	25		0 1 1 2	2	18/24	
50	End of boring at 50 ft.										
					395						
55											
					390						
60											

CONTRACTOR TSC
EQUIPMENT CME 75
DRILL MTHD HOLLOWSTEM AUGER
DIAMETER 6-inch
LOGGER C. CHRISTENSON
REVIEWER L. CARR

NORTHING 1688527.77
EASTING 2526767.44
COORDINATE SYSTEM: STATE PLANE ILLINOIS WEST

NOTES:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

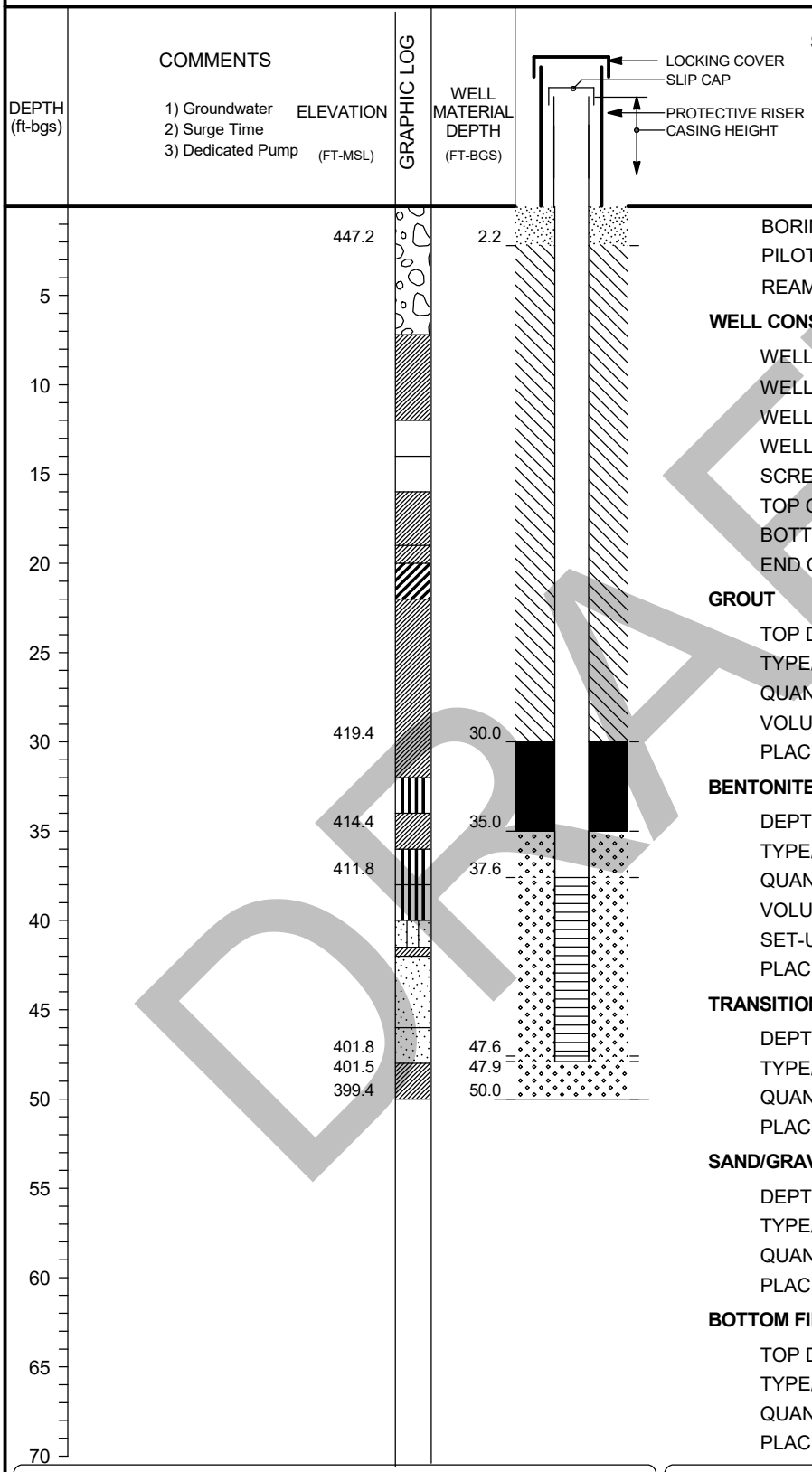
Geosyntec consultants

1 McBride and Sons Center Dr
Suite 202
Chesterfield, MO 63005

BORING	**MW-21R**	**SHEET**	**1 OF 1**
START DRILL DATE	February 5, 2020	**ELEVATION DATA:**	
FINISH DRILL DATE	February 5, 2020	**GROUND SURF. (Ft)**	449.37
LOCATION	PUTNAM COUNTY, HENNEPIN IL	**TOP OF CASING (Ft)**	452.05
PROJECT	HENNEPIN POWER STATION	**DATUM**	NAVD 1988
NUMBER	CHE8400		

GS FORM: WELL COMP AG 01/04

WELL CONSTRUCTION LOG



SURFACE COMPLETION:

TYPE	3-inch diameter steel
RISER HEIGHT	2.8-ft ags
RISER DIAM.	3-inch
WELL CASING HEIGHT	2.6-ft ags
CONCRETE PAD SIZE	
BORING DEPTH	50-ft bgs
PILOT BORING DIAMETER	6-inch
REAM BORING DIAMETER	

WELL CONSTRUCTION

WELL CONSTRUCTION DATE	2/6/2020
WELL DEPTH	47.9 ft bgs
WELL CASING DIAMETER	2-inch
WELL CASING MATERIAL	Sch. 40 PVC
SCREEN SLOT SIZE/DIRECTION	0.01-inch
TOP OF SCREEN	37.6 ft bgs
BOTTOM OF SCREEN	47.6 ft bgs
END CAP/SUMP LENGTH	0.33 ft

GROUT

TOP DEPTH	2.2 ft bgs
TYPE/BRAND	Portland Cement/Quickgel
QUANTITY USED	150lbs cement/40 lbs gel
VOLUME FLUID USED	45 Gal
PLACEMENT METHOD	Pump

BENTONITE SEAL

DEPTH	30 ft bgs
TYPE/BRAND	3/8-inch bentonite pellets
QUANTITY USED	
VOLUME FLUID USED	None
SET-UP TIME	
PLACEMENT METHOD	Hand

TRANSITION SAND

DEPTH	
TYPE/BRAND	
QUANTITY USED	
PLACEMENT METHOD	

SAND/GRAVEL PACK

DEPTH	35 ft bgs
TYPE/BRAND	R.W. Sidley, Inc # 5 Sand
QUANTITY USED	~150 lbs
PLACEMENT METHOD	Hand

BOTTOM FILL

TOP DEPTH	
TYPE/BRAND	
QUANTITY USED	
PLACEMENT METHOD	

CONTRACTOR	TSC	**NORTHING**	1688527.77
EQUIPMENT	CME 75	**EASTING**	2526767.44
DRILL MTHD	HOLLOWSTEM AUGER	**COORDINATE SYSTEM:**	
DIAMETER	6-inch		STATE PLANE ILLINOIS WEST
LOGGER	C. CHRISTENSON	**REVIEWER**	L. CARR

Notes

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

PROJECT Hydrogeologic Study
Hennepin Power Plant
JOB NO. 82-1293

BORING W-2
SHEET 1 OF 1

22

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL AND TYPE	SAMPLE ADVANCED / RECOVERED (in)	SEE REMARK #	DESCRIPTION OF MATERIALS (Color Modifier MATERIAL. Classification)	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)
					Soil Classification System Unified Surface Elevation 461.4'		
	1	AS			Brown Sandy CLAY, CL		
5	2	SS	18/9		Gray - Brown Silty CLAY Trace Sand, CL	3-5-5	
10	3	SS	18/16		Brown Fine SAND w/Silt Trace Gravel, SM	5-7-5	
15	4	SS	18/16		Gray-Brown GRAVEL w/Sand Trace Clay, GP	19-20-28	
20	5	SS	18/18			17-27-38	
25	6	SS	18/13		-Coal @ 25.4'	23-18-12	
					Brown Fine SAND, SP		
30	7	SS	18/15		Brown GRAVEL w/Sand Trace Clay, GP-GC	6-11-11	
35	8	SS	18/6		TOB	0-4-6	

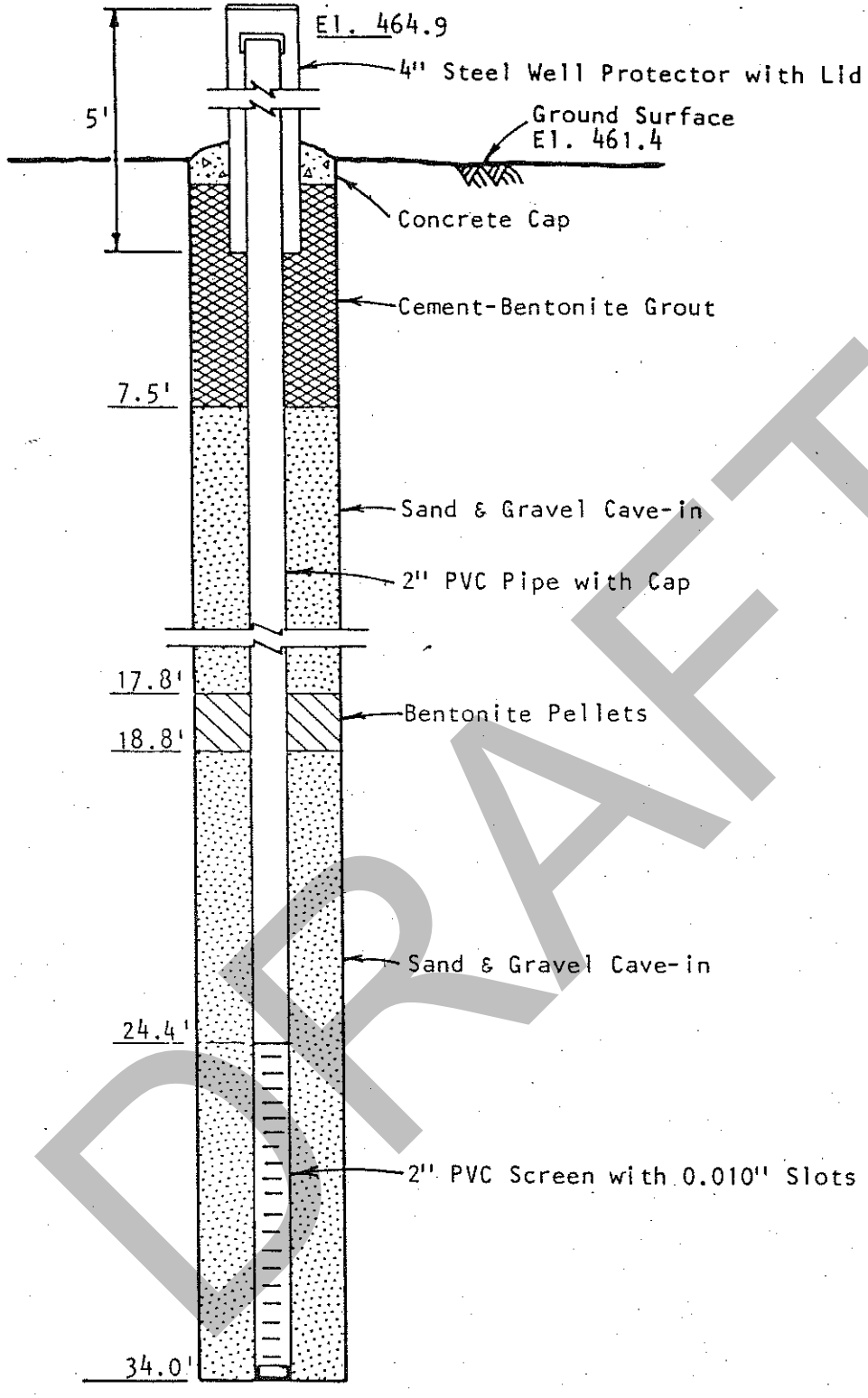
Shear Strength, tsf
SV△ QP/2□ QU/2○
0 ½ 1 1½ 2 2½
PL + NMC • LL x
0 50 100
Rock Quality Designation
0 50 100

DRILLING METHOD Hollow Auger
DATE DRILLED 12/9/82
DRILLED BY Roberts
LOGGED BY Maxeiner
PIEZOMETER Yes

GROUNDWATER LEVELS
Encountered at 8.0 Feet
___ Hours after completion ___ Feet
6 Days after completion 8.0 Feet
___ after completion ___ Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.

John Mathes & Associates, Inc.



6" Borehole to Termination Depth

Not to Scale

22

PIEZOMETER W-2

SOIL BORING LOG INFORMATION

RAMBOLL

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Hennepin Power Station - Hennepin West Delineation		22D

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Jeff Croel Mateco Drilling	8/6/2019	8/7/2019	Mini Sonic

Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
22D	Feet (NAVD88)	461.83 Feet (NAVD88)	6.0 inches

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

State Planel ,689,328.25 N, 2,528,778.84 E E/W

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

Lat 41° 18' 7.2341"

Long -89° 19' 17.6376"

Local Grid Location

Feet ☐N ☐S Feet ☐E ☐W

Facility ID	County	State	Civil Town/City/ or Village
	Putnam	Illinois	Hennepin

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID 10.6 eV Lamp	Soil Properties: Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1 CS	60 / 54		0	0 - 1.8' **TOPSOIL:** (ML)s, brown, little fine sand.										
			1	1' - 1.8' gray.	(ML)s									
			2	1.8 - 4.75' **SANDY SILT WITH GRAVEL:** to **SILTY SAND WITH GRAVEL:** s(ML)g, yellowish brown, fine sand, coarse gravel, dry.										
			3		s(ML)g									
			4											
2 CS	120 / 84		5	4.75 - 7.6' **LEAN CLAY:** CL, brownish gray, trace subangular gravel, hard, low plasticity, dry.										
			6		CL									
			7											
			8	7.6 - 17' **POORLY-GRADED GRAVEL WITH SAND:** (GP)s, yellowish brown, coarse gravel to cobbles, dense, dry.										
			9											
			10		(GP)s									
			11											
			12											

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

Signature SH WK

Firm Ramboll
234 W. Florida St., Fifth Floor, Milwaukee, WI 53204
Tel: (414) 837-3607
Fax: (414) 837-3608

RAMBOLL

Boring Number 22D

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID 10.6 eV Lamp	Soil Properties: Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			13	7.6 - 17' **POORLY-GRADED GRAVEL WITH SAND:** (GP)s, yellowish brown, coarse gravel to cobbles, dense, dry. *(continued)*										
			14											
3 CS	120 78		15	15' '- 17' brown, cobbles to gravel.	(GP)s									
			16											
			17	17 - 18' **POORLY-GRADED SAND:** SP, brown, fine to medium sand.	SP									
			18	18 - 25' **POORLY-GRADED GRAVEL WITH SAND:** (GP)s, brown, coarse gravel to cobbles, dense, dry.										
			19											
			20											
			21		(GP)s									
			22											
			23											
			24											
4 CS	120 48		25	25 - 27' **POORLY-GRADED SAND WITH GRAVEL:** (SP)g, brown, fine to medium sand, wet.										
			26		(SP)g									
			27	27 - 39' **POORLY-GRADED GRAVEL WITH SAND:** (GP)s, brown, cobbles to gravel.										
			28											
			29											
			30		(GP)s									
			31											
			32											

RAMBOLL

Boring Number 22D

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID 10.6 eV Lamp	Soil Properties: Compressive Strength (tsf)	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			33	27 - 39' **POORLY-GRADED GRAVEL WITH SAND:** (GP)s, brown, cobbles to gravel. *(continued)*										
			34											
5 CS	120 72		35											
			36		(GP)s									
			37											
			38											
			39	39 - 60' **POORLY-GRADED SAND:** SP, brown, fine sand, wet.										
			40											
			41											
			42											
			43											
			44											
6 CS	120 120		45		SP									
			46											
			47											
			48											
			49											
			50											
			51											
			52											

RAMBOLL

Boring Number 22D

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID 10.6 eV Lamp	Soil Properties: Compressive Strength (tsf)	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
7 CS	60 60		53 54 55 56 57 58 59 60	39 - 60' **POORLY-GRADED SAND:** SP, brown, fine sand, wet. *(continued)*	SP									
				60' End of Boring.										

RAMBOLL

MONITORING WELL CONSTRUCTION

Facility/Project Name: Hennepin Power Station - Hennepin West Delineation

Facility License, Permit or Monitoring No.:

Facility ID:

Type of Well: mw

Distance from Waste/Source: ft.

State: Illinois

Local Grid Location of Well: ☐ N. ☐ S. ft. ☐ E. ☐ W.

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

Lat. 41° 18' 7.234" Long. -89° 19' 17.638" or

St. Plane 1,689,328.25 ft. N, 2,528,778.84 ft. E. E/Ⓦ

Section Location of Waste/Source: ☐ E ☐ W

1/4 of 1/4 of Sec. , T. N, R.

Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☐ Downgradient n ☐ Not Known

Gov. Lot Number:

Well Name: 22D

Date Well Installed: 08/07/2019

Well Installed By: (Person's Name and Firm): Jeff Croel; Mateco Drilling

A. Protective pipe, top elevation 465.56 ft. MSL

B. Well casing, top elevation 465.43 ft. MSL

C. Land surface elevation 461.83 ft. MSL

D. Surface seal, bottom 461.1 ft. MSL or 0.8 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☒
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis attached? ☐ Yes ☒ No

14. Drilling method used: Rotary ☐ Hollow Stem Auger ☐ Sonic Other ☒

15. Drilling fluid used: Water ☒ 0 2 Air ☐ Drilling Mud ☐ 0 3 None ☐

16. Drilling additives used? ☐ Yes ☒ No

Describe

17. Source of water (attach analysis, if required): Distilled

E. Bentonite seal, top 416.8 ft. MSL or 45.0 ft.

F. Fine sand, top ft. MSL or ft.

G. Filter pack, top 414.3 ft. MSL or 47.5 ft.

H. Screen joint, top 412.2 ft. MSL or 49.7 ft.

I. Well bottom 402.2 ft. MSL or 59.7 ft.

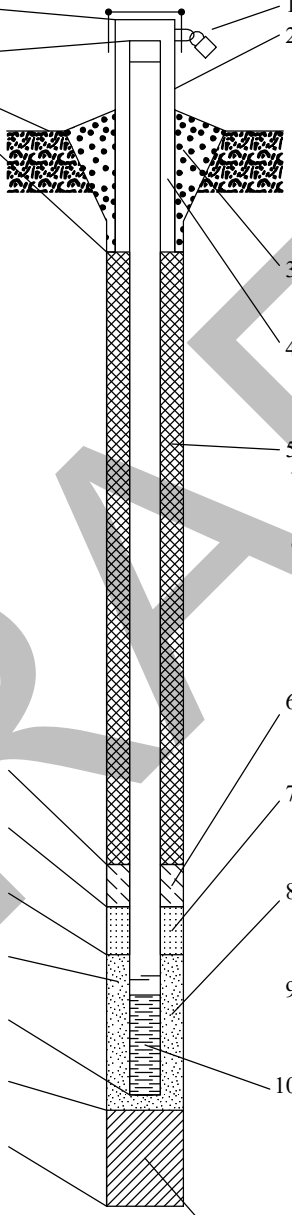
J. Filter pack, bottom 402.2 ft. MSL or 59.7 ft.

K. Borehole, bottom 401.8 ft. MSL or 60.0 ft.

L. Borehole, diameter 6.0 in.

M. O.D. well casing 2.38 in.

N. I.D. well casing 2.07 in.



1. Cap and lock? ☒ Yes ☐ No
2. Protective cover pipe:
   a. Inside diameter: 4.0 in.
   b. Length: 5.0 ft.
   c. Material: Steel ☒ Other ☐
   d. Additional protection? ☒ Yes ☐ No
   If yes, describe: 3 Steel Bollards
3. Surface seal: Bentonite ☐ Concrete ☒ Other ☐
4. Material between well casing and protective pipe: Bentonite ☐ Sand Other ☒
5. Annular space seal: a. Granular/Chipped Bentonite ☒
   b. Lbs/gal mud weight . . . Bentonite-sand slurry ☐
   c. 9.5 Lbs/gal mud weight . . . Bentonite slurry ☒
   d. % Bentonite . . . Bentonite-cement grout ☐
   e. 7.8 Ft^3 volume added for any of the above
   f. How installed: Tremie ☐ Tremie pumped ☒ Gravity ☐
6. Bentonite seal: a. Bentonite granules ☐
   b. ☐ 1/4 in. ☒ 3/8 in. ☐ 1/2 in. Bentonite chips ☒
   c. Other ☐
7. Fine sand material: Manufacturer, product name & mesh size
   a.
   b. Volume added ft^3
8. Filter pack material: Manufacturer, product name & mesh size
   a. K & E Well Gravel
   b. Volume added 2.1 ft^3
9. Well casing: Flush threaded PVC schedule 40 ☒ Flush threaded PVC schedule 80 ☐ Other ☐
10. Screen material: Schedule 40 PVC
    a. Screen Type: Factory cut ☒ Continuous slot ☐ Other ☐
    b. Manufacturer Johnson
    c. Slot size: 0.010 in.
    d. Slotted length: 10.0 ft.
11. Backfill material (below filter pack): None ☒ collapsed formation materials Other ☐

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

Date Modified: 11/19/2019

Signature: SH WL

Firm: Ramboll
234 W. Florida Street, Floor 5, Milwaukee, WI 53204
Tel: (414) 837-3607
Fax: (414) 837-3608

RECORD OF SUBSURFACE EXPLORATION

PROJECT Hydrogeologic Study
Hennepin Power Plant
JOB NO. 82-1293

BORING W-3 (23)
SHEET 1 OF 2

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL AND TYPE	SAMPLE ADVANCED / RECOVERED (in)	SEE REMARK #	DESCRIPTION OF MATERIALS	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)
					(Color Modifier MATERIAL. Classification) Soil Classification System Unified Surface Elevation 460.2'		
	1	AS			Brown Sandy CLAY w/Gravel, Fill, CL		
					Dark Gray FLYASH w/Bottom Ash, FILL, ML		
-5-	2	SS	18/18			7-9-8	
					Dark Gray BOTTOM ASH, FILL, ML		
-10-	3	SS	18/14			7-17-16	
-15-	4	SS	18/12			7-7-5	
					Dark Gray Silty CLAY, CL		
-20-	5	SS	18/15			1-1-1	
-25-	6	SS	18/16			WH-2-1	
					Dark Gray CLAY w/Silt Trace Sand, Shells, OH		
-30-	7	SS	18/18			WH-2-2	
					Brown GRAVEL w/Sand Trace Clay, GP-GC		
-35-	8	SS	18/10			8-19-16	

Shear Strength, tsf
SV△ QP/2□ QU/2○
0 ½ 1 1½ 2 2½
PL + NMC • LL x
0 50 100
Rock Quality Designation
0 50 100

DRILLING METHOD Hollow Auger
DATE DRILLED 12/10/82
DRILLED BY Roberts
LOGGED BY Maxeiner
PIEZOMETER Yes

GROUNDWATER LEVELS

Encountered at	18.4	Feet
0 Hours after completion	4.2	Feet
5 Days after completion	6.8	Feet
___ after completion	___	Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.

RECORD OF SUBSURFACE EXPLORATION

PROJECT Hydrogeologic Study
Hennepin Power Plant
JOB NO. 82-1293

BORING W-3 (23)
SHEET 2 OF 2

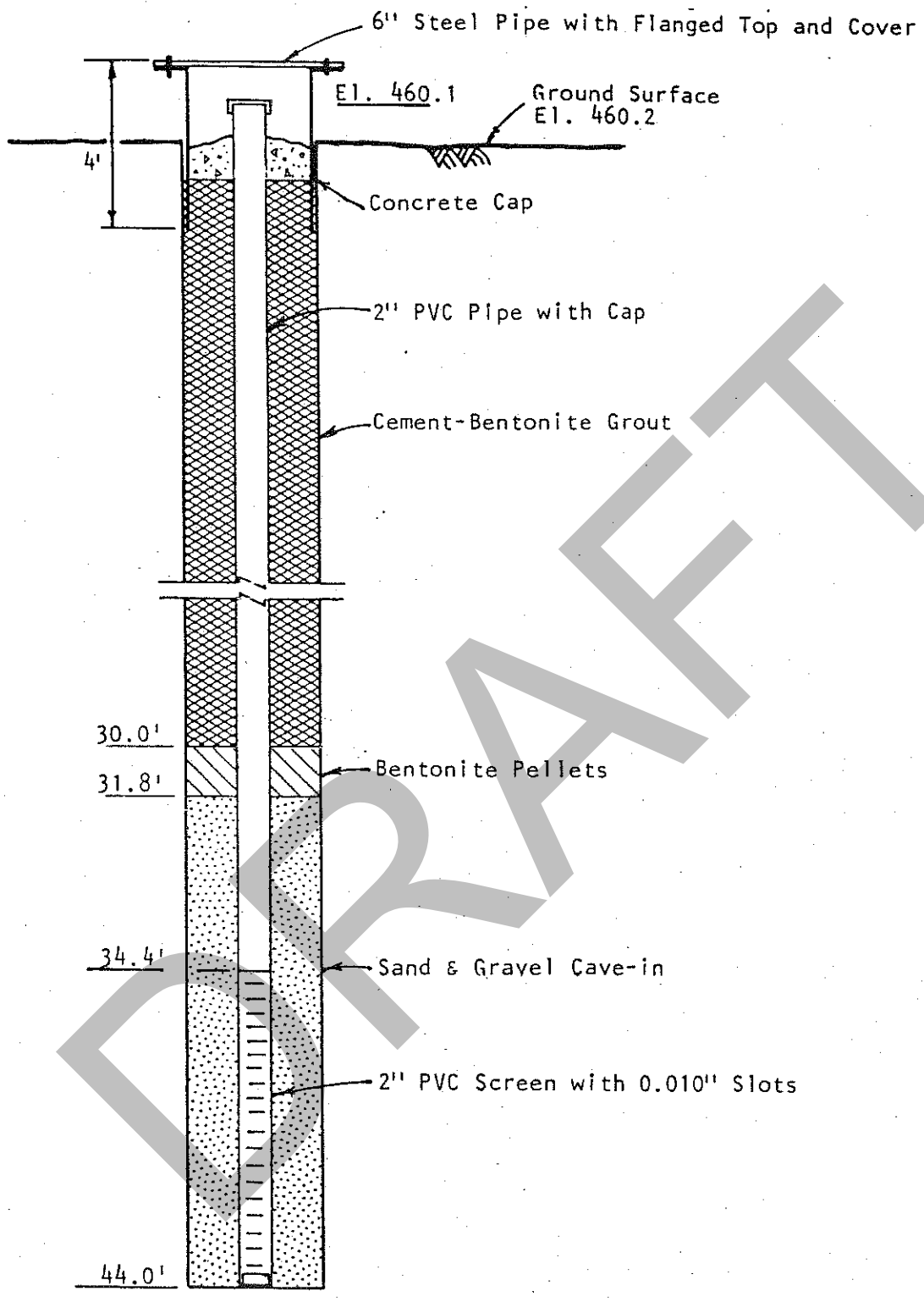
DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL AND TYPE	SAMPLE ADVANCED / RECOVERED (in)	SEE REMARK #	DESCRIPTION OF MATERIALS (Color Modifier MATERIAL. Classification)	BLOWS (per 6 in)	DRY UNIT WEIGHT (pcf)
					Soil Classification System Unified Surface Elevation 460.2'		
					Brown GRAVEL w/Sand Trace Clay, GP-GC		
					Brown Sandy CLAY w/Gravel, CL		
40	9	SS	18/18			4-2-37	
					Brown GRAVEL w/Sand Trace Clay, GP-GC		
45	10	SS	18/10		TOB	10-33-38	
50							

Shear Strength, tsf
SV△ QP/2□ QU/2○
0 ½ 1 1½ 2 2½
PL + NMC • LL x
0 50 100
Rock Quality Designation
0 50 100

DRILLING METHOD Hollow Auger
DATE DRILLED 12/10/82
DRILLED BY Roberts
LOGGED BY Maxeiner
PIEZOMETER Yes

GROUNDWATER LEVELS
Encountered at 18.9 Feet
0 Hours after completion 4.2 Feet
5 Days after completion 6.8 Feet
___ after completion ___ Feet

NOTE: Refer to the attached GENERAL NOTES and NOTATION USED ON RECORDS OF SUBSURFACE EXPLORATION for abbreviations, explanations, and qualifications relative to this log.



6" Borehole to Termination Depth

Not to Scale

23

PIEZOMETER W-3

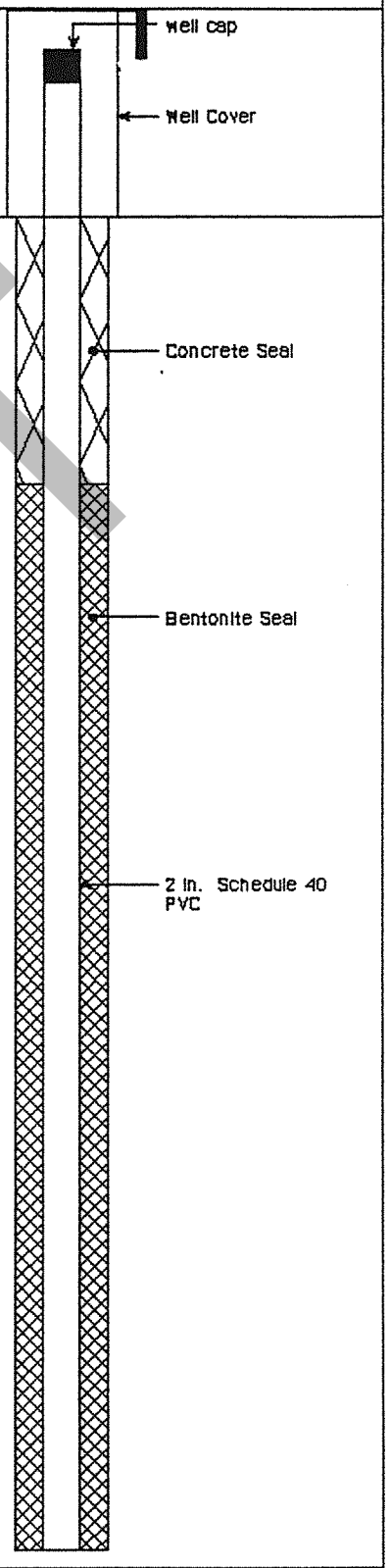
Monitoring Well No. 27

PROJECT Title: Hennepin West Ash Impoundment
DRILL RIG: Hollow Stem Auger
DRILLER: Boart Longyear

DATE: 09-11-95
HOLE DIA.: 7 in.
FINAL GW: 3.88 ft.

LOGGED BY: Hensel/Tu
SAMPLER: Split spoon
HOLE ELEV.: 447.94 ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE
Dark gray, clayey silt, uniform, organic matter, soft, stickey			0–5	
Dark gray, clayey silt w/ some sand, roots, soft, uniform, wet			5–10	SS-1
Same as above, except color changes to lighter gray at 16 ft.			10–15	SS-2
Mottled gray, orange, uniform, clayey silt, soft, moist			15–20	SS-3



STMI
2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:

Project No. 135-1.31

Monitoring Well No. 27

PROJECT Title: Hennepin West Ash Impoundment
DRILL RIG: Hollow Stem Auger
DRILLER: Boart Longyear

DATE: 09-11-95
HOLE DIA.: 7 in.
FINAL GW: 3.88 ft.

LOGGED BY: Hensel/Tu
SAMPLER: Split spoon
HOLE ELEV.: 447.94 ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE	WELL CONSTRUCTION DETAIL
Same as above			20–23	SS-3	2 in. Schedule 40 PVC
Uniform, brown grading to gray silty fine sand, wet, soft			24–26	SS-4	Bentonite Seal
uniform gray silty fine sand, wet, soft			27–29		#7 Fine Sand
uniform brown fine-medium sand, wet, soft			30–33	SS-5	Formation Collapse and #5 Sand
Uniform brown fine-medium sand with pebbles (may be blown in)			34		.01 Slotted Well Screen
Poorly sorted brown coarse sand and gravel, wet (glacial)			35–36	SS-6	
			37–40		

STMI
2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:

Project No. 135-1.31

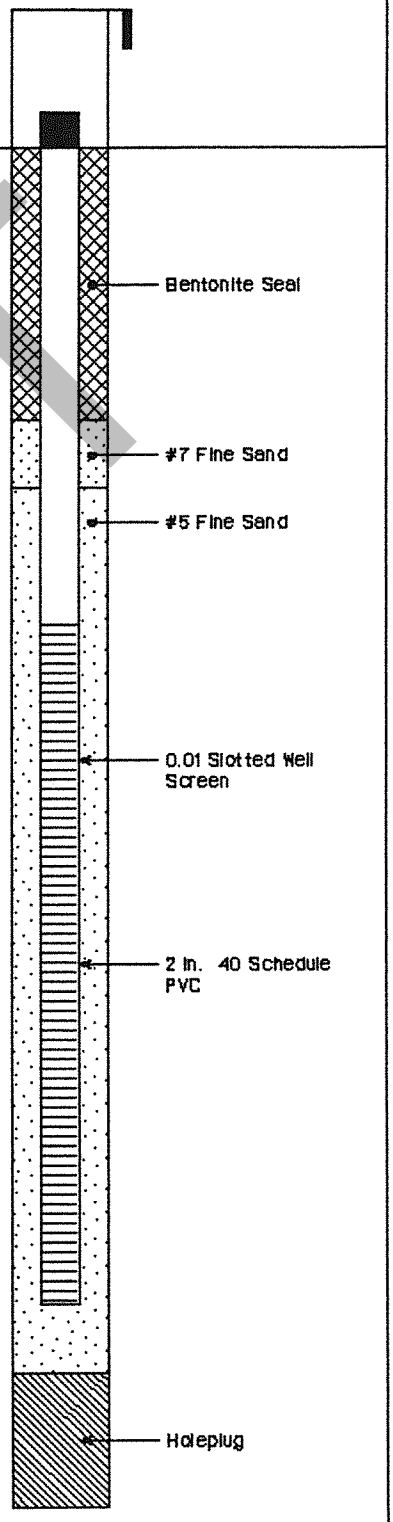
Monitoring Well No. 32

PROJECT Title: Hennepin West Ash Impoundment
DRILL RIG: Hollow Stem Auger
DRILLER: Boart Longyear

DATE: 8-21-96
HOLE DIA.: 7 in.
FINAL GW: 5.06 ft.

LOGGED BY: Mueller/Tu
SAMPLER: Split Spoon
HOLE ELEV.: 451.35 ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE
Clay, little organic debris (twigs, wood chips, fine roots), dark brown, low to medium plasticity, moist (alluvium)			0–4	A-1A
Sand, well sorted, subangular to rounded, little silt, some clay, loose red to brown in color. Saturated at approximately 4 to 4.5ft.			4–11	A-1B
Sand and gravel, medium-grained, well-rounded, well sorted quartz and sand, fine to coarse-grained, subangular to subrounded quartz and calcareous gravel. Redish-brown in color (alluvium). Wet.			11–20	A-1C, A-1D



STMI
2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:
Dicontinuously sampled every 5 feet. Sample numbers refer to saved samples

Project No.
135-1.31

Monitoring Well No. 32

PROJECT TITLE: Hennepin West Ash Impoundment
DRILL RIG: Hollow Stem Auger
DRILLER: Boart Longyear

DATE: 8-21-96
HOLE DIA.: 7 in.
FINAL GW: 5.06 ft.

LOGGED BY: Mueller/Tu
SAMPLER: Split Spoon
HOLE ELEV.: 461.35 ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE	WELL CONSTRUCTION DETAIL
Sandy clay, no plasticity, reddish brown in color, with rusty red laminations. Wet.			20–40	A-1E, A-1F, A-1G	Holeplug
Silty clay, trace coarse subangular sand, mixed lithologies, olive gray, no to low plasticity, hard, moist (till).					

STMI
2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:
Discontinuously sampled every 5 feet. Sample numbers refer to saved samples

Project No. 135-1.31

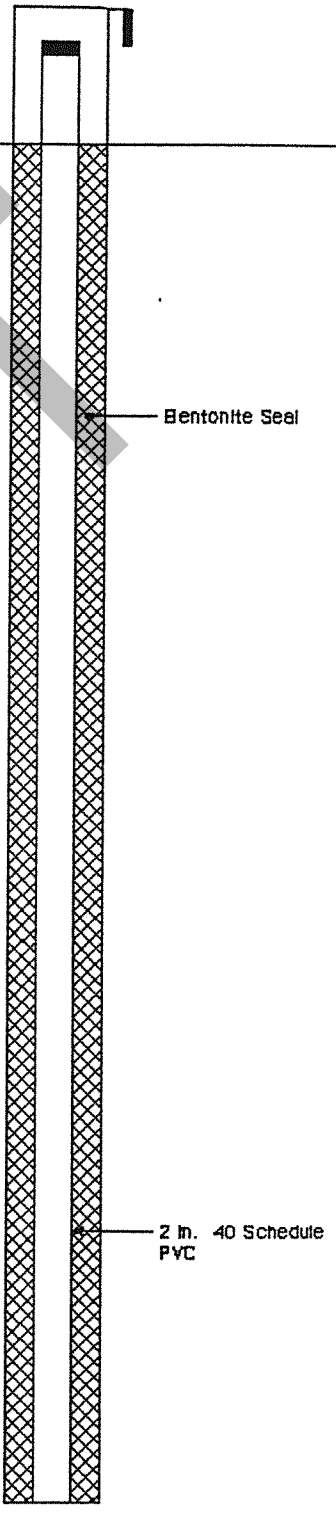
Monitoring Well No. 34

PROJECT Title: Hennepin West Ash Impoundment
DRILL RIG: Hollow Stem Auger
DRILLER: Boart Longyear

DATE: 8-22-96
HOLE DIA.: 7 in.
FINAL GW: 7.54 ft.

LOGGED BY: Mueller/Tu
SAMPLER: Split Spoon
HOLE ELEV.: 448.19 ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE
Silty clay, trace of plant debris, little fine-grained sand, very dark brown in color, medium to high plasticity (alluvium).			0 to 20	C-1A, C-1B, C-1C, C-1D



STMI
2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:

Project No. 135-1.31

Monitoring Well No. 34

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LOGGED BY: Mueller/Tu
SAMPLER: Split Spoon
HOLE ELEV.: 448.19 ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE	WELL CONSTRUCTION DETAIL
Clayey silt, trace to little fine-grained sand and shell fragments, soft, olive-gray. Wet.			20–40	C-1E, C-1F, C-1G	Bentonite Seal; 2 in. 40 Schedule PVC; #7 Fine Sand; #5 Fine Sand; 0.01 Slotted Well Screen; Holeplug
Sand, fine-grained to medium-grained, well-sorted, quartz, trace of silt, loose. Yellowish brown color grades to olive gray below 31 ft.					

STMI
2511 N. 124th St. Suite 205
Brookfield, Wisconsin 53005-8208

Notes:

Project No. 135-1.31

Natural Resource Technology, Inc.
Standard Soil Boring Log

Route To:
☐ Solid Waste ☐ Haz. Waste
☐ Emergency Response ☐ Underground Tanks
☐ Wastewater ☐ Water Resources
☐ Superfund ☐ Other:

SOIL BORING LOG INFORMATION
Form Rev. 5-92

Facility/Project Name	**License/Permit/Monitoring Number**	**Boring Number**
DYNEGY – Hennepin Ash Impoundment		*WELL-35*

Boring Drilled By (Firm name and name of crew chief)	**Date Drilling Started**	**Date Drilling Completed**	**Drilling Method**
Boart Longyear *Bob Erickson*	*9/28/99*	*9/28/99*	*HSA 4 1/4"*

Facility Well No.	**Unique Well No.**	**Common Well Name**	**Final Static Water Level**	**Surface Elevation**	**Borehole Diameter**
			-- Feet MSL	*Feet MSL*	*8.25 inches*

Boring Location **State Plane**	**Feet N** **Feet E**	**Lat** **Long**	**Local Grid Location (If applicable)** ☐ N ☐ E ☐ S ☐ W

County		**Civil Town/City/ or Village**
Putnam		*Hennepin, IL*

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			1–11	0–5' Fill, white–grey,angular sandy gravel, dry.	FILL									
			5–7	5–7' Black silty sand, roots, small grey pebbles, dry.	SM									
			7–18	7–18' Brown medium sand, uniform texture.	SP									

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

Signature

Firm **Natural Resource Technology, Inc.**

Sample		Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	
			13		SP									
			14											
			15											
			16											
			17											
			18											
			19	EOB @ 19'										
			20											
			21											
			22											
			23											
			24											
			25											
			26											
			27											
			28											
			29											
			30											
			31											

SOIL BORING LOG INFORMATION

RAMBOLL

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Hennepin Power Station - Hennepin West Delineation		50

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Jeff Croel Mateco Drilling	8/6/2019	8/7/2019	Mini Sonic

Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
50	Feet (NAVD88)	460.59 Feet (NAVD88)	6.0 inches

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Planel ,689,413.16 N, 2,529,032.25 E E/W
1/4 of 1/4 of Section , T N, R
Lat 41° 18' 8.0486"
Long -89° 19' 14.3067"
Local Grid Location
Feet ☐N ☐S Feet ☐E ☐W

Facility ID	County	State	Civil Town/City/ or Village
	Putnam	Illinois	Hennepin

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID 10.6 eV Lamp	Soil Properties: Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1 CS	60 24		0 1 2 3	0 - 3.5' **TOPSOIL:** s(ML)g, brown, little gravel.	s(ML)g									
			4	3.5 - 12.5' **SANDY LEAN CLAY WITH GRAVEL:** s(CL)g, brown, little fine gravel, firm, low plasticity.										
2 CS	90 90		5						1					
			6 7 8 9 10 11 12		s(CL)g									

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

Signature SH WL

Firm Ramboll
234 W. Florida St., Fifth Floor, Milwaukee, WI 53204
Tel: (414) 837-3607
Fax: (414) 837-3608

RAMBOLL

Boring Number 50

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID 10.6 eV Lamp	Soil Properties: Compressive Strength (tsf)	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
				12' gravel content increases,.										
3 CS	90 72		13	12.5 - 22.5' **POORLY-GRADED GRAVEL WITH SAND:** (GP)s, coarse gravel, wet.										
			14											
			15											
			16											
			17											
			18		(GP)s									
			19											
4 CS	120 90		20	20' - 22.5' cobbles.										
			21											
			22											
			23	22.5 - 30' **WELL-GRADED SAND:** SW, trace coarse rounded gravel, wet.										
			24											
			25											
			26		SW									
			27											
			28											
			29											
			30	30' End of Boring..										

Geosyntec consultants

1 McBride and Sons Center Dr
Suite 202
Chesterfield, MO 63005

GS FORM: WELL BORE 01/04

BOREHOLE LOG

BORING	**MW-51**	**SHEET**	**1 OF 3**
START DRILL DATE	February 4, 2020	**ELEVATION DATA:**	
FINISH DRILL DATE	February 4, 2020	**GROUND SURF. (Ft)**	461.50
LOCATION	PUTNAM COUNTY, HENNEPIN IL	**TOP OF CASING (Ft)**	464.80
PROJECT	HENNEPIN POWER STATION	**DATUM**	NAVD 1988
NUMBER	CHE8400		

DEPTH (ft-bgs)	DESCRIPTION (1) Unit/Formation, Mem. 2) USCS Name 3) Color 4) Moisture 5) Percent Grain Size 6) Plasticity 7) Density/Consistency 8) Structure 9) Other (Mineralization, Discoloration, Odor, etc.)	GRAPHIC LOG	WELL LOG	GROUNDWATER OR STRUCTURE	ELEVATION (ft)	SAMPLE NO.	TYPE	BLOW COUNT	N-Value	RECOVERY (%)	COMMENTS (1) Rig Behavior 2) Air Monitoring
	Brown/red, clayey gravel, GC, fill material				460	01		2 4 4 3	8	17/24	
						02		5 3 11 12	14	18/24	
5	Brown/red, clayey sand with trace coarse sand, SC, low plasticity					03		5 6 9 5	15	16/24	
					455	04		6 3 4 5	7	2/24	
	Dark gray, fly ash, ML, non-plastic, non-cohesive					05		3 4 5 9	9	21/24	
10						06		3 3 3 4	6	24/24	
					450	07		2 1 1 2	2	24/24	
	@14 ft changes to dark gray/black					08		4 4 32 40	36	24/24	
15											
					445	09		3 3 3 4	6	24/24	
	Dark gray/black silty clay, CL, medium plasticity, damp					10		2 3 3 3	6	24/24	
20						11		2 1 3 2	4	18/24	
					440	12		0 1 2 2	3	24/24	
	@ 24 ft red brown coarse gravel lens					13		0 2 3 4	5	24/24	
25	@ 26 ft changes to dark gray				435	14		0 1 1 1	2	24/24	
	@ 28 ft changes to medium stiff					15		1 2 2 3	4	18/24	
30											

CONTRACTOR TSC
EQUIPMENT CME 75
DRILL MTHD HOLLOWSTEM AUGER
DIAMETER 6-inch
LOGGER C. CHRISTENSON
REVIEWER L. CARR

NORTHING 1688814.68
EASTING 2527303.58
COORDINATE SYSTEM: STATE PLANE ILLINOIS WEST

NOTES:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Geosyntec consultants

1 McBride and Sons Center Dr
Suite 202
Chesterfield, MO 63005

GS FORM: WELL BORE 01/04

BOREHOLE LOG

BORING	**MW-51**	**SHEET**	**2 OF 3**
START DRILL DATE	February 4, 2020	**ELEVATION DATA:**	
FINISH DRILL DATE	February 4, 2020	**GROUND SURF. (Ft)**	461.50
LOCATION	PUTNAM COUNTY, HENNEPIN IL	**TOP OF CASING (Ft)**	464.80
PROJECT	HENNEPIN POWER STATION	**DATUM**	NAVD 1988
NUMBER	CHE8400		

DESCRIPTION
1) Unit/Formation, Mem. 6) Plasticity
2) USCS Name 7) Density/Consistency
3) Color 8) Structure
4) Moisture 9) Other (Mineralization, Discoloration, Odor, etc.)
5) Percent Grain Size

DEPTH (ft-bgs)	DESCRIPTION	ELEVATION (ft)	SAMPLE NO.	TYPE	BLOW COUNT	N-Value	RECOVERY (%)
	@ 31 ft medium gravel lens	430	16		3 4 5 5	8	6/24
			17		0 1 2 2	3	19/24
35			18		2 3 4 5	7	24/24
	Dark gray clay and gravel mixture, wet, GC	425	19		2 2 3 5	5	6/24
	Dark gray, silt with trace clay, ML, low plasticity, damp		20		0 0 2 2	2	24/24
40	Dark gray silt with trace clay, ML, low plasticity, damp						
	Dark gray silty clay, CL, medium plasticity, damp, medium stiff	420	21		2 1 1 2	2	24/24
	Dark gray silt with trace clay, ML, low plasticity, damp, medium stiff		22		2 2 2 3	4	24/24
45			23		1 1 2 3	3	24/24
	@ 47 ft few diatomaceous/shells	415	24		0 0 2 2	2	24/24
			25		0 1 2 2	3	10/24
50			26		3 4 4 7	8	14/24
	Dark gray, fine to medium sand, trace coarse sand, SM	410	27			0	24/24
55			28		1 3 5 7	8	24/24
	@ 56 ft changes to some coarse sand, SM-SP	405	29		7 6 7 6	13	24/24
	Dark gray, medium sand with some fine and coarse sand, SP, wet		30		3 3 9 1	12	24/24
60							

GRAPHIC LOG / WELL LOG / GROUNDWATER OR STRUCTURE

SAMPLE

COMMENTS
1) Rig Behavior
2) Air Monitoring

CONTRACTOR TSC
EQUIPMENT CME 75
DRILL MTHD HOLLOWSTEM AUGER
DIAMETER 6-inch
LOGGER C. CHRISTENSON
REVIEWER L. CARR

NORTHING 1688814.68
EASTING 2527303.58
COORDINATE SYSTEM:
STATE PLANE ILLINOIS WEST

NOTES:

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Chesterfield, MO 63005

GS FORM:
WELL BORE 01/04

BOREHOLE LOG

BORING	**MW-51**	**SHEET**	**3 OF 3**
START DRILL DATE	February 4, 2020	**ELEVATION DATA:**	
FINISH DRILL DATE	February 4, 2020	**GROUND SURF. (Ft)**	461.50
LOCATION	PUTNAM COUNTY, HENNEPIN IL	**TOP OF CASING (Ft)**	464.80
PROJECT	HENNEPIN POWER STATION	**DATUM**	NAVD 1988
NUMBER	CHE8400		

DEPTH (ft-bgs)	DESCRIPTION 1) Unit/Formation, Mem. 6) Plasticity 2) USCS Name 7) Density/Consistency 3) Color 8) Structure 4) Moisture 9) Other (Mineralization, Discoloration, Odor, etc.) 5) Percent Grain Size	GRAPHIC LOG	WELL LOG	GROUNDWATER OR STRUCTURE	ELEVATION (ft)	SAMPLE NO.	TYPE	BLOW COUNT	N-Value	RECOVERY (%)	COMMENTS 1) Rig Behavior 2) Air Monitoring
	Dark gray, medium sand with some fine and coarse sand, SP, wet					31		1 1 3 4	4	2/24	
	@ 62 ft, changes to few fine gravel, fine sand absent, SW				400	32		5 7 13 18	20	24/24	
65						33		5 8 14 17	22	24/24	
	Dark gray, medium-fine sand with some coarse sand, SW				395	34		3 10	13	12/12	
	@ 67 ft lens of medium gravel End of boring at 67 ft.										
70					390						
75					385						
80					380						
85					375						
90											

CONTRACTOR	TSC	**NORTHING**	1688814.68
EQUIPMENT	CME 75	**EASTING**	2527303.58
DRILL MTHD	HOLLOWSTEM AUGER	**COORDINATE SYSTEM:**	
DIAMETER	6-inch		STATE PLANE ILLINOIS WEST
LOGGER	C. CHRISTENSON	**REVIEWER**	L. CARR

NOTES:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

07-WELL BORE CHICAGO PROJECT.GPJ GEOSNTEC.GDT 2/24/20