REPORT

MCU Assessment of Corrective Measures - Addendum #3

Northern Indiana Public Service Company LLC
Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Submitted to:

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Northern Indiana Public Service Company LLC (NIPSCO)
R. M. Schahfer Generating Station – MSRB, MCWB and DA (collectively the Multi-Cell Unit [MCU] or CCR Unit)
Wheatfield, Indiana

Certification of Addendum #3 to the Assessment of Corrective Measures Report
40 CFR §257.96 & Corresponding Regulations under Indiana Administrative Code

I have personally reviewed Addendum #3 to the assessment of corrective measures (ACM) report that was prepared by Golder Associates Inc. (Golder) and dated July 2021. The subject of Addendum #3 to the ACM Report is three impoundments, the Material Storage Runoff Basin (MSRB), Metal Cleaning Waste Basin (MCWB), and Drying Area (DA), which are collectively referred to as the Multi-Cell Unit (MCU) or simply the CCR Unit, at the NIPSCO R. M. Schahfer Generating Station. Based on an inquiry of those individuals immediately responsible and on supporting data that I understand to be true, accurate, and complete, I verify the information in this Addendum #3 to the ACM Report is accurate and meets the applicable requirements of the CCR Rule and Indiana Administrative Code. In consideration of the above, I certify to the best of my knowledge, information, and belief, that Addendum #3 to the ACM Report for the regulated CCR management unit referred to as the MCU has been prepared and meets the applicable requirements of 40 CFR §257.96 and corresponding State of Indiana requirements.

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6/17/2022
Date

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Acronyms

ACM	Assessment of Corrective Measures
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
COC	Constituents of Concern
DA	Drying Area
GAC	granular activated carbon
GDL	Geocomposite drainage layer
GWPS	Groundwater Protection Standards
Golder	Golder Associated USA Inc.
IDEM	Indiana Department of Environmental Management
ISS	In situ Stabilization/Solidification
LLDPE	linear low-density polyethylene
MCWB	Metal Cleaning Waste Basin
MCU	Multi-Cell Unit
MNA	Monitored Natural Attenuation
MSRB	Material Storage Runoff Basin
NIPSCO	Northern Indiana Public Service Company LLC
NPDES	National Pollutant Discharge Elimination System
O&M	Operations & Maintenance
POC	Point of Compliance
POTW	Publicly Owned Treatment Works
PRB	Permeable Reactive Barrier
SSL	Statistically Significant Level
SOR	Selection of Remedy
ug/L	Microgram per liter
USEPA	United States Environmental Protection Agency
ZVI	zero-valent iron

1.0 INTRODUCTION

On behalf of Northern Indiana Public Service Company LLC (NIPSCO), Golder Associates USA Inc.*, a member of WSP* (Golder) has prepared this Addendum #3 to supplement, refine, and update findings of the April 2019 CCR Assessment of Corrective Measures (ACM) Report and the November 2020 and July 2021 ACM Addenda for the Rollin M. Schahfer Generating Station (RMSGS, Site) located at 2723 E 1500 N Road, in Wheatfield, Jasper County, Indiana (see ACM Addendum #3, Figure 1). Specifically, Golder has included updated findings relative to the detection of cobalt, a 40 Code of Federal Regulations (CFR) Coal Combustion Residuals (CCR) Rule as amended Appendix IV constituent, at a statistically significant level (SSL) above the groundwater protection standard (GWPS). Cobalt has been identified as the only CCR Rule Appendix IV SSL above the GWPS, detected at a single shallow groundwater monitoring location immediately downgradient of three collectively monitored impoundments, the Material Storage Runoff Basin (MSRB), Metal Cleaning Waste Basin (MCWB), and Drying Area (DA), together the Multi-Cell Unit (MCU) or simply the CCR Unit (ACM Report, Golder 2019; ACM Addendum #1, Golder 2020; and ACM Addendum #2, Golder 2021). Addendum #3, Figure 2 shows the location of the MCU on RMSGS as well as the names/locations of the individual impoundments.

Previous ACM documents were by design predicated on and tied closely to time frames associated with key regulatory agency approval processes and NIPSCO planned impoundment closure events. These include the MCU Closure Application regulatory review and approval by Indiana Department of Environmental Management (IDEM) and NIPSCO's scheduled 2023 construction implementation. The MCU Closure Application, which addresses critical aspects interrelated with the groundwater remedy, has undergone multiple reviews by IDEM and revisions by NIPSCO. However, additional review comments were recently received, and the Closure Application has not yet been approved by IDEM. Nevertheless, although lacking this approval, NIPSCO/Golder will immediately proceed to the Selection of Remedy (SOR) process following completion of this ACM Addendum #3.

Preparation of an SOR report will be preceded by scheduling/holding a public meeting to present the results of the revised ACM. This meeting will be held at least 30 days prior to the final selection of a groundwater remedy. At present, NIPSCO believes an ACM-based public meeting can be held within the next 60-90 days, subject to personnel availability, logistical details, and input from IDEM.

Following a preliminary review by and based on feedback from conversations with United States Environmental Protection Agency (EPA) Headquarters CCR Rule staff, Golder prepared ACM Addendum #1 to the initial April 2019 ACM to provide further details of its evaluation of the potential corrective measures for the MCU. In accordance with EPA Headquarters staff observations and late 2020 informal discussions with EPA regarding NIPSCO ACM documents prepared at that time, ACM Addendum #1 and succeeding Addenda specifically focus on addressing the following requirements under 40 CFR §257.96(c)

> *"The assessment under paragraph (a) of this section must include an analysis of the effectiveness of potential corrective measures in meeting all of the requirements and objectives of the remedy as described under §257.97 addressing at least the following:*
>
> 1) *The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies including safety impacts, cross-media impacts, and control of exposure to any residual contamination;*
>
> 2) *The time required to begin and complete the remedy;*

3) *The institutional requirements, such as state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy(s).”*

Like the ACM and Addendum #1, ACM Addendum #2 addressed potential groundwater impacts beyond the identified Appendix IV constituent SSL, cobalt. ACM Addendum #2, which superseded and fully replaced ACM Addendum #1, also revised and updated information provided in the predecessor documents, and it incorporated an enhanced final cap design along with post-closure management requirements to supplement MCU source removal (i.e., impoundment closure-by-removal) in all corrective measure alternatives.

Evolution and revision of the enhanced cover system design reflected ongoing requests for additional information by and subsequent discussions with IDEM over the course of more than a year. Although a final closure design in accordance with IDEM requests was prepared and submitted in May 2021, IDEM provided further comments and requested additional information in March 2022. NIPSCO/Golder are currently working to address these requests. Thus, IDEM approval and public notification and request for comment on the draft Closure Application have not yet been issued.

Like the ACM and previous addenda, ACM Addendum #3 addresses groundwater remedial alternatives, consistent with the requirements of the assessment of corrective measures process as outlined in 40 CFR §257.96. Unlike the previous documents, however, ACM Addendum #3 focuses solely on cobalt. This focus is based on an evaluation of groundwater monitoring results from July 2016 to present that showed the following:

- Cobalt is the sole Appendix IV constituent detected in shallow groundwater at a statistically significant level (SSL)
- The Cobalt SSL was detected in a single shallow-screened monitoring well that is located immediately downgradient of the MCU
- Cobalt concentrations have been and are continuing to decline since the initial identification of cobalt at an SSL.

This progression of the ACM process, including revision of the most recent ACM document and preparation of this ACM Addendum #3, reflects the ongoing CCR Unit-specific state regulatory review and closure approval processes. Furthermore, this progression is consistent with EPA Headquarters’ staff observations and their subsequent discussions with NIPSCO regarding previously prepared ACM documents. The specific discussion during October 13 and November 24, 2020, conference calls included comments by several senior EPA representatives[1] that ACMs were “living documents” and thus subject to revisions in accordance with changes in conditions. As part of this progression, NIPSCO has revised the ACM, as appropriate, in response to site conditions, evolving state regulatory agency (i.e., IDEM) requests/requirements, and changing Federal (i.e., EPA) regulation and policy interpretations.

This Addendum #3, in combination with the remaining applicable sections of the ACM Report (Golder 2019) and Addendum #2 (Golder 2021), results in a process for NIPSCO to move forward towards the selection of a corrective measure that addresses cobalt impacts in groundwater. The following text provides an updated

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[1] Senior EPA representatives on the October 13, 2020, conference call included Lydia Anderson, Frank Behan, Laurel Celeste, Kirsten Hillyer, Richard Huggins, Susan Mooney, and Jessica Schumacher. Senior EPA representatives on the November 24, 2020, conference call included Richard Huggins and Stacey Yonce.

summary of the Site background and contaminant plume conditions along with modifications to the identification and evaluation sections of the ACM.

2.0 BACKGROUND

NIPSCO owns and operates the RMSGS which, among other activities, manages CCR in surface impoundments subject to applicable requirements of 40 CFR Part 257 as amended (CCR Rule). Pursuant to 40 CFR §257.96(a), the MCU is subject to an ACM, the results of which were presented in the ACM Report and Addenda. ACM Addendum #3, Figures 2 through 6, show the monitoring well network, geologic cross sections, groundwater elevation contours and cobalt isoconcentration contour maps for the Site. Regional and Site Hydrogeology are summarized in the ACM and supported by mass and volume calculations, slug test data and calculations, and vertical gradient calculation included in Appendices A, B, and C, respectively.

NIPSCO plans to close the MCU by removal in accordance with 40 CFR §257.102(c) and an approved IDEM Closure Application. To meet the requirements of 40 CFR §257.97-98, NIPSCO plans to combine the following MCU closure activities in conjunction with additional groundwater corrective measures for cobalt to demonstrate achievement of applicable groundwater protection standards (GWPS):

- Removal of CCR source material from the MCU
- Construction and maintenance of a low permeability cap over residual materials in the MCU
- Long-term monitoring

These corrective measures are further described in ACM Addendum #3, Table 1.

In the 2019 ACM Report, Golder presented the analytical data for the MCU monitoring wells, identified general groundwater response actions (Table 3), presented an initial screening of corrective measure alternatives/process options for groundwater, and identified eight potential groundwater corrective measures and their key components for further consideration following closure of the MCU.

After preparation of the ACM Report and ACM Addendum #1, NIPSCO performed additional work with respect to future performance of the initially proposed closure approach and its possible impact on groundwater conditions. Based upon this assessment, NIPSCO determined that an enhanced combination soil/geomembrane cap along with a minor modification of the remaining in-place slurry wall, designed to alleviate potential groundwater level build up under the cap, would provide better long-term performance post-closure than either no cap or a soil-only cap. Consequently, NIPSCO proposed this alternative design to IDEM and prepared ACM Addendum #2. As referenced above and as of this writing, consideration of the alternative design remains under IDEM review.

Based on further review of groundwater data and recent EPA policy interpretations, Golder prepared Addendum #3, to modify the ACM to include an evaluation of groundwater remediation alternatives to address cobalt in groundwater.

Because of NIPSCO’s decision and subsequent proposal to IDEM to construct a low permeability cap in conjunction with source removal during the closure process, ACM Alternative 2 – Capping with MNA was effectively removed from future consideration. Furthermore, other alternatives that did not previously include or consider the implications of constructing a low permeability cap immediately following source removal were likewise removed from future consideration while other alternatives were modified to reflect the inclusion of a low permeability cap. The alternatives that were previously removed or modified in ACM Addenda #1 and #2 are listed below:

Alternatives Removed

- In situ Stabilization/Solidification (ISS) and MNA
- Capping, Pump-and-Treat and MNA
- ISS, Pump-and-Treat, and MNA

Alternatives Modified

- MNA
- Vertical Barrier/Hydraulic Controls and MNA
- Pump-and-Treat and MNA
- Vertical Barrier/Hydraulic Controls, Pump-and-Treat, and MNA

Based on the revised focus of Addendum #3 on the SSL exceedance of cobalt in a single shallow location, certain previously removed technologies and alternatives may now be feasible and will be revaluated. These alternatives include Vertical Barriers in the form of permeable reactive barriers and ISS with MNA as presented in the table below:

Alternative	**Status**	**Comments**
Monitored Natural Attenuation (MNA)	Retained	MNA feasibility and appropriateness is validated by the Tier I-III evaluation and requires no modifications to the current closure strategy.
Capping and MNA	Removed	Capping is already included in the current closure strategy but remains under review by IDEM with no predictable approval status or timeframe.
Vertical Barrier/Hydraulic Controls and MNA	Retained/Modified	Hydraulic controls can be integrated into the current closure strategy with limited modifications to the cap.
In situ Stabilization/Solidification (ISS) and MNA	Reevaluated	ISS cannot be integrated into the current closure strategy without significant modifications and potentially severe damage to the cap. However, ISS may be an appropriate remedial alternative for the cobalt groundwater plume located downgradient of the MCU.
Pump-and-Treat and MNA	Retained/Modified	Pump and treat external to the current MCU footprint can be integrated into the current closure strategy with no impact to the cap.

Alternative	Status	Comments
Capping, Pump-and-Treat, and MNA	Removed	Capping is already included in the current closure strategy.
Vertical Barrier/Hydraulic Control, Pump-and-Treat, and MNA	Retained/Modified	Hydraulic controls and pump-and-treat external to the current MCU footprint can be integrated into the current closure strategy with limited modifications to the cap.
ISS, Pump-and-Treat, and MNA	Removed	ISS cannot be integrated into the current closure strategy without significant modifications and potentially severe damage to the cap. Furthermore, ISS and pump-and-treat would be incompatible technologies for treatment of the downgradient cobalt plume.

3.0 CONTAMINANT PLUME CONDITIONS

Due to the required schedule for closure and EPA’s recent interpretations of the timeline to select and implement a corrective remedy, the ACM is being revised to address Appendix IV constituents with SSL exceedances as described in Section 1. The only such constituent is cobalt, which has been found to exceed the SSL level of 6 micrograms per liter (μg/L) and the GWPS of 10 μg/l in one well, GAMW-08 located hydraulically downgradient and immediately to the north of the MCU.

In accordance with the requirement of 40 CFR 257.95(g)(1), the nature, mass, and extent of contamination must be characterized for the ACM. Groundwater samples have been collected at least bi-annually from GAMW-08 since July 2016. The analytical sampling results indicate cobalt concentrations ranging from 7.9 to 59 μg/L, with an average of 29 μg/L. The cobalt concentration detected during the most recent monitoring event in September 2021 was 15 μg/L (see Table 2) which exceeds the GWPS. However, cobalt concentrations in this well have reflected a generally decreasing trend since November 2016.

No other assessment monitoring wells adjacent to the MCU have been found to contain cobalt at an SSL above the GWPS. The maximum cobalt concentration detected in porewater samples collected from the MSRB portion of the MCU is 2.2 μg/L. An alternative source determination has not been made regarding the detections in GAMW-08; therefore, for the purposes of this ACM addendum the source of the contamination is assumed to be due to a release from the MCWB portion of the MCU, the porewater of which has not been sampled. Cobalt has not been detected in monitoring well GAMW-08B, which is co-located with GAMW-08 and screened from 27.5 to 37.5 feet below ground surface (ft bgs), compared to the screened interval of GAMW-08 which extends from 5 to 15 ft bgs.

The assumed extent of the plume potentially requiring treatment (i.e., cobalt concentrations exceeding the GWPS) is shown on Figure 6. The plume dimensions shown were developed by extrapolating cobalt concentrations between an assumed concentration of 20 μg/L at the downgradient end of the slurry wall and known concentrations at GAWM-08, cross-gradient wells GAMW-16R and -17, and downgradient wells GAMW-53, -54, and -55. Based on these extents and concentrations the mass of cobalt within the plume needing to be treated was calculated to be between 0.07 and 0.18 kilograms (see Appendix A for calculation).

4.0 IDENTIFICATION OF POTENTIAL CORRECTIVE MEASURES

4.1 Source Material

As discussed in the ACM Report and Addendum #2, NIPSCO plans to close the MCU in accordance with 40 CFR §257.102(c) and an approved IDEM Closure Application. NIPSCO's approach combines CCR source removal/capping and groundwater remediation, including addressing a single-location cobalt GWPS exceedance in accordance with recommendations of the ACM/SOR processes, and monitoring to demonstrate achievement of the IDEM-approved Closure Application requirements and applicable GWPS. The multi-part corrective action approach will be integrated, but it will also be sequenced to address both the requirements of 40 CFR §257.97-98 for cobalt exceedances of GWPS during the near-term and allow for monitoring of early-stage post-closure results and plume stability. This approach will facilitate optimization of subsequent groundwater monitoring steps following completion of the initial source removal and capping stages.

The first phase of the integrated CCR Unit closure approach is closure by removal/capping of the MCU. Following dewatering activities, the three impoundments will be excavated. In accordance with the Closure Application, excavations are being planned to remove CCR and non-CCR materials to the original design limits (sides and bottom) of the impoundments, leaving the slurry wall in-place. Satisfactory excavation will be confirmed by a visual determination that the CCR materials have been removed (Wood 2021).

Following completion of CCR excavation and visual verification of the source removal activities, a final low permeability cap will be installed. As proposed to IDEM, the final cap will consist of the following components presented in descending order from top to bottom (Wood 2021):

- Topsoil (6-inch)
- Cover soil (18-inch)
- Geocomposite drainage layer (GDL)
- 40-mil linear low-density polyethylene (LLDPE) geomembrane
- Subgrade fill.

During cap construction a hydraulically downgradient section of the slurry wall will be permanently removed down to the average elevation of the groundwater table to address the water buildup/overtopping possibility within the former impoundment. This action should reduce concerns regarding long-term cap performance and maintenance; however, it may result in periodic discharges from within the former impoundment of diluted water that has previously been in contact with CCR. Monitoring within and outside the capped former impoundment will inform NIPSCO with future water quality data, allowing review of closure remedy performance and identifying post-closure groundwater quality trends outside the former CCR Unit.

4.2 Groundwater Impacts

As noted above, ACM Addendum #3 focuses on addressing cobalt-impacted groundwater downgradient of the MCU. As such, those alternatives that are effective at remediating groundwater in the downgradient plumes will be evaluated further. These include alternatives that were previously considered and are still applicable (e.g., ISS), and alternatives that were not previously considered but are now applicable (e.g., passive reactive barriers). For clarification and to differentiate the ACM Addendum #3 alternatives from those presented and discussed in predecessor documents, the remaining alternatives are renumbered as follow:

- Alternative A – MNA
- Alternative B – Vertical Barrier/Hydraulic Controls and MNA
- Alternative C – Pump-and-Treat and MNA
- Alternative D – Vertical Barrier and MNA
- Alternative E – ISS and MNA

Initial corrective action measures screening results are presented in ACM Addendum #3 Table 4 and a summary of the retained groundwater corrective measure alternatives is shown in ACM Addendum #3 Table 5. The remedial components of the groundwater corrective measure alternatives following source removal and capping are described further in Section 5.

5.0 EVALUATION OF POTENTIAL GROUNDWATER CORRECTIVE MEASURES

5.1 Evaluation Criteria

In conformance with the applicable requirements of 40 CFR §257.96 and 40 CFR §257.97, Golder evaluated the effectiveness of each of the five remaining potential groundwater corrective measures originally identified in the ACM Report (Golder 2019) using the following criteria:

- **Performance** - Potential corrective measures were evaluated for their relative performance based on the magnitude of reduction of existing risks, ability to obtain the GWPS at the point of compliance (POC), the magnitude of residual risks in terms of likelihood of future releases due to remaining CCR following implementation of remedy, and the required type and degree of long-term management including monitoring, operation, and maintenance associated with the corrective measure.
- **Reliability** - Potential corrective measures were evaluated for their relative reliability based on the long-term reliability of engineering and institutional controls, potential need for the replacement of the remedy, extent to which containment practices will reduce further releases, and extent to which the treatment technologies may be used.
- **Ease of Implementation** - Potential corrective measures were evaluated based on their relative ease of implementation based on difficulty associated with construction of the technology, operational reliability of the technology(ies), coordination of regulatory approvals and permits from pertinent agencies, availability of necessary equipment and specialists, and availability capacity and location of needed treatment, storage, and disposal services.
- **Potential Impacts** - Potential corrective measures were evaluated based on their relative potential impacts based on safety impacts, cross-media impacts, and control of exposure. Exposure controls include short-term risks during implementation of a remedy and potential exposure to remaining wastes to the community or environment including potential threats associated with excavation, transportation, re-disposal of CCR, or contaminant.
- **Time Requirements** - Potential corrective measures were evaluated based on the time required to initiate, construct, and complete the remedy.

- **Institutional Requirements** - Potential corrective measures were evaluated based on their institutional requirements including local, state, and federal permit needs.

5.2 Evaluation Summaries

Relative to the above evaluation criteria, the following sections present brief summaries of the proposed groundwater corrective measure alternatives considered prior to and following source removal, associated dewatering, and capping. It should be noted that these closure-related actions are considered a part of all the remedial alternatives discussed in this section because source removal and dewatering will address and help control the presumed source of the release and reduce or eliminate further releases of cobalt (and any other CCR-related Appendix IV constituents) as required under 40 CFR 257.97(b)(3). In addition, the summaries highlight areas where a particular remedy may perform well or poorly relative to other alternatives. A summary of Golder's evaluation of the retained groundwater corrective measure alternatives is provided in ACM Addendum #3 Table 6.

5.2.1 Alternative A: Monitored Natural Attenuation

Golder evaluated MNA alone as a potential groundwater corrective measure for a number of CCR-related potential Site constituents of concern (COCs), including the Appendix IV SSL cobalt. The MNA Evaluation (Golder 2020) is presented in Appendix D. The results of the evaluation indicate that MNA is a technically feasible and appropriate corrective measure for groundwater at the Site based on the following factors:

- Attenuation is already occurring at the Site at a reasonable rate
- The dissolved plume is stable
- The aquifer has the long-term capacity to attenuate COCs
- Cobalt has been detected at only a single location immediately downgradient of the MCU and concentrations appear to be decreasing with time

Based on the results of the Tier I, II, and III MNA evaluations for the Site, Golder concluded that MNA is expected to provide good long-term performance at reducing cobalt concentrations through chemical (i.e., adsorption and co-precipitation) and physical processes (e.g., diffusion, dispersion). While MNA alone typically will not substantially affect groundwater concentrations in the short-term, Golder's review of cobalt concentrations since monitoring began in 2016 indicates the concentrations are currently decreasing.

Linear Regression Analysis

A linear regression analysis of the cobalt concentrations at GAMW-08 indicates that groundwater would attain the GWPS for cobalt (0.010 mg/l) by January 2022 without implementation of any active remedial technologies. Furthermore, if similar attenuation rates are assumed at the MCU boundary along with a starting cobalt concentration of 0.020 mg/l, groundwater will meet the GWPS at the downgradient side of the MCU in approximately 2 years.

The above cobalt concentration estimates are based on current conditions and do not take source removal and dewatering into account, which would likely further shorten these timeframes. While these timeframes are based on incomplete data and linear interpolation of existing data with a degree of variation, they do provide an order-of-magnitude estimate of the remediation timeline indicating a relatively short timeframe for MNA alone to remediate groundwater at the Site.

MNA Evaluation

For the MNA evaluation, Golder conducted a point decay evaluation at monitoring wells downgradient of the MCU. Based on the results of the evaluation, the maximum concentration of cobalt observed in downgradient wells over the period of monitoring would take approximately 39 years to attenuate to concentrations below the GWPS (Golder 2020). However, this estimate is based on a point decay constant calculated using the decrease in concentration between GAWM-08 and the next nearest downgradient well GAMW-52, which is located approximately 1,200 feet downgradient. Cobalt has not been detected in GAMW-52 so the point decay constant and subsequently the estimated time for the cobalt concentration to reach the GWPS was a conservative estimate. As discussed above, more recent data from GAMW-08 indicates that the rate of attenuation may be significantly higher than estimated.

For the evaluation, Golder also considered the following factors:

- The low groundwater flow velocities observed at the Site
- The distance from the MCU to the property boundary and lack of off-Site migration of groundwater impacts
- The lack of potable water supply wells at the Site in the vicinity of the MCU and the downgradient plume
- Planned institutional controls prohibiting use of groundwater from any impacted area at the Site for drinking water

Based on these other factors, MNA is expected to be protective of human health and reduce environmental degradation of groundwater containing cobalt that is not removed during closure.

Because there is an existing monitoring well network downgradient of the MCU, implementation of a supplemental MNA program is unlikely to require any component construction/installation apart from additional monitoring wells between GAMW-08 and GAMW-53, -54, and -55. Installation of such wells may be complicated by the presence of a complex subsurface utility network and surface infrastructure located hydraulically downgradient of and adjacent to the MCU. Therefore, MNA will be relatively easy to implement following regulatory approval and poses no short-term safety risks, but it may not be feasible to install new MNA performance monitoring wells at optimal locations (i.e., immediately downgradient of GAMW-08). Long-term operation and maintenance (O&M) will include routine semi-annual groundwater sampling and potentially periodic well redevelopment.

5.2.2 Alternative B: Vertical Barrier/Hydraulic Controls and MNA

For the Vertical Barrier/Hydraulic Control and MNA Alternative, hydraulic controls within the existing slurry wall would be added to the MNA alternative. The Vertical Barrier/Hydraulic Control and MNA alternative would be implemented to reduce or eliminate downgradient migration of potentially impacted groundwater by generating a hydraulic gradient inward toward the MCU. This alternative assumes that the existing slurry wall is intact, albeit slightly modified from the original design to address potential water buildup with the former impoundment cell, and that implementation of this alternative consists of installation and operation of a pump-and-treat system within the former impoundment areas as necessary to prevent potential over-topping of the modified slurry wall by water impacted above the GWPS due to groundwater recharge.

The Vertical Barrier/Hydraulic Control and MNA Alternative would have a similar effect as the MNA Alternative on groundwater downgradient of the closed MCU with the added benefit of active contaminant mass removal (to the extent such remains an issue of concern following closure by removal) and reduction of Appendix IV constituent contaminated groundwater releases from the MCU. It would reduce or eliminate the volume of impacted groundwater potentially overtopping and/or passing through the existing or modified slurry wall(s), thus removing a potential residual source of contamination, and allowing for more efficient natural attenuation. This remedy would also result in removal of contaminant mass through groundwater extraction and treatment with an appropriate media such as cobalt-specific ion exchange resin or granular activated carbon (GAC) depending on the results of pilot treatment studies, which would reduce the potential for future releases of impacted groundwater if the integrity of the slurry wall is shown to be compromised.

Because there is an existing and functional slurry wall around the MCU, corrective measure implementation would include design, well installation, enclosure construction, and treatment system assembly/construction. Some treatment system components may require lead times prior to delivery; however, most components should be readily available. An amendment to the Site’s National Pollutant Discharge Elimination System (NPDES) permit would likely be required to discharge treated water to an on-site stormwater pond, which could delay implementation while awaiting regulatory review.

Well installation would be complicated due to the geomembrane cap to be installed as part of the unit closure. Extraction wells would either need to be installed prior to cap placement and incorporated into the cap design, or the cap would need to be penetrated and repaired following well installation.

In the event of unidentified contaminant breakthrough, there is the potential for treated water containing unacceptable contaminant levels to be discharged in the treatment system effluent. However, this is unlikely to occur as the treatment media vessel effluent will be monitored routinely and the system will be designed with a redundant “lag” vessel to treat any breakthrough contaminants in the lead vessel effluent until the lead vessel can be changed out.

The hydraulic control system will require a high level of periodic O&M compared to more passive alternatives (i.e., MNA, vertical barriers, ISS) as influent and effluent samples will likely need to be collected monthly and there is significant potential for shut-downs due to the number of different components (filter vessels, ion-exchange columns, pH adjustment system, etc.) that are needed to keep the system operational. Most or all these components will also need replacement over the 30-year design lifetime of the system.

5.2.3 Alternative C: Pump-and-Treat and MNA

For the Pump-and-Treat and MNA Alternative, a groundwater pump-and-treat system would be designed and installed to capture contaminated groundwater present downgradient of the MCU and GAMW-08, to remove impacts from the environment and prevent downgradient off-Site migration. The captured groundwater would then be treated to reduce concentrations to an acceptable concentration and discharged to surface water. Portions of the plume downgradient of the extraction well capture zone would then be subject to MNA as a polishing step in the remedy process.

The Pump-and-Treat and MNA Alternative offers a higher level of short- term protection than vertical barrier/hydraulic control and vertical reactive barriers as it would be quicker and easier to implement due to the limited subsurface infrastructure required and does not need to be coordinated with the CCR Unit closure, though source removal and dewatering during closure are important measures related to controlling/eliminating the release. Contaminant mass removal through operation of the pump-and-treat system will reduce contaminant concentrations and thereby enhance natural attenuation downgradient of the capture zone.

Some treatment system components may require lead times prior to delivery, but most components should be readily available. An amendment to the Site's NPDES permit would likely be required to discharge treated water to an on-site stormwater pond, which could delay implementation while awaiting regulatory review. In the event of unidentified contaminant breakthrough, there is the potential for treated water containing unacceptable contaminant levels to be discharged in the treatment system effluent. However, this is unlikely to occur as the treatment media vessel effluent will be monitored routinely and the system will be designed with a redundant "lag" vessel to treat any breakthrough contaminants in the lead vessel effluent until the lead vessel can be changed out. The system will require a higher level of periodic O&M compared to vertical barrier and ISS as effluent samples will likely need to be collected monthly and there is significant potential for shut-downs due to the number of different components (filter vessels, ion-exchange columns, pH adjustment system, etc.) that are needed to keep the system operational. The O&M would be similar to the vertical barrier/hydraulic control alternative, though would likely be somewhat less onerous due to the need for fewer wells and a lower pumping rate to achieve capture compared to the pumping rate required to generate an inward gradient inside the closed impoundments. Most or all these components will also need replacement over the 30-year design lifetime of the system.

5.2.4 Alternative D: Vertical Barrier and MNA

The Vertical Barrier and MNA Alternative would include a funnel-and-gate permeable reactive barrier (PRB) using an appropriate treatment media such as mixed zero-valent iron (ZVI) and GAC, which has been shown to remove cobalt (Mueller et al. 2009), with MNA to further reduce concentrations of cobalt in any portion of the plume located downgradient of the PRB, and/or cobalt migrating downgradient of the PRB following breakthrough. This alternative would offer a high level of short-term protection as little to no contaminated media would be transported off-site, and long-term protection through the immobilization and subsequent removal (during media changeout) of cobalt-contaminated groundwater. This alternative would offer a similar level of contaminant mass removal to Alternatives B and C as all three alternatives include intercepting or capturing the plume followed by adsorption to a treatment media that can be removed and disposed of off-site. Implementation/installation of a PRB would be substantially more difficult due to the extent and depth of excavation required coupled with the high density of subsurface infrastructure downgradient of the MCU. Long-term O&M requirements consisting of routine monitoring and media changeouts would be less onerous than for the alternatives incorporating active groundwater extraction systems.

5.2.5 Alternative E: ISS and MNA

ISS could be used within the plume area to bind cobalt in a cementitious matrix and reduce its potential to leach into groundwater. MNA would be implemented to address any remaining contaminant mass that is not bound by the ISS process. ISS does not remove contaminant mass, but it does result in sequestration of contaminants from the environment, eliminating potential exposure pathways for human and ecological receptors.

The ISS program would include stabilizing the soil within the cobalt plume. Based on the lack of detections in GAWM-08B and the nearby deep monitoring wells (GAMW-16B and GAMW-17B), the plume appears to be limited vertically to the top 27.5 feet bgs, at most. ISS would be accomplished using a large-diameter (6- to 10-ft diameter) rotary auger capable of injecting slurry chemicals through the auger flight to mix the residual soil with a stabilizing agent. The stabilizing agent will be determined during a design-phase pilot study and will likely consist of a mixture of Portland cement, pozzolans, and/or bentonite. At each location within the plume, the auger would be advanced through the depth of the plume and rotated to thoroughly mix the soil within the auger diameter with the stabilizing agent, generating one "column" of stabilized soil. The auger will then be advanced to an adjacent area and advanced such that it overlaps with the last column and there are no gaps between stabilized columns. This will continue until the entire plume area exceeding the GWPS has been mixed.

Short-term protection by ISS is low compared to other alternatives due to the high level of effort and materials required to implement and the associated traffic and construction safety issues associated with this technology. ISS offers good long-term protection through the isolation of contaminants from the environment and the geochemical conditions (pH 6.8 to 7.5) at the Site are favorable for the long-term lifetime of the stabilized material. However, due to the high density of subsurface utilities in the area north of the MCU, the ease of implementation for ISS is ranked lowest of the alternatives evaluated and would likely require substantial rerouting of buried piping currently in-service. ISS would also likely take the longest of the alternatives to implement apart from potentially the PRB portion of Alternative D.

5.2.6 Retained Alternatives

Based on the evaluations presented in the preceding sections, each alternative is considered feasible for the Site and fully consistent with the requirements of 40 CFR 257.98, and therefore, retained for further evaluation in the Selection of Remedy (SOR) process. The retained alternatives for the Selection of Remedy process are presented below:

- Alternative A - Monitored Natural Attenuation (MNA)
- Alternative B - Vertical Barrier/Hydraulic Controls and MNA
- Alternative C - Pump-and-Treat and MNA
- Alternative D - Vertical Barrier and MNA
- Alternative E – ISS and MNA

6.0 SUMMARY AND NEXT STEPS

This Addendum #3 supplements the ACM Report (Golder 2019) and replaces in full ACM Addenda #1 (Golder 2020) and #2 (Golder 2021) by providing additional details regarding the remaining five potential groundwater corrective measures originally identified in those reports and evaluating those corrective measures in accordance with the performance requirements identified in 40 CFR §257.96(c). It reflects NIPSCO's enhanced closure strategy, is consistent with ongoing discussions with IDEM in response to comments on the latest Closure Application, and considers recent EPA interpretations of ACM/SOR timing requirements. Addendum #3 is also consistent with EPA's earlier statements regarding ACMs as being living documents, and therefore subject to revision in accordance with changing conditions. A summary of Golder's evaluation of the five retained groundwater corrective measure alternatives is provided in Table 6.

In addition to updating the ACM to reflect the most recent discussions with IDEM and the revision/submission of the Closure Application for IDEM for review and approval, NIPSCO continues to conduct activities in accordance with the expectations of the ACM and SOR processes, including the following:

- Meeting with IDEM mid-April to discuss status and anticipated timing of the Closure Application approval.
- Preparation of bid documents (specifications and drawings) for closure of the MCU.

- Contractor procurement (including contractor pre-qualification, scheduling of site walks, scope of work question-and-answer, request for alternative approach(es), and establishment of a bid due date) to perform the source removal/capping phase of the corrective measures.
- Communications with vendors regarding water treatment technologies, equipment availability, and media costs/handling. This activity also informs and helps refine cost and schedule aspects of the SOR evaluation.
- Developing logistics and potential meeting dates for a public meeting in accordance with 40 CFR 257.96(e).

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Table 1: Applicable Groundwater Cleanup Standards
CCR Unit Schahfer MSRB, MCWB, and DA
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	MCL (mg/L)	GWPS (mg/L)	IDEM RCG (mg/L)
Appendix III Constituents			
Boron	-	NA	4
Calcium	-	NA	-
Chloride	-	NA	-
Fluoride	4	4	0.8
pH	-	NA	-
Sulfate	-	NA	-
Total Dissolved Solids	-	NA	-
Appendix IV Constituents			
Antimony	0.006	0.006	0.006
Arsenic	0.01	0.078	0.01
Barium	2	2	2
Beryllium	0.004	0.004	0.004
Cadmium	0.005	0.005	0.005
Chromium	0.1	0.1	0.1
Cobalt(1)	**0.006(2)**	**0.01**	**0.006**
Fluoride	4	4	0.8
Lead(1)	0.015(2)	0.0007	0.015
Lithium(1)	0.04(2)	0.0082	0.04
Mercury	0.002	0.002	0.002
Molybdenum(1)	0.1(2)	0.036	0.1
Radium 226+228	5	5	-
Selenium	0.05	0.05	0.05
Thallium	0.002	0.002	0.002

Prepared by: DFS
Checked by: KMC
Reviewed by: MAH

Notes:

MCL= Environmental Protection Agency Maximum Contaminant Level

GWPS= Groundwater Protection Standard calculated August 23, 2018.

Guidance- Table A-6 2018 Revision

mg/L= milligrams per liter

NA= not applicable; GWPS are calculated for Appendix IV constituents only

1) These four constituents do not have an established MCL. Prior to the Phase 1 Part 1 amendment, effective August 29, 2018, the GWPS was calculated based on background concentrations according to the CCR Final Rule.

2) The Phase 1 Part 1 amended health-based standard, effective August 29, 2018 pursuant to 40 CFR §257.95(h)(2)

Table 2: Analytical Results for MCU Monitoring Wells
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	MCL	IDEM RCG	Unit	GAMW04																						
				2016-07-12	2016-09-08	2016-11-09	2017-01-10		2017-03-01	2017-04-26	2017-06-28	2017-08-22	2017-10-04	2018-03-13	2018-03-14	2018-04-20		2018-10-25	2019-04-23	2019-11-07	2020-05-13		2020-10-22	2021-04-15	2021-09-23	2021-09-23
				N	N	N	FD	N	N	N	N	N	N	FD	N	FD	N	N	N	N	FD	N	N	N	FD	N
Appendix III Parameters																										
Boron		4	mg/L	0.48	1.4	2.4 O	1.1	1	1.2	0.74	0.92	1.2	0.54			0.74	0.72	0.78	0.74	1.3	0.66	0.64	0.4	1.1	0.36	0.35
Calcium			mg/L	110	230	300 O	270	240	230	220	200	200	140			140	140	210	130	190	115	112	90.3	178	108	107
Chloride			mg/L	2.2	27	69 O	13	14	13	5.4	12	13	4.5			3.7 J	4.4	10	3.7	9.5	2	2	4.9	6.2	3.7	3.6
Fluoride	4	4	mg/L	0.92 J+	0.2 J	10 UO	0.19 J	0.17 J	5 U	5 U	0.19 J	0.21 J	0.24 J	0.15 J	5 U	5 U	0.17 J-	0.26	0.16 J+	0.23	0.15	0.15	0.59	0.2	0.35	0.35
pH			SU	7.22	6.83	6.75		6.93	7.01	6.76	6.88	7.21	7.28		6.95		7.2	6.39	7	7.14		7.42	7.79	7.26		7.4
Sulfate			mg/L	140 J-	460	480 O	460	470	390	470	370	440	250			220	210	530	260	490	136	139	82.1	375	116	121
Total Dissolved Solids			mg/L	420	990	1400 O	1000	1000	890	870	880	920	610			580 J	580	980	600	900	411	419	299	726	381	380
Appendix IV Parameters																										
Antimony	0.006	0.006	mg/L	0.002 U	0.002 U	0.00027 JO	0.002 U	0.00057 J	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U	0.002 U			0.002 U	0.00065 J	0.00092 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Arsenic	0.01	0.01	mg/L	0.0059	0.013	0.0052 O	0.0058	0.0072	0.005 U	0.0099	0.012	0.012		0.004 J	0.0054			0.014	0.0023 J	0.0018 J	0.002	0.002	0.0055	0.0019	0.0041	0.0036
Barium	2	2	mg/L	0.041	0.077	0.11 O	0.095	0.079	0.089	0.069	0.084	0.09		0.11	0.077			0.074	0.068	0.066	0.076	0.077	0.054	0.079	0.057	0.056
Beryllium	0.004	0.004	mg/L	0.00027 J	0.001 U	0.001 UO	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U			0.00048 J	0.00053 J	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Cadmium	0.005	0.005	mg/L	0.001 U	0.001 U	0.001 UO	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U			0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Chromium	0.1	0.1	mg/L	0.002 U	0.002 U	0.00036 JO	0.00036 J	0.0052 JO	0.002 U	0.002 U	0.002 U	0.002 U		0.0011 J	0.0012 J			0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt		0.006	mg/L	0.001 U	0.00031 J	0.00064 JO	0.0061	0.0058	0.0038	0.0049	0.003	0.0023		0.0028	0.0031			0.0026	0.0011	0.00043 J	0.001 U	0.001 U	0.001 U	0.0016	0.001 U	0.001 U
Fluoride	4	4	mg/L	0.92 J+	0.2 J	10 UO	0.19 J	0.17 J	5 U	5 U	0.19 J	0.21 J	0.24 J	0.15 J	5 U	5 U	0.17 J-	0.26	0.16 J+	0.23	0.15	0.15	0.59	0.2	0.35	0.35
Lead	0.015	0.015	mg/L	0.001 U	0.001 U	0.001 UO	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U			0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium		0.04	mg/L	0.0018 J	0.008 U	0.008 UO	0.0021 J	0.0023 J	0.0033 J	0.0033 J	0.0062 J	0.0062 J		0.008 U	0.008 U			0.0023 J	0.0045 J	0.0028 J	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U
Mercury	0.002	0.002	mg/L	0.0002 U	0.0002 U	0.0002 UO	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U	0.0002 U			0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum		0.1	mg/L	0.0075 J	0.023	0.073 O	0.037	0.038	0.034	0.016	0.02	0.034		0.0048 J	0.024			0.039	0.024	0.055	0.022	0.022	0.01	0.066	0.015	0.016
Radium 226 + 228	5		pCi/L	5 U	0.583	0.697 O	0.804	0.515 U	0.362 U	0.379 U	0.364 U	0.352 U		1.35 J+	0.778 J+			0.473	0.591		1.7 U	1.62 U		0.659 U		
Selenium	0.05	0.05	mg/L	0.005 U	0.005 U	0.00064 JO	0.0017 J	0.0021 J	0.005 U	0.005 U	0.005 U	0.005 U		0.001 J	0.001 J			0.005 U	0.0013 J	0.0052	0.001 U	0.001 U	0.001 U	0.0033	0.001 U	0.001 U
Thallium	0.002	0.002	mg/L	0.001 U	0.001 U	0.001 UO	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U			0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Field Parameters																										
Dissolved Oxygen			mg/L	0.09	0.58	0.37		1.82	1.47	0.12	0.3	0.52	0.09		0.66		2.3	0.15	7.08	2.55		1.32	0.37	1.71		0.31
Oxidation Reduction Potential			millivolts	59.6	-24	-6.9		-31.7	14	-57.8	-45	-27	-105.8		-181.8		-81.2	-58.1	19	-60.7		-28.6	-7	-29		0.149
pH			SU	7.22	6.83	6.75		6.93	7.01	6.76	6.88	7.21	7.28		6.95		7.2	6.39	7	7.14		7.42	7.79	7.26		7.4
Specific Conductivity			uS/cm	595	1345	1681		1109	910	1137	911	1153	813		562		770	1311	549	866		681	521	950		595
Temperature			deg C	13	17.3	16.3		10.5	8.05	10.2	13.1	15.9	16.1		7.55		3.5	15.5	4.2	13.2		9.8	16.2	9.24		15.9
Turbidity			NTU	4.04	1.48	2.21		2.28	4.26	4.04	4.88	1.65	0.51		4.92		3.12	1.92	4.48	1.38		3.51	1.9	4.67		7.06

Notes:

IDEM RCG= Indiana Department of Environmental Management Remediation Closure Guidance Table A-6 Screening Levels - 2021 Revision

MCL= Maximum Contaminant Level
mg/L = milligrams per liter
SU = standard units
pCi/L = picoCuries per liter
uS/cm = microSiemens per centimeter
deg C = degrees Celsius
NTU = Nepholometic Turbidity Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J-" = Indicates the result is estimated and may be biased low.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.

"O" = Indicates te result was identified as an outlier and removed from the data set.

Table 2: Analytical Results for MCU Monitoring Wells
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	MCL	IDEM RCG	Unit	GAMW07																					GAMW07B							
				2016-07-12	2016-09-08	2016-11-09	2017-01-10	2017-03-01	2017-04-26	2017-06-29	2017-08-23	2017-10-03		2018-03-15	2018-04-23	2018-10-26	2019-05-02	2019-11-08	2020-04-28		2020-10-27	2021-04-16	2021-09-21	2021-09-21	2018-09-06	2018-10-26	2019-05-02	2019-11-12	2020-04-28	2020-10-27	2021-04-16	2021-09-23
				N	N	N	N	N	N	N	N	FD	N	N	N	N	N	N	FD	N	N	N	FD	N	N	N	N	N	N	N	N	N
Appendix III Parameters																																
Boron		4	mg/L	1.2	1	0.91	0.91	1	0.68	0.67	0.68	0.71	0.72		1.2	1.3	0.85	0.85	0.87	0.87	1.1	0.81	0.91	0.85	20	23	18	15	11.1	5.3	5.9	6.9
Calcium			mg/L	170	190	200	170	170	190	220	190	220	220		210	230	220	180	209	211	213	198	215	212	370	430	380	400	370	282	327	373
Chloride			mg/L	7.8	6.6	5.3	6	7.6	2.8	3 J	3.2 J	3 J	3.6 J		4.7 J	6.3	6.5	4.8	6.5	6.3	12.3	11.7	11.9	12	10 UO	250	170	150	113	21	38	60.3
Fluoride	4	4	mg/L	0.72 J+	0.91 J	0.8 J	0.85 J	0.66 J	0.76 J	0.79 J	0.66 J	1.1 J	0.93 J	0.58 J	0.57 J	0.73	0.97	0.88	0.64	0.64	0.88	0.66	0.85	0.85	10 UO	1.5	1.3	1.2	1.2	1.2	0.79	0.95
pH			SU	7.03	7.27	7.04	7.15	7.2	7.17	6.57	7.2		7.1	7.28	7.35	5.71	7.2	7.44		7.3	6.98	7.14		7.14	8.29	6.78	7.58	7.13	7.73	8.26	7.94	7.58
Sulfate			mg/L	310 J-	330	320	320	290	310	360	380	460	450		450	530	500	480	403	399	439	352	362	359	10 UO	1600	1500	1400	1260	1040	1010	1060
Total Dissolved Solids			mg/L	770	830	840	750	710	810	970	910	970	1000		900	970	1100	940	840	846	911	846	887	894	2700	2600	920	2300	2140	1590	1700	1790
Appendix IV Parameters																																
Antimony	0.006	0.006	mg/L	0.00035 J	0.00039 J	0.00035 J	0.00028 J	0.002 U	0.002 U	0.002 U	0.002 U			0.002 U		0.002 U	0.002 U	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.002 U	0.002 U	0.002 U	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U
Arsenic	0.01	0.01	mg/L	0.0013 J	0.0016 J	0.0018 J	0.0028 J	0.005 U	0.0028 J	0.0025 J	0.0016 J			0.005 U		0.0012 J	0.0019 J	0.0011 J	0.001 U	0.001 U	0.001 U	0.001 U	0.0012	0.0013	0.0028 J	0.0015 J	0.0019 J	0.0017 J	0.0023	0.0021	0.0022	0.0022
Barium	2	2	mg/L	0.052	0.055	0.056	0.042	0.05	0.05	0.059	0.059			0.056		0.064	0.053	0.043	0.041	0.04	0.057	0.046	0.053	0.052	0.072	0.063	0.053	0.043	0.044	0.036	0.041	0.037
Beryllium	0.004	0.004	mg/L	0.00011 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U			0.001 U		0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Cadmium	0.005	0.005	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0003 J	0.00022 J			0.001 U		0.00047 J	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Chromium	0.1	0.1	mg/L	0.002 U	0.002 U	0.00047 J	0.00046 J	0.002 U	0.002 U	0.002 U	0.002 U			0.002 U		0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt		0.006	mg/L	0.0056	0.0077	0.0055	0.0038	0.0044	0.0063	0.01	0.0095			0.006		0.01	0.0074	0.0049	0.0063	0.0064	0.0074	0.0056	0.0061	0.006	0.00074 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0011	0.001 U
Fluoride	4	4	mg/L	0.72 J+	0.91 J	0.8 J	0.85 J	0.66 J	0.76 J	0.79 J	0.66 J	1.1 J	0.93 J	0.58 J	0.57 J	0.73	0.97	0.88	0.64	0.64	0.88	0.66	0.85	0.85	10 U	1.5	1.3	1.2	1.2	1.2	0.79	0.95
Lead	0.015	0.015	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0007 J			0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium		0.04	mg/L	0.0034 J	0.008 U	0.008 U	0.0035 J	0.0031 J	0.0041 J	0.0037 J	0.0038 J			0.0024 J		0.0054 J	0.0041 J	0.0033 J	0.008 U	0.008 U	0.008 U	0.008 U	0.0091	0.0088	0.0043 J	0.0045 J	0.004 J	0.0035 J	0.008 U	0.008 U	0.008 U	0.013
Mercury	0.002	0.002	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ			0.0002 U		0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum		0.1	mg/L	0.0084 J	0.0098 J	0.0095 J	0.01 U	0.01 U	0.0083 J	0.0081 J	0.007 J			0.0066 J		0.0087 J	0.0097 J	0.0087 J	0.0073	0.0073	0.0094	0.0078	0.01	0.01	0.015	0.017	0.025	0.026	0.026	0.036	0.029	0.023
Radium 226 + 228	5		pCi/L	1.59	0.696	0.548	0.412 U	0.42 U	0.371 U	0.45	0.588			0.749 J+		0.823 J+	0.37 U		1.62	2.01 U		1.29 U			2.63	2.6 J+	2.31		1.92 U		2.16	
Selenium	0.05	0.05	mg/L	0.005 U	0.005 U	0.003 J	0.003 J	0.005 U	0.008	0.0054	0.005			0.0028 J		0.0016 J	0.0045 J	0.0019 J	0.0017	0.0018	0.0013	0.0069	0.0044	0.0039	0.0012 J	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U
Thallium	0.002	0.002	mg/L	0.00011 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U			0.001 U		0.00024 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Field Parameters																																
Dissolved Oxygen			mg/L	0.6	1.81	0.59	0.52	0.51	1.96	1.02	0.84		0.48	0.8	3.52	2.64	0.81	0.38		0.34	0.47	0.39		0.25	0.13	0.67	0.19	0.2	0.1	0.32	0.23	0.26
Oxidation Reduction Potential			millivolts	111.2	64.2	-6.4	71.3	65.3	76.9	291.1	8.5		95.4	-55	-98.7	-233.3	135.1	-131.8		115.2	259.4	55.5		0.1	-197.6	-230.2	34.9	-196.7	-128.6	-73.9	-124.1	0.224
pH			SU	7.03	7.27	7.04	7.15	7.2	7.17	6.57	7.2		7.1	7.28	7.35	5.71	7.2	7.44		7.3	6.98	7.14		7.14	8.29	6.78	7.58	7.13	7.73	8.26	7.94	7.58
Specific Conductivity			uS/cm	966	1072	1106	928	832	1121	1151	1157		1273	760	1060	1240	975	828		1223	1250	1064		123	5178	3237	2357	1686	2722	2055	1970	222.4
Temperature			deg C	14.4	19.2	16.7	12.9	10.63	11.8	14.6	16.5		18	10	10	16.95	10.3	15.3		10.5	15.5	11.06		17	15.03	13.86	12.4	12.9	12.7	13.3	12.2	14.7
Turbidity			NTU	4.6	4.51	1.26	3.2	4.76	2.17	2.87	0.9		0.49	1.3	1.75	1.08	2.72	4.58		3.2	1.51	3.4		2.65	4.48	3.01	2.86	1.11	3.48	8.02	2.6	4.84

Notes:
IDEM RCG= Indiana Department of Environmental Management Remediation Closure Guidance Table A-6 Screening Levels - 2021 Revision

MCL= Maximum Contaminant Level
mg/L = milligrams per liter
SU = standard units
pCi/L = picoCuries per liter
uS/cm = microSiemens per centimeter
deg C = degrees Celsius
NTU = Nephelometic Turbidity Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J-" = Indicates the result is estimated and may be biased low.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.

"O" = Indicates te result was identified as an outlier and removed from the data set.

Table 2: Analytical Results for MCU Monitoring Wells
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	MCL	IDEM RCG	Unit	GAMW08																		GAMW-08B							
				2016-07-13	2016-09-08	2016-11-09	2017-01-10	2017-03-02	2017-04-27	2017-06-29	2017-08-23	2017-10-04	2018-03-14	2018-04-23	2018-10-26	2019-05-08	2019-11-07	2020-04-24	2020-10-26	2021-04-22	2021-09-24	2018-09-07	2018-10-26	2019-05-03	2019-11-07	2020-04-2	2020-10-23	2021-04-22	2021-09-24
				N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Appendix III Parameters																													
Boron		4	mg/L	3.5	3.9	3.2	3.4	3.3	3.2	2.9	2.2	3.7		2.4	1.8	1.4	2.5	3	0.52	0.89	1.1	18	15	14	13	20.4	7	7.7	8.4
Calcium			mg/L	310	310	300	260	270	310	340	270	290		360	230	250	280	309	168	266	260	380	370	350	340	355	203	198	235
Chloride			mg/L	88	71	89	99	110	86	83	39	87		64	56	49	66	67	26.4	50	14.9	240	180	160	180	220	134	178	179
Fluoride	4	4	mg/L	1 J+	1.2 J	0.73 J	0.87 J	0.94 J	0.92 J	1.3 J	2 J	0.68 J	1.2 J	1.3 J-	1.6	2.2	1.9	1.1 J-	0.71	0.97	0.44	1.6 J	1.5	1.9	1.7	1.5 J-	0.93	0.9	0.73
pH			SU	6.92	7.03	6.85	7.02	7.09	6.93	7	7.27	6.89	7.41	7.41	6.99	7.37	7.5	7.35	6.87	7.04	7.04	7.7	7.45	7.57	7.85	7.89	7.95	7.49	7.44
Sulfate			mg/L	770 J-	690	680	610	630	770	800	640	670		800	460	540	670	719	229	477	841	1500	1500	1400	1300	1280	769	751	1060
Total Dissolved Solids			mg/L	1600	1500	1600	1300	1400	1700	2000	1400	1500		1700	1100	1300	1300	1550	636	1120	2380	1900 J+	2300	2300	2200	2560	1250	1620	2040
Appendix IV Parameters																													
Antimony	0.006	0.006	mg/L	0.00073 J	0.00069 J	0.0014 J	0.00041 J	0.00043 J	0.002 U	0.00059 J	0.00075 J		0.002 U		0.00082 J	0.00076 J	0.00077 J	0.001 U	0.001 U	0.001 U	0.001 U	0.002 U	0.002 U	0.002 U	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U
Arsenic	0.01	0.01	mg/L	0.0018 J	0.0019 J	0.0018 J	0.0027 J	0.0016 J	0.0031 J	0.0027 J	0.0023 J		0.005 U		0.0011 J	0.0015 J	0.0016 J	0.0012	0.001 U	0.001 U	0.0013	0.005 U	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U
Barium	2	2	mg/L	0.068	0.065	0.065	0.05	0.055	0.064	0.074	0.077		0.066	0.069	0.053	0.058	0.066	0.061	0.056	0.07	0.076	0.042	0.03	0.025	0.023	0.028	0.031	0.039	0.046
Beryllium	0.004	0.004	mg/L	0.00017 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.0004 J	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Cadmium	0.005	0.005	mg/L	7.4E-05 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.00037 J	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.00022	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Chromium	0.1	0.1	mg/L	0.002 U	0.002 U	0.002 U	0.00029 J	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt		0.006	mg/L	0.036	0.034	0.059	0.047	0.05	0.037	0.047	0.02		0.022	0.027	0.011	0.0079	0.011	0.022	0.037	0.017	0.015	0.00066 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Fluoride	4	4	mg/L	1 J+	1.2 J	0.73 J	0.87 J	0.94 J	0.92 J	1.3 J	2 J	0.68 J	1.2 J	1.3 J-	1.6	2.2	1.9	1.1 J-	0.71	0.97	0.44	1.6 J	1.5	1.9	1.7	1.5 J-	0.93	0.9	0.73
Lead	0.015	0.015	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium		0.04	mg/L	0.0098	0.012	0.009	0.0098	0.0093	0.012	0.011	0.012		0.0089	0.009	0.011	0.015	0.0091	0.0087	0.008 U	0.012	0.015	0.0098	0.0073 J	0.0063 J	0.0058 J	0.008 U	0.008 U	0.012	0.014
Mercury	0.002	0.002	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U		0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum		0.1	mg/L	0.034	0.036	0.024	0.02	0.019	0.038	0.049	0.083		0.058	0.058	0.059	0.08	0.068	0.048	0.013	0.034	0.043	0.037	0.039	0.057	0.044	0.05	0.0096	0.011	0.011
Radium 226 + 228	5		pCi/L	1.07	1.08	1.09	0.581	0.777	0.632	1.11	0.762		1.13 J+	0.99	1 J+	0.473		1.25 U		1.57		1.67 J+	1.02 J+	0.704		1.67 U		2.53	
Selenium	0.05	0.05	mg/L	0.005 U	0.0065	0.0033 J	0.0014 J	0.0032 J	0.011	0.0088	0.0081		0.024	0.022	0.0021 J	0.016	0.0036 J	0.0062	0.0011	0.01	0.005	0.0014 J	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U
Thallium	0.002	0.002	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.00045 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Field Parameters																													
Dissolved Oxygen			mg/L	1.9	0.38	1.62	1.27	0.96	0.63	1.96	0.93	0.21	0.97	5.09	0.21	0.44	4.2	0.34	0.44	1	0.35	0.42	0.12	0.13	2.61	0.12	0.33	0.29	0.27
Oxidation Reduction Potential			millivolts	159.7	64.6	-8	58.4	49.9	60.4	242.5	61.9	-15.9	110.1	-106.4	27.7	62.2	44.1	52.5	300	22	19.3	-185.5	-67	7.9	-67	-142.2	-51.2	-120.1	0.218
pH			SU	6.92	7.03	6.85	7.02	7.09	6.93	7	7.27	6.89	7.41	7.41	6.99	7.37	7.5	7.35	6.87	7.04	7.04	7.7	7.45	7.57	7.85	7.89	7.95	7.49	7.44
Specific Conductivity			uS/cm	1925	1807	1664	1517	1494	2098	1834	1713	1840	1121	1732	1440	1102	1322	2009	1040	1432	167.2	2538	2375	2190	1896	3391	1917	2151	286.3
Temperature			deg C	15.5	18.78	17.75	12.2	10.06	11.1	15.8	18.5	18.3	9.6	10.2	17.2	11	10.84	10.5	16.3	11.2	18.8	14.6	14.5	12.8	8.05	13	14	13	15.2
Turbidity			NTU	2.3	3.22	0.58	1.26	1.56	1.1	2.41	0.68	4.38	1.11	1.54	1.4	1.81	0.31	2.5	2.39	1.99	1.48	3.4	1.63	1.72	2.89	2.91	3.85	2.78	3.9

Notes:
IDEM RCG= Indiana Department of Environmental Management Remediation Closure Guidance Table A-6 Screening Levels - 2021 Revision

MCL= Maximum Contaminant Level
mg/L = milligrams per liter
SU = standard units
pCi/L = picoCuries per liter
uS/cm = microSiemens per centimeter
deg C = degrees Celsius
NTU = Nepholometic Turbidity Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J-" = Indicates the result is estimated and may be biased low.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.

"O" = Indicates te result was identified as an outlier and removed from the data set.

Table 2: Analytical Results for MCU Monitoring Wells
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	MCL	IDEM RCG	Unit	GAMW09																				
				2016-07-13	2016-09-08	2016-11-09	2017-01-10	2017-03-01		2017-04-26		2017-06-28	2017-08-23	2017-10-03	2018-03-14	2018-04-23	2018-10-25	2019-05-02		2019-11-07	2020-04-24	2020-10-23	2021-04-20	2021-09-23
				N	N	N	N	FD	N	FD	N	N	N	N	N	N	N	FD	N	N	N	N	N	N
Appendix III Parameters																								
Boron		4	mg/L	5.7	4.7	7.3	5.3	7.7	7.6	5.9	6.1	4.9	7.9	7.3		4.9	6.3	3	3	2.7	3.3	3.7	3.5	3.8
Calcium			mg/L	320	240	210	210	200	200	220	240	270	280	220		220	220	200	200	150	178	192	168	227
Chloride			mg/L	63	55	58	58	75	73	71	67	53	39	64		58	82	46	46	39	54.4	59.8	41.6	54.7
Fluoride	4	4	mg/L	0.15 J+	10 U	10 U	0.22 J	0.13 J	0.14 J	0.16 J	0.13 J	0.18 J	2 JO	0.21 J	5 U	0.26 J-	0.28	0.27	0.27	0.33	0.3 J-	0.31	0.26	0.34
pH			SU	7.27	7.25	7.12	6.68		7.44		7.15	7.25	7.31	7.3	7.28	6.87	6.88		7.1	7.06	7.15	7.92	8.48 O	7.51
Sulfate			mg/L	910 J-	570	360	500	440	420	460	460	600	740	540		510	510 J-	530	530	380	390	397	418	509
Total Dissolved Solids			mg/L	1500	1100	880	980	1000	990	1000	960	1300	1400	1100		930	1100	970	980	770	772	796	659	1040
Appendix IV Parameters																								
Antimony	0.006	0.006	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U
Arsenic	0.01	0.01	mg/L	0.0015 J	0.0013 J	0.00076 J	0.0031 J	0.005 U	0.005 U	0.0028 J	0.0029 J	0.002 J	0.0027 J		0.005 U		0.005 U	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U
Barium	2	2	mg/L	0.059	0.043	0.036	0.039	0.035	0.037	0.039	0.042	0.047	0.054		0.041	0.039	0.039	0.041	0.041	0.036	0.032	0.046	0.037	0.053
Beryllium	0.004	0.004	mg/L	0.00012 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.00036 J	0.001 U	0.001 U	0.001 U		0.001 UO		0.00092 J	0.00058 J	0.00052 J	0.00049 J	0.00039	0.0002 U	0.0002 U	0.0002 U
Cadmium	0.005	0.005	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.00033 J	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Chromium	0.1	0.1	mg/L	0.0036	0.002 U	0.00062 J	0.0013 J	0.002 U	0.002 U	0.002 U	0.002 U	0.0011 J	0.0015 J		0.0016 J		0.002 U	0.0012 J	0.0012 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt		0.006	mg/L	0.001 U	0.00018 J	0.0002 J	0.0002 J	0.001 U	0.001 U	0.00029 J	0.00025 J	0.001 U	0.001 U		0.001 U		0.00038 J	0.00049 J	0.00055 J	0.00035 J	0.001 U	0.001 U	0.001 U	0.001 U
Fluoride	4	4	mg/L	0.15 J+	10 U	10 U	0.22 J	0.13 J	0.14 J	0.16 J	0.13 J	0.18 J	2 JO	0.21 J	5 U	0.26 J-	0.28	0.27	0.27	0.33	0.3 J-	0.31	0.26	0.34
Lead	0.015	0.015	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium		0.04	mg/L	0.0019 J	0.008 U	0.008 U	0.0016 J	0.0011 J	0.0012 J	0.008 U	0.008 U	0.0017 J	0.0018 J		0.008 U		0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U
Mercury	0.002	0.002	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U		0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum		0.1	mg/L	0.02	0.017	0.029	0.023	0.027	0.027	0.021	0.021	0.028	0.032		0.025	0.035	0.04	0.043	0.043	0.035	0.052	0.051	0.04	0.058
Radium 226 + 228	5		pCi/L	1.5	0.568	0.477 U	0.467 U	0.55	0.469	0.593	0.414	0.707	0.803		1.45 J+	0.096	0.679	0.505	0.427 U		1.47 U		0.649 U	
Selenium	0.05	0.05	mg/L	0.014	0.0091	0.0049 J	0.011	0.014	0.014	0.019	0.02	0.013	0.027		0.0082	0.011	0.0098	0.012	0.012	0.0077	0.0096	0.0082	0.0053	0.0079
Thallium	0.002	0.002	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Field Parameters																								
Dissolved Oxygen			mg/L	3.59	6.69	1.98	6.1		3.41		3.92	5.27	3.24	5.98	6.71	5.43	0.22		5.82	5.54	3.14	3.43	3.42	6.2
Oxidation Reduction Potential			millivolts	-1.4	75.7	27.6	236		90.5		152.6	280.8	58.9	139.5	-116.3	-90.8	-48.8		53.6	-25.7	44	337.2	-20.6	0.2
pH			SU	7.27	7.25	7.12	6.68		7.44		7.15	7.25	7.31	7.3	7.28	6.87	6.88		7.1	7.06	7.15	7.92	8.48	7.51
Specific Conductivity			uS/cm	1671	736	1110	822		1041		1209	702	1542	1331	600	1156	1274		888	685	774	1218	970	138.4
Temperature			deg C	14.4	18.4	16.9	11.9		10.75		11.9	14.7	17.2	18.2	10.2	10.6	17.9		11.4	15.9	10.3	17.8	10.6	18.7
Turbidity			NTU	1.59	3.92	1.15	1.34		3.12		1.88	1.91	0.91	0.39	0.82	2.44	2.41		3.41	1.55	2.37	4	1.02	2.95

Notes:

IDEM RCG= Indiana Department of Environmental Management Remediation Closure Guidance Table A-6 Screening Levels - 2021 Revision

MCL= Maximum Contaminant Level
mg/L = milligrams per liter
SU = standard units
pCi/L = picoCuries per liter
uS/cm = microSiemens per centimeter
deg C = degrees Celsius
NTU = Nepholometic Turbidity Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J-" = Indicates the result is estimated and may be biased low.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.

"O" = Indicates te result was identified as an outlier and removed from the data set.

Table 2: Analytical Results for MCU Monitoring Wells
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	MCL	IDEM RCG	Unit	GAMW09B																						
				2016-07-13		2016-09-08	2016-11-09	2017-01-10	2017-03-01	2017-04-26	2017-06-28	2017-08-23		2017-10-03	2018-03-14	2018-04-23	2018-09-06	2018-10-26	2019-05-08		2019-11-07	2020-04-27	2020-10-23	2021-04-20		2021-09-23
				FD	N	N	N	N	N	N	N	FD	N	N	N	N	N	N	FD	N	N	N	N	FD	N	N
Appendix III Parameters																										
Boron		4	mg/L	24	25	25	16	11	11	11	12	16	16	16		14	12	12	14	14	8	6.1	6.3	6.1	6.2	6.7
Calcium			mg/L	260	280	270	190	200	170	170	180	180	180	160		160	150	180	150	150	150	148	162	169	171	163
Chloride			mg/L	210	180	190	130	110	120	130	150	170	160	140		150	180	150	140	140	110	117	107	102	94	113
Fluoride	4	4	mg/L	0.54 J+	0.55 J+	0.67 J	0.68 J	0.1 J	1.3 J	1.2 J	1.4 J	1.2 J	0.37 J	1.5 J	1.4 J	1.6 J	1.8 J	1.6	1.6	1.6	1.5	1.3	1.4	1.4	1.4	1.3
pH			SU		7.08	7.15	6.96	7.36	7.44	7.29	7.36		7.46	7.36	7.56	7.43	7.32	7.46		7.49	7.56	7.65	8		10.49 O	7.56
Sulfate			mg/L	970 J-	1000 J-	960	740	670 J+	550	570	640	630	650	550		430	570	580	510	520	440	387	540	582 J	1040 J	773
Total Dissolved Solids			mg/L	2100	2000	2100	1700	1300	1200	1200	1500	1500	1500	1300		990	1300	1200	1200	1200	990	906	1010	1030	982	1430
Appendix IV Parameters																										
Antimony	0.006	0.006	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Arsenic	0.01	0.01	mg/L	0.0024 J	0.0026 J	0.002 J	0.0014 J	0.0027 J	0.005 U	0.004 J	0.004 J	0.0031 J	0.0031 J		0.0054	0.0064	0.0044 J	0.004 J	0.0052	0.0057	0.0042 J	0.0049	0.0034	0.0033	0.0034	0.0031
Barium	2	2	mg/L	0.069	0.071	0.076	0.062	0.048	0.04	0.046	0.055	0.062	0.058		0.045	0.04	0.049	0.047	0.042	0.041	0.029	0.034	0.039	0.036	0.035	0.059
Beryllium	0.004	0.004	mg/L	0.00012 J	9.1E-05 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Cadmium	0.005	0.005	mg/L	0.00027 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Chromium	0.1	0.1	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt		0.006	mg/L	0.001 U	0.001 U	0.00069 J	0.00028 J	0.00045 J	0.001 U	0.00028 J	0.00045 J	0.00041 J	0.00041 J		0.001 U		0.00058 J	0.00028 J	0.00022 J	0.00025 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Fluoride	4	4	mg/L	0.54 J+	0.55 J+	0.67 J	0.68 J	0.1 J	1.3 J	1.2 J	1.4 J	1.2 J	0.37 J	1.5 J	1.4 J	1.6 J	1.8 J	1.6	1.6	1.6	1.5	1.3	1.4	1.4	1.4	1.3
Lead	0.015	0.015	mg/L	0.001 U	0.001 U	0.001 U	0.00017 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium		0.04	mg/L	0.0055 J	0.0065 J	0.008 U	0.008 U	0.0049 J	0.0045 J	0.0056 J	0.0054 J	0.0047 J	0.0042 J		0.0031 J		0.0037 J	0.0052 J	0.0053 J	0.0055 J	0.0033 J	0.008 U	0.008 U	0.008 U	0.008 U	0.0095
Mercury	0.002	0.002	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U		0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum		0.1	mg/L	0.01 U	0.0079 J	0.0075 J	0.0097 J	0.013	0.015	0.015	0.013	0.0094 J	0.01		0.014	0.012	0.01	0.011	0.012	0.012	0.0096 J	0.013	0.011	0.012	0.012	0.015
Radium 226 + 228	5		pCi/L	1.12	1.86	1.65	1.14	0.453	1.09	0.774	1.85	1.01	1.27		1.18 J+	0.868	1.04	1.24 J+	1.03	1.01		1.28 U		0.924 U	1.67 U	
Selenium	0.05	0.05	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.002 J	0.005 U	0.0014 J	0.001 J	0.0015 J	0.0016 J		0.005 U		0.002 J	0.0019 J	0.005 U	0.005 U	0.0011 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Thallium	0.002	0.002	mg/L	0.0003 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.0002 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Field Parameters																										
Dissolved Oxygen			mg/L		0.44	1.06	0.43	0.38	0.44	0.61	0.71		0.57	0.45	0.1	0.04	0.61	0.28		0.04	0.35	0.17	0.34		0.2	0.31
Oxidation Reduction Potential			millivolts		-57.7	67.3	-76.4	-100.1	-80.6	-102.6	68.2		19.7	-46.8	-121.6	-130.5	-100.5	-101.1		-16.8	-131.8	-106	-29.9		-113.1	0.204
pH			SU		7.08	7.15	6.96	7.36	7.44	7.29	7.36		7.46	7.36	7.56	7.43	7.32	7.46		7.49	7.56	7.65	8		10.49	7.56
Specific Conductivity			uS/cm		2356	2435	2088	1559	1352	1592	1561		1922	1722	1053	1301	1556	1693		1165	9.24	1419	1513		1459	201.2
Temperature			deg C		14.1	14.7	15.1	13.6	13.45	14.5	14.8		15.5	16	14	14.4	16.1	16		14.2	14.4	13.3	15.4		13.4	16.4
Turbidity			NTU		3.48	4.29	2.17	0.99	2.58	1.88	1.69		2.54	1.96	4.18	4.11	2.96	1.39		4.7	3.36	4.8	2.76		4.26	3.02

Notes:
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"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.

"O" = Indicates te result was identified as an outlier and removed from the data set.

Table 2: Analytical Results for MCU Monitoring Wells
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	**MCL**	**IDEM RCG**	**Unit**	GAMW15																		
				2016-07-13	2016-09-08		2016-11-09	2017-01-11	2017-03-02	2017-04-27	2017-06-29	2017-08-23	2017-10-03	2018-03-15	2018-04-24	2018-10-26	2019-05-06	2019-11-08	2020-04-27	2020-10-27	2021-04-16	2021-09-22
				N	FD	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Appendix III Parameters																						
Boron		4	mg/L	0.75	0.45 J	1 J	1.1	0.6	0.44	0.45	0.87	0.91	0.66		0.72	0.76	0.71	0.73	0.68	0.47 O	8 O	3.5
Calcium			mg/L	100	130	120	100	82	81	95	160	150	77		170	120	140	100	128	122 O	160 O	136
Chloride			mg/L	28	31	31	27	28	27	27	27	25	19		24	21	22	28	25.2	95.7 O	99.3 O	49.8
Fluoride	4	4	mg/L	1.2 J+	0.85 J	0.85 J	0.74 J	0.8 J	0.77 J	0.74 J	0.82 J	0.82 J	0.93 J	0.67 J	0.76 J	0.69	0.52	0.73	0.6	0.85 O	0.76 O	0.77 J-
pH			SU	6.88		6.98	6.83	6.96	6.99	6.76	6.61	6.96	6.88	6.95	6.89	5.2	7.1	7.34	7.34	7.02 O	7.1 O	7.12
Sulfate			mg/L	160 J-	260	260	150	140	140	160	300	330	260		410	240	380	260	227	153 O	371 O	265
Total Dissolved Solids			mg/L	570	660	630	520	400	400	420	780	750	660		790	5900 O	740	640	572	556 O	770 O	675
Appendix IV Parameters																						
Antimony	0.006	0.006	mg/L	0.002 U	0.00041 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U	0.001 U	0.001 UO	0.001 UO	0.001 U
Arsenic	0.01	0.01	mg/L	0.056	0.072	0.069	0.078	0.076	0.054	0.062	0.059	0.066		0.058		0.091	0.081	0.075	0.061	0.078 O	0.046 O	0.09
Barium	2	2	mg/L	0.044	0.053	0.053	0.039	0.032	0.031	0.034	0.054	0.058		0.047		0.046	0.047	0.037	0.039	0.053 O	0.058 O	0.05
Beryllium	0.004	0.004	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 UO	0.0002 UO	0.0002 U
Cadmium	0.005	0.005	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 UO	0.0002 UO	0.0002 U
Chromium	0.1	0.1	mg/L	0.002 U	0.002 U	0.002 U	0.00027 J	0.00028 J	0.00029 J	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U	0.002 U	0.002 UO	0.002 UO	0.002 U
Cobalt		0.006	mg/L	0.0019	0.0022	0.0022	0.0021	0.0019	0.0018	0.0022	0.0029	0.0027		0.0025		0.0023	0.0035	0.0017	0.0018	0.0019 O	0.003 O	0.0021
Fluoride	4	4	mg/L	1.2 J+	0.85 J	0.85 J	0.74 J	0.8 J	0.77 J	0.74 J	0.82 J	0.82 J	0.93 J	0.67 J	0.76 J	0.69	0.52	0.73	0.6	0.85 O	0.76 O	0.77 J-
Lead	0.015	0.015	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 UO	0.001 UO	0.001 U
Lithium		0.04	mg/L	0.0053 J	0.008 U	0.008 U	0.008 U	0.004 J	0.0024 J	0.0041 J	0.0058 J	0.005 J		0.0023 J		0.0054 J	0.0053 J	0.0027 J	0.008 U	0.008 UO	0.008 UO	0.01
Mercury	0.002	0.002	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U		0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UO	0.0002 UO	0.0002 U
Molybdenum		0.1	mg/L	0.02	0.027	0.026	0.023	0.022	0.022	0.026	0.017	0.019		0.029		0.016	0.017	0.029	0.031	0.031 O	0.028 O	0.027
Radium 226 + 228	5		pCi/L	5 U	0.479	0.513	0.646 U	0.555 J+	0.339 U	0.463 U	0.335	0.342 U		0.657 J+		0.858 J+	0.476 U		1.72 U		0.191 UO	
Selenium	0.05	0.05	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U		0.005 U		0.005 U	0.005 U	0.005 U	0.001 U	0.001 UO	0.0036 O	0.001 U
Thallium	0.002	0.002	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 UO	0.001 UO	0.001 U
Field Parameters																						
Dissolved Oxygen			mg/L	0.48		0.48	0.14	0.25	0.16	0.19	1	0.32	0.29	0.06	0.02	1.97	0.15	0.12	0.09	0.3	0.2	0.28
Oxidation Reduction Potential			millivolts	-79.2		-60.1	-111	-114.3	-104.1	-104.4	-46.9	-43.7	-13.8	-56.8	-99.1	-254.7	-27.5	-100	-103.9	-45.8	-64.1	0.193
pH			SU	6.88		6.98	6.83	6.96	6.99	6.76	6.61	6.96	6.88	6.95	6.89	5.2	7.1	7.34	7.34	7.02	7.1	7.12
Specific Conductivity			uS/cm	779		909	733	594	584	674	9.32	1004	901	581	933	855	730	598	950	941	1153	104.8
Temperature			deg C	15.3		20.3	19.9	14.6	12.1	11.6	14.6	16.6	18.1	10.8	10.6	17.1	8.3	15.8	11.5	22.3	14.38	19.2
Turbidity			NTU	4.48		2.96	3.41	3.98	4.4	4.92	4.2	3.1	4.11	3.98	4.29	3.1	4.9	6.9	4.51	4.15	9.82	6.36

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mg/L = milligrams per liter
SU = standard units
pCi/L = picoCuries per liter
uS/cm = microSiemens per centimeter
deg C = degrees Celsius
NTU = Nepholometic Turbidity Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J-" = Indicates the result is estimated and may be biased low.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.

"O" = Indicates te result was identified as an outlier and removed from the data set.

Table 2: Analytical Results for MCU Monitoring Wells
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	MCL	IDEM RCG	Unit	GAMW15B																					
				2016-07-13	2016-09-08	2016-11-09	2017-01-11	2017-03-02	2017-04-27	2017-06-29	2017-08-24	2017-10-03	2018-03-15	2018-04-24	2018-09-06		2018-10-26	2019-05-08	2019-11-08		2020-04-27	2020-10-27	2021-04-16		2021-09-22
				N	N	N	N	N	N	N	N	N	N	N	FD	N	N	N	FD	N	N	N	FD	N	N
Appendix III Parameters																									
Boron		4	mg/L	1.1	1.7	2	3.7	3.3	3.6	3.1	2.1	2.1		4.4		4.1	4.9	10		6.2	7.9	42.5 O	32.7 O	32.5 O	28.1
Calcium			mg/L	160	160	160	180	160	170	190	170	73		230		200	210	280		280	273	446 O	335 O	321 O	352
Chloride			mg/L	52	58	62	81	64	65	71	64	64		87		89	93	110		80	104	613 O	372 O	396 O	269
Fluoride	4	4	mg/L	0.65 J+	0.62 J	0.46 J	0.74 J	0.77 J	0.75 J	0.72 J	0.61 J	0.5 J	0.69 J	0.79 J		0.6 J	0.6	0.84 J+		0.89	0.84	0.41 O	0.37 O	0.35 O	0.44 J-
pH			SU	7.81	7.49	7.04	7.52	7.48	7.11	7.26	7.37	7.42	7.45	7.36		7.8	6.74	7.43		7.57	7.56	6.6 O		7.15 O	7.08
Sulfate			mg/L	380 J-	390	340	500	390	460	530	540	500		790		720	770	1300		940	912	468 O	596 O	643 O	900
Total Dissolved Solids			mg/L	830	800	840	1000	890	980	1200	1100	1100		1400		1400	1400	2100		1600	1720	2170 O	1740 O	1870 O	2030
Appendix IV Parameters																									
Antimony	0.006	0.006	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U			0.002 U	0.002 U	0.002 U		0.002 U	0.001 U	0.001 UO	0.001 UO	0.001 UO	0.001 U
Arsenic	0.01	0.01	mg/L	0.003 J	0.0011 J	0.0014 J	0.0022 J	0.0011 J	0.00098 J	0.00084 J	0.00081 J		0.005 U			0.005 U	0.005 U	0.00088 J		0.005 U	0.001 U	0.001 UO	0.001 UO	0.001 UO	0.001 U
Barium	2	2	mg/L	0.054	0.053	0.056	0.056	0.051	0.052	0.064	0.069		0.068			0.07	0.064	0.081		0.054	0.054	0.21 O	0.18 O	0.18 O	0.17
Beryllium	0.004	0.004	mg/L	7.8E-05 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U			0.001 U	0.001 U	0.001 U		0.001 U	0.0002 U	0.0002 UO	0.0002 UO	0.0002 UO	0.0002 U
Cadmium	0.005	0.005	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U			0.001 U	0.001 U	0.001 U		0.001 U	0.0002 U	0.0002 UO	0.0002 UO	0.0002 UO	0.0002 U
Chromium	0.1	0.1	mg/L	0.00062 J	0.002 U	0.002 U	0.00033 J	0.00034 J	0.002 U	0.002 U	0.002 U		0.002 U			0.002 U	0.002 U	0.002 U		0.002 U	0.002 U	0.002 UO	0.002 UO	0.002 UO	0.002 U
Cobalt		0.006	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.00016 J	0.001 U	0.001 U	0.001 U		0.00029 J			0.00037 J	0.001 U	0.001 U		0.001 U	0.001 U	0.001 UO	0.0011 O	0.001 O	0.001 U
Fluoride	4	4	mg/L	0.65 J+	0.62 J	0.46 J	0.74 J	0.77 J	0.75 J	0.72 J	0.61 J	0.5 J	0.69 J	0.79 J		0.6 J	0.6	0.84 J+		0.89	0.84	0.41 O	0.37 O	0.35 O	0.44 J-
Lead	0.015	0.015	mg/L	0.001 U	0.001 U	0.00023 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U			0.001 U	0.001 U	0.001 U		0.001 U	0.001 U	0.001 UO	0.001 UO	0.001 UO	0.001 U
Lithium		0.04	mg/L	0.0069 J	0.008 U	0.008 U	0.0077 J	0.0053 J	0.0082	0.0082	0.0077 J		0.007 J			0.008	0.0096	0.012		0.0085	0.0086	0.015 O	0.011 O	0.012 O	0.026
Mercury	0.002	0.002	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U			0.0002 U	0.0002 U	0.0002 U		0.0002 U	0.0002 U	0.0002 UO	0.0002 UO	0.0002 UO	0.0002 U
Molybdenum		0.1	mg/L	0.011	0.013	0.01	0.012	0.015	0.014	0.014	0.012		0.011			0.01	0.011	0.012		0.01	0.012	0.001 UO	0.0012 O	0.0012 O	0.0029
Radium 226 + 228	5		pCi/L	1.26	0.594	0.61	1.14 J+	0.876	0.687	0.789	0.872		1.69 J+			1.31	1.51 J+	1.61			1.63 U		2.96 O	2.15 O	
Selenium	0.05	0.05	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U		0.005 U			0.0017 J	0.005 U	0.005 U		0.005 U	0.001 U	0.001 UO	0.001 UO	0.001 UO	0.001 U
Thallium	0.002	0.002	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U			0.001 U	0.001 U	0.0003 J		0.001 U	0.001 U	0.001 UO	0.001 UO	0.001 UO	0.001 U
Field Parameters																									
Dissolved Oxygen			mg/L	0.22	0.91	0.56	0.22	0.46	0.3	0.43	0.64	0.23	0.08	0.04		0.29	2.06	0.23		0.16	0.16	0.36		0.26	0.32
Oxidation Reduction Potential			millivolts	-129.7	-21.6	-94.6	-132.6	-81.7	-79.6	-21.3	-36.5	-42.6	-64	-102.4		-91.2	-256.1	46.3		-189.2	-98.1	-7.2		-65.7	0.164
pH			SU	7.81	7.49	7.04	7.52	7.48	7.11	7.26	7.37	7.42	7.45	7.36		7.8	6.74	7.43		7.57	7.56	6.6		7.15	7.08
Specific Conductivity			uS/cm	834	1049	1060	1237	940	1096	1099	1110	1294	1255	1612		2757	1889	1798		1384	2359	3077		2491	286.6
Temperature			deg C	12.71	15.9	16.1	13.9	13.6	13	13.8	14.2	14.5	13.3	13		14.13	13.6	8.1		13.8	13.9	19.8		17.6	17
Turbidity			NTU	4.72	1.56	1.48	3.8	2.23	3.65	3.16	1.78	0.4	4.59	4.88		3.59	1.35	3.56		1.49	4.3	2.06		1.1	1.7

Notes:

IDEM RCG= Indiana Department of Environmental Management Remediation Closure Guidance Table A-6 Screening Levels - 2021 Revision

MCL= Maximum Contaminant Level
mg/L = milligrams per liter
SU = standard units
pCi/L = picoCuries per liter
uS/cm = microSiemens per centimeter
deg C = degrees Celsius
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"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
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"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.

"O" = Indicates te result was identified as an outlier and removed from the data set.

Table 2: Analytical Results for MCU Monitoring Wells
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	MCL	IDEM RCG	Unit	GAMW16																	GAMW16R			
				2016-07-13	2016-09-08	2016-11-09	2017-01-11	2017-03-02	2017-04-27	2017-06-29	2017-08-24	2017-10-04	2018-03-15	2018-04-24	2018-10-29		2019-05-03	2019-11-08		2020-04-23	2020-10-29		2021-04-22	2021-09-21
				N	N	N	N	N	N	N	N	N	N	N	FD	N	N	FD	N	N	FD	N	N	N
Appendix III Parameters																								
Boron		4	mg/L	1.1	1.8	1.6	1.2	0.89	1.3	1	1.4	1.1		1.4	1.4	1.4	1.6		1.9	1.1	9.6 O	9.7 O	3.6 O	4.1
Calcium			mg/L	230	180	170	120	160	210	220	240	57		220	160	160	210		210	302	312 O	313 O	410 O	275
Chloride			mg/L	53	37	30	28	24	25	28	31	42		58	36	36	28		59	21.9	155 O	155 O	81.1 O	112
Fluoride	4	4	mg/L	1.4 J+	1.6 J	1.3 J	1.5	1.3 J	1.3 J	1.2 J	1.3 J	1.5 J	1 J	1.2 J	1.1	1.1	0.99		1.1	0.88	0.5 O	0.5 O	0.39 O	0.57
pH			SU	7.92	7.18	7.48	7.5	7.58	7.17	7.36	7.06	7.62	7.41	7.67		7.28	7.46		7.8	7.79		7.21 O	7.16 O	7.1
Sulfate			mg/L	530 J-	400	320	47 O	300	500	480	630	520		530	340	350	570		530	757	720 O	698 O	1060 O	633
Total Dissolved Solids			mg/L	1100	810	790	570	670	930	1000	1100	980		1100	740	730	1100		1100	1290	1600 O	1540 O	1850 O	1370
Appendix IV Parameters																								
Antimony	0.006	0.006	mg/L	0.002 U	0.002 U	0.00028 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U		0.002 U	0.001 U	0.001 UC	0.001 UO	0.001 UO	0.001 U
Arsenic	0.01	0.01	mg/L	0.011	0.0077	0.012	0.0084	0.0079	0.006	0.008	0.0096		0.002 J	0.0065	0.01	0.0098	0.005		0.0082	0.009	0.0059 O	0.0058 O	0.0042 O	0.0088
Barium	2	2	mg/L	0.049	0.042	0.035	0.024	0.029	0.043	0.044	0.054		0.057	0.045	0.035	0.035	0.034		0.034	0.046	0.097 O	0.097 O	0.074 O	0.06
Beryllium	0.004	0.004	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U		0.001 U	0.0002 U	0.0002 U	0.0002 UO	0.0002 UO	0.0002 U
Cadmium	0.005	0.005	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U		0.001 U	0.0002 U	0.0002 U	0.0002 UO	0.0002 UO	0.0002 U
Chromium	0.1	0.1	mg/L	0.00062 J	0.002 U	0.002 U	0.0031	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U		0.002 U	0.002 U	0.002 UC	0.002 UO	0.002 UO	0.002 U
Cobalt		0.006	mg/L	0.001 U	0.00068 J	0.00051 J	0.00046 J	0.00055 J	0.00092 J	0.00094 J	0.0011		0.0013		0.00059 J	0.00061 J	0.00066 J		0.00061 J	0.0012	0.0039 O	0.004 O	0.0064 O	0.0038
Fluoride	4	4	mg/L	1.4 J+	1.6 J	1.3 J	1.5	1.3 J	1.3 J	1.2 J	1.3 J	1.5 J	1 J	1.2 J	1.1	1.1	0.99		1.1	0.88	0.5 O	0.5 O	0.39 O	0.57
Lead	0.015	0.015	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U		0.001 U	0.001 U	0.001 UC	0.001 UO	0.001 UO	0.001 U
Lithium		0.04	mg/L	0.00043 J	0.008 U	0.008 U	0.00023 J	0.008 U	0.008 U	0.008 U	0.008 U		0.008 U		0.008 U	0.008 U	0.008 U		0.008 U	0.008 U	0.008 UC	0.008 UO	0.008 UO	0.011
Mercury	0.002	0.002	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U		0.0002 U	0.0002 U	0.0002 U		0.0002 U	0.0002 U	0.0002 U	0.0002 UO	0.0002 UO	0.0002 U
Molybdenum		0.1	mg/L	0.024	0.036	0.045	0.044	0.03	0.027	0.023	0.024		0.027	0.031	0.033	0.033	0.027		0.028	0.022	0.019 O	0.019 O	0.027 O	0.019
Radium 226 + 228	5		pCi/L	1.68	0.543	0.527 U	0.629 U	0.648	0.392 U	0.339 U	0.429		0.862 J+	0.29	0.862 J+	1.32 J+	0.685 U			1.69 U			0.968 UO	
Selenium	0.05	0.05	mg/L	0.005 U	0.005 U	0.0005 J	0.0005 J	0.005 U	0.0012 J	0.005 U	0.005 U		0.0015 J		0.005 U	0.005 U	0.005 U		0.0015 J	0.001 U	0.042 O	0.043 O	0.001 UO	0.001 U
Thallium	0.002	0.002	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U		0.001 U	0.001 U	0.001 UC	0.001 UO	0.001 UO	0.001 U
Field Parameters																								
Dissolved Oxygen			mg/L	0.16	0.27	0.48	0.31	0.36	0.14	0.5	0.14	0.06	0.22	0.22		1.27	0.29		4.02	0.19		0.48	0.27	0.29
Oxidation Reduction Potential			millivolts	-18.06	711.6	-124.8	-78.8	-136.9	-73.6	-114.2	9.6	-158.4	-55.9	-106.5		-216.8	8		-2	-124.3		39.1	-78.9	0.208
pH			SU	7.92	7.18	7.48	7.5	7.58	7.17	7.36	7.06	7.62	7.41	7.67		7.28	7.46		7.8	7.79		7.21	7.16	7.1
Specific Conductivity			uS/cm	1331	1112	927	751	821	1257	1123	1406	1254	1029	1239		1046	1001		1014	1680		2098	2025	185
Temperature			deg C	15.02	18.8	18.15	12.1	9.72	10.6	15.41	18	17.8	8.71	9.2		17.81	10.5		17.52	10.3		20.4	15.08	25
Turbidity			NTU	3.89	2.16	1.93	3.16	4.14	3.25	4.33	2.45	4.95	4.62	12.81		3.64	4.65		3.98	8.11		2.69	4.65	1.79

Notes:

IDEM RCG= Indiana Department of Environmental Management Remediation Closure Guidance Table A-6 Screening Levels - 2021 Revision

MCL= Maximum Contaminant Level
mg/L = milligrams per liter
SU = standard units
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deg C = degrees Celsius
NTU = Nepholometic Turbidity Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J-" = Indicates the result is estimated and may be biased low.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.

"O" = Indicates te result was identified as an outlier and removed from the data set.

Table 2: Analytical Results for MCU Monitoring Wells
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	MCL	IDEM RCG	Unit	GAMW16B																		GAMW16BR		
				2016-07-13	2016-09-08	2016-11-09		2017-01-11	2017-03-02	2017-04-27	2017-06-29	2017-08-24	2017-10-04	2018-03-15	2018-04-24	2018-09-07	2018-10-29	2019-05-06	2019-11-08		2020-04-24	2020-10-26	2021-04-22	2021-09-21
				N	N	FD	N	N	N	N	N	N	N	N	N	N	N	N	FD	N	N	N	N	N
Appendix III Parameters																								
Boron		4	mg/L	1.8	1.6	1.4	1.4	1.4	1.4	1.1	3.4	6.5	2.9		4.1	7.6	9.7	12	11	10	8.2	41 O	24.8 O	25.3
Calcium			mg/L	230	190	180	180	210	210	270	220	260	100		250	310	350	350	300	280	230	439 O	380 O	265
Chloride			mg/L	63	56	57	55	57	47	71	71	120	78		140	160	150	190	220	210	122	566 O	331 O	516
Fluoride	4	4	mg/L	1.1 J+	1.1 J	0.84 J	0.73 J	0.99 J	0.87 J	0.83 J	0.76 J	0.78 J	1 J	0.8 J	0.76 J	0.73 J	0.64	0.76	1	1	0.78 J-	0.68 O	0.41 O	2.6
pH			SU	7.76	7.47		7.41	7.57	7.55	7.3	7.51	7.28	7.54	7.6	7.65	7.97	7.02	7.49		7.85	7.73	7.2 O	7.21 O	7.5
Sulfate			mg/L	580 J-	480	500	440	50 O	470	730	720	640	580		690	760	890	940	1500	1500	884	570 O	723 O	2970
Total Dissolved Solids			mg/L	1100	1000	1000	1000	1000	1000	1300	1200	1400	1200		1400	20 UO	1600	1800	2400	2400	1860	2170 O	2080 O	5970
Appendix IV Parameters																								
Antimony	0.006	0.006	mg/L	0.002 U	0.002 U	0.00057 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.00095 J		0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.001 U	0.001 UO	0.001 UO	0.001 U
Arsenic	0.01	0.01	mg/L	0.0068	0.0064	0.011	0.011	0.012	0.0095	0.012	0.0096	0.0081		0.0099	0.0097	0.011	0.0088	0.0071	0.0079	0.0076	0.008	0.001 UO	0.001 UO	0.0042
Barium	2	2	mg/L	0.072	0.04	0.036	0.035	0.038	0.039	0.055	0.043	0.046		0.053	0.058	0.068	0.071	0.079	0.055	0.054	0.043	0.091 O	0.073 O	0.041
Beryllium	0.004	0.004	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 UO	0.0002 UO	0.0002 U
Cadmium	0.005	0.005	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.00022 J		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 UO	0.0002 UO	0.0002 U
Chromium	0.1	0.1	mg/L	0.002 U	0.002 U	0.00029 J	0.002 U	0.00026 J	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 UO	0.002 UO	0.0023
Cobalt		0.006	mg/L	0.001 U	0.00016 J	0.00019 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.0003 J		0.00054 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UO	0.001 UO	0.001 U
Fluoride	4	4	mg/L	1.1 J+	1.1 J	0.84 J	0.73 J	0.99 J	0.87 J	0.83 J	0.76 J	0.78 J	1 J	0.8 J	0.76 J	0.73 J	0.64	0.76	1	1	0.78 J-	0.68 O	0.41 O	2.6
Lead	0.015	0.015	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UO	0.001 UO	0.001 U
Lithium		0.04	mg/L	0.0055 J	0.008 U	0.0032 J	0.0022 J	0.0058 J	0.0035 J	0.0072 J	0.006 J	0.0061 J		0.007 J		0.0059 J	0.0059 J	0.007 J	0.0054 J	0.0055 J	0.008 U	0.013 O	0.033 O	0.031
Mercury	0.002	0.002	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U		0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UO	0.0002 UO	0.0002 U
Molybdenum		0.1	mg/L	0.013	0.012	0.012	0.012	0.012	0.013	0.023	0.016	0.013		0.016	0.015	0.012	0.011	0.014	0.02	0.019	0.017	0.001 UO	0.001 UO	0.043
Radium 226 + 228	5		pCi/L	1.31	1.05	0.866	0.794	0.998 J+	0.577	1.23	0.795	1.21		1.11 J+	0.99	1.17 J+	1.64 J+	0.984			1.5 U		2.06 O	
Selenium	0.05	0.05	mg/L	0.005 U	0.005 U	0.00061 J	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U		0.005 U		0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.001 U	0.001 UO	0.001 UO	0.0013
Thallium	0.002	0.002	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UO	0.001 UO	0.001 U
Field Parameters																								
Dissolved Oxygen			mg/L	1.23	1.63		0.39	0.3	0.21	0.12	0.32	0.16	0.15	0.28	0.25	1.02	4.23	0.33		3.41	0.14	0.47	0.28	0.31
Oxidation Reduction Potential			millivolts	-122.6	-89		-126.3	-148.5	-132.2	-130.2	-123.1	-32.7	-135.8	-75.5	-117.8	-101.5	-166.8	21.2		-99.5	-129.6	-21.2	-95.1	0.212
pH			SU	7.76	7.47		7.41	7.57	7.55	7.3	7.51	7.28	7.54	7.6	7.65	7.97	7.02	7.49		7.85	7.73	7.2	7.21	7.5
Specific Conductivity			uS/cm	1147	1297		1158	1230	1192	1645	1333	1665	1461	1142	1653	3104	2098	1692		2340	2595	3281	2510	795.5
Temperature			deg C	13.04	14.44		15.27	14.3	13.37	12.3	13.48	14.3	15	12.6	12.3	15	17.7	11.2		14.65	13	17.5	16.38	19.5
Turbidity			NTU	4.1	3.99		1.8	2.76	4.21	4.58	3.27	2.48	3.9	4.08	4.2	4.99	3.49	3.72		2.81	6.61	8.93	7.82	20.19

Notes:

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MCL= Maximum Contaminant Level
mg/L = milligrams per liter
SU = standard units
pCi/L = picoCuries per liter
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deg C = degrees Celsius
NTU = Nepholometic Turbidity Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J-" = Indicates the result is estimated and may be biased low.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.

"O" = Indicates te result was identified as an outlier and removed from the data set.

Table 2: Analytical Results for MCU Monitoring Wells
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	MCL	IDEM RCG	Unit	GAMW17																			
				2016-07-14	2016-09-08	2016-11-09	2017-01-10	2017-03-02	2017-04-27	2017-06-29	2017-08-24	2017-10-04	2018-03-14		2018-04-23		2018-10-29	2019-05-09	2019-11-08	2020-04-24	2020-10-26	2021-04-14	2021-09-22
				N	N	N	N	N	N	N	N	N	FD	N	FD	N	N	N	N	N	N	N	N
Appendix III Parameters																							
Boron		4	mg/L	12	12	11	11	11	8.9	7.6	12	12			5.8	5.8	16	7.7	4.9	7.6	4.6	4.3	12.5
Calcium			mg/L	150	160	170	180	200	180	120	150	64			110	110	200	130	120	198	144	139	346
Chloride			mg/L	110	100	130	150	140	81	170	130	160			40	38	150	90	92	106	79.4	79	175
Fluoride	4	4	mg/L	1.8 J+	2.2 J	2 J	1.9 J	1.6 J	1.6 J	0.79 J	1.9 J	2.4 J	5 U	1.7 J	1.9 J	1.9 J-	1.7	1.6	1.7	1.2 J-	1.5	1.2	1.3 J-
pH			SU	7.56	7.27	7.21	7.33	7.54	7.23	7.4	7.16	7.22		7.62		7.82	6.85	7.53	7.75	7.34	7.38	7.3	7.16
Sulfate			mg/L	330 J-	330	360	390	390	390	520	250	350			240	220	430	300	290	459	396	358	964
Total Dissolved Solids			mg/L	940	920	940	1000	1100	950	1400	890	1000			630	620	1100	800	860	1120	726	806	1890
Appendix IV Parameters																							
Antimony	0.006	0.006	mg/L	0.00034 J	0.00032 J	0.00032 J	0.002 U	0.00028 J	0.002 U	0.002 U	0.002 U		0.002 U	0.002 U			0.002 U	0.002 U	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U
Arsenic	0.01	0.01	mg/L	0.0054	0.0056	0.0042 J	0.0069	0.0055	0.0054	0.0035 J	0.0028 J		0.005 U	0.0027 J			0.004 J	0.0021 J	0.0028 J	0.0023	0.0027	0.0024	0.0027
Barium	2	2	mg/L	0.047	0.056	0.054	0.05	0.054	0.048	0.044	0.06		0.041	0.058		0.029	0.073	0.041	0.052	0.067	0.071	0.059	0.17
Beryllium	0.004	0.004	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U			0.001 U	0.00076 J	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Cadmium	0.005	0.005	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U			0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Chromium	0.1	0.1	mg/L	0.0015 J	0.002 U	0.0011 J	0.0011 J	0.0012 J	0.0012 J	0.002 U	0.002 U		0.0017 J	0.0014 J			0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt		0.006	mg/L	6.3E-05 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U			0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0012	0.001 U
Fluoride	4	4	mg/L	1.8 J+	2.2 J	2 J	1.9 J	1.6 J	1.6 J	0.79 J	1.9 J	2.4 J	5 U	1.7 J	1.9 J	1.9 J-	1.7	1.6	1.7	1.2 J-	1.5	1.2	1.3 J-
Lead	0.015	0.015	mg/L	0.00018 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U			0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium		0.04	mg/L	0.0047 J	0.008 U	0.0036 J	0.0047 J	0.0024 J	0.0045 J	0.0058 J	0.0076 J		0.008 U	0.0035 J			0.0066 J	0.0035 J	0.0052 J	0.008 U	0.008 U	0.008 U	0.021
Mercury	0.002	0.002	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U	0.0002 U			0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum		0.1	mg/L	0.015	0.012	0.011	0.01 U	0.01	0.011	0.018	0.024		0.024	0.024		0.02	0.017	0.017	0.012	0.03	0.013	0.012	0.01
Radium 226 + 228	5		pCi/L	0.569	0.451 U	0.447 U	0.553 U	0.428	0.477	0.403 U	0.71		0.816 J+	0.384 U		0.205	1.1 J+	0.518 U		1.58 U		1.05 U	
Selenium	0.05	0.05	mg/L	0.019	0.03	0.018	0.023	0.028	0.026	0.0081	0.0032 J		0.0074	0.021		0.015	0.022	0.004 J	0.011	0.0011	0.0047	0.01	0.0036
Thallium	0.002	0.002	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U			0.001 U	0.00063 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Field Parameters																							
Dissolved Oxygen			mg/L	5.78	1.7	1.8	1.01	2.35	7.33	3.18	4.33	3.3		4.99		9	1.78	5.75	6.47	3.15	1.21	2.52	3.75
Oxidation Reduction Potential			millivolts	45.8	825.9	6.1	82.3	6.6	67.9	23.3	8	57.9		-90.2		-90.2	-237	53.1	35	25.2	234.5	29.8	10.2
pH			SU	7.56	7.27	7.21	7.33	7.54	7.23	7.4	7.16	7.22		7.62		7.82	6.85	7.53	7.75	7.34	7.38	7.3	7.16
Specific Conductivity			uS/cm	1059	1287	1141	1272	1541	1290	902	1151	1357		832		675	1513	894	798	1017	1188	1152	236.5
Temperature			deg C	17.23	20.6	18.63	13.6	10.95	11.8	17.71	24.4	22.3		10.9		11.4	20	12.1	17.23	9.31	20.4	11.95	21.8
Turbidity			NTU	1.56	1.09	0.58	2.58	0.44	2.21	1.02	1.5	2.51		0.54		1.19	0.45	0.44	0.86	0.73	3.85	1.25	1.47

Notes:
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deg C = degrees Celsius
NTU = Nepholometic Turbidity Units

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"J-" = Indicates the result is estimated and may be biased low.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.

"O" = Indicates te result was identified as an outlier and removed from the data set.

Table 2: Analytical Results for MCU Monitoring Wells
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	MCL	IDEM RCG	Unit	GAMW17B																		
				2016-07-13	2016-09-08	2016-11-09	2017-01-10	2017-03-02	2017-04-27	2017-06-29	2017-08-23	2017-10-04	2018-03-14	2018-04-23	2018-09-06	2018-10-29	2019-05-09	2019-11-08	2020-04-24	2020-10-26	2021-04-14	2021-09-22
				N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Appendix III Parameters																						
Boron		4	mg/L	18	19	19	21	22	20	16	13	11		13	10	12	12	9.4	8.7	7.8	10.2	7.3
Calcium			mg/L	230	250	240	250	270	250	240	160	57		180	150	150	180	150	141	152	164	155
Chloride			mg/L	180	170	180	190	200	200	71	99	130		140	120	110	130	110	111	118	135	105
Fluoride	4	4	mg/L	0.9 J+	0.98 J	0.68 J	0.58 J	0.6 J	0.6 J	2.1 J	1.3 J	1.1 J	0.55 J	0.58 J	0.84 J	0.71	0.62	0.67	0.68 J-	0.53	0.3	0.49 J-
pH			SU	7.43	7.37	7.1	7.24	7.44	7.02	7.25	7.19	7.38	7.48	7.39	7.63	7.4	7.15	7.66	7.22	8.21	7.84	7.6
Sulfate			mg/L	710 J-	680	710	740	710	680	300	380	420		520	350	350	270	350	314	404	549	365
Total Dissolved Solids			mg/L	1500	1400	1400	1500	1700	1500	660	1000	960		1100	940	950	980	990	835	866	1250	928
Appendix IV Parameters																						
Antimony	0.006	0.006	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U
Arsenic	0.01	0.01	mg/L	0.0024 J	0.0021 J	0.0024 J	0.0035 J	0.0023 J	0.0022 J	0.0023 J	0.0026 J		0.0011 J		0.0017 J	0.0023 J	0.0022 J	0.0019 J	0.0015	0.0022	0.0012	0.0021
Barium	2	2	mg/L	0.078	0.079	0.086	0.092	0.1	0.089	0.065	0.06		0.085	0.069	0.066	0.073	0.11	0.074	0.065	0.061	0.094	0.053
Beryllium	0.004	0.004	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.00033 J	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Cadmium	0.005	0.005	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Chromium	0.1	0.1	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt		0.006	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.0003 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0015	0.001 U
Fluoride	4	4	mg/L	0.9 J+	0.98 J	0.68 J	0.58 J	0.6 J	0.6 J	2.1 J	1.3 J	1.1 J	0.55 J	0.58 J	0.84 J	0.71	0.62	0.67	0.68 J-	0.53	0.3	0.49 J-
Lead	0.015	0.015	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium		0.04	mg/L	0.0017 J	0.008 U	0.008 U	0.0019 J	0.00046 J	0.0021 J	0.0019 J	0.008 U		0.008 U		0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U
Mercury	0.002	0.002	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U		0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum		0.1	mg/L	0.024	0.021	0.013	0.011	0.012	0.011	0.017	0.021		0.017	0.016	0.01	0.011	0.0073 J	0.01	0.014	0.0082	0.0058	0.012
Radium 226 + 228	5		pCi/L	1.79	1.84	2.53	2.58	1.25	1.94	1.03	2.4		1.64 J+	1.21	1.47	2.48 J+	1.71		1.74		1.47 U	
Selenium	0.05	0.05	mg/L	0.005 U	0.005 U	0.005 U	0.00053 J	0.00051 J	0.005 U	0.005 U	0.005 U		0.005 U		0.0011 J	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U
Thallium	0.002	0.002	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.00022 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Field Parameters																						
Dissolved Oxygen			mg/L	0.33	0.24	0.67	0.36	0.13	0.13	0.18	0.14	0.09	0.16	0.11	0.2	0.88	0.23	4.2	0.2	0.4	0.21	0.29
Oxidation Reduction Potential			millivolts	-115	654	-100.8	-119.6	-91.8	102.3	-98.6	-51.1	-129.4	-95.2	-131.9	-91.9	-244.5	11.8	-3.6	-94.1	-55.5	-117.5	0.215
pH			SU	7.43	7.37	7.1	7.24	7.44	7.02	7.25	7.19	7.38	7.48	7.39	7.63	7.4	7.15	7.66	7.22	8.21	7.84	7.6
Specific Conductivity			uS/cm	1525	1734	1568	171.9	2251	1950	1488	1244	1337	1235	1463	2077	1380	1060	890	920	1396	1778	138.8
Temperature			deg C	15.29	16.16	15.77	15	14.8	14.4	15.62	16.5	16.6	15.2	15.2	16.55	16.1	13.6	15.05	13.12	16.9	15.19	16.7
Turbidity			NTU	4.09	2.48	0.62	0.92	0.58	2.11	2.35	1.86	3.45	3.76	3.88	3.55	4.86	3.61	2.68	4.58	4	1.44	4.22

Notes:

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"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J-" = Indicates the result is estimated and may be biased low.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.

"O" = Indicates te result was identified as an outlier and removed from the data set.

Table 2: Analytical Results for MCU Monitoring Wells
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	MCL	IDEM RCG	Unit	GAMW18																				
				2016-07-13	2016-09-08	2016-11-09		2017-01-10	2017-03-01	2017-04-26	2017-07-12		2017-08-23	2017-10-03		2018-03-14	2018-04-23	2018-10-25	2019-04-29	2019-11-07	2020-04-23	2020-10-23	2021-04-20	2021-09-16
				N	N	FD	N	N	N	N	FD	N	N	FD	N	N	N	N	N	N	N	N	N	N
Appendix III Parameters																								
Boron		4	mg/L	1.8	3.5	1.9	1.8	1.3	1	0.77	1.2	1.2	1.5	1.9	1.9		1.2	1.7	0.95	1.7	1.2	3.6	3.1	5.9
Calcium			mg/L	320	610 O	370	360	330	280	210	280	290	300	380 J	64 J		320	230	320	360	294	341	436	456
Chloride			mg/L	17	39	17	17	9.3	5	4.3	10	10	11	23	23		7.3	22	12	27	16.7	54.8	40.3	97
Fluoride	4	4	mg/L	0.047 J+	0.036 J	10 U	10 U	5 U	5 U	2 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.057	0.074	0.15	0.17	0.19	0.16	0.16 J-
pH			SU	6.95	6.83		6.7	6.88	7.11	6.6		6.96	7.02		6.91	7.2	7.21	6.54	6.71	7.18	6.96	7.1	10.36 O	7.1
Sulfate			mg/L	760 J-	1400	850	830	640	540	370	600	610	690	960	950		670	550	780	920	679	765	1310	1160
Total Dissolved Solids			mg/L	1300	2200	1500	1500	1200	1000	730	1100	1100	1300	1600	1500		2400	1100	1400	1500	1130	1450	1440	2020
Appendix IV Parameters																								
Antimony	0.006	0.006	mg/L	0.002 U	0.002 U	0.00096 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U			0.002 U		0.002 U	0.002 U	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U
Arsenic	0.01	0.01	mg/L	0.0014 J	0.0023 J	0.0014 J	0.00091 J	0.0014 J	0.005 U	0.0015 J	0.0021 J	0.0021 J	0.0011 J			0.005 U		0.005 U	0.00079 J	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U
Barium	2	2	mg/L	0.038	0.047	0.041	0.039	0.037	0.024	0.021	0.051	0.052	0.055			0.048	0.035	0.037	0.039	0.05	0.033	0.053	0.044	0.057
Beryllium	0.004	0.004	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U			0.001 U		0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Cadmium	0.005	0.005	mg/L	8.1E-05 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U			0.001 U		0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Chromium	0.1	0.1	mg/L	0.002 U	0.002 U	0.00067 J	0.00046 J	0.0005 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U			0.002 U		0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt		0.006	mg/L	0.001 U	0.00023 J	0.00047 J	0.0002 J	0.00024 J	0.001 U	0.00023 J	0.001 U	0.001 U	0.001 U			0.001 U		0.001 U	0.00028 J	0.001 U	0.001 U	0.001 U	0.001 U	0.0011
Fluoride	4	4	mg/L	0.047 J+	0.036 J	10 U	10 U	5 U	5 U	2 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.057	0.074	0.15	0.17	0.19	0.16	0.16 J-
Lead	0.015	0.015	mg/L	0.001 U	0.001 U	0.00051 J	0.00025 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U			0.00067 J		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium		0.04	mg/L	0.00096 J	0.008 U	0.008 U	0.008 U	0.00042 J	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U			0.008 U		0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.011
Mercury	0.002	0.002	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ			0.0002 U		0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum		0.1	mg/L	0.11	0.18 O	0.14 O	0.13 O	0.094	0.1	0.1	0.1	0.11	0.1			0.097	0.085	0.057	0.062	0.076	0.071	0.079	0.082	0.14
Radium 226 + 228	5		pCi/L	5 U	0.803	0.474	0.449	0.581 U	0.398 U	0.384 U	0.493	0.337 U	0.629			0.373 U	0.259	0.477	0.365 U		1.74 U		0.538 U	
Selenium	0.05	0.05	mg/L	0.01	0.018	0.0065	0.0052	0.0099	0.011	0.0053	0.012	0.012	0.006			0.009	0.0084	0.015	0.015	0.012	0.018	0.034	0.042	0.028
Thallium	0.002	0.002	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U			0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Field Parameters																								
Dissolved Oxygen			mg/L	4.83	4.77		5.93	7.52	8.86	7.79		6.04	4.52		5.32	6.5	8.49	3.78	7.01	2.95	5.6	6.58	6.82	5.39
Oxidation Reduction Potential			millivolts	98.9	76.8		28.7	106.8	97.9	209.2		203.2	24.7		121.9	-129.6	-51.6	-36.6	129.2	-41.1	241.3	320.6	-64.3	56.8
pH			SU	6.95	6.83		6.7	6.88	7.11	6.6		6.96	7.02		6.91	7.2	7.21	6.54	6.71	7.18	6.96	7.1	10.36	7.1
Specific Conductivity			uS/cm	1474	2362		1740	1255	986	970		1299	1414		1760	905	1170	1230	1060	1338	995	1921	1699	245.9
Temperature			deg C	16.3	20.1		16.6	9.65	8.47	11.2		17.9	19.8		19.3	8.1	8.9	17.4	8.8	14.2	9.18	17.4	10.29	21.4
Turbidity			NTU	3.32	1.63		2.38	3.05	4.44	2.48		1.71	1.03		4.16	4.59	0.71	1.29	4.55	2.04	1.33	2.84	2.84	3.74

Notes:

IDEM RCG= Indiana Department of Environmental Management Remediation Closure Guidance Table A-6 Screening Levels - 2021 Revision

MCL= Maximum Contaminant Level
mg/L = milligrams per liter
SU = standard units
pCi/L = picoCuries per liter
uS/cm = microSiemens per centimeter
deg C = degrees Celsius
NTU = Nepholometic Turbidity Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J-" = Indicates the result is estimated and may be biased low.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.

"O" = Indicates te result was identified as an outlier and removed from the data set.

Table 2: Analytical Results for MCU Monitoring Wells
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	MCL	IDEM RCG	Unit	GAMW18B										GAMW46											
				2018-09-10	2018-10-25		2019-04-29	2019-11-07	2020-04-23	2020-10-23	2021-04-21	2021-09-17		2018-06-13	2019-03-01	2019-04-17	2019-06-06	2019-07-18	2019-08-26	2019-10-04	2019-11-19	2020-04-21	2020-10-19	2021-04-27	2021-09-15
				N	FD	N	N	N	N	N	N	FD	N	N	N	N	N	N	N	N	N	N	N	N	N
Appendix III Parameters																									
Boron		4	mg/L	13	12	13	14	11	10.9	9	8.4	8.2	8.2	0.055 JO	0.1 U	0.033 J	0.1 U	0.032 J	0.053 J	0.043 J	0.049 J	0.1 U	0.1 U	0.1 U	0.1 U
Calcium			mg/L	260	200	220	240	180	299	301	317	325	323	56 O	14	28	25 J-	25	25	23	27	24.5	22.7	29.1	29.3
Chloride			mg/L	150	140	140	170	140	117	114	112	85.8	86.3	8.4 O	2.4	1.9		1.8	1.6	1.6	1.6	1.6	1.3	2.1	2.1
Fluoride	4	4	mg/L	0.77 J	0.74	0.73	0.88	0.99	0.91	0.8	0.35	0.6	0.6	0.052 JO	0.068	0.063		0.065	0.06	0.079 J+	0.062	0.062	0.05 U	0.078	0.11
pH			SU	7.73		6.86	7.15	7.68	7.21	7.43	7.51		7.34	7.93	8.17	8.23	7.52	8.15	7.9	7.81	7.77	8.64	8.67	8.36	8.16
Sulfate			mg/L	1100	1000	1100	1100	840	1220	1240	1260	1100	1120	55 O	34	30		28	29	30	27	24.7	23.9	33 J+	31.8
Total Dissolved Solids			mg/L	2100	2000	2000	2100	1500	2060	1830	3340	1930	2010	260 O	160	150		130	150	140 J+	140	101	85	112	137
Appendix IV Parameters																									
Antimony	0.006	0.006	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.002 UO	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U
Arsenic	0.01	0.01	mg/L	0.0018 J	0.0026 J	0.0028 J	0.0037 J	0.0041 J	0.0029	0.0025	0.0025	0.0028	0.0027	0.0014 JO	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.00086 J	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U
Barium	2	2	mg/L	0.048	0.035	0.039	0.039	0.024	0.041	0.032	0.041	0.028	0.029	0.027 O	0.0028 J	0.0059	0.0065	0.0054	0.0054	0.0049 J	0.0059	0.0053	0.0046	0.005	0.0044
Beryllium	0.004	0.004	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.001 UO	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U	0.00054 J	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Cadmium	0.005	0.005	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.001 UO	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Chromium	0.1	0.1	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 UO	0.002 U	0.002 U	0.002 U	0.002 U	0.0014 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt		0.006	mg/L	0.00027 J	0.00026 J	0.00028 J	0.00024 J	0.00024 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 JO	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Fluoride	4	4	mg/L	0.77 J	0.74	0.73	0.88	0.99	0.91	0.8	0.35	0.6	0.6	0.052 JO	0.068	0.063		0.065	0.06	0.079 J+	0.062	0.062	0.05 U	0.078	0.11
Lead	0.015	0.015	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UO	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium		0.04	mg/L	0.025	0.015	0.016	0.023	0.015	0.026	0.03	0.037	0.031	0.028	0.008 UO	0.04 U	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U
Mercury	0.002	0.002	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UO	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum		0.1	mg/L	0.024	0.014	0.015	0.026	0.011	0.039	0.05	0.074	0.03	0.031	0.0031 JO	0.01	0.01 U	0.01 U	0.01 U	0.01 U	0.0015 J	0.01 U	0.001 U	0.001 U	0.001 U	0.001 U
Radium 226 + 228	5		pCi/L	1.7	1.28	1.46			1.7 U		2.14			0.384 UO	0.486 U	0.33 U		0.427 U	0.505 U	0.566		1.7 U		1.28 U	
Selenium	0.05	0.05	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 JO	0.025 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U
Thallium	0.002	0.002	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UO	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.00059 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Field Parameters																									
Dissolved Oxygen			mg/L	0.24		0.29	0.92	0.36	0.18	0.35	0.25		0.19	0.12	1.85	4.18	6.44	6.58	4.03	2.44	3.36	3.42	4.78	1.59	1.26
Oxidation Reduction Potential			millivolts	-140.7		-103.4	109.2	-144.8	-77.7	15.9	-104.5		0.192	-171.4	1.9	7.7	157.6	25.5	40.6	9.16	-141.1	125.6	127	109.8	-130
pH			SU	7.73		6.86	7.15	7.68	7.21	7.43	7.51		7.34	7.93	8.17	8.23	7.52	8.15	7.9	7.81	7.77	8.64	8.67	8.36	8.16
Specific Conductivity			uS/cm	3311		2147	1902	1475	1897	2646	2494		247.3	367	155	161	179	153	153	152	132	208	175.1	238.2	238
Temperature			deg C	15.39		14.9	11.8	13.7	12.1	15.2	12.15		15.8	11.4	8	9.1	11.1	13.2	14.2	14.8	11.7	8.3	13.5	10.7	15.1
Turbidity			NTU	2.78		3.58	3.21	3.14	2.35	3.28	4.19		4.59	3.96	1.91	1.33	0.51	0.82	0.69	0.89	0.66	2.18	3.02	1.73	3.21

Notes:
IDEM RCG= Indiana Department of Environmental Management Remediation Closure Guidance Table A-6 Screening Levels - 2021 Revision

MCL= Maximum Contaminant Level
mg/L = milligrams per liter
SU = standard units
pCi/L = picoCuries per liter
uS/cm = microSiemens per centimeter
deg C = degrees Celsius
NTU = Nepholometic Turbidity Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J-" = Indicates the result is estimated and may be biased low.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.

"O" = Indicates te result was identified as an outlier and removed from the data set.

Table 2: Analytical Results for MCU Monitoring Wells
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	**MCL**	**IDEM RCG**	**Unit**	GAMW46B												GAMW52							
				2018-06-13	2019-03-04	2019-04-17	2019-06-07	2019-07-18	2019-08-26	2019-10-04	2019-11-19	2020-04-21	2020-10-19	2021-04-27	2021-09-15	2018-09-10	2018-10-31	2019-05-09	2019-11-1	2020-04-30	2020-10-22	2021-04-16	2021-09-30
				N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Appendix III Parameters																							
Boron		4	mg/L	0.05 JO	0.05 J	0.037 J	0.047 J	0.03 J	0.05 J	0.047 J	0.046 J	0.1 U	0.1 U	0.1 U	0.1 U	0.34	0.17	0.077 J	0.13	0.1 U	0.1	0.1	0.1
Calcium			mg/L	25 O	58	58	56	52	58	49	56	53.8	51	54.3	51	75	59	52	72	48.3	71.4	59.9	62.5
Chloride			mg/L	3 O	7.9	7.9		7.2	8	7.1	6.9	5.5	4.6	5.5	5.4	34	9.1	5.5	37	8.2	49.1	18.7	15.9
Fluoride	4	4	mg/L	0.048 JO	0.066	0.076		0.072	0.069	0.073 J+	0.072	0.084	0.058	0.077	0.12	0.36 J	0.3	0.25 J+	0.3	0.29	0.26	0.22	0.31
pH			SU	8.2	7.11	7.99	7.58	8.18	7.62	7.44	7.47	8.08	7.97	7.69	7.73	7.5	7.06	7.17	7.59	7.98	7.82	7.5	7.6
Sulfate			mg/L	29 O	64	64		64	68	65	64	58.8	60.5	61.6 J+	55.3	86	39	24	67	21.6	58.6	55.8	50.1
Total Dissolved Solids			mg/L	150 O	260	290		240	220 J	250	240	209	197	190	243	400	250	240	350	205	336	269	276
Appendix IV Parameters																							
Antimony	0.006	0.006	mg/L	0.002 UO	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.002 U	0.002 U	0.002 U	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U
Arsenic	0.01	0.01	mg/L	0.0015 JO	0.0012 J	0.00076 J	0.005 U	0.00091 J	0.00095 J	0.0013 J	0.001 J	0.001 U	0.001 U	0.001 U	0.001 U	0.005 U	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U
Barium	2	2	mg/L	0.0086 O	0.027	0.026	0.025	0.023	0.024	0.021	0.025	0.025	0.023	0.025	0.023	0.039	0.019	0.015	0.02	0.013	0.014	0.011	0.014
Beryllium	0.004	0.004	mg/L	0.001 UO	0.0011	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0011	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Cadmium	0.005	0.005	mg/L	0.001 UO	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.001 U	0.00024 J	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Chromium	0.1	0.1	mg/L	0.0021 O	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt		0.006	mg/L	0.00034 JO	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.00058 J	0.00031 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Fluoride	4	4	mg/L	0.048 JO	0.066	0.076		0.072	0.069	0.073 J+	0.072	0.084	0.058	0.077	0.12	0.36 J	0.3	0.25 J+	0.3	0.29	0.26	0.22	0.31
Lead	0.015	0.015	mg/L	0.001 UO	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium		0.04	mg/L	0.008 UO	0.0017 J	0.008 U	0.008 U	0.002 J	0.008 U	0.008 U	0.003 J	0.008 U	0.008 U	0.008 U	0.008 U	0.0017 J	0.008 U	0.008 U	0.0025 J	0.008 U	0.008 U	0.008 U	0.008 U
Mercury	0.002	0.002	mg/L	0.0002 UO	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum		0.1	mg/L	0.0018 JO	0.0024 J	0.0022 J	0.0025 J	0.0028 J	0.0028 J	0.0025 J	0.003 J	0.0021	0.0022	0.0018	0.0018	0.005 J	0.0035 J	0.0016 J	0.0017 J	0.0012	0.0022	0.0021	0.0025
Radium 226 + 228	5		pCi/L	0.392 UO	0.402 U	0.308 U		0.427 U	0.609 U	0.408 U		1.68 U		1.65 U		0.796	1 J+	0.53 U		1.64 U		0.23 U	
Selenium	0.05	0.05	mg/L	0.0017 JO	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0014 J	0.0017 J	0.0014 J	0.0011 J	0.001 U	0.0011	0.0011	0.001 U
Thallium	0.002	0.002	mg/L	0.001 UO	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.00068 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Field Parameters																							
Dissolved Oxygen			mg/L	3.59	0.08	1.9	0.3	1.4	1.25	0.31	0.3	0.17	1.1	0.64	0.2	0.48	0.21	6.42	2.2	6.9	0.35	0.91	0.56
Oxidation Reduction Potential			millivolts	-29.4	111.9	-111.1	-133.1	-93.9	-119.9	33.7	-229.6	-137.1	-40.5	-101.3	-241	-30.3	85.1	108.2	-43.2	165.6	227.8	-23.1	0.38
pH			SU	8.2	7.11	7.99	7.58	8.18	7.62	7.44	7.47	8.08	7.97	7.69	7.73	7.5	7.06	7.17	7.59	7.98	7.82	7.5	7.6
Specific Conductivity			uS/cm	211	268	294	282	274	284	260	242	405	358.9	351	388	0.896	448	308	320	389	641	545	501
Temperature			deg C	11.3	9.6	10.8	11	11.9	12.3	12.3	11.3	10	11.7	11.37	12.2	19.97	17.6	14.2	15.3	10.9	19	12	20
Turbidity			NTU	3.45	3.26	4.3	3.25	3.11	1.15	4.16	2.84	4.02	4.69	4.58	4.3	0.45	0.83	0.42	0.74	1.57	1.09	1.79	1.39

Notes:

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mg/L = milligrams per liter
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deg C = degrees Celsius
NTU = Nepholometic Turbidity Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J-" = Indicates the result is estimated and may be biased low.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.

"O" = Indicates te result was identified as an outlier and removed from the data set.

Table 2: Analytical Results for MCU Monitoring Wells
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	MCL	IDEM RCG	Unit	GAMW52B								GAMW53								
				2018-09-11	2018-10-31	2019-05-09	2019-11-14	2020-04-30	2020-10-23	2021-04-16	2021-09-30	2018-09-11	2018-10-30	2019-04-30	2019-11-14	2020-05-01	2020-10-23		2021-04-16	2021-09-30
				N	N	N	N	N	N	N	N	N	N	N	N	N	FD	N	N	N
Appendix III Parameters																				
Boron		4	mg/L	0.75	0.8	1	1.3	0.77	1.7	1.2	0.64	0.19	0.25	0.056 J	0.13	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Calcium			mg/L	160	160	110	130	129	142	94.9	120	45	53	17	25	32	16.9	17	17.5	28.3
Chloride			mg/L	530	470	380	370	496	248	131	135	4.9	4.6	1.9	3.6	4.3	1.8	2	2.4	2.7
Fluoride	4	4	mg/L	10 U	0.18	0.21 J+	0.23	0.26	0.26	0.24	0.38	0.17 J	0.17	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
pH			SU	8.3	7.1	7.42	7.34	7.6	7.29	7.46	7.57	6	6.47	5.93	6.21	6.42		5.88	5.76	6.17
Sulfate			mg/L	210	190	220	290	216	259	181	156	51	56	37	36	32.6	26.6	28.2	35.2	49.4
Total Dissolved Solids			mg/L	1500	1300	1100	1100	1260	982	673	667	240	250	130	160	161	89	99	97	147
Appendix IV Parameters																				
Antimony	0.006	0.006	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.002 U	0.002 U	0.002 U	0.00061 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Arsenic	0.01	0.01	mg/L	0.0013 J	0.0016 J	0.00083 J	0.0012 J	0.0011	0.001 U	0.0011	0.0011	0.013	0.015	0.00097 J	0.0018 J	0.0015	0.0014	0.0014	0.0012	0.0012
Barium	2	2	mg/L	0.32	0.31	0.25	0.28	0.29	0.23	0.15	0.14	0.027	0.028	0.019	0.026	0.023	0.022	0.023	0.027	0.033
Beryllium	0.004	0.004	mg/L	0.001 U	0.00042 J	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Cadmium	0.005	0.005	mg/L	0.001 U	0.00029 J	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Chromium	0.1	0.1	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.0019 J	0.0018 J	0.0012 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt		0.006	mg/L	0.001 U	0.00032 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.00084 J	0.00099 J	0.0005 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Fluoride	4	4	mg/L	10 U	0.18	0.21 J+	0.23	0.26	0.26	0.24	0.38	0.17 J	0.17	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Lead	0.015	0.015	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0014	0.00089 J	0.00057 J	0.00063 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium		0.04	mg/L	0.0041 J	0.0031 J	0.0033 J	0.0071 J	0.0086	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.0021 J	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U
Mercury	0.002	0.002	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum		0.1	mg/L	0.014	0.015	0.0095 J	0.0086 J	0.016	0.015	0.013	0.011	0.012	0.015	0.0051 J	0.011	0.0068	0.0066	0.0066	0.0052	0.0097
Radium 226 + 228	5		pCi/L	3.52	5.55 J+	2.63		2.44		1.05 U		0.547 U	1.45 J+	0.344 U		1.9 U			0 U	
Selenium	0.05	0.05	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U	0.005 U	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0019
Thallium	0.002	0.002	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Field Parameters																				
Dissolved Oxygen			mg/L	0.44	0.1	0.15	0.19	0.09	1.02	0.42	0.28	0.53	0.86	3.11	0.84	1.39		1.16	1.99	0.92
Oxidation Reduction Potential			millivolts	-214.9	-103.5	6.31	-102.9	-104.2	-141.6	-123.5	0.241	-24.6	-199.5	43.7	-54.8	168		122.8	111.7	94.9
pH			SU	8.3	7.1	7.42	7.34	7.6	7.29	7.46	7.57	6	6.47	5.93	6.21	6.42		5.88	5.76	6.17
Specific Conductivity			uS/cm	1934	2005	1652	1353	2424	1400	1159	110.4	307	400	125	155	260		144	173	204
Temperature			deg C	17.26	16.6	15.3	16.1	15.3	17.1	15.8	18	21.3	20.1	11.4	17.5	13.3		19	13	20.4
Turbidity			NTU	1.6	0.88	2.35	1.01	4.92	2.36	3.9	1.27	9.93	5.17	4.76	4.8	4.8		2.19	4.56	4.51

Notes:
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"O" = Indicates te result was identified as an outlier and removed from the data set.

Table 2: Analytical Results for MCU Monitoring Wells
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	MCL	IDEM RCG	Unit	GAMW53B								GAMW54							
				2018-09-11	2018-10-3	2019-04-30	2019-11-14	2020-05-01	2020-10-23	2021-04-16	2021-09-30	2018-09-10	2018-10-31	2019-04-30	2019-11-14	2020-05-04	2020-10-23	2021-04-19	2021-10-01
				N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Appendix III Parameters																			
Boron		4	mg/L	2.5	3.1	2.2	0.73	3.3	2.5	1.9	2.7	0.84	0.77	0.39	0.37	0.42	0.72	0.5	0.63
Calcium			mg/L	180	190	150	140	180	136	142	128	93	88	93	81	131	154	164	114
Chloride			mg/L	90	85	81	74	107	84.6	84.8	66.4	15	10	10	4	12.3	50.3	53.9	24.6
Fluoride	4	4	mg/L	0.52 J	0.46	0.51	0.7	0.46	0.58	0.4	0.46	0.18 J	0.17	0.14	0.28	0.18	0.28	0.2	0.3
pH			SU	7.3	7.35	7.41	7.52	7.48	7.39	7.28	7.48	6.24	7.92	6.82	7.08	6.74	6.21	6.52	6.82
Sulfate			mg/L	430	510	340	320	488	327	304	295	190	150	190	76	284	341	492	191
Total Dissolved Solids			mg/L	1100	1100	900	770	1060	730	748	802	500	400	470	350	618	689	735	506
Appendix IV Parameters																			
Antimony	0.006	0.006	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0011 J	0.00074 J	0.00078 J	0.001 J	0.001 U	0.0011	0.001 U	0.001 U
Arsenic	0.01	0.01	mg/L	0.00079 J	0.00083 J	0.001 J	0.0016 J	0.0028	0.001 U	0.001 U	0.0014	0.0024 J	0.0028 J	0.0022 J	0.0045 J	0.0045	0.0038	0.0075	0.024
Barium	2	2	mg/L	0.052	0.054	0.044	0.072	0.099	0.061	0.067	0.051	0.043	0.039	0.031	0.031	0.052	0.068	0.071	0.048
Beryllium	0.004	0.004	mg/L	0.001 U	0.001 U	0.00059 J	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Cadmium	0.005	0.005	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Chromium	0.1	0.1	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt		0.006	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.00053 J	0.00052 J	0.00062 J	0.001 U	0.001 U	0.001 U	0.0011	0.001 U
Fluoride	4	4	mg/L	0.52 J	0.46	0.51	0.7	0.46	0.58	0.4	0.46	0.18 J	0.17	0.14	0.28	0.18	0.28	0.2	0.3
Lead	0.015	0.015	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium		0.04	mg/L	0.0042 J	0.0052 J	0.005 J	0.0066 J	0.011	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.0023 J	0.008 U	0.008 U	0.008 U	0.008 U
Mercury	0.002	0.002	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum		0.1	mg/L	0.0083 J	0.0075 J	0.0098 J	0.02	0.016	0.011	0.015	0.011	0.043	0.044	0.023	0.03	0.014	0.023	0.011	0.025
Radium 226 + 228	5		pCi/L	1.69	0.48 J+	1.26		1.73		1.21 U		0.5	1.08 J+	0.393 U		1.51 U		0.694 U	
Selenium	0.05	0.05	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0017 J	0.0012 J	0.0043 J	0.0035 J	0.0043	0.0029	0.0044	0.001 U
Thallium	0.002	0.002	mg/L	0.001 U	0.001 U	0.00049 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Field Parameters																			
Dissolved Oxygen			mg/L	0.26	0.8	0.36	0.09	0.12	0.65	0.39	0.24	0.61	1.41	0.72	0.26	0.65	1.04	0.68	0.29
Oxidation Reduction Potential			millivolts	-183.2	-168	27.7	-75.3	-118.9	-111.8	-104	-232.6	107.8	-294.7	48.4	-69.5	24.5	67.5	81.2	-153.9
pH			SU	7.3	7.35	7.41	7.52	7.48	7.39	7.28	7.48	6.24	7.92	6.82	7.08	6.74	6.21	6.52	6.82
Specific Conductivity			uS/cm	1354	1620	1160	870	1634	1091	1227	125.6	675	630	493	374	960	875	1097	782
Temperature			deg C	20.89	20.4	18.7	19.7	20.2	19.5	17.6	20	21.2	18.53	10.5	15.3	11.4	17	11.8	20.1
Turbidity			NTU	2.43	3	3.45	2.5	7.86	4.03	3.27	3.62	2.03	1	3.24	2.31	4.9	2.45	6.79	3.79

Notes:

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NTU = Nepholometic Turbidity Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J-" = Indicates the result is estimated and may be biased low.
"J+" = Indicates the result is estimated and may be biased high.

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"O" = Indicates te result was identified as an outlier and removed from the data set.

Table 2: Analytical Results for MCU Monitoring Wells
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	MCL	IDEM RCG	Unit	GAMW54B								GAMW55				GAMW55R				
				2018-09-10	2018-10-3	2019-05-01	2019-11-15	2020-05-0	2020-10-23	2021-04-19	2021-10-01	2018-09-10		2018-10-29		2019-11-15	2020-05-05	2020-10-28	2021-04-20	2021-10-01
				N	N	N	N	N	N	N	N	FD	N	FD	N	N	N	N	N	N
Appendix III Parameters																				
Boron		4	mg/L	5.6	6.5	5.9	6	2.7	2.2	3.1	3.1	1.9	1.9	1.8	1.8	1.1	0.96	0.95	0.87	1.7
Calcium			mg/L	210	220	200	240	214	195	236	190	260	250	270	260	180	169	170	237	197
Chloride			mg/L	100	95	110	120	68.3	49.2	83.9	70.4	58	59	69	70	61	46.3	48.2 J-	51.4	44.1
Fluoride	4	4	mg/L	0.41 J	0.52	0.59	0.58	0.54	0.59	0.53	0.52	0.51 J	0.52 J	0.47	0.47	0.62	0.52	0.63	0.46	0.51
pH			SU	6.95	8.71	7.27	7.2	7.43	6.97	7.3	7.36		6.77		7.04	7.31	7.51	7.45	7.6	7.27
Sulfate			mg/L	750	730	710	720	470	438	891	501	590	600	630	620	480	345	351	867	389
Total Dissolved Solids			mg/L	1600	1400	1500	1400	1000	878	1120	1030	1200	1300	1300	1300	950	846	789	842	948
Appendix IV Parameters																				
Antimony	0.006	0.006	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U
Arsenic	0.01	0.01	mg/L	0.0025 J	0.0032 J	0.0045 J	0.005	0.0042	0.0042	0.0044	0.004	0.00083 J	0.005 U	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U
Barium	2	2	mg/L	0.098	0.093	0.08	0.084	0.06	0.054	0.063	0.056	0.099	0.097	0.068	0.069	0.035	0.046	0.038	0.032	0.038
Beryllium	0.004	0.004	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Cadmium	0.005	0.005	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Chromium	0.1	0.1	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt		0.006	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0065	0.0058	0.0044	0.0044	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Fluoride	4	4	mg/L	0.41 J	0.52	0.59	0.58	0.54	0.59	0.53	0.52	0.51 J	0.52 J	0.47	0.47	0.62	0.52	0.63	0.46	0.51
Lead	0.015	0.015	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium		0.04	mg/L	0.0048 J	0.0036 J	0.0048 J	0.0074 J	0.008 U	0.008 U	0.008 U	0.008 U	0.0021 J	0.0017 J	0.008 U	0.008 U	0.0035 J	0.008 U	0.008 U	0.008 U	0.01
Mercury	0.002	0.002	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum		0.1	mg/L	0.018	0.019	0.0085 J	0.012	0.018	0.029	0.017	0.025	0.03	0.028	0.026	0.026	0.024	0.02	0.025	0.013	0.017
Radium 226 + 228	5		pCi/L	2.03	2.7 J+	1.82		1.41 U		1.43		1.4	0.802	0.922 J+	1.24 J+		1.58 U		1.47 R	
Selenium	0.05	0.05	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0037 J	0.0031 J	0.0027 J	0.0027 J	0.0046 J	0.0045	0.0028	0.0029	0.0046
Thallium	0.002	0.002	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.00021 J	0.001 U	0.00023 J	0.00022 J	0.00022 J	0.001 U	0.001 U	0.001 U	0.001 U
Field Parameters																				
Dissolved Oxygen			mg/L	0.42	2.12	0.42	0.31	0.1	0.72	0.45	0.26		1.73		0.33	0.72	1.95	2.5	1.19	0.47
Oxidation Reduction Potential			millivolts	-123.4	-315.7	-23.1	-43.3	117.5	-143.2	-105.3	-211.7		21.6		-69.4	-28.9	148.6	12.8	32.3	-16.8
pH			SU	6.95	8.71	7.27	7.2	7.43	6.97	7.3	7.36		6.77		7.04	7.31	7.51	7.45	7.6	7.27
Specific Conductivity			uS/cm	1816	1983	1636	1310	0.63	1105	1626	149.4		1493		1574	1017	1270	994	1319	139.1
Temperature			deg C	17.6	17.29	15.5	15.8	15.6	16.2	14.3	17.3		21.1		19.4	16.7	12.8	17.6	11.3	20.6
Turbidity			NTU	4.2	1.64	4.49	1.67	4.31	4.6	6.74	3.54		1.74		0.66	2.26	2.4	1.2	2.35	1.59

Notes:

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MCL= Maximum Contaminant Level
mg/L = milligrams per liter
SU = standard units
pCi/L = picoCuries per liter
uS/cm = microSiemens per centimeter
deg C = degrees Celsius
NTU = Nepholometic Turbidity Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J-" = Indicates the result is estimated and may be biased low.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.

"O" = Indicates te result was identified as an outlier and removed from the data set.

Table 2: Analytical Results for MCU Monitoring Wells
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	MCL	IDEM RCG	Unit	GAMW55B										GAMW56							
				2018-09-11		2018-10-29	2019-05-01	2019-11-15	2020-05-05		2020-10-28	2021-04-20	2021-10-01	2018-09-11	2018-10-26	2019-04-29	2019-11-15	020-05-0	2020-10-28	2021-04-20	2021-10-04
				FD	N	N	N	N	FD	N	N	N	N	N	N	N	N	N	N	N	N
Appendix III Parameters																					
Boron		4	mg/L	7.1	7.4	8.2	9.1	11	0.21 J	10.9 J	10.8	9.9	8.3	0.26	0.28	0.21	0.2	0.22	0.3	0.23	0.19
Calcium			mg/L	250	250	260	210	210	116 J	219 J	226	254	205	130	110	91	120	115	111	130	108
Chloride			mg/L	220	220	190	170	150	119	119	120 J-	120	79.4	3.1	2.4	3.2	2.1	2.8	3.2 J-	2.9	1.7
Fluoride	4	4	mg/L	0.29 J	10 U	0.25	0.31	0.31	0.33	0.32	0.28	0.3	0.3	1.2 J	0.99	0.53	0.71	0.66	0.83	0.05 U	1
pH			SU		7.07	7.19	7.31	7.46		7.45	7.56	7.7	7.44	6.82	7.17	6.83	7.06	7.05	7.07	7.05	7.09
Sulfate			mg/L	820	820	910	790	750	676	674	720	985	496	57	63	54	56	56.3	49.6	57.6	64.8
Total Dissolved Solids			mg/L	1800	1900	1800	1700	1400	1400	1420	1380	1370	1120	470	480	420	440	456	390	480	379
Appendix IV Parameters																					
Antimony	0.006	0.006	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.002 U	0.002 U	0.002 U	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U
Arsenic	0.01	0.01	mg/L	0.0014 J	0.0011 J	0.005 U	0.005 U	0.005 U	0.0079 J	0.001 UJ	0.001 U	0.001 U	0.001 U	0.019	0.022	0.011	0.0097	0.0076	0.0059	0.007	0.0018
Barium	2	2	mg/L	0.14	0.14	0.12	0.074	0.067	0.045 J	0.067 J	0.06	0.061	0.05	0.068	0.049	0.044	0.04	0.047	0.044	0.042	0.04
Beryllium	0.004	0.004	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Cadmium	0.005	0.005	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Chromium	0.1	0.1	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt		0.006	mg/L	0.00034 J	0.00028 J	0.001 U	0.001 U	0.001 U	0.0087 J	0.001 UJ	0.001 U	0.001 U	0.001 U	0.0017	0.0053	0.0084	0.0081	0.0092	0.01	0.016	0.0045
Fluoride	4	4	mg/L	0.29 J	10 U	0.25	0.31	0.31	0.33	0.32	0.28	0.3	0.3	1.2 J	0.99	0.53	0.71	0.66	0.83	0.05 U	1
Lead	0.015	0.015	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium		0.04	mg/L	0.0064 J	0.0064 J	0.0054 J	0.0055 J	0.0078 J	0.008 U	0.013	0.008 U	0.008 U	0.012	0.0034 J	0.0039 J	0.0023 J	0.0053 J	0.008 U	0.008 U	0.008 U	0.008 U
Mercury	0.002	0.002	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum		0.1	mg/L	0.0057 J	0.0055 J	0.0055 J	0.0046 J	0.005 J	0.009 J	0.0053 J	0.0062	0.0068	0.0058	0.013	0.0094 J	0.0072 J	0.0079 J	0.0093	0.0093	0.0083	0.011
Radium 226 + 228	5		pCi/L	3.35	3.18	3.66 J+	2.08		3.06	3.02		1.49 U		0.728	0.698 J+			1.24 U		0.222 U	
Selenium	0.05	0.05	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.002	0.001 U	0.001 U	0.001 U	0.001 U	0.005 U	0.005 U	0.005 U	0.005 U	0.0022	0.001 U	0.0011	0.001 U
Thallium	0.002	0.002	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Field Parameters																					
Dissolved Oxygen			mg/L		0.37	0.17	0.11	0.17		0.1	1.37	0.65	0.26	0.99	0.28	1.3	0.34	0.21	1.88	1	0.37
Oxidation Reduction Potential			millivolts		-129.5	-115.9	-57.5	-137.9		-101.9	-130.1	-97.3	-213.9	-97.4	-95.4	64	-86.6	-42.1	-64.4	65.9	-133.7
pH			SU		7.07	7.19	7.31	7.46		7.45	7.56	7.7	7.44	6.82	7.17	6.83	7.06	7.05	7.07	7.05	7.09
Specific Conductivity			uS/cm		2109	2201	1967	1491		2018	1588	1896	162.3	749	835	460	466	782	560	740	655
Temperature			deg C		19.2	18.5	18.1	17.9		17.1	17.2	15.3	18.7	17	15.7	8.7	14	9.6	14.7	9	17.2
Turbidity			NTU		4.38	1.74	4.77	3.92		4.11	3.22	4.78	4.48	2.91	2.99	2.31	2.01	2.4	0.83	2.67	3.48

Notes:

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"O" = Indicates te result was identified as an outlier and removed from the data set.

Table 2: Analytical Results for MCU Monitoring Wells
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

Analyte	MCL	IDEM RCG	Unit	GAMW56B							
				2018-09-11	2018-10-29	2019-04-29	2019-11-15	2020-05-05	2020-10-28	2021-04-21	2021-10-04
				N	N	N	N	N	N	N	N
Appendix III Parameters											
Boron		4	mg/L	1.2	1.2	2.3	3.2	2.1	2	1.6	1.4
Calcium			mg/L	140	140	150	150	141	138	157	160
Chloride			mg/L	50	36	55	64	50.8	45.7 J-	70.8	73.7
Fluoride	4	4	mg/L	0.41 J	0.33	0.4	0.44	0.55	0.51	0.41	0.46
pH			SU	6.95	6.91	7.08	7.21	7.52	7.47	7.55	7.34
Sulfate			mg/L	170	130	260	360	280	275	277	268
Total Dissolved Solids			mg/L	740	690	830	860	753	696	738	802
Appendix IV Parameters											
Antimony	0.006	0.006	mg/L	0.002 U	0.002 U	0.002	0.002 U	0.001 U	0.001 U	0.001 U	0.001 U
Arsenic	0.01	0.01	mg/L	0.005 U	0.005 U	0.005	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U
Barium	2	2	mg/L	0.076	0.072	0.082	0.076	0.071	0.066	0.071	0.081
Beryllium	0.004	0.004	mg/L	0.001 U	0.001 U	0.001	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Cadmium	0.005	0.005	mg/L	0.001 U	0.001 U	0.001	0.001 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Chromium	0.1	0.1	mg/L	0.002 U	0.002 U	0.002	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt		0.006	mg/L	0.001 U	0.001 U	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Fluoride	4	4	mg/L	0.41 J	0.33	0.4	0.44	0.55	0.51	0.41	0.46
Lead	0.015	0.015	mg/L	0.001 U	0.001 U	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium		0.04	mg/L	0.0051 J	0.0035 J	0.0044	0.0062 J	0.0082	0.008 U	0.008 U	0.0091
Mercury	0.002	0.002	mg/L	0.0002 U	0.0002 U	0.0002	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum		0.1	mg/L	0.004 J	0.003 J	0.0031	0.0064 J	0.0086	0.0075	0.0074	0.0062
Radium 226 + 228	5		pCi/L	1.26	1.28 J+			2.11		2.97	
Selenium	0.05	0.05	mg/L	0.005 U	0.005 U	0.005	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U
Thallium	0.002	0.002	mg/L	0.001 U	0.001 U	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Field Parameters											
Dissolved Oxygen			mg/L	0.29	0.26	0.79	0.18	0.09	1.48	0.23	0.29
Oxidation Reduction Potential			millivolts	-102.8	-44.4	31.8	-105.7	-105.5	-123.9	-110.5	-214.1
pH			SU	6.95	6.91	7.08	7.21	7.52	7.47	7.55	7.34
Specific Conductivity			uS/cm	928	1036	856	741	1179	772	1100	124.4
Temperature			deg C	13.9	13.8	11.6	12.9	11.8	12.9	12	14.3
Turbidity			NTU	2.96	1.45	4.77	1.4	4.56	2.39	6.72	4.65

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pCi/L = picoCuries per liter
uS/cm = microSiemens per centimeter
deg C = degrees Celsius
NTU = Nepholometic Turbidity Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
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Prepared by: SLG
Checked by: DFSC
Reviewed by: MAH

Table 3: General Groundwater Response Actions
CCR Unit Schahfer MSRB, MCWB, and DA
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

General Response Action	Comments	Corrective Measure Area	
		Below CCR Unit	Downgradient of CCR Unit
Limited Action	Access Restrictions Institutional Controls Use Restrictions Environmental Monitoring Monitored Natural Attenuation	X	X
Containment	Physical	X	
Removal	Extraction	X	X
Treatment	In-Situ Ex-Situ	X	X
On-Site Disposal	Surface Water Discharge Groundwater Discharge POTW Discharge	X	X
Off-Site Disposal	Permitted Disposal Facility	X	X

Notes:
X - General Response Action Selected for further screening at the indicated Corrective Measure Area

Prepared by: DFS
Checked by: KMC
Reviewed by: MAH

Table 4: **Initial Screening of Corrective Measure Alternatives / Process Options for Groundwater**
CCR Unit Schahfer MSRB, MCWB, and DA
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

General Response Action	Remedial Technology	Process Option	Description	Screening Comments	Retained for Further Evaluation
Limited Action	Institutional Controls	Permitting and Notices	Administrative controls to restrict groundwater use.	Potentially implementable.	Yes
		Access Restrictions	Physical restrictions or structures that prevent access by unauthorized persons.	Potentially implementable.	Yes
	Monitoring	Groundwater Monitoring	Periodic sampling and analyses of groundwater as a means of detecting unacceptable changes in constituent concentrations.	Potentially implementable.	Yes
	Use Restriction	Deed Restrictions	Administrative controls to provide future land use	Potentially implementable.	Yes
	Monitored Natural Attenuation	Monitored Natural Attenuation	Long-term monitoring of natural attenuation, including advection/dispersion/adsorption and biotic and abiotic degradation/transformation, of the inorganic constituents dissolved in groundwater; advection/dispersion/adsorption of inorganics.	Potentially implementable.	Yes
Containment	Physical Containment	Capping	Low-permeable cap covering the source area.	Potentially implementable, minimizes stormwater infiltration reducing the potential for plume migration.	No
		Vertical Barriers	Vertical barriers including slurry walls and sheet piling placed around the area of contamination to contain groundwater.	Potentially implementable, reduces potential for plume migration.	No
Removal	Extraction	Extraction Wells	Use of extraction wells to extract contaminated groundwater and control groundwater movement within capture zone.	Potentially implementable, results in physical removal of dissolved constituents of concern and reduces potential for plume migration.	Yes
		Extraction Trench	Removal of groundwater by pumping from extraction trenches.	Potentially implementable, results in physical removal of dissolved constituents of concern and reduces potential for plume migration.	Yes
In Situ Treatment	Stabilization/ Solidification	Solidification	Blending soil with grout to contain and immobilize contaminated groundwater.	Potentially implementable. Reduces potential for plume migration.	Yes
	Permeable Reactive Barrier	Vertical Reactive Barrier	Construction of vertical reactive barrier (e.g., zero-valent iron or carbon wall) to treat groundwater as it flows through the treatment zone.	Potentially implementable, results in physical removal of dissolved constituents of concern by treatment media changeout and reduces potential for plume migration.	Yes
In Situ Treatment	Chemical Addition/ Treatment	Chemical Precipitation	Increasing inorganic precipitation through chemical injection, either by changing site geochemical conditions (i.e., pH, Eh, or ionic strength) or the addition of a co-precipitate that reacts with or acts as an adsorbent for the COC.	Non-permanent - does not remove contaminant mass.	No
		Chemical Reduction	Injection of a reducing agent such as nanoscale or microscale zero valent iron into groundwater. Reduction reactions chemically convert constituents to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert.	Non-permanent - does not remove contaminant mass.	No
	Biological Treatment	Bioremediation	Use of microorganisms to oxidize/reduce metal contaminants directly or by the production of chemical oxidizing/reducing agents.	Not effective on all Site COCs.	No
Ex Situ Treatment	On-Site Treatment Facility	On-Site, Various Physical/chemical Process Options	Extracted groundwater is pumped to the on-Site treatment facility (physical/chemical treatment).	Potentially implementable to treat extracted contaminated groundwater. Treatment processes that could remediate the Site COCs include chemical/physical precipitation, activated carbon, and reverse osmosis.	Yes
Disposal	On-Site Discharge	On-Site Discharge to Surface Water	Treated groundwater discharged to local water body pursuant to updated NPDES permit.	Potentially implementable. Treated landfill leachate is currently discharged to a local water body pursuant to a NPDES permit.	Yes
		On-Site Discharge to Groundwater	Treated groundwater discharged to groundwater within the Station Area.	Potentially implementable.	Yes
		POTW Discharge	Discharge of treated groundwater to POTW under a discharge authorization.	No access to POTW.	No
	Off-Site Treatment	Off-Site Disposal/Treatment of Collected Groundwater	Transport and treatment of extracted groundwater at off-Site treatment facility.	Not retained due to higher safety concerns and much higher disposal costs.	No

Notes
COC- constituent of concern
NPDES- National Pollutant Discharge Elimination System
POTW- publicly owned treatment works
NA- not applicable

Prepared by DFS
Checked by: KMC
Reviewed by: MAH

Table 5: Summary of Groundwater Corrective Measure Alternatives For Multi-Cell Unit (MSRB, MCWB, and DA) NIPSCO Rollin M. Schahfer Generating Station Wheatfield, Indiana

Alternative		Key Components
A	Monitored natural attenuation	Permitting Implementation of deed restrictions Environmental monitoring
B	Vertical barrier/hydraulic controls and monitored natural attenuation	Permitting Implementation of deed restrictions Installation of hydraulic controls within existing vertical barrier wall *Ex situ* treatment of pumped groundwater by an on-Site treatment facility Disposal of treated groundwater to on-Site surface water or groundwater NPDES permit or installation of injection wells and UIC permit Long-term maintenance Environmental monitoring
C	Pump-and-treat and monitored natural attenuation	Permitting Implementation of deed restrictions Installation of monitoring wells or extraction trench immediately downgradient of the slurry wall *Ex situ* treatment of pumped groundwater by an on-Site treatment facility Disposal of treated groundwater to on-Site surface water or groundwater NPDES permit or of injection wells and UIC permit Long-term maintenance Environmental monitoring
D	Vertical barrier and monitored natural attenuation	Permitting Implementation of deed restrictions Installation of permeable reactive barrier – simple trench or funnel and gate Long-term maintenance Environmental monitoring
E	In-Situ Stabilization and monitored natural attenuation	Permitting Implementation of deed restrictions Stabilization of plume area using Portland cement, pozzolans, and/or bentonite Environmental monitoring

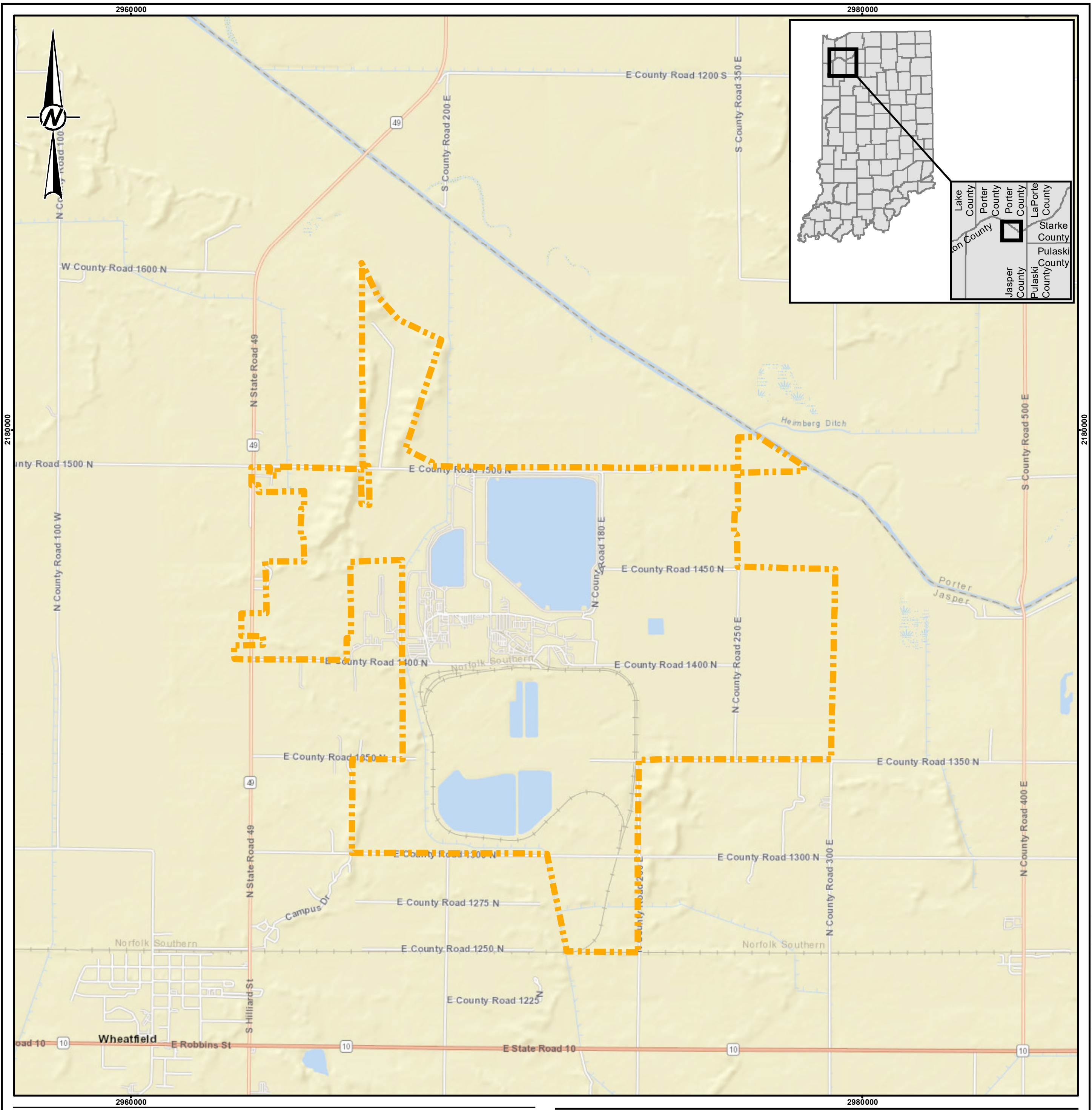
Note:
All alternatives also include impoundment closure by removal with associated dewatering

Prepared by:	JBG
Checked by:	CMJ
Reviewed by:	JBG

Table 6: Evaluation of Groundwater Corrective Measure Alternatives
For Multi-Cell Unit (MSRB, MCWB, and DA)
NIPSCO Rollin M. Schahfer Generating Station
Wheatfield, Indiana

	Corrective Measure Alternatives				
	Alternative A	**Alternative B**	**Alternative C**	**Alternative D**	**Alternative E**
Evaluation Criteria	**Monitored natural attenuation**	**Vertical barrier/hydraulic controls and monitored natural attenuation**	**Pump-and-treat and monitored natural attenuation**	**Permeable reactive barrier and monitored natural attenuation**	**In-situ stabilization and monitored natural attenuation**
Performance	Initial review of site conditions indicates plume stability and confirmation of attenuation and immobilization, therefore, monitored natural attenuation could be effective in reducing the COC concentrations and mobility. Relative short-term effectiveness varies depending on success of excavation to remove the source material and the low-permeability cap to reduce the mobility of residual COCs and potential for plume migration. Minimally effective short-term. Relatively effective long-term. Functions through physical and chemical mechanisms. Contaminant mass is removed from groundwater through adsorption and co-precipitation, but is not removed from the environment and could be remobilized following changes to groundwater geochemistry.	Hydraulic controls generating an inward gradient within the existing vertical barrier (slurry wall) are an effective means of containing the source area and reducing/eliminating downgradient migration of cobalt-contaminated groundwater from the MCU. Relatively effective both short-term and long-term.	Groundwater extraction of contaminated groundwater would be effective in reducing contaminant mass, volume, and mobility of dissolved COCs in groundwater. Relatively effective both short-term and long-term.	A permeable reactive barrier installed with an appropriate treatment media placed downgradient of the MCU in the path of the cobalt groundwater plume would be effective at removing contaminant mass and preventing further downgradient migration. Contaminant mass is removed from the environment through media changeout. Relatively effective both short-term and long-term.	In-situ stabilization of the groundwater plume would be effective at reducing mobility of contaminants. Contaminant mass is not removed, but is effectively permanently sequestered from the environment. Relatively effective both short-term and long-term.
Reliability	Moderate to High. No O&M required, but long-term changes to geochemistry may impact attenuation.	Moderate. Some O&M required and potential treatment replacement.	Moderate, some O&M required and potential treatment replacement.	Moderate, some O&M required and potential treatment replacement.	High, no O&M required apart from monitoring.
Ease of Implementation	Already occurring.	Technology is common; some installation challenges expected based on existing slurry walls and proposed cap.	Technology is common, some installation and drilling challenges expected.	Technology is common; installation would be extremely challenging due to the high density of subsurface utilities to the north of the MCU.	Technology is common; installation would be extremely challenging due to the high density of subsurface utilities to the north of the MCU.
Potential Impacts	Minimal potential for impacts to surface water and off-site groundwater.	Hydraulic controls within an existing vertical barrier control cross media impacts outside of the wall. Some safety concerns related to drilling wells and operating treatment plant (e.g., regenerating resin).	Groundwater collection and treatment will reduce long-term downgradient cross media impacts. Some safety concerns related to drilling wells and operating treatment plant (e.g., regenerating resin).	Groundwater treatment will reduce long-term downgradient cross media impacts. Safety concerns related to excavation for construction.	Subsurface agitation during installation could mobilize sorbed contaminants. Potential high pH conditions due to cement/bentonite required for stabilization.
Time Requirements	Relatively long, no active remediation.	Moderate, should be shorter than MNA alone.	Moderate, should be shorter than MNA alone.	Moderate, should be shorter than MNA alone, but longer than pump-and-treat as the PRB uses the natural groundwater gradient as a driving force compared to the higher induced gradient from the extraction wells.	Installation would be longer than any of the other alternatives, but implementation would then be substantially complete save for long-term monitoring.
Institutional Requirements	Low permitting requirements	May require NPDES permit modifications or UIC permit, overall low permitting requirements	May require NPDES permit modifications or UIC permit, overall low permitting requirements	May require Underground Injection Control permit.	Low permitting requirements

Prepared by: JBG
Checked by: CMJ
Reviewed by: JBG



LEGEND

▨ Approximate Property Line

0 0.75 1.5

1 " = 0.75 miles Miles

REFERENCE(S)

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, USGS, INTERMAP, INCREMENT P, NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI KOREA, ESRI (THAILAND), NGCC, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

CLIENT

NORTHERN INDIANA PUBLIC SERVICE COMPANY LLC

PROJECT

R.M. SCHAHFER GENERATING STATION
WHEATFIELD, INDIANA

TITLE

SITE LOCATION MAP

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2/7/2022
DESIGNED	DFS
PREPARED	SHL
REVIEWED	JSP
APPROVED	MAH

PROJECT NO.	CONTROL	REV.	FIGURE
20447130	A	0	1

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1 in

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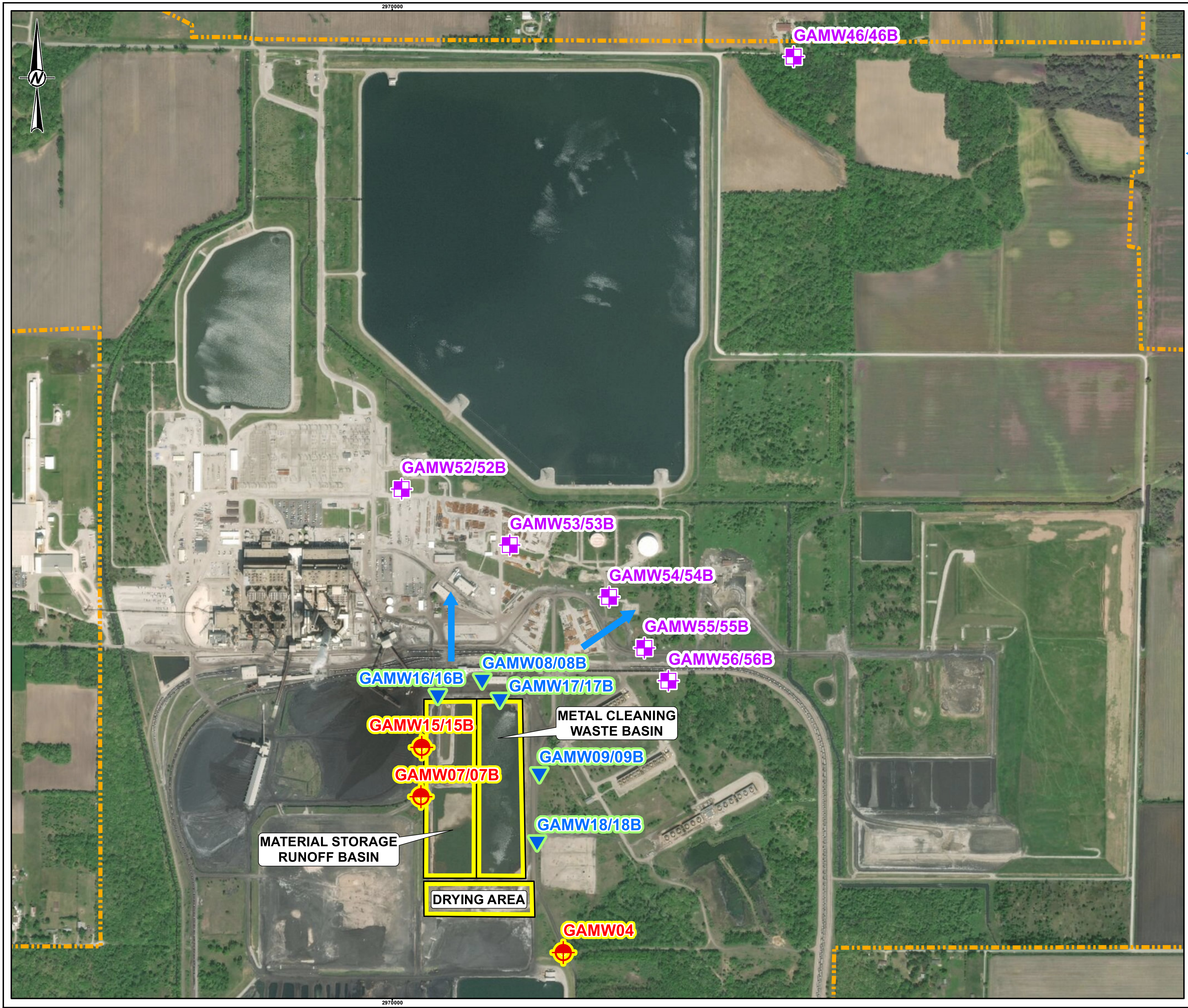

LEGEND

- Assessment Monitoring Well
- Background Monitoring Well
- Downgradient Monitoring Well
- Generalized Groundwater Flow Direction
- CCR Units
- Approximate Property Line

0 850 1,700

1 " = 850 feet Feet

NOTE(S)

1. THIS FIGURE DEPICTS THE GENERALIZED GROUNDWATER FLOW DIRECTION WITHIN THE UPPER PORTION OF THE SURFICIAL AQUIFER.

REFERENCE(S)

1. SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

CLIENT

NORTHERN INDIANA PUBLIC SERVICE COMPANY

PROJECT

NORTHERN INDIANA PUBLIC SERVICE COMPANY
R.M. SCHAHFER GENERATING STATION
WHEATFIELD, INDIANA

TITLE

MONITORING WELL LOCATIONS
DRYING AREA, MSRB, AND MCWB

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	1/31/2019
DESIGNED	DFS
PREPARED	SHL
REVIEWED	MAH
APPROVED	MAH

PROJECT NO.	CONTROL	REV.	FIGURE
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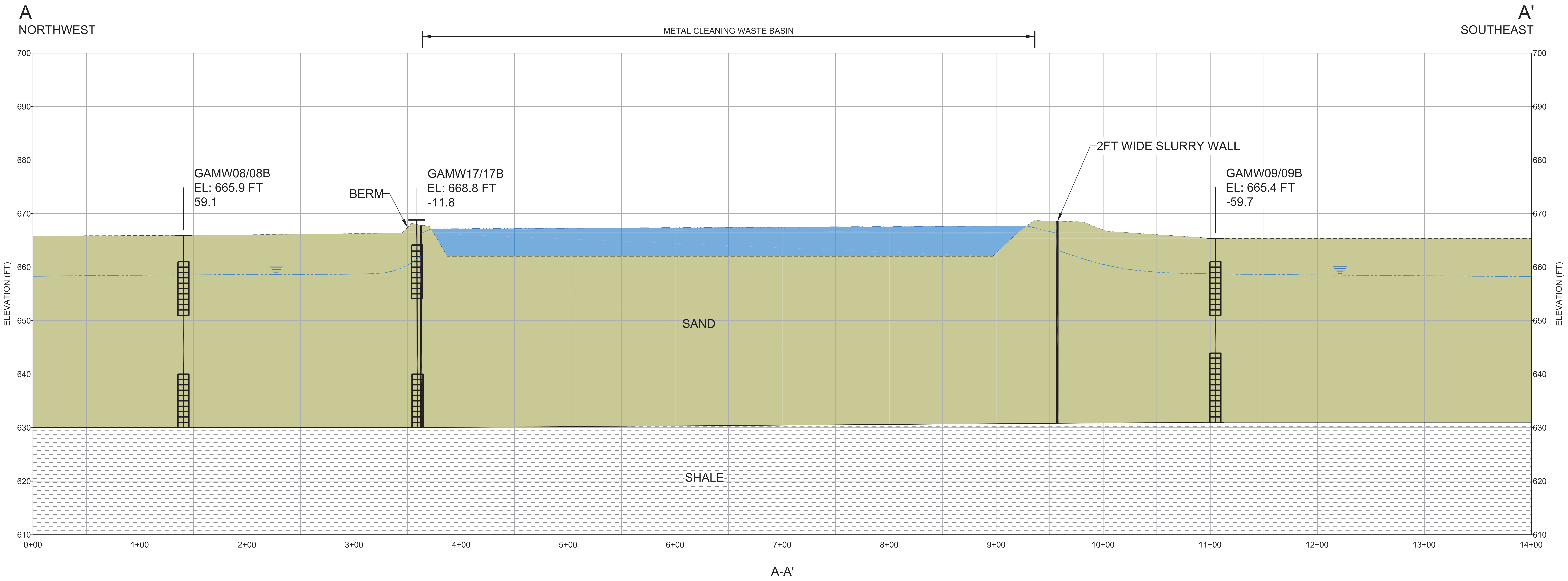
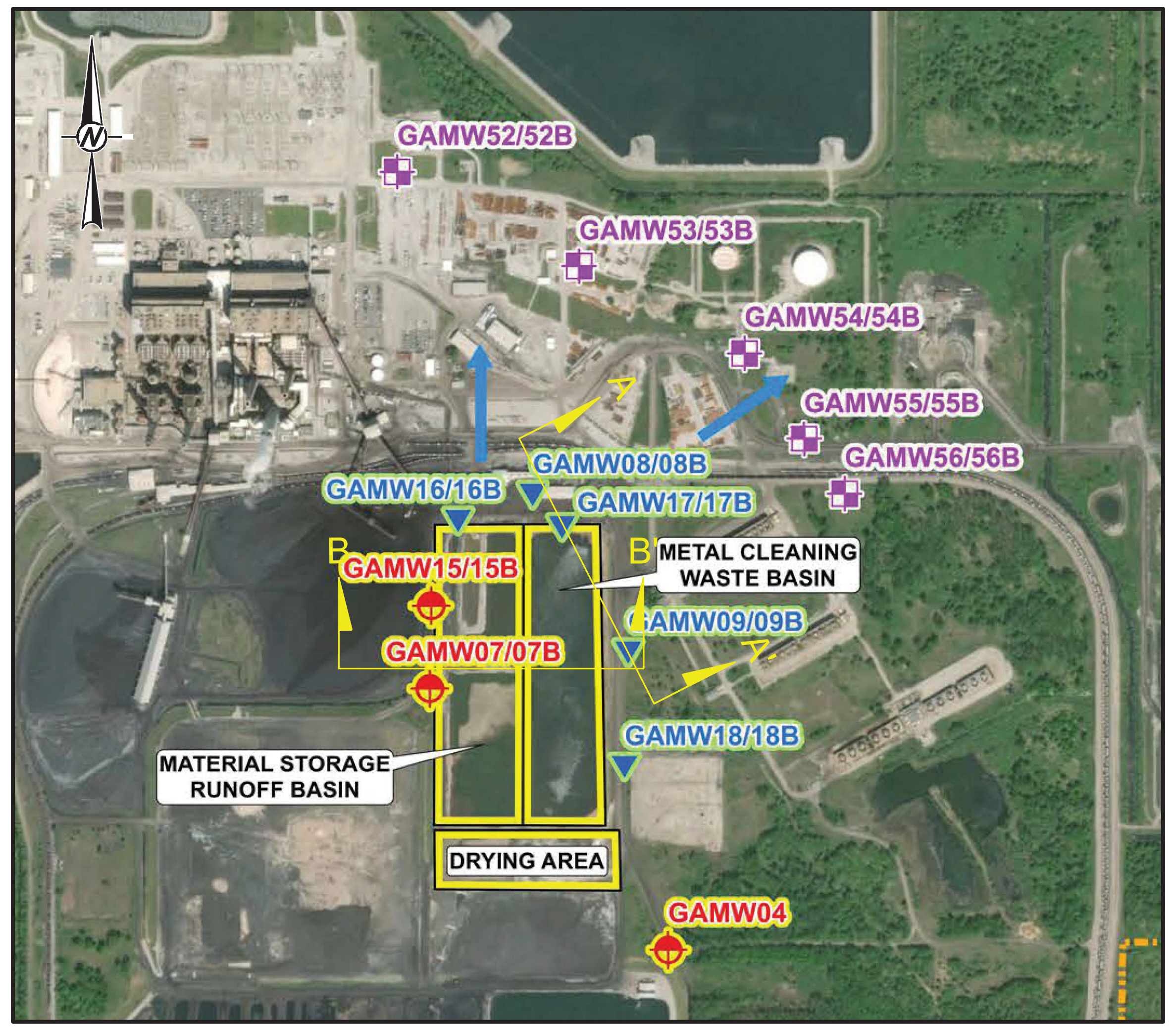
0 1 in



A-A'

VERTICAL SCALE: 0 10 20 1" = 10' FEET

HORIZONTAL SCALE: 0 50 100 1" = 50' FEET



NOTE(S)

1. GEOLOGIC CONTACTS ILLUSTRATED BETWEEN AND BELOW BORINGS ARE INFERRED AND SHOULD NOT BE INTERPRETED AS EXACT INDICATORS OF GEOLOGIC CONDITIONS AT, BETWEEN, OR BELOW BORINGS.

LEGEND

GAMW-08/08B = WELL I.D.
EL: 665.9 = GROUND SURFACE ELEVATION
59.1 = OFFSET DISTANCE
C/L = CENTERLINE

▽ = GROUNDWATER ELEVATION
▦ = WELL SCREEN
⊥ = END OF BORING LOCATION

🟦	IMPOUNDMENT WATER
🟩	SAND
┄┄	SHALE

CLIENT
NORTHERN INDIANA PUBLIC SERVICE COMPANY

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-07
DESIGNED	RWC
PREPARED	RWC
REVIEWED	JBG
APPROVED	MAH

PROJECT
NORTHERN INDIANA PUBLIC SERVICE COMPANY
ROLLIN M. SCHAHFER GENERATING STATION
WHEATFIELD, INDIANA

TITLE
GEOLOGIC INTERPRETATION
CROSS SECTION A-A'

PROJECT NO.	CONTROL	REV.	FIGURE
20447130	03	0	3

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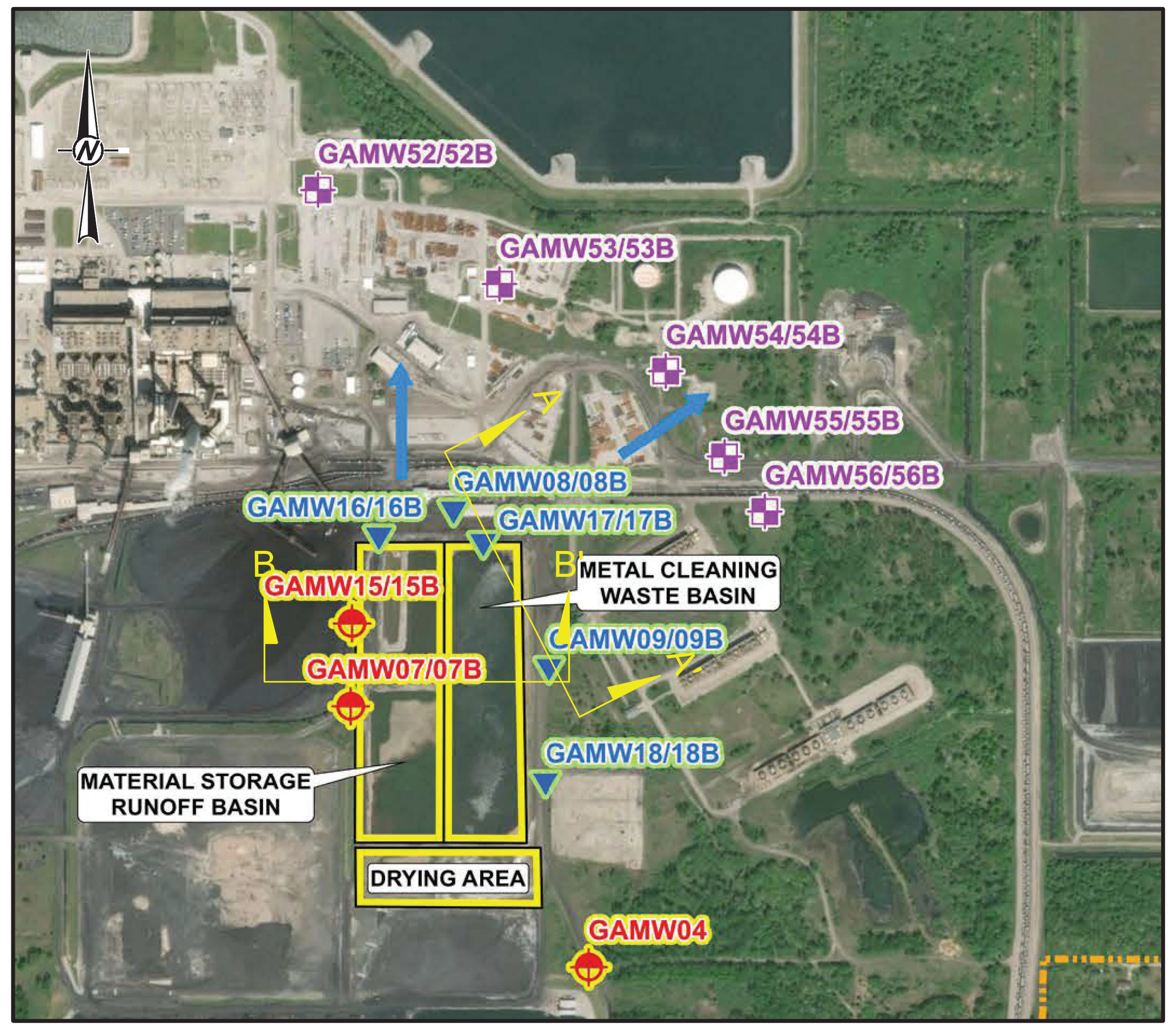
0 1 in IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D



VERTICAL SCALE: 0 10 20 FEET 1" = 10'

HORIZONTAL SCALE: 0 50 100 FEET 1" = 50'

LEGEND

GAMW-15/15B = WELL I.D.
EL: 665.14 = GROUND SURFACE ELEVATION
1.9 = OFFSET DISTANCE
C/L = CENTERLINE

▽ = GROUNDWATER ELEVATION
▥ = WELL SCREEN
⊥ = END OF BORING LOCATION

🟦 IMPOUNDMENT WATER
🟩 SAND
▤ SHALE

NOTE(S)

1. GEOLOGIC CONTACTS ILLUSTRATED BETWEEN AND BELOW BORINGS ARE INFERRED AND SHOULD NOT BE INTERPRETED AS EXACT INDICATORS OF GEOLOGIC CONDITIONS AT, BETWEEN, OR BELOW BORINGS.

CLIENT
NORTHERN INDIANA PUBLIC SERVICE COMPANY

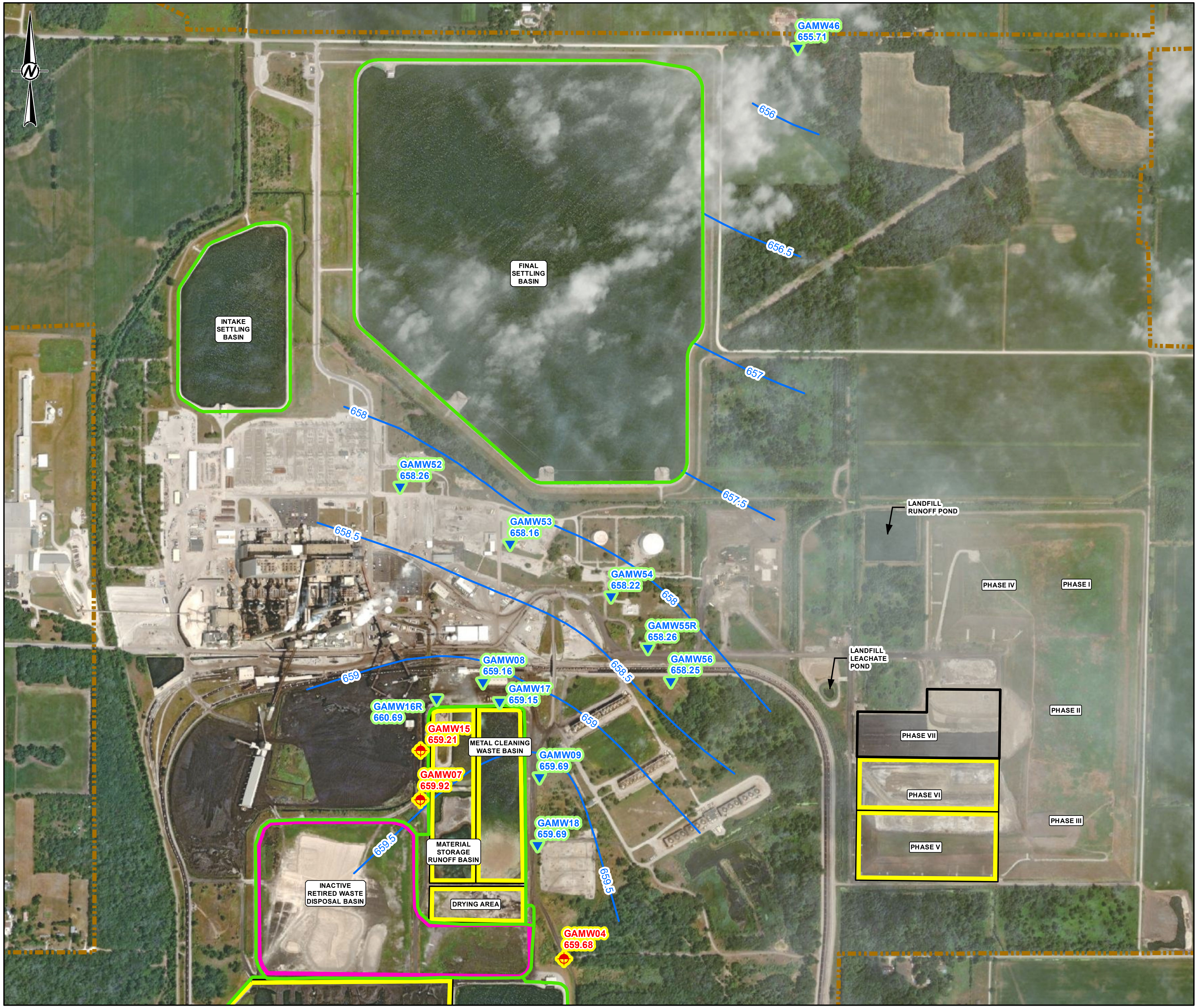
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-07
DESIGNED	RWC
PREPARED	RWC
REVIEWED	JBG
APPROVED	MAH

PROJECT
NORTHERN INDIANA PUBLIC SERVICE COMPANY
ROLLIN M. SCHAHFER GENERATING STATION
WHEATFIELD, INDIANA

TITLE
GEOLOGIC INTERPRETATION
CROSS SECTION B-B'

PROJECT NO.	CONTROL	REV.	FIGURE
20447130	03	0	4



LEGEND

◆	Background Monitoring Well
▼	Downgradient Monitoring Well
●	Non-CCR Well
▲	Surface Water Location
—	September 2021 Groundwater Elevation Contour (0.5 ft interval)
—	Slurry Wall
▭	Approximate Property Line
▭	CCR Units
▭	Inactive Retired Waste Disposal Basin
▭	Phase VII

0 850 1,700

1 " = 850 feet Feet

FIGURE NARRATIVE

THIS FIGURE DEPICTS THE GROUNDWATER ELEVATION, AS MEASURED IN 77 MONITORING WELLS SCREENED WITHIN THE UPPER PORTION OF THE SURFICIAL AQUIFER, AND IS INTENDED TO REPRESENT THE APPROXIMATE ELEVATION OF THE GROUNDWATER POTENTIOMETRIC SURFACE. THE POSTED DATA WERE CALCULATED FROM DEPTH TO WATER MEASUREMENTS MADE BY GOLDER ON SEPTEMBER 9, 2021.

THE DIRECTION OF HORIZONTALGROUNDWATER FLOW AT AND NEAR THE POTENTIOMETRIC SURFACE CAN BE GENERALLY INTERPRETED AS BEING PERPENDICULAR TO THE GROUNDWATER ELEVATION CONTOURS. GOLDER INFERRED THE ELEVATION CONTOURS BASED ON THE DATA ILLUSTRATED.

THE ACTUAL ELEVATION OF THE POTENTIOMETRIC SURFACE IS LIKELY MORE HETEROGENEOUS THAN SHOWN AND ACTUAL CONDITIONS WILL VARY. OTHER INTERPRETATIONS ARE POSSIBLE. THE DEPTH TO GROUNDWATER IS KNOWN TO VARY WITH TIME.

NOTE(S)

1. NS INDICATES LOCATION WAS NOT SAMPLED.
2. * INDICATES NOT USED IN CONTOURING

REFERENCE(S)

1. SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

CLIENT

NORTHERN INDIANA PUBLIC SERVICE COMPANY LLC

PROJECT

R.M. SCHAHFER GENERATING STATION
WHEATFIELD, INDIANA

TITLE

MONITORING WELL LOCATIONS AND GROUNDWATER ELEVATION CONTOURS (SEPTEMBER 2021)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-07
DESIGNED	DFS
PREPARED	TBH
REVIEWED	JBG
APPROVED	MAH

PROJECT NO.	CONTROL	REV.	FIGURE
20447130	A	0	5

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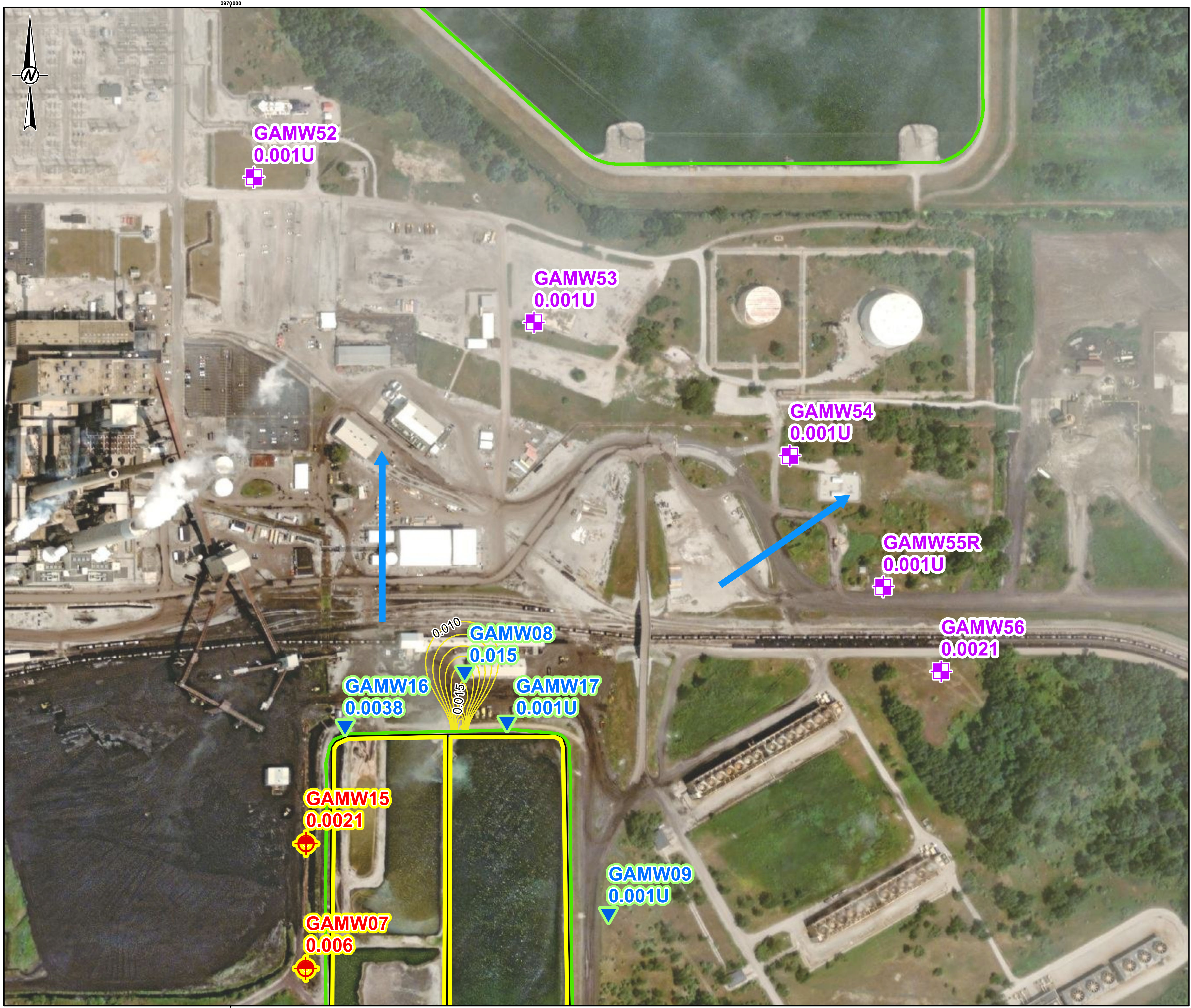

LEGEND

0.015	September 2021 Cobalt Concentration (mg/L)
⊞	Assessment Monitoring Well
⊕	Background Monitoring Well
▼	Downgradient Monitoring Well
—	Septemeber 2021 Shallow Cobalt Contour (mg/L)
←	Generalized Groundwater Flow Direction
—	Slurry Wall
▭	CCR Units

0 340 680
1 " = 333 feet
Feet

FIGURE NARRATIVE

THIS FIGURE SHOWS THE INTERPRETED COBALT ISOCONCENTRATION CONTOURS BASED ON GROUNDWATER ANALYTICAL DATA FROM THE SEPTEMBER 2021 SAMPLING EVENT FOR SHALLOW WELLS SCREENED IN THE SURFICIAL AQUIFER. THE ISOCONCENTRATION CONTOURS ARE INTENDED TO DEPICT THE INFERRED DISTRIBUTION OF COBALT IN GROUNDWATER ON THE BASIS OF THE DATA ILLUSTRATED. THE DISTRIBUTION IS LIKELY MORE HETEROGENEOUS THAN SHOWN, AND THE ACTUAL CONDITIONS WILL VARY. OTHER INTERPRETATIONS ARE POSSIBLE. COBALT DISTRIBUTION IN GROUNDWATER IS KNOWN TO VARY WITH TIME.

NOTE(S)

1. THIS FIGURE DEPICTS THE GENERALIZED GROUNDWATER FLOW DIRECTION WITHIN THE UPPER PORTION OF THE SURFICIAL AQUIFER.
2. ALL VALUES SHOWN ARE IN MILLIGRAMS PER LITER (MG/L)

REFERENCE(S)

1. SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

CLIENT
NORTHERN INDIANA PUBLIC SERVICE COMPANY LLC

PROJECT
R.M. SCHAHFER GENERATING STATION
WHEATFIELD, INDIANA

TITLE
COBALT ISOCONCENTRATION CONTOUR MAP SEPTEMBER 2021 (SHALLOW)

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2/21/2022
DESIGNED	CMJ
PREPARED	DTD
REVIEWED	CMJ
APPROVED	JBG

PROJECT NO.	CONTROL	REV.	FIGURE
20447130	A	0	6

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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APPENDIX A

Volume Calculations

MASS AND VOLUME CALCULATIONS

Contaminant Mass Within Cobalt Plume

Assumptions:

Plume extents are as shown on Figure 6.

Plume extends from average depth to water in September 2021 in nearby monitoring wells (GAMW-08, GAMW-17, etc…) at 8.50 feet bgs, to top of screened interval of deep wells (GAMW-08B, GAMW-17B, etc…) at 27.5 feet bgs for a asturated thickness of 18.37 feet.

Soil porosity estimated at 0.16 to 0.42.

Only the mass of contaminants in portions of the plume exceeding the GWPS (10 μg/l) estimated

1 cubic foot = 28.32 liters

Contour areas calculated by Surfer.

Volume calculation: Volume = Area between contours * saturated thickness * porosity

Mass calculation: Mass = volume * concentration * 28.32 liters/cubic foot * 1x10-9 kg/μg

Contour Value (μg/l)	Area between contours (ft^2)	Volume at Porosity 0.16 (ft^3)	Volume at Porosity 0.42 (ft^3)	Cobalt Mass at Porosity 0.16 (kg)	Cobalt Mass at Porosity 0.42 (kg)
10	19071	56052	147137	0.017	0.046
11	14287	41994	110233	0.014	0.037
12	10726	31527	82757	0.012	0.030
13	8256	24265	63695	0.010	0.025
14	7753	22788	59819	0.010	0.025
15	3611	10613	27858	0.005	0.013
16	536	1576	4137	0.001	0.002
17	472	1389	3645	0.001	0.002
18	75	221	581	-	-
			Total	**0.07**	**0.18**

Volume of impacted material below the CCR Unit

Assumptions:

Entire remaining volume of water within the slurry walls after excavation is impacting.
Area is estimated by the combined area of the three impoundments (Figure 6).
Depth is estimated by the approximate saturated thickness outside the slurry walls (Figure 3).

Area	36.2	acre	(A)	(Wood 2019)
Saturated depth	32	feet	(D)	(Golder 2017)

Estimated volume of impacted material was calculated using the following formula:

$$\text{Volume}= A*D= V_1$$

1 acre= 43560 ft^2

V_1	1158	acre-ft
V_1	5.0E+07	ft^3

Volume of impacted material downgradient of the CCR Unit

Assumptions:

The volume is estimated by the volume with boron concentrations greater than 4 mg/L.
Plume areas are calculated based on the 4 mg/L contours displayed on Figure 6 and Figure 7.

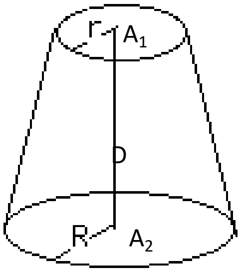
Shallow plume area	21.75	acre		
	9.474E+05	ft^2	(A1)	
Deep plume area	87.40	acre		
	3.807E+06	ft^2	(A2)	
Saturated depth	32	feet	(D)	(Golder 2017)
Assumed effective porosity	0.3		(n)	(Golder 2017)

The plume area were approximated as circles, and the volume of impacted material was estimated as a frustrum using the following formula:

$$\text{Volume}= \pi*D/3*(R^2 + Rr + r^2)= V_2$$

$$r= (A_1 /\pi)^{1/2} , R= (A_2 /\pi)^{1/2}$$

r	549.2	ft
R	1101	ft
V_2	7.10E+07	ft^3
V_2	1629	acre-ft



Estimated volume of impacted groundwater was calculated using the following forumula:

$$\text{Volume}= V_2*n = V_{water}$$

V_{water}	2.13E+07	ft^3
V_{water}	1.59E+08	gallons

Prepared by: DFS
Checked by: BPC
Reviewed by: JBG

Golder Associates, Groundwater Monitoring Program Implementation Manual, October 2017

Wood, 2019. Multi-Cell Unit Surface Impoundments (CCR Final Rule) Draft Closure Application. March 8, 2019.

APPENDIX B

Slug Test Data and Calculations

Appendix B
HYDRAULIC CONDUCTIVITY TESTING RESULTS

Well	Date	Screened Interval	Type	Test Duration	Test Number	Hvorslev Method		Bouwer and Rice Method		van der Kamp Method		Hvorslev/Bouwer and Rice Arithmetic Mean	
						cm/sec	ft/day	cm/sec	ft/day	cm/sec	ft/day	cm/sec	ft/day
GAMW03	7/7/2016	5-15	Transducer (Rising)	<2 min	1	7.44E-03	2.11E+01	4.99E-03	1.42E+01	n/a	n/a	6.22E-03	1.77E+01
					2	7.45E-03	2.11E+01	5.22E-03	1.48E+01	n/a	n/a	6.34E-03	1.80E+01
GAMW13	7/7/2016	5-15	Transducer (Rising)	<2 min	1	5.75E-02	1.63E+02	3.91E-02	1.11E+02	n/a	n/a	4.83E-02	1.37E+02
					2	6.50E-02	1.84E+02	4.81E-02	1.36E+02	n/a	n/a	5.66E-02	1.60E+02
GAMW15	7/7/2016	5-15	Transducer (Rising)	<2 min	1	2.59E-02	7.34E+01	1.63E-02	4.63E+01	n/a	n/a	2.11E-02	5.99E+01
					2	1.11E-02	3.15E+01	1.08E-02	3.05E+01	n/a	n/a	1.10E-02	3.10E+01
GAMW19	7/7/2016	6-16	Transducer (Rising)	<2 min	1	3.70E-02	1.05E+02	2.25E-02	6.38E+01	n/a	n/a	2.98E-02	8.44E+01
					2	1.01E-01	2.87E+02	6.85E-02	1.94E+02	n/a	n/a	8.48E-02	2.41E+02
Average Shallow (515 ftbgs)						**3.90E-02**	**1.11E+02**	**2.69E-02**	**7.63E+01**	**n/a**	**n/a**	**3.30E-02**	**9.35E+01**
GAMW03B	7/8/2016	27-37	Transducer (Falling)	<2 min	1	6.78E-03	1.92E+01	5.81E-03	1.65E+01	n/a	n/a	6.30E-03	1.79E+01
					2	4.30E-03	1.22E+01	4.79E-03	1.36E+01	n/a	n/a	4.55E-03	1.29E+01
			Transducer (Rising)	<2 min	1	5.65E-03	1.60E+01	6.42E-03	1.82E+01	n/a	n/a	6.04E-03	1.71E+01
					2	1.47E-02	4.16E+01	1.25E-02	3.55E+01	1.49E-02	4.22E+01	1.36E-02	3.86E+01
GAMW13B	7/7/2016	25-35	Transducer (Falling)	<2 min	1	8.48E-03	2.40E+01	9.27E-03	2.63E+01	n/a	n/a	8.88E-03	2.52E+01
					2	8.09E-03	2.29E+01	9.27E-03	2.63E+01	n/a	n/a	8.68E-03	2.46E+01
			Transducer (Rising)	<2 min	1	1.11E-02	3.15E+01	1.16E-02	3.30E+01	2.73E-02	7.74E+01	1.14E-02	3.23E+01
					2	1.06E-02	3.00E+01	1.08E-02	3.06E+01	1.06E-02	3.01E+01	1.07E-02	3.03E+01
GAMW15B	7/7/2016	27.7-37.7	Transducer (Falling)	<2 min	1	4.50E-03	1.28E+01	3.45E-03	9.79E+00	n/a	n/a	3.98E-03	1.13E+01
					2	1.03E-02	2.91E+01	8.75E-03	2.48E+01	9.53E-03	2.70E+01	9.53E-03	2.70E+01
			Transducer (Rising)	<2 min	1	1.17E-02	3.32E+01	1.06E-02	3.02E+01	1.24E-02	3.50E+01	1.12E-02	3.17E+01
					2	1.06E-02	3.02E+01	9.79E-03	2.77E+01	1.69E-02	4.80E+01	1.02E-02	2.90E+01
GAMW19B	7/7/2016	23-33	Transducer (Falling)	<2 min	1	1.37E-02	3.88E+01	1.44E-02	4.09E+01	n/a	n/a	1.41E-02	3.99E+01
					2	6.82E-03	1.93E+01	6.31E-03	1.79E+01	n/a	n/a	6.57E-03	1.86E+01
			Transducer (Rising)	<2 min	1	1.84E-02	5.21E+01	1.83E-02	5.18E+01	1.29E-02	3.67E+01	1.84E-02	5.20E+01
					2	1.21E-02	3.43E+01	1.03E-02	2.91E+01	1.21E-02	3.43E+01	1.12E-02	3.17E+01
Average Deep (2535 ftbgs)						**9.86E-03**	**2.80E+01**	**9.52E-03**	**2.70E+01**	**1.46E-02**	**4.13E+01**	**9.69E-03**	**2.75E+01**

Notes:

ft/day = feet per day

cm/sec = centimeters per second

n/a = not analyzed

Prepared by: DFS
Checked by: KMC
Reviewed by: MAH

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-03 (TEST 1)

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

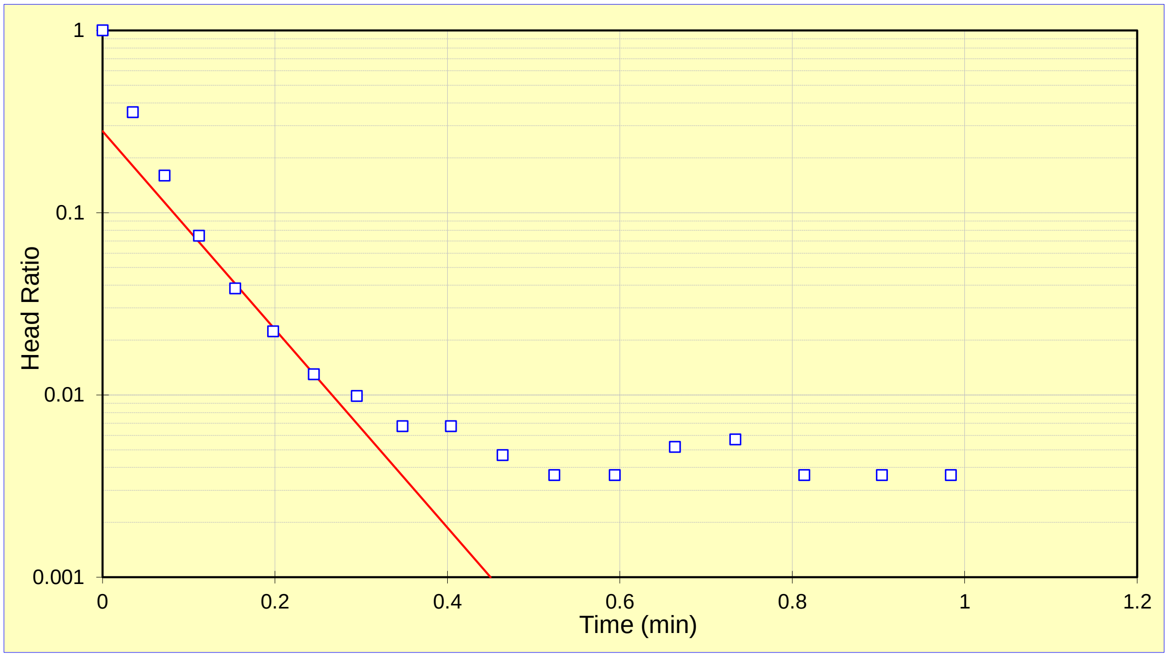
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.34
L_e =	10
t_1 =	0
t_2 =	0.45
h_1/h_0 =	0.28
h_2/h_0 =	0.00

RESULTS

K=	7.44E-03	cm/sec
K=	2.11E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/25/2016

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-03 (TEST 1)

$$K = \frac{r_c^{\,2} \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

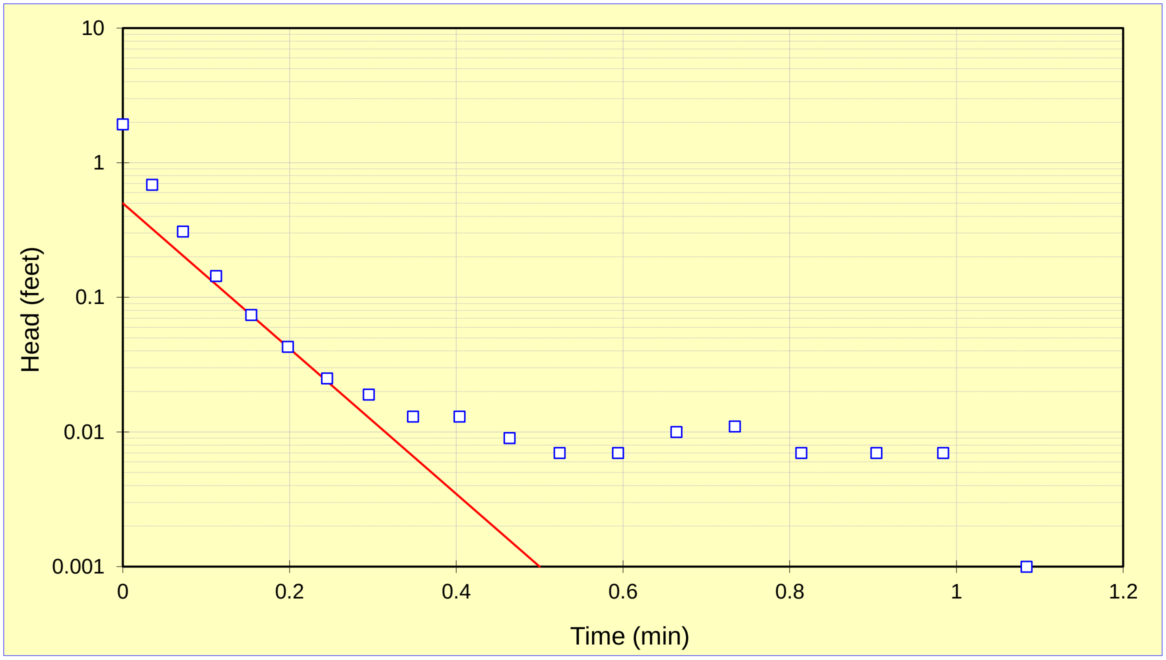
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c = 0.08
r_w = 0.34
L_e = 10
$\ln(R_e/r_w)$= 2.28
y_0 = 0.50
y_t = 0.001
t = 0.5

RESULTS

K= 4.99E-03 cm/sec
K= 1.42E+01 ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-03 (TEST 2)

$$K = \frac{r_c^{2}}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

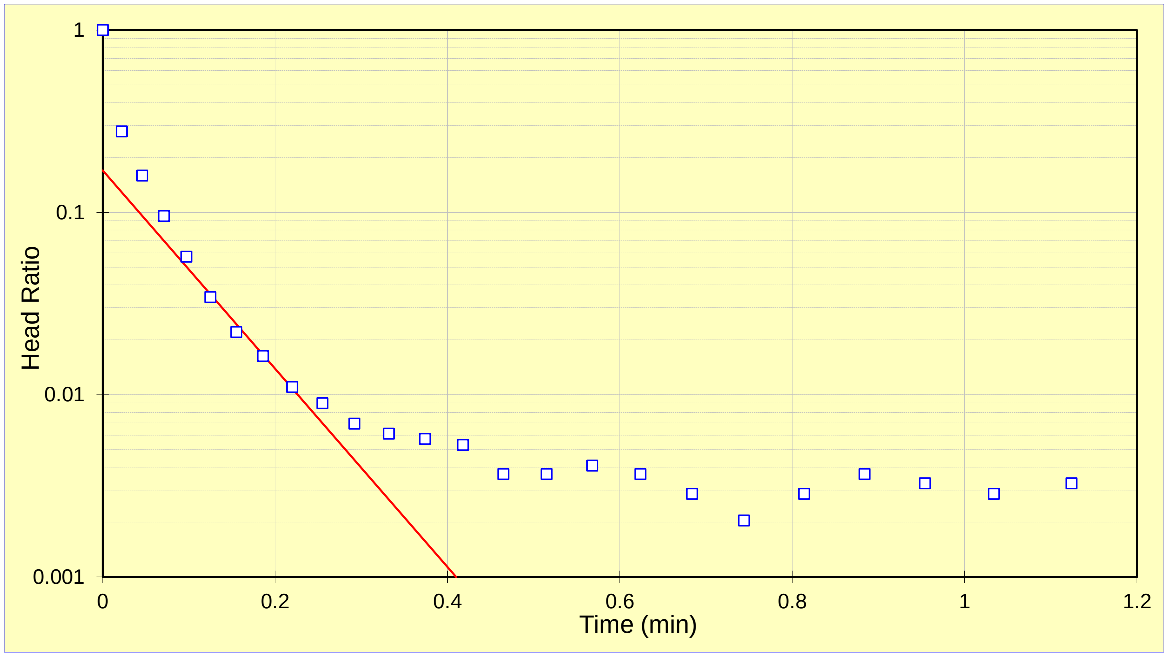
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.34
L_e =	10
t_1 =	0
t_2 =	0.41
h_1/h_0 =	0.17
h_2/h_0 =	0.00

RESULTS

K=	7.45E-03	cm/sec
K=	2.11E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-03 (TEST 2)

$$K = \frac{r_c^{\,2} \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

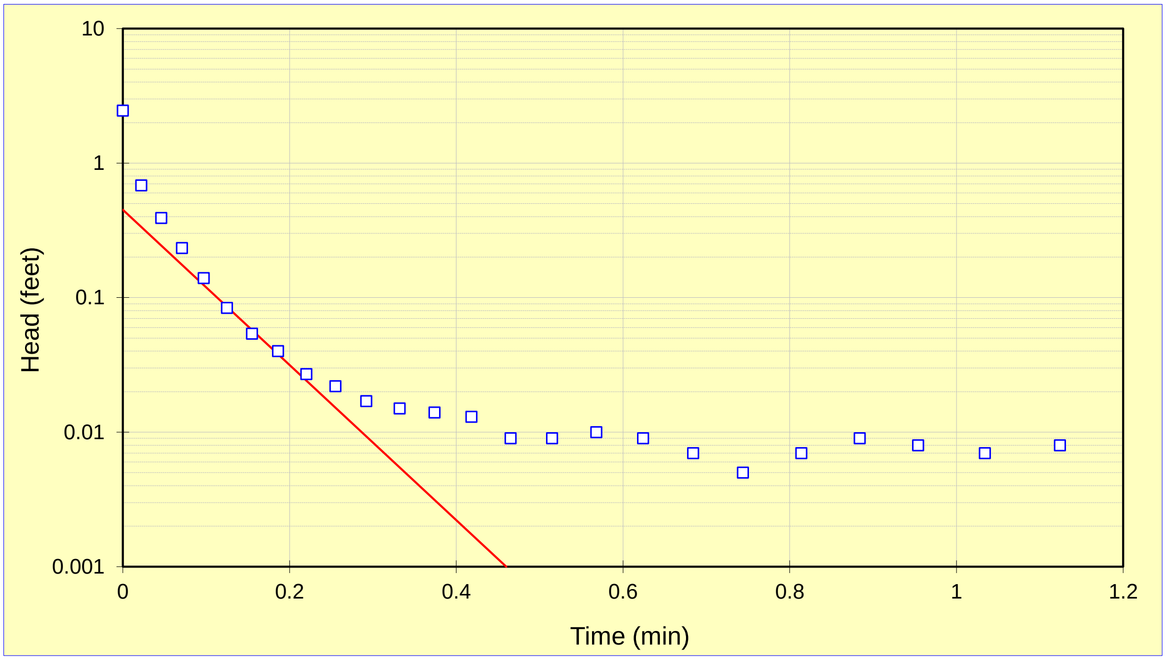
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.34
L_e =	10
$\ln(R_e/r_w)$=	2.23
y_0 =	0.45
y_t =	0.001
t =	0.5

RESULTS

K=	5.22E-03	cm/sec
K=	1.48E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST GAMW-03B (TEST 1)

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

where:

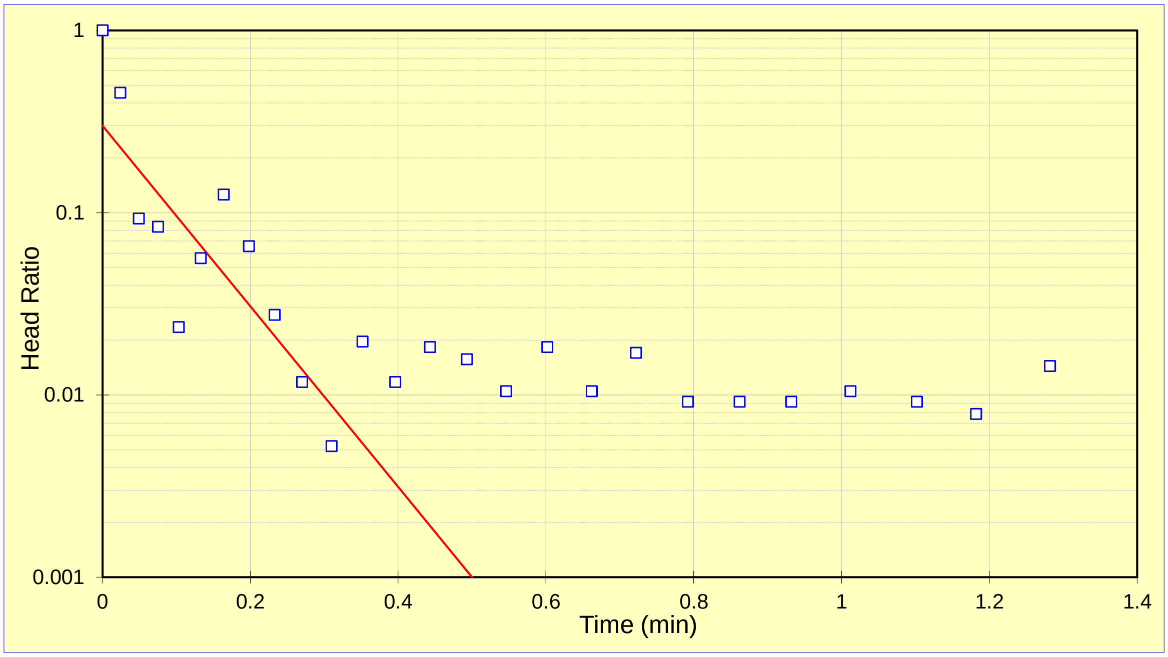
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.34
L_e = 10
t_1 = 0
t_2 = 0.5
h_1/h_0 = 0.30
h_2/h_0 = 0.00

RESULTS

K= 6.78E-03 cm/sec
K= 1.92E+01 ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/08/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST GAMW-03B (TEST 1)

$$K = \frac{r_c^2 \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

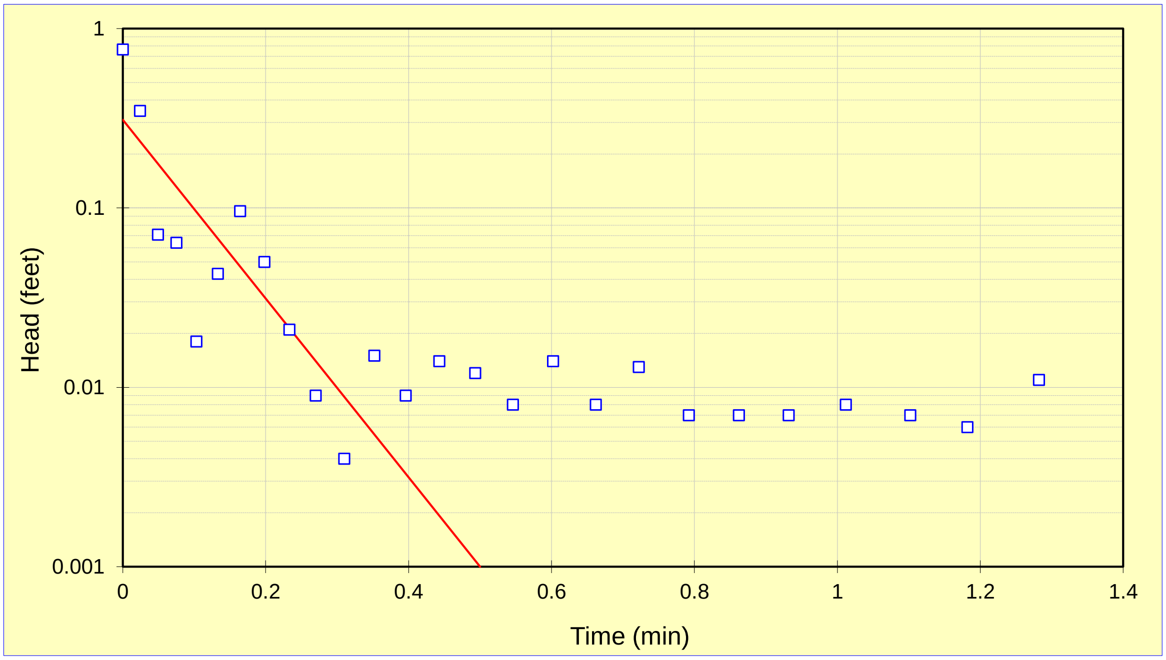
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.34
L_e =	10
$\ln(R_e/r_w)$=	2.87
y_0 =	0.31
y_t =	0.001
t =	0.5

RESULTS

K=	5.81E-03	cm/sec
K=	1.65E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/08/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST GAMW-03B (TEST 2)

$$K = \frac{r_c^{2}}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

where:

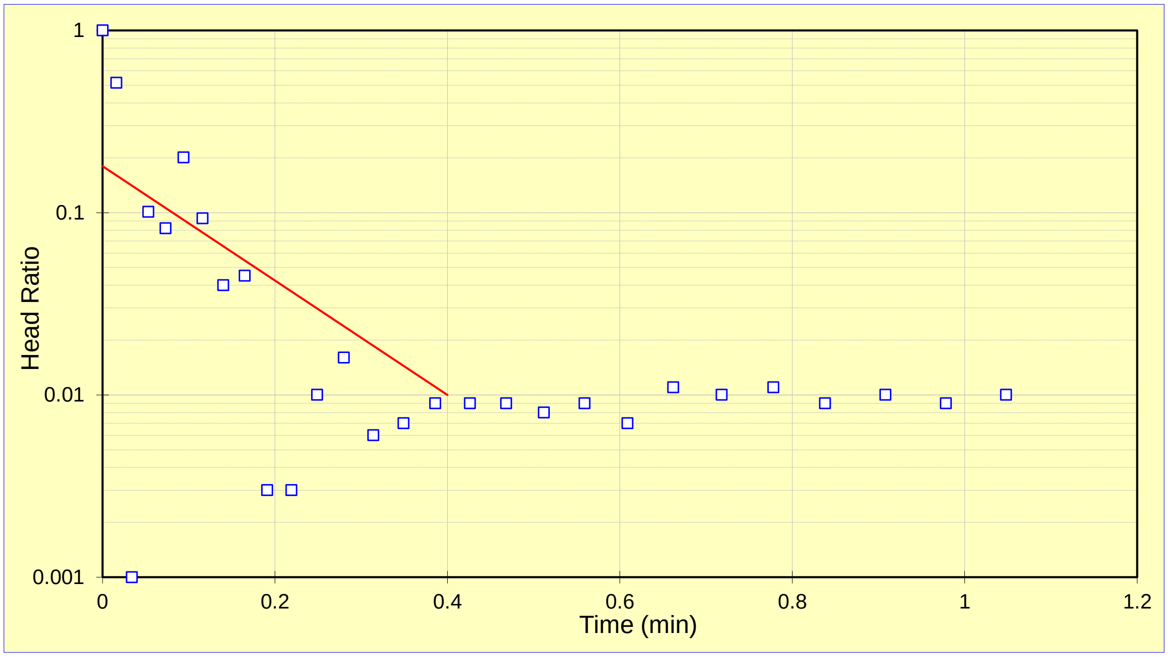
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.34
L_e = 10
t_1 = 0
t_2 = 0.4
h_1/h_0 = 0.18
h_2/h_0 = 0.01

RESULTS

K= 4.30E-03 cm/sec
K= 1.22E+01 ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/08/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST GAMW-03B (TEST 2)

$$K = \frac{r_c^{\,2} \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

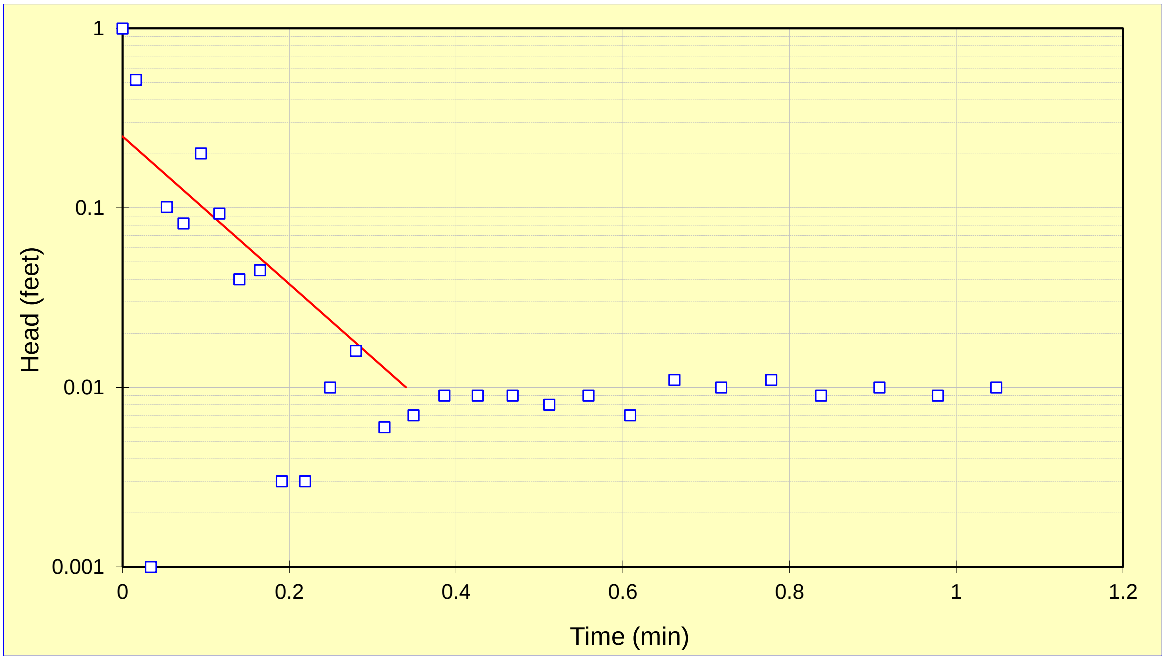
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c = 0.08
r_w = 0.34
L_e = 10
$\ln(R_e/r_w)$= 2.87
y_0 = 0.25
y_t = 0.010
t = 0.3

RESULTS

K=	4.79E-03	cm/sec
K=	1.36E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/08/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-03B (TEST 1)

$$K = \frac{r_c^{\,2}}{2L_e}\ln\frac{L_e}{R_e}\left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2-t1)}\right]30.48$$

where:

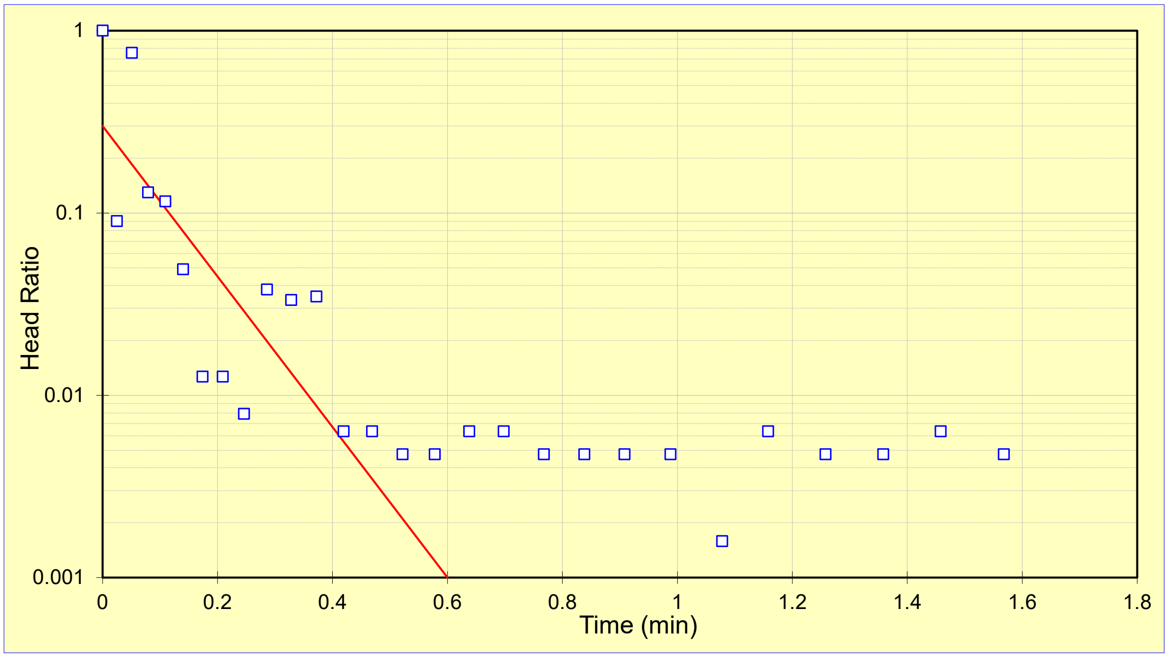
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = **0.08**
R_e = **0.34**
L_e = **10**
t_1 = **0**
t_2 = **0.6**
h_1/h_0 = **0.30**
h_2/h_0 = **0.00**

RESULTS

K= 5.65E-03 cm/sec
K= 1.60E+01 ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/08/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-03B (TEST 1)

$$K = \frac{r_c^{\,2} \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

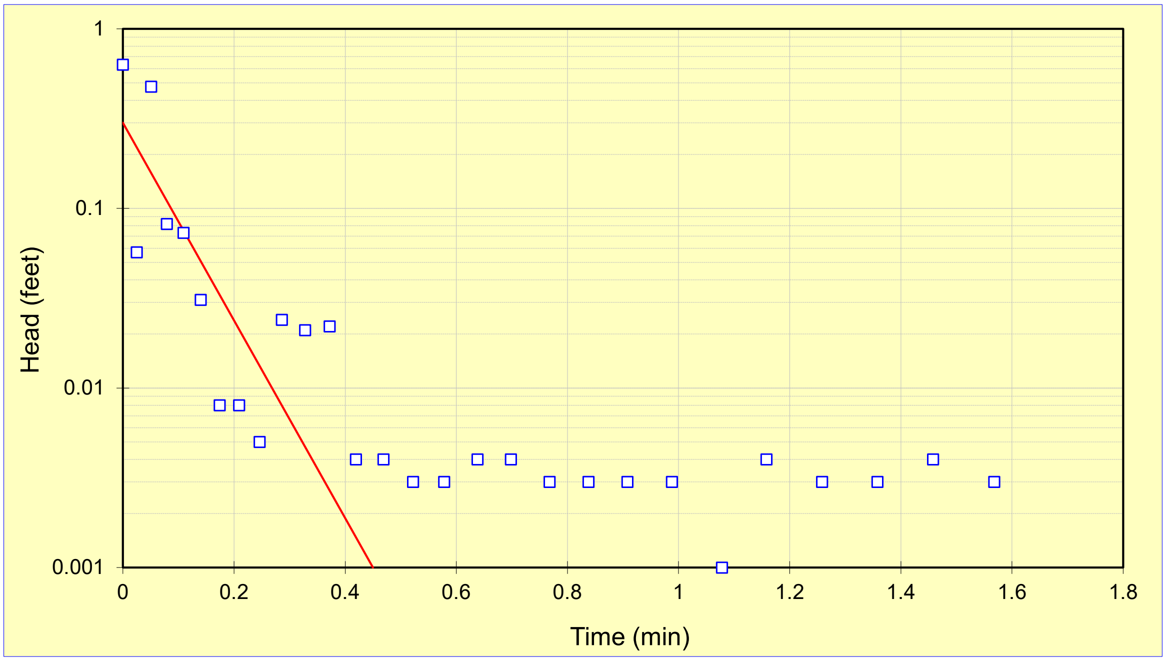
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.34
L_e =	10
$\ln(R_e/r_w)$=	2.87
y_0 =	0.30
y_t =	0.001
t =	0.5

RESULTS

K=	6.42E-03	cm/sec
K=	1.82E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/08/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

van der KAMP RISING HEAD SLUG TEST ANALYSIS

UNDERDAMPED SLUG TEST GAMW-03B (TEST 2)

$$T = b + a \ln T$$

where:

$$b = -a \ln\left[0.79 r_s^2 S (g/L)^{1/2}\right]$$

$$a = r_c^2 \left(g / L^{1/2}\right) / 8d$$

$$d = \gamma / (g/L)^{1/2}$$

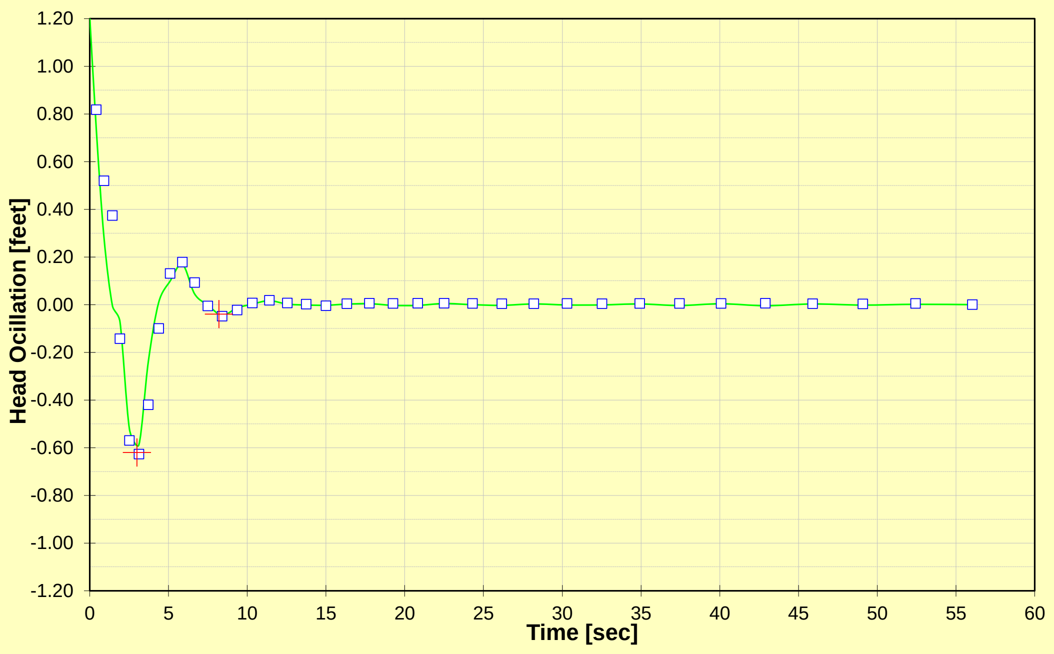
$$L = g / \left(\omega^2 + \gamma^2\right)$$

INPUT PARAMETERS

r_c =	0.08	ft	$(g/L)^{\wedge 1/2}$ =	1.31826	ft^2
r_s =	0.08	ft	d =	0.3998	ft^{-1}
L_c =	19.62	ft	a =	0.00286	ft^3
L_s =	10.00	ft	t_1 =	3.00	sec
ω =	1.2083	ft^{-1}	t_2 =	8.20	sec
γ =	0.5271	ft^{-1}	$h(t_1)$ =	0.62	ft
L =	18.52	ft^3/sec^2	$h(t_2)$ =	0.04	ft
g =	32.19	ft/sec^2	S =	1.00E-02	dim

RESULTS

$b = T_0$ =	2.73E-02	ft^2/sec	$\alpha < 0.1$?	YES
T =	1.53E-02	ft^2/sec	$d < 0.7$?	YES
T =	1.32E+03	ft^2/day	L_1 =	18.52
K =	4.22E+01	ft/day	L_2 =	24.62
K =	1.49E-02	cm/sec	$L_1:L_2$ Diff <20% ?	NO



Project Name: NIPSCO RMSGS
Project No.: 164-8171
Test Date: 07/08/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 8/8/2016

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-03 (TEST 2)

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

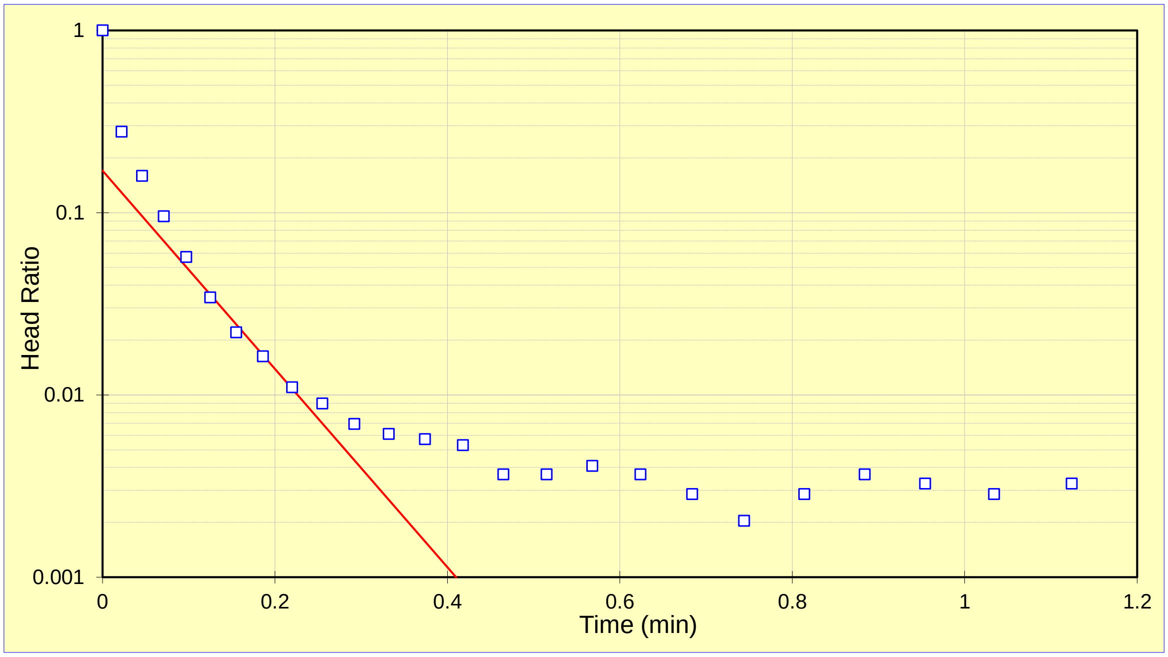
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.34
L_e =	10
t_1 =	0
t_2 =	0.41
h_1/h_0 =	0.17
h_2/h_0 =	0.00

RESULTS

K=	7.45E-03	cm/sec
K=	2.11E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-03 (TEST 2)

$$K = \frac{r_c^{\,2} \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln\frac{y_0}{y_t}$$

where:

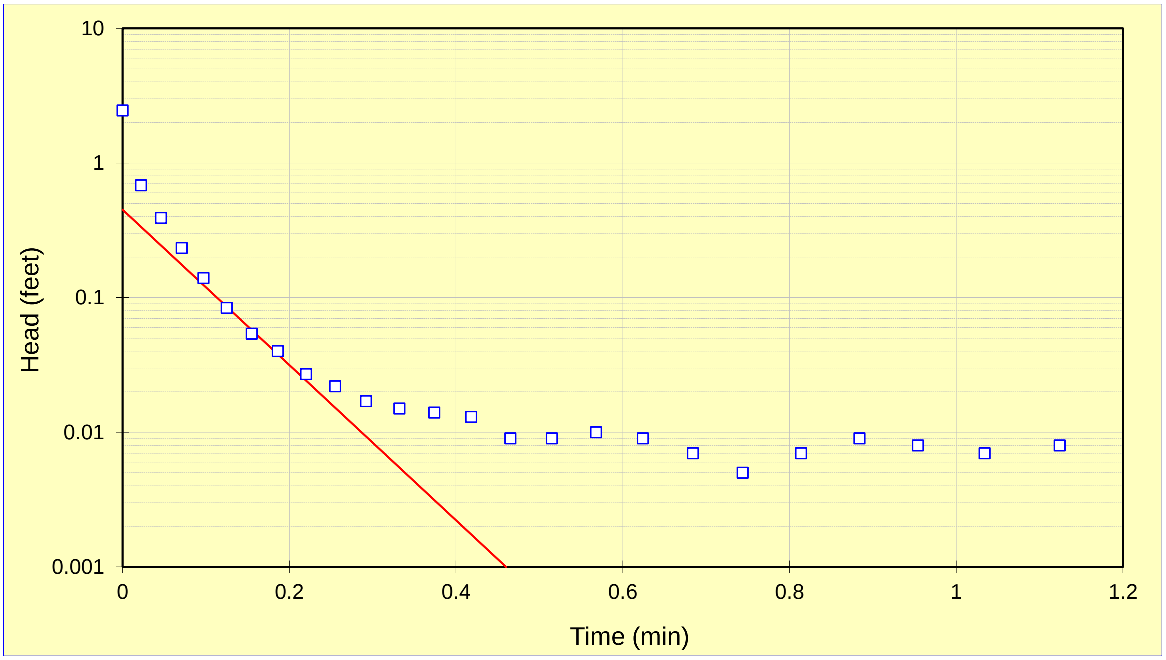
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.34
L_e =	10
$\ln(R_e/r_w)$=	2.23
y_0 =	0.45
y_t =	0.001
t =	0.5

RESULTS

K=	5.22E-03	cm/sec
K=	1.48E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-13B (TEST 1)

$$K = \frac{r_c^{2}}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

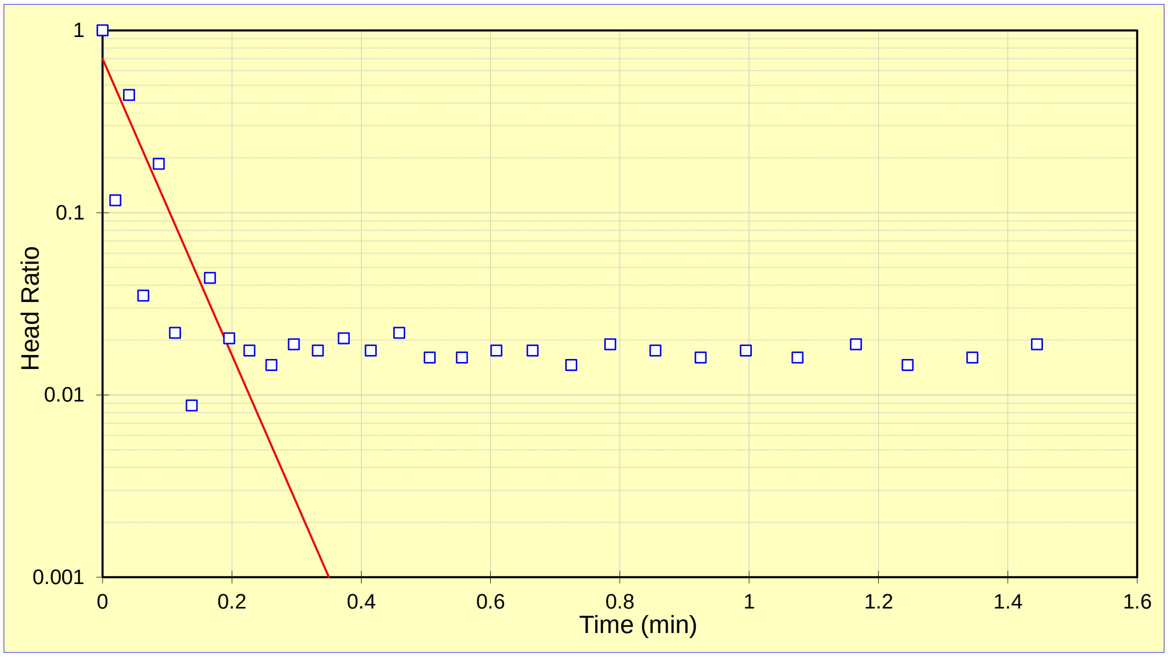
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.34
L_e = 10
t_1 = 0
t_2 = 0.35
h_1/h_0 = 0.70
h_2/h_0 = 0.00

RESULTS

K= 1.11E-02 cm/sec
K= 3.15E+01 ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-13B (TEST 1)

$$K = \frac{r_c^{\,2} \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

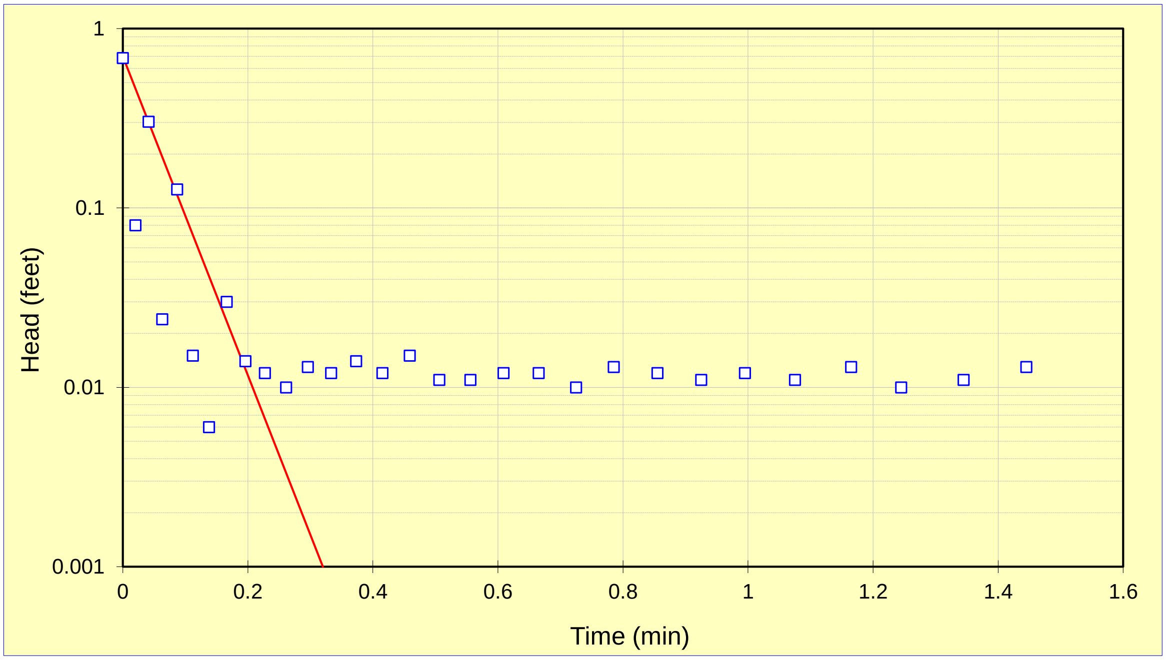
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c = 0.08
r_w = 0.34
L_e = 10
$\ln(R_e/r_w)$= 3.22
y_0 = 0.70
y_t = 0.001
t = 0.3

RESULTS

K= 1.16E-02 cm/sec
K= 3.30E+01 ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-13 (TEST 2)

$$K = \frac{r_c^{\,2}}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

where:

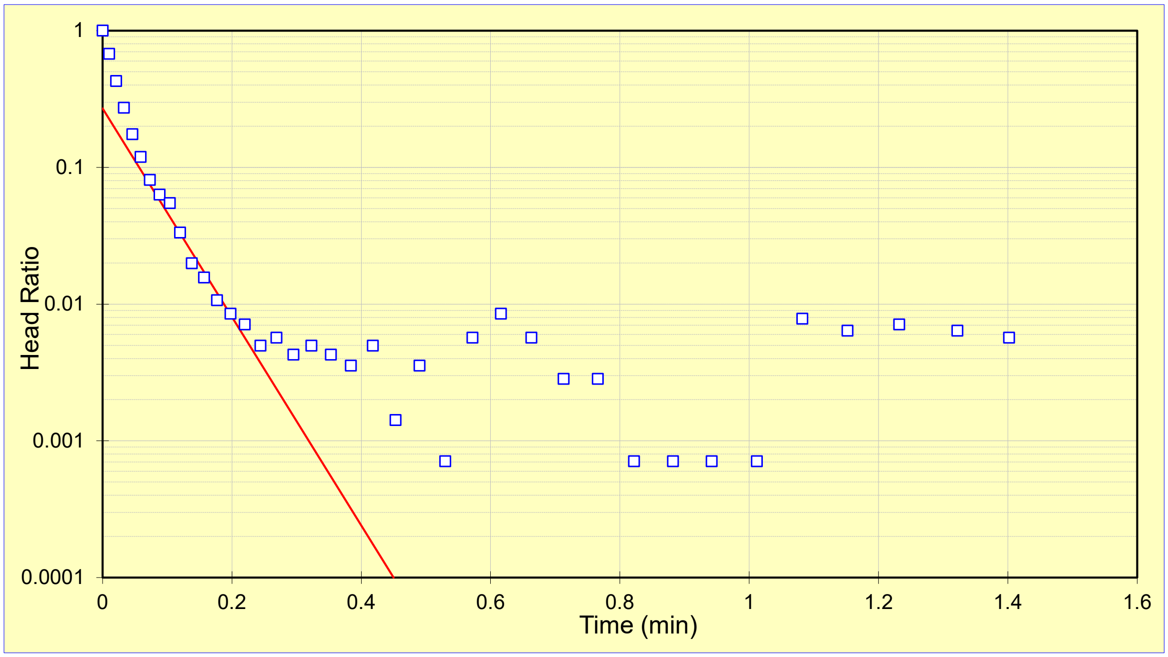
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.20
R_e =	0.34
L_e =	9.037
t_1 =	0
t_2 =	0.45
h_1/h_0 =	0.27
h_2/h_0 =	0.00

RESULTS

K=	6.50E-02	cm/sec
K=	1.84E+02	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-13 (TEST 2)

$$K = \frac{r_c^2 \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

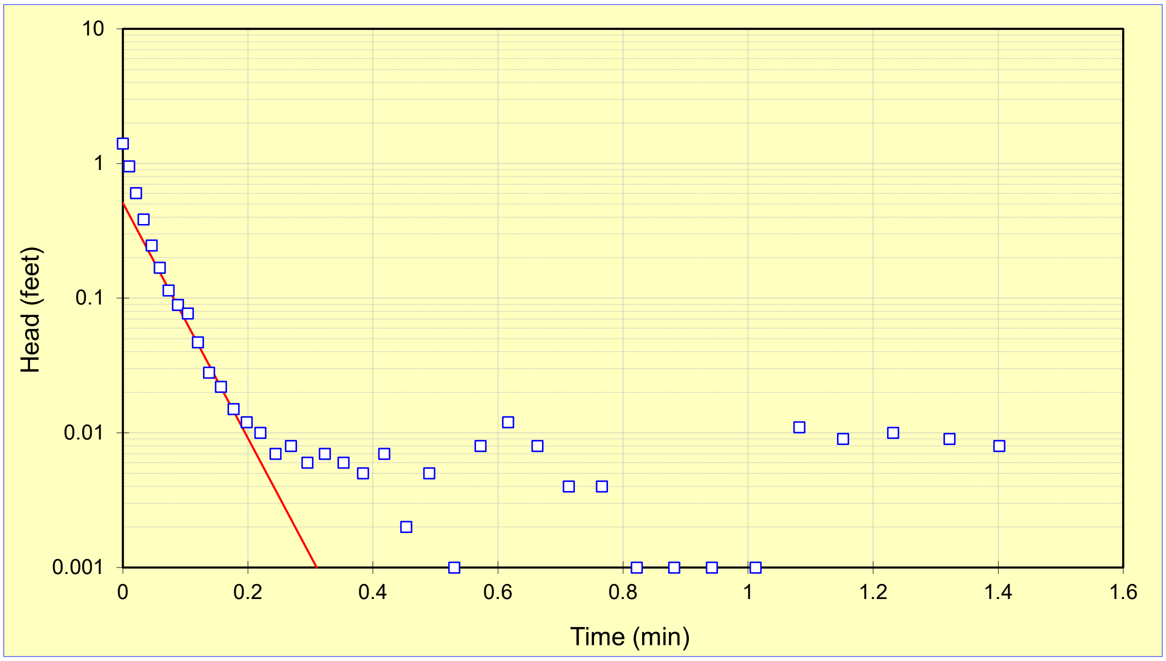
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.20
r_w =	0.34
L_e =	9.037
$\ln(R_e/r_w)$=	2.11
y_0 =	0.51
y_t =	0.001
t =	0.3

RESULTS

K=	4.81E-02	cm/sec
K=	1.36E+02	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST GAMW-13B (TEST 1)

$$K = \frac{r_c^2}{2L_e} \ln\frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

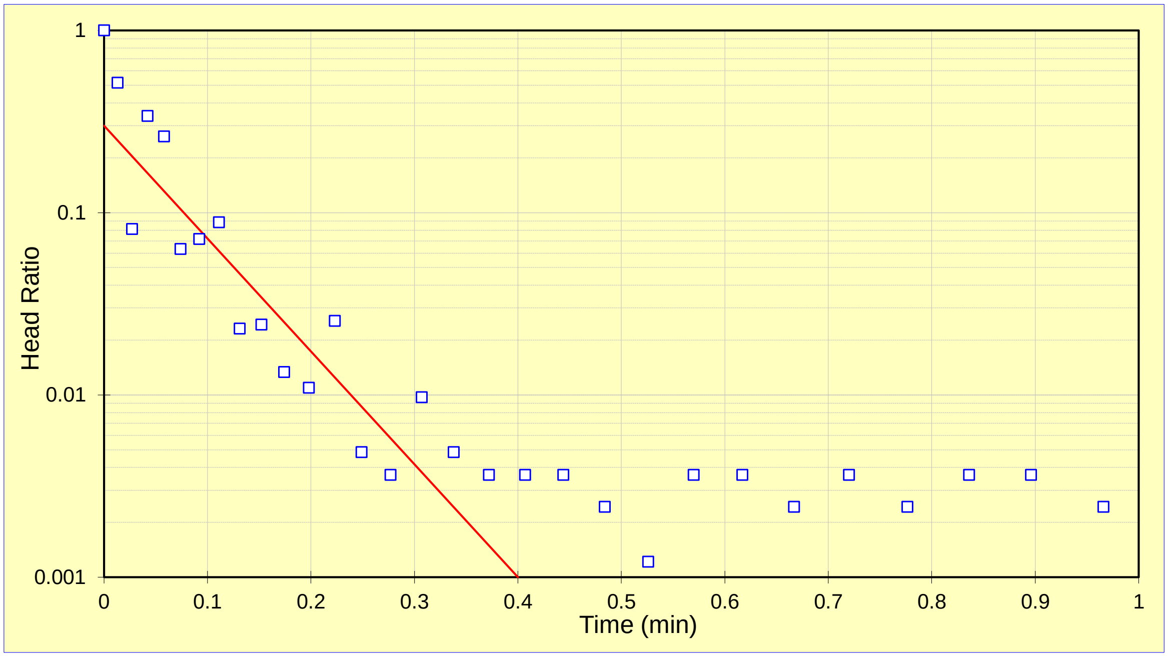
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.34
L_e = 10
t_1 = 0
t_2 = 0.4
h_1/h_0 = 0.30
h_2/h_0 = 0.00

RESULTS

K=	8.48E-03	cm/sec
K=	2.40E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST GAMW-13B (TEST 1)

$$K = \frac{r_c^{\,2} \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

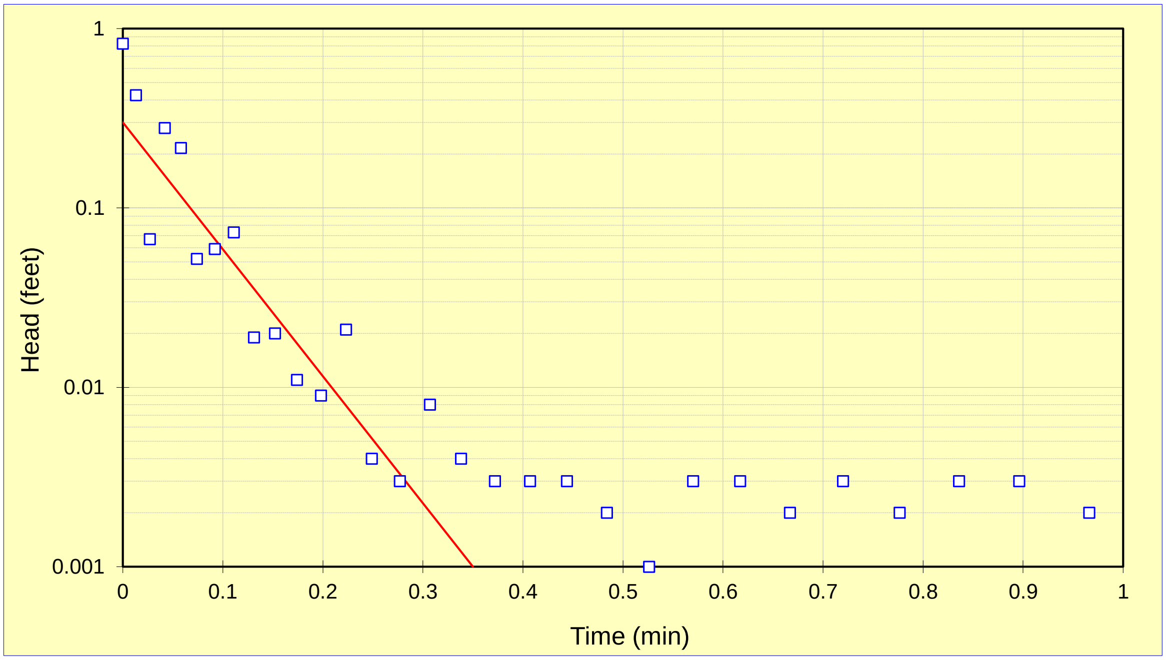
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c = 0.08
r_w = 0.34
L_e = 10
$\ln(R_e/r_w)$= 3.22
y_0 = 0.30
y_t = 0.001
t = 0.4

RESULTS

K=	9.27E-03	cm/sec
K=	2.63E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST GAMW-13B (TEST 2)

$$K = \frac{r_c^{2}}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

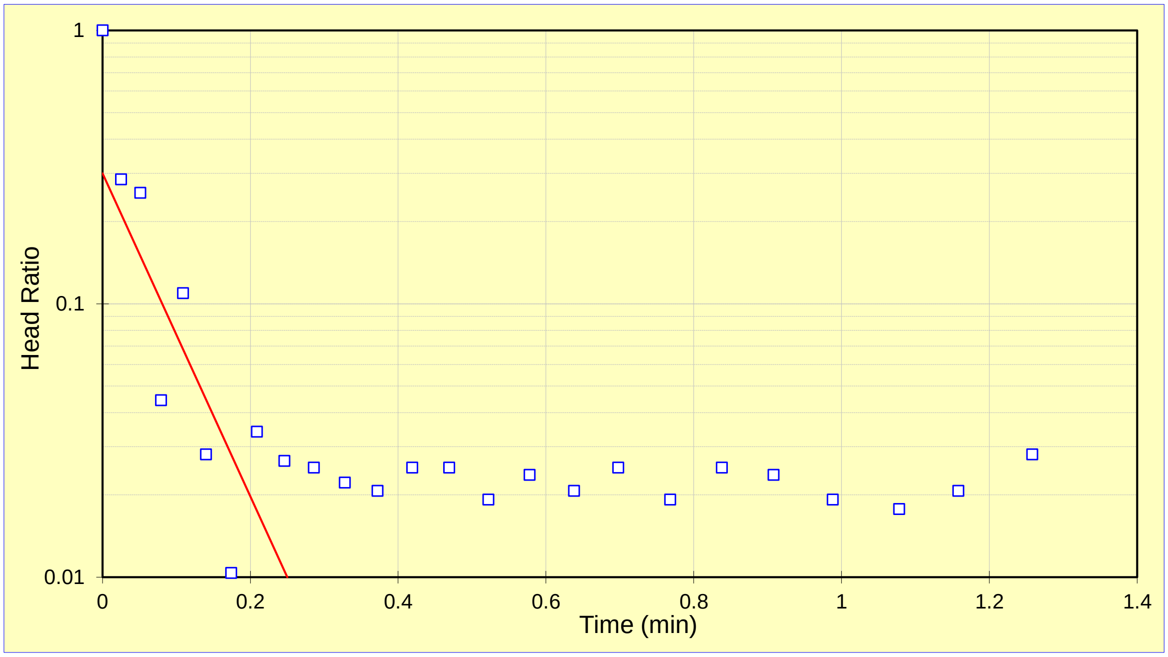
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.34
L_e = 10
t_1 = 0
t_2 = 0.25
h_1/h_0 = 0.30
h_2/h_0 = 0.01

RESULTS

K= 8.09E-03 cm/sec
K= 2.29E+01 ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST GAMW-13B (TEST 2)

$$K = \frac{r_c^{\,2} \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

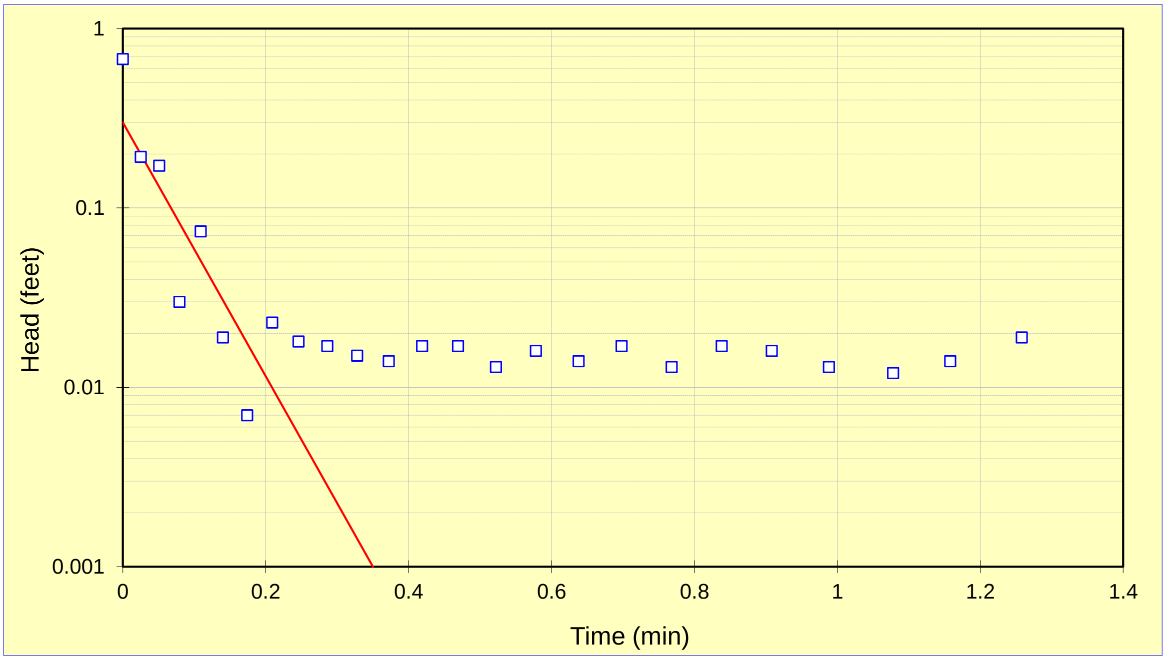
where:

r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS	
r_c =	0.08
r_w =	0.34
L_e =	10
$\ln(R_e/r_w)$=	3.22
y_0 =	0.30
y_t =	0.001
t =	0.4

RESULTS

K=	9.27E-03	cm/sec
K=	2.63E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

File:GAMW-13B Falling 2.xlsx\BOUWER

van der KAMP RISING HEAD SLUG TEST ANALYSIS

UNDERDAMPED SLUG TEST GAMW-13B (TEST 1)

$$T = b + a \ln T$$

where:

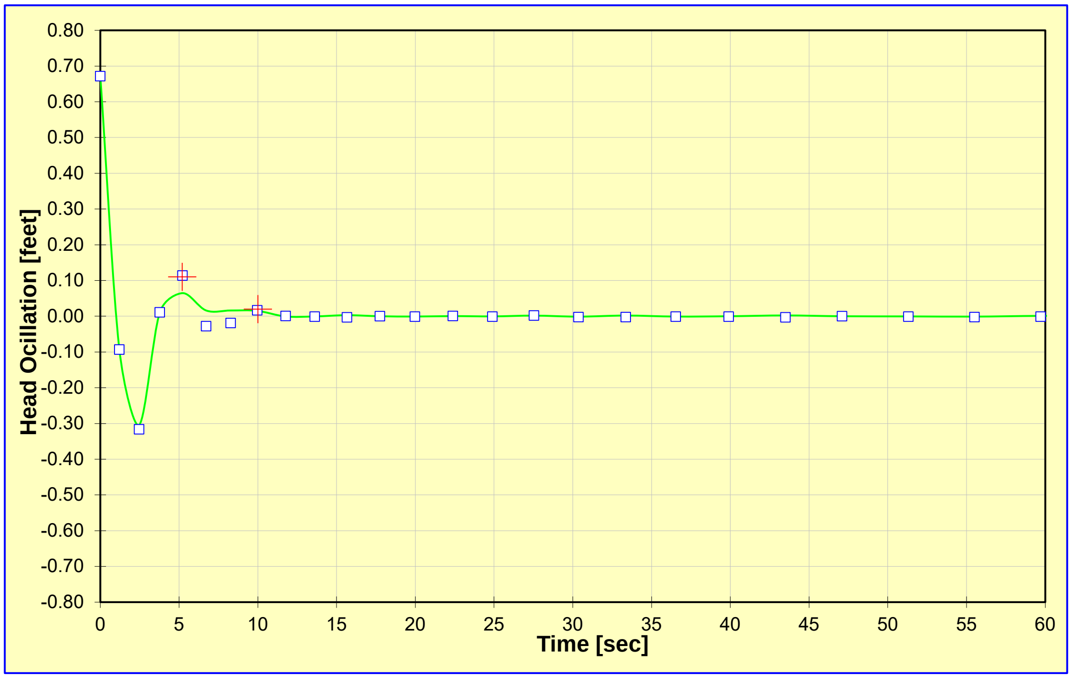
$$b = -a \ln\left[0.79 r_s^2 S (g/L)^{1/2}\right]$$
$$a = r_c^2 \left(g/L^{1/2}\right)/8d$$
$$d = \gamma / (g/L)^{1/2}$$
$$L = g/\left(\omega^2 + \gamma^2\right)$$

INPUT PARAMETERS

r_c =	0.08	ft	$(g/L)^{1/2}$ =	1.35632	ft^2
r_s =	0.08	ft	d =	0.2619	ft^{-1}
L_c =	19.45	ft	a =	0.00450	ft^3
L_s =	9.98	ft	t_1 =	5.20	sec
w =	1.3090	ft^{-1}	t_2 =	10.00	sec
g =	0.3552	ft^{-1}	$h(t_1)$ =	0.11	ft
L =	17.50	ft^3/sec^2	$h(t_2)$ =	0.02	ft
g =	32.19	ft/sec^2	S =	1.00E-02	dim

RESULTS

$b = T_0$ =	4.27E-02	ft^2/sec	$a < 0.1$?	YES
T =	2.64E-02	ft^2/sec	$d < 0.7$?	YES
T =	2.28E+03	ft^2/day	L_1 =	17.50
K =	7.74E+01	ft/day	L_2 =	24.44
K =	2.73E-02	cm/sec	L_1:L_2 Diff <20% ?	NO



Project Name:	NIPSCO RMSGS	Analysis By:	DFS
Project No.:	164-8171	Checked By:	JRS
Test Date:	07/07/16	Analysis Date:	7/31/2017

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-13B (TEST 1)

$$K = \frac{r_c^{\,2}}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

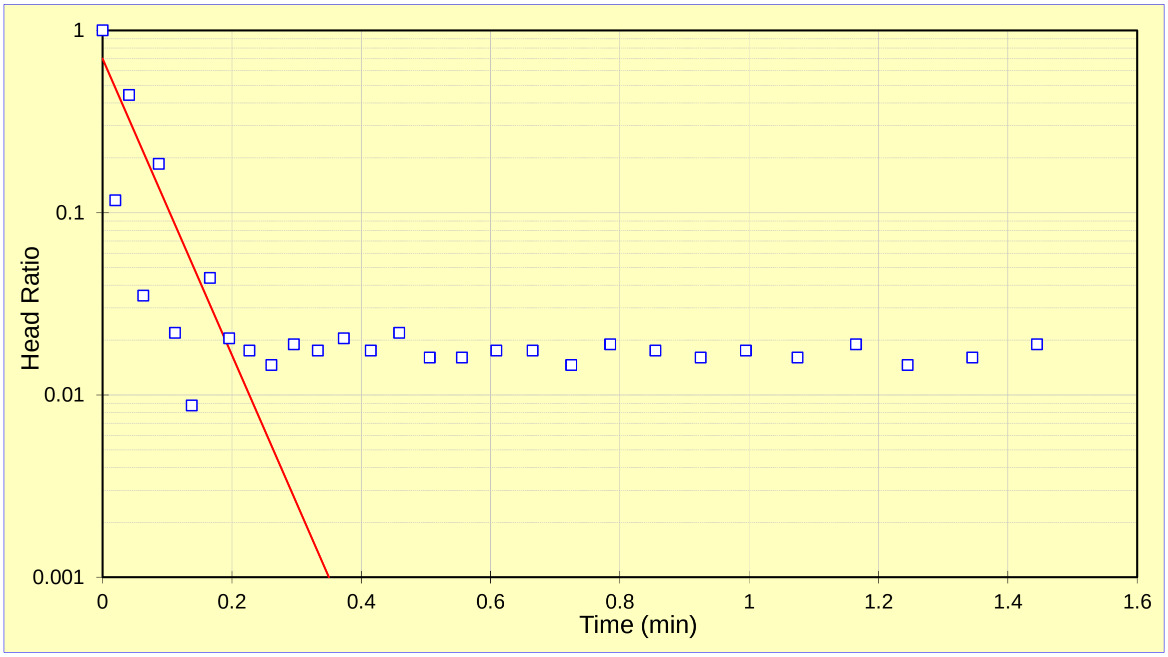
where: r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.34
L_e = 10
t_1 = 0
t_2 = 0.35
h_1/h_0 = 0.70
h_2/h_0 = 0.00

RESULTS

K= 1.11E-02 cm/sec
K= 3.15E+01 ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-13B (TEST 1)

$$K = \frac{r_c^{2} \ln\left(\frac{R_e}{r_w}\right)}{2L_e}\frac{1}{t}\ln\frac{y_0}{y_t}$$

where:

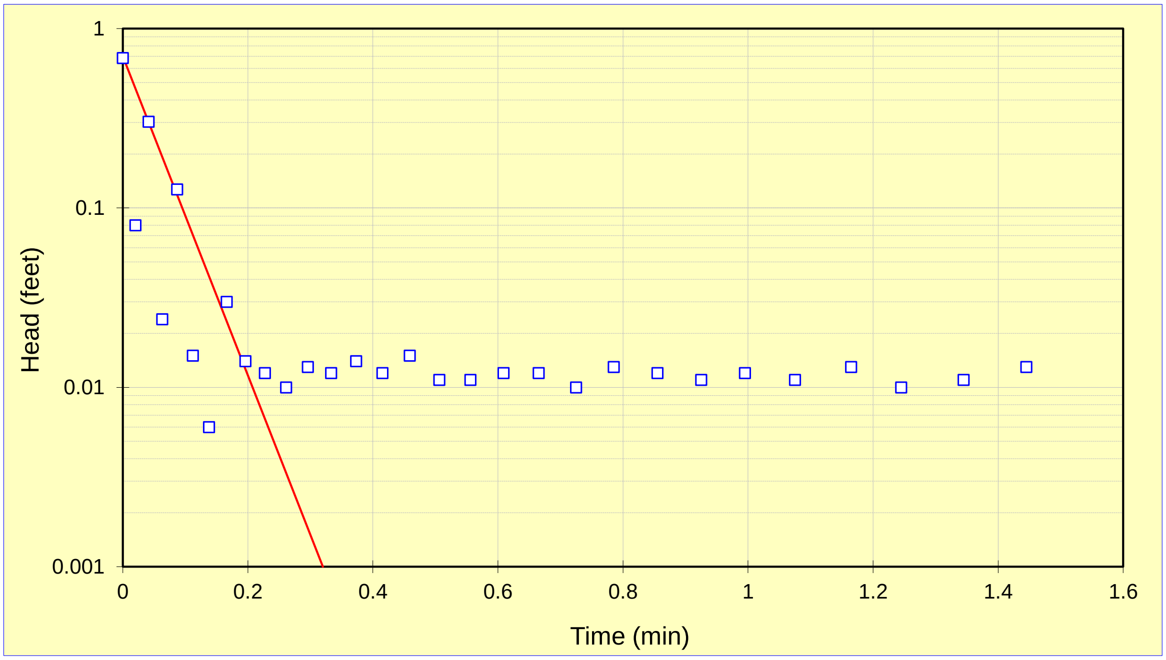
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c = 0.08
r_w = 0.34
L_e = 10
$\ln(R_e/r_w)$= 3.22
y_0 = 0.70
y_t = 0.001
t = 0.3

RESULTS

K= 1.16E-02 cm/sec
K= 3.30E+01 ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

van der KAMP RISING HEAD SLUG TEST ANALYSIS

UNDERDAMPED SLUG TEST GAMW-13B (TEST 2)

$$T = b + a \ln T$$

where:

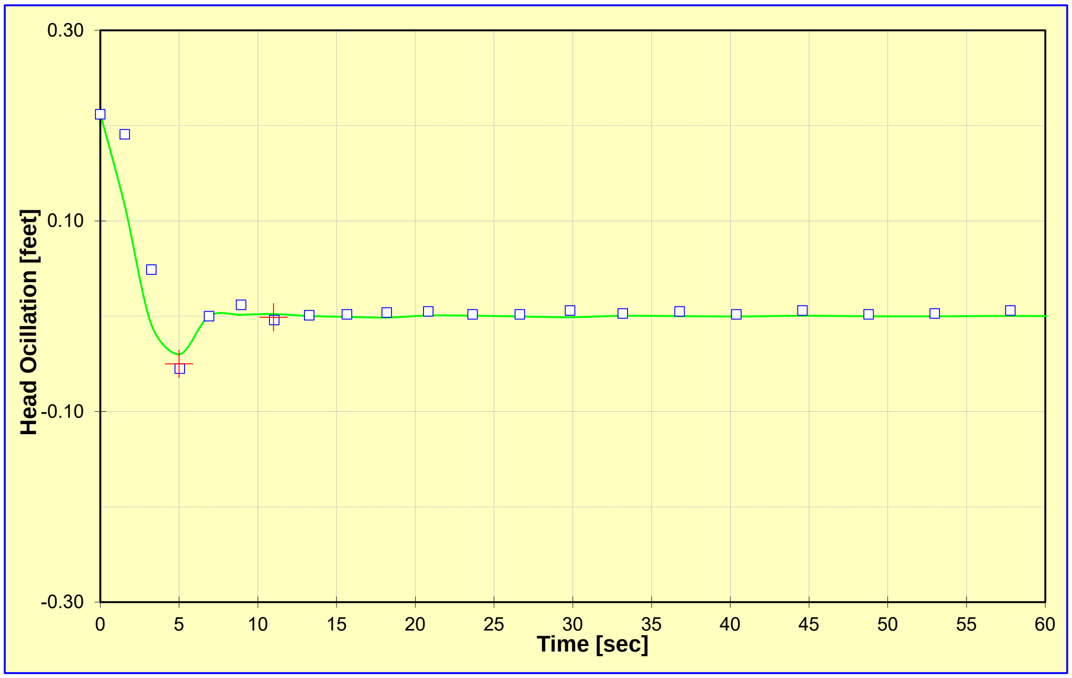
$$b = -a \ln\left[0.79 r_s^2 S (g/L)^{1/2}\right]$$
$$a = r_c^2 \left(g/L^{1/2}\right)/8d$$
$$d = \gamma/(g/L)^{1/2}$$
$$L = g/\left(\omega^2 + \gamma^2\right)$$

INPUT PARAMETERS

r_c =	0.08	ft	(g/L)^ $^{1/2}$ =	1.23358	ft^2
r_s =	0.08	ft	d =	0.5285	ft^{-1}
L_c =	19.14	ft	a =	0.00203	ft^3
L_s =	9.98	ft	t_1 =	5.00	sec
w =	1.0472	ft^{-1}	t_2 =	11.00	sec
g =	0.6520	ft^{-1}	$h(t_1)$ =	0.05	ft
L =	21.15	ft^3/sec^2	$h(t_2)$ =	0.00	ft
g =	32.19	ft/sec^2	S =	1.00E-02	dim

RESULTS

$b = T_0$ =	1.95E-02	ft^2/sec	$a < 0.1$?	YES
T =	1.02E-02	ft^2/sec	$d < 0.7$?	YES
T =	8.77E+02	ft^2/day	L_1 =	21.15
K =	3.01E+01	ft/day	L_2 =	24.13
K =	1.06E-02	cm/sec	$L_1:L_2$ Diff <20% ?	YES



Project Name: NIPSCO RMSGS
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/31/2017

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-13B (TEST 2)

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

where:

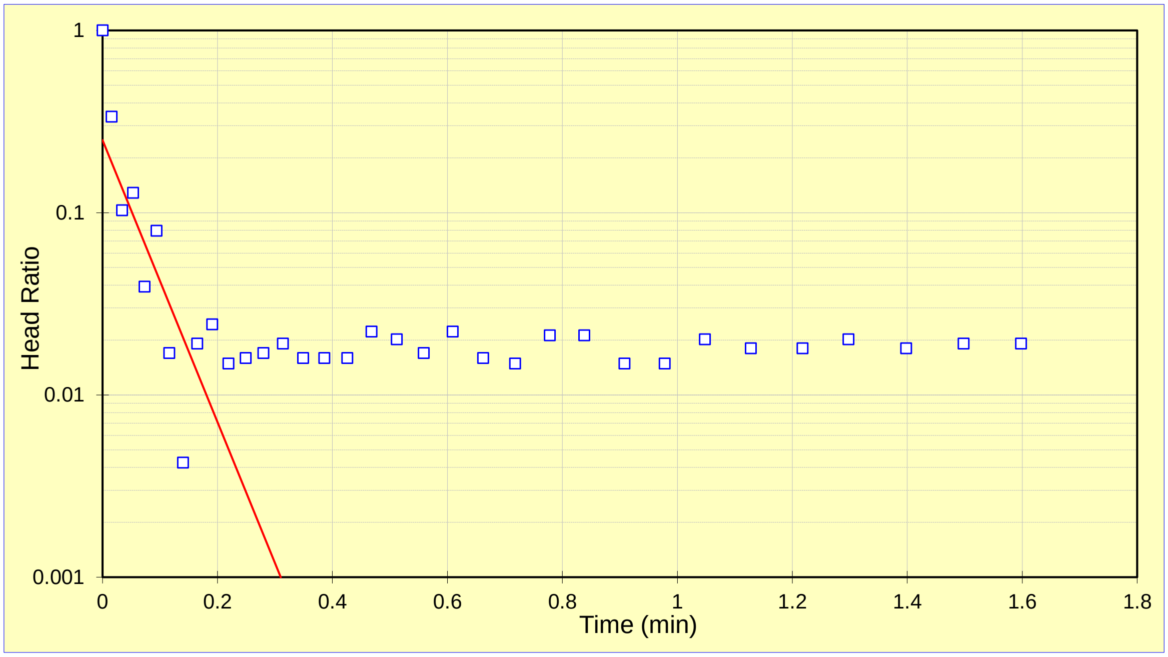
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.34
L_e = 10
t_1 = 0
t_2 = 0.31
h_1/h_0 = 0.25
h_2/h_0 = 0.00

RESULTS

K=	1.06E-02	cm/sec
K=	3.00E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-13B (TEST 2)

$$K = \frac{r_c^{\,2} \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

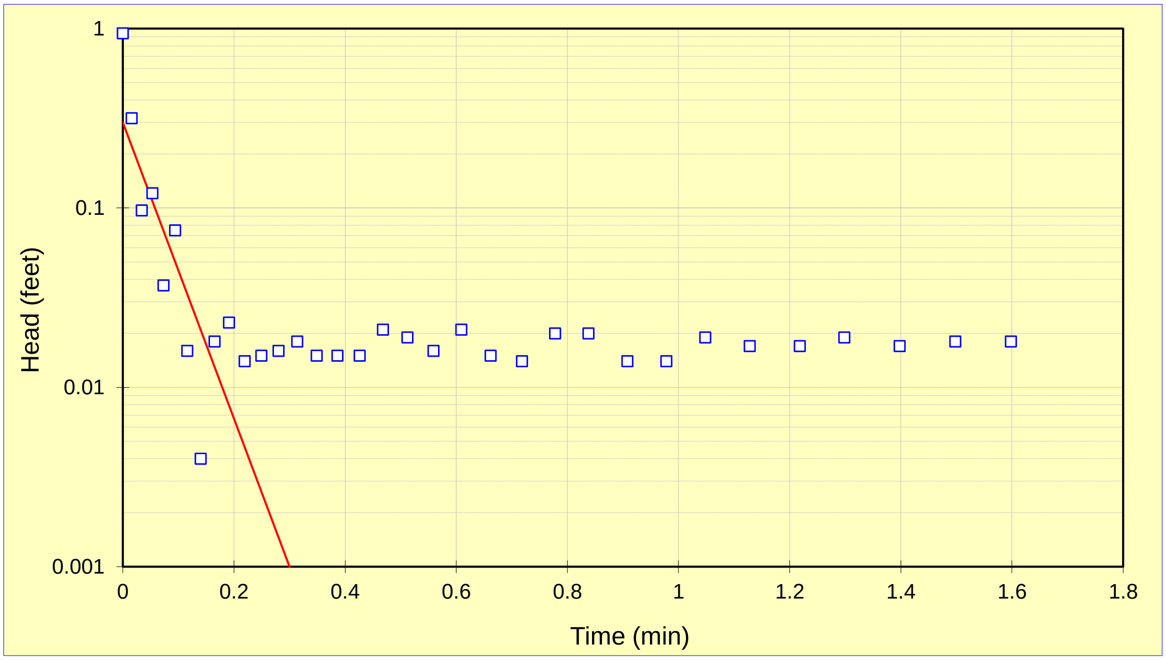
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.34
L_e =	10
$\ln(R_e/r_w)$=	3.22
y_0 =	0.30
y_t =	0.001
t =	0.3

RESULTS

K=	1.08E-02	cm/sec
K=	3.06E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-15 (TEST 1)

$$K = \frac{r_c^{\,2}}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

where:

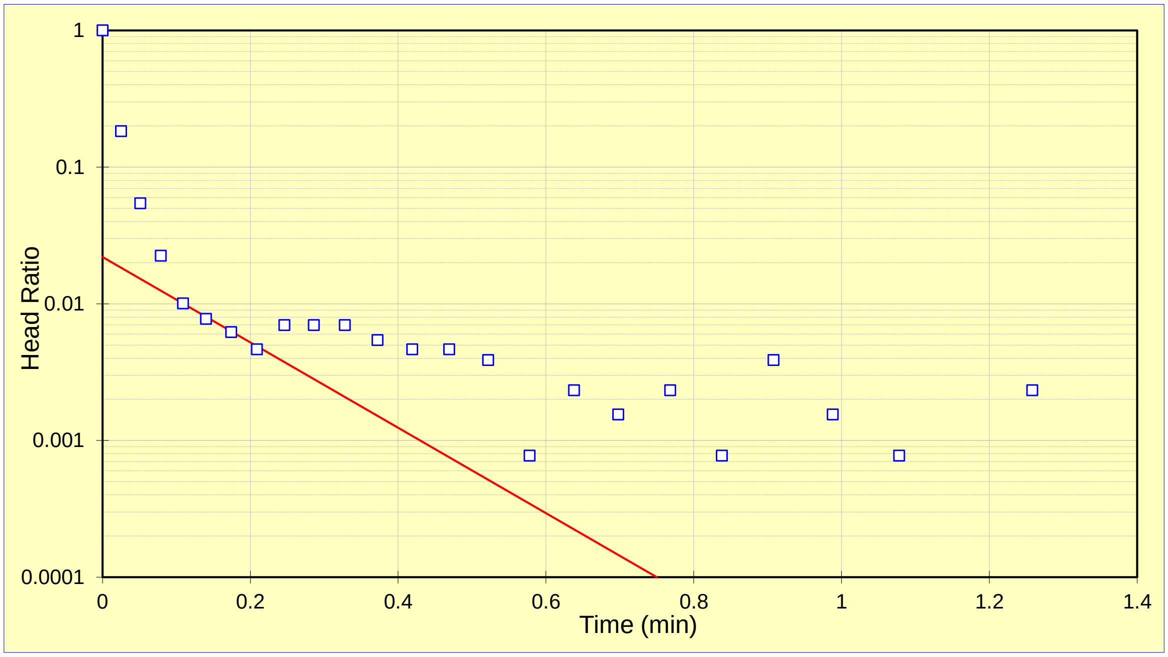
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.20
R_e = 0.34
L_e = 9.417
t_1 = 0
t_2 = 0.75
h_1/h_0 = 0.02
h_2/h_0 = 0.00

RESULTS

K= 2.59E-02 cm/sec
K= 7.34E+01 ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-15 (TEST 1)

$$K = \frac{r_c^2 \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

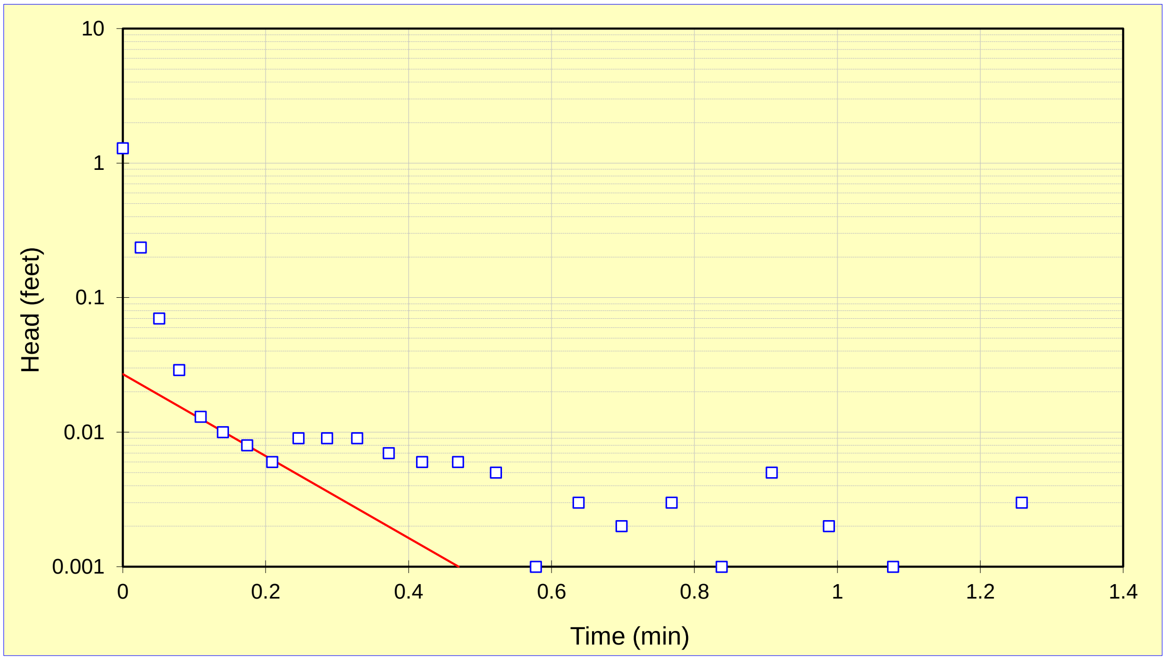
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.20
r_w =	0.34
L_e =	9.417
$\ln(R_e/r_w)$=	2.14
y_0 =	0.03
y_t =	0.001
t =	0.5

RESULTS

K=	1.63E-02	cm/sec
K=	4.63E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-15 (TEST 2)

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

where:

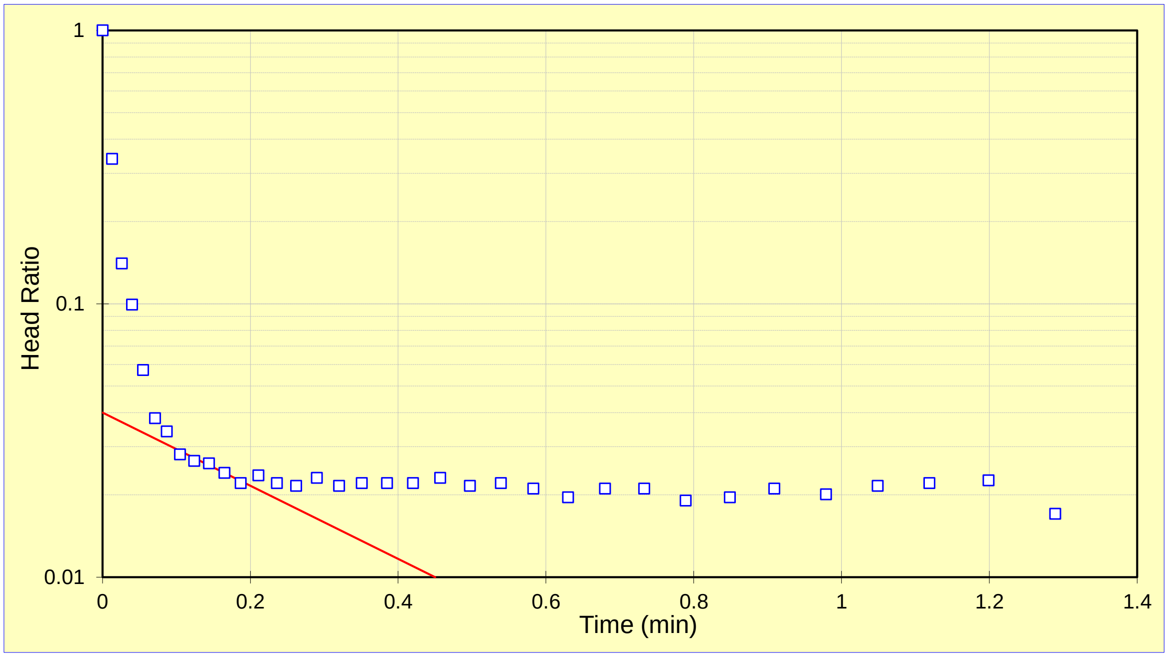
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.20
R_e = 0.34
L_e = 9.348
t_1 = 0
t_2 = 0.45
h_1/h_0 = 0.04
h_2/h_0 = 0.01

RESULTS

K= 1.11E-02 cm/sec
K= 3.16E+01 ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-15 (TEST 2)

$$K = \frac{r_c^{\,2} \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

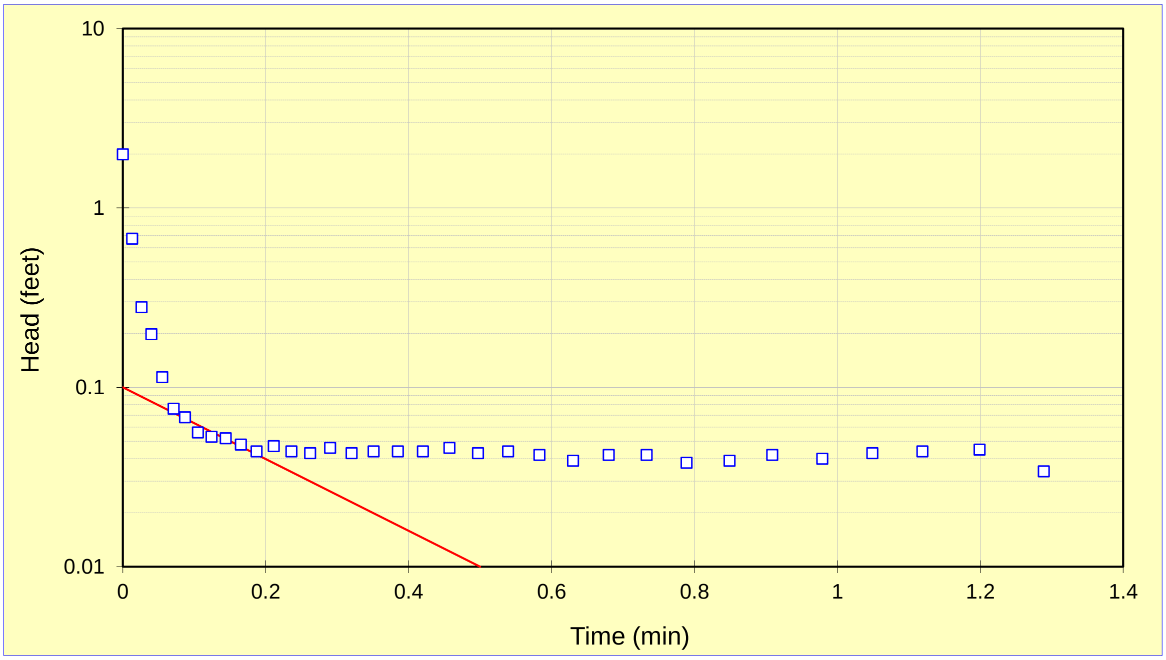
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.20
r_w =	0.34
L_e =	9.348
$\ln(R_e/r_w)$=	2.13
y_0 =	0.10
y_t =	0.010
t =	0.5

RESULTS

K=	1.08E-02	cm/sec
K=	3.05E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST GAMW-15B (TEST 1)

$$K = \frac{r_c^{\,2}}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

where:

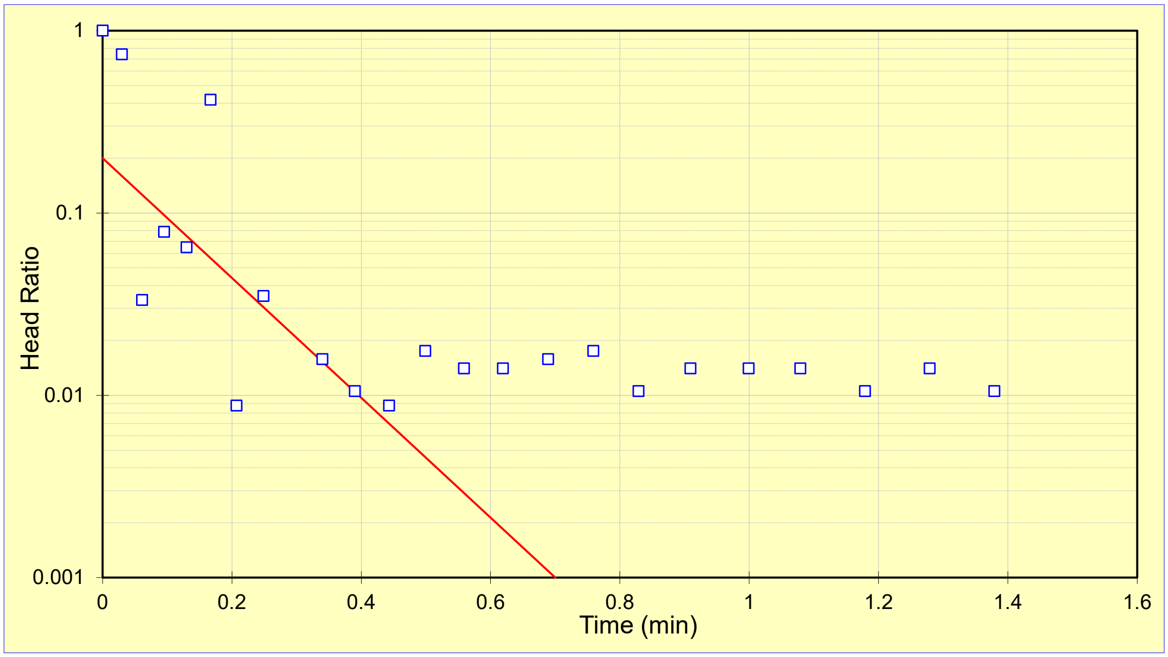
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.34
L_e =	10
t_1 =	0
t_2 =	0.7
h_1/h_0 =	0.20
h_2/h_0 =	0.00

RESULTS

K=	4.50E-03	cm/sec
K=	1.28E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST GAMW-15B (TEST 1)

$$K = \frac{r_c^{2} \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

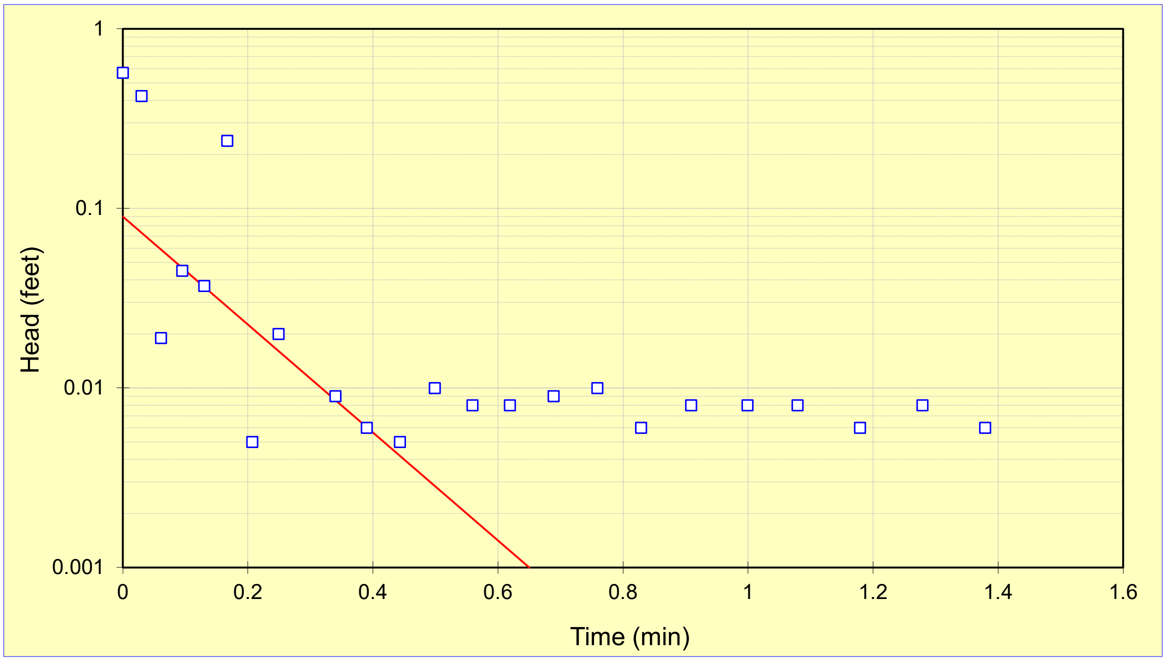
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.34
L_e =	10
$\ln(R_e/r_w)$=	2.83
y_0 =	0.09
y_t =	0.001
t =	0.7

RESULTS

K=	3.45E-03	cm/sec
K=	9.79E+00	ft/day



Project Name: NIPSCO Schahfer

Project No.: 164-8171

Test Date: 07/07/16

Analysis By: DFS

Checked By: JRS

Analysis Date: 7/27/2016

van der KAMP FALLING HEAD SLUG TEST ANALYSIS

UNDERDAMPED SLUG TEST GAMW-15B (TEST 2)

$$T = b + a \ln T$$

where:

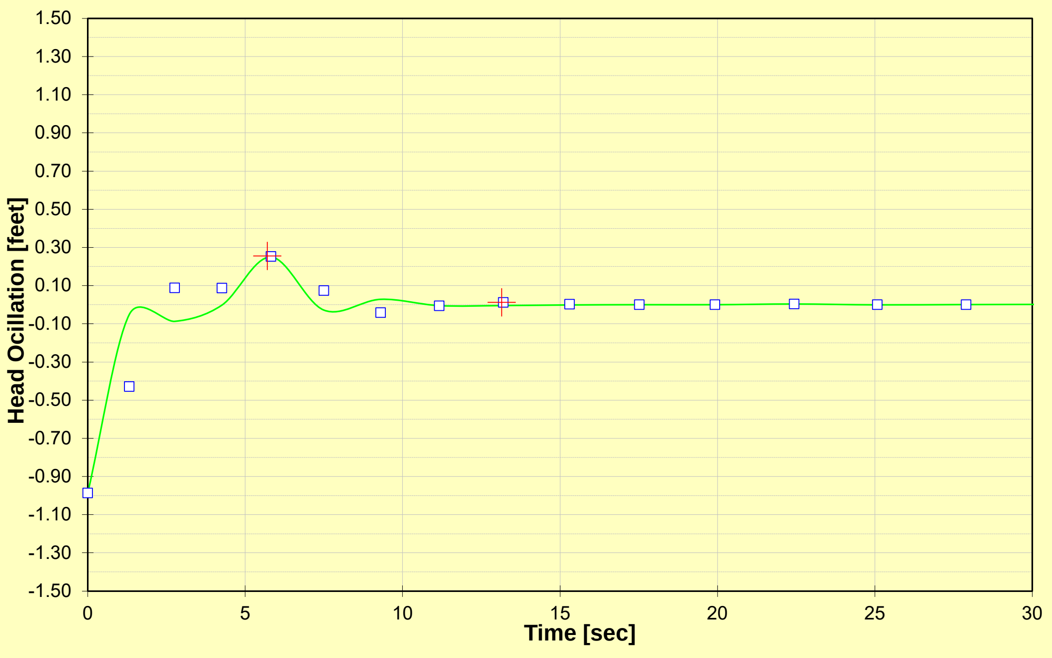
$$b = -a \ln\left[0.79 r_s^2 S (g/L)^{1/2}\right]$$
$$a = r_c^2 \left(g/L^{1/2}\right)/8d$$
$$d = \gamma/(g/L)^{1/2}$$
$$L = g/\left(\omega^2 + \gamma^2\right)$$

INPUT PARAMETERS

r_c =	0.08	ft	$(g/L)^{\wedge 1/2}$ =	0.93787	ft^2
r_s =	0.08	ft	d =	0.4374	ft^{-1}
L_c =	19.23	ft	a =	0.00186	ft^3
L_s =	10.00	ft	t_1 =	5.70	sec
w =	0.8434	ft^{-1}	t_2 =	13.15	sec
g =	0.4102	ft^{-1}	$h(t_1)$ =	0.26	ft
L =	36.60	ft^3/sec^2	$h(t_2)$ =	0.01	ft
g =	32.19	ft/sec^2	S =	1.00E-02	dim

RESULTS

$b = T_0$ =	1.84E-02	ft^2/sec	$a < 0.1$?	YES
T =	9.76E-03	ft^2/sec	$d < 0.7$?	YES
T =	8.44E+02	ft^2/day	L_1 =	36.60
K =	2.70E+01	ft/day	L_2 =	24.23
K =	9.53E-03	cm/sec	$L_1:L_2$ Diff <20% ?	NO



Project Name: NIPSCO RMSGS
Project No.: 164-8171
Test Date: 07/08/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/31/2017

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST GAMW-15B (TEST 2)

$$K = \frac{r_c^{\,2}}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

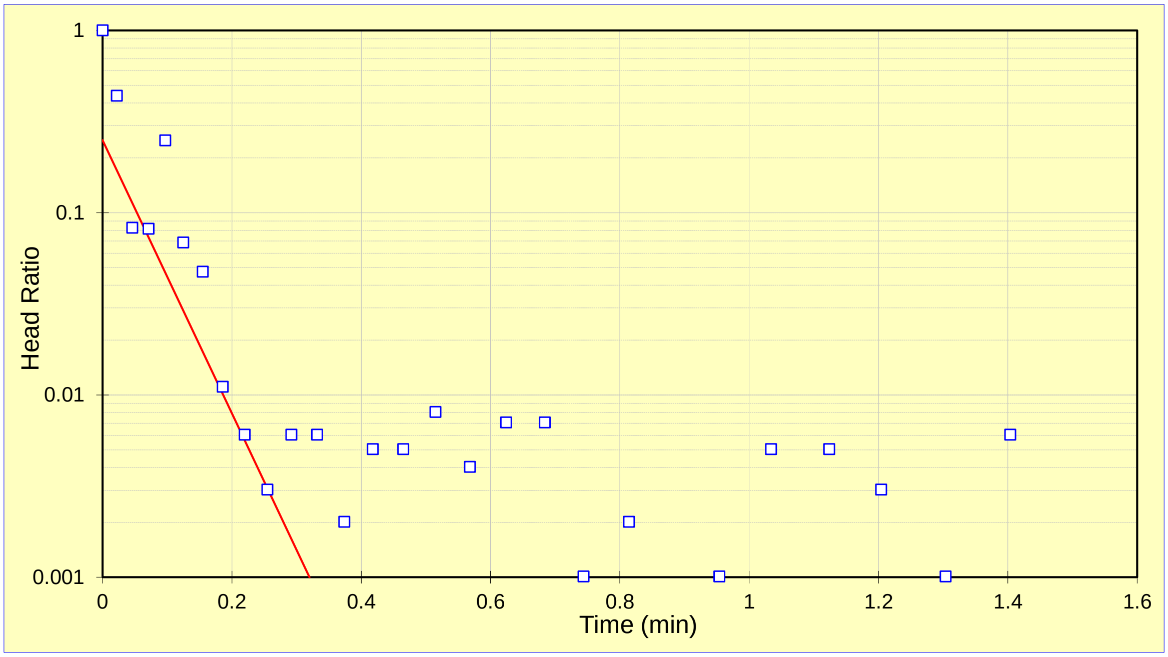
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.34
L_e = 10
t_1 = 0
t_2 = 0.32
h_1/h_0 = 0.25
h_2/h_0 = 0.00

RESULTS

K= 1.03E-02 cm/sec
K= 2.91E+01 ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/08/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST GAMW-15B (TEST 2)

$$K = \frac{r_c^2 \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

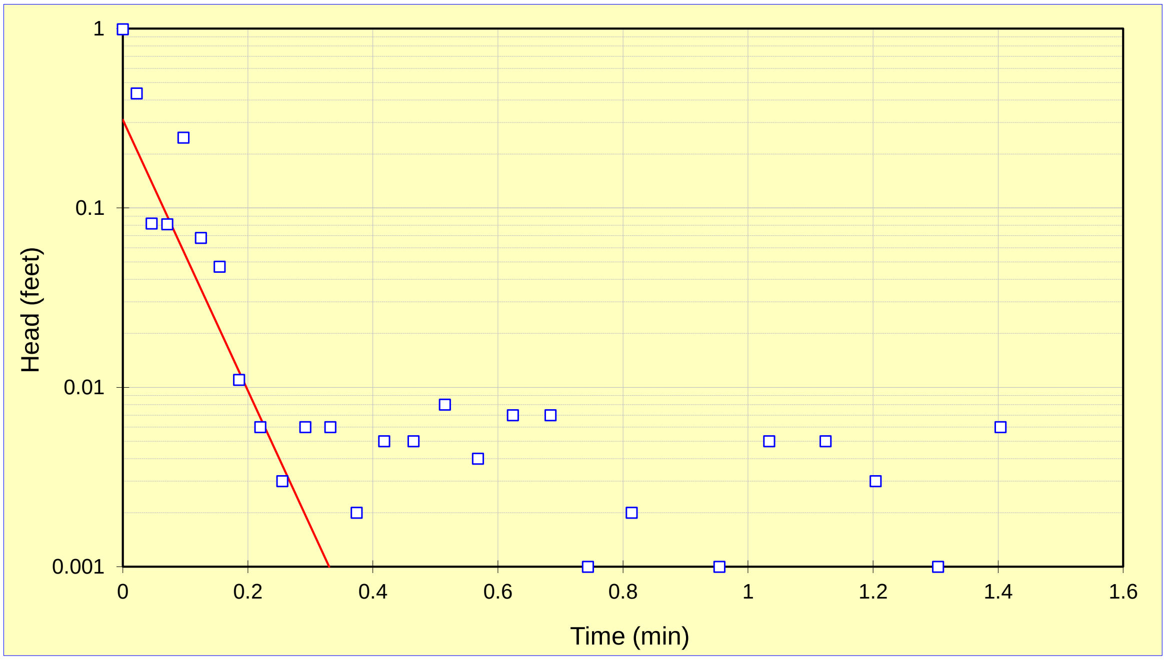
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.34
L_e =	10
$\ln(R_e/r_w)$=	2.85
y_0 =	0.31
y_t =	0.001
t =	0.3

RESULTS

K=	8.75E-03	cm/sec
K=	2.48E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/08/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

File:GAMW-15B Falling 2.xlsx\BOUWER

van der KAMP RISING HEAD SLUG TEST ANALYSIS

UNDERDAMPED SLUG TEST GAMW-15B (TEST 1)

$$T = b + a \ln T$$

where:

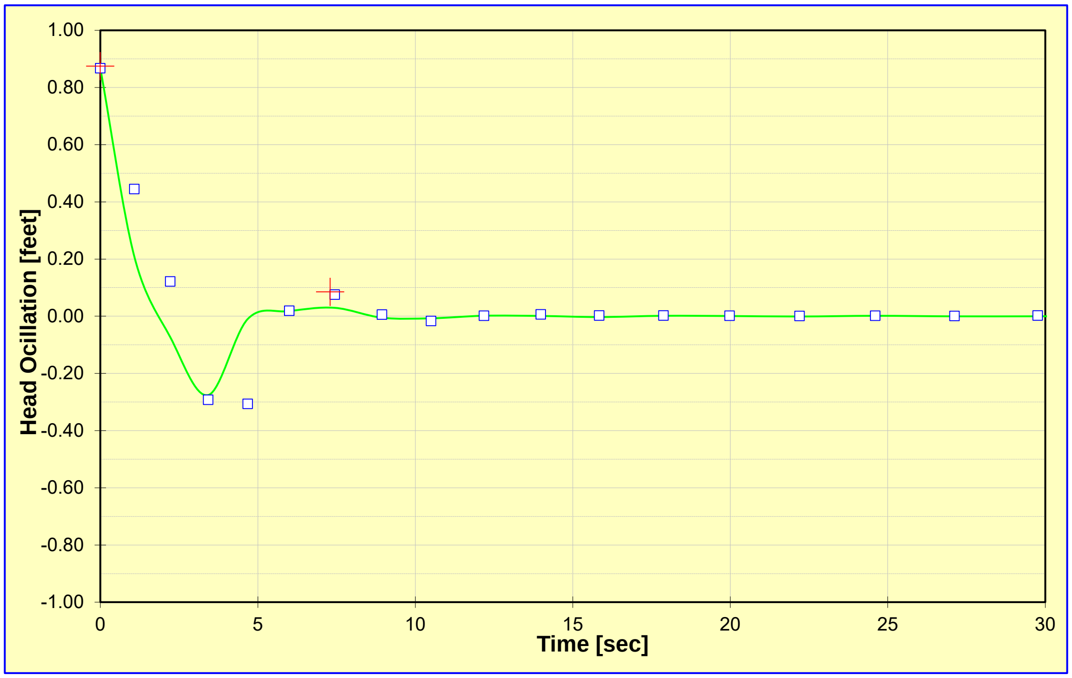
$$b = -a \ln\left[0.79 r_s^2 S (g/L)^{1/2}\right]$$
$$a = r_c^2 \left(g/L^{1/2}\right)/8d$$
$$d = \gamma/(g/L)^{1/2}$$
$$L = g/\left(\omega^2 + \gamma^2\right)$$

INPUT PARAMETERS

r_c =	0.08	ft	$(g/L)^{\wedge 1/2}$ =	0.91806	ft^2
r_s =	0.08	ft	d =	0.3479	ft^{-1}
L_c =	19.23	ft	a =	0.00229	ft^3
L_s =	10.00	ft	t_1 =	0.00	sec
w =	0.8607	ft^{-1}	t_2 =	7.30	sec
g =	0.3194	ft^{-1}	$h(t_1)$ =	0.88	ft
L =	38.19	ft^3/sec^2	$h(t_2)$ =	0.09	ft
g =	32.19	ft/sec^2	S =	1.00E-02	dim

RESULTS

$b = T_0$ =	2.27E-02	ft^2/sec	a < 0.1?	YES
T =	1.27E-02	ft^2/sec	d < 0.7?	YES
T =	1.09E+03	ft^2/day	L_1 =	38.19
K =	3.50E+01	ft/day	L_2 =	24.23
K =	1.24E-02	cm/sec	L_1:L_2 Diff <20% ?	NO



Project Name: NIPSCO RMSGS
Project No.: 164-8171
Test Date: 07/08/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/31/2017

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-15B (TEST 1)

$$K = \frac{r_c^{\,2}}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

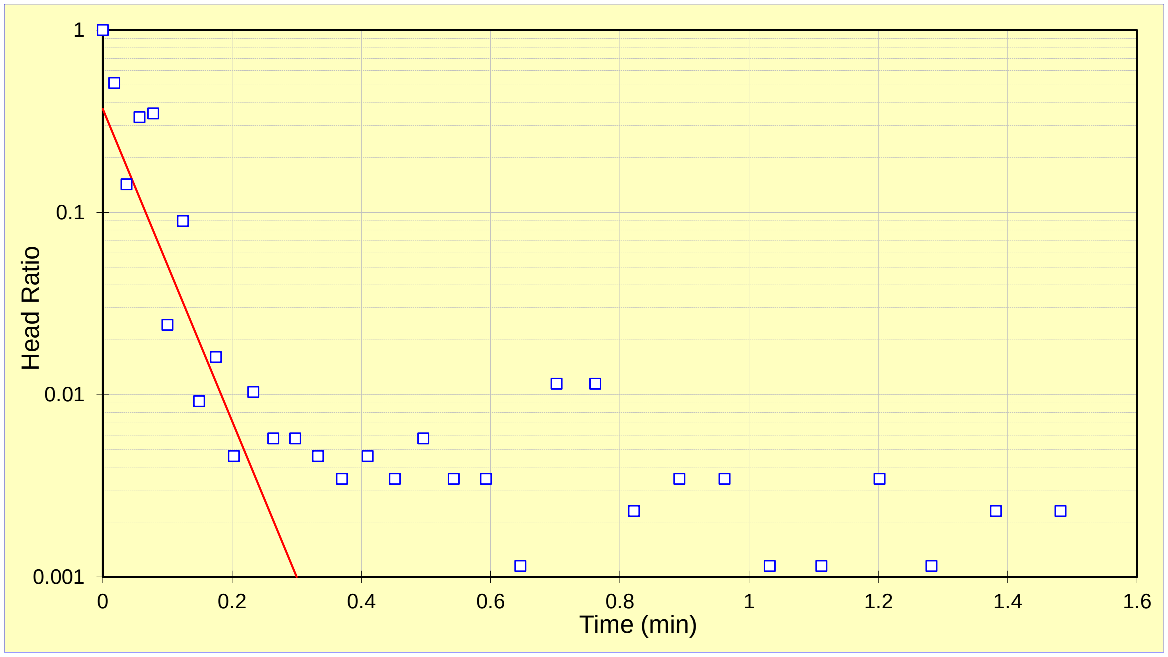
where:

r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS	
r_c =	0.08
R_e =	0.34
L_e =	10
t_1 =	0
t_2 =	0.3
h_1/h_0 =	0.37
h_2/h_0 =	0.00

RESULTS

K=	1.17E-02	cm/sec
K=	3.32E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/08/16

Analysis By: DFS
Checked By: JRS
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BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-15B (TEST 1)

$$K = \frac{r_c^{\,2} \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c = 0.08

r_w = 0.34

L_e = 10

$ln(R_e/r_w)$= 2.85

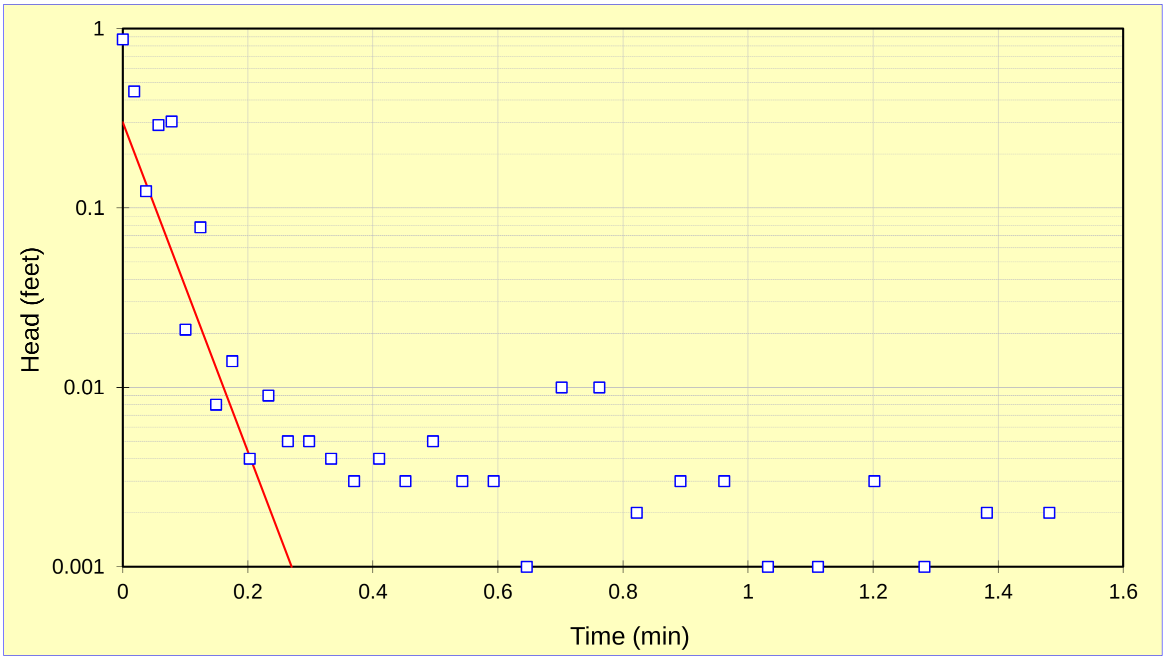
y_0 = 0.30

y_t = 0.001

t = 0.3

RESULTS

K=	1.06E-02	cm/sec
K=	3.02E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/08/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

van der KAMP RISING HEAD SLUG TEST ANALYSIS

UNDERDAMPED SLUG TEST GAMW-15B (TEST 2)

$$T = b + a \ln T$$

where:

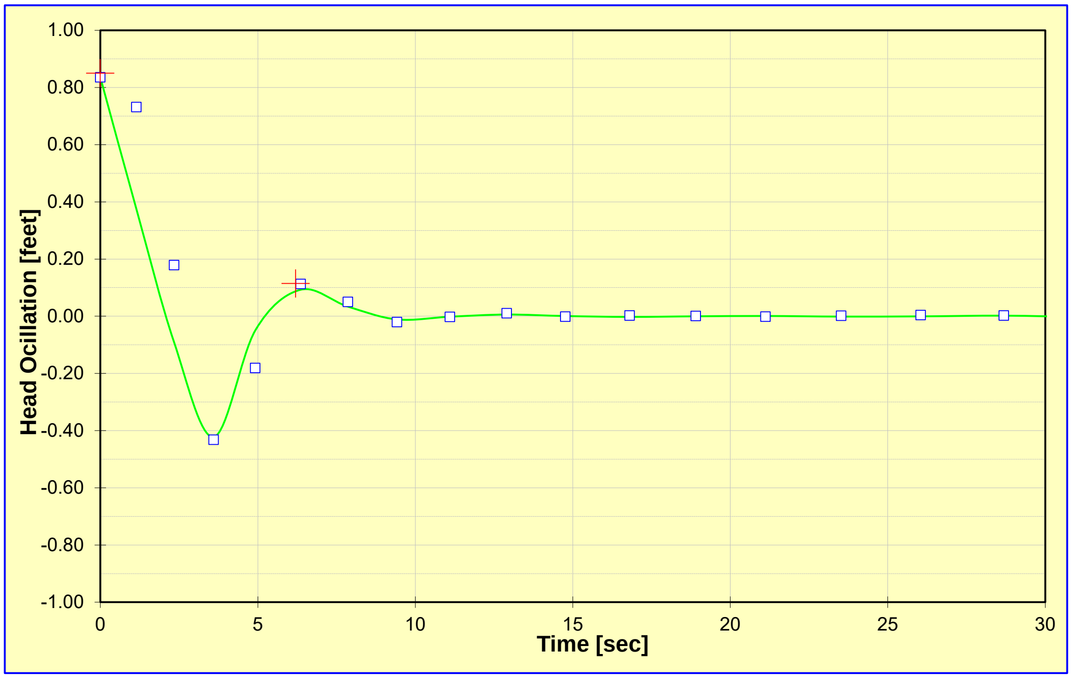
$$b = -a \ln\left[0.79 r_s^2 S (g/L)^{1/2}\right]$$
$$a = r_c^2 \left(g/L^{1/2}\right)/8d$$
$$d = \gamma/(g/L)^{1/2}$$
$$L = g/\left(\omega^2 + \gamma^2\right)$$

INPUT PARAMETERS

r_c =	0.08	ft	(g/L)^ $^{1/2}$ =	1.06353	ft^2
r_s =	0.08	ft	d =	0.3034	ft^{-1}
L_c =	19.22	ft	a =	0.00304	ft^3
L_s =	10.00	ft	t_1 =	0.00	sec
w =	1.0134	ft^{-1}	t_2 =	6.20	sec
g =	0.3226	ft^{-1}	$h(t_1)$ =	0.85	ft
L =	28.46	ft^3/sec^2	$h(t_2)$ =	0.12	ft
g =	32.19	ft/sec^2	S =	1.00E-02	dim

RESULTS

$b = T_0$ =	2.97E-02	ft^2/sec	a < 0.1?	YES
T =	1.73E-02	ft^2/sec	d < 0.7?	YES
T =	1.50E+03	ft^2/day	L_1 =	28.46
K =	4.80E+01	ft/day	L_2 =	24.22
K =	1.69E-02	cm/sec	L_1:L_2 Diff <20% ?	YES



Project Name: NIPSCO RMSGS
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/31/2017

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-15B (TEST 2)

$$K = \frac{r_c^{\,2}}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

where: r_c = casing radius (feet)

R_e = equivalent radius (feet)

L_e = length of screened interval (feet)

t = time (minutes)

h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08

R_e = 0.34

L_e = 10

t_1 = 0

t_2 = 0.38

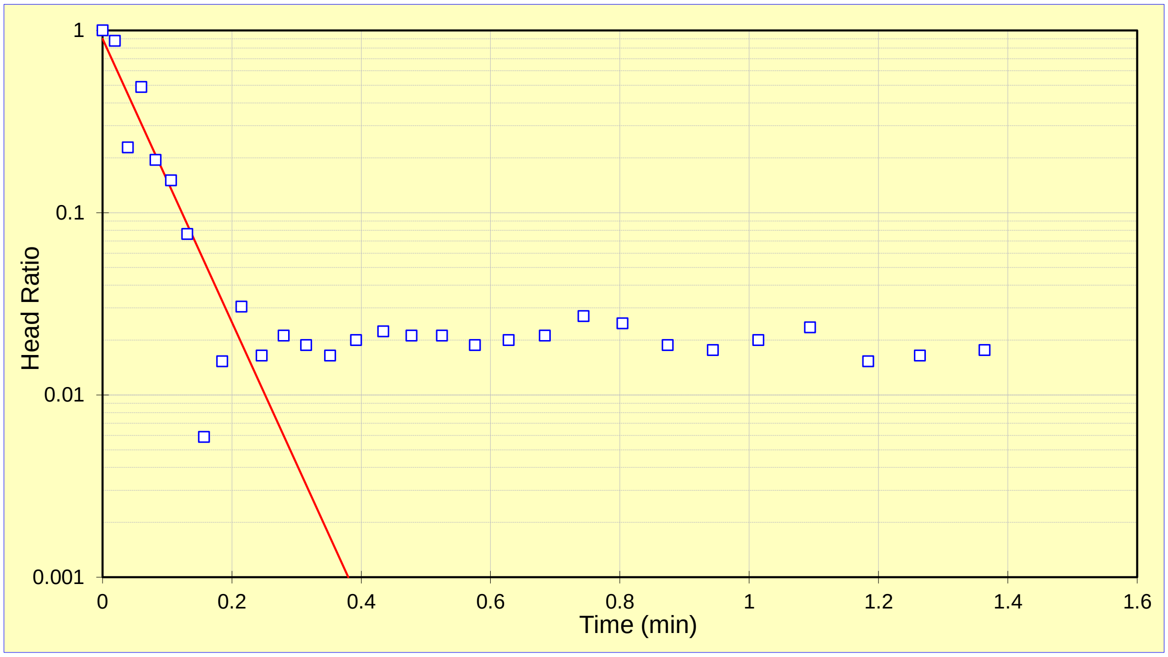
h_1/h_0 = 0.90

h_2/h_0 = 0.00

RESULTS

K= 1.06E-02 cm/sec

K= 3.02E+01 ft/day



Project Name: NIPSCO Schahfer

Project No.: 164-8171

Test Date: 07/08/16

Analysis By: DFS

Checked By: JRS

Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-15B (TEST 2)

$$K = \frac{r_c^{\,2} \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

r_c = casing radius (feet);

R_e = effective radius (feet);

L_e = length of screened interval (feet);

r_w = radial distance to undisturbed aquifer (feet)

y_0 = initial drawdown (feet)

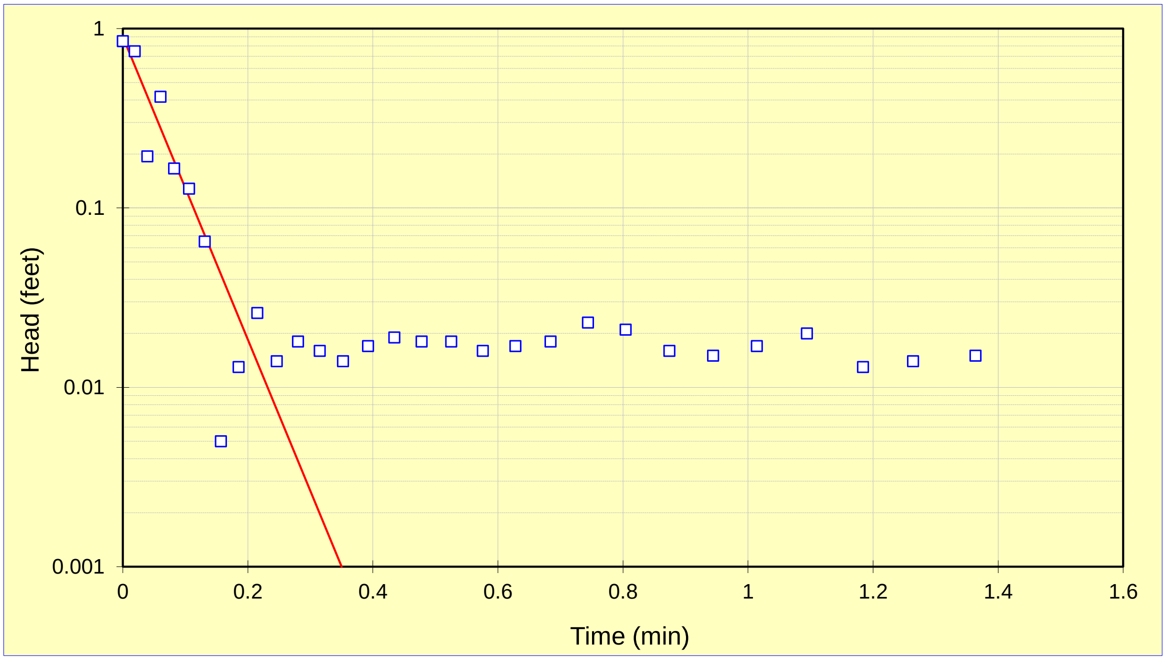
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.34
L_e =	10
$\ln(R_e/r_w)$=	2.85
y_0 =	0.90
y_t =	0.001
t =	0.4

RESULTS

K=	9.79E-03	cm/sec
K=	2.77E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/08/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-19 (TEST 1)

$$K = \frac{r_c^{2}}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

where:

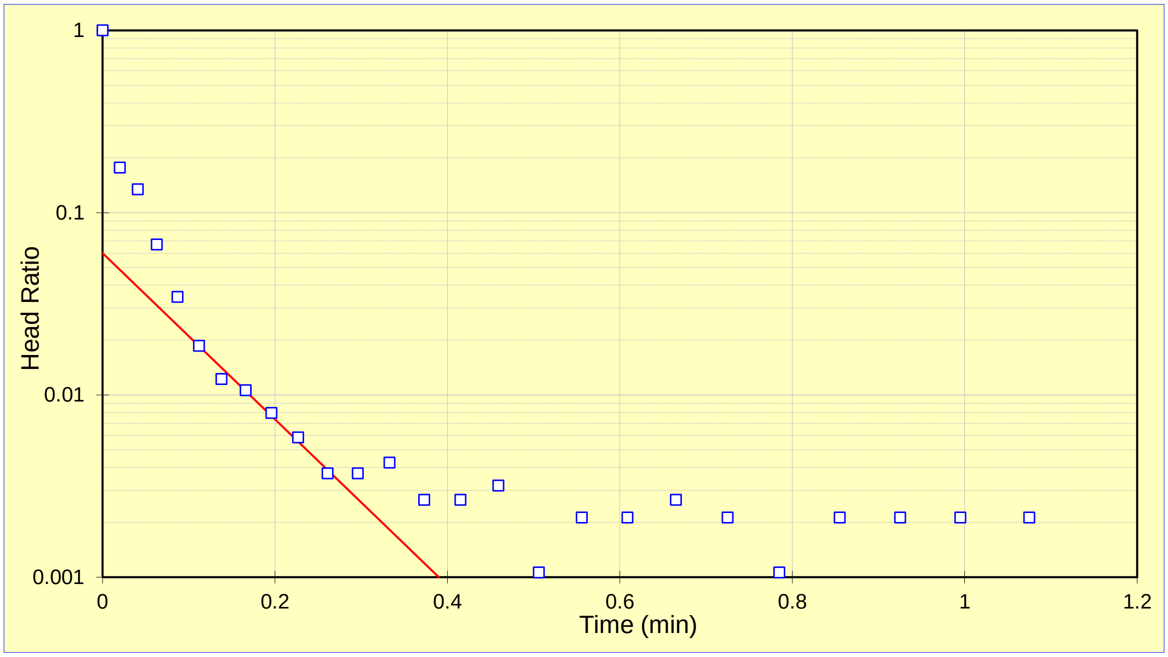
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.20
R_e = 0.34
L_e = 9.705
t_1 = 0
t_2 = 0.39
h_1/h_0 = 0.06
h_2/h_0 = 0.00

RESULTS

K= 3.70E-02 cm/sec
K= 1.05E+02 ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-19 (TEST 1)

$$K = \frac{r_c^2 \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

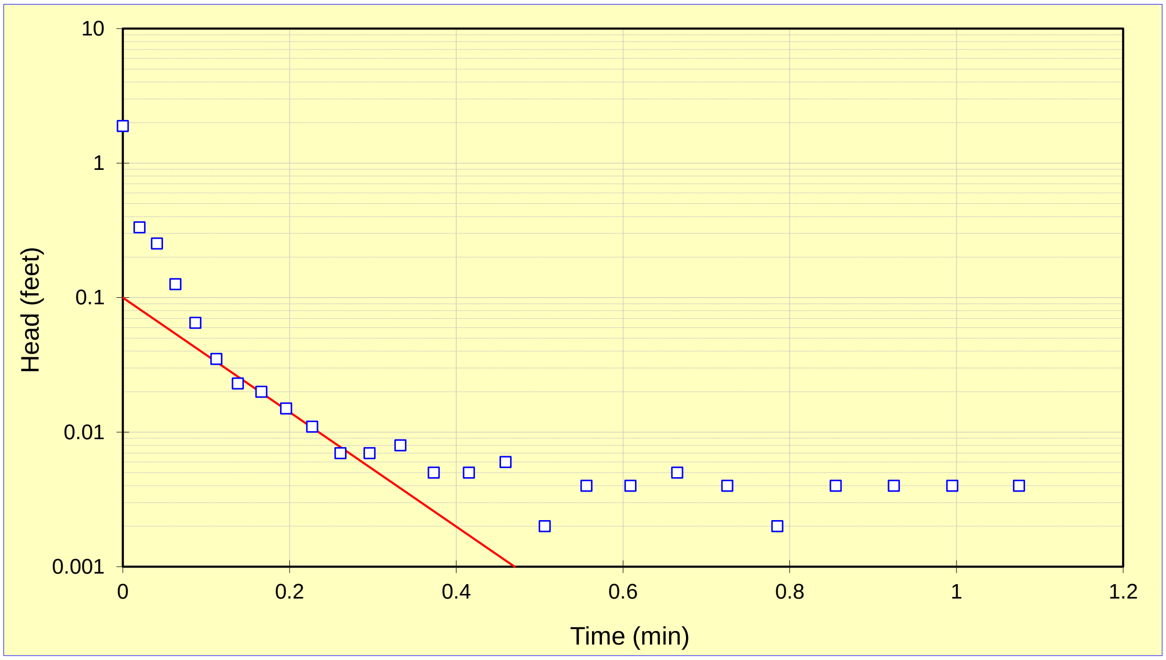
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.20
r_w =	0.34
L_e =	9.705
$\ln(R_e/r_w)$=	2.18
y_0 =	0.10
y_t =	0.001
t =	0.5

RESULTS

K=	2.25E-02	cm/sec
K=	6.38E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-19 (TEST 2)

$$K = \frac{r_c^{\,2}}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

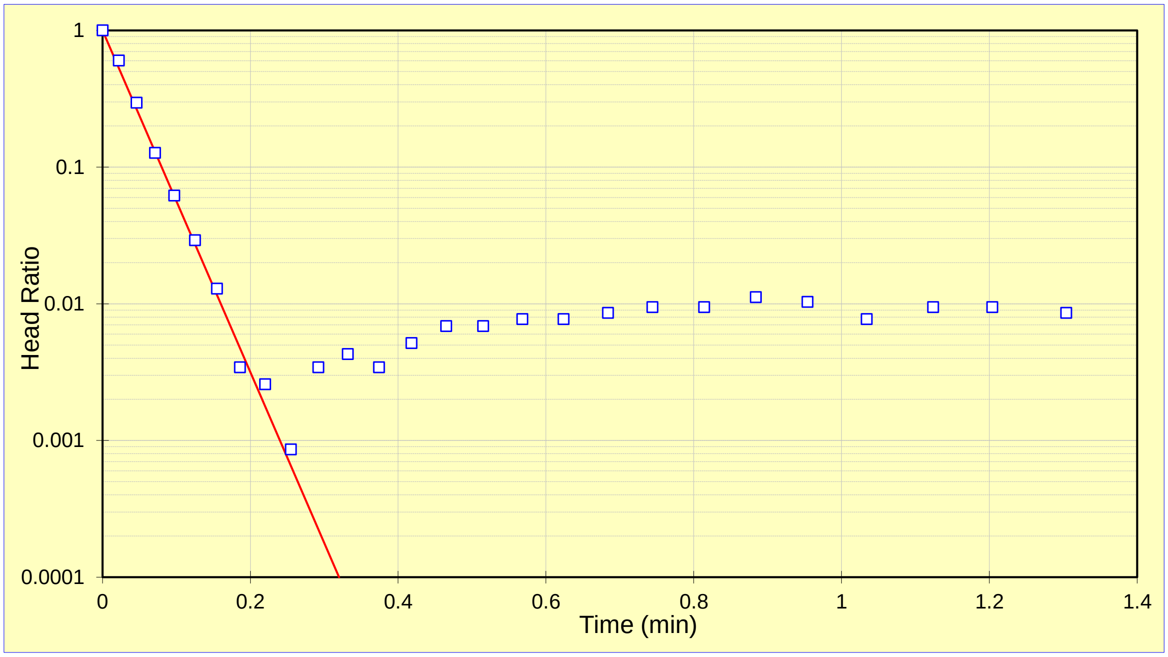
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.20
R_e = 0.34
L_e = 9.735
t_1 = 0
t_2 = 0.32
h_1/h_0 = 1.00
h_2/h_0 = 0.00

RESULTS

K= 1.01E-01 cm/sec
K= 2.87E+02 ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-19 (TEST 2)

$$K = \frac{r_c^{\,2} \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln\frac{y_0}{y_t}$$

where:

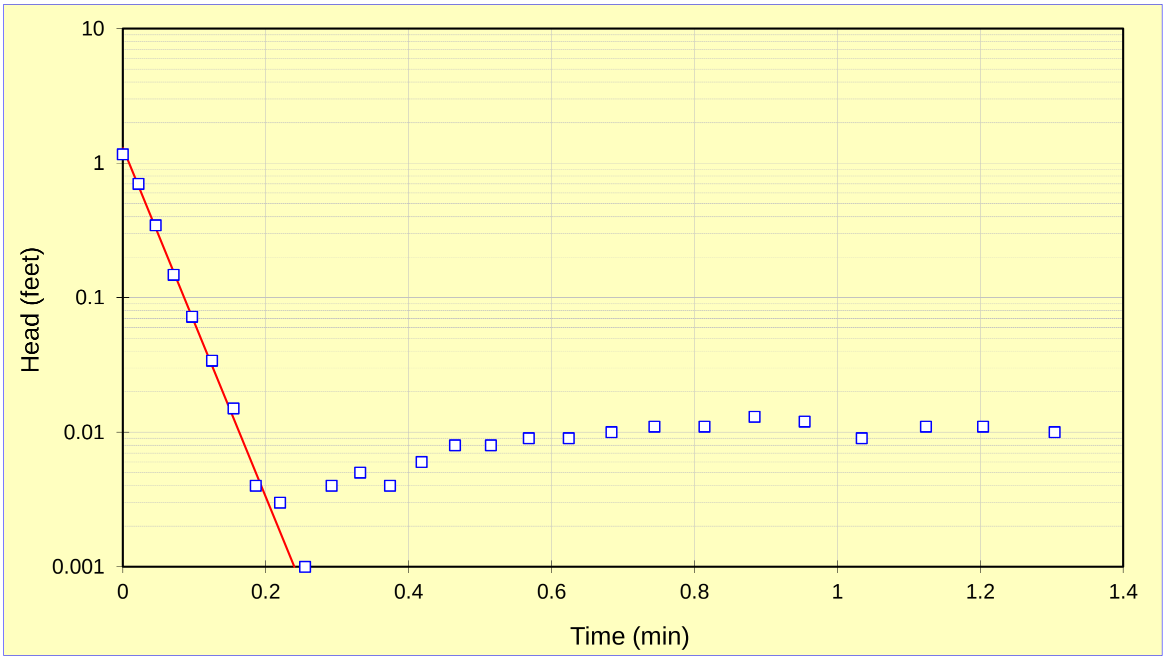
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c = 0.20
r_w = 0.34
L_e = 9.735
$ln(R_e/r_w)$= 2.18
y_0 = 1.30
y_t = 0.001
t = 0.2

RESULTS

K= 6.85E-02 cm/sec
K= 1.94E+02 ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST GAMW-19B (TEST 1)

$$K = \frac{r_c^2}{2L_e} \ln\frac{L_e}{R_e}\left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)}\right] 30.48$$

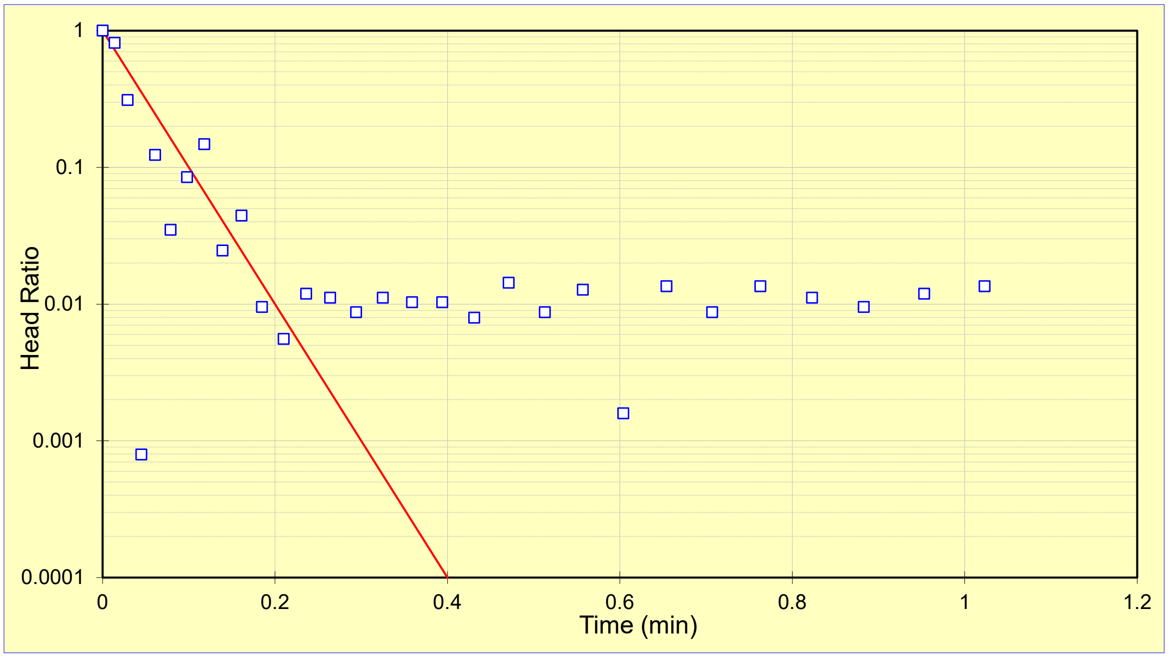
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c = 0.08
R_e = 0.34
L_e = 10
t_1 = 0
t_2 = 0.4
h_1/h_0 = 1.00
h_2/h_0 = 0.00

RESULTS

K= 1.37E-02 cm/sec
K= 3.88E+01 ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST GAMW-19B (TEST 1)

$$K = \frac{r_c^{\,2} \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

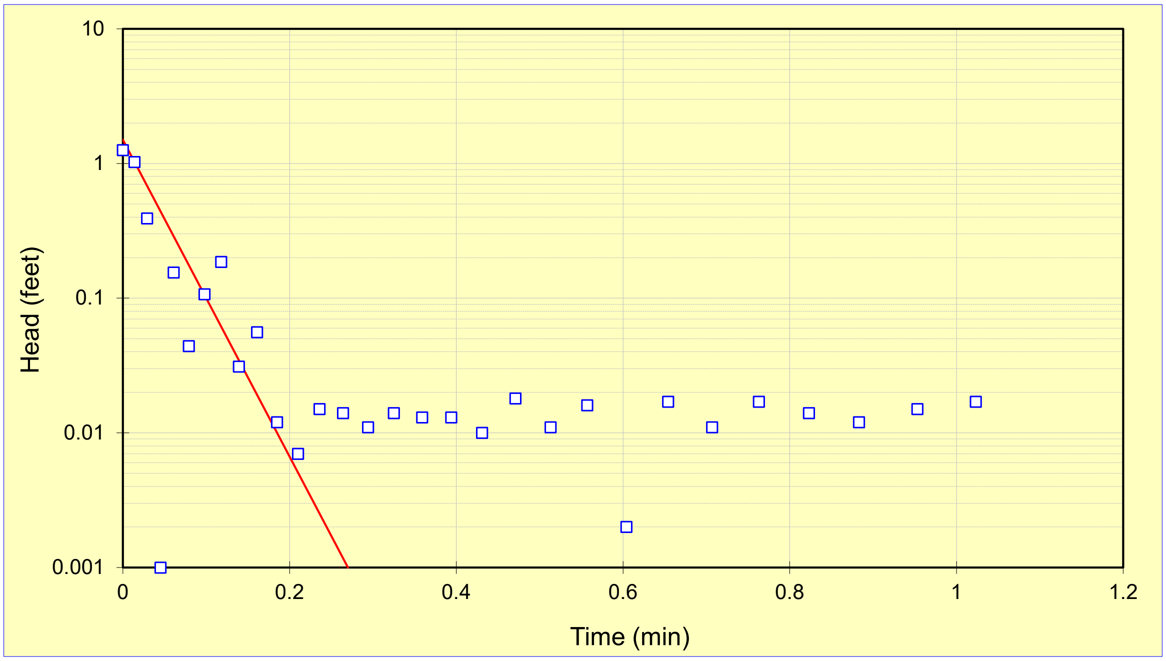
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.34
L_e =	10
$\ln(R_e/r_w)$=	3.02
y_0 =	1.50
y_t =	0.001
t =	0.3

RESULTS

K=	1.44E-02	cm/sec
K=	4.09E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST GAMW-19B (TEST 2)

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

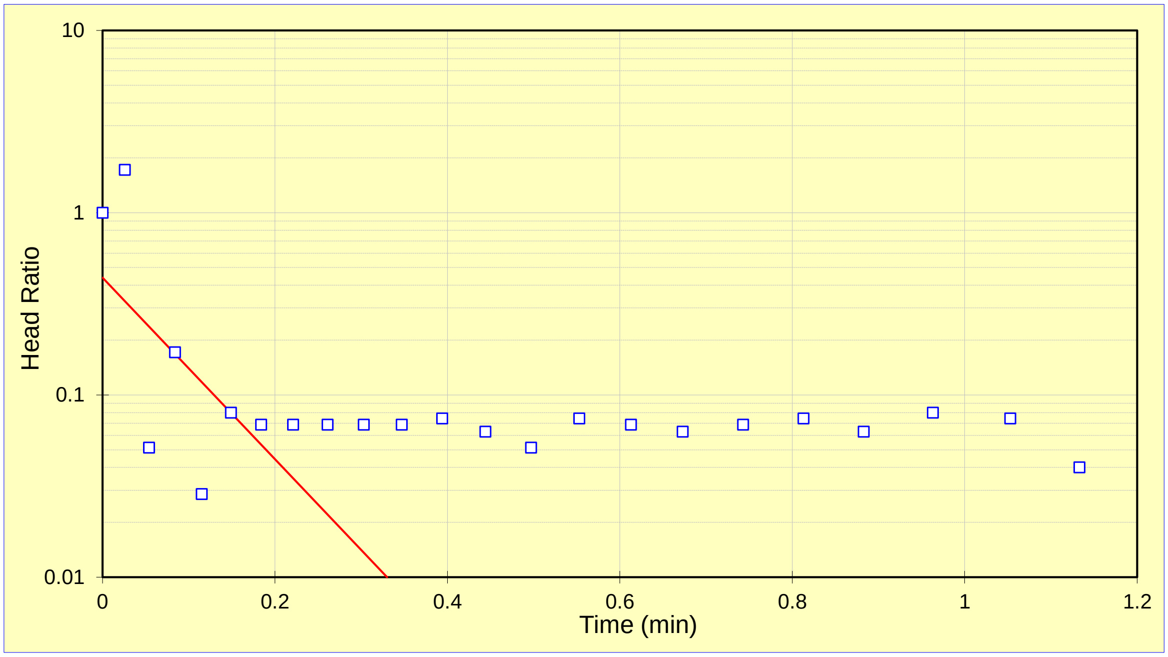
where:
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.34
L_e =	10
t_1 =	0
t_2 =	0.33
h_1/h_0 =	0.44
h_2/h_0 =	0.01

RESULTS

K=	6.82E-03	cm/sec
K=	1.93E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
FALLING HEAD TEST GAMW-19B (TEST 2)

$$K = \frac{r_c^2 \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

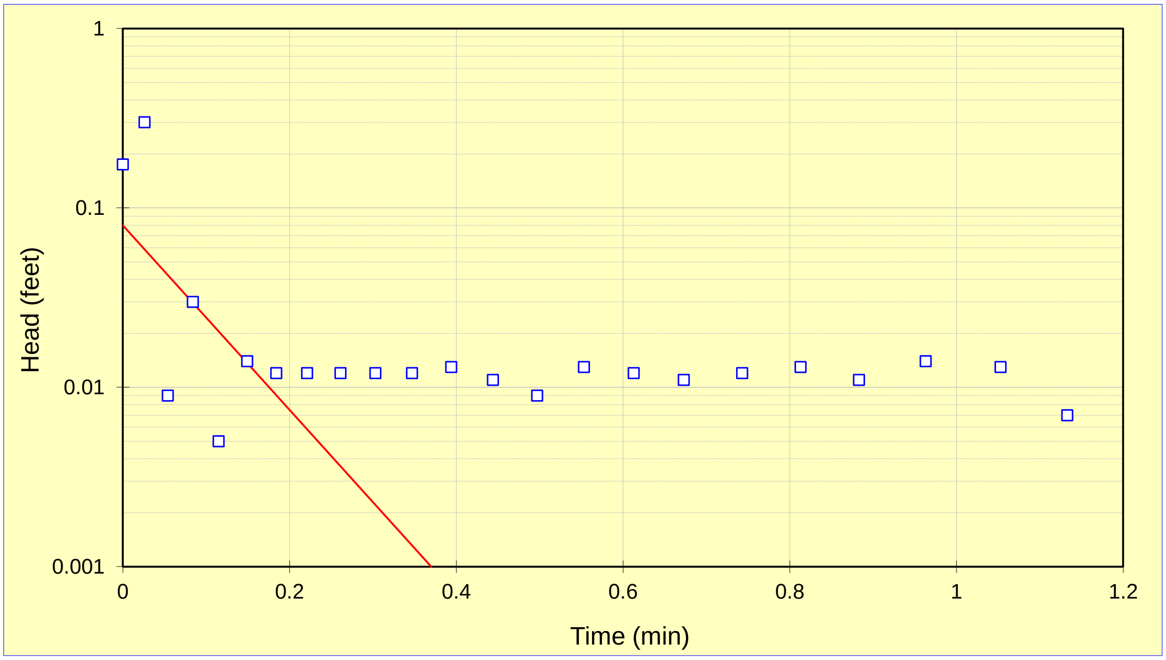
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c = 0.08
r_w = 0.34
L_e = 10
$\ln(R_e/r_w)$= 3.02
y_0 = 0.08
y_t = 0.001
t = 0.4

RESULTS

K=	6.31E-03	cm/sec
K=	1.79E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

van der KAMP RISING HEAD SLUG TEST ANALYSIS

UNDERDAMPED SLUG TEST GAMW-19B (TEST 1)

$$T = b + a \ln T$$

where:

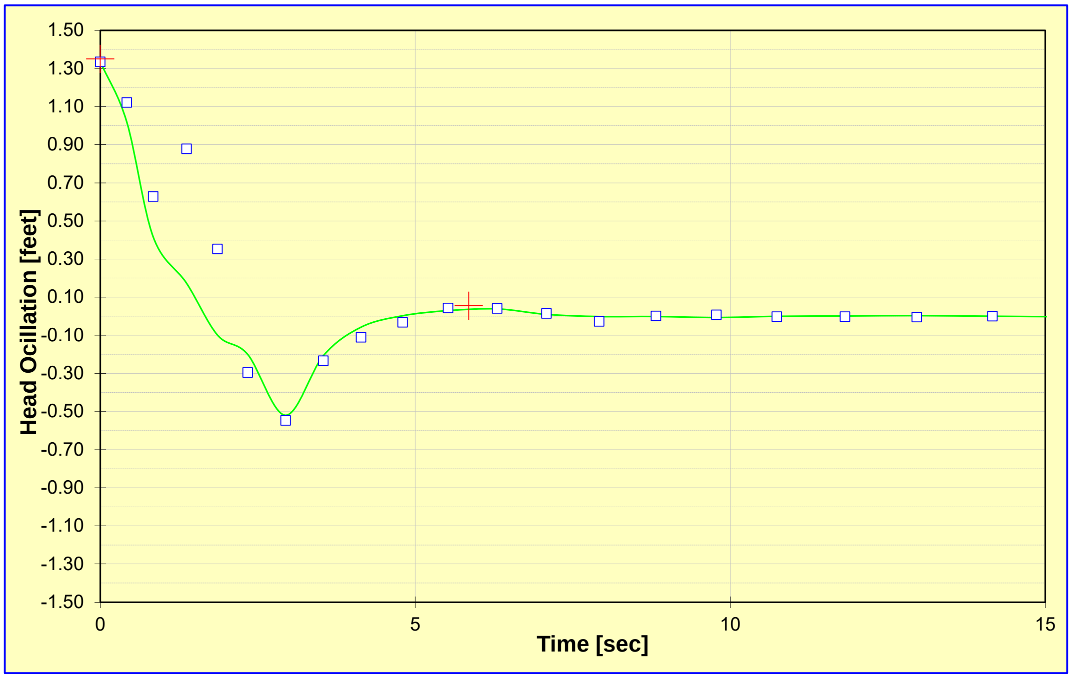
$$b = -a \ln\left[0.79 r_s^2 S (g/L)^{1/2}\right]$$
$$a = r_c^2 \left(g/L^{1/2}\right)/8d$$
$$d = \gamma / (g/L)^{1/2}$$
$$L = g/\left(\omega^2 + \gamma^2\right)$$

INPUT PARAMETERS

r_c =	0.08	ft	$(g/L)^{\wedge 1/2}$ =	1.20536	ft^2
r_s =	0.08	ft	d =	0.4539	ft^{-1}
L_c =	17.92	ft	a =	0.00231	ft^3
L_s =	10.00	ft	t_1 =	0.00	sec
w =	1.0740	ft^{-1}	t_2 =	5.85	sec
g =	0.5471	ft^{-1}	$h(t_1)$ =	1.35	ft
L =	22.16	ft^3/sec^2	$h(t_2)$ =	0.06	ft
g =	32.19	ft/sec^2	S =	1.00E-02	dim

RESULTS

$b = T_0$ =	2.22E-02	ft^2/sec	$a < 0.1$?	YES
T =	1.20E-02	ft^2/sec	$d < 0.7$?	YES
T =	1.04E+03	ft^2/day	L_1 =	22.16
K =	3.67E+01	ft/day	L_2 =	22.92
K =	1.29E-02	cm/sec	$L_1:L_2$ Diff <20% ?	YES



Project Name: NIPSCO RMSGS
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/31/2017

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-19B (TEST 1)

$$K = \frac{r_c^2}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

where:

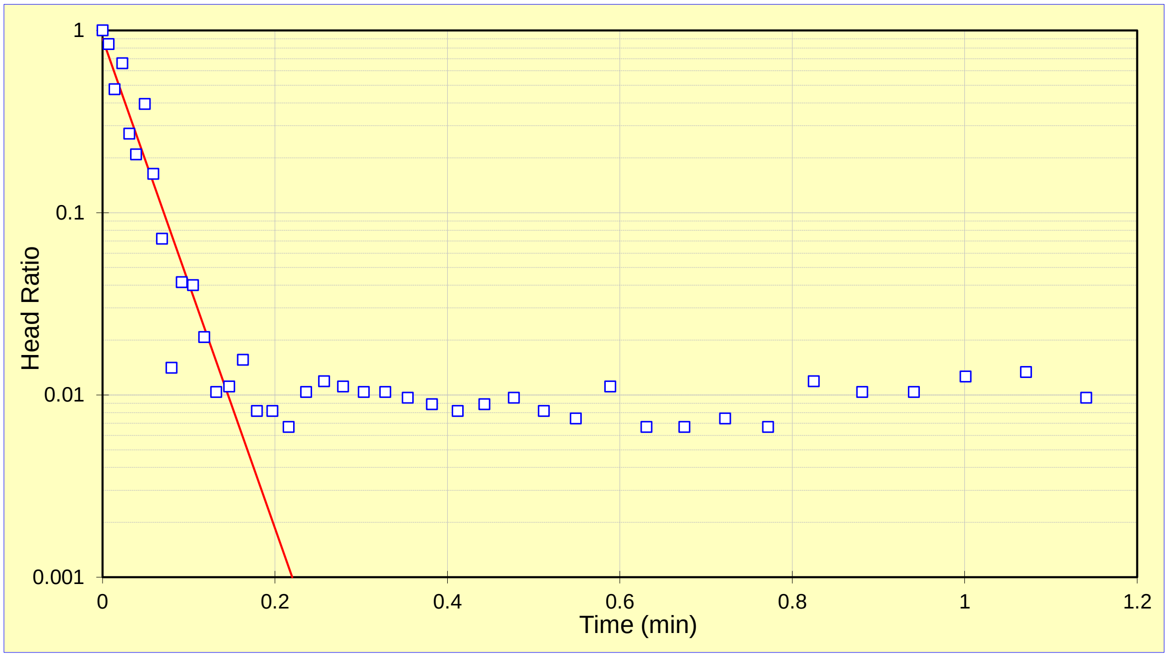
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.34
L_e =	10
t_1 =	0
t_2 =	0.22
h_1/h_0 =	0.90
h_2/h_0 =	0.00

RESULTS

K=	1.84E-02	cm/sec
K=	5.21E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-19B (TEST 1)

$$K = \frac{r_c^{\,2} \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

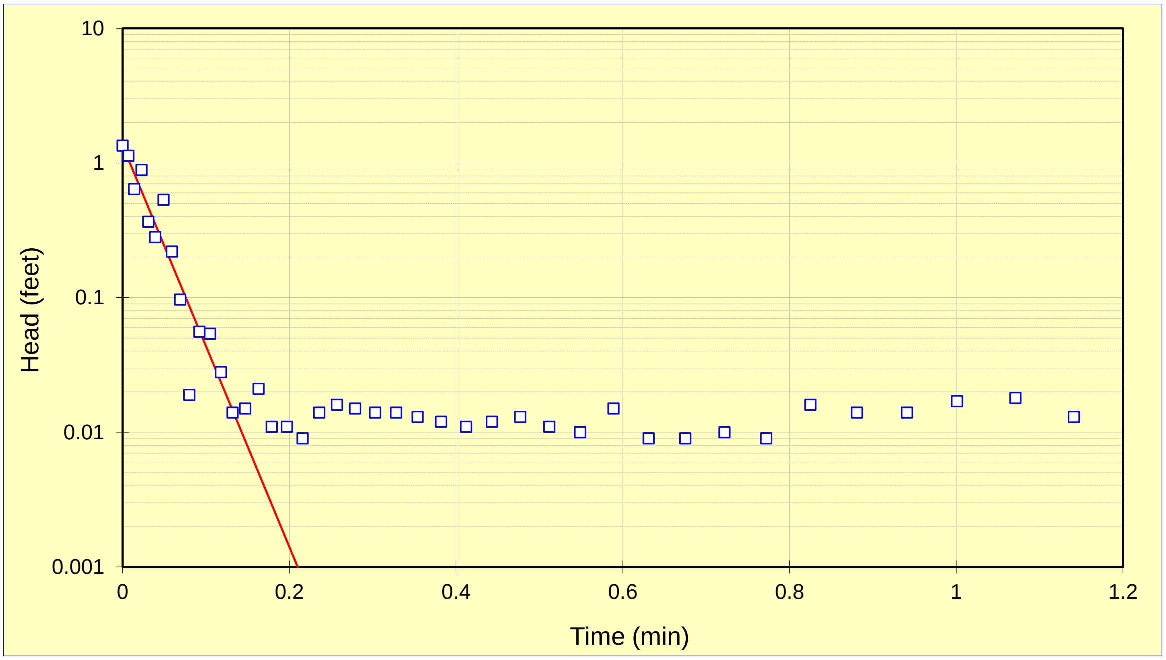
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c =	0.08
r_w =	0.34
L_e =	10
$\ln(R_e/r_w)$=	3.02
y_0 =	1.35
y_t =	0.001
t =	0.2

RESULTS

K=	1.83E-02	cm/sec
K=	5.18E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

van der KAMP RISING HEAD SLUG TEST ANALYSIS

UNDERDAMPED SLUG TEST GAMW-19B (TEST 2)

$$T = b + a \ln T$$

where:

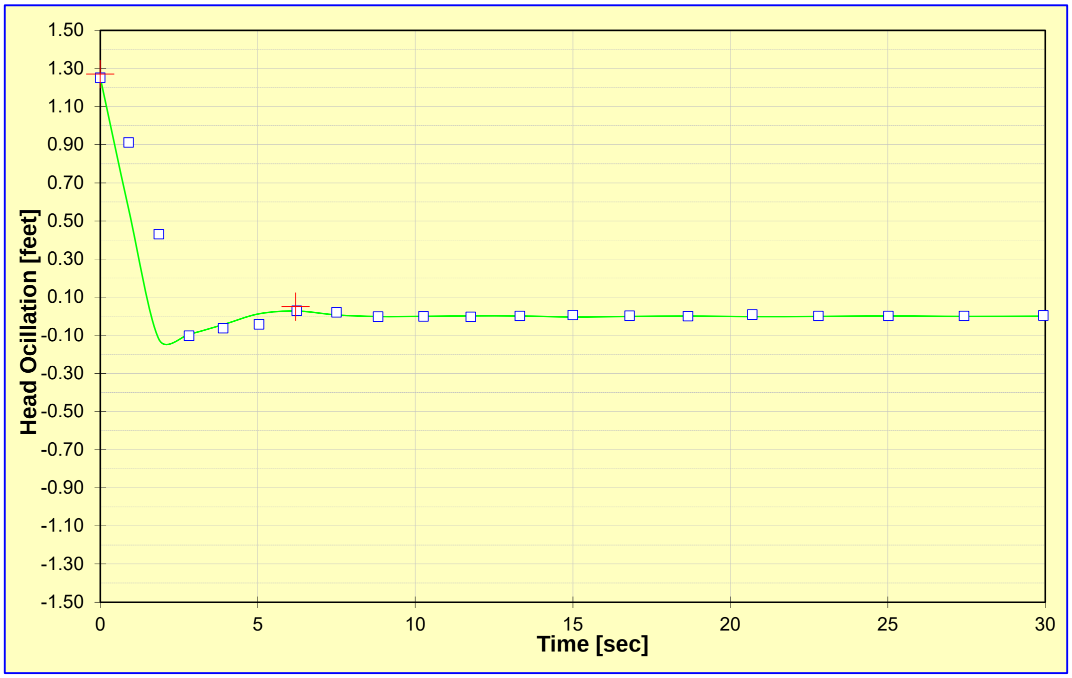
$$b = -a \ln\left[0.79 r_s^2 S (g/L)^{1/2}\right]$$
$$a = r_c^2 \left(g/L^{1/2}\right)/8d$$
$$d = \gamma / (g/L)^{1/2}$$
$$L = g/\left(\omega^2 + \gamma^2\right)$$

INPUT PARAMETERS

r_c =	0.08	ft	(g/L)^ $^{1/2}$ =	1.13983	ft^2
r_s =	0.08	ft	d =	0.4577	ft^{-1}
L_c =	17.95	ft	a =	0.00216	ft^3
L_s =	10.00	ft	t_1 =	0.00	sec
w =	1.0134	ft^{-1}	t_2 =	6.20	sec
g =	0.5217	ft^{-1}	$h(t_1)$ =	1.27	ft
L =	24.78	ft^3/sec^2	$h(t_2)$ =	0.05	ft
g =	32.19	ft/sec^2	S =	1.00E-02	dim

RESULTS

$b = T_0$ =	2.09E-02	ft^2/sec	a < 0.1?	YES
T =	1.12E-02	ft^2/sec	d < 0.7?	YES
T =	9.69E+02	ft^2/day	L_1 =	24.78
K =	3.43E+01	ft/day	L_2 =	22.95
K =	1.21E-02	cm/sec	L_1:L_2 Diff <20% ?	YES



Project Name: NIPSCO RMSGS
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/31/2017

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-19B (TEST 2)

$$K = \frac{r_c^{\,2}}{2L_e} \ln \frac{L_e}{R_e} \left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t2 - t1)} \right] 30.48$$

where:

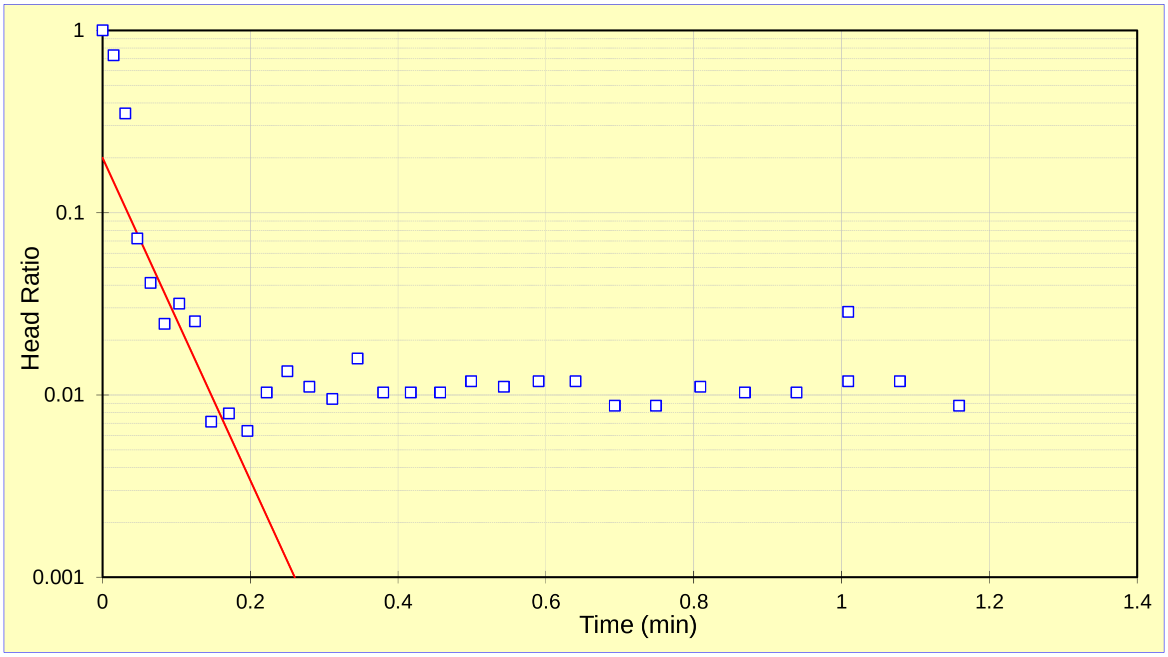
r_c = casing radius (feet)
R_e = equivalent radius (feet)
L_e = length of screened interval (feet)
t = time (minutes)
h_t = head at time t (feet)

INPUT PARAMETERS

r_c =	0.08
R_e =	0.34
L_e =	10
t_1 =	0
t_2 =	0.26
h_1/h_0 =	0.20
h_2/h_0 =	0.00

RESULTS

K=	1.21E-02	cm/sec
K=	3.43E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

BOUWER AND RICE SLUG TEST ANALYSIS
RISING HEAD TEST GAMW-19B (TEST 2)

$$K = \frac{r_c^{\,2} \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t}$$

where:

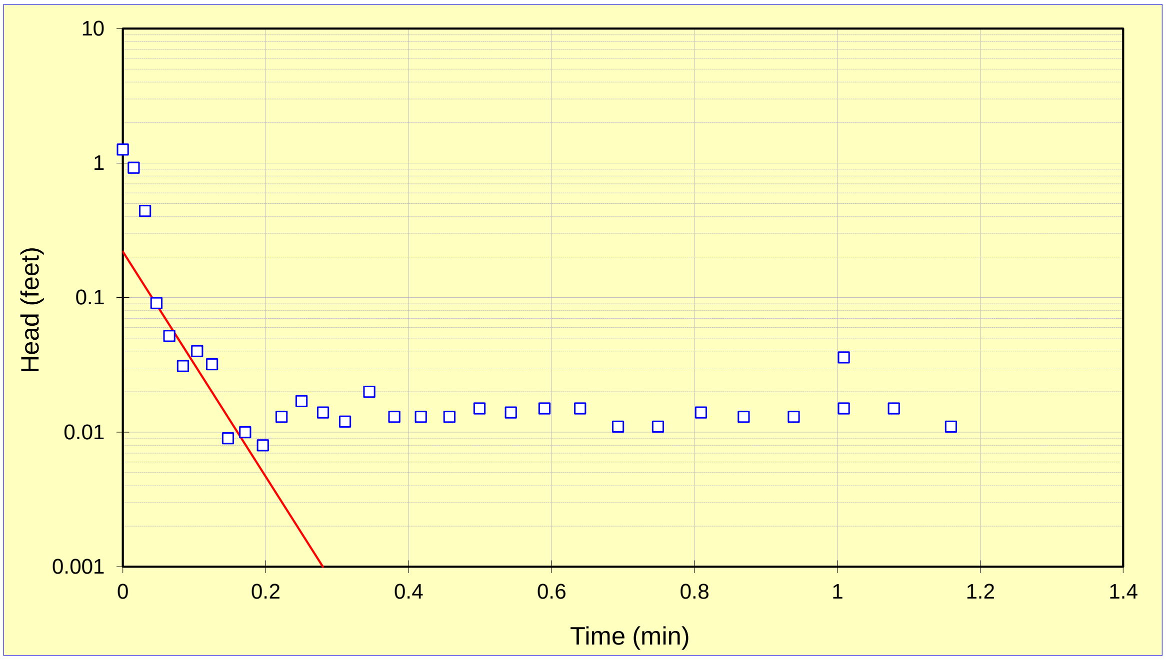
r_c = casing radius (feet);
R_e = effective radius (feet);
L_e = length of screened interval (feet);
r_w = radial distance to undisturbed aquifer (feet)
y_0 = initial drawdown (feet)
y_t = drawdown (feet) at time t (minutes)

INPUT PARAMETERS

r_c = 0.08
r_w = 0.34
L_e = 10
$\ln(R_e/r_w)$= 3.02
y_0 = 0.22
y_t = 0.001
t = 0.3

RESULTS

K=	1.03E-02	cm/sec
K=	2.91E+01	ft/day



Project Name: NIPSCO Schahfer
Project No.: 164-8171
Test Date: 07/07/16

Analysis By: DFS
Checked By: JRS
Analysis Date: 7/27/2016

APPENDIX C

Vertical Gradient Calculation

APPENDIX C

Vertical Gradient Calculation

Appendix C
VERTICAL GRADIENT FLOW CALCULATIONS

Monitoring Well Locations	Ground Surface Elevation (ft-msl)	Top of Casing Elevation (ft-msl)	Screen Interval				June 13, 2016				July 11, 2016				September 6, 2016				November 7, 2016			
			Top (ft-bgs)	Bottom (ft-bgs)	Center (ft bgs)	Center (ft msl)	Depth To Water (ft-btoc)	Groundwater Elevation (ft-msl)	Vertical Gradient (ft/ft)	Flow Direction	Depth To Water (ft-btoc)	Groundwater Elevation (ft-msl)	Vertical Gradient (ft/ft)	Flow Direction	Depth To Water (ft-btoc)	Groundwater Elevation (ft-msl)	Vertical Gradient (ft/ft)	Flow Direction	Depth To Water (ft-btoc)	Groundwater Elevation (ft-msl)	Vertical Gradient (ft/ft)	Flow Direction
GAMW07	666.55	669.89	5	15	10	656.55	10.17	659.72	NA	NA	10.48	659.41	NA	NA	8.57	661.32	NA	NA	7.88	662.01	-1.08E-01	Down
GAMW07B	666.83	669.39	30	40	35	631.83	-	-			-	-			-	-			10.04	659.35		
GAMW08	665.95	669.66	5	15	10	655.95	8.91	660.75	NA	NA	-	-	NA	NA	9.86	659.80	NA	NA	10.40	659.26	-3.95E-02	Down
GAMW08B	665.92	668.47	26	36	31	634.92	-	-			-	-			-	-			10.04	658.43		
GAMW09	665.1	668.99	5	15	10	655.51	9.02	659.97	-2.19E-02	Down	10.09	658.90	-2.14E-02	Down	8.41	660.58	-2.24E-02	Down	8.92	660.07	-2.34E-02	Down
GAMW09B	665.35	668.29	24.5	34.5	29.5	635.87	8.75	659.54			9.81	658.48			8.15	660.14			8.68	659.61		
GAMW15	665.01	668.25	5	15	10	654.54	8.59	659.66	-4.91E-04	Down	8.82	659.43	0.00E+00	Up	7.32	660.93	1.97E-03	Up	6.76	661.49	0.00E+00	Up
GAMW15B	665.14	668.05	27.7	37.7	32.7	634.19	8.40	659.65			8.62	659.43			7.08	660.97			6.56	661.49		
GAMW16	665.2	668.37	5	15	10	655.17	9.21	659.16	-1.33E-02	Down	9.61	658.76	4.44E-04	Up	8.08	660.29	4.44E-04	Up	8.24	660.13	4.39E-02	Up
GAMW16B	665.16	667.76	27.75	37.75	32.75	632.63	8.90	658.86			8.99	658.77			7.46	660.30			6.64	661.12		
GAMW17	668.81	671.93	5	15	10	658.93	13.13	658.80	4.22E-04	Up	9.72	662.21	-1.66E-01	Down	12.05	659.88	-4.22E-04	Down	12.60	659.33	-4.22E-04	Down
GAMW17B	668.86	670.6	28	38	33	635.26	11.79	658.81			12.31	658.29			10.73	659.87			11.28	659.32		
GAMW18	666.04	669.07	5	15	10	656.04	8.75	660.32	NA	NA	9.96	659.11	NA	NA	8.44	660.63	NA	NA	8.86	660.21	-8.86E-02	Down
GAMW18B	665.94	668.47	25	35	30	635.94	-	-			-	-			-	-			10.04	658.43		
GAMW46	661.99	664.80	5	15	10	651.99	-	-	NA	NA	-	-	NA	NA	-	-	NA	NA	7.04	657.76	-1.18E-03	Down
GAMW46B	661.98	664.79	22	32	27	634.98	-	-			-	-			-	-			7.05	657.74		
GAMW52	664.07	666.79	5	15	10	654.07	-	-	NA	NA	-	-	NA	NA	-	-	NA	NA	7.04	659.75	4.64E-03	Up
GAMW52B	664.50	666.90	27	37	32	632.50	-	-			-	-			-	-			7.05	659.85		
GAMW53	664.68	667.24	5	15	10	654.68	-	-	NA	NA	-	-	NA	NA	-	-	NA	NA	6.05	661.19	1.42E-03	Up
GAMW53B	664.62	667.29	26	36	31	633.62	-	-			-	-			-	-			6.07	661.22		
GAMW54	663.87	666.37	5	15	10	653.87	-	-	NA	NA	-	-	NA	NA	-	-	NA	NA	6.05	660.32	4.74E-03	Up
GAMW54B	663.98	666.47	22	32	27	636.98	-	-			-	-			-	-			6.07	660.40		
GAMW55	665.06	667.64	5	15	10	655.06	-	-	NA	NA	-	-	NA	NA	-	-	NA	NA	10.04	657.60	-1.56E-02	Down
GAMW55B	665.18	667.53	25	35	30	635.18	-	-			-	-			-	-			10.24	657.29		
GAMW56	665.43	667.91	5	15	10	655.43	-	-	NA	NA	-	-	NA	NA	-	-	NA	NA	7.04	660.87	-4.98E-03	Down
GAMW56B	665.33	667.82	25	35	30	635.33	-	-			-	-			-	-			7.05	660.77		

Notes:
ft-bgs = Feet below ground surface
ft-msl = Feet above mean sea level
ft-btoc = Feet below top of casing
ft/ft = Feet/Feet
NA= not applicable

Appendix C
VERTICAL GRADIENT FLOW CALCULATIONS

Monitoring Well Locations	Ground Surface Elevation (ft-msl)	Top of Casing Elevation (ft-msl)	Screen Interval				January 4, 2017				February 27, 2017				April 24, 2017				June 26, 2017			
			Top (ft-bgs)	Bottom (ft-bgs)	Center (ft bgs)	Center (ft msl)	Depth To Water (ft-btoc)	Groundwater Elevation (ft-msl)	Vertical Gradient (ft/ft)	Flow Direction	Depth To Water (ft-btoc)	Groundwater Elevation (ft-msl)	Vertical Gradient (ft/ft)	Flow Direction	Depth To Water (ft-btoc)	Groundwater Elevation (ft-msl)	Vertical Gradient (ft/ft)	Flow Direction	Depth To Water (ft-btoc)	Groundwater Elevation (ft-msl)	Vertical Gradient (ft/ft)	Flow Direction
GAMW07	666.55	669.89	5	15	10	656.55	10.09	659.80	-1.62E-03	Down	8.82	661.07	-6.67E-02	Down	8.56	661.33	NA	NA	9.52	660.37	NA	NA
GAMW07B	666.83	669.39	30	40	35	631.83	9.63	659.76			9.97	659.42			-	-			-	-		
GAMW08	665.95	669.66	5	15	10	655.95	10.82	658.84	5.41E-15	Up	10.62	659.04	-2.57E-02	Down	9.71*	659.95	NA	NA	10.15	659.51	NA	NA
GAMW08B	665.92	668.47	26	36	31	634.92	9.63	658.84			9.97	658.50			-	-			-	-		
GAMW09	665.1	668.99	5	15	10	655.51	8.95	660.04	-2.09E-02	Down	8.50	660.49	-2.09E-02	Down	7.59	661.40	-1.93E-02	Down	8.30	660.69	-2.14E-02	Down
GAMW09B	665.35	668.29	24.5	34.5	29.5	635.87	8.66	659.63			8.21	660.08			7.27	661.02			8.02	660.27		
GAMW15	665.01	668.25	5	15	10	654.54	8.63	659.62	0.00E+00	Up	7.35	660.90	4.91E-04	Up	7.00	661.25	1.47E-03	Up	8.00	660.25	0.00E+00	Up
GAMW15B	665.14	668.05	27.7	37.7	32.7	634.19	8.43	659.62			7.14	660.91			6.77	661.28			7.80	660.25		
GAMW16	665.2	668.37	5	15	10	655.17	9.18	659.19	4.44E-04	Up	8.66	659.71	2.22E-03	Up	7.87	660.50	8.87E-04	Up	8.72	659.65	1.33E-03	Up
GAMW16B	665.16	667.76	27.75	37.75	32.75	632.63	8.56	659.20			8.00	659.76			7.24	660.52			8.08	659.68		
GAMW17	668.81	671.93	5	15	10	658.93	NA	-	NA	NA	12.67	659.26	0.00E+00	Up	11.75	660.18	8.45E-04	Up	12.30	659.63	1.65E-02	Up
GAMW17B	668.86	670.6	28	38	33	635.26	11.62	658.98			11.34	659.26			10.40	660.20			10.58	660.02		
GAMW18	666.04	669.07	5	15	10	656.04	8.96	660.11	-6.32E-02	Down	8.55	660.52	-1.00E-01	Down	7.45	661.62	NA	NA	8.55	660.52	NA	NA
GAMW18B	665.94	668.47	25	35	30	635.94	9.63	658.84			9.97	658.50			-	-			-	-		
GAMW46	661.99	664.80	5	15	10	651.99	6.75	658.05	-5.88E-04	Down	7.05	657.75	5.88E-04	Up	-	-	NA	NA	-	-	NA	NA
GAMW46B	661.98	664.79	22	32	27	634.98	6.75	658.04			7.03	657.76			-	-			-	-		
GAMW52	664.07	666.79	5	15	10	654.07	6.75	660.04	5.10E-03	Up	7.05	659.74	6.03E-03	Up	-	-	NA	NA	-	-	NA	NA
GAMW52B	664.50	666.90	27	37	32	632.50	6.75	660.15			7.03	659.87			-	-			-	-		
GAMW53	664.68	667.24	5	15	10	654.68	5.85	661.39	2.37E-03	Up	6.07	661.17	2.37E-03	Up	-	-	NA	NA	-	-	NA	NA
GAMW53B	664.62	667.29	26	36	31	633.62	5.85	661.44			6.07	661.22			-	-			-	-		
GAMW54	663.87	666.37	5	15	10	653.87	5.85	660.52	5.92E-03	Up	6.07	660.30	5.92E-03	Up	-	-	NA	NA	-	-	NA	NA
GAMW54B	663.98	666.47	22	32	27	636.98	5.85	660.62			6.07	660.40			-	-			-	-		
GAMW55	665.06	667.64	5	15	10	655.06	9.63	658.01	-1.56E-02	Down	9.97	657.67	-1.51E-02	Down	-	-	NA	NA	-	-	NA	NA
GAMW55B	665.18	667.53	25	35	30	635.18	9.83	657.70			10.16	657.37			-	-			-	-		
GAMW56	665.43	667.91	5	15	10	655.43	6.75	661.16	-4.48E-03	Down	7.05	660.86	-3.48E-03	Down	-	-	NA	NA	-	-	NA	NA
GAMW56B	665.33	667.82	25	35	30	635.33	6.75	661.07			7.03	660.79			-	-			-	-		

Notes:
ft-bgs = Feet below ground surface
ft-msl = Feet above mean sea level
ft-btoc = Feet below top of casing
ft/ft = Feet/Feet
NA= not applicable

Appendix C
VERTICAL GRADIENT FLOW CALCULATIONS

Monitoring Well Locations	Ground Surface Elevation (ft-msl)	Top of Casing Elevation (ft-msl)	Screen Interval				August 21, 2017				October 2, 2017				February 26, 2018				March 12, 2018			
			Top (ft-bgs)	Bottom (ft-bgs)	Center (ft bgs)	Center (ft msl)	Depth To Water (ft-btoc)	Groundwater Elevation (ft-msl)	Vertical Gradient (ft/ft)	Flow Direction	Depth To Water (ft-btoc)	Groundwater Elevation (ft-msl)	Vertical Gradient (ft/ft)	Flow Direction	Depth To Water (ft-btoc)	Groundwater Elevation (ft-msl)	Vertical Gradient (ft/ft)	Flow Direction	Depth To Water (ft-btoc)	Groundwater Elevation (ft-msl)	Vertical Gradient (ft/ft)	Flow Direction
GAMW07	666.55	669.89	5	15	10	656.55	9.08	660.81	NA	NA	10.16	659.73	NA	NA	-	-	NA	NA	8.8	661.09	NA	NA
GAMW07B	666.83	669.39	30	40	35	631.83	-	-			-	-			-	-			-	-		
GAMW08	665.95	669.66	5	15	10	655.95	10.15	659.51	NA	NA	NA	-	NA	NA	-	-	NA	NA	8.38	661.28	NA	NA
GAMW08B	665.92	668.47	26	36	31	634.92	-	-			-	-			-	-			-	-		
GAMW09	665.1	668.99	5	15	10	655.51	8.11	660.88	-2.24E-02	Down	10.06	658.93	-2.29E-02	Down	-	-	NA	NA	6.23	662.76	-2.14E-02	Down
GAMW09B	665.35	668.29	24.5	34.5	29.5	635.87	7.85	660.44			9.81	658.48			-	-			5.95	662.34		
GAMW15	665.01	668.25	5	15	10	654.54	7.56	660.69	1.47E-03	Up	9.02	659.23	2.46E-03	Up	-	-	NA	NA	7.38	660.87	9.83E-04	Up
GAMW15B	665.14	668.05	27.7	37.7	32.7	634.19	7.33	660.72			8.77	659.28			-	-			7.16	660.89		
GAMW16	665.2	668.37	5	15	10	655.17	8.45	659.92	0.00E+00	Up	10.56	657.81	4.44E-04	Up	-	-	NA	NA	7.38	660.99	4.44E-03	Up
GAMW16B	665.16	667.76	27.75	37.75	32.75	632.63	7.84	659.92			9.94	657.82			-	-			6.67	661.09		
GAMW17	668.81	671.93	5	15	10	658.93	12.24	659.69	-1.69E-03	Down	NA	-	NA	NA	-	-	NA	NA	10.45	661.48	4.80E-15	Up
GAMW17B	668.86	670.6	28	38	33	635.26	10.95	659.65			13.33	657.27			-	-			9.12	661.48		
GAMW18	666.04	669.07	5	15	10	656.04	8.23	660.84	NA	NA	10.03	659.04	NA	NA	-	-	NA	NA	6.3	662.77	NA	NA
GAMW18B	665.94	668.47	25	35	30	635.94	-	-			-	-			-	-			-	-		
GAMW46	661.99	664.80	5	15	10	651.99	-	-	NA	NA	-	-	NA	NA	-	-	NA	NA	-	-	NA	NA
GAMW46B	661.98	664.79	22	32	27	634.98	-	-			-	-			-	-			-	-		
GAMW52	664.07	666.79	5	15	10	654.07	-	-	NA	NA	-	-	NA	NA	-	-	NA	NA	-	-	NA	NA
GAMW52B	664.50	666.90	27	37	32	632.50	-	-			-	-			-	-			-	-		
GAMW53	664.68	667.24	5	15	10	654.68	-	-	NA	NA	-	-	NA	NA	-	-	NA	NA	-	-	NA	NA
GAMW53B	664.62	667.29	26	36	31	633.62	-	-			-	-			-	-			-	-		
GAMW54	663.87	666.37	5	15	10	653.87	-	-	NA	NA	-	-	NA	NA	-	-	NA	NA	-	-	NA	NA
GAMW54B	663.98	666.47	22	32	27	636.98	-	-			-	-			-	-			-	-		
GAMW55	665.06	667.64	5	15	10	655.06	-	-	NA	NA	-	-	NA	NA	-	-	NA	NA	-	-	NA	NA
GAMW55B	665.18	667.53	25	35	30	635.18	-	-			-	-			-	-			-	-		
GAMW56	665.43	667.91	5	15	10	655.43	-	-	NA	NA	-	-	NA	NA	-	-	NA	NA	-	-	NA	NA
GAMW56B	665.33	667.82	25	35	30	635.33	-	-			-	-			-	-			-	-		

Notes:
ft-bgs = Feet below ground surface
ft-msl = Feet above mean sea level
ft-btoc = Feet below top of casing
ft/ft = Feet/Feet
NA= not applicable

Appendix C
VERTICAL GRADIENT FLOW CALCULATIONS

Monitoring Well Locations	Ground Surface Elevation (ft-msl)	Top of Casing Elevation (ft-msl)	Screen Interval				April 18, 2018				June 12, 2018				August 27-28, 2018				October 22-24, 2018			
			Top (ft-bgs)	Bottom (ft-bgs)	Center (ft bgs)	Center (ft msl)	Depth To Water (ft-btoc)	Groundwater Elevation (ft-msl)	Vertical Gradient (ft/ft)	Flow Direction	Depth To Water (ft-btoc)	Groundwater Elevation (ft-msl)	Vertical Gradient (ft/ft)	Flow Direction	Depth To Water (ft-btoc)	Groundwater Elevation (ft-msl)	Vertical Gradient (ft/ft)	Flow Direction	Depth To Water (ft-btoc)	Groundwater Elevation (ft-msl)	Vertical Gradient (ft/ft)	Flow Direction
GAMW07	666.55	669.89	5	15	10	656.55	8.9	660.99	1.78E-01	Up	9.15	660.74	1.75E-01	Up	9.95	659.94	2.83E-03	Up	10.62	659.27	8.09E-04	Up
GAMW07B	666.83	669.39	30	40	35	631.83	4	665.39			4.32	665.07			9.38	660.01			10.1	659.29		
GAMW08	665.95	669.66	5	15	10	655.95	9.58	660.08	2.09E-01	Up	9.55	660.11	1.92E-01	Up	10.22	659.44	4.28E-03	Up	10.6	659.06	2.85E-03	Up
GAMW08B	665.92	668.47	26	36	31	634.92	4	664.47			4.32	664.15			8.94	659.53			9.35	659.12		
GAMW09	665.1	668.99	5	15	10	655.51	7.42	661.57	-2.04E-02	Down	7.5	661.49	-2.19E-02	Down	8.36	660.63	-2.04E-02	Down	8.65	660.34	-2.04E-02	Down
GAMW09B	665.35	668.29	24.5	34.5	29.5	635.87	7.12	661.17			7.23	661.06			8.06	660.23			8.35	659.94		
GAMW15	665.01	668.25	5	15	10	654.54	7.62	660.63	9.83E-04	Up	7.9	660.35	5.06E-02	Up	8.56	659.69	1.97E-03	Up	9.15	659.1	1.47E-03	Up
GAMW15B	665.14	668.05	27.7	37.7	32.7	634.19	7.4	660.65			6.67	661.38			8.32	659.73			8.92	659.13		
GAMW16	665.2	668.37	5	15	10	655.17	8.15	660.22	3.99E-03	Up	8.28	660.09	3.11E-03	Up	8.94	659.43	1.77E-03	Up	9.3	659.07	3.11E-03	Up
GAMW16B	665.16	667.76	27.75	37.75	32.75	632.63	7.45	660.31			7.6	660.16			8.29	659.47			8.62	659.14		
GAMW17	668.81	671.93	5	15	10	658.93	11.75	660.18	4.80E-15	Up	11.65	660.28	0.00E+00	Up	12.28	659.65	-2.11E-03	Down	12.7	659.23	-2.11E-03	Down
GAMW17B	668.86	670.6	28	38	33	635.26	10.42	660.18			10.32	660.28			11	659.6			11.42	659.18		
GAMW18	666.04	669.07	5	15	10	656.04	7.17	661.9	1.28E-01	Up	7.72	661.35	1.39E-01	Up	8.86	660.21	0.00E+00	Up	9.5	659.57	2.89E-02	Up
GAMW18B	665.94	668.47	25	35	30	635.94	4	664.47			4.32	664.15			8.26	660.21			8.32	660.15		
GAMW46	661.99	664.80	5	15	10	651.99	-	-	NA	NA	7.55	657.25	-5.88E-04	Down	9.24	655.56	-5.88E-04	Down	8.75	655.75	-7.23E-02	Down
GAMW46B	661.98	664.79	22	32	27	634.98	-	-			7.55	657.24			9.24	655.55			9.80	654.52		
GAMW52	664.07	666.79	5	15	10	654.07	-	-	NA	NA	-	-	NA	NA	8.50	658.29	4.64E-04	Up	8.80	657.99	4.64E-04	Up
GAMW52B	664.50	666.90	27	37	32	632.50	-	-			-	-			8.60	658.30			8.90	658.00		
GAMW53	664.68	667.24	5	15	10	654.68	-	-	NA	NA	7.13	660.11	7.12E-03	Up	8.80	658.44	4.27E-03	Up	9.10	658.14	4.75E-03	Up
GAMW53B	664.62	667.29	26	36	31	633.62	-	-			7.03	660.26			8.76	658.53			9.05	658.24		
GAMW54	663.87	666.37	5	15	10	653.87	7.20	-7.20	5.92E-03	Up	7.93	658.44	9.47E-03	Up	7.58	658.79	-4.14E-03	Down	7.90	658.47	-2.96E-03	Down
GAMW54B	663.98	666.47	22	32	27	636.98	7.10	-7.10			7.87	658.60			7.75	658.72			8.05	658.42		
GAMW55	665.06	667.64	5	15	10	655.06	-	-	NA	NA	8.64	659.00	2.52E-03	Up	8.68	658.96	-2.52E-03	Down	8.92	658.72	-2.01E-03	Down
GAMW55B	665.18	667.53	25	35	30	635.18	-	-			8.48	659.05			8.62	658.91			8.85	658.68		
GAMW56	665.43	667.91	5	15	10	655.43	-	-	NA	NA	7.55	660.36	-4.48E-03	Down	8.92	658.99	4.98E-04	Up	9.05	658.86	4.98E-04	Up
GAMW56B	665.33	667.82	25	35	30	635.33	-	-			7.55	660.27			8.82	659.00			8.95	658.87		

Notes:
ft-bgs = Feet below ground surface
ft-msl = Feet above mean sea level
ft-btoc = Feet below top of casing
ft/ft = Feet/Feet
NA= not applicable

Appendix C
VERTICAL GRADIENT FLOW CALCULATIONS

Monitoring Well Locations	Ground Surface Elevation (ft-msl)	Top of Casing Elevation (ft-msl)	Screen Interval				February 25, 2019				Average Vertical Gradient (ft/ft)	Flow Direction
			Top (ft-bgs)	Bottom (ft-bgs)	Center (ft bgs)	Center (ft msl)	Depth To Water (ft-btoc)	Groundwater Elevation (ft-msl)	Vertical Gradient (ft/ft)	Flow Direction		
GAMW07	666.55	669.89	5	15	10	656.55	8.85	661.04	4.85E-03	Up	0.0232	Up
GAMW07B	666.83	669.39	30	40	35	631.83	8.23	661.16				
GAMW08	665.95	669.66	5	15	10	655.95	9.46	660.2	6.66E-03	Up	0.0437	Up
GAMW08B	665.92	668.47	26	36	31	634.92	8.13	660.34				
GAMW09	665.1	668.99	5	15	10	655.51	6.78	662.21	-2.04E-02	Down	-0.0214	Down
GAMW09B	665.35	668.29	24.5	34.5	29.5	635.87	6.48	661.81				
GAMW15	665.01	668.25	5	15	10	654.54	7.78	660.47	3.44E-03	Up	0.0042	Up
GAMW15B	665.14	668.05	27.7	37.7	32.7	634.19	7.51	660.54				
GAMW16	665.2	668.37	5	15	10	655.17	8.28	660.09	6.21E-03	Up	0.0037	Up
GAMW16B	665.16	667.76	27.75	37.75	32.75	632.63	7.53	660.23				
GAMW17	668.81	671.93	5	15	10	658.93	11.46	660.47	-1.27E-03	Down	-0.0111	Down
GAMW17B	668.86	670.6	28	38	33	635.26	10.16	660.44				
GAMW18	666.04	669.07	5	15	10	656.04	6.69	662.38	1.19E-02	Up	0.0070	Up
GAMW18B	665.94	668.47	25	35	30	635.94	5.85	662.62				
GAMW46	661.99	664.80	5	15	10	651.99	7.05	657.75	5.88E-04	Up	-0.0106	Down
GAMW46B	661.98	664.79	22	32	27	634.98	7.03	657.76				
GAMW52	664.07	666.79	5	15	10	654.07	8.10	658.69	4.64E-04	Up	0.0029	Up
GAMW52B	664.50	666.90	27	37	32	632.50	8.20	658.70				
GAMW53	664.68	667.24	5	15	10	654.68	8.45	658.79	7.12E-03	Up	0.0042	Up
GAMW53B	664.62	667.29	26	36	31	633.62	8.35	658.94				
GAMW54	663.87	666.37	5	15	10	653.87	6.90	659.47	-5.92E-03	Down	0.0024	Up
GAMW54B	663.98	666.47	22	32	27	636.98	7.10	659.37				
GAMW55	665.06	667.64	5	15	10	655.06	8.03	659.61	5.03E-03	Up	-0.0062	Down
GAMW55B	665.18	667.53	25	35	30	635.18	7.82	659.71				
GAMW56	665.43	667.91	5	15	10	655.43	7.91	660.00	-5.66E-15	Down	-0.0023	Down
GAMW56B	665.33	667.82	25	35	30	635.33	7.82	660.00				

Notes:
ft-bgs = Feet below ground surface
ft-msl = Feet above mean sea level
ft-btoc = Feet below top of casing
ft/ft = Feet/Feet
NA= not applicable

Prepared by: ERW
Checked by: TK
Reviewed by: MAH

APPENDIX D

Monitored Natural Attenuation Evaluation

REPORT

MONITORED NATURAL ATTENUATION EVALUATION

Northern Indiana Public Service Company LLC
Rollin M Schahfer Generating Station
Wheatfield, IN

Submitted to:

Submitted by:

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November 2020

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Acronyms

ACM	Assessment of Corrective Measures
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
DO	Dissolved Oxygen
Eh	Reduction Potential
ft bgs	feet below ground surface
g	Gram
GMPIM	Groundwater Monitoring Program Implementation Manual
GWPS	Groundwater Protection Standards
IAP	Ion Activity Product
IDEM	Indiana Department of Environmental Management
ITRC	Interstate Technology Regulatory Council
kg	kilogram
Ksp	Solubility Product
MCL	Maximum Contaminant Level
MCWB	Metal Cleaning Waste Basin
mg	milligram
mg/L	milligram per liter
MNA	Monitored Natural Attenuation
mV	millivolt
MSRB	Material Storage Runoff Basin
NIPSCO LLC	Northern Indiana Public Service Company LLC
ORP	Oxidation-Reduction Potential
RMSGS	R. M. Schahfer Generating Station
SCM	surface complexation model
SEP	Sequential Extraction Potential
SI	Saturation Index
SSL	Statistically Significant Level
SU	Standard Unit
TAL	Target Analyte List
TDS	Total Dissolved Solids
USEPA	United States Environmental Protection Agency
XRD	X-ray diffraction

1.0 OVERVIEW

Groundwater and solid materials were evaluated to determine the feasibility of Monitored Natural Attenuation (MNA) as part of the assessment of corrective measures process for the Coal Combustion Residuals (CCR) surface impoundments (i.e., Material Storage Runoff Basin (MSRB), Metal Cleaning Waste Basin (MCWB), and the Drying Area (together, the CCR Unit) at the Northern Indiana Public Service Company LLC (NIPSCO LLC) Rollin M. Schahfer Generating Station (RMSGS, or Site). The structure of this feasibility evaluation closely follows the United States Environmental Protection Agency (USEPA) guidance on using MNA as a remedial strategy (USEPA 2007a and 2007b) and considers best practices from the Interstate Technology Regulatory Council (ITRC) document: “A Decision Framework for Applying Monitored Natural Attenuation Processes to Metals and Radionuclides in Groundwater” (ITRC 2010).

RMSGS manages CCR in the surface impoundments subject to applicable requirements of 40 Code of Federal Regulations (CFR) Part 257 as amended (CCR Rule). In April 2019, pursuant to 40 CFR §257.96(a), an assessment of corrective measures (ACM) was completed for the CCR Unit. This evaluation identified MNA as a potential remedial alternative for cobalt due to a detection at a Statistically Significant Level (SSL) in groundwater. Additionally, arsenic, boron, lithium, and molybdenum were evaluated as part of this assessment due to the potential for future SSLs, should they ever occur. The results of the evaluation will be used to assess the performance and reliability of MNA as a potential remedial alternative as required by 40 CFR §257.97, Golder determined the overall feasibility of MNA for the CCR Unit by evaluating the following tiers (USEPA 2007a,b):

1) Demonstrate active constituent removal from groundwater and dissolved plume stability (Tier I)

2) Determine the mechanisms and rates of the operative attenuation processes (Tier II)

3) Determine the long-term capacity for attenuation and the stability of immobilized constituents (Tier III)

Following completion of this multi-tier evaluation, the fourth and final tier of an MNA program, which involves the design of a performance monitoring program and the development of a contingency plan, will be developed.

2.0 APPROACH

Golder evaluated the feasibility, mechanisms, rates, and stability of MNA as a remedy for groundwater impacts from the CCR Unit. In order to perform the evaluation, Golder collected samples of groundwater and overburden soil between July 24, 2018 and March 3, 2020 for geochemical analysis. The supplemental MNA assessment included the following activities:

- Groundwater:
  - Characterization to identify temporal and geographical trends, where present, and to estimate site-wide attenuation rates using temporal and spatial trends in groundwater quality data.
  - Geochemical modeling to identify the major chemical species and evaluate saturation indices of minerals relevant to attenuation of arsenic, boron, cobalt, lithium, and molybdenum.
  - Determination of the capacity of different mechanisms to attenuate arsenic, boron, cobalt, lithium, and molybdenum, including adsorption, precipitation and co-precipitation, and physical attenuation (dilution/dispersion).
  - Geochemical modeling to assess the stability and reversibility of attenuation due to adsorption.

- Overburden soil:
  - Mineralogical analysis of overburden soils to identify and quantify the major mineral components.
  - Chemical analysis of overburden soils to quantify the total metal content and identify the environmentally-available fraction of metals.

The results generated by this supplemental assessment were used by Golder to complete the Tier I, Tier II, and Tier III evaluation (USEPA 2007a,b). In addition, groundwater data collected during previous sampling events were used. The results of the Tier I, Tier II, and Tier III are described in the subsequent sections to establish a basis for the likely success of MNA at the RMSGS site.

2.1 Groundwater and Porewater Sampling

2.1.1 Sample Collection

Golder personnel collected groundwater and porewater samples in accordance with the Golder RMSGS Groundwater Monitoring Program Implementation Manual (GMPIM, Golder 2017) from the background, downgradient, Assessment, and property boundary monitoring wells presented in Table 1, and from piezometers located within the CCR Unit. Piezometer GAPIEZ-06 is located interior of the slurry wall on the western edge of the MSRB and is screened within the CCR materials. Piezometers DAPZ-02A and DAPZ-02B (abandoned in April 2020) were installed interior of the slurry wall on the eastern edge of the Drying Area and were screened in native materials (i.e., below the extent of CCR) from approximately five to 20 feet below ground surface (ft bgs) and 33 to 38 ft bgs, respectively. The monitoring well and former piezometer locations are shown in Figure 1.

Table 1: Overview of the Wells Used in the Monitored Natural Attenuation Assessment

Background Wells	Downgradient Wells	Assessment Wells	Property Boundary Wells
GAMW-04, GAMW-07, GAMW-07B, GAMW-15, GAMW-15B	GAMW-08, GAMW-08B, GAMW-09, GAMW-09B, GAMW-16, GAMW-16B, GAMW-17, GAMW-17B, GAMW-18, GAMW-18B	GAMW-52, GAMW-52B, GAMW-53, GAMW-53B, GAMW-54, GAMW-54B, GAMW-55/55R, GAMW-55B, GAMW-56, GAMW-56B	GAMW-46, GAMW-46B

2.1.2 Groundwater and Porewater Analysis

The geochemical characterization of porewater and groundwater samples included the measurement of field parameters and the laboratory analysis of samples for total metals and major cations and anions. The field parameters and laboratory analyses included:

Field Parameters: Parameters measured in the field included pH, dissolved oxygen (DO), oxidation reduction potential (ORP), conductivity, and temperature. These measurements were used to determine general geochemical conditions in the groundwater and support geochemical modeling.

Metals: Analysis of Appendix III and IV metals concentrations was conducted to understand the geochemical composition of groundwater and porewater. Metals analysis allows for the delineation of a potential plume, evaluation of mineral saturation indices, development of partitioning coefficients (in conjunction with solid material analyses), and evaluation of background contributions from natural sources or anthropogenic sources.

Major Cations and Anions: Geochemical modeling of mineral solubility, metals attenuation and background contributions requires analysis of major cations and anions because they affect and participate in sorption and mineral dissolution or precipitation reactions.

The groundwater and porewater samples were analyzed using the following methods:

- pH following SW846 9040C “pH Electrometric Measurement” (USEPA 2004)
- Total dissolved solids standard method (SM) 2540C “Total Dissolved Solids Dried at 180°C” (USEPA 1993a)
- Total hardness following SM 2340B (USEPA 1997)
- Chloride, fluoride, and sulfide following USEPA SW846 9056A “Determination of Inorganic Anions by Ion Chromatography”, Revision 1 (USEPA 2007c)
- Nitrate and nitrite following USEPA 353.2 “Determination of Nitrate-Nitrite Nitrogen by Automated Colorimetry, Revision 2.0” (USEPA 1993b)
- Alkalinity following SM 2320B “Alkalinity by Titration” (USEPA 2005a)
- Phosphorous following SM 4500-P E “Phosphorous by Ascorbic Acid Method” (USEPA 2005b)
- Total Target Analyte List (TAL) metals following USEPA SW846 6010C “Inductively Coupled Plasma-Atomic Emission Spectrometry”, Revision 3, SW846 6020B “Inductively Coupled Plasma-Mass Spectrometry”, Revision 2, and SW846 6020A “Inductively Coupled Plasma-Mass Spectrometry”, Revision 1 (USEPA 1998a)

2.2 Overburden Soil Sampling and Analysis

2.2.1 Sample Collection

Golder subcontracted a licensed well driller to advance borings into the overburden soil and install monitoring wells using roto sonic drilling methods. During boring operations, the driller collected continuous drill cores from all deep wells (i.e.” B” flagged wells). From the drill cores, Golder staff collected overburden samples from the depth of the screened intervals (i.e. 10-foot screened interval) from one background well soil boring (SB-07B), two downgradient well soil borings (SB-08B and SB-18B) and from five Assessment Monitoring well soil borings (SB-52B, SB-53B, SB-54B, SB-55B, and SB-56B). Golder staff also collected an additional sample from SB-53B (25’-27’) at the top of the screened interval due to minor unidentified visual soil staining encountered within the planned interval itself. An additional soil boring was completed just external to the slurry wall on the eastern side of the MCWB (OW-9) and samples were collected on approximately 10-foot intervals.

The driller used a “marsh buggy” with a hollow stem auger drill rig specifically designed to work in the wet, soft soil/ash conditions inside the CCR Unit to advance eight soil borings within the Drying Area. From these eight borings, 23 samples were analyzed for total metals with one of these samples (DA-14_4-6’) also analyzed using the 7-step sequential extraction. The only sample for which data are included in this report is DA-14_4-6’; all other data, which were obtained for other purposes, are provided in the Ash Pond Assessment Report (Golder 2020).

Soil borings were numbered to match the equivalent monitoring wells, where applicable. Golder field staff prepared a composite overburden sample from boreholes by selecting a two-foot interval from each drill core and submitting it to the laboratory for analysis under chain-of-custody procedures. The unique descriptions used to identify the samples included the boring name and depth of the sample below ground surface (e.g., SB-07B-35’-37’). The sample type and analytical testing conducted on each sample are provided in Table 2.

Table 2: Summary of Overburden Soil Samples/Analyses

Sample Location	Number of Samples	Analyses
Background boring (SB-07B) 35’-37’	1	Total metals, sequential extraction
Downgradient boring (SB-08B) 30’-32’	1	Total metals, sequential extraction
Downgradient boring (SB-18B) 32’-34’	1	Total metals, sequential extraction
Assessment boring (SB-52B) 35’-37’	1	Total metals, sequential extraction, mineralogical composition
Assessment boring (SB-53B) 25’-27’ & 30’-32’	2	Total metals, sequential extraction
Assessment boring (SB-54B) 30’-32’	1	Total metals, sequential extraction, mineralogical composition
Assessment boring (SB-55B) 30’-32’	1	Total metals, sequential extraction
Assessment boring (SB-56B) 30’-32’	1	Total metals, sequential extraction, mineralogical composition
Downgradient boring (OW-9) 10’-12’ & 18’-20’	2	Total metals, sequential extraction, mineralogical composition
Drying area boring (DA-14) 4’-6’	1	Total metals, sequential extraction

2.2.2 Overburden Soil Analyses

Multiple geochemical methods were used to assess the mineralogical and chemical composition of the overburden soil samples. The selected geochemical test methods included the following:

- **Mineralogical composition:** The mineralogical analysis was used to identify and quantify the crystalline mineral phases in each sample. This information is required for geochemical modeling as the release or attenuation of constituents of interest is influenced by the mineral phase(s) present in the aquifer (Hem 1985). The mineralogical testing laboratory (SGS Minerals Services) performed the mineralogical analysis using quantitative (Rietveld) X-ray diffraction (XRD) and a Bruker AXS D8 Advance Diffractometer.
- **Total metals:** This analysis was used to quantify the chemical composition of overburden soils. The total mass of metals, in combination with the results of sequential extraction testing, can be used to determine the provenance of metals and verify sequential extraction results. The laboratory analyzed a target analyte list of

metals following the methods USEPA SW846 6010C “Inductively Coupled Plasma-Atomic Emission Spectrometry”, Revision 3 (November 2000) and USEPA SW846 7471B “Mercury in Solid or Semisolid Wastes (Manual Cold-Vapor Technique)”, Revision 2.

- **Sequential extraction:** The sequential extraction procedure (SEP) consisted of a seven-step procedure to extract metals from solids, as per Tessier et al. (1979), to identify the provenance of constituents of interest (i.e. the operationally-defined fraction that contains the metal)[1] and determine their potential environmental mobility. For instance, metals bound in the carbonate fraction, or that are exchangeable, are much more likely to become mobile due to changes in groundwater conditions than metals bound within a sulfide or silicate fraction. The summed concentration of a metal measured from all seven steps (SEP SUM) can be compared to the concentration determined from a total metals analysis (SEP Total) for compositional accountability. The laboratory analyzed the metals content of the extracted samples using the method USEPA SW846 6020B “Inductively Coupled Plasma-Mass Spectrometry”, Revision 2 (July 2014).

2.3 Groundwater Assessment Monitoring

Following the installation of a groundwater monitoring system in 2016 and throughout calendar year 2017, Golder collected background groundwater samples and performed Detection Monitoring around the CCR Unit pursuant to the requirements of 40 CFR §257.94. In 2018, Golder performed the first and second Assessment Monitoring sampling events pursuant to the requirements of 40 CFR §257.95. Following the first Assessment Monitoring sampling event, including verification sampling, the constituents that were detected above the groundwater protection standards (GWPS) at SSLs included:

- Cobalt and Lithium at GAMW-08
- Molybdenum at GAMW-18

The GWPS is the larger value of the Maximum Contaminant Level (MCL) or the unit-specific background concentration for each analyte based on a tolerance/prediction limit statistical procedure. However, USEPA amended the CCR Rule (i.e., Phase 1 Part 1 amendment) and created health-based standards for cobalt, lead, lithium, and molybdenum, constituents that do not have MCLs, as of August 29, 2018. Pursuant to 40 CFR §257.95(h)(2), the health-based standards can be used in place of background levels to calculate the GWPS. Consequently, after the second Assessment Monitoring event (October 2018), cobalt in monitoring well GAMW-08 remained as the only constituent detected at an SSL. Arsenic has never been detected above the GWPS or at an SSL, however, Golder also assessed arsenic as part of this evaluation due to sporadic detections at or above the MCL.

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[1] Sequential extraction of metals from overburden samples consisted of seven discrete steps for this investigation:

Step 1 - Exchangeable Phase: This extraction includes trace elements that are reversibly adsorbed to overburden minerals, amorphous solids, and/or organic material by electrostatic forces.

Step 2 - Carbonate Phase: This extraction targets trace elements that are adsorbed or otherwise bound to carbonate minerals.

Step 3 – Non-Crystalline Materials Phase: This extraction targets trace elements that are complexed by amorphous minerals (e.g., iron).

Step 4 - Metal Hydroxide Phase: Trace elements bound to hydroxides of iron, manganese, and/or aluminum.

Step 5 - Organic Phase: This extraction targets trace elements strongly bound via chemisorption to organic material.

Step 6 - Acid/Sulfide Fraction: The extraction is used to identify trace elements precipitated as sulfide minerals.

Step 7 - Residual Fraction: Trace elements remaining in the overburden after the previous extractions will be distributed between silicates, phosphates, and refractory oxides.

Although boron is not currently an Appendix IV constituent, USEPA is reportedly considering adding it to the Appendix IV list. The Indiana Department of Environmental Management (IDEM) has, however, established a health-based standard as part of the state cleanup program. Boron is frequently used as a tracer to indicate the extent of a release from a CCR management unit. Due to these characteristics and as a conservative measure, boron was selected by Golder to assess the nature and extent of groundwater impacts at the Site.

The health-based standards, unit-specific background concentration, and groundwater protection standards used in this evaluation are summarized in Table 3.

Table 3: Summary of Health-Based Standards, Background Concentrations, and Groundwater Protection Standards for the Constituents of Interest

Constituent	Health-Based Standard (mg/L)	Background Concentration (mg/L)	Groundwater Protection Standard (mg/L)
Arsenic	0.01	0.091	0.091
Boron	4(1)		
Cobalt	0.006	0.01	0.01
Lithium	0.04	0.01	0.04
Molybdenum	0.1	0.05	0.1

(1) IDEM health-based standard, not currently part of the CCR Rule

2.4 Groundwater and Porewater Geochemical Analysis

2.4.1 Estimation of Attenuation Rates

To evaluate the attenuation of arsenic, boron, cobalt, lithium, and molybdenum in groundwater at the Site and to assess the rate of attenuation, Golder applied the point decay method (USEPA 2011). The point decay method is used to determine the rate at which a constituent's concentrations are increasing or decreasing in groundwater at a single well between sampling events and this method can thus be used to predict when the constituent's concentrations will fall back below regulatory limits. Equation 1 describes first-order decay for a constituent:

$$\mathrm{Ln}(C_t) = kt + \mathrm{Ln}(C_0) \qquad \text{(Equation 1)}$$

where C_0 is the initial constituent concentration, C_t is the constituent concentration at time t, t is the amount of time in years that has passed since the initial concentration measurement, and k is the first-order decay rate constant (1 per year). Equation 2 shows Equation 1 reorganized to solve for the decay rate constant:

$$k = (\mathrm{Ln}(C_t) - \mathrm{Ln}(C_0))/t \qquad \text{(Equation 2)}$$

Groundwater water quality data from the background and downgradient wells collected between July 2016 and November 2019 were used to determine the mean first-order decay rate for each constituent of interest. Due to variable detection limits, results that were reported as below detection limits were not used in the point decay analysis. Using Equation 1 and the mean first-order decay rate, Golder calculated the number of years that it would take for constituents of interest concentrations greater than the GWPS to decrease below their respective thresholds.

2.4.2 Geochemical Speciation Modeling Methods

Golder conducted geochemical modeling to evaluate general groundwater and porewater composition, determine the potential for precipitation of sorbent media, evaluate the potential for mineral precipitation or adsorption in the aquifer, and determine the speciation of metals of interest. The geochemical computer code developed by the United States Geological Survey (USGS), PHREEQC (Parkhurst and Appelo 2013), was used for these simulations. PHREEQC version 3.4 is a general-purpose geochemical modeling code used to simulate reactions in water and between water and solid mineral phases (e.g., rocks and sediments). Reactions include aqueous equilibria, mineral dissolution and precipitation, ion exchange, surface complexation, solid solutions, gas-water equilibrium, and kinetic biogeochemical reactions. The widely-accepted thermodynamic database, Minteq.v4, 2017 edition, was used as a basis for the thermodynamic constants required for modeling (USEPA 1998b).

The Geochemist's Workbench version 12 (Bethke 2015) was used to generate graphical representations of geochemical modeling outputs in the form of predominance, or Pourbaix diagrams (also known as Eh-pH diagrams) for the species of interest (i.e. arsenic, boron, cobalt, lithium, and molybdenum) and trilinear plots (also known as Piper plots) displaying the relative abundance of major ions. The Minteq.v4 database was used as the basis for the Pourbaix diagrams.

2.4.3 Predictive Geochemical Modeling Methods

Golder performed geochemical modeling to assess viable attenuation mechanisms and to predict the quantity and stability of the attenuated constituents of concern.

2.4.3.1 Capacity of Adsorption as an Attenuation Mechanism

Adsorption is an important mechanism by which constituents in groundwater can be attenuated. The adsorptive partitioning between dissolved and solid phases was simulated using a two-layer surface complexation model (SCM). The SCM approach is described in Davis and Kent (1990), with additional parameterization based on Dzombak and Morel (1990) and Karamalidis and Dzombak (2011) utilizing iron (hydrous ferric oxide [Hfo]) as ferrihydrite [$Fe(OH)_{3(am)}$], and aluminum (hydrous aluminum oxide [Hao]) as gibbsite [$Al(OH)_{3(am)}$], as adsorbing surfaces.

The amount of Hfo and Hao available at the site for attenuation was based on the amorphous and metal hydroxide phase iron and aluminum concentrations measured in the SEP as described in Section 3.2.2. The minimum, mean, and maximum concentrations in soil borings were used in the adsorption models to capture the range of expected site concentrations. The Hfo and Hao surface properties (i.e., surface area, site density, and types of sites) from Dzombak and Morel (1990) and Karamalidis and Dzombak (2011) were used to quantify the iron and aluminum adsorption sites per mole of mineral.

The calculation methodology of Appelo and Postma (2010) was used to determine the specific quantity of sites on each mineral surface type as a function of the amount of mineral available to participate in these reactions. The methodology assumes the number of surface sites (sites) equals the product of the moles of iron ([Fe]) and the moles of surface sites per mole of iron ([sites]/[Fe]= 0.2 moles of sites per mole of iron). For the amount of ferrihydrite available for sorption, the Appelo and Postma methodology further assumes the mass of ferrihydrite (M_{HFO}) in grams (g) available equals the product of the [Fe] and the molecular weight of ferrihydrite (MW_{HFO} = 88.85 g/mole). The same approach was used to calculate the number of sites from gibbsite, assuming the [sites]/[Al] is 0.41 moles of sites per mole of aluminum and the molecular weight of gibbsite is 78.003 g/mole.

The geochemical thermodynamic database Minteq V.4 was used to conduct adsorption modeling. However, new and updated thermodynamic data have been released in scientific literature. These new data are important to include in the geochemical modeling exercises for certain elements or minerals as they allow further refinement of potential reactions, or for correction of previous data that may have been less accurate or more broadly defined. For groundwater modeling at the Site, Golder made numerous updates to the Minteq V.4 database, including the addition of data relating to partitioning coefficients for metals on gibbsite, developed by Karamalidis and Dzombak (2011). Of the five constituents of interest, the database did not contain partitioning coefficients for ferrihydrite or gibbsite for lithium, so its potential for adsorption could not be assessed.

To quantify current levels of adsorption, the concentration of constituents that adsorb in soils (as milligram (mg) of constituent/kilogram (kg) of soil) was modeled for the minimum, maximum, and mean Hfo and Hao contents when equilibrated with the range of groundwater qualities observed at the Site. To quantify the capacity of soil to adsorb additional amounts of each constituent, Golder simulated a step-wise increase in arsenic, boron, cobalt, and molybdenum concentrations (similar in concept to a titration, using the mean proportions observed in porewater) into the range of observed groundwater qualities while allowing equilibration with the sorption surfaces in soils (minimum, maximum and mean Hfo and Hao). The model was then used to predict the quantity of each constituent that would adsorb with this titration of additional arsenic, boron, cobalt, and molybdenum.

2.4.3.2 Mineral Precipitation and Co-precipitation

The potential for mineral precipitation was assessed in PHREEQC using a saturation index (SI) calculated according to Equation 3.

$$SI = \log (IAP/Ksp) \quad \text{(Equation 3)}$$

The saturation index is the ratio of the ion activity product (IAP) of a mineral to the solubility product (Ksp). An SI value greater than zero indicates that the solution is supersaturated with respect to a particular mineral phase and, therefore, precipitation of this mineral may occur. An evaluation of precipitation kinetics is then required to determine whether the supersaturated mineral will indeed form. An SI value less than zero indicates the solution is undersaturated with respect to a particular mineral phase. An SI value close to zero indicates equilibrium conditions exist between the mineral and the solution. SI values between -0.5 and 0.5 are considered to represent ‘equilibrium’ in this report to account for the uncertainties inherent in the analytical methods and geochemical modeling.

Co-precipitation was evaluated based on published literature and known association between minerals and constituents of concern. For example, cobalt is known to coprecipitate with iron oxyhydroxides as well as adsorb to Hfo (Norstrom and Alpers 1999). Therefore, to evaluate co-precipitation, minerals identified by PHREEQC to be at equilibrium ($SI > -0.5$) were evaluated for their potential to host arsenic, boron, cobalt, lithium, and molybdenum.

2.4.3.3 Capacity of Dilution and Dispersion as Attenuation Mechanisms

Dilution and dispersion are physical mechanisms of attenuation by which concentrations of constituents in groundwater decrease with migration along groundwater flowpaths.

To assess the potential for dilution and dispersion downgradient of the CCR Unit, Golder used MODPATH (Pollack 1989) and the calibrated Site Groundwater Flow model (discussed in Section 4.0 and Appendix B) to simulate travel times for particles released from the MCWB. The length of the particle traces produced by

MODPATH along with travel time estimates were used to calculate average groundwater velocities for the following flow paths: (see Figure 1):

- GAMW-16 to GAMW-53
- GAMW-18 to GAMW-55
- GAMW-17 to GAMW-54
- GAMW-09 to GAMW-54

The results of these flow path travel time simulations are presented in Table 4.

Golder estimated the capacity of dilution and dispersion to attenuate constituent concentrations from the CCR Unit using ratios of concentrations measured in monitoring wells along these flow paths, as presented in Table 8. For example, along the flow path from GAMW-16 to GAMW-53, concentrations of boron decreased from 9.7 milligram per liter (mg/L) to 3.1 mg/L, representing an estimated 68% decrease in concentration along the flow path due to dilution and attenuation.

2.4.3.4 Long Term Stability of Attenuated Constituents

Three sensitivity analyses were performed to assess the stability of adsorbed constituents under variable pH, redox, and ionic strength conditions. Variations in pH, redox, and ionic strength are the most likely types of changes that will occur in an aquifer over time affecting the stability of the constituents of interest (ITRC 2010). The sensitivity analyses were conducted applying the minimum, mean, and maximum Hfo and Hao contents determined for the Site soils, equilibrated with the groundwater qualities observed at the Site at the measured pH and redox conditions. For each sensitivity analysis, a single parameter was varied:

- **pH -** Hydrochloric acid or sodium hydroxide addition was modeled to vary the pH between 4 and 12 standard units (SU). A pH range of 4 to 10 is the typical range considered for evaluating metal speciation.
- **Redox -** DO addition was simulated to adjust reduction potential (Eh) values between -200 and +700 millivolts (mV) based on the historical and anticipated range of Eh in the region.
- **Ionic Strength -** Total dissolved solids (TDS) concentrations were increased by titrating in calcium, magnesium, sodium, potassium, chloride, and sulfate in the proportions observed in porewater. TDS concentrations were evaluated up to 10,000 mg/L, which is approximately four times higher than the highest TDS concentration observed in groundwater at the CCR Unit.

2.4.4 Geochemical Modeling Assumptions and Data Handling

Geochemical modeling assumptions and data handling included the following:

- **Groundwater continuity:** Three or four groundwater quality samples were collected from each well during sampling events conducted between September 2018 and November 2019. Samples from this period were selected for the geochemical modeling because all wells related to the CCR Unit were sampled and analyzed for the full suite of parameters described in Section 2.1.2 and the resulting data are assumed to provide a comprehensive overview of groundwater conditions. Temporal trend analysis for arsenic, boron, cobalt, lithium, and molybdenum made use of all available sampling events between July 2016 and November 2019.

- **Porewater chemistry:** Porewater samples collected from GAPIEZ-06 (three samples total in August, September, and October 2018), DAPZ-02A (one sample collected in March 2020), and DAPZ-02B (one sample collected in March 2020) were assumed to be representative of porewater found in the CCR Unit. Data from three sampling events from GAPIEZ-06 were used to evaluate porewater trends.
- **Redox values:** ORP values measured in the field were converted to Eh by adding 200 mV to the field-measured values as per YSI Tech Note (YSI 2015).
- **Non-detect values:** Constituents with concentrations less than their respective method reporting limits were assumed to have a concentration equal to half the reporting limit in model simulations.
- **Total recoverable concentrations:** Total recoverable fraction results were used for geochemical modeling.
- **Charge balance:** Groundwater and porewater compositions with charge balance errors less than 10% were considered valid. Compositions with charge balance errors greater than 10% were flagged as potentially less reliable, but still included in the geochemical modeling effort.

3.0 SUPPLEMENTAL ASSESSMENT RESULTS

3.1 Groundwater and Porewater

3.1.1 Groundwater Characterization

Groundwater quality data for background, downgradient, and Assessment Monitoring wells used for this evaluation were collected from September 2016 to November 2019. Non-regulated (per the CCR Rule) groundwater parameters (e.g., alkalinity, potassium, sodium) are only available from September 2018 to November 2019. The assessment of trends in arsenic, boron, cobalt, lithium, and molybdenum concentrations in groundwater included observations of all validated data collected during that time frame. Groundwater quality monitoring data are presented in Appendix A and can be summarized as follows:

- **Charge balance error:** Charge balance errors could only be assessed for samples for which the full suite of cations and anions was reported. Eleven groundwater samples had charge balance errors greater than 10%. Eight out of the eleven samples (GAMW-07 in November 2019, GAMW-07B in November 2019, GAMW-08B October 2018, GAMW-08B in November 2019, GAMW-18 in October 2018, GAMW-18B in October 2018, GAMW-18B in November 2019 and GAMW-56B in April 2019) reported charge balance errors between 10% and 15%. Only samples from GAMW-07B in September 2018, GAMW-18B in April 2019, and GAMW-56 in April 2019 had a charge balance error greater than 40%. All eleven results were flagged (Table 5) and retained, with the understanding that they may be somewhat less reliable. Upon subsequent sampling, charges balance errors decreased to <10 % in these wells.
- **pH:** Groundwater pH across background, downgradient, and Assessment Monitoring wells ranged from 5.2 to 8.7. The geometric mean pH across all wells was 7.2. GAMW-07B, GAMW-52B, GAMW-54B were the only wells that produced samples with a pH exceeding 8.0.
- **ORP (Redox):** Field-measured redox, corrected to Eh (+200 millivolts [mV]) values, ranged from -115 to +335 mV in the background monitoring well, downgradient monitoring well, Assessment Monitoring well, and porewater samples collected between September 2018 to November 2019. There was no apparent trend in redox conditions based on sample location or depth.

- **Total Dissolved Solids:** Groundwater TDS concentrations were variable. Generally, the lowest TDS concentrations (less than 400 mg/L) were measured in groundwater at Assessment Monitoring wells (GAMW-46, GAMW-46B, GAMW-52, GAMW-53) while TDS concentrations up to an order of magnitude higher were determined in groundwater at wells located immediately downgradient of the CCR Unit (e.g., GAMW-08B). In general, deep wells demonstrated higher TDS concentrations than shallower companion wells at the same locations.

- **Major ion chemistry:** A Piper plot was generated for all porewater samples and groundwater samples from background, downgradient, and Assessment Monitoring wells to facilitate the identification of water types and changes in major ion chemistry over time (Figure 2a-c). The majority of background, downgradient, and porewater samples are calcium-sulfate dominated. In general, deep wells have a higher proportion of sodium and sulfate than the shallower companion wells. The differences between shallow and deep companion wells are more pronounced in the Assessment Monitoring wells. Except for GAMW-54 and GAMW-55, the shallow samples from the assessment wells are calcium-(bi)carbonate dominated and plot in a different location on the Piper plot than background, downgradient, and porewater samples. Shallow wells GAMW-54 and GAMW-55, along with all the deep Assessment Monitoring wells, are calcium-sulfate dominated and plot with background, downgradient, and porewater samples. The water types have remained generally unchanged between September 2018 and November 2019. Generally, this indicates that groundwater types are consistent. However, based on major ion chemistry, there are different water types on the site that are likely influenced by variable site geology.

- **Arsenic:** Arsenic concentrations in groundwater samples collected from downgradient monitoring and Assessment Monitoring wells between September 2016 to November 2019 ranged from non-detect (<0.005 mg/L) to 0.022 mg/L (Figure 4a-c). The highest measured arsenic concentration in groundwater at the CCR Unit (0.091 mg/L) was reported in a sample collected from background well GAMW-15 in September 2018 (Figure 4a). No downgradient monitoring well has ever exceeded the GWPS of 0.091 mg/L designated for the CCR Unit. Arsenic concentrations in groundwater appear to be stable or decreasing in all downgradient monitoring wells (Figure 4b). Arsenic concentrations in the CCR Unit porewater (GAPIEZ-06) ranged from 0.011 to 0.012 mg/L in August and October 2018 (Appendix A-2). Arsenic concentrations collected from the Drying Area in March 2020 (DAPZ-02A and DAPZ-02B) were an order of magnitude lower (<0.0010 and 0.0018 mg/L, respectively). Based on the observed pH and Eh conditions, arsenic predominately occurs as an oxidized arsenate (As^{+5}) species, with arsenic in only a small number of samples present as a reduced arsenite (As^{+3}) species (Figure 3a). Arsenite is less readily adsorbed than arsenate and is thus generally regarded to be more mobile in natural environments (Nordstrom 2014).

- **Boron:** Boron concentrations in downgradient groundwater samples collected between September 2016 to November 2019 ranged from 0.056 mg/L to 25 mg/L (Figure 5a-c). The highest boron concentration (25 mg/L) was measured in monitoring well GAMW-09B in September 2017. Two background wells (GAMW-07B and GAMW-15B), seven downgradient wells (GAMW-08B, GAMW-09, GAMW-09B, GAMW-16B, GAMW-17, GAMW-17B, and GAMW-18B) and two Assessment Monitoring wells (GAMW-54B and GAMW-55B) reported boron concentrations greater than the health-based standards (4 mg/L). Boron concentrations in porewater were between 7.4 mg/L and 13.8 mg/L. Based on pH conditions on the Site, boron in all wells occurs predominately in the form of protonated boric acid (H_3BO_3) (Figure 3b). Generally, boron concentrations in the background and downgradient wells have remained stable or has decreased. This is also the case for all assessment and boundary well except for GAMW-55B, where boron has increased slightly. GAMW-55B is a deep well and heavily influenced by bedrock.

- **Cobalt:** Cobalt concentrations ranged from non-detect (<0.001 mg/L) to 0.059 mg/L in groundwater samples collected between September 2016 to November 2019 at the CCR Unit (Figure 6a-c). GAMW-08 had the highest cobalt concentration of all monitoring wells (0.059 mg/L in November 2016) and generally reported a decreasing trend thereafter (Figure 6b). The second highest concentration (0.010 mg/L in June 2017 and October 2018) occurred in GAMW-07, a background well (Figure 6a). GAMW-08 is the only well on Site to have reported a historic cobalt level greater than the GWPS (0.010 mg/L). Cobalt in porewater ranged from below the laboratory reporting limit (<0.0010 mg/L) to 0.0022 mg/L. Cobalt in all wells occurs predominately as the divalent cation Co^{+2}, based on pH and Eh conditions (Figure 3c). Cobalt concentrations appear to be stable or decreasing in groundwater samples collected from the upgradient, downgradient, and Assessment Monitoring wells.

- **Lithium:** Lithium concentrations in groundwater ranged from non-detect (<0.008 mg/L) to 0.025 mg/L between September 2016 to November 2019 (Figure 7a-c). Two downgradient wells, GAMW-18B and GAMW-08, located directly downgradient of the MCWB, have historically had the highest lithium concentrations (Figure 7b). Lithium concentrations historically have not exceeded 0.040 mg/L, the health-based standard. Lithium levels in GAMW-08 appear generally consistent over time, and a trend cannot be determined for GAMW-18B, as the well was recently installed and fewer than four sampling events have been conducted. Lithium concentrations in groundwater at all other wells downgradient of the CCR Unit appear to be stable. Lithium was not detected above the laboratory reporting limit (0.008 mg/L) in the CCR Unit porewater (GAPIEZ-06). Lithium concentrations collected from the Drying Area in March 2020 (DAPZ-02A and DAPZ-02B) were <0.008 mg/L and 0.016 mg/L, respectively. Lithium predominately occurs as the monovalent cationic species Li^{+} based on field pH and Eh conditions (Figure 3d).

- **Molybdenum:** Molybdenum concentrations in groundwater ranged from non-detect (<0.010 mg/L) to 0.18 mg/L (Figure 8a-c). Although GAMW-18 has reported historical levels of up to 0.18 mg/L, concentrations have been below 0.1 mg/L (the health-based standard) since August 2017. No other CCR Unit monitoring wells have reported concentrations exceeding 0.1 mg/L. The molybdenum concentration in porewater has ranged from 0.063 mg/L to 0.81 mg/L. Molybdenum is predominately present in the form of the divalent anionic molybdate (MoO_4^{-2}) species based on field-measured pH and Eh conditions (Figure 3e).

- **Iron:** Total (un-filtered) iron concentrations were variable, ranging from non-detect (<0.1 mg/L) to 13 mg/L between September 2018 and November 2019 (Appendix A-1). The highest concentration of 13 mg/L was observed in the groundwater sample collected from Assessment Monitoring well GAMW-56. No geographical trend is apparent; however, deeper "B wells" generally tended to have higher total iron contents. Ferric iron (Fe^{+3}) concentrations were higher than ferrous iron (Fe^{+2}) concentrations in all samples, except for those collected from wells GAMW-15, GAMW-55B, and GAMW-56.

- **Nutrients:** Total nitrogen (nitrate + nitrite) was measured in groundwater samples collected in October 2018 and was present at low levels (i.e. less than 2.8 mg/L). Nitrate concentrations were measured in samples collected in 2019 and concentrations ranged from below the detection limit (<0.05 mg/L) to 7.7 mg/L. The highest reported nitrate concentration was found in GAMW-08 in May 2019 (7.7 mg/L-N). The presence of low-level nitrate confirms oxidized conditions surround the CCR Unit. Phosphate concentrations exceeding 1 mg/L were detected in groundwater samples from GAMW-15 and GAMW-16. Phosphate concentrations were below detection in groundwater samples collected from 18 of the 25 wells between September 2018 and November 2019. No geographical or temporal trend is apparent in the phosphate concentrations related to the CCR Unit (Appendix A).

The monitoring data also indicate that sulfate generally occurs at the highest concentrations immediately downgradient of the CCR Unit and in background monitoring wells (Figure 9a-c). As identified in Figure 2a-c, considering major groundwater chemistry and sulfate, the CCR Unit is likely influencing groundwater quality in Assessment Monitoring wells GAMW-54/54B and GAMW-55/55B. However, while affected by the CCR Unit, these wells report low concentrations of arsenic, cobalt, lithium, and molybdenum below health-based standards or below detection limits. Boron concentrations were elevated above its GWPS in both upgradient and downgradient wells, suggesting elevated concentrations are naturally occurring or due to an alternate source at the Site.

3.1.2 Evaluation of Attenuation Rates

The results of the point decay analysis for groundwater at background and downgradient wells (including Assessment Monitoring wells) between September 2016 and November 2019 are provided in Table 6, as mean site attenuation rates. This evaluation reveals that, despite concentrations generally increasing in background wells over time (as indicated by positive point decay constants), boron, cobalt, lithium, and molybdenum concentrations in downgradient wells have decreased (negative point decay constants) over that same monitoring period. The mean downgradient decay rates can be used to estimate the number of years it would take for elevated groundwater concentrations to decrease to the GWPS. Maximum concentrations of boron, cobalt and molybdenum observed in downgradient monitoring wells over the period of monitoring would take approximately 41 years, 39 years, and 20 years, respectively, to attenuate to concentrations below GWPS (or health-based standard for boron) based on these decay rates. The durations required to achieve regulatory standards for arsenic and lithium were not calculated because there are no exceedances of the GWPS for these constituents.

The positive mean point decay rate for arsenic in downgradient monitoring wells indicates that, on average, concentrations are increasing. Given the low concentrations in the porewater samples (≤ 0.012 mg/L), this trend is unlikely to be caused by the CCR Unit. Low-level increasing arsenic concentrations in Assessment Monitoring wells GAMW-52B, GAMW-53B, GAMW-54, and GAMW-54B are driving the positive point decay rate, but the arsenic concentrations in these wells remain sufficiently low (≤ 0.005 mg/L) and are likely caused by natural variability. Although an increasing trend of arsenic at these wells currently may exist, it is unlikely this trend will continue given the potential for attenuation (e.g., through sorption and dilution) to maintain arsenic concentrations below the GWPS.

3.1.3 Mineralogical Controls in Groundwater and Porewater

The results of speciation modeling of groundwater data from background, downgradient, and Assessment Monitoring wells between September 2018 and November 2019 are provided in Table 5, including saturation indices for relevant minerals. Mineral saturation can play an important role in attenuation of metals, either directly by their removal through mineral precipitation, or indirectly by providing sorptive surfaces or opportunities for co-precipitation.

- **Iron-bearing minerals:** Ferrihydrite was indicated to be at equilibrium with groundwater or oversaturated in nearly all samples, indicating a strong potential for ongoing precipitation of solid-phase iron oxides. Only two samples from Assessment Monitoring well GAMW-53 (April 2019 and November 2019) were modeled to be undersaturated with respect to ferrihydrite. Thus, it is assumed that iron (hydr)oxides are prevalent in the Site aquifers.
- **Other minerals:** Nearly all groundwater samples, with the exception of samples from GAMW-07 and GAMW-52, were simulated to be in equilibrium or oversaturated with respect to barite ($BaSO_4$). Fluorite

(CaF_2) equilibrium was indicated in wells GAMW-07B, GAMW-08/08B, GAMW-17, and GAMW-52B. Gypsum ($CaSO_4.2H_2O$) was modeled to be in equilibrium in seven wells (GAMW-07B, GAMW-08B, GAMW-15B, GAMW-16B, GAMW-18, GAMW-18B, and GAMW-55B), most of which were deeper “B-wells” nearer to bedrock. Calcite ($CaCO_3$) equilibrium was indicated in all wells except GAMW-53.

In summary, several mineral phases likely control groundwater composition at some or all wells: barite, calcite, fluorite, ferrihydrite, and gypsum. In the case of ferrihydrite, the dissolved concentrations of constituents of interest can be reduced through its ability to act as a substrate for adsorption.

3.2 Overburden Soil

3.2.1 Mineralogical Composition

Quantitative XRD with Rietveld refinement was used to identify and quantify minerals in five overburden soil samples collected during the drilling activities (Table 7). Three of the samples were collected from the Assessment Monitoring well’s soil borings and two samples were collected from the downgradient soil boring (OW-9). These samples were obtained to better understand the mineralogical composition of the aquifer system and identify any minerals that would potentially influence attenuation of constituents of interest. In addition, and in contrast, the presence of certain minerals could also indicate a potential for naturally occurring release of metals into groundwater, for instance due to oxidation of sulfide minerals.

The mineralogical analysis identified the iron sulfide minerals pyrite and marcasite at low levels in three of the five overburden soil samples, at concentrations up to 0.6 wt.%. These minerals can oxidize in the presence of even trace amounts of dissolved oxygen, which would lead to the liberation of trace metals or metalloids known to associate with sulfide minerals (e.g., arsenic, cobalt, and molybdenum) into groundwater (Smith and Huyck 1997). In addition, the associated release of iron creates the potential for formation of minerals with the ability to sorb trace elements.

The presence of the oxidized iron mineral hematite (Fe_2O_3) at 0.3 to 0.6 wt.% in three of the five overburden soil samples in the presence of reduced iron sulfide minerals indicates a spectrum of oxidation occurring in overburden soil samples. As pyrite or marcasite is oxidized, intermediate amorphous iron phases, such as ferrihydrite, would likely occur first. Over time, crystallization would progress, forming iron oxide-oxyhydroxides such as hematite or goethite (FeOOH). Therefore, it is likely a range of iron solid phases is present in the overburden soil, and the potential exists over time for an increased presence of amorphous and crystallized iron oxides-oxyhydroxides with a strong affinity to attenuate certain metals and metalloids (Dzombak and Morel 1990).

The mineralogical analysis also identified the carbonate minerals calcite ($CaCO_3$) and dolomite ($CaMg(CO_3)_2$) in all overburden soil samples, with combined concentrations between 9 and 16 wt.%. Carbonate minerals are known to adsorb cobalt (Brady et al. 2003) while sorption and uptake of arsenic are possible as well (e.g., Romero et al. 2004). Carbonate minerals can dissolve when exposed to sulfuric acid formed by oxidation of sulfide minerals and release associated trace metals and metalloids (Section 3.2.2) into groundwater. Iron can also be released as carbonate minerals dissolve and potentially form metal hydroxide minerals.

3.2.2 Chemical Composition and Sequential Extraction

Chemical analysis and sequential extraction were conducted to determine the chemical composition and the distribution of constituents of interest over various operationally defined fractions of the overburden soil. This testing was completed per Table 2 on nine overburden soil samples from eight monitoring well locations, two samples from the OW-9 borehole, and one sample from within the Drying Area (reported in Table 8). Soil samples from soil borings that correspond to well locations were collected from within the screened depth (except SB-53B 25'-27' which was collected above the screened depth).

A description of the individual fractions determined by sequential extraction is presented in Section 2.2.2, footnote 1. Metals extracted in steps 1 through 5 are considered environmentally available, whereas metals extracted in steps 6 and 7 are present in refractory fractions and are not expected to be released under conditions typically encountered in aquifers (Tessier et al. 1979). The sum of metal concentrations from the sequential extraction steps is expressed as "SEP SUM" in Table 8 and does not represent an analytically determined value. The concentration measured by total metals analysis is referred to as "SEP Total" in Table 8. Boron was not included in the SEP analysis due to method limitations.

The results from the chemical analysis and sequential extraction can be summarized as follows:

- **Iron:** Iron was present in all twelve samples analyzed, varying from 3,400 milligram per kilogram (mg/kg) (DA-14) to 9,900 mg/kg (SB-54B). In all samples, the refractory sulfide and residual fractions accounted for the largest proportion of total iron and, as such, most of the iron is not environmentally available (Figure 10). The labile fraction in steps 1 through 5 can generally be considered representative of the amount of iron in the overburden that may be available as a sorbing medium. While not a constituent of interest, iron and its minerals commonly represent the most important reservoir for metal/metalloid attenuation in soils or overburden. The labile fraction calculated from sequential extraction, therefore, can be used as a proxy for determining the total number of adsorption sites available for attenuation of arsenic, boron, cobalt, and molybdenum in the environment.

- **Arsenic:** Total arsenic in the soil overburden samples ranged from 1.9 to 6.2 mg/kg while the environmentally-available fraction ranged from 0.44 mg/kg in SB-55B to 3.0 mg/kg in SB-53B, representing from 31% to 59% of total arsenic (Figure 11). The majority of arsenic was present in the refractory fraction, predominantly associated with sulfide minerals. The amorphous metal and metal hydroxide fractions hosted all arsenic that was environmentally available except in SB-52B, where the carbonate fraction represented 8.5% of total arsenic. The highest concentrations of environmentally-available arsenic occurred in sample SB-56B, and the lowest concentrations were encountered in samples DA-14, SB-53B and SB-55B. The Drying Area sample (DA-14) had the second lowest environmentally-available arsenic concentrations (0.45 mg/kg) of all samples analyzed. Arsenic in DA-14 predominantly occurred in the sulfide and insoluble fractions.

- **Cobalt:** Total cobalt in soil borings ranged from 2.5 mg/kg to 6.1 mg/kg while the environmentally-available fraction ranged from 1.1 mg/kg in OW-9 to 2.9 mg/kg in SB-53B, representing from 27% to 60% of total cobalt (Figure 12). Those samples downgradient of the CCR Unit had similar total cobalt in the environmentally-available fraction as the background samples. In all boring samples, cobalt was most abundant in the metal hydroxide, sulfide, and residual fractions. Cobalt was also present in the carbonate phase in the nine soil bore samples (5% to 14% of total). Cobalt in the carbonate phase is most likely sorbed onto or coprecipitated with the calcite that was indicated to be in equilibrium with groundwater in geochemical modeling. Cobalt was not detected in the exchangeable phase. DA-14 reported the lowest total and environmentally-available cobalt concentrations (0.87 mg/L and 0.39 mg/L, respectively) of all samples analyzed, predominantly in the metal hydroxide and sulfide fractions.

- **Lithium:** Total lithium ranged from 4.2 to 11 mg/kg while the environmentally-available fraction ranged from 0.5 mg/kg in DA-14 to 11.4 mg/kg in SB-18B, representing from 12% to 74% of total lithium (Figure 13). The majority of lithium was present in either the organic or the refractory fraction. The organic, carbonate, and metal hydroxide fractions hosted all lithium that was environmentally available. The highest concentrations of environmentally-available lithium occurred in samples SB-18B, SB-54B, SB-55B and SB-56B, and the lowest amount was encountered in SB-53B. Lithium concentrations in DA-14 were generally lower than in background and downgradient monitoring wells, with the majority of the lithium present in the sulfide and residual fractions.

- **Molybdenum:** Total molybdenum in overburden ranged from 0.15 to 3.8 mg/kg while the environmentally-available fraction ranged from non-detect to 2.83 mg/kg, in SB-53B (25'-27'), and accounted for 100% of all molybdenum in SB-18B and SB-53B (30'-32') (Figure 14). Molybdenum was most commonly present in the amorphous and metal hydroxide fractions. Notably, in background boring SB-07B and in SB-08B, a downgradient boring in close proximity of the CCR Unit, molybdenum was non-detect in overburden soil samples. The soil boring with the highest total molybdenum content, SB-53B, is located further downgradient from the CCR Unit. The Drying Area sample (DA-14) had the highest concentrations (15 mg/kg) of all samples analyzed. Molybdenum in DA-14 was present predominantly in the exchangeable fraction.

In summary, no definitive trends were present for arsenic, cobalt, lithium or molybdenum that indicated a higher concentration immediately downgradient of the CCR Unit relative to background locations or locations further downgradient. Based on the above results, attenuation by adsorption of all four constituents of interest is likely occurring, with the carbonates, amorphous metal oxides, and metal hydroxide fractions accounting for the majority of the attenuation.

4.0 GROUNDWATER MODELING RESULTS

Through standard numerical groundwater modeling procedures, Golder developed a steady state groundwater flow model for the Site that is considered calibrated and verified. Details of the flow model development are presented in Appendix B. This model was utilized to inform the natural attenuation study by simulating travel times for particles released from the MCWB, as presented in Table 4.

5.0 GEOCHEMICAL MODELING RESULTS

5.1 Identification and Capacity of Attenuation Mechanisms

5.1.1 Adsorption to Iron and Aluminum Oxyhydroxides

The Hfo and Hao surface area and sorption site calculations for the minimum, mean, and maximum soil boring iron and aluminum concentrations are presented in Table 10. Adsorption modeling in PHREEQC revealed a large range of adsorption capacities expected for the different constituents at the site. Figure 15 displays the predicted trajectories of aqueous concentrations before and after adsorption onto Hfo and Hao in soils (minimum, mean and maximum Hfo and Hao), as additional arsenic, boron, cobalt, and molybdenum are titrated into solution. The bold lines display the geometric means for all groundwater scenarios within each soil scenario and the grey area represents the range for the 5th to 95th percentile of all soil scenarios. As mentioned in Section 2.4.3.1.2, lithium adsorption to iron and aluminum oxyhydroxides was not modeled due to a lack of available thermodynamic data.

The predicted trajectories are compared against the GWPS and porewater concentrations. On the plots, the further the predicted trajectories are to the right of the 1:1 line, the larger the amount of the constituent that has sorbed to Hfo and Hao surface sites in soils and is no longer predicted to reside in the aqueous phase. For boron, little to no adsorption is predicted by the model, so aqueous concentration before adsorption are almost identical to concentrations after adsorption. For arsenic, a large proportion is expected to adsorb, with a capacity to bring average arsenic concentrations to below 0.01 mg/L when concentrations are at approximately 10 mg/L or lower prior to adsorption. At higher arsenic concentrations (> 10 mg/L), the relative sorption capacity is diminished as sorption sites are filled and aqueous concentrations after adsorption are predicted to increase above its GWPS. For cobalt and molybdenum, the trajectories run parallel to the 1:1 line, indicating that sorption capacity is directly proportional to the concentration before adsorption. The modeling results suggest that adsorption has the capacity to reduce cobalt concentrations below approximately 0.1 mg/L down to the GWPS of 0.01 mg/L and molybdenum concentrations below approximately 0.2 mg/L down to the GWPS of 0.1 mg/L. The 95th percentile of modeled trajectories show that a minority of pH and redox conditions at site were less favorable for attenuating cobalt or molybdenum, as seen by the proximity to the 1:1 line.

5.1.2 Co-precipitation

In addition to adsorption, co-precipitation or the direct incorporation of trace metals such as cobalt into precipitated iron oxide-oxyhydroxides has been well studied in literature (Butt et al. 2000; Dzombak and Morel 1990; Smith 1999). For the soils analyzed by sequential extraction (Section 3.2.2), all samples had higher concentrations of cobalt in the amorphous and metal hydroxide phases than indicated by adsorption modeling. This suggests that cobalt concentrations also may be attenuated during the formation of ferrihydrite (Butt et al. 2000; Tebo et al. 2004). Cobalt was also identified by SEP to be associated with carbonate minerals, likely due to co-precipitation with the dolomite or calcite identified by mineralogical analysis. Arsenic co-precipitation with amorphous phases of iron and other metal oxyhydroxides is also considered possible. However, per the SEP results, no arsenic was found to be associated with carbonate minerals. Co-precipitation is either not likely or relevant for boron, lithium, and molybdenum.

5.1.3 Physical Attenuation

Table 9 presents the predicted concentrations at Assessment Monitoring wells, assuming the minimum and maximum amount of dilution and dispersion downgradient of the CCR Unit (Section 4.0). The highest concentrations of arsenic, boron, cobalt, lithium, and molybdenum measured in porewater were “diluted” in the geochemical simulations with the maximum concentrations observed in side-gradient wells GAMW-52, GAMW-52B, GAMW-56, and GAMW-56B to provide a conservative estimate of dilution and dispersion.

For arsenic, cobalt, and lithium, the maximum concentrations in porewater were below the GWPS. Dilution and dispersion with groundwater from side-gradient wells generally resulted in a further decrease below the GWPS. At GAMW-56, arsenic and cobalt concentrations were elevated over those in porewater. Consequently, dilution/dispersion of porewater with water from GAMW-56 resulted in higher concentrations relative to porewater, though still below GWPS.

For boron the maximum porewater concentrations were elevated above the health-based standard (345%) and for molybdenum, the maximum porewater concentrations were elevated above the GWPS (810%). The 32 to 63 percent reduction in concentrations by dilution and dispersion alone was not sufficient to bring the maximum porewater concentrations below the relevant standards. For boron, concentrations in background monitoring well GAMW-15 were twice as high as those in porewater. Due to this background source, boron concentrations in side-gradient wells are also relatively high and limit the effectiveness of dilution to reduce boron concentrations downgradient of the CCR Unit. For molybdenum, concentrations in monitoring wells have been below GWPS since March 2018, indicating additional dilution/dispersion or other attenuating processes have reduced porewater concentrations between the CCR Unit and the monitoring wells. As a consequence, molybdenum concentrations will likely remain below the GWPS.

5.2 Long-Term Stability of Attenuated Constituents

The expected variations in dissolved concentration as a function of pH, Eh, and TDS are presented in Figures 16, 17, and 18, respectively. Results are presented along with GWPS values and the range of pH, Eh, or TDS values (5th percentile to 95th percentile) observed at the Site. Responses to changes in pH, Eh, and TDS vary widely by constituent. The results of the adsorption stability modeling for arsenic, boron, cobalt, and molybdenum can be summarized as follows:

- **Arsenic:** For the range of pH values observed at the site, greater than 95% of the arsenic is expected to sorb to Hfo and Hao (Figure 16a). At pH values below 6.0, a conversion of arsenate to arsenite is modeled to release the adsorbed arsenic into groundwater. For alkaline pH values between 8.0 and 10.0, there is a small amount of additional capacity for arsenic to adsorb. At extremely alkaline conditions (pH greater than 10.0), higher proportions of negatively-charged sorption sites on Hfo and Hao limit the effectiveness of sorption of anionic species, resulting in higher amounts of desorbed arsenic. Under reducing conditions (Eh less than -100 mV), arsenic is largely present as arsenite and sorption is limited (Figure 17a). Over intermediate redox conditions (Eh between 0 and 500 mV), adsorbed arsenic is relatively stable. Above 500 mV, arsenic is expected to desorb again. Under increasing TDS concentrations (Figure 18a), arsenic sorption declines as other anions compete with and replace arsenic from sorption surfaces. For arsenic, TDS concentrations at the Site could quadruple relative to observed values before aqueous concentrations increase above the GWPS.

- **Boron:** Based on the relatively small proportion of boron that can be adsorbed to Hfo and Hao surface sites, changes in pH, Eh, and TDS concentrations are modeled to have only a minor impact on aqueous concentrations, as evidenced by the horizontal trends in Figures 16b, 17b, and 18b.

- **Cobalt:** The pH response of cobalt (Figure 16c) is broadly similar to that of arsenic, with cobalt being nearly completely in dissolved form under acidic conditions but generally sorbed under alkaline conditions. Cobalt was generally modeled to be unresponsive to changes in redox conditions (Figure 17c), with little additional cobalt sorbing or desorbing over the range of tested Eh conditions. Cobalt was also not responsive to increases in TDS concentrations (Figure 18c), with sorption remaining relatively unchanged as TDS concentrations increased 4- to 40-fold above the commonly-observed range at the Site.

- **Molybdenum:** For molybdenum, lower pH values (more acidic conditions) were generally more favorable for adsorption (Figure 16d). At alkaline pH values (pH greater than 10), nearly all molybdenum is desorbed and present in the dissolved phase. Over the range of common Eh values at site (Figure 17d), molybdenum sorption is relatively stable. Highly reducing conditions are predicted to increase molybdenum adsorption and highly oxidizing conditions are predicted to reduce adsorption. Molybdenum adsorption is generally insensitive to increases in TDS concentrations (Figure 18d), with TDS concentrations up to 10,000 mg/L less than doubling the aqueous concentrations due to desorption.

6.0 TIER I EVALUATION

The potential for natural attenuation of arsenic, boron, cobalt, lithium, and molybdenum was evaluated in accordance with recommended practices and guidance promulgated by the USEPA and the ITRC (USEPA 2007a; USEPA 2007b; ITRC 2010). According to USEPA (USEPA 2007a), the purpose of the Tier 1 evaluation is to “Demonstrate that the groundwater plume is not expanding and that sorption of the contaminant onto aquifer solids is occurring where immobilization is the predominant attenuation process.” Based on this definition, the following observations support MNA as a viable corrective measure for the CCR Unit:

- **Plume Stability:** Based on the water quality monitoring data presented in this Assessment Monitoring, groundwater concentrations of arsenic, boron, cobalt, lithium, and molybdenum outside of the CCR Unit appear to be stable or decreasing. Evaluation of trend charts generally did not reveal increasing trends in wells downgradient of the CCR Unit (Figures 4 to 8), including for parameters such as boron and sulfate, which are considered common indicators of CCR leaching (Figures 5 and 10). These observations indicate that the distribution of arsenic, boron, cobalt, lithium, and molybdenum in the aquifer is stable.

- **Magnitude of Exceedances:** Arsenic has remained below the CCR Unit GWPS (0.091 mg/L) in all downgradient monitoring wells. Boron concentrations exceed the health-based standard (4 mg/L) in nine of the downgradient (Downgradient Monitoring and Assessment Monitoring) wells, but concentrations are generally within the range of background monitoring well concentrations, suggesting naturally-elevated levels or an alternative source of boron causing the concentrations in groundwater at the Site. The cobalt concentration in groundwater at GAMW-08, the only downgradient monitoring well exceeding the GWPS, has shown a decreasing trend since 2016. The most recent concentration of cobalt (0.011 mg/L in November 2019) was just 0.001 mg/L above the GWPS of 0.010 mg/L. No wells exceed the health-based lithium standard (0.04 mg/L). Molybdenum concentrations in all wells have been consistently below the health-based standard of 0.1 mg/L since August 2017, indicating a low likelihood of a future exceedances based on historical trends.

- **CCR Unit Porewater:** The CCR Unit at RMSGS was placed into service in 1976 and historical records are not available for ash additions or porewater concentrations over the CCR Unit’s lifespan. However, based on recent porewater data, the arsenic concentration in the CCR Unit (0.011 mg/L to 0.018 mg/L) is well below the GWPS of 0.091 mg/L. Cobalt and lithium concentrations in porewater in the CCR Unit were low and only detected above their laboratory reporting limit in a single sample (0.0022 mg/L and 0.016 mg/L, respectively). This indicates that the CCR Unit is not a potential source for these metals. Boron concentrations in the porewater (8.3 mg/L to 13.8 mg/L) are elevated above the health-based standard of 4 mg/L but are below levels observed in the two deep background monitoring wells GAMW-07B (15-23 mg/L) and GAMW-15B (13-18 mg/L). Molybdenum in the CCR Unit was measured at concentrations up to 0.81 mg/L, above its GWPS. Even so, molybdenum concentrations in groundwater downgradient of the CCR Unit are currently below the GWPS.

- **Groundwater Chemistry:** The groundwater monitoring results and the findings of the geochemical modeling support the potential for natural attenuation of arsenic, boron, cobalt, lithium, and molybdenum. Equilibrium of groundwater with the mineral phase ferrihydrite was modeled to occur in all groundwater samples and calcite equilibrium was indicated in all downgradient monitoring wells except GAMW-53. This is consistent with the results from the sequential extraction analysis that indicate carbonate, amorphous, and metal hydroxide fractions sequester arsenic, boron, cobalt, lithium, and molybdenum.

- **Confirmation of Attenuation/Immobilization:** Based on both mineralogical and chemical analysis, it is evident that attenuation of arsenic, cobalt, lithium, and molybdenum by aquifer materials is occurring. Iron, capable of forming (hydr)oxide phases that facilitate metals attenuation (Dzombak and Morel 1990), was identified in all overburden samples. Mineralogical analysis confirmed iron was present as an oxide phase in the form of hematite in all overburden samples. Arsenic, cobalt, lithium, and molybdenum demonstrated a high degree of immobilization due to attenuation on carbonate, amorphous, and metal hydroxide fractions. This indicates that these phases have been and are scavenging or attenuating constituents that were once present in solution. Groundwater samples from Assessment Monitoring wells GAMW-53/53B, GAMW-

54/54B, GAMW-55/55B, and GAMW-56/56B report a similar major ion signature as groundwater in monitoring wells proximal to the CCR Unit. However, no arsenic, cobalt, lithium, or molybdenum has been detected in these wells above background levels. In addition, soil borings from these wells contained significant proportions of constituents attenuated in various phases, especially in the case of lithium. As a result, the groundwater concentrations of these constituents are maintained at low levels, demonstrating attenuation.

Based on these findings, arsenic, boron, cobalt, lithium, and molybdenum were considered candidates for an MNA remedy application and were deemed to meet the criteria for Tier I MNA in accordance with USEPA guidance (USEPA 2007a,b).

7.0 TIER II EVALUATION

The purpose of the Tier II evaluation is to “Identify mechanisms and rates of the operative attenuation process.” Based on this definition, the following modeling results and observations support MNA as a viable corrective measure for the CCR Unit:

- **Adsorption Capacity Modeling:** PHREEQC modeling results show that adsorption is likely attenuating arsenic, cobalt and, to a lesser degree, molybdenum downgradient of the CCR Unit. This is concluded based on equilibration of site-specific groundwater compositions with the range of Hfo and Hao concentrations observed in SEP results of Site overburden soils. Minor amounts of boron are also expected to attenuate. The sorbing capacity of Hfo and Hao surface sites is partially dependent on the concentrations of the constituents of interest in groundwater. The titration modeling (Figure 15) shows how the soil’s capacity to adsorb constituents increases if groundwater concentrations of arsenic, boron, cobalt, and molybdenum were to increase above current levels. In addition to metal oxyhydroxides, clay minerals and/or particular organics can also act as a substrate for attenuation (Goldberg et al. 1993; Goldberg and Forster 1996), but this mechanism was not included in the current evaluation.

  The findings from the modeling are supported by the results of the sequential extraction testing. The presence of arsenic, cobalt, lithium, and molybdenum in the amorphous and metal oxyhydroxide fractions of soils indicates that adsorption is occurring spatially across the monitored area downgradient of the CCR Unit.

- **Co-precipitation:** In addition to adsorption, co-precipitation or the direct incorporation of trace metals such as cobalt into precipitated iron oxide-oxyhydroxides has been well studied in literature (Butt et al. 2000; Dzombak and Morel 1990; Smith 1999). For the soils analyzed by sequential extraction (Section 3.2.2), all samples had higher concentrations of cobalt in the amorphous and metal hydroxide phases than indicated by adsorption modeling. This suggests that cobalt concentrations also may be attenuated during the formation of ferrihydrite (Butt et al. 2000; Tebo et al. 2004). Cobalt was also identified by SEP to be associated with carbonate minerals, likely the result of co-precipitation with dolomite or calcite, which were identified by mineralogical analysis. Arsenic co-precipitation with amorphous phases of iron and other metal oxyhydroxides is also possible. However, there was no arsenic associated with carbonate minerals as identified by SEP. Co-precipitation is either not likely or relevant for boron, lithium, and molybdenum.

- **Estimated Site Attenuation Rates:** Concentrations of boron, cobalt, lithium, and molybdenum are decreasing in downgradient monitoring wells, resulting in negative calculated point decay rates. A positive point decay rate for arsenic suggests that its concentrations are increasing, but low concentrations in porewater indicate that the trend does not imply an impact from the CCR Unit. Increasing arsenic concentrations in Assessment Monitoring wells GAMW-52B, GAMW-53B, GAMW-54, and GAMW-54B are driving the positive point decay rate, but the arsenic concentrations in these wells are low (less than 0.005 mg/L) and are likely driven by natural variability. Using the mean decay rate, maximum concentrations of boron, cobalt and molybdenum observed in downgradient and Assessment monitoring wells would take approximate 41 years, 39 years, and 20 years, respectively, to attenuate to below GWPS. Arsenic and lithium concentrations in downgradient and Assessment Monitoring wells are already below the GWPS.

- **Advanced Groundwater Modeling:** Groundwater flow results indicate between 32% and 63% dilution and dispersion of groundwater at monitoring wells with upgradient and side-gradient water as it flows towards the Assessment Monitoring wells. This dilution and dispersion attenuate concentrations along the flow paths. Arsenic, cobalt, and lithium concentrations in porewater are already below GWPS in the available monitoring data (August 2018 to March 2020). Dilution and dispersion with groundwater from side-gradient Assessment Monitoring wells (GAMW-52/52B and GAMW-56/56B) would further reduce these concentrations relative to the GWPS. Boron and molybdenum concentrations are elevated above the health-based standards in porewater (and in background wells for boron). As such, while dilution and dispersion reduce concentrations by about 30% to 60%, this is insufficient to dilute porewater to such a degree that the resulting boron and molybdenum concentration decline to below the health-based standards. The concentrations of molybdenum measured in downgradient groundwater at Assessment Monitoring wells have remained below the GWPS, so additional physical and/or chemical attenuation is likely occurring between the CCR Unit and the Assessment Monitoring wells. Modeled groundwater velocities indicate that travel times between downgradient and Assessment Monitoring wells are between 4.5 and 31 years. The modeling results also indicate that groundwater would take between 27 and 130 years to travel from the downgradient monitoring wells to the property boundary (GAMW-46/46B).

Based on these findings, arsenic, boron, cobalt, lithium, and molybdenum were considered to be candidates for an MNA remedy application and deemed to meet the criteria for Tier II MNA in accordance with USEPA guidance (USEPA 2007a and 2007b).

8.0 TIER III EVALUATION

According to USEPA (USEPA 2007a), the purpose of the Tier III evaluation is to eliminate sites for an MNA remedy where (1) “Capacity of the aquifer is insufficient to attenuate the COC mass to regulatory standards” and/or (2) “Stability of the immobilized COC is insufficient to prevent remobilization due to future changes in groundwater chemistry”. Based on this definition, the following observations support MNA as a viable corrective measure for the CCR Unit:

- **Adsorption Capacity Modeling:** For arsenic, titration modeling shows that groundwater concentrations could increase up to approximately 2.5 mg/L before exceeding the capacity of soils (95th percentile of scenarios) to attenuate arsenic below the GWPS (0.091 mg/L). Groundwater arsenic concentrations up to 10 mg/L are predicted to attenuate below the GWPS for the average soil capacity scenario. Similarly, cobalt concentrations in groundwater could increase up to approximately 0.02 mg/L before exceeding the capacity of soils (95th percentile of scenarios) to attenuate cobalt below the GWPS (0.01 mg/L). Under the average soil capacity scenario, the aquifer has the capacity to reduce cobalt concentrations as high as 0.1 mg/L to below the GWPS.

  For boron and molybdenum, modeling suggests that adsorption can reduce a portion of the dissolved load, but that there is not sufficient adsorption capacity alone to reduce the concentrations observed in porewater below the health-based standard. However, current molybdenum concentrations observed in downgradient and Assessment Monitoring wells indicate that the combined long-term attenuation from sorption, dilution, and dispersion is sufficient to reduce concentrations below health-based standards. In addition to iron oxyhydroxides, molybdenum and boron (as well as arsenic and cobalt) are known to adsorb to other metal (hydr)oxides (e.g., manganese, aluminum), clay minerals and particulate organic matter, providing additional sorption capacity in the soils.

- **Stability Modeling for Adsorbed Constituents:** Stability modeling indicates that for the conditions (i.e. pH, Eh, and TDS ranges) determined in groundwater at the Site, adsorbed species of arsenic, boron, cobalt, and molybdenum are relatively stable and remain attenuated. The modeling results further suggest that the adsorption of arsenic, cobalt, and molybdenum could be reversed with sufficiently large fluctuations in pH and Eh conditions at the Site, but there is no historical basis to expect such occurrences. Based on the mineralogical test results for Site soils, carbonate minerals are widely distributed downgradient of the CCR Unit. Groundwater that is in contact with carbonate minerals is typically buffered against large fluctuations in pH. Total alkalinity concentrations in groundwater at the Site (generally between 50 and 410 mg $CaCO_3$/L) support the notion that the groundwater has significant buffering capacity.

  Modeling results also indicate that increasing TDS concentrations could result in an increase in aqueous concentrations of arsenic, cobalt, and molybdenum due to competition for sorption sites. However, the impact is predicted to be relatively minor over the range of TDS concentrations observed at the site. The maximum TDS concentration measured in porewater was 3,830 mg/L and even at those levels, there is sufficient attenuation capacity from the soils to maintain arsenic, boron, cobalt, and molybdenum concentrations below GWPS

9.0 CONCLUSIONS

Golder performed a supplemental Assessment Monitoring followed by an attenuation evaluation, which serve as the Tier I, II, and III evaluation of MNA feasibility at RMSGS for arsenic, boron, cobalt, lithium, and molybdenum with respect to the CCR Unit. This evaluation has been completed in accordance with guidance and best practices promulgated by the USEPA (USEPA 2007a and 2007b) and the ITRC (ITRC 2010). Based on the results of this evaluation, Golder makes the following assessment for the individual parameters:

- Arsenic: Physical and chemical attenuation is occurring and co-precipitation is possible, levels are stable, and the aquifer has the capacity to attenuate arsenic. Arsenic is a candidate for MNA at the RMSGS Site.
- Boron: Physical attenuation of boron is occurring at the RMSGS based on substantial decreases of boron in assessment wells. However, the high levels of boron upgradient of the CCR impoundments make it difficult to determine if the evaluation of if MNA will be successful. An alternative or natural source of boron should be further investigated prior to making a MNA determination for boron based on current findings.
- Cobalt: Chemical and physical attenuation is occurring and co-precipitation is possible, levels are stable, and the aquifer has the capacity to attenuate arsenic. Cobalt is a candidate for MNA at the RMSGS Site.
- Lithium: Physical attenuation is occurring, levels are stable, and the aquifer has the capacity to attenuate arsenic. Lithium is a candidate for MNA at the RMSGS Site.
- Molybdenum: Physical and some chemical attenuation is occurring, levels are stable, and the aquifer has the capacity to attenuate arsenic. Molybdenum is a candidate for MNA at the RMSGS Site.

Therefore, it is recommended that a Tier IV evaluation be completed to design a long-term monitoring plan and contingent remedy for arsenic, boron, cobalt, lithium, and molybdenum.

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Tables

Table 4: Summary of Travel Time Simulations and Attenuation Estimates
Groundwater Flow Model Technical Memorandum
NIPSCO LLC R. M. Schahfer Generating Station

	Shallow Flow Paths				**Deep Flow Paths**			
Starting Well	**GAMW-16**	**GAMW-18**	**GAMW-17B**	**GAMW-09B**	**GAMW-16B**	**GAMW-18B**	**GAMW-17B**	**GAMW-09B**
Ending Well	**GAMW-53**	**GAMW-55**	**GAMW-54B**	**GAMW-54B**	**GAMW-53B**	**GAMW-55B**	**GAMW-54B**	**GAMW-54B**
Distance (ft)	**1521**	**1964**	**1200**	**1714**	**1521**	**1964**	**1200**	**1714**
Effective Porosity = 16%								
Travel Time (years)	4.8	11.0	4.5	8.9	5.0	11.0	5.5	9.0
Velocity (ft/year)	317	179	267	193	304	179	218	190
Time to Davis Ditch (years)	5.5	-	-	-	6	-	-	-
Time to property boundry near GAMW46B (years)	-	27	49	41	-	28.5	45	41
Effective Porosity = 30%								
Travel Time (years)	8.5	19.8	8.0	16.0	8.9	20.0	10.0	16.5
Velocity (ft/year)	179	99	150	107	171	98	120	104
Time to Davis Ditch (years)	10	-	-	-	9.9	-	-	-
Time to property boundry near GAMW46B (years)	-	49.8	79	75	-	51.5	80	76
Effective Porosity = 46%								
Travel Time (years)	13.0	31.0	12.0	25.0	13.5	29.0	15.0	25.0
Velocity (ft/year)	117	63	100	69	113	68	80	69
Time to Davis Ditch (years)	15	-	-	-	15	-	-	-
Time to property boundry near GAMW46B (years)	-	76.8	122	117	-	77	130	120
Estimate of Dilution/Attenuation Along Flow Path								
Starting concentration (mg/L)	9.7	13	12	12	9.7	13	12	12
End concentration (mg/L)	3.1	8.2	6.4	6.4	3.1	8.2	6.4	6.4
End Concentration as % of starting concentration	32%	63%	53%	53%	32%	63%	53%	53%
Dilution/Attenuation along flow path	68%	37%	47%	47%	68%	37%	47%	47%

Notes:
ft = feet
mg/L = milligrams per liter

Prepared by:	GOL
Checked by:	PJN
Reviewed by:	RWB

Table 5: Groundwater Geochemical Modeling Results
Monitored Natural Attenuation Evaluation
NIPSCO LLC R. M. Schahfer Generating Station

Parameter	Units	GAPIEZ06	GAPIEZ06	GAPIEZ06	DAPZ-02A	DAPZ-02B	GAMW04	GAMW04	GAMW04	GAMW07	GAMW07	GAMW07	GAMW07B	GAMW07B	GAMW07B	GAMW07B
		08-2018	09-2018	10-2018	03-2020	03-2020	10-2018	04-2019	11-2019	10-2018	05-2019	11-2019	09-2018	10-2018	05-2019	11-2019
Charge Balance	% error	-3.9	-1.3	-5.5	-7.8	-4.3	5.1	-1.3	-9.0	-3.7	-3.7	**-10.8**	**82.8**	-6.8	-7.0	**-10.1**
MINERAL PHASES - Saturation Indices [a]																
Otavite	$CdCO_3$	-2.3	-2.3	-1.1	-3.2	-2.6	-2.9	-3.1	-2.4	-3.8	-2.3	-2.1	-1.5	-3.2	-2.4	-2.8
Ferrihydrite	$Fe(OH)_3$	**2.1**	**2.1**	**3.1**	**0.5**	**2.2**	**2.9**	**1.4**	**0.5**	-6.6	**1.9**	**0.4**	**3.6**	-1.6	**4.2**	**-0.2**
Siderite	$FeCO_3$	**-0.1**	**-0.1**	-0.8	**-0.4**	-0.7	-2.1	**0.5**	-1.7	-3.3	-3.6	-1.4	**1.1**	-0.5	-0.7	**-0.3**
Melanterite	$FeSO_4\ 7H_2O$	-4.9	-5.0	-7.2	-4.5	-5.1	-6.1	-4.0	-6.5	-6.7	-8.3	-6.5	-6.8	-4.4	-5.3	-4.5
Anglesite	$PbSO_4$	-4.5	-4.5	-6.1	-4.2	-4.4	-4.0	-4.2	-4.5	-4.2	-4.5	-4.7	-7.4	-4.0	-4.3	-4.1
Gypsum	$CaSO_4{:}2H_2O$	-0.6	-0.6	-0.6	-0.7	-1.0	**0.0**	**-0.4**	-0.7	-0.6	-0.7	-0.7	-2.5	**-0.2**	**-0.2**	**-0.2**
Jarosite-H	$(H_3O)Fe_3(SO_4)_2(OH)_6$	-7.1	-6.9	-11.4	-7.6	-5.6	-3.6	-8.9	-10.7	-26.4	-6.7	-12.2	-10.2	-15.0	-0.7	-12.1
Jarosite-K	$KFe_3(SO_4)_2(OH)_6$	**-0.4**	**-0.3**	-3.0	-2.1	**1.3**	**4.5**	-1.3	-4.3	-21.4	**0.2**	-5.3	-2.2	-8.4	**6.8**	-5.1
Jarosite-Na	$NaFe_3(SO_4)_2(OH)_6$	-2.5	-2.4	-4.9	-5.0	-1.8	**1.6**	-3.0	-6.7	-24.5	-3.0	-8.6	-4.3	-10.6	**4.5**	-7.6
Calcite	$CaCO_3$	**0.3**	**0.2**	**1.8**	-0.6	**-0.4**	**0.0**	**0.1**	**0.1**	-1.2	**0.2**	**0.4**	**1.3**	**-0.3**	**0.4**	**0.0**
Magnesite	$MgCO_3$	-0.9	-1.0	**0.5**	-2.1	-1.7	-1.5	-1.4	-1.3	-2.6	-1.1	-0.9	**0.0**	-1.5	-0.8	-1.3
Barite	$BaSO_4$	**0.7**	**0.6**	**0.7**	**1.0**	**0.9**	**0.9**	**1.1**	**0.9**	**0.9**	**0.9**	**0.7**	-1.2	**1.2**	**1.1**	**1.0**
Witherite	$BaCO_3$	-3.8	-3.9	-2.3	-4.4	-3.9	-4.4	-3.7	-3.6	-5.1	-3.7	-3.5	-2.7	-4.3	-3.6	-4.1
Fluorite	CaF_2	-1.0	-0.8	-1.0	-2.0	-2.4	-2.3	-1.5	-2.1	-1.1	-0.8	-1.0	**0.8**	**-0.4**	-0.6	-0.6
CoCO3	$CoCO_3$	-4.2	-4.4	-2.9	-4.3	-4.2	-4.1	-4.2	-4.3	-4.3	-3.1	-3.0	-3.2	-5.0	-4.2	-4.6
Cerrusite	$PbCO_3$	-2.0	-2.1	-2.1	-2.6	-2.0	-2.2	-2.0	-2.1	-3.2	-2.0	-2.0	-1.9	-2.5	-2.0	-2.2
Carbon Dioxide	$pCO_2(g)$ [b]	-2.3	-2.2	-4.5	-1.0	-1.8	-2.4	-2.4	-1.7	**-0.3**	-1.8	-2.1	-3.2	-1.6	-2.4	-2.0

Notes:

Charge balances errrors highlighted in **red** are greater than +/-10%

Non-detect values assumed equal to 1/2 analytical detection limit

Redox converted from field ORP to Eh by +200 mV

[a] Saturation indices greater than -0.5 are identified by bold type and grey shading

[b] pCO2(g) values presented at $10^{\wedge\text{value}}$ atm

Table 5: Groundwater Geochemical Modeling Re
Monitored Natural Attenuation Evaluation
NIPSCO LLC R. M. Schahfer Generating Station

Parameter	**Units**	**GAMW08**	**GAMW08**	**GAMW08**	**GAMW08B**	**GAMW08B**	**GAMW08B**	**GAMW08B**	**GAMW09**	**GAMW09**	**GAMW09**	**GAMW09B**	**GAMW09B**	**GAMW09B**	**GAMW09B**
		10-2018	**05-2019**	**11-2019**	**09-2018**	**10-2018**	**05-2019**	**11-2019**	**10-2018**	**05-2019**	**11-2019**	**09-2018**	**10-2018**	**05-2019**	**11-2019**
Charge Balance	% error	-2.9	-3.7	-6.6	-9.7	-12.2	-8.3	-11.7	-5.0	-5.0	-6.0	-5.7	-6.7	-3.0	-6.5
MINERAL PHASES - Saturation Indices [(a)]															
Otavite	$CdCO_3$	-2.5	-2.1	-2.0	-2.3	-2.5	-2.5	-2.2	-3.0	-2.8	-2.8	-2.4	-2.3	-2.2	-2.2
Ferrihydrite	$Fe(OH)_3$	**1.7**	**2.3**	**2.4**	**1.8**	**3.1**	**4.1**	**3.6**	**0.2**	**1.3**	**0.7**	**2.0**	**2.5**	**3.7**	**2.2**
Siderite	$FeCO_3$	-1.8	-2.2	-2.1	**0.2**	**0.1**	**-0.4**	**0.1**	-2.3	-3.1	-2.5	**-0.2**	**-0.1**	**-0.2**	**0.1**
Melanterite	$FeSO_4\ 7H_2O$	-6.7	-7.3	-7.2	-4.5	-4.4	-4.9	-4.6	-6.7	-7.3	-7.0	-5.1	-5.1	-5.2	-5.0
Anglesite	$PbSO_4$	-4.6	-4.8	-4.8	-4.4	-4.2	-4.2	-4.4	-4.3	-4.2	-4.3	-4.5	-4.6	-4.7	-4.7
Gypsum	$CaSO_4{:}2H_2O$	-0.7	-0.6	-0.5	**-0.2**	**-0.2**	**-0.2**	**-0.2**	-0.7	-0.6	-0.8	-0.8	-0.7	-0.8	-0.9
Jarosite-H	$(H_3O)Fe_3(SO_4)_2(OH)_6$	-6.6	-6.5	-6.5	-8.4	-3.5	-0.9	-3.6	-10.6	-8.2	-10.1	-6.8	-6.1	-2.6	-7.3
Jarosite-K	$KFe_3(SO_4)_2(OH)_6$	**0.0**	**0.9**	**1.0**	-1.3	**3.4**	**6.2**	**4.0**	-4.3	-1.3	-3.7	**-0.3**	**0.5**	**4.2**	-0.7
Jarosite-Na	$NaFe_3(SO_4)_2(OH)_6$	-2.9	-2.1	-1.9	-3.1	**1.4**	**4.3**	**2.0**	-7.1	-4.2	-6.5	-2.2	-1.5	**2.1**	-2.9
Calcite	$CaCO_3$	**0.2**	**0.5**	**0.7**	**0.6**	**0.3**	**0.3**	**0.6**	**-0.3**	**-0.3**	**-0.4**	**0.0**	**0.3**	**0.2**	**0.2**
Magnesite	$MgCO_3$	-1.2	-0.7	-0.6	-0.9	-1.1	-1.2	-0.8	-2.0	-1.8	-2.0	-1.0	-0.8	-0.8	-0.8
Barite	$BaSO_4$	**0.7**	**0.9**	**1.0**	**1.0**	**0.9**	**0.8**	**0.8**	**0.6**	**0.8**	**0.6**	**0.8**	**0.8**	**0.7**	**0.5**
Witherite	$BaCO_3$	-3.7	-3.3	-3.2	-3.6	-4.0	-4.0	-3.7	-4.3	-4.2	-4.3	-3.7	-3.6	-3.6	-3.7
Fluorite	CaF_2	**-0.4**	**-0.1**	**-0.2**	**-0.4**	**-0.5**	**-0.2**	**-0.3**	-1.9	-1.9	-1.9	-0.5	-0.6	-0.6	-0.6
CoCO3	$CoCO_3$	-2.9	-2.8	-2.5	-4.0	-4.4	-4.3	-4.0	-4.8	-4.7	-4.8	-4.1	-4.3	-4.4	-4.0
Cerrusite	$PbCO_3$	-2.2	-1.9	-1.9	-2.0	-2.1	-2.1	-1.9	-2.4	-2.2	-2.3	-2.1	-2.0	-2.0	-2.0
Carbon Dioxide	$pCO_2(g)$ [(b)]	-1.5	-1.8	-2.0	-2.6	-2.3	-2.5	-2.7	-1.7	-2.1	-2.0	-2.1	-2.2	-2.2	-2.4

Notes:

Charge balances errrors highlighted in **red** are greater than +/-10%

Non-detect values assumed equal to 1/2 analytical detection limit

Redox converted from field ORP to Eh by +200 mV

[(a)] Saturation indices greater than -0.5 are identified by bold type and grey shading

[(b)] pCO2(g) values presented at $10^{\wedge value}$ atm

Table 5: Groundwater Geochemical Modeling Re
Monitored Natural Attenuation Evaluation
NIPSCO LLC R. M. Schahfer Generating Station

Parameter	Units	GAMW15	GAMW15	GAMW15	GAMW15B	GAMW15B	GAMW15B	GAMW15B	GAMW16	GAMW16	GAMW16	GAMW16B	GAMW16B	GAMW16B	GAMW16B
		10-2018	05-2019	11-2019	09-2018	10-2018	05-2019	11-2019	10-2018	05-2019	11-2019	09-2018	10-2018	05-2019	11-2019
Charge Balance	% error	0.4	-4.5	-7.1	-5.7	-3.8	-5.0	-5.3	-0.7	-7.5	8.2	-3.0	-2.7	-4.4	-8.7
MINERAL PHASES - Saturation Indices [(a)]															
Otavite	$CdCO_3$	-4.3	-2.6	-2.3	-2.0	-3.0	-2.5	-2.3	-2.3	-2.2	-4.1	-1.8	-2.7	-2.4	-2.1
Ferrihydrite	$Fe(OH)_3$	-6.2	**2.7**	**2.5**	**3.3**	-2.6	**3.8**	**1.1**	**0.0**	**3.3**	**4.1**	**4.1**	**0.5**	**4.2**	**3.8**
Siderite	$FeCO_3$	-1.6	**0.1**	**0.2**	**0.0**	-0.9	-0.8	**0.0**	**-0.3**	-0.7	-3.0	**0.6**	**-0.1**	**-0.1**	**0.5**
Melanterite	$FeSO_4\ 7H_2O$	-4.7	-4.4	-4.9	-5.1	-5.0	-5.2	-4.8	-5.3	-5.6	-6.2	-4.8	-4.6	-4.8	-4.5
Anglesite	$PbSO_4$	-4.3	-4.4	-4.7	-4.7	-4.1	-4.2	-4.5	-4.6	-4.5	-4.1	-4.9	-4.3	-4.4	-4.6
Gypsum	$CaSO_4{:}2H_2O$	-1.1	-0.9	-1.1	-0.6	-0.6	**-0.3**	**-0.4**	-0.9	-0.6	-0.6	**-0.4**	**-0.4**	**-0.3**	**-0.3**
Jarosite-H	$(H_3O)Fe_3(SO_4)_2(OH)_6$	-23.5	-4.2	-5.9	-4.8	-18.1	-1.4	-10.2	-13.0	-3.6	-2.5	-2.9	-9.9	-0.7	-3.0
Jarosite-K	$KFe_3(SO_4)_2(OH)_6$	-19.4	**2.5**	**0.5**	**2.3**	-12.0	**5.9**	-3.2	-6.6	**3.4**	**4.5**	**4.3**	-3.7	**6.4**	**4.3**
Jarosite-Na	$NaFe_3(SO_4)_2(OH)_6$	-21.9	**-0.1**	-2.0	**0.3**	-13.9	**3.9**	-5.3	-9.1	**0.8**	**1.9**	**2.1**	-5.9	**4.1**	**2.6**
Calcite	$CaCO_3$	-2.1	**-0.3**	**-0.1**	**0.6**	**-0.4**	**0.2**	**0.4**	**0.1**	**0.3**	-1.5	**0.9**	**0.1**	**0.4**	**0.7**
Magnesite	$MgCO_3$	-3.4	-1.4	-1.3	-0.8	-1.8	-0.9	-1.0	-1.4	-1.1	-3.0	**-0.5**	-1.4	-0.9	-0.7
Barite	$BaSO_4$	**0.5**	**0.8**	**0.5**	**1.1**	**1.0**	**1.4**	**1.0**	**0.5**	**0.7**	**0.6**	**1.0**	**1.0**	**1.2**	**1.1**
Witherite	$BaCO_3$	-5.8	-4.0	-3.8	-3.1	-4.2	-3.5	-3.5	-3.9	-3.7	-5.6	-3.0	-3.9	-3.4	-3.2
Fluorite	CaF_2	-1.3	-1.5	-1.3	-1.4	-1.3	-1.0	-0.9	-0.8	-0.8	-0.8	-1.0	-1.1	-1.0	-0.9
CoCO3	$CoCO_3$	-5.5	-3.6	-3.6	-4.0	-4.8	-4.3	-4.1	-4.1	-4.0	-5.8	-3.6	-4.5	-4.2	-3.9
Cerrusite	$PbCO_3$	-3.7	-2.1	-2.1	-1.9	-2.4	-2.0	-2.0	-2.1	-2.0	-3.4	-1.9	-2.3	-2.0	-2.0
Carbon Dioxide	$pCO_2(g)$ [(b)]	**0.1**	-1.9	-2.1	-2.6	-1.5	-2.2	-2.4	-2.0	-2.2	-4.8	-2.7	-1.7	-2.3	-2.6

Notes:

Charge balances errrors highlighted in **red** are greater than +/-10%

Non-detect values assumed equal to 1/2 analytical detection limit

Redox converted from field ORP to Eh by +200 mV

(a) Saturation indices greater than -0.5 are identified by bold type and grey shading

(b) pCO2(g) values presented at $10^{\wedge value}$ atm

Table 5: Groundwater Geochemical Modeling Re
Monitored Natural Attenuation Evaluation
NIPSCO LLC R. M. Schahfer Generating Station

Parameter	Units	GAMW17	GAMW17	GAMW17	GAMW17B	GAMW17B	GAMW17B	GAMW17B	GAMW18	GAMW18	GAMW18	GAMW18B	GAMW18B	GAMW18B	GAMW18B
		10-2018	05-2019	11-2019	09-2018	10-2018	05-2019	11-2019	10-2018	04-2019	11-2019	09-2018	10-2018	04-2019	11-2019
Charge Balance	% error	0.8	-0.5	-6.6	-3.6	1.1	0.6	-4.3	-10.9	-6.4	-9.2	-3.2	-10.4	-48.7	-10.9
MINERAL PHASES - Saturation Indices [(a)]															
Otavite	$CdCO_3$	-2.8	-2.2	-1.9	-2.0	-2.2	-2.3	-2.0	-3.0	-3.0	-2.5	-2.0	-2.9	-4.7	-2.1
Ferrihydrite	$Fe(OH)_3$	-2.9	**2.5**	**2.9**	**3.3**	**0.1**	**3.6**	**4.3**	-0.7	**1.7**	**0.9**	**2.8**	**0.6**	**2.1**	**2.2**
Siderite	$FeCO_3$	-2.1	-2.6	-2.6	**0.4**	**0.3**	**0.1**	**-0.1**	-2.5	-2.9	-1.8	**0.6**	-0.5	-5.1	**0.1**
Melanterite	$FeSO_4\ 7H_2O$	-6.8	-7.7	-8.1	-5.0	-4.9	-5.0	-5.5	-6.7	-6.8	-6.4	-4.5	-4.7	-7.3	-4.9
Anglesite	$PbSO_4$	-4.5	-4.8	-5.0	-4.9	-4.8	-4.8	-4.9	-4.3	-4.1	-4.3	-4.6	-4.1	-3.7	-4.6
Gypsum	$CaSO_4{:}2H_2O$	-0.8	-1.0	-1.1	-0.9	-0.9	-1.0	-0.9	-0.6	**-0.4**	**-0.3**	**-0.4**	**-0.5**	**-0.4**	-0.6
Jarosite-H	$(H_3O)Fe_3(SO_4)_2(OH)_6$	-19.9	-6.7	-6.3	-4.5	-13.3	-2.1	-1.6	-12.0	-5.3	-9.3	-5.6	-8.8	-5.3	-7.6
Jarosite-K	$KFe_3(SO_4)_2(OH)_6$	-14.0	**0.2**	**0.6**	**2.5**	-6.5	**4.7**	**5.5**	-6.4	**0.8**	-2.8	**1.6**	-2.6	**1.1**	-0.5
Jarosite-Na	$NaFe_3(SO_4)_2(OH)_6$	-16.7	-2.4	-2.1	**0.2**	-8.8	**1.8**	**2.9**	-9.0	-1.7	-5.3	**-0.3**	-4.4	-2.5	-2.4
Calcite	$CaCO_3$	**-0.2**	**0.1**	**0.4**	**0.5**	**0.3**	**0.2**	**0.4**	**-0.4**	**-0.4**	**0.3**	**0.6**	**-0.3**	-2.1	**0.4**
Magnesite	$MgCO_3$	-1.4	-0.8	-0.7	-0.9	-1.0	-0.9	-0.7	-2.2	-2.1	-1.5	-0.6	-1.5	-4.6	-0.7
Barite	$BaSO_4$	**0.8**	**0.6**	**0.6**	**0.7**	**0.8**	**0.9**	**0.8**	**0.7**	**0.9**	**1.0**	**1.0**	**0.9**	**1.0**	**0.6**
Witherite	$BaCO_3$	-4.0	-3.6	-3.3	-3.2	-3.4	-3.3	-3.2	-4.5	-4.5	-3.8	-3.3	-4.3	-6.0	-3.7
Fluorite	CaF_2	**-0.5**	-0.6	-0.6	-1.1	-1.3	-1.3	-1.3	-3.3	-2.9	-2.3	-1.2	-1.3	-0.9	-1.0
CoCO3	$CoCO_3$	-4.6	-4.0	-3.8	-4.0	-4.0	-4.2	-3.8	-4.8	-5.2	-4.3	-4.1	-5.0	-6.8	-4.3
Cerrusite	$PbCO_3$	-2.4	-2.0	-2.0	-2.0	-2.0	-2.1	-2.0	-2.5	-2.4	-2.1	-2.0	-2.3	-3.8	-2.0
Carbon Dioxide	$pCO_2(g)$ [(b)]	-1.6	-2.4	-2.6	-2.3	-2.1	-1.7	-2.4	-1.2	-1.5	-1.8	-2.4	-1.5	-3.9	-2.4

Notes:

Charge balances errrors highlighted in red are greater than +/-10%

Non-detect values assumed equal to 1/2 analytical detection limit

Redox converted from field ORP to Eh by +200 mV

(a) Saturation indices greater than -0.5 are identified by bold type and grey shading

(b) pCO2(g) values presented at $10^{\wedge value}$ atm

Table 5: Groundwater Geochemical Modeling Re
Monitored Natural Attenuation Evaluation
NIPSCO LLC R. M. Schahfer Generating Station

Parameter	Units	GAMW52	GAMW52	GAMW52	GAMW52	GAMW52B	GAMW52B	GAMW52B	GAMW52B	GAMW53	GAMW53	GAMW53	GAMW53	GAMW53B	GAMW53B
		09-2018	10-2018	05-2019	11-2019	09-2018	10-2018	05-2019	11-2019	09-2018	10-2018	04-2019	11-2019	09-2018	10-2018
Charge Balance	% error	-2.9	3.4	4.0	-1.3	-7.2	1.1	-1.7	-6.4	3.9	2.9	-1.5	1.3	-0.7	-1.6
MINERAL PHASES - Saturation Indices (a)															
Otavite	$CdCO_3$	-1.9	-2.7	-2.3	-1.9	-1.6	-2.9	-2.3	-2.4	-3.5	-3.0	-4.0	-3.5	-2.2	-2.2
Ferrihydrite	$Fe(OH)_3$	**2.9**	**2.2**	**2.3**	**2.3**	**3.4**	**1.5**	**3.8**	**2.0**	**-0.1**	-1.9	-0.8	-1.1	**1.1**	**1.3**
Siderite	$FeCO_3$	-1.0	-2.7	-3.1	-1.3	**1.2**	**-0.1**	**-0.4**	**-0.1**	-1.4	-1.1	-2.9	-2.3	**0.1**	**0.1**
Melanterite	$FeSO_4\ 7H_2O$	-6.9	-8.4	-8.9	-7.3	-5.2	-5.3	-5.7	-5.3	-5.9	-6.0	-6.7	-6.7	-5.1	-5.1
Anglesite	$PbSO_4$	-5.4	-5.3	-5.5	-5.5	-5.9	-4.9	-5.0	-4.8	-4.4	-4.6	-4.5	-4.7	-4.8	-4.7
Gypsum	$CaSO_4{:}2H_2O$	-1.6	-2.0	-2.3	-1.7	-1.2	-1.2	-1.3	-1.1	-2.0	-1.9	-2.4	-2.3	-0.8	-0.7
Jarosite-H	$(H_3O)Fe_3(SO_4)_2(OH)_6$	-6.2	-7.4	-7.9	-8.7	-7.5	-8.4	-2.7	-7.4	-9.6	-16.9	-11.6	-13.6	-9.8	-9.2
Jarosite-K	$KFe_3(SO_4)_2(OH)_6$	**0.3**	-1.3	-1.7	-2.0	**0.1**	-1.9	**4.2**	-0.7	-5.0	-11.7	-6.6	-8.6	-3.6	-2.8
Jarosite-Na	$NaFe_3(SO_4)_2(OH)_6$	-2.4	-4.1	-4.5	-4.7	-1.8	-3.8	**2.2**	-2.6	-7.9	-14.6	-9.6	-11.7	-5.6	-4.8
Calcite	$CaCO_3$	**0.2**	**-0.4**	**-0.4**	**0.2**	**1.1**	**0.0**	**0.1**	**0.1**	-1.7	-1.1	-2.6	-2.0	**0.3**	**0.3**
Magnesite	$MgCO_3$	-1.1	-1.6	-1.5	-1.0	**-0.2**	-1.3	-1.1	-1.2	-2.9	-2.4	-3.5	-3.0	-1.3	-1.3
Barite	$BaSO_4$	**0.0**	-0.6	-0.8	**-0.3**	**1.1**	**1.1**	**1.1**	**1.3**	**-0.3**	**-0.3**	**-0.3**	**-0.3**	**0.6**	**0.7**
Witherite	$BaCO_3$	-3.5	-4.3	-4.3	-3.7	-1.9	-3.1	-2.8	-2.9	-5.3	-4.8	-5.9	-5.3	-3.5	-3.5
Fluorite	CaF_2	-2.0	-2.2	-2.4	-2.1	**0.4**	-2.4	-2.4	-2.3	-2.8	-2.7	-4.8	-4.7	-1.5	-1.6
CoCO3	$CoCO_3$	-3.7	-4.4	-4.2	-3.8	-3.2	-4.5	-4.0	-4.1	-5.1	-4.6	-5.9	-5.4	-4.0	-4.0
Cerrusite	$PbCO_3$	-2.0	-2.1	-2.0	-2.0	-2.0	-2.2	-2.0	-2.1	-2.6	-2.3	-3.1	-2.8	-2.1	-2.1
Carbon Dioxide	$pCO_2(g)$ (b)	-2.1	-1.8	-1.9	-2.3	-3.0	-1.8	-2.1	-2.1	-0.9	-1.3	-1.2	-1.3	-1.9	-2.0

Notes:

Charge balances errrors highlighted in **red** are greater than +/-10%

Non-detect values assumed equal to 1/2 analytical detection limit

Redox converted from field ORP to Eh by +200 mV

(a) Saturation indices greater than -0.5 are identified by bold type and grey shading

(b) pCO2(g) values presented at 10^^{value} atm

Table 5: Groundwater Geochemical Modeling Re
Monitored Natural Attenuation Evaluation
NIPSCO LLC R. M. Schahfer Generating Station

Parameter	Units	GAMW53B	GAMW53B	GAMW54	GAMW54	GAMW54	GAMW54	GAMW54B	GAMW54B	GAMW54B	GAMW54B	GAMW55	GAMW55	GAMW55B	GAMW55B
		04-2019	11-2019	09-2018	10-2018	04-2019	11-2019	09-2018	10-2018	05-2019	11-2019	09-2018	10-2018	09-2018	10-2018
Charge Balance	% error	-2.8	-2.7	-1.7	2.0	-3.0	-3.0	-1.5	1.8	-6.0	-3.8	-1.3	0.7	-6.0	-2.6
MINERAL PHASES - Saturation Indices [(a)]															
Otavite	$CdCO_3$	-2.1	-2.1	-3.3	-1.7	-2.8	-2.3	-2.7	-1.2	-2.4	-2.4	-2.8	-2.5	-2.6	-2.5
Ferrihydrite	$Fe(OH)_3$	**4.1**	**3.3**	**1.5**	**-0.3**	**1.4**	**1.0**	**1.0**	**2.9**	**3.4**	**2.8**	**2.1**	**0.9**	**1.2**	**1.7**
Siderite	$FeCO_3$	**-0.4**	**0.1**	-2.5	-0.6	-2.1	-1.1	**-0.1**	**1.5**	**0.1**	**0.1**	-1.2	-1.4	**-0.1**	**0.0**
Melanterite	$FeSO_4\ 7H_2O$	-5.8	-5.3	-6.7	-6.6	-6.6	-6.5	-4.7	-4.7	-4.8	-4.7	-5.8	-6.1	-4.7	-4.7
Anglesite	$PbSO_4$	-4.9	-4.9	-4.5	-5.4	-4.5	-5.1	-4.3	-5.8	-4.5	-4.5	-4.4	-4.5	-4.4	-4.4
Gypsum	$CaSO_4{:}2H_2O$	-0.9	-1.0	-1.3	-1.4	-1.2	-1.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.5	-0.5	**-0.5**
Jarosite-H	$(H_3O)Fe_3(SO_4)_2(OH)_6$	-1.4	-4.2	-4.8	-17.1	-7.5	-10.3	-8.3	-9.7	-2.4	-3.8	-4.3	-9.0	-7.9	-6.8
Jarosite-K	$KFe_3(SO_4)_2(OH)_6$	**5.2**	**2.4**	**0.0**	-10.5	-1.7	-4.4	-2.1	-1.6	**4.2**	**2.7**	**1.7**	-2.6	-1.7	**-0.4**
Jarosite-Na	$NaFe_3(SO_4)_2(OH)_6$	**3.0**	**0.2**	-2.4	-12.9	-4.1	-7.0	-4.0	-3.6	**2.2**	**0.7**	-0.9	-5.2	-3.6	-2.3
Calcite	$CaCO_3$	**0.4**	**0.3**	-1.1	**0.5**	-0.7	**-0.2**	**-0.1**	**1.6**	**0.2**	**0.2**	**-0.1**	**0.1**	**0.1**	**0.2**
Magnesite	$MgCO_3$	-1.1	-1.2	-2.5	-0.8	-1.8	-1.5	-1.5	**0.2**	-1.1	-1.1	-1.7	-1.4	-1.4	-1.2
Barite	$BaSO_4$	**0.5**	**0.7**	**0.4**	**0.3**	**0.4**	**-0.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.0**	**0.9**	**1.3**	**1.2**
Witherite	$BaCO_3$	-3.5	-3.3	-4.8	-3.2	-4.4	-4.0	-3.7	-2.1	-3.5	-3.5	-3.8	-3.7	-3.5	-3.4
Fluorite	CaF_2	-1.5	-1.3	-2.6	-2.6	-2.7	-2.2	-1.7	-1.5	-1.4	-1.3	-1.4	-1.5	-2.0	-2.1
CoCO3	$CoCO_3$	-3.9	-3.9	-5.1	-3.5	-4.6	-4.2	-4.5	-3.0	-4.2	-4.2	-3.5	-3.4	-4.6	-4.3
Cerrusite	$PbCO_3$	-2.0	-2.1	-2.8	-2.0	-2.2	-2.1	-2.3	-2.0	-2.1	-2.1	-2.4	-2.2	-2.3	-2.2
Carbon Dioxide	$pCO_2(g)$ [(b)]	-2.0	-2.2	-1.0	-2.7	-1.6	-1.7	-1.6	-3.5	-1.9	-1.8	-1.4	-1.7	-1.7	-1.9

Notes:

Charge balances errrors highlighted in **red** are greater than +/-10%

Non-detect values assumed equal to 1/2 analytical detection limit

Redox converted from field ORP to Eh by +200 mV

(a) Saturation indices greater than -0.5 are identified by bold type and grey shading

(b) pCO2(g) values presented at $10^{\wedge \text{value}}$ atm

Table 5: Groundwater Geochemical Modeling Re
Monitored Natural Attenuation Evaluation
NIPSCO LLC R. M. Schahfer Generating Station

Parameter	Units	GAMW55B	GAMW55B	GAMW55R	GAMW56	GAMW56	GAMW56	GAMW56	GAMW56B	GAMW56B	GAMW56B	GAMW56B
		05-2019	11-2019	11-2019	09-2018	10-2018	04-2019	11-2019	09-2018	10-2018	04-2019	11-2019
Charge Balance	% error	-5.4	-6.2	-5.5	4.4	-1.6	**61.8**	3.5	0.7	2.6	**-13.1**	-4.8
MINERAL PHASES - Saturation Indices [(a)]												
Otavite	$CdCO_3$	-2.4	-2.2	-2.3	-2.4	-2.0	-2.7	-2.2	-2.3	-2.3	-2.3	-2.3
Ferrihydrite	$Fe(OH)_3$	**3.0**	**2.0**	**1.4**	**1.5**	**2.5**	**2.9**	**1.7**	**1.2**	**2.0**	**3.7**	**1.7**
Siderite	$FeCO_3$	**0.0**	**0.2**	-1.9	**0.5**	**0.8**	-0.7	**0.1**	**0.2**	**0.1**	**0.2**	**0.1**
Melanterite	$FeSO_4\ 7H_2O$	-4.8	-4.8	-6.9	-5.1	-5.1	-5.9	-5.6	-5.0	-5.2	-4.8	-4.9
Anglesite	$PbSO_4$	-4.5	-4.6	-4.6	-5.4	-5.5	-5.1	-5.4	-5.0	-5.1	-4.7	-4.7
Gypsum	$CaSO_4{:}2H_2O$	-0.6	-0.6	-0.8	-1.7	-1.7	-1.9	-1.7	-1.2	-1.3	-1.0	-0.9
Jarosite-H	$(H_3O)Fe_3(SO_4)_2(OH)_6$	-3.6	-7.1	-8.6	-8.3	-6.6	-4.3	-8.7	-8.8	-6.6	-1.5	-7.8
Jarosite-K	$KFe_3(SO_4)_2(OH)_6$	**2.9**	**-0.5**	-1.9	-2.5	**-0.4**	**2.4**	-2.6	-2.6	**-0.4**	**4.6**	-1.2
Jarosite-Na	$NaFe_3(SO_4)_2(OH)_6$	**1.0**	-2.4	-4.4	-5.4	-3.2	**0.4**	-5.7	-5.0	-2.7	**1.7**	-3.5
Calcite	$CaCO_3$	**0.2**	**0.4**	**0.2**	**-0.1**	**0.2**	-0.6	**0.1**	**0.0**	**0.0**	**0.0**	**0.1**
Magnesite	$MgCO_3$	-1.1	-1.0	-1.2	-1.5	-1.1	-1.2	-1.2	-1.2	-1.1	-1.3	-1.1
Barite	$BaSO_4$	**1.0**	**1.0**	**0.6**	**0.0**	**0.0**	**-0.1**	**-0.1**	**0.6**	**0.4**	**0.8**	**0.9**
Witherite	$BaCO_3$	-3.5	-3.4	-3.8	-3.7	-3.5	-4.2	-3.7	-3.6	-3.6	-3.5	-3.5
Fluorite	CaF_2	-2.0	-2.0	-1.3	-0.8	-1.0	-1.7	-1.2	-1.7	-1.9	-1.7	-1.7
CoCO3	$CoCO_3$	-4.2	-4.0	-4.1	-3.8	-2.9	-3.4	-2.9	-4.2	-4.2	-4.2	-4.2
Cerrusite	$PbCO_3$	-2.1	-2.1	-2.1	-2.2	-2.0	-2.2	-2.1	-2.1	-2.1	-2.0	-2.0
Carbon Dioxide	$pCO_2(g)$ [(b)]	-2.0	-2.1	-2.0	-1.2	-1.6	-1.6	-1.6	-1.4	-1.3	-1.6	-1.8

Notes:

Charge balances errrors highlighted in **red** are greater than +/-10%

Non-detect values assumed equal to 1/2 analytical detection limit

Redox converted from field ORP to Eh by +200 mV

[(a)] Saturation indices greater than -0.5 are identified by bold type and grey shading

[(b)] pCO2(g) values presented at $10^{\wedge value}$ atm

Prepared by: GOL
Checked by: PJN
Reviewed by: RV

Table 6: Average Point Decay Rates in Background and Downgradient Wells
Monitored Natural Attenuation Evaluation
NIPSCO LLC R. M. Schahfer Generating Station

Constituent	Units	Point Decay Constants (first-order decay)	
		Background Wells	All Downgradient Wells (including Assessment Wells)
Arsenic	yr^{-1}	-0.33	**0.11**
Boron	yr^{-1}	0.04	**-0.04**
Cobalt	yr^{-1}	0.36	**-0.05**
Lithium	yr^{-1}	0.20	**-0.06**
Molybdenum	yr^{-1}	0.28	**-0.03**

Notes:

yr^{-1} = rate per year

Prepared by:	GOL
Checked by:	PJN
Reviewed by:	RV

Table 7: Summary of Rietveld Quantitative Analysis X-Ray Diffraction Results
Monitored Natural Attenuation Evaluation
NIPSCO LLC R. M. Schahfer Generating Station

Mineral	Mineral Formula	OW-9 18-20'	OW-9 10-12'	SB-52B-35'-37'	SB-54B-30'-32'	SB-56B-30'-32'
		(wt %)	(wt %)	(wt %)	(wt %)	(wt %)
Quartz	SiO_2	69	60	53	61	72
Pyrite	FeS_2	-	-	0.39	0.10	0.12
Marcasite	FeS_2	-	-	0.22	-	-
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	3.6	3.5	7.8	1.7	1.3
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$	-	-	1.1	0.57	0.16
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$	-	-	2.6	1.0	1.1
Microcline	$KAlSi_3O_8$	5.2	9.1	9.2	7.5	6.6
Orthoclase	$KAlSi_3O_8$	-	-	2.2	0.65	0.57
Hematite	Fe_2O_3	-	-	0.26	0.44	0.57
Dolomite	$CaMg(CO_3)_2$	6.5	9.8	7.9	9.6	5.3
Calcite	$CaCO_3$	4.8	3.6	4.7	5.8	3.9
Albite	$NaAlSi_3O_8$	8.3	11	7.3	9.1	6.4
Epidote	$Ca_2(Al,Fe)Al_2O(SiO_4)(Si_2O_7)(OH)$	1.6	1.5	2.8	2.1	1.9
Anatase	TiO_2	-	-	-	-	-
Cancrinite	$Na_6Ca(CO_3)(AlSiO_4)_6\cdot 2H_2O$	0.87	1.7	-	-	-
TOTAL		100	100	100	100	100

Notes:

wt % = percent by weight of each mineral

Non-detect minerals within a sample are represented with "-"

Prepared by: GOL
Checked by: PJN
Reviewed by: RV

Table 8: Sequential Extraction Procedure and Total Metal Solids Results
Monitored Natural Attenuation Evaluation
NIPSCO LLC R. M. Schahfer Generating Station

	Sample Location	SB-07B	DA-14	OW-9	OW-9	SB-08B	SB-52B	SB-53B	SB-53B	SB-54B	SB-55B	SB-56B
	Sample Start Depth (ft bgs)	35	4	10	18	30	35	25	30	30	30	30
	Sample End Depth (ft bgs)	37	6	12	20	32	37	27	32	32	32	32
	Well Type	Background	Drying Well	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient
	Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	SEP Step											
Aluminum	Total Metal Result	1900	3100 J+	2200 J+	1100	1300	3200	1500	1400	2000	2200	1600
Aluminum	SEP Step 1	52 U	48 U	47 U	47 U	51 U	44 U	48 U	44 U	49 U	48 U	49 U
Aluminum	SEP Step 2	15 J	63 J	16 J	35 UJ	38 UJ	8.8 J	11 J	33 UJ	12 J	36 UJ	5.9 J
Aluminum	SEP Step 3	44	540	60	15	31	33	75	30	34	23	29
Aluminum	SEP Step 4	300	1600	280	160	130	110	130	100	130	100	360
Aluminum	SEP Step 5	200 UJ	80 J	180 U	170 U	190 UJ	28 J	31 J	34 J	180 UJ	180 UJ	180 UJ
Aluminum	SEP Step 6	1000	1600	840	520	1100	1200	750	820	1400	1200	1300
Aluminum	SEP Step 7	22000	11000	23000	15000	23000	25000	16000	19000	23000	21000	25000
Aluminum	SEP SUM	23000	15000	24000	16000	24000	26000	17000	20000	24000	22000	27000
Aluminum	SEP TOTAL	25000	21000	29000	19000	23000	28000	18000	20000	29000	31000	23000
Antimony	Total Metal Result	7.7 U	18 U	17 U	17 U	7 U	6.3 UJ	6.9 UJ	6.6 UJ	7 U	7 U	7 U
Antimony	SEP Step 1	16 U	14 U	14 U	14 U	15 U	13 U	14 U	13 U	15 U	14 U	15 U
Antimony	SEP Step 2	12 U	11 U	11 U	10 U	12 U	10 U	11 U	10 U	11 U	11 U	11 U
Antimony	SEP Step 3	3.9 U	3.6 U	3.5 U	3.5 U	3.8 U	3.3 U	3.6 U	3.3 U	3.7 U	3.6 U	3.6 U
Antimony	SEP Step 4	3.9 U	3.6 U	3.5 U	3.5 U	3.8 U	3.3 U	3.6 U	3.3 U	3.7 U	3.6 U	3.6 U
Antimony	SEP Step 5	59 U	54 U	53 U	52 U	58 U	50 U	53 U	50 U	55 U	54 U	55 U
Antimony	SEP Step 6	3.9 U	3.6 U	3.5 U	3.5 U	3.8 U	3.3 U	3.6 U	3.3 U	3.7 U	3.6 U	3.6 U
Antimony	SEP Step 7	0.45 J	3.6 U	3.5 U	3.5 U	0.54 J	3.3 U	3.6 U	0.16 J	0.29 J	3.6 U	0.3 J
Antimony	SEP SUM	0.45 J	3 U	3 U	3 U	0.54 J	3 U	3 U	0.16 J	0.29 J	3 U	0.3 J
Antimony	SEP TOTAL	0.53 J	3.6 U	3.5 U	3.5 U	0.27 J	3.3 U	3.6 J	3.3 U	0.33 J	3.6 U	0.29 J
Arsenic	Total Metal Result	1.7 J	0.62 J	1.7 J	0.69 J	1.9 J	5.4 J	5	1.3 J	2.3	2 J	5
Arsenic	SEP Step 1	2.6 U	2.4 U	2.3 U	2.3 U	2.6 U	2.2 U	2.4 U	2.2 U	2.4 U	2.4 U	2.4 U
Arsenic	SEP Step 2	2 U	1.8 UJ	1.8 U	1.7 U	1.9 U	0.46 J	1.8 U	1.7 U	1.8 UJ	1.8 UJ	1.8 UJ
Arsenic	SEP Step 3	0.37 J	0.45 J	0.43 J	0.17 J	0.27 J	0.83	0.83	0.44 J	0.45 J	0.37 J	1.9
Arsenic	SEP Step 4	0.69	0.6 U	0.94	0.73	0.66	0.71 J+	0.59 U	0.56 U	0.68	0.5 J	1.1
Arsenic	SEP Step 5	9.8 U	9 U	8.8 U	8.7 U	9.6 U	8.3 UJ	8.9 UJ	8.3 UJ	9.1 U	9 U	9.1 U
Arsenic	SEP Step 6	1.2	0.3 J	0.56 J	0.54 J	1.7	2.2	1.6	0.89	1.8	1.4	3.8
Arsenic	SEP Step 7	1.3 U	0.7	0.39 J	0.34 J	1.3 U	1.2	1	0.88	1.2 U	0.6 U	1.2 U
Arsenic	SEP SUM	2.2	1.4	2.3	1.8	2.6	5.4	4	2.7	2.9	2.7	7.3
Arsenic	SEP TOTAL	2.1	2.2	1.9	3	3.1	5.4 J	5.6	2.5	4.7	3.9	6.2

Table 8: Sequential Extraction Procedure and Total Metal Solids Results
Monitored Natural Attenuation Evaluation
NIPSCO LLC R. M. Schahfer Generating Station

	Sample Location	SB-07B	DA-14	OW-9	OW-9	SB-08B	SB-52B	SB-53B	SB-53B	SB-54B	SB-55B	SB-56B
	Sample Start Depth (ft bgs)	35	4	10	18	30	35	25	30	30	30	30
	Sample End Depth (ft bgs)	37	6	12	20	32	37	27	32	32	32	32
	Well Type	Background	Drying Well	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient
	Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	SEP Step											
Barium	Total Metal Result	6.9 J+	7.3 J+	13	4.1	4.3 J+	8.4 J+	4.6 J+	4.3 J+	6.2	6.1	6.1
Barium	SEP Step 1	13 U	1.1 J	0.58 J	12 U	13 U	11 U	12 U	11 U	12 U	12 U	12 U
Barium	SEP Step 2	0.5 J	1.7 J	0.62 J	8.7 UJ	0.46 J	0.52 J	0.54 J	0.54 J	0.56 J	0.44 J	0.96 J
Barium	SEP Step 3	3.3 U	3.6	2.9 U	2.9 U	3.2 U	2.8 U	3 U	2.8 U	3 U	3 U	3 U
Barium	SEP Step 4	2.2 J	2.6 J	5.3	1.6 J	1.4 J	2.4 J	0.97 J	1.1 J	2.2 J	1.9 J	2.2 J
Barium	SEP Step 5	49 UJ	45 UJ	44 UJ	44 UJ	48 UJ	42 UJ	45 UJ	42 UJ	46 UJ	45 UJ	46 UJ
Barium	SEP Step 6	2.3 J	2.2 J	2.2 J	1.2 J	1.9 J	2 J	1.6 J	1.5 J+	2.3 J	2 J	2.4 J
Barium	SEP Step 7	250	230	350	220	220	250 J	190	220	230	190	260
Barium	SEP SUM	250	240	360	220	230	250	190	220	240	190	260
Barium	SEP TOTAL	270	300	390	210	190	200	170	200	220	200	230
Beryllium	Total Metal Result	1.3 U	0.053 J	0.12 J	0.064 J	1.2 U	0.19 J	1.1 U	1.1 U	1.2 U	1.2 U	1.2 U
Beryllium	SEP Step 1	1.3 U	1.2 U	1.2 U	1.2 U	1.3 U	1.1 U	1.2 U	1.1 U	1.2 U	1.2 U	1.2 U
Beryllium	SEP Step 2	0.98 UJ	0.9 UJ	0.88 UJ	0.87 UJ	0.96 UJ	0.83 UJ	0.89 UJ	0.83 UJ	0.91 UJ	0.9 UJ	0.91 UJ
Beryllium	SEP Step 3	0.33 U	0.026 J	0.021	0.29 U	0.32 U	0.28 U	0.3 U	0.28 U	0.3 U	0.3 U	0.3 U
Beryllium	SEP Step 4	0.33 U	0.026 J	0.024 J	0.02 J	0.32 U	0.28 U	0.3 U	0.28 U	0.3 U	0.3 U	0.03 J
Beryllium	SEP Step 5	4.9 UJ	4.5 UJ	4.4 UJ	4.4 UJ	4.8 UJ	4.2 UJ	4.5 UJ	4.2 UJ	4.6 UJ	4.5 UJ	4.6 UJ
Beryllium	SEP Step 6	0.045 J	0.024 J	0.036 J	0.027 J	0.039 J	0.042 J	0.026 J	0.027 J	0.045 J	0.037 J	0.067 J
Beryllium	SEP Step 7	0.29 J	0.21 J	0.39	0.24 J	0.31 J	0.35	0.23 J	0.28	0.3	0.25 J	0.46
Beryllium	SEP SUM	0.34	0.29	0.47	0.28	0.35	0.39	0.25	0.31	0.34	0.29	0.56
Beryllium	SEP TOTAL	0.37	0.3	0.41	0.28 J	0.26 J	0.35	0.25 J	0.27 J	0.33	0.27 J	0.33
Boron	Total Metal Result	26 U	5.5	7.4	3.6	23 U	21 U	23 U	22 U	23 U	23 U	23 U
Cadmium	Total Metal Result	0.64 U	0.24 U	0.11 J	0.072 J	0.59 U	0.53 U	0.57 U	0.55 U	0.58 U	0.58 U	0.3 J
Cadmium	SEP Step 1	1.3 U	1.2 U	1.2 U	1.2 U	1.3 U	1.1 U	1.2 U	1.1 U	1.2 U	1.2 U	1.2 U
Cadmium	SEP Step 2	0.98 U	0.9 U	0.88 U	0.87 U	0.96 U	0.83 U	0.89 U	0.83 U	0.91 U	0.9 U	0.91 U
Cadmium	SEP Step 3	0.33 U	0.3 UJ	0.29 UJ	0.29 UJ	0.32 U	0.28 UJ	0.3 UJ	0.28 UJ	0.3 UJ	0.3 UJ	0.3 UJ
Cadmium	SEP Step 4	0.077 J	0.059 J	0.09 J	0.083 J	0.076 J	0.086 J	0.08 J	0.076 J	0.069 J	0.065 J	0.059 J
Cadmium	SEP Step 5	4.9 U	4.5 U	4.4 U	4.4 U	4.8 U	4.2 U	4.5 U	4.2 U	4.6 U	4.5 U	4.6 U
Cadmium	SEP Step 6	0.33 U	0.3 U	0.29 U	0.29 U	0.32 U	0.28 U	0.3 U	0.28 U	0.026 J	0.013 J	0.3 U
Cadmium	SEP Step 7	0.33 U	0.3 U	0.29 U	0.29 U	0.32 U	0.28 U	0.3 U	0.28 U	0.3 U	0.3 U	0.3 U
Cadmium	SEP SUM	0.077 J	0.11 J	0.09 J	0.083 J	0.076 J	0.086 J	0.08 J	0.076 J	0.095 J	0.077 J	0.059 J
Cadmium	SEP TOTAL	0.015 J	0.3 U	0.29 U	0.29 U	0.065 J	0.28 U	0.3 U	0.28 U	0.18 J	0.12 J	0.058 J

Table 8: Sequential Extraction Procedure and Total Metal Solids Results
Monitored Natural Attenuation Evaluation
NIPSCO LLC R. M. Schahfer Generating Station

	Sample Location	SB-07B	DA-14	OW-9	OW-9	SB-08B	SB-52B	SB-53B	SB-53B	SB-54B	SB-55B	SB-56B
	Sample Start Depth (ft bgs)	35	4	10	18	30	35	25	30	30	30	30
	Sample End Depth (ft bgs)	37	6	12	20	32	37	27	32	32	32	32
	Well Type	Background	Drying Well	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient
	Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	SEP Step											
Chromium	Total Metal Result	4.3	2.9	4.4	2.5	2.8	8.2 J	5.1	3.4	5	6	3.2
Chromium	SEP Step 1	2.6 U	2.4 U	2.3 U	2.3 U	2.6 U	2.2 U	2.4 U	2.2 U	2.4 U	2.4 U	2.4 U
Chromium	SEP Step 2	2 UJ	1.8 U	0.28 J	1.7 U	1.9 UJ	0.37 J	0.37 J	1.7 U	0.31 J	1.8 U	1.8 U
Chromium	SEP Step 3	0.29 J	0.37 J	0.52 J	0.16 J	0.17 J	1.1	0.97	0.27 J	1.1	0.14 J	0.19 J
Chromium	SEP Step 4	1.2	1.1	0.94	0.57 J	0.55 J	0.68	0.58 J	0.51 J	0.73	0.6	1
Chromium	SEP Step 5	9.8 U	9 UJ	1.5 J	1.3 J	9.6 U	8.3 U	8.9 U	8.3 U	9.1 U	9 U	9.1 U
Chromium	SEP Step 6	2.5	0.99	2.1	1.7	3.1	3.5	2.2	2.2	3.7	3.3	3
Chromium	SEP Step 7	5.5	3.7	7.3	5.2	7.2	9	5	7.3	8.5	6.7	13
Chromium	SEP SUM	9.4	8.1	13	8.8	11	15	9.1	10	14	11	17
Chromium	SEP TOTAL	9.5	6.9	11	8.3	8.8	16 J	10	8.7	17	13	9.2
Cobalt	Total Metal Result	3.5 J	1.1	1.8	2.2	2.9 J	5.2 J	5.7	2.6 J	5.7 J	3.9 J	3 J
Cobalt	SEP Step 1	13 U	12 U	12 U	12 U	13 U	11 U	12 U	11 U	12 U	12 U	12 U
Cobalt	SEP Step 2	0.54 J	9 U	8.8 U	8.7 U	0.35 J	0.44 J	0.63 J	0.38 J	0.62 J	0.41 J	0.26 J
Cobalt	SEP Step 3	0.55 J	0.1 J	0.27 J	0.19 J	0.37 J	0.45 J	1.2 J	0.53 J	0.47 J	0.39 J	0.37 J
Cobalt	SEP Step 4	0.83 J	0.29 J	0.87 J	1.2 J	0.97 J	0.71 J	1.1 J	0.66 J	1.6 J	0.91 J	0.76 J
Cobalt	SEP Step 5	49 UJ	45 UJ	44 UJ	44 UJ	48 UJ	42 UJ	45 UJ	42 UJ	46 UJ	45 UJ	46 UJ
Cobalt	SEP Step 6	1.3 J	0.3 J	0.66 J	0.68 J	1.8 J	2.1 J	1.5 J	0.97 J	2.5 J	1.5 J	2.9 J
Cobalt	SEP Step 7	0.8 J	3 U	0.69 J	0.69 J	1.1 J	0.82 J	0.44 J	0.43 J	1.5 J	0.8 J	0.81 J
Cobalt	SEP SUM	4	0.69 J	2.5	2.8	4.6	4.5	4.8	3	6.7	4	5.1
Cobalt	SEP TOTAL	4.2 J	0.87 J	2.5 J	3.2	4.8 J	4.7 J	5.2 J	3.2	6.1	4.3	4.5 J
Iron	Total Metal Result	4900	1500	4400	2600	3400	6800	7900	3700	5800	5900	5600
Iron	SEP Step 1	26 U	24 U	23 U	23 U	26 U	22 U	24 U	22 U	24 U	24 U	24 U
Iron	SEP Step 2	260 J	31 J	61 J	29 J	190 J	130 J	200 J	99 J	280 J	160 J	140 J
Iron	SEP Step 3	950	280	710	150	600	590	2600	470	740	700	1200
Iron	SEP Step 4	1100	770	1700	1100	1000	1200	1100	830	1400	1500	1400
Iron	SEP Step 5	98 UJ	90 UJ	88 UJ	87 UJ	96 UJ	83 UJ	89 UJ	83 UJ	91 UJ	90 UJ	91 UJ
Iron	SEP Step 6	2600	870	2100	1500	2800	3300	2600	2000	3800	3300	4600
Iron	SEP Step 7	1800	1300	2400	2000	2900	2500	2000	2100	3700	2400	3100
Iron	SEP SUM	6700	3200	7100	4700	7600	7700	8500	5500	9900	8100	10000
Iron	SEP TOTAL	6300	3400	7500	5500	7000	8400	8700	5700	9900	8600	6800

Table 8: Sequential Extraction Procedure and Total Metal Solids Results
Monitored Natural Attenuation Evaluation
NIPSCO LLC R. M. Schahfer Generating Station

	Sample Location	SB-07B	DA-14	OW-9	OW-9	SB-08B	SB-52B	SB-53B	SB-53B	SB-54B	SB-55B	SB-56B
	Sample Start Depth (ft bgs)	35	4	10	18	30	35	25	30	30	30	30
	Sample End Depth (ft bgs)	37	6	12	20	32	37	27	32	32	32	32
	Well Type	Background	Drying Well	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient
	Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	SEP Step											
Lead	Total Metal Result	4.4	1.4	3.1	1.8	2.9	6.6 J	3.2	2.4	4.2	3.7	3.5
Lead	SEP Step 1	2.6 U	2.4 U	2.3 U	2.3 U	2.6 U	2.2 U	2.4 U	2.2 U	2.4 U	2.4 U	2.4 U
Lead	SEP Step 2	1.9 J	1.8 U	1.8 U	1.7 U	0.92 J	0.85 J	1.8 U	0.66 J	0.86 J	0.82 J	0.75 J
Lead	SEP Step 3	0.66 UJ	0.61 J	0.59 UJ	0.58 UJ	0.64 UJ	0.55 UJ	0.59 UJ	0.56 UJ	0.61 UJ	0.6 UJ	0.61 UJ
Lead	SEP Step 4	1.2	0.65	1.7	1.2	1.4	2.3	1.8	1.5	2.3	1.8	2
Lead	SEP Step 5	9.8 UJ	9 UJ	8.8 UJ	8.7 UJ	9.6 UJ	8.3 UJ	8.9 UJ	8.3 UJ	9.1 UJ	9 UJ	9.1 UJ
Lead	SEP Step 6	1.1	0.67	0.67	0.35 J	0.78	1.8	1.1	0.72	1.6	1.3	3.4
Lead	SEP Step 7	3.2	3.1	5.3	3.2	3.5	3.3	2.5	2.6	2.8	4.7	2.9
Lead	SEP SUM	7.4	5	7.7	4.8	6.6	8.2	5.3	5.5	7.5	8.6	9.1
Lead	SEP TOTAL	7	5.7	7.4	5.6	5	7.5 J	4.9	5.1	6.7	5.6	6.2
Lithium	Total Metal Result	4.6 J	1.4 J	3.6 J	2.2 J	3.3 J	6.6 J+	3.1 J+	3.4 J+	5.4 J	5.2 J	3.5 J
Lithium	SEP Step 1	13 U	12 U	12 U	12 U	13 U	11 U	12 U	11 U	12 U	12 U	12 U
Lithium	SEP Step 2	9.8 U	9 U	8.8 U	8.7 U	9.6 U	8.3 U	8.9 U	8.3 U	0.71 J	0.72 J	9.1 U
Lithium	SEP Step 3	3.3 U	3 U	2.9 U	2.9 U	3.2 U	2.8 U	3 U	2.8 U	3 U	3 U	3 U
Lithium	SEP Step 4	0.78 J	0.5 J	0.81 J	0.55 J	0.62 J	1 J	0.64 J	0.71 J	1.1 J	1 J	1.3 J
Lithium	SEP Step 5	49 U	45 U	44 U	44 U	48 U	42 U	45 U	42 U	46 U	45 U	46 U
Lithium	SEP Step 6	2.3 J	1.1 J	1.8 J	1.2 J	2.2 J	3	1.7 J	1.9 J	3.5	2.9 J	2.8 J
Lithium	SEP Step 7	4.4	2.5 J	3.4	2.1 J	3.8	6.1	2.6 J	3.1	5.6	4.2	7.1
Lithium	SEP SUM	12	4.1	6	3.8	11	14	7.8	5.7	19	18	19
Lithium	SEP TOTAL	8	4.2	6.8	5.4	7.5	10	6	7.5	11	10	7.2
Molybdenum	Total Metal Result	5.1 U	6.3	1.1 U	1.1 U	4.7 U	3.8 J	4 J	4.4 U	0.88 J	4.7 U	2.1 J
Molybdenum	SEP Step 1	10 U	13	9.4 U	9.3 U	10 U	8.9 U	9.5 U	8.9 U	9.8 U	9.6 U	9.7 U
Molybdenum	SEP Step 2	7.9 U	0.51 J	7 U	7 U	7.7 U	6.7 U	7.1 U	6.7 U	7.3 U	7.2 U	7.3 U
Molybdenum	SEP Step 3	2.6 U	1.2 J	2.3 U	2.3 U	2.6 U	0.51 J	2.2 J	0.27 J	0.59 J	2.4 U	0.5 J
Molybdenum	SEP Step 4	2.6 U	1.3 J	2.3 U	2.3 U	2.6 U	0.39 J	0.63 J	0.24 J	0.53 J	2.4 U	0.36 J
Molybdenum	SEP Step 5	39 U	36 U	35 U	35 U	38 U	33 U	36 U	33 U	37 U	36 U	1.7 J
Molybdenum	SEP Step 6	2.6 U	0.13 J	2.3 U	2.3 U	2.6 U	0.21 J	0.13 J	2.2 U	0.18 J	0.2 J	1.5 J
Molybdenum	SEP Step 7	2.6 U	2.4 U	2.3 U	2.3 U	2.6 U	2.2 U	2.4 U	2.2 U	2.4 U	2.4 U	0.16 J
Molybdenum	SEP SUM	2 U	16	2 U	2 U	2 U	1.1 J	3	0.51 J	1.3 J	0.2 J	4.3
Molybdenum	SEP TOTAL	0.94 J	15	0.22 J	0.15 J	0.54 J	2.4	3.8	0.67 J	2.4	0.48 J	2.4

Table 8: Sequential Extraction Procedure and Total Metal Solids Results
Monitored Natural Attenuation Evaluation
NIPSCO LLC R. M. Schahfer Generating Station

	Sample Location	SB-07B	DA-14	OW-9	OW-9	SB-08B	SB-52B	SB-53B	SB-53B	SB-54B	SB-55B	SB-56B
	Sample Start Depth (ft bgs)	35	4	10	18	30	35	25	30	30	30	30
	Sample End Depth (ft bgs)	37	6	12	20	32	37	27	32	32	32	32
	Well Type	Background	Drying Well	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient
	Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	SEP Step											
Selenium	Total Metal Result	1.9 U	4.8 U	4.6 U	4.6 U	0.53 J	1.6 U	0.51 J	0.74 J	0.68 J	0.65 J	1.8 U
Selenium	SEP Step 1	2.6 U	2.4 U	2.3 U	2.3 U	2.6 U	2.2 U	2.4 U	2.2 U	2.4 U	2.4 U	2.4 U
Selenium	SEP Step 2	2 U	1.8 U	1.8 U	1.7 U	1.9 U	1.7 U	1.8 U	1.7 U	1.8 UJ	1.8 UJ	1.8 UJ
Selenium	SEP Step 3	0.66 U	0.6 U	0.22 J	0.58 U	0.64 U	0.55 U	0.59 U	0.56 U	0.61 U	0.6 U	0.61 U
Selenium	SEP Step 4	1.1 J	0.6 UJ	0.6 J+	0.75 J+	1.3 J	0.64 J	0.59 UJ	0.56 UJ	0.71 J	0.6 UJ	0.59 J
Selenium	SEP Step 5	9.8 U	9 U	8.8 U	8.7 U	9.6 U	8.3 U	3.3 J	8.3 U	9.1 U	9 U	9.1 U
Selenium	SEP Step 6	0.66 U	0.6 U	0.59 U	0.58 U	0.64 U	0.55 U	0.59 U	0.56 U	0.61 U	0.6 U	0.61 U
Selenium	SEP Step 7	1.3 U	0.6 U	0.59 U	0.58 U	1.3 U	1.1 U	0.59 U	0.56 U	0.74 J	0.6 U	1.2 U
Selenium	SEP SUM	2.7	0.5 U	0.82	0.75	2.5	0.64	3.3	0.5 U	1.5	0.5 U	0.59
Selenium	SEP TOTAL	1.3 U	1.2 U	0.59 U	0.58 U	1.3 U	1.1 U	1.2 U	0.56 U	0.61 U	0.24 J	1.2 U
Thallium	Total Metal Result	4.5 U	7.2 U	6.9 U	6.8 U	4.1 U	3.7 u	4 U	3.9 U	4.1 U	4.1 U	4.1 U
Thallium	SEP Step 1	9.2 U	8.4 U	8.2 U	8.2 U	8.9 U	7.8 U	8.3 U	7.8 U	8.5 U	8.4 U	8.5 U
Thallium	SEP Step 2	6.9 U	6.3 U	6.2 U	6.1 U	6.7 U	5.8 U	6.2 U	5.8 U	6.4 U	6.3 U	6.4 U
Thallium	SEP Step 3	2.3 U	2.1 U	2.1 U	2 U	2.2 U	1.9 U	2.1 U	1.9 U	2.1 U	2.1 U	2.1 U
Thallium	SEP Step 4	2.3 U	2.1 U	2.1 UJ	2 UJ	2.2 U	1.9 U	2.1 U	1.9 U	2.1 U	2.1 U	2.1 U
Thallium	SEP Step 5	34 UJ	31 UJ	31 UJ	31 UJ	34 UJ	29 UJ	31 UJ	29 UJ	32 UJ	32 UJ	32 UJ
Thallium	SEP Step 6	2.3 U	2.1 U	2.1 U	2 U	2.2 U	1.9 U	2.1 U	1.9 U	2.1 U	2.1 U	2.1 U
Thallium	SEP Step 7	0.48 J	2.1 U	0.62 J	0.56 J	1.1 J	3.9 U	2.1 U	1.9 U	0.97 J	0.74 J	1.3 J
Thallium	SEP SUM	0.48 J	1.8 U	0.62 J	0.56 J	1.4 J	1.8 U	1.8 U	1.8 U	0.97 J	0.74 J	1.3 J
Thallium	SEP TOTAL	0.87 J	4.2 U	0.58 J	0.47 J	0.9 J	3.9 U	4.2 U	1.9 U	0.88 J	0.85 J	1.3 J

Notes:
All results displayed in milligram per kilogram (mg/kg).
ft bgs = feet below ground surface
SEP: Sequential Extraction Procedure
Step 1 - Exchangeable Phase: This extraction includes trace elements that are reversibly adsorbed to soil minerals, amorphous solids, and organic material by electrostatic forces.
Step 2 - Carbonate Phase: This extraction targets trace elements that are adsorbed or otherwise bound to carbonate minerals.
Step 3 - Non-Crystalline Materials Phase: This extraction targets trace elements that are complexed by amorphous minerals (e.g. iron).
Step 4 - Metal Hydroxide Phase: This extraction targets trace elements bound to hydroxides of iron, manganese, and/or aluminum.
Step 5 - Organic Phase: This extraction targets trace elements strongly bound via chemisorption to organic material.
Step 6 - Acid/Sulfide Fraction: The extraction is used to identify trace elements precipitated as sulfide minerals.
Step 7 - Residual Fraction: Trace elements remaining in the soil after the previous extractions will be distributed between silicates, phosphates, and refractory oxides.
U= The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
UJ= The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit, the quantitation limit is considered estimated.
J= The analyte was positively identified. The associated numerical value is the approximate concentration.
J+= The analyte was positively identified. The associated numerical value is the approximate concentration of the analyte in the sample and biased high.
Total Metal Results are the results of the 6010C analysis

Prepared by: DFSC
Checked by: KMC
Reviewed by: MAH

Table 9: Predicted Range of COI Concentrations in Assessment Wells Assuming Only Dilution and Dispersion
Monitored Natural Attenuation Evaluation
NIPSCO LLC R. M. Schahfer Generating Station

Constituent	Units	Site-Specific Groundwater Protection Standard[2]	Health-Based Standard	Maximimum concentration observed in Porewater	Maximimum concentration at side-gradient Assessment Wells:				Concentration at Assessment Wells assuming 32%[3] dilution of porewater with maximum concentration measured at:				Concentration at Assessment Wells assuming 63%[4] dilution of porewater with maximum concentration measured at:			
					GAMW-52	GAMW-52B	GAMW-56	GAMW-56B	GAMW-52	GAMW-52B	GAMW-56	GAMW-56B	GAMW-52	GAMW-52B	GAMW-56	GAMW-56B
Arsenic	mg/L	0.091	0.010	0.012	0.0025	0.0016	0.022	0.0025	0.0090	0.0087	0.015	0.0090	0.0060	0.0054	0.018	0.0060
Boron[1]	mg/L	-	4.0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Cobalt	mg/L	0.010	0.0060	0.0022	0.00058	0.00050	0.0084	0.00050	0.0017	0.0017	0.0042	0.0017	0.0012	0.0011	0.0061	0.0011
Lithium	mg/L	0.040	0.040	0.016	0.0062	0.0071	0.0053	0.0062	0.013	0.013	0.013	0.013	0.0098	0.010	0.0093	0.0098
Molybdenum	mg/L	0.10	0.10	0.81	0.0064	0.015	0.013	0.0064	0.55	0.56	0.55	0.55	0.30	0.31	0.31	0.30

Arsenic	Percentage relative to Groundwater Protection Standard	100%	-	13%	3%	2%	24%	3%	10%	10%	17%	10%	7%	6%	20%	7%
Boron		100%	-	345%	80%	33%	7%	80%	260%	245%	237%	260%	178%	148%	132%	178%
Cobalt		100%	-	22%	6%	5%	84%	5%	17%	17%	42%	17%	12%	11%	61%	11%
Lithium		100%	-	40%	16%	18%	13%	16%	32%	33%	31%	32%	25%	26%	23%	25%
Molybdenum		100%	-	810%	6%	15%	13%	6%	553%	556%	555%	553%	304%	309%	308%	304%

Notes:
(1) Boron does not have a groundwater protection standard, results are compated to the health-based standard
(2) The groundwater protection standard is equal to the higher of the background tolerance limit and the relevant health-based standard
(3) 32% dilution was minimum dilution predicted in Table 8
(4) 63% dilution was maximum dilution predicted in Table 8
ft = feet
mg/L = milligrams per liter

Prepared by: GOL
Checked by: PJN
Reviewed by: RV

Table 10: Sorption Site and Surface Area Calculations
Monitored Natural Attenuation Evaluation
NIPSCO LLC R. M. Schahfer Generating Station

	Units	Minimum	Mean	Maximum
Ferrihydrite				
Amorphous Iron (Step 3 SEP) + Metal Hydroxide Iron (Step 4 SEP)	Sample Name	SB-18B-32/34	Mean of all samples	SB-53B-25-27
	ppm of Fe	1278	2006	3787
	millimoles of Fe	22.9	35.9	67.8
	moles of Fe	0.0229	0.0359	0.0678
Specific Surface Area	m^2/g	600		
Surface Site Concentration	moles weak sites/ mole of Fe	0.2		
Surface Sites	moles of weak sites	0.00458	0.00719	0.01356
Mass of Ferrihydrite	g	2.03	3.19	6.03
Gibbsite				
Amorphous Aluminum (Step 3 SEP) + Metal Hydroxide Aluminum (Step 4 SEP)	Sample Name	SB-53B-30-32	Mean of all samples	OW-9-10-12
	ppm of Al	130	221	408
	millimoles of Al	4.8	8.2	15.1
	moles of Al	0.0048	0.0082	0.0151
Specific Surface Area	m^2/g	32		
Surface Site Concentration	moles weak sites/ mole of Al	0.41		
Surface Sites	moles of weak sites	0.00198	0.00335	0.00619
Mass of Gibbsite	g	0.38	0.64	1.18

Notes:

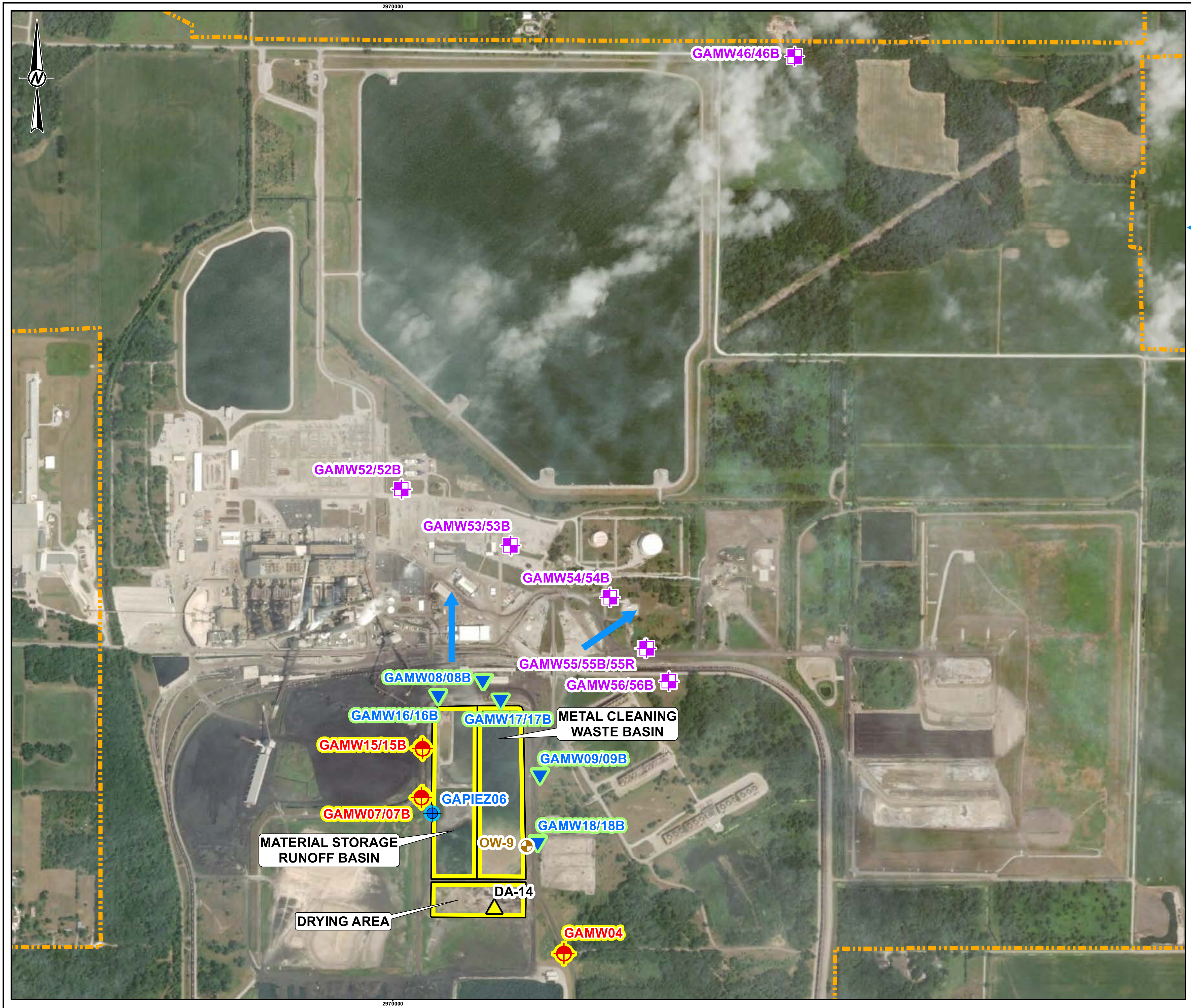
ppm = parts per million

m^2/g = meters squared per gram

g = grams

Prepared by:	GOL
Checked by:	PJN
Reviewed by:	RV

Figures



LEGEND

✚	Assessment Monitoring Well
⊕	Background Monitoring Well
▼	Downgradient Monitoring Well
◑	Downgradient Boring Location
⊕	Porewater Sample Location
△	CCR Source Material Sample Location
←	Generalized Groundwater Flow Direction
▭	CCR Units
⬚	Approximate Property Line

0 850 1,700

1 " = 850 feet Feet

NOTE(S)

1. THIS FIGURE DEPICTS THE GENERALIZED GROUNDWATER FLOW DIRECTION WITHIN THE UPPER PORTION OF THE SURFICIAL AQUIFER.

REFERENCE(S)

1. SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

CLIENT

NORTHERN INDIANA PUBLIC SERVICE COMPANY LLC

PROJECT

MONITORED NATURAL ATTENUATION EVALUATION
MSRB, MCWB, AND DRYING AREA
NIPSCO LLC R. M. SCHAHFER GENERATING STATION

TITLE

SAMPLE LOCATION MAP

CONSULTANT

GOLDER

YYYY-MM-DD	6/16/2020
DESIGNED	DFS
PREPARED	SHL
REVIEWED	JSP
APPROVED	MAH

PROJECT NO.	CONTROL	REV.	FIGURE
19121567	A	0	1

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

1 in

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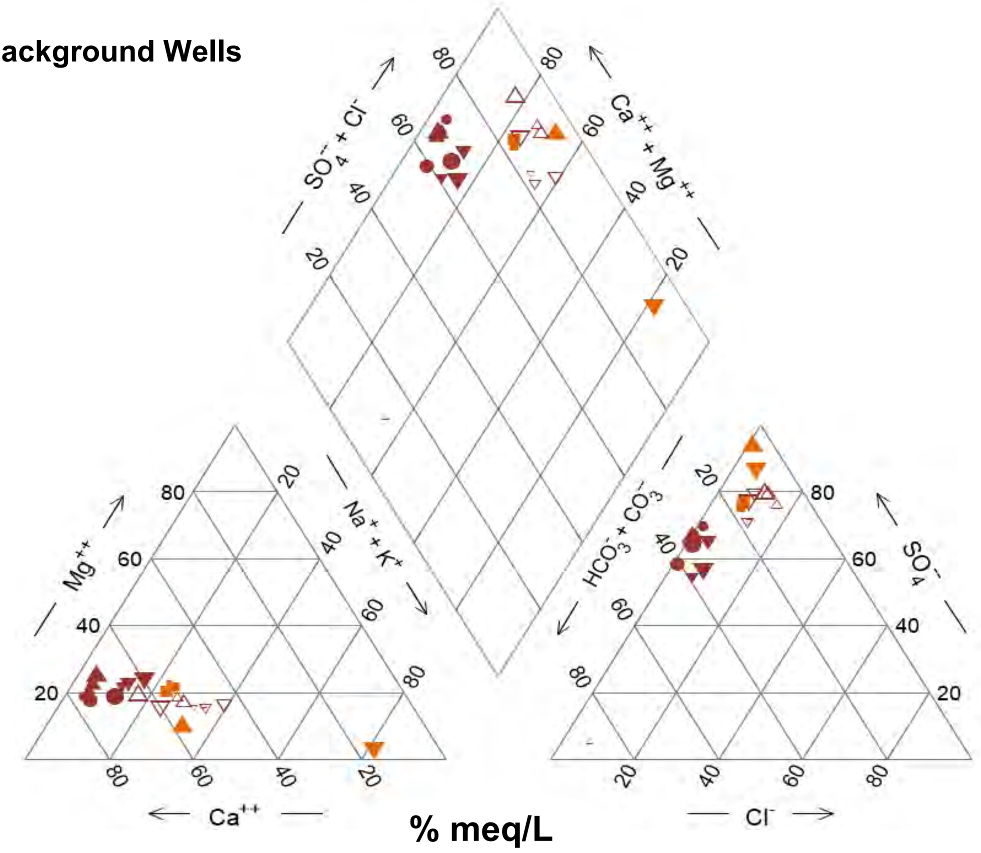
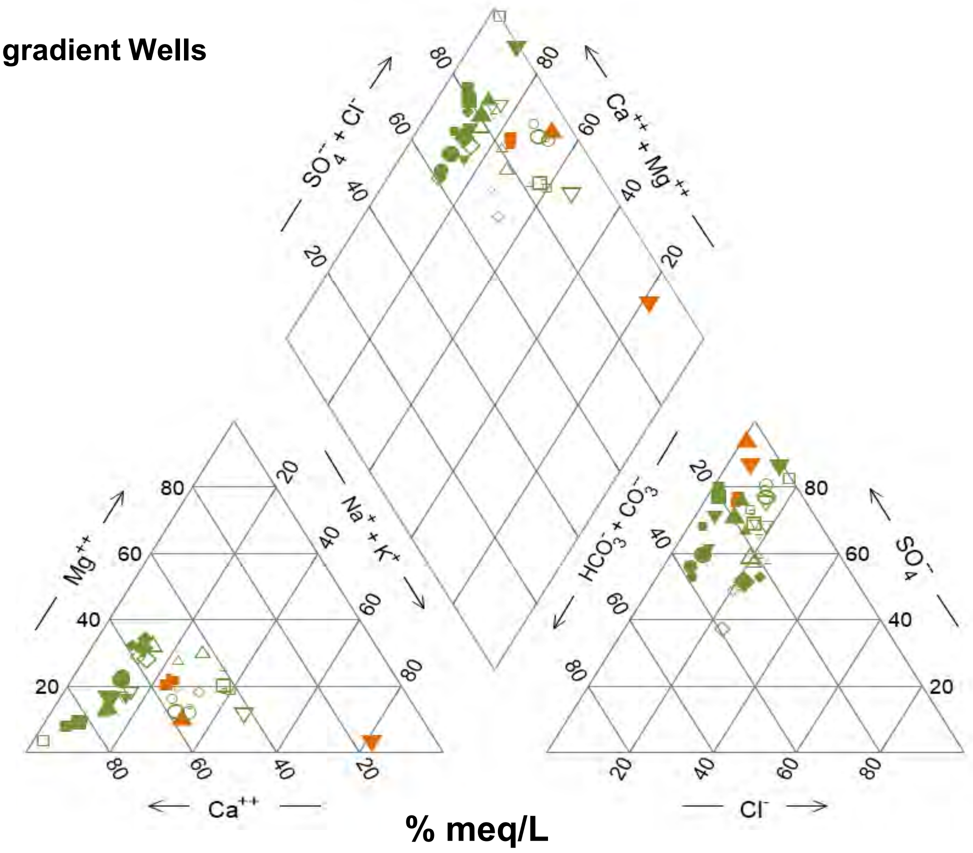
PATH: https://golderassociates.sharepoint.com/sites/nipscoccrgwmonitoring/Shared Documents/RMSGS/Reports/MNA Report | FILE NAME: 2020_11_MNA_RMSGS_Figures.xlsx

(a) Background Wells



(b) Downgradient Wells



Porewater

- ■ GAPIEZ–06
- ▲ DAPZ–02A
- ▼ DAPZ–02B

Upgradient Wells

- ● GAMW–04
- ▲ GAMW–07
- △ GAMW–07B
- ▼ GAMW–15
- ▽ GAMW–15B

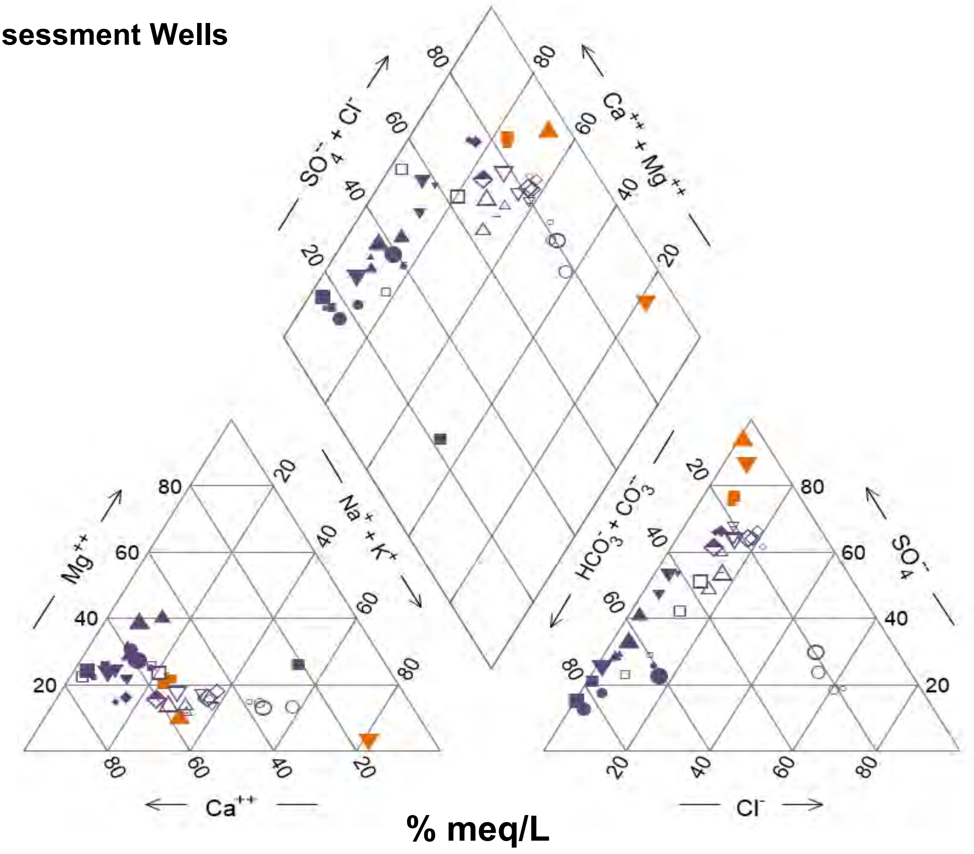
Downgradient Wells

- ● GAMW–08
- ○ GAMW–08B
- ▲ GAMW–09
- △ GAMW–09B
- ▼ GAMW–16
- ▽ GAMW–16B
- ◆ GAMW–17
- ◇ GAMW–17B
- ■ GAMW–18
- □ GAMW–18B

Assessment Wells

- ● GAMW–52
- ○ GAMW–52B
- ▲ GAMW–53
- △ GAMW–53B
- ▼ GAMW–54
- ▽ GAMW–54B
- ◆ GAMW–55
- ⬘ GAMW–55R
- ◇ GAMW–55B
- ■ GAMW–56
- □ GAMW–56B

(c) Assessment Wells



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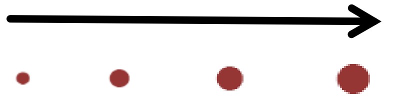

Least Recent

Most Recent

CLIENT
NIPSCO LLC

CONSULTANT
GOLDER

PROJECT
Monitored Natural Attenuation Evaluation
MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station

TITLE
Piper Diagrams - Groundwater Characterization of Background, Monitoring, and Assessment Wells

PROJECT NO.	PHASE	REV.	FIGURE
19121567	192	A	2a-c

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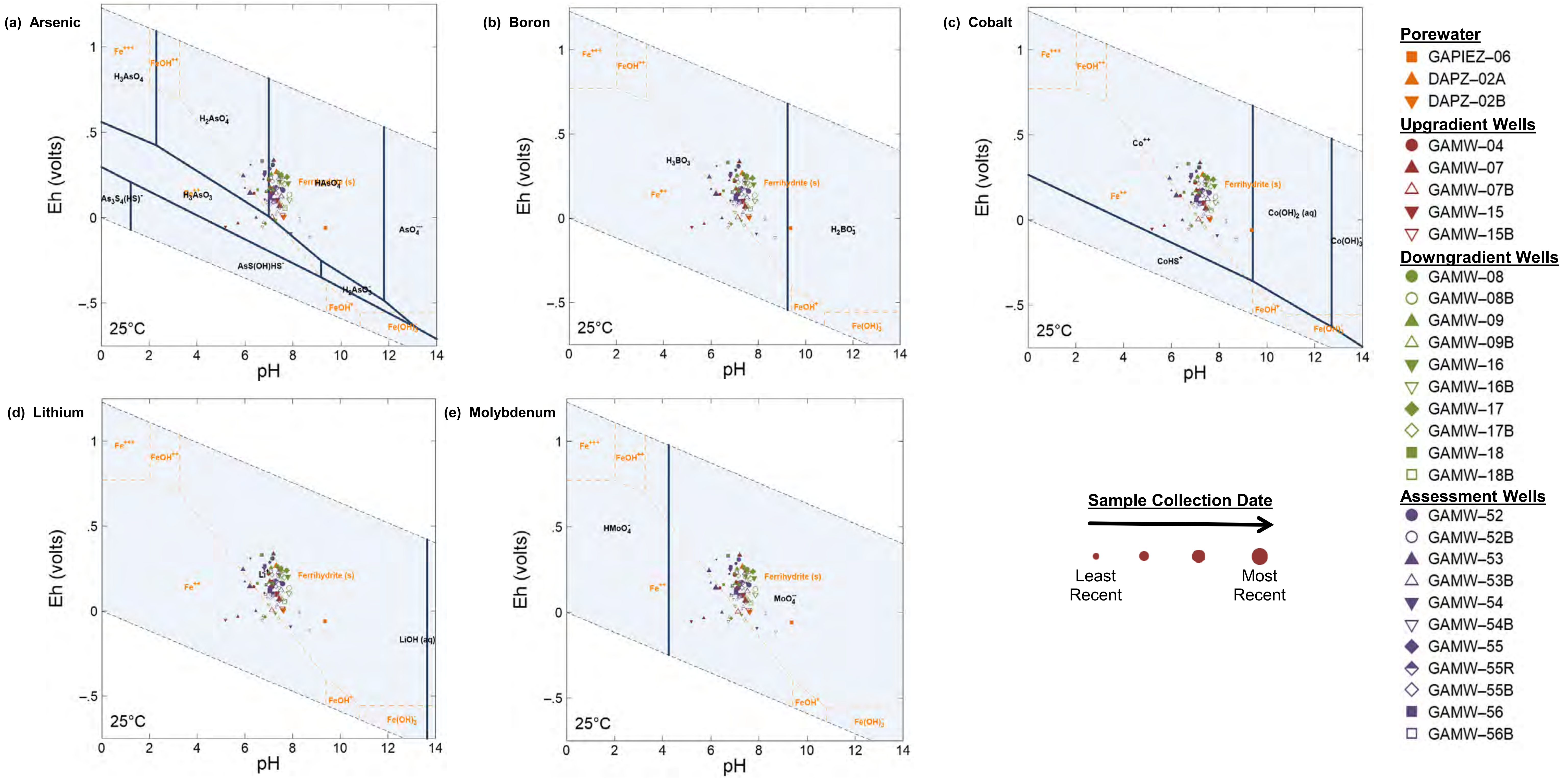

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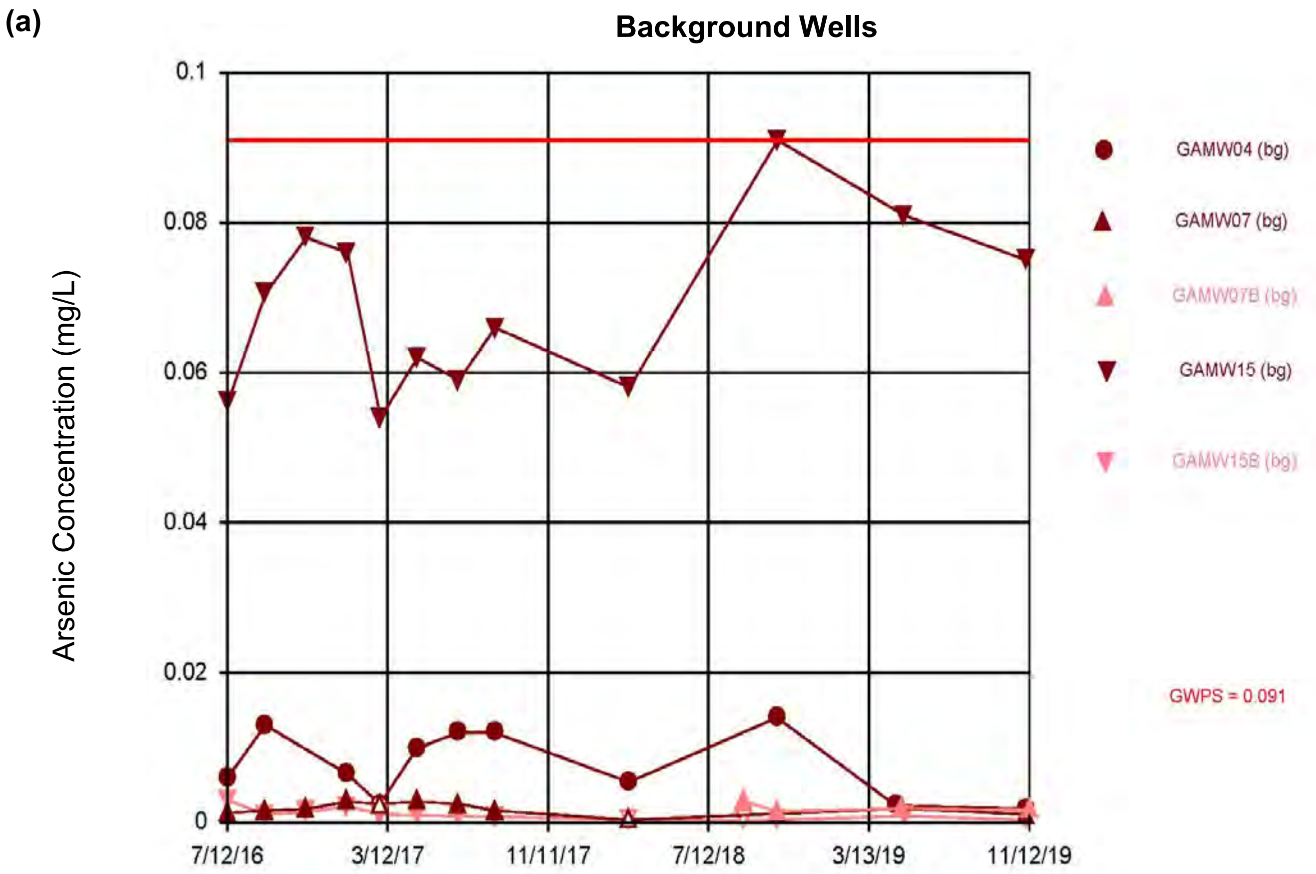
NIPSCO LLC

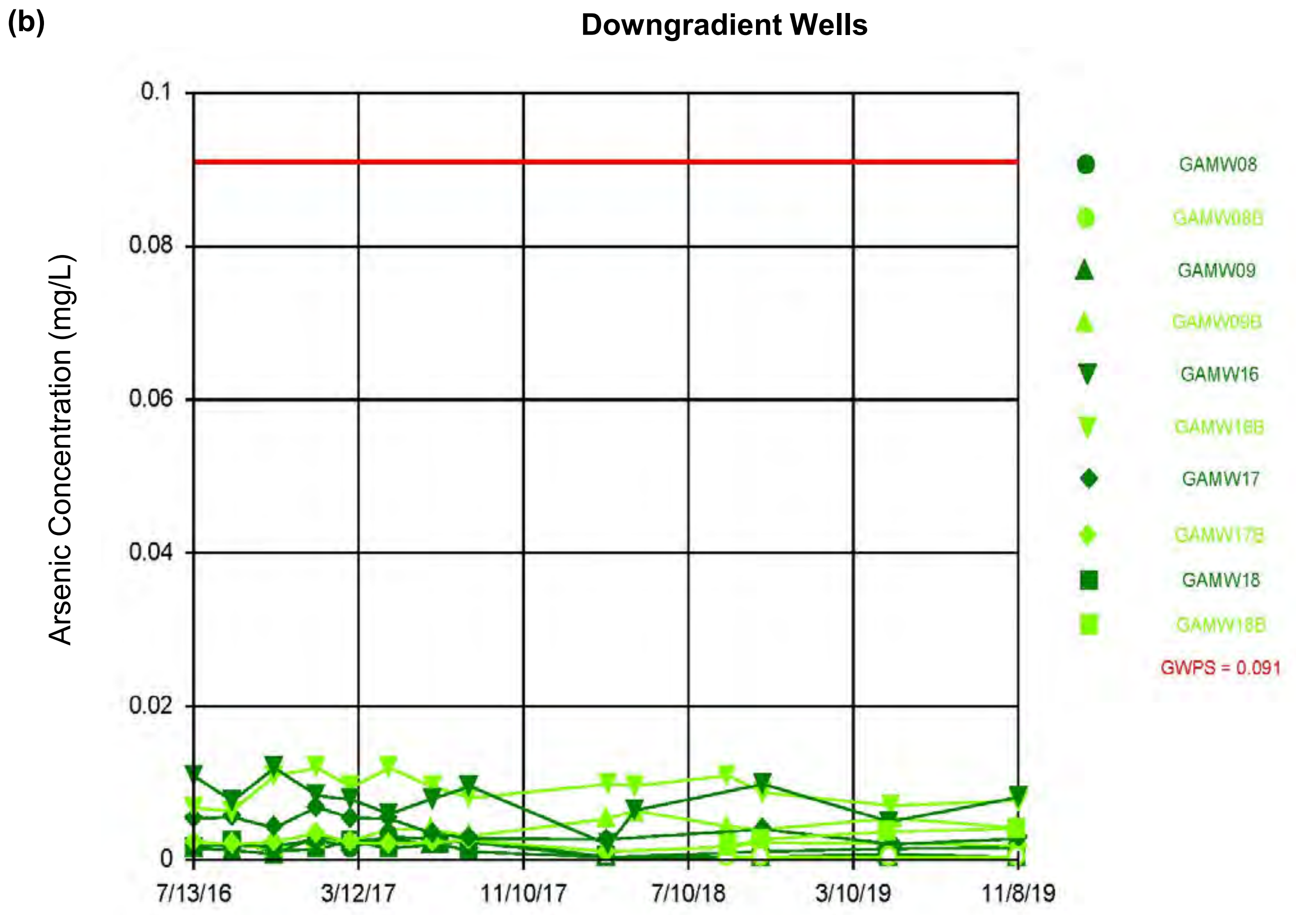
CONSULTANT
GOLDER

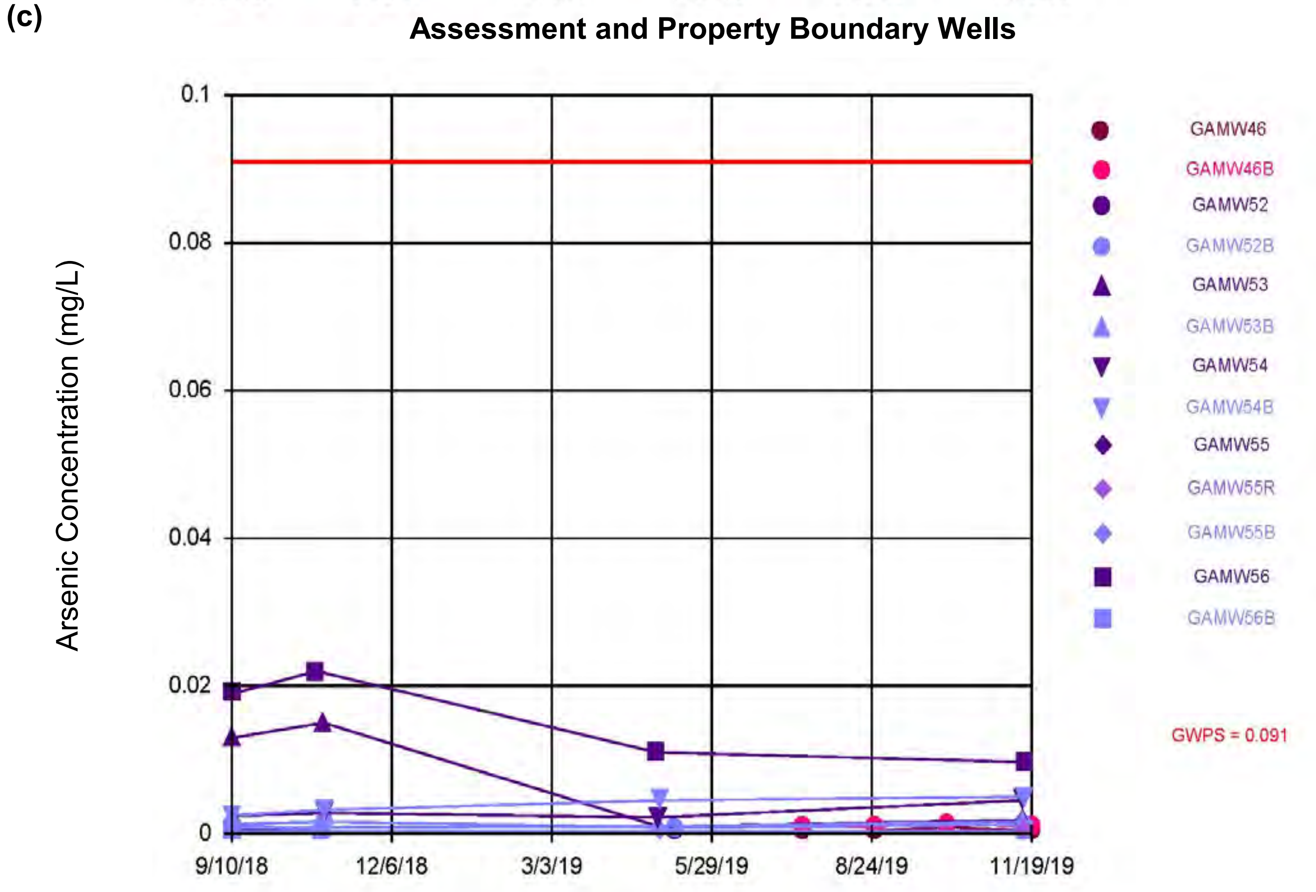
PROJECT
Monitored Natural Attenuation Evaluation
MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station

TITLE
Pourbaix Diagrams For Arsenic, Boron, Cobalt, Lithium, and Molybdenum

PROJECT NO.	PHASE	REV.	FIGURE
19121567	192	A	3a-e







Note: Open symbols reflect sample measurements below the laboratory method detection limit.

CLIENT
NIPSCO LLC

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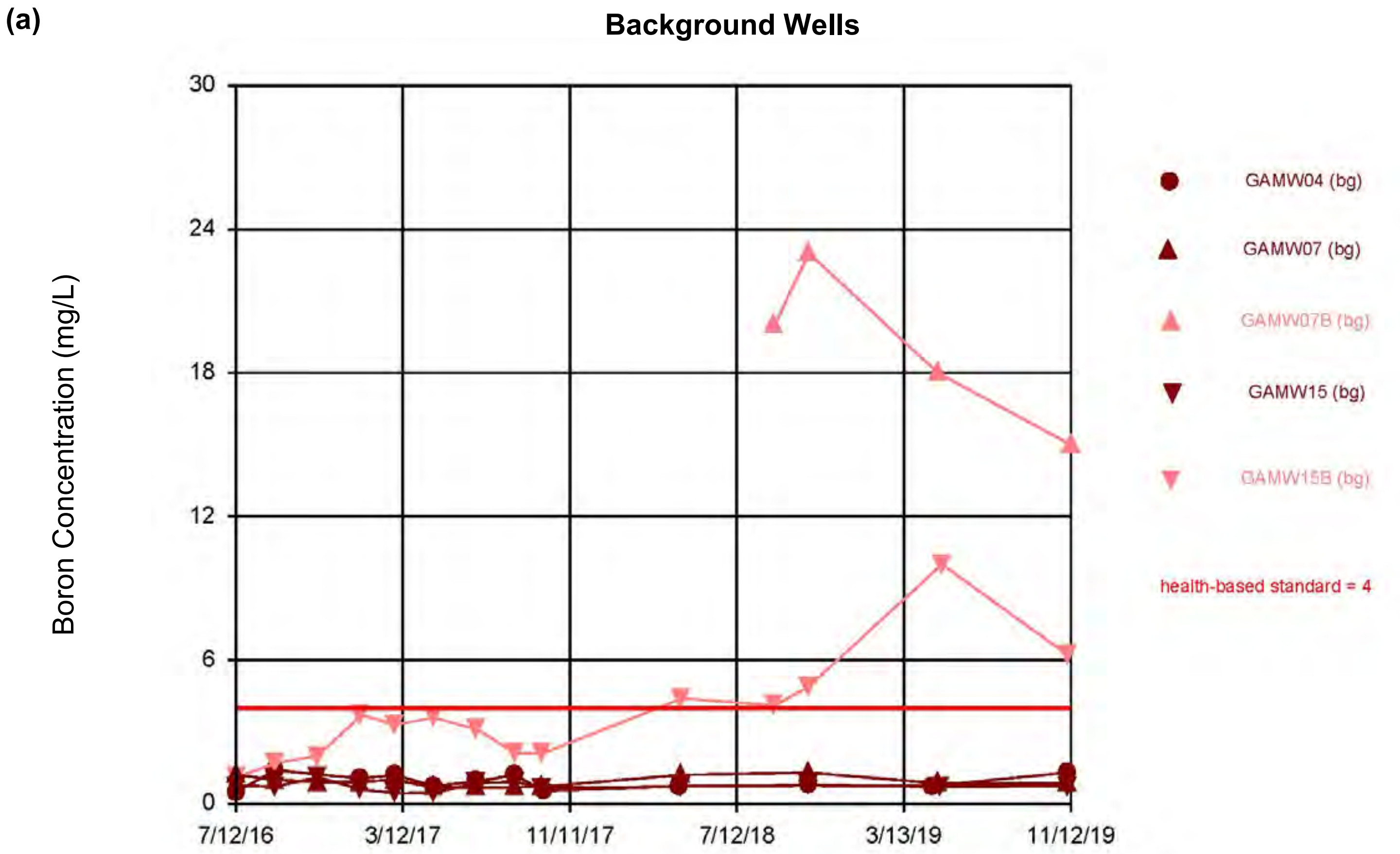
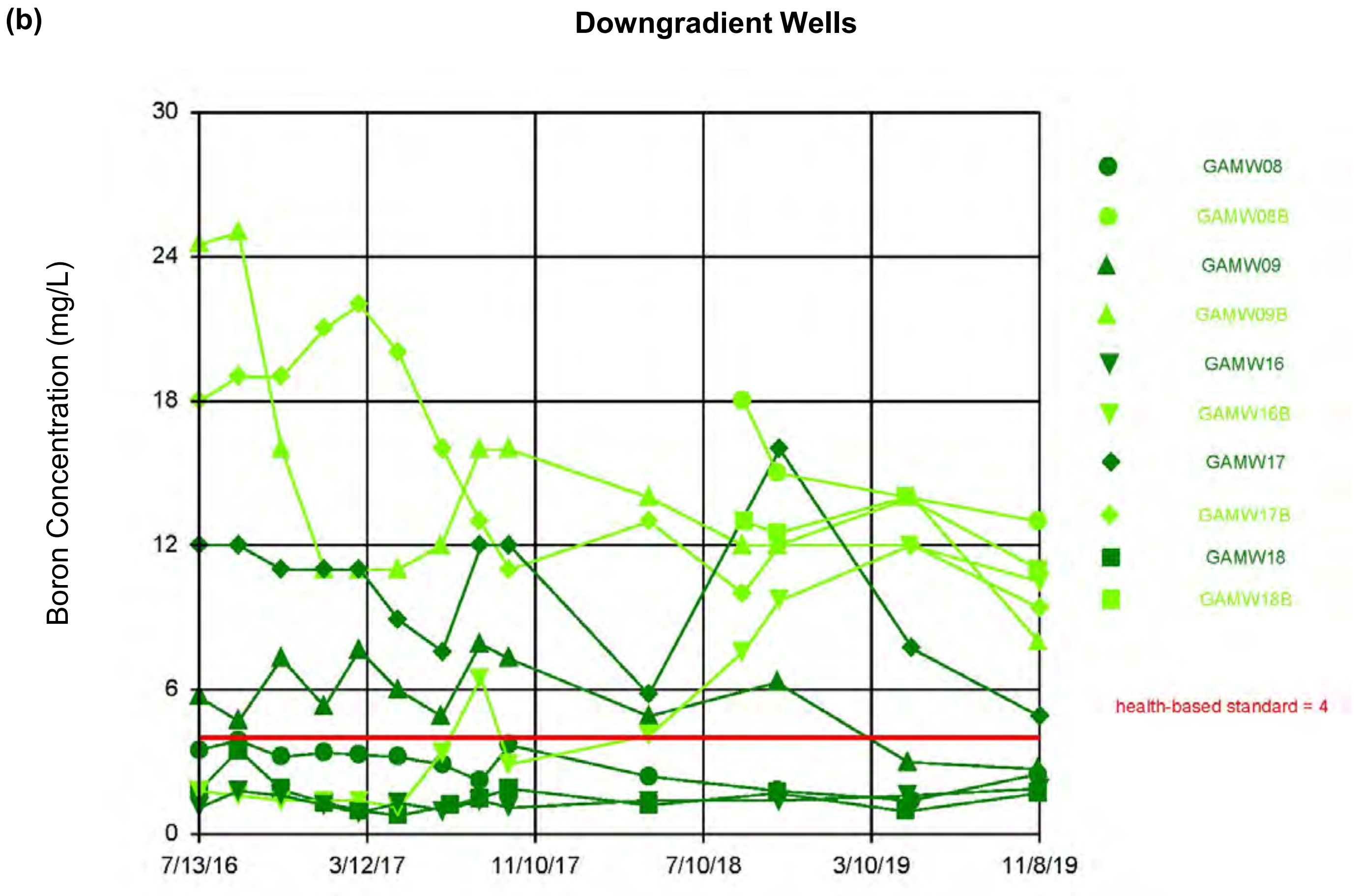
GOLDER

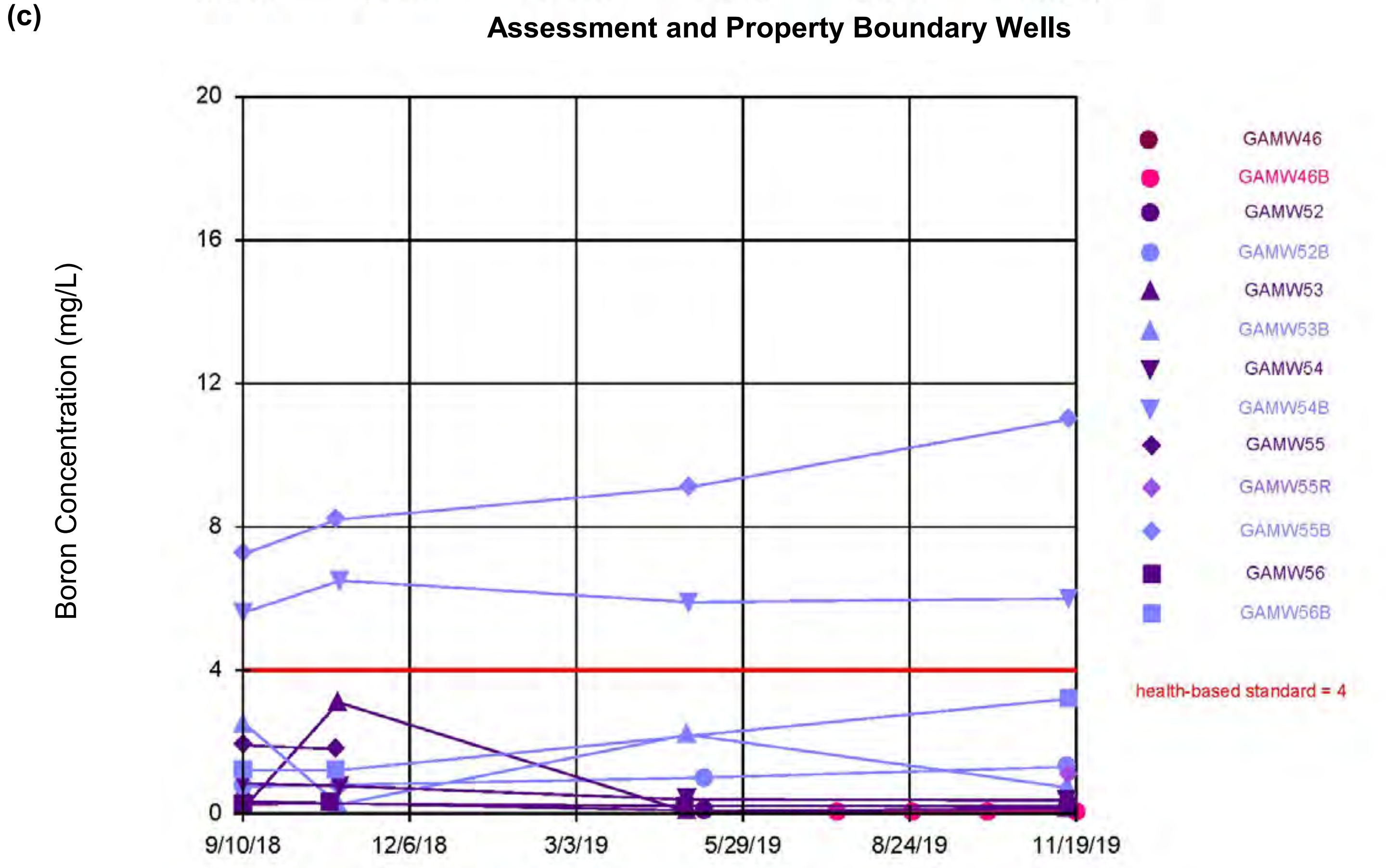
PROJECT
Monitored Natural Attenuation Evaluation
MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station

TITLE
Arsenic Time Series for Background, Monitoring, and Assessment and Property Boundary Wells

PROJECT NO.	PHASE	REV.	FIGURE
19121567	192	A	4a-c







Note: Open symbols reflect sample measurements below the laboratory method detection limit

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NIPSCO LLC

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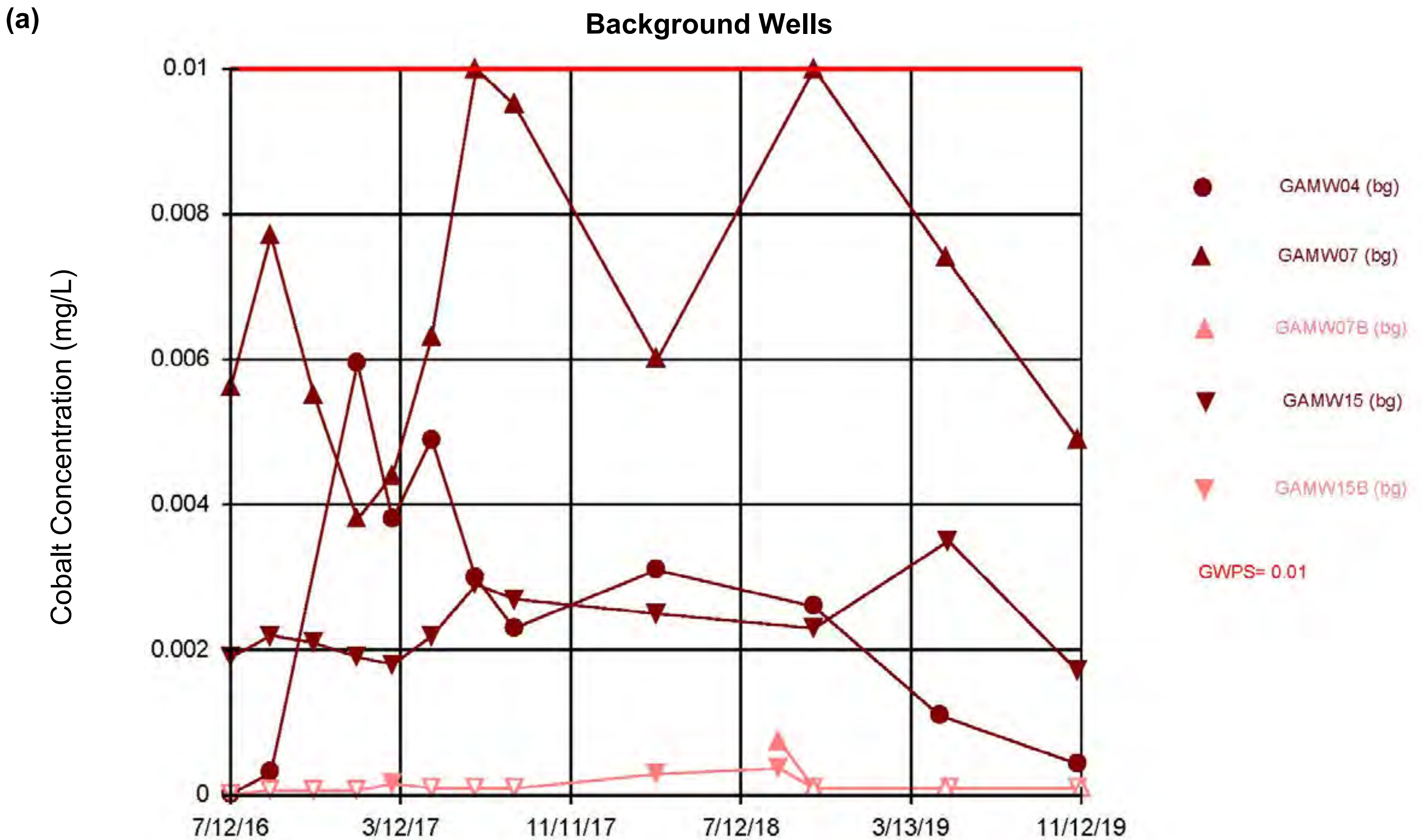
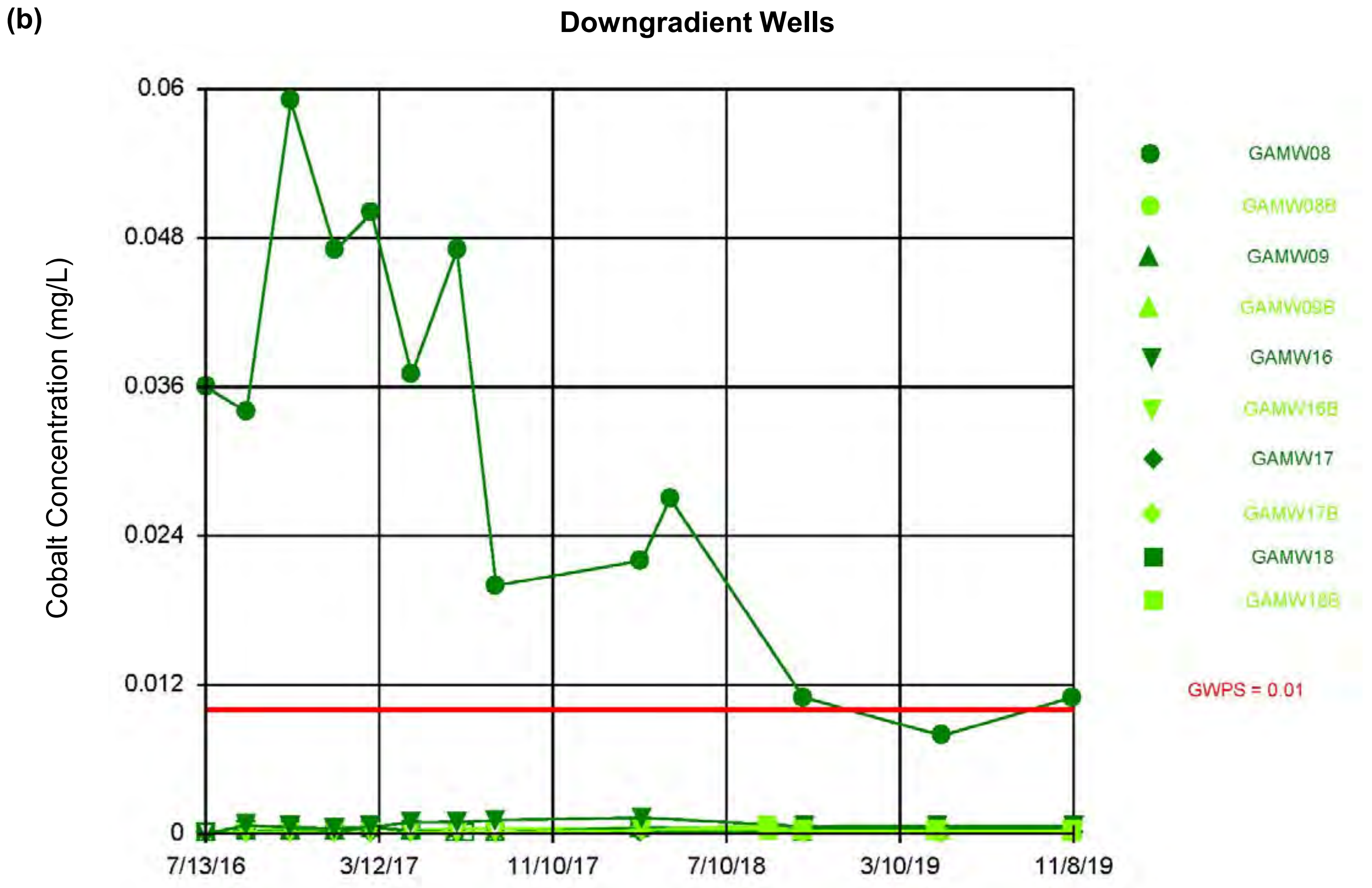
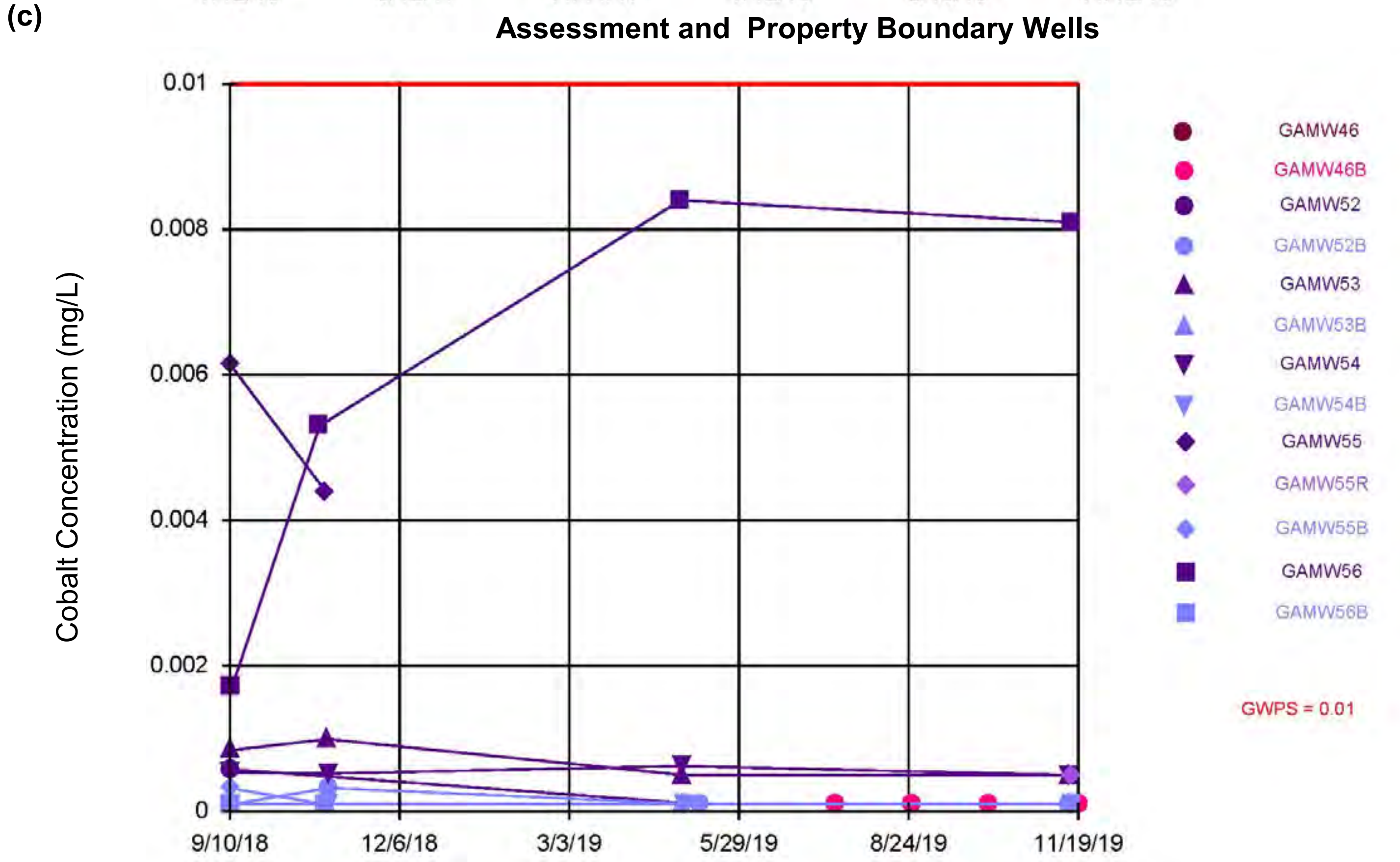
PROJECT
Monitored Natural Attenuation Evaluation
MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station

TITLE
Boron Time Series for Background, Monitoring, and Assessment and Property Boundary Wells

PROJECT NO.	PHASE	REV.	FIGURE
19121567	192	A	5a-c







Note: Open symbols reflect sample measurements below the laboratory method detection limit

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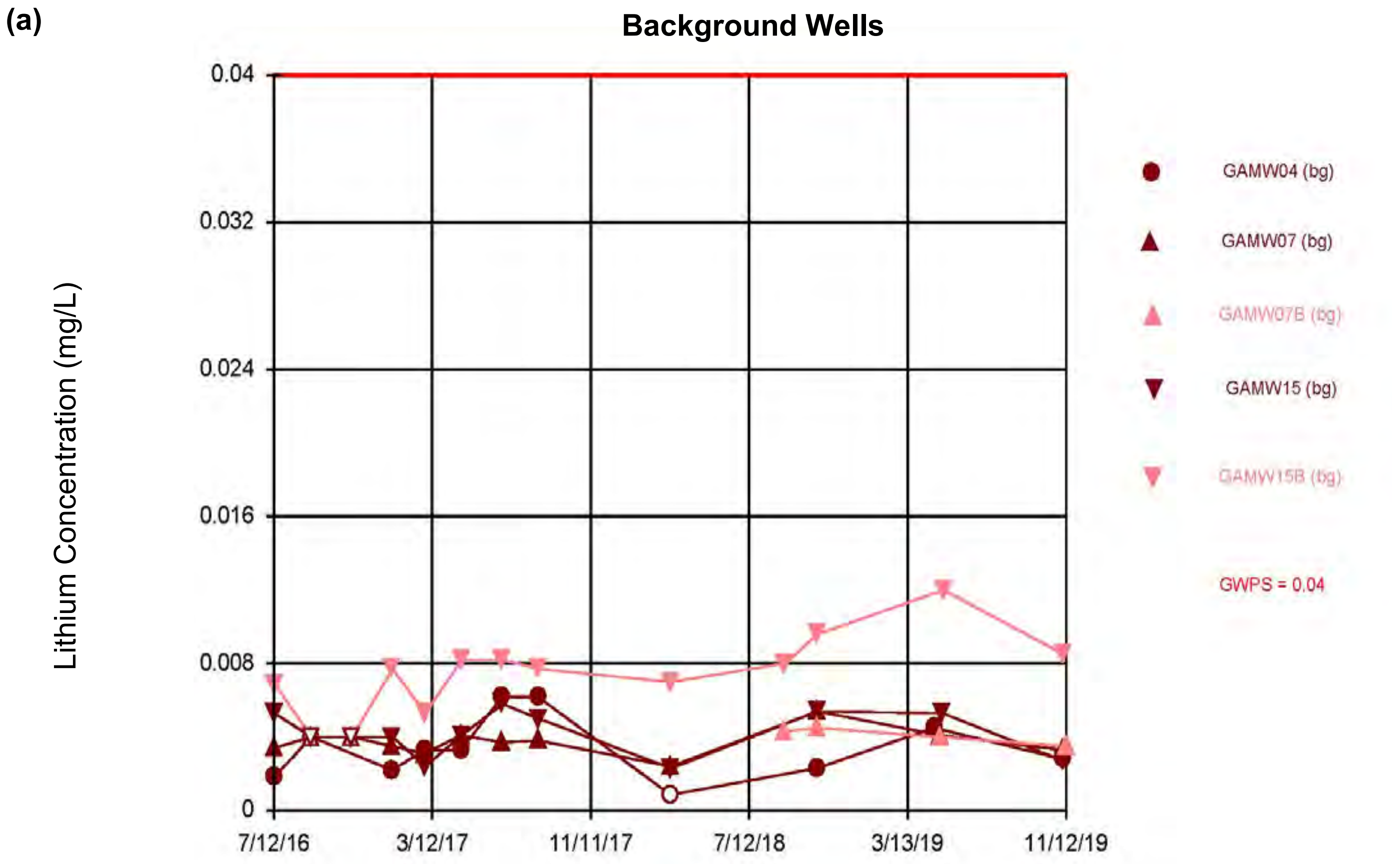
NIPSCO LLC

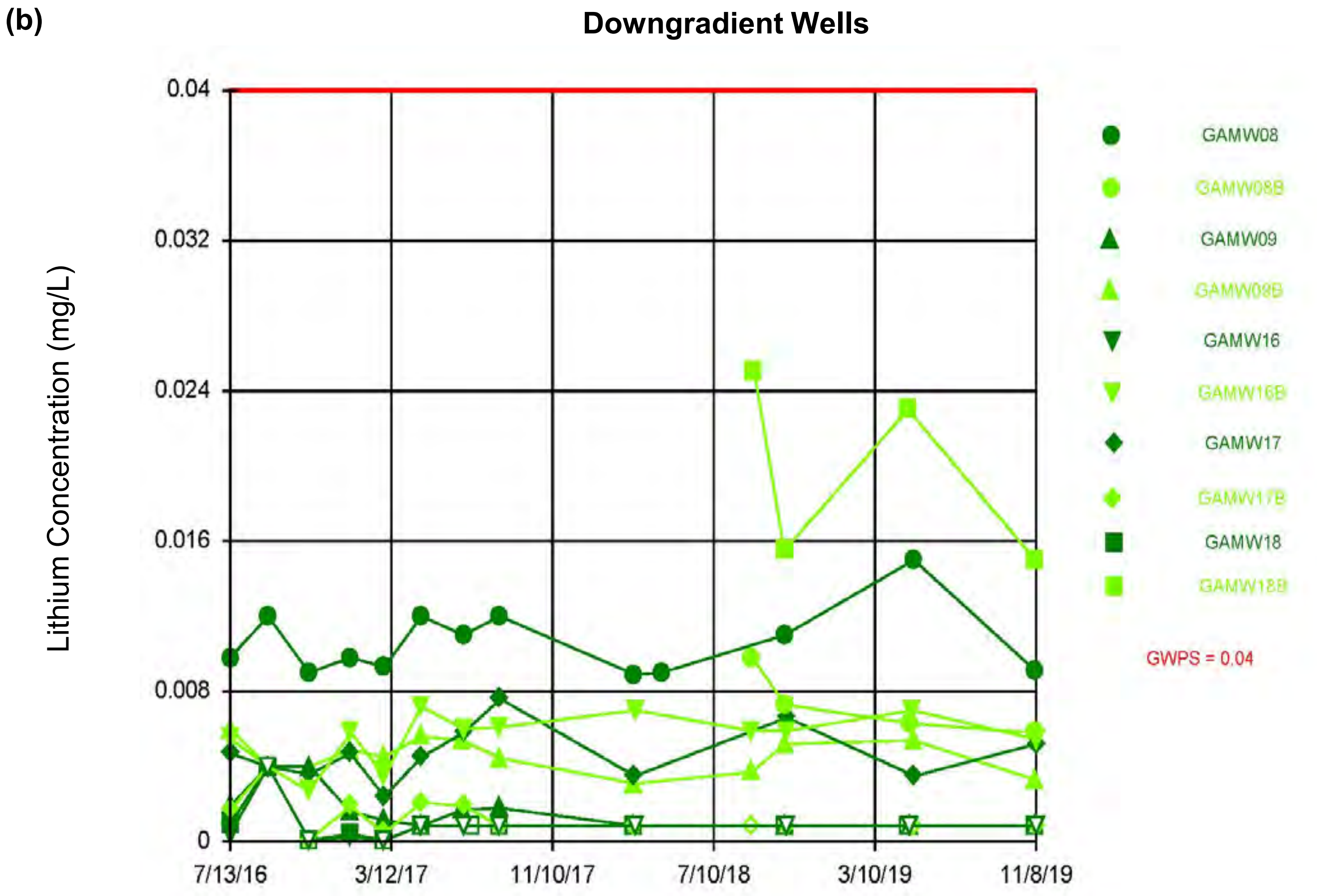
CONSULTANT
GOLDER

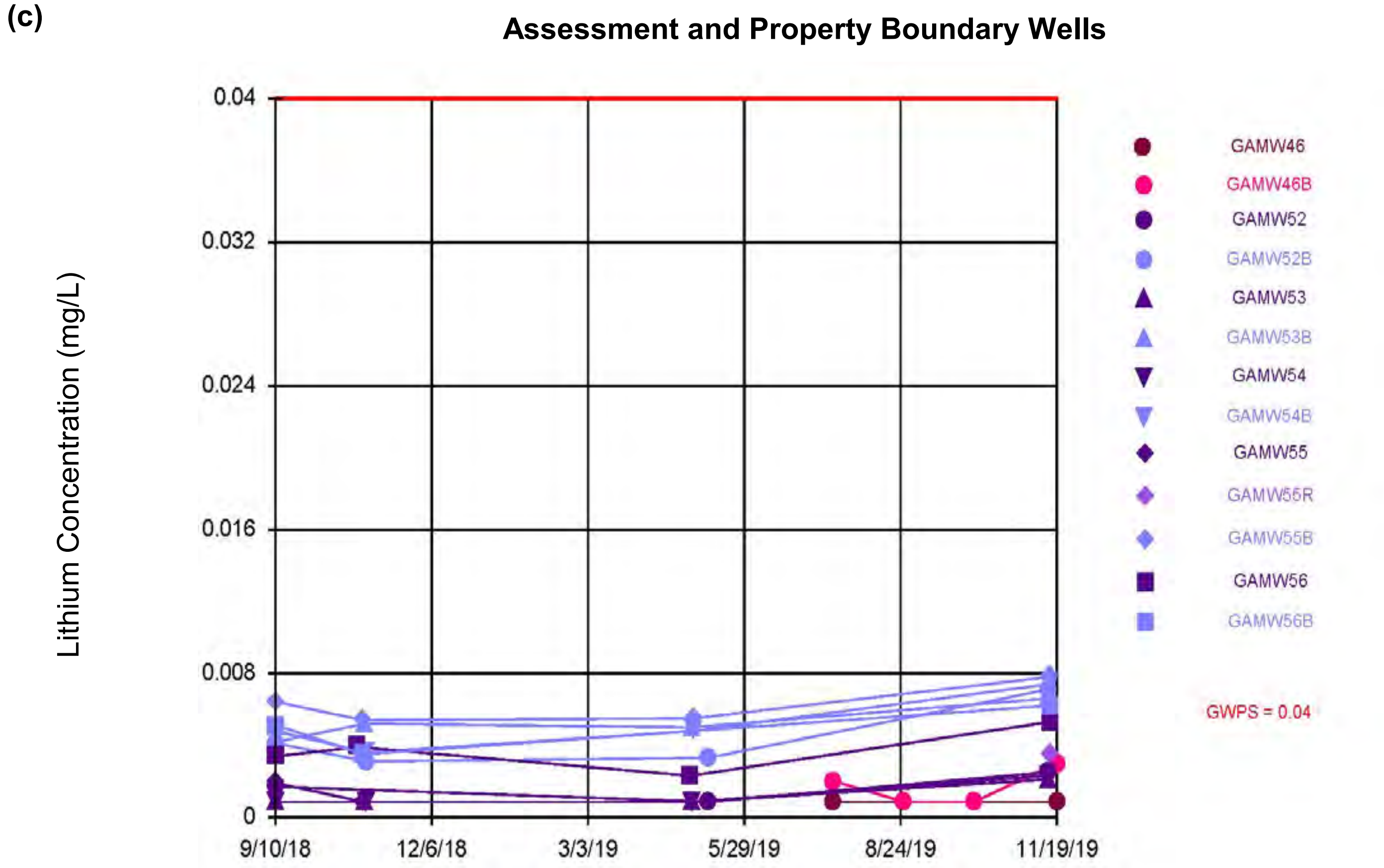
PROJECT
Monitored Natural Attenuation Evaluation
MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station

TITLE
Cobalt Time Series for Background, Monitoring, and Assessment and Property Boundary Wells

PROJECT NO.	PHASE	REV.	FIGURE
19121567	192	A	6a-c







Note: Open symbols reflect sample measurements below the laboratory method detection limit

CLIENT
NIPSCO LLC

PROJECT
Monitored Natural Attenuation Evaluation
MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station

CONSULTANT
GOLDER

TITLE
Lithium Time Series for Background, Monitoring, and Assessment and Property Boundary Wells

PROJECT NO.	PHASE	REV.	FIGURE
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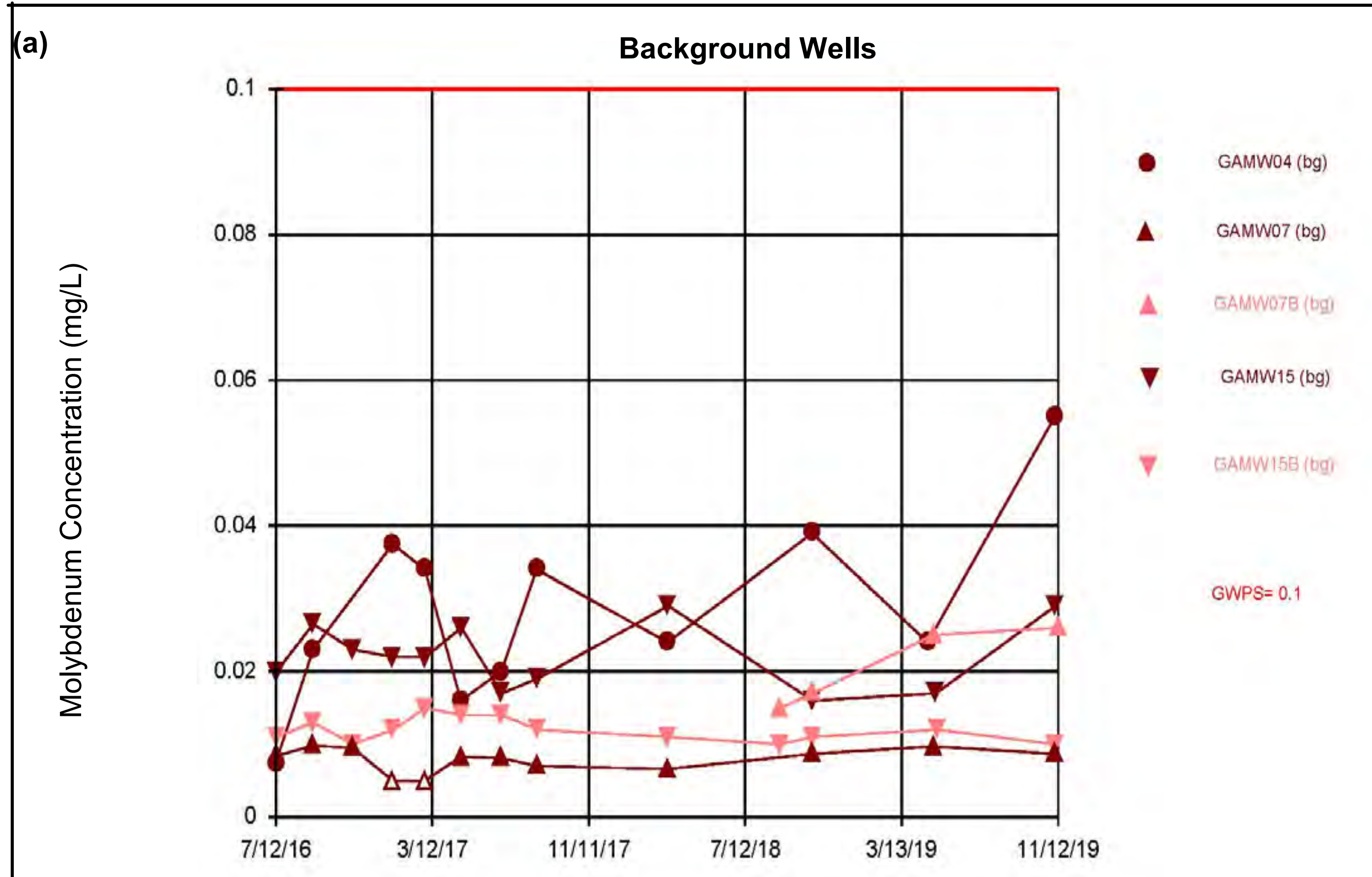

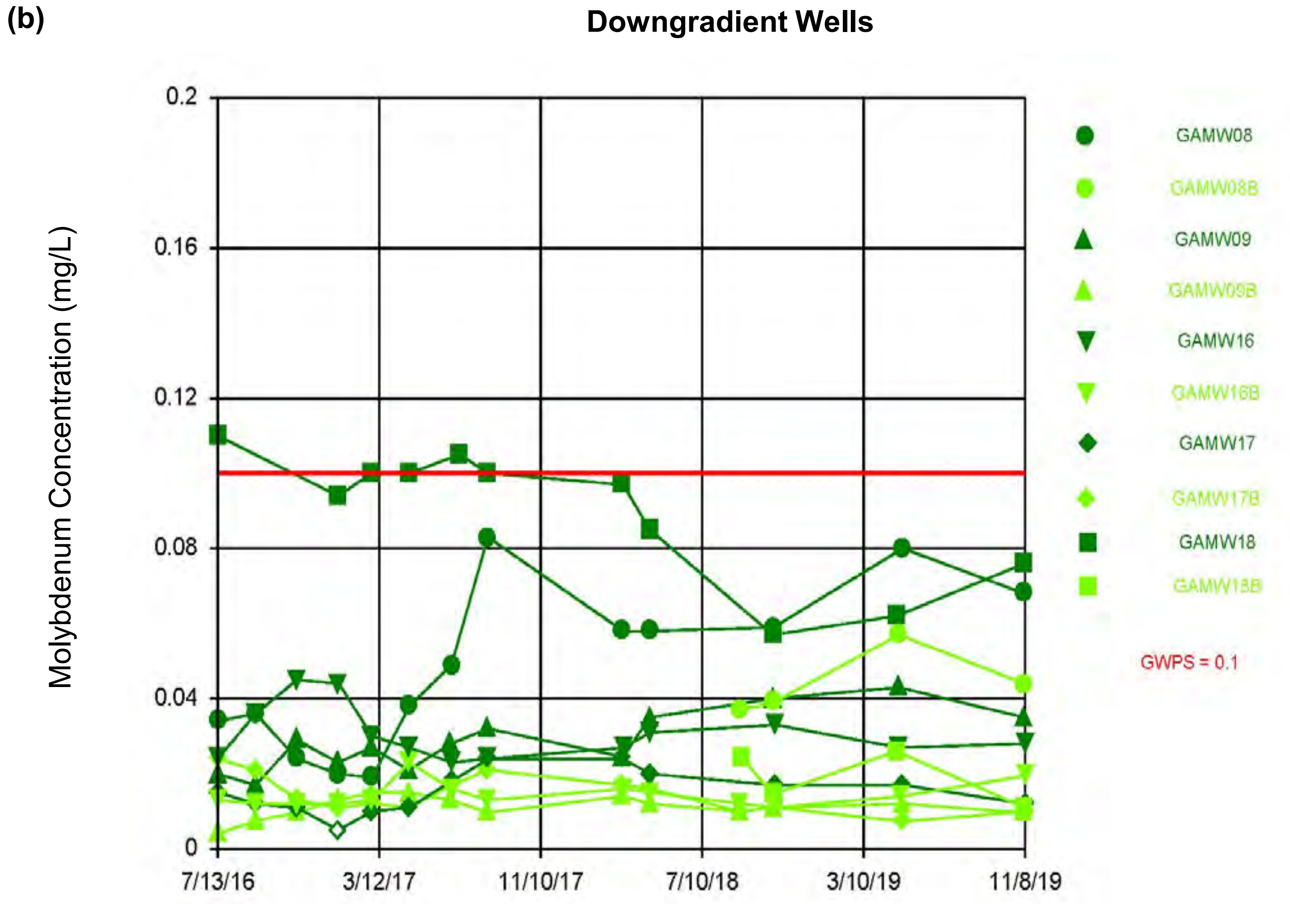

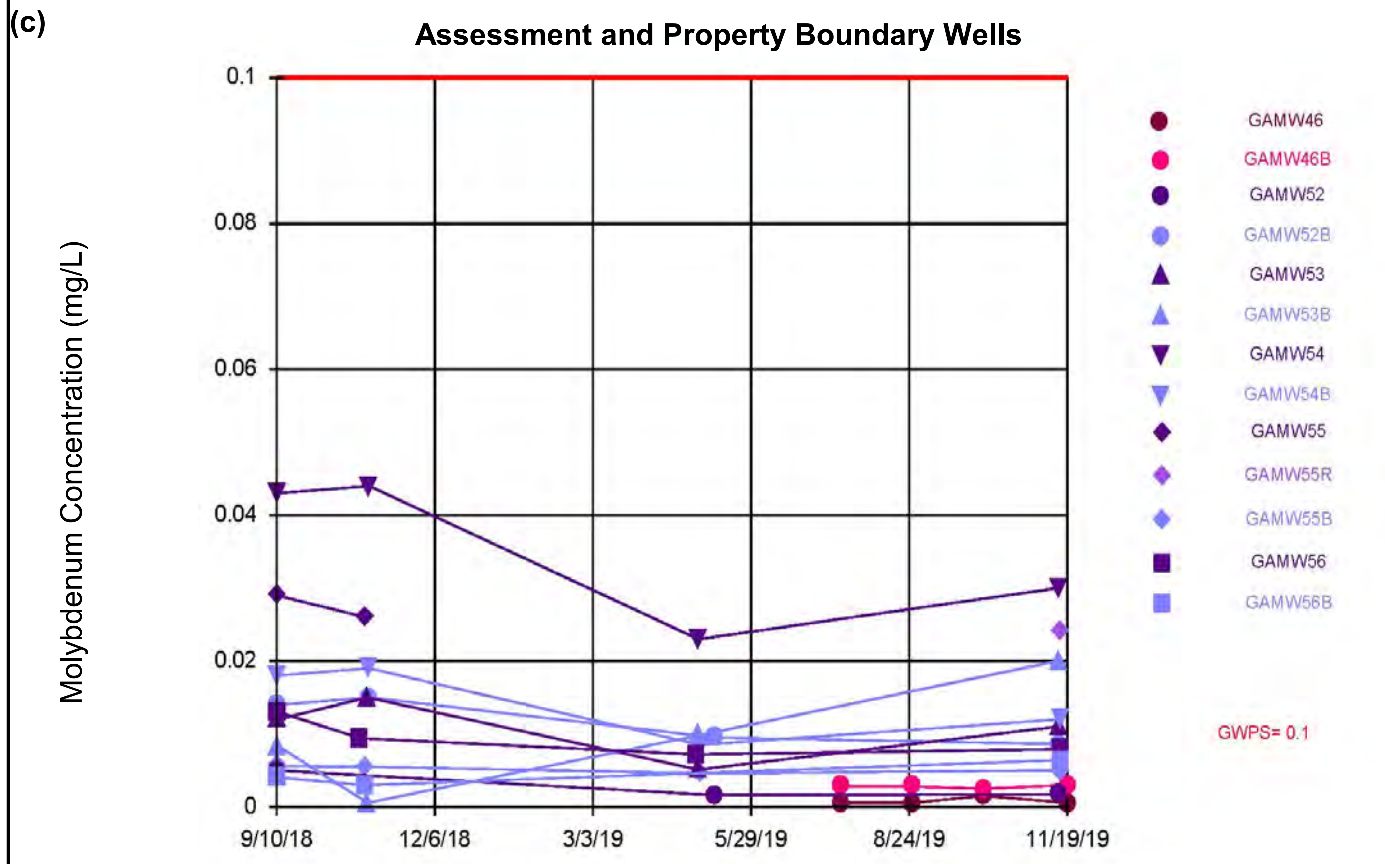

Note: Open symbols reflect sample measurements below the laboratory method detection limit

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NIPSCO LLC

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PROJECT
Monitored Natural Attenuation Evaluation
MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station

TITLE
Molybdenum Time Series for Background, Monitoring, and Assessment and Property Boundary Wells

PROJECT NO.	PHASE	REV.	FIGURE
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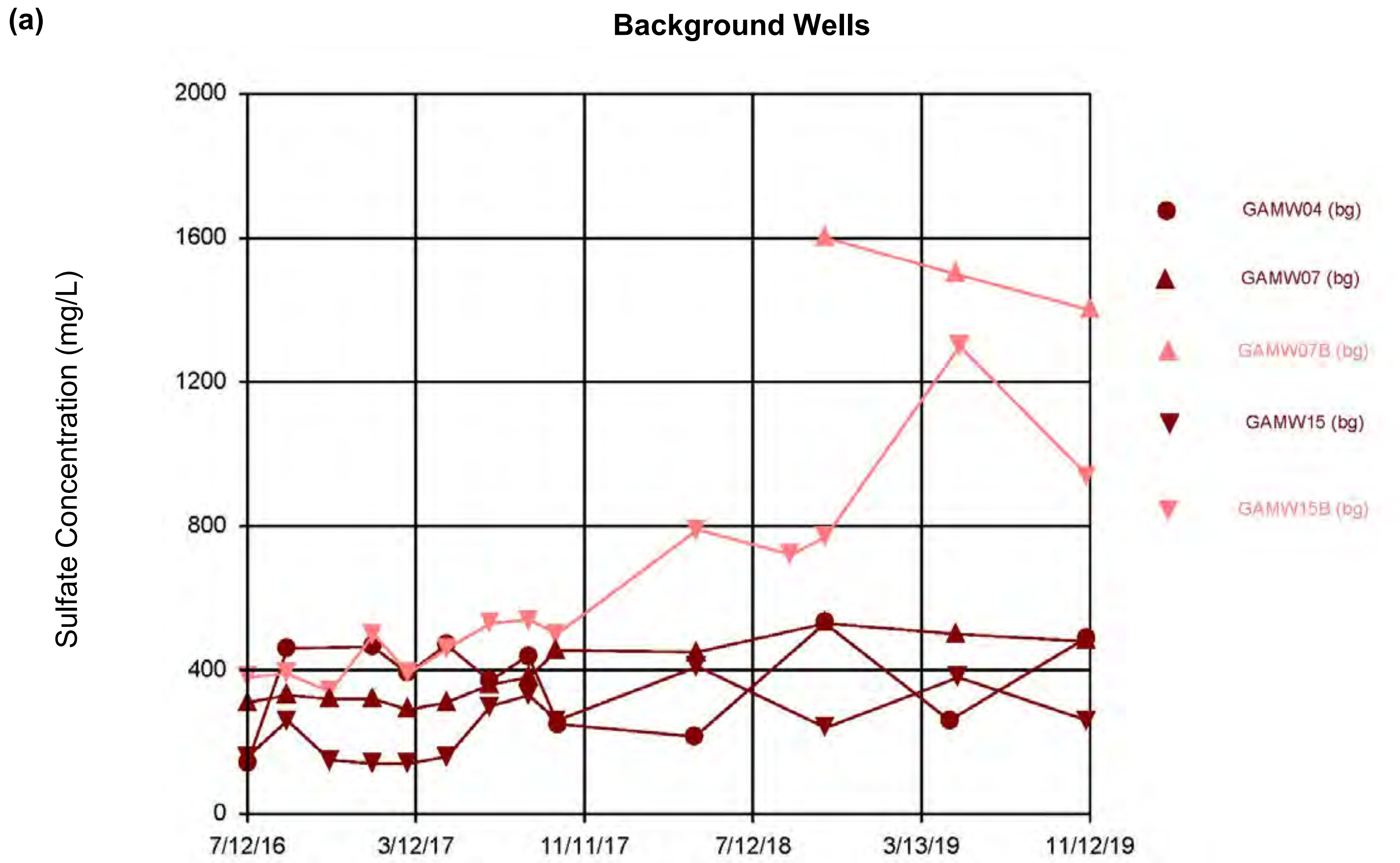

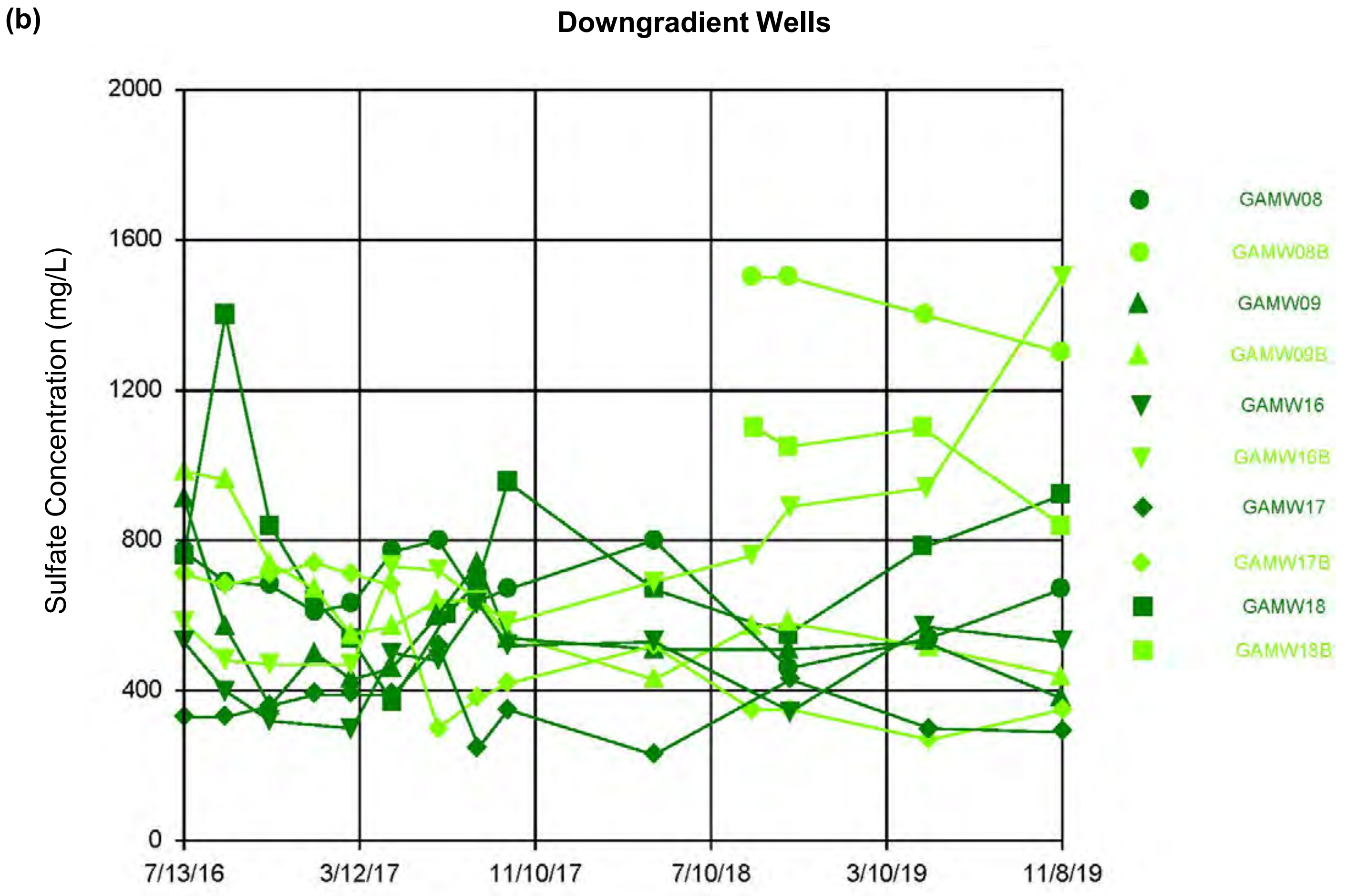

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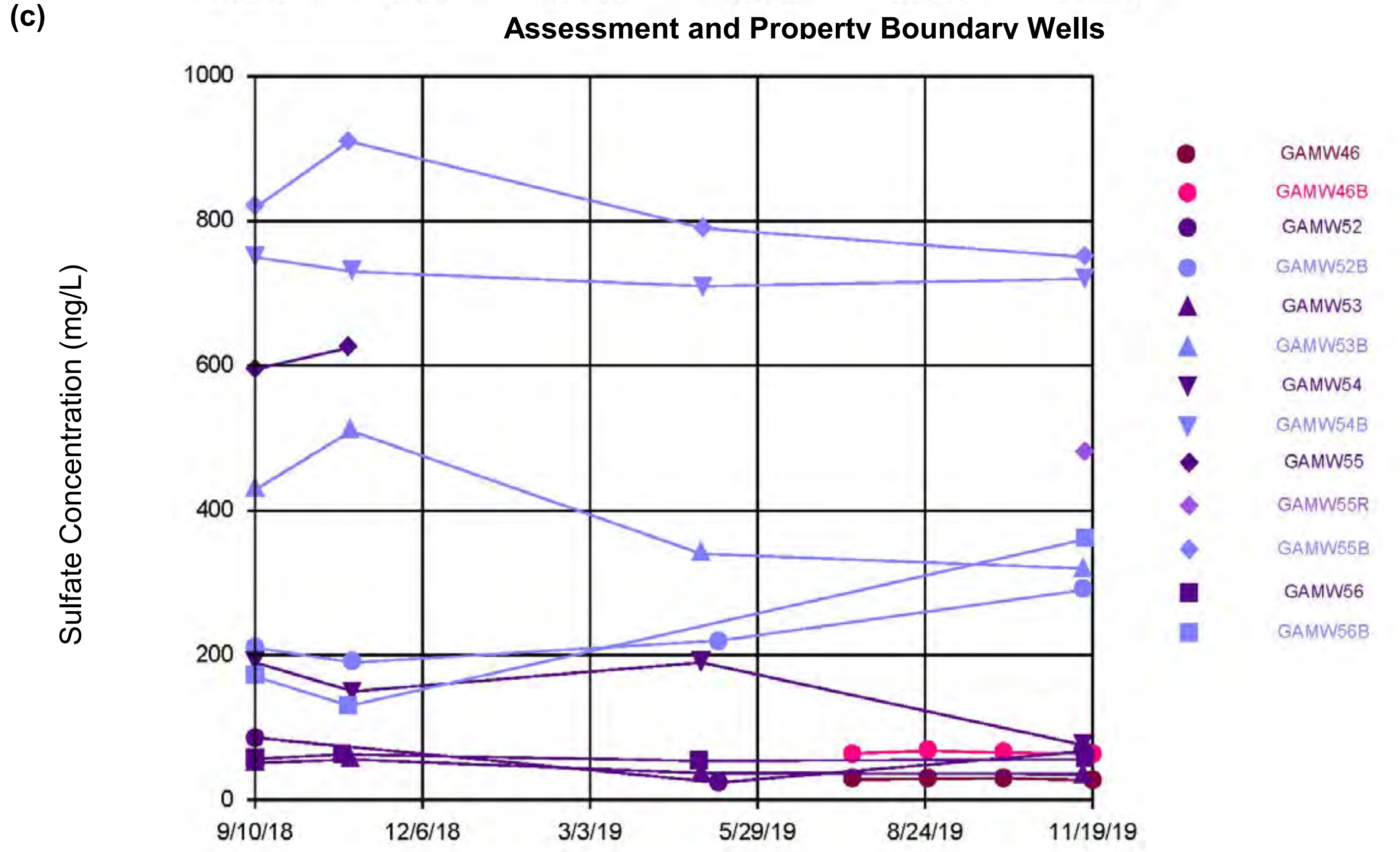


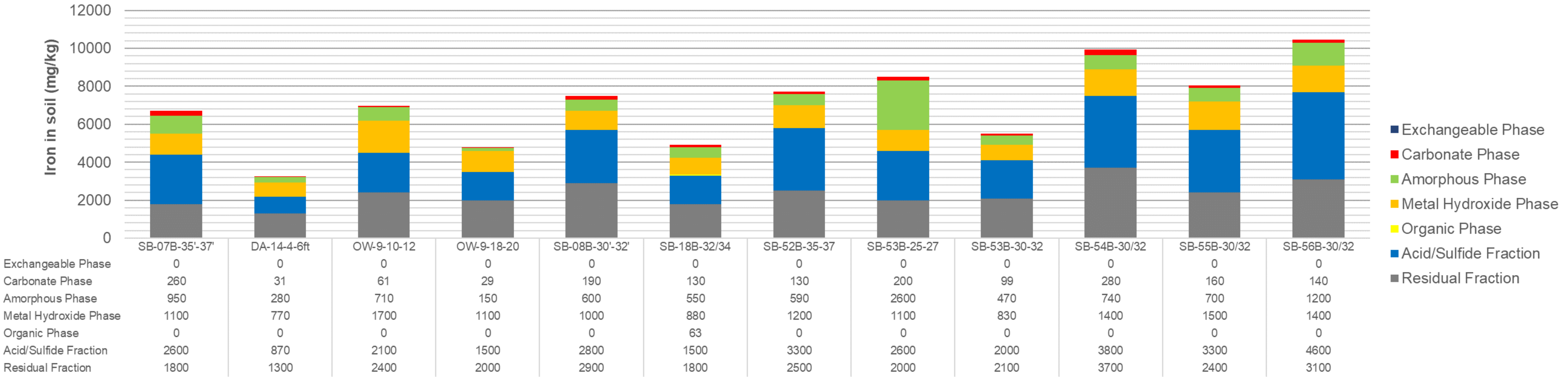
CLIENT
NIPSCO LLC

CONSULTANT
GOLDER

PROJECT
Monitored Natural Attenuation Evaluation
MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station

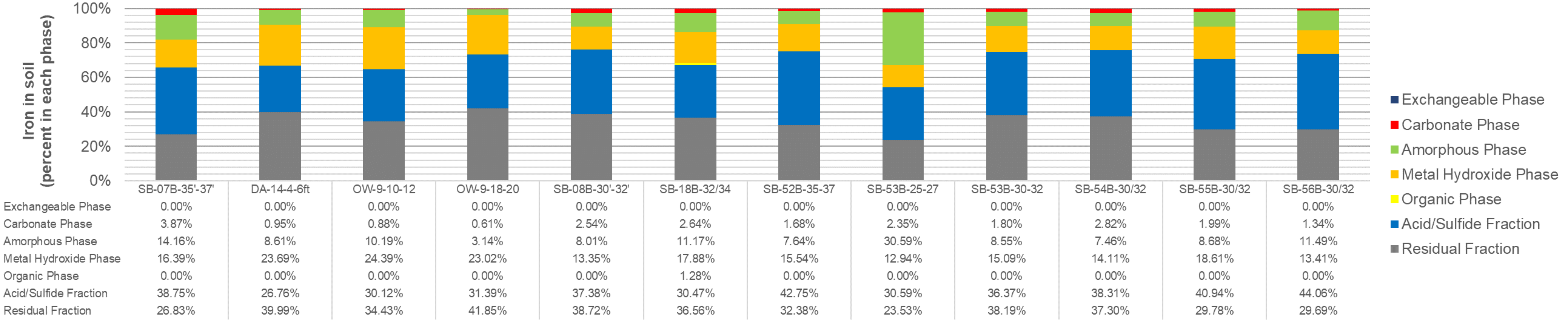
TITLE
Sulfate Time Series for Background, Monitoring, and Assessment and Property Boundary Wells

PROJECT NO.	PHASE	REV.	FIGURE
19121567	192	A	9a-c



	SB-07B-35'-37'	DA-14-4-6ft	OW-9-10-12	OW-9-18-20	SB-08B-30'-32'	SB-18B-32/34	SB-52B-35-37	SB-53B-25-27	SB-53B-30-32	SB-54B-30/32	SB-55B-30/32	SB-56B-30/32
Exchangeable Phase	0	0	0	0	0	0	0	0	0	0	0	0
Carbonate Phase	260	31	61	29	190	130	130	200	99	280	160	140
Amorphous Phase	950	280	710	150	600	550	590	2600	470	740	700	1200
Metal Hydroxide Phase	1100	770	1700	1100	1000	880	1200	1100	830	1400	1500	1400
Organic Phase	0	0	0	0	0	63	0	0	0	0	0	0
Acid/Sulfide Fraction	2600	870	2100	1500	2800	1500	3300	2600	2000	3800	3300	4600
Residual Fraction	1800	1300	2400	2000	2900	1800	2500	2000	2100	3700	2400	3100

Borehole and depth below ground surface (Iron in mg/kg soil)



	SB-07B-35'-37'	DA-14-4-6ft	OW-9-10-12	OW-9-18-20	SB-08B-30'-32'	SB-18B-32/34	SB-52B-35-37	SB-53B-25-27	SB-53B-30-32	SB-54B-30/32	SB-55B-30/32	SB-56B-30/32
Exchangeable Phase	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Carbonate Phase	3.87%	0.95%	0.88%	0.61%	2.54%	2.64%	1.68%	2.35%	1.80%	2.82%	1.99%	1.34%
Amorphous Phase	14.16%	8.61%	10.19%	3.14%	8.01%	11.17%	7.64%	30.59%	8.55%	7.46%	8.68%	11.49%
Metal Hydroxide Phase	16.39%	23.69%	24.39%	23.02%	13.35%	17.88%	15.54%	12.94%	15.09%	14.11%	18.61%	13.41%
Organic Phase	0.00%	0.00%	0.00%	0.00%	0.00%	1.28%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Acid/Sulfide Fraction	38.75%	26.76%	30.12%	31.39%	37.38%	30.47%	42.75%	30.59%	36.37%	38.31%	40.94%	44.06%
Residual Fraction	26.83%	39.99%	34.43%	41.85%	38.72%	36.56%	32.38%	23.53%	38.19%	37.30%	29.78%	29.69%

Borehole and depth below ground surface (Iron in percent of total)

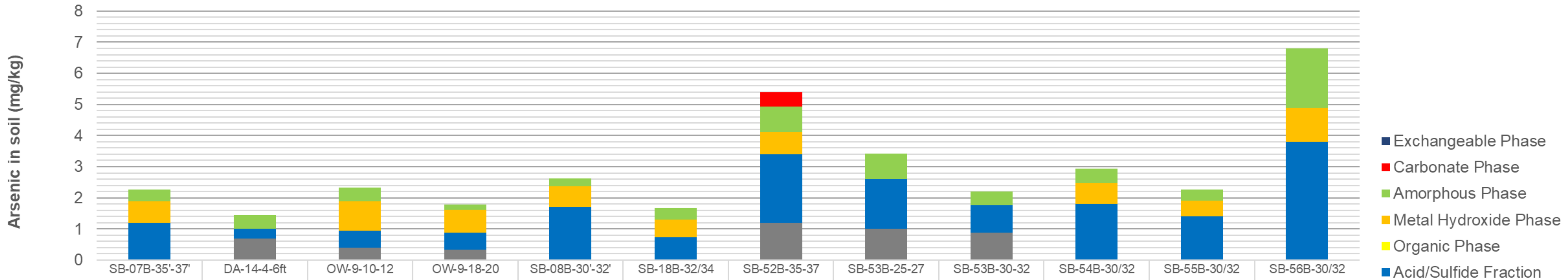
CLIENT
NIPSCO LLC

CONSULTANT
GOLDER

PROJECT
Monitored Natural Attenuation Evaluation
MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station

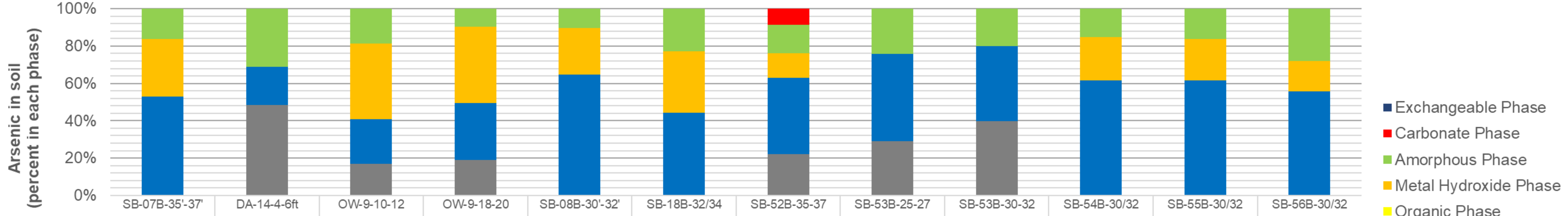
TITLE
Iron Sequential Extraction Results

PROJECT NO.	PHASE	REV.	FIGURE
19121567	192	A	10



	SB-07B-35'-37'	DA-14-4-6ft	OW-9-10-12	OW-9-18-20	SB-08B-30'-32'	SB-18B-32/34	SB-52B-35-37	SB-53B-25-27	SB-53B-30-32	SB-54B-30/32	SB-55B-30/32	SB-56B-30/32
Exchangeable Phase	0	0	0	0	0	0	0	0	0	0	0	0
Carbonate Phase	0	0	0	0	0	0	0.46	0	0	0	0	0
Amorphous Phase	0.37	0.45	0.43	0.17	0.27	0.38	0.83	0.83	0.44	0.45	0.37	1.9
Metal Hydroxide Phase	0.69	0	0.94	0.73	0.66	0.55	0.71	0	0	0.68	0.5	1.1
Organic Phase	0	0	0	0	0	0	0	0	0	0	0	0
Acid/Sulfide Fraction	1.2	0.3	0.56	0.54	1.7	0.74	2.2	1.6	0.89	1.8	1.4	3.8
Residual Fraction	0	0.7	0.39	0.34	0	0	1.2	1	0.88	0	0	0

Borehole and depth below ground surface (Arsenic in mg/kg soil)



	SB-07B-35'-37'	DA-14-4-6ft	OW-9-10-12	OW-9-18-20	SB-08B-30'-32'	SB-18B-32/34	SB-52B-35-37	SB-53B-25-27	SB-53B-30-32	SB-54B-30/32	SB-55B-30/32	SB-56B-30/32
Exchangeable Phase	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Carbonate Phase	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	8.52%	0.00%	0.00%	0.00%	0.00%	0.00%
Amorphous Phase	16.37%	31.03%	18.53%	9.55%	10.27%	22.75%	15.37%	24.20%	19.91%	15.36%	16.30%	27.94%
Metal Hydroxide Phase	30.53%	0.00%	40.52%	41.01%	25.10%	32.93%	13.15%	0.00%	0.00%	23.21%	22.03%	16.18%
Organic Phase	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Acid/Sulfide Fraction	53.10%	20.69%	24.14%	30.34%	64.64%	44.31%	40.74%	46.65%	40.27%	61.43%	61.67%	55.88%
Residual Fraction	0.00%	48.28%	16.81%	19.10%	0.00%	0.00%	22.22%	29.15%	39.82%	0.00%	0.00%	0.00%

Borehole and depth below ground surface (Arsenic in percent of total)

CLIENT
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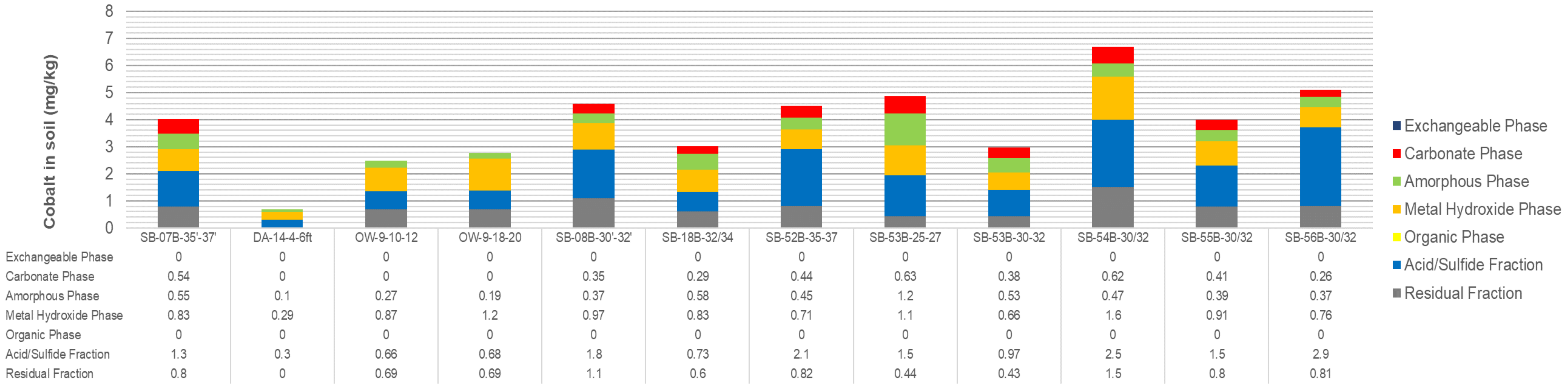
GOLDER

PROJECT
Monitored Natural Attenuation Evaluation
MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station

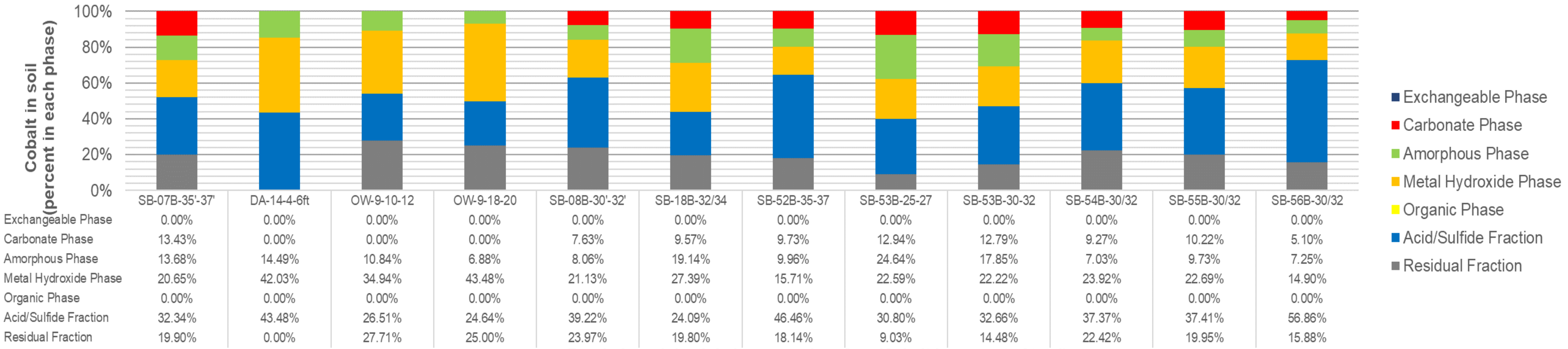
TITLE
Arsenic Sequential Extraction Results

PROJECT NO.	PHASE	REV.	FIGURE
19121567	192	A	11



	SB-07B-35'-37'	DA-14-4-6ft	OW-9-10-12	OW-9-18-20	SB-08B-30'-32'	SB-18B-32/34	SB-52B-35-37	SB-53B-25-27	SB-53B-30-32	SB-54B-30/32	SB-55B-30/32	SB-56B-30/32
Exchangeable Phase	0	0	0	0	0	0	0	0	0	0	0	0
Carbonate Phase	0.54	0	0	0	0.35	0.29	0.44	0.63	0.38	0.62	0.41	0.26
Amorphous Phase	0.55	0.1	0.27	0.19	0.37	0.58	0.45	1.2	0.53	0.47	0.39	0.37
Metal Hydroxide Phase	0.83	0.29	0.87	1.2	0.97	0.83	0.71	1.1	0.66	1.6	0.91	0.76
Organic Phase	0	0	0	0	0	0	0	0	0	0	0	0
Acid/Sulfide Fraction	1.3	0.3	0.66	0.68	1.8	0.73	2.1	1.5	0.97	2.5	1.5	2.9
Residual Fraction	0.8	0	0.69	0.69	1.1	0.6	0.82	0.44	0.43	1.5	0.8	0.81

Borehole and depth below ground surface (Cobalt in mg/kg soil)



	SB-07B-35'-37'	DA-14-4-6ft	OW-9-10-12	OW-9-18-20	SB-08B-30'-32'	SB-18B-32/34	SB-52B-35-37	SB-53B-25-27	SB-53B-30-32	SB-54B-30/32	SB-55B-30/32	SB-56B-30/32
Exchangeable Phase	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Carbonate Phase	13.43%	0.00%	0.00%	0.00%	7.63%	9.57%	9.73%	12.94%	12.79%	9.27%	10.22%	5.10%
Amorphous Phase	13.68%	14.49%	10.84%	6.88%	8.06%	19.14%	9.96%	24.64%	17.85%	7.03%	9.73%	7.25%
Metal Hydroxide Phase	20.65%	42.03%	34.94%	43.48%	21.13%	27.39%	15.71%	22.59%	22.22%	23.92%	22.69%	14.90%
Organic Phase	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Acid/Sulfide Fraction	32.34%	43.48%	26.51%	24.64%	39.22%	24.09%	46.46%	30.80%	32.66%	37.37%	37.41%	56.86%
Residual Fraction	19.90%	0.00%	27.71%	25.00%	23.97%	19.80%	18.14%	9.03%	14.48%	22.42%	19.95%	15.88%

Borehole and depth below ground surface (Cobalt in percent of total)

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PROJECT
Monitored Natural Attenuation Evaluation
MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station

TITLE
Cobalt Sequential Extraction Results

PROJECT NO.	PHASE	REV.	FIGURE
19121567	192	A	12

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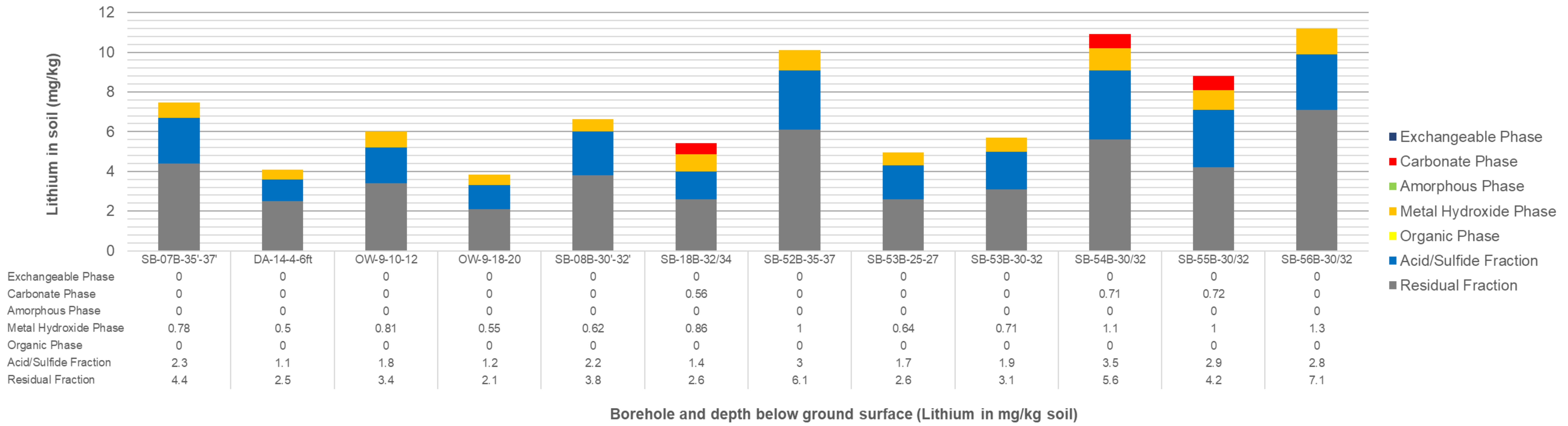
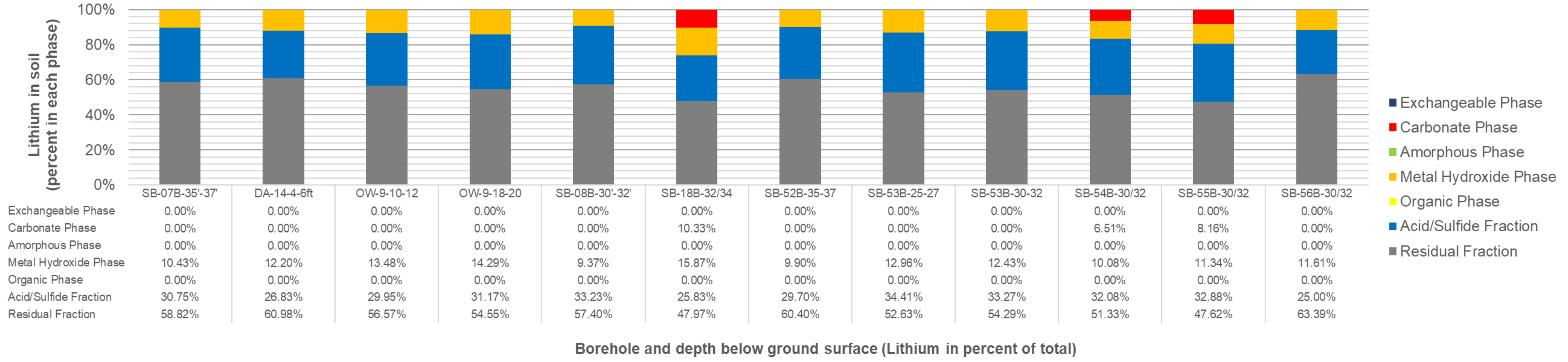


	SB-07B-35'-37'	DA-14-4-6ft	OW-9-10-12	OW-9-18-20	SB-08B-30'-32'	SB-18B-32/34	SB-52B-35-37	SB-53B-25-27	SB-53B-30-32	SB-54B-30/32	SB-55B-30/32	SB-56B-30/32
Exchangeable Phase	0	0	0	0	0	0	0	0	0	0	0	0
Carbonate Phase	0	0	0	0	0	0.56	0	0	0	0.71	0.72	0
Amorphous Phase	0	0	0	0	0	0	0	0	0	0	0	0
Metal Hydroxide Phase	0.78	0.5	0.81	0.55	0.62	0.86	1	0.64	0.71	1.1	1	1.3
Organic Phase	0	0	0	0	0	0	0	0	0	0	0	0
Acid/Sulfide Fraction	2.3	1.1	1.8	1.2	2.2	1.4	3	1.7	1.9	3.5	2.9	2.8
Residual Fraction	4.4	2.5	3.4	2.1	3.8	2.6	6.1	2.6	3.1	5.6	4.2	7.1



	SB-07B-35'-37'	DA-14-4-6ft	OW-9-10-12	OW-9-18-20	SB-08B-30'-32'	SB-18B-32/34	SB-52B-35-37	SB-53B-25-27	SB-53B-30-32	SB-54B-30/32	SB-55B-30/32	SB-56B-30/32
Exchangeable Phase	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Carbonate Phase	0.00%	0.00%	0.00%	0.00%	0.00%	10.33%	0.00%	0.00%	0.00%	6.51%	8.16%	0.00%
Amorphous Phase	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Metal Hydroxide Phase	10.43%	12.20%	13.48%	14.29%	9.37%	15.87%	9.90%	12.96%	12.43%	10.08%	11.34%	11.61%
Organic Phase	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Acid/Sulfide Fraction	30.75%	26.83%	29.95%	31.17%	33.23%	25.83%	29.70%	34.41%	33.27%	32.08%	32.88%	25.00%
Residual Fraction	58.82%	60.98%	56.57%	54.55%	57.40%	47.97%	60.40%	52.63%	54.29%	51.33%	47.62%	63.39%

CLIENT
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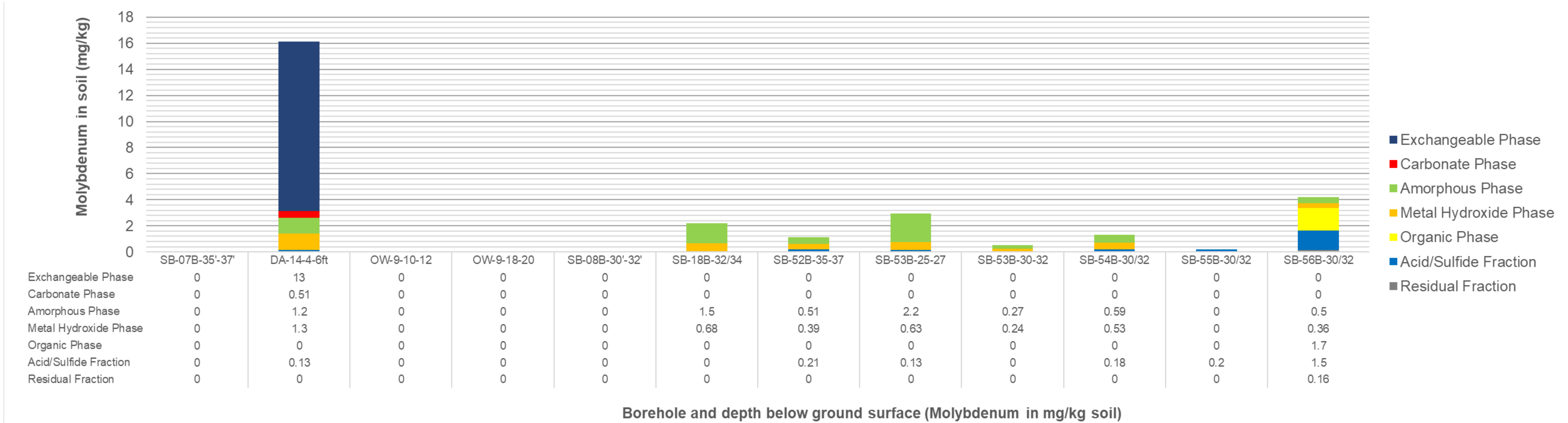
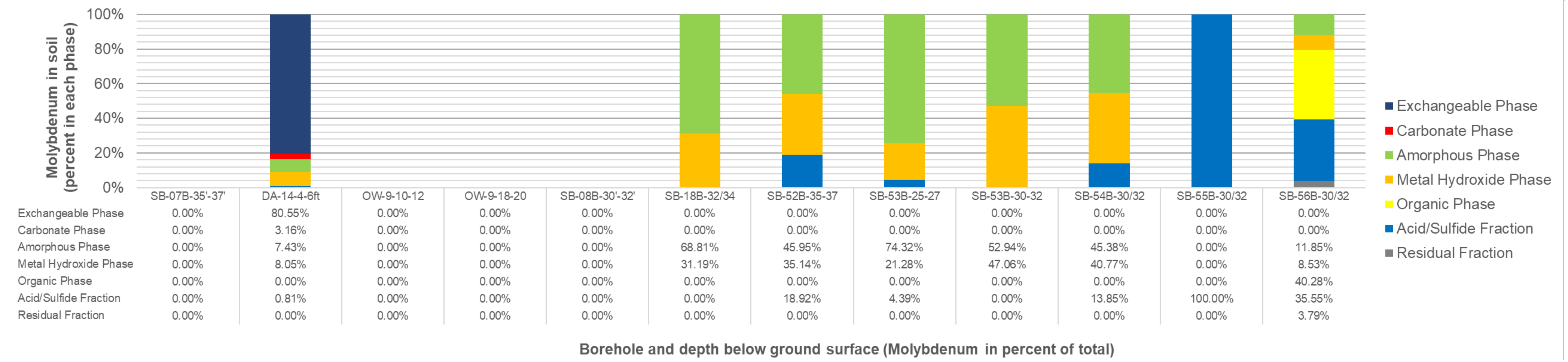
PROJECT
Monitored Natural Attenuation Evaluation
MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station

TITLE
Lithium Sequential Extraction Results

PROJECT NO.	PHASE	REV.	FIGURE
19121567	192	A	13



	SB-07B-35'-37'	DA-14-4-6ft	OW-9-10-12	OW-9-18-20	SB-08B-30'-32'	SB-18B-32/34	SB-52B-35-37	SB-53B-25-27	SB-53B-30-32	SB-54B-30/32	SB-55B-30/32	SB-56B-30/32
Exchangeable Phase	0	13	0	0	0	0	0	0	0	0	0	0
Carbonate Phase	0	0.51	0	0	0	0	0	0	0	0	0	0
Amorphous Phase	0	1.2	0	0	0	1.5	0.51	2.2	0.27	0.59	0	0.5
Metal Hydroxide Phase	0	1.3	0	0	0	0.68	0.39	0.63	0.24	0.53	0	0.36
Organic Phase	0	0	0	0	0	0	0	0	0	0	0	1.7
Acid/Sulfide Fraction	0	0.13	0	0	0	0	0.21	0.13	0	0.18	0.2	1.5
Residual Fraction	0	0	0	0	0	0	0	0	0	0	0	0.16



	SB-07B-35'-37'	DA-14-4-6ft	OW-9-10-12	OW-9-18-20	SB-08B-30'-32'	SB-18B-32/34	SB-52B-35-37	SB-53B-25-27	SB-53B-30-32	SB-54B-30/32	SB-55B-30/32	SB-56B-30/32
Exchangeable Phase	0.00%	80.55%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Carbonate Phase	0.00%	3.16%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Amorphous Phase	0.00%	7.43%	0.00%	0.00%	0.00%	68.81%	45.95%	74.32%	52.94%	45.38%	0.00%	11.85%
Metal Hydroxide Phase	0.00%	8.05%	0.00%	0.00%	0.00%	31.19%	35.14%	21.28%	47.06%	40.77%	0.00%	8.53%
Organic Phase	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	40.28%
Acid/Sulfide Fraction	0.00%	0.81%	0.00%	0.00%	0.00%	0.00%	18.92%	4.39%	0.00%	13.85%	100.00%	35.55%
Residual Fraction	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.79%

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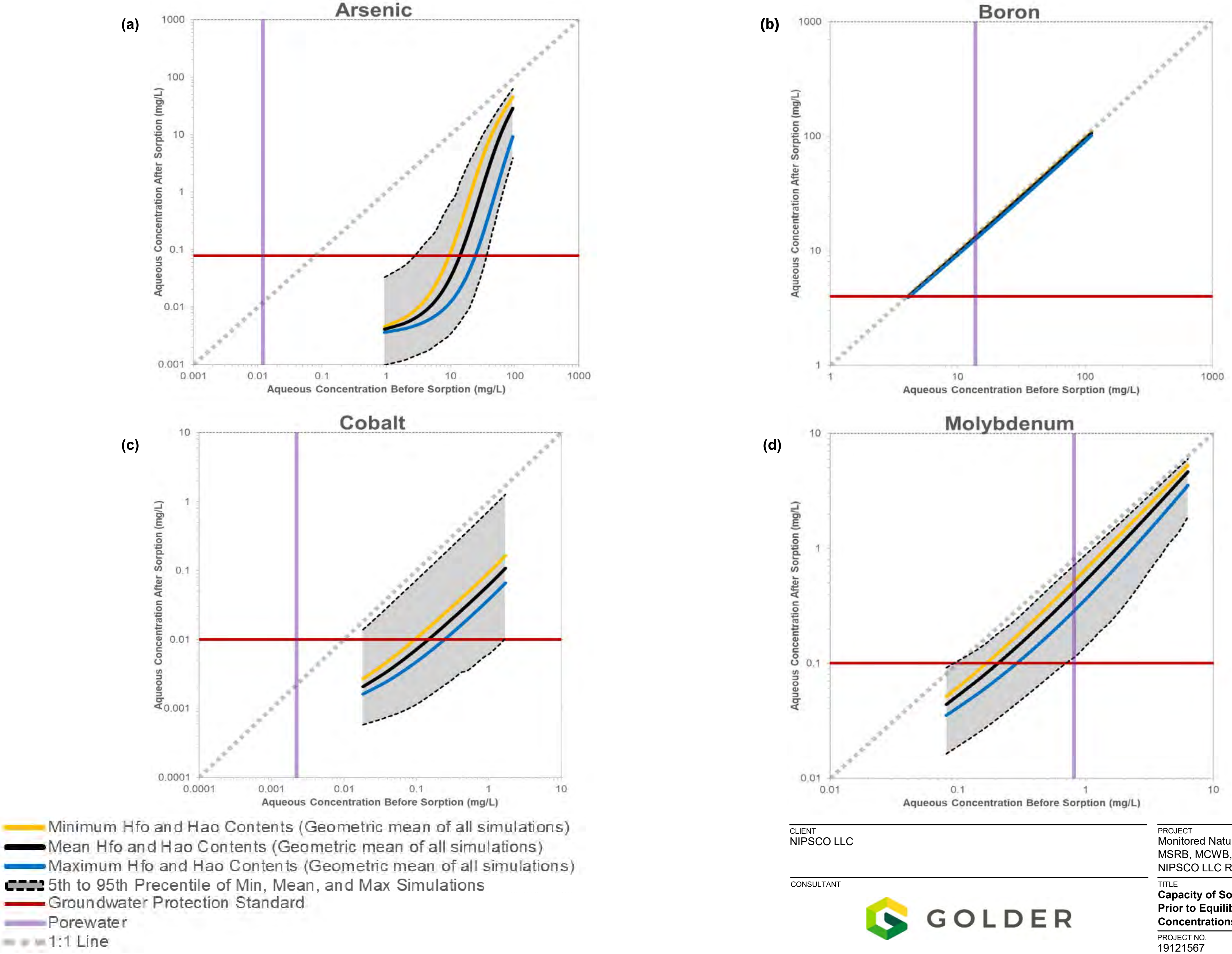
PROJECT
Monitored Natural Attenuation Evaluation
MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station

TITLE
Molybdenum Sequential Extraction Results

PROJECT NO.	PHASE	REV.	FIGURE
19121567	192	A	14



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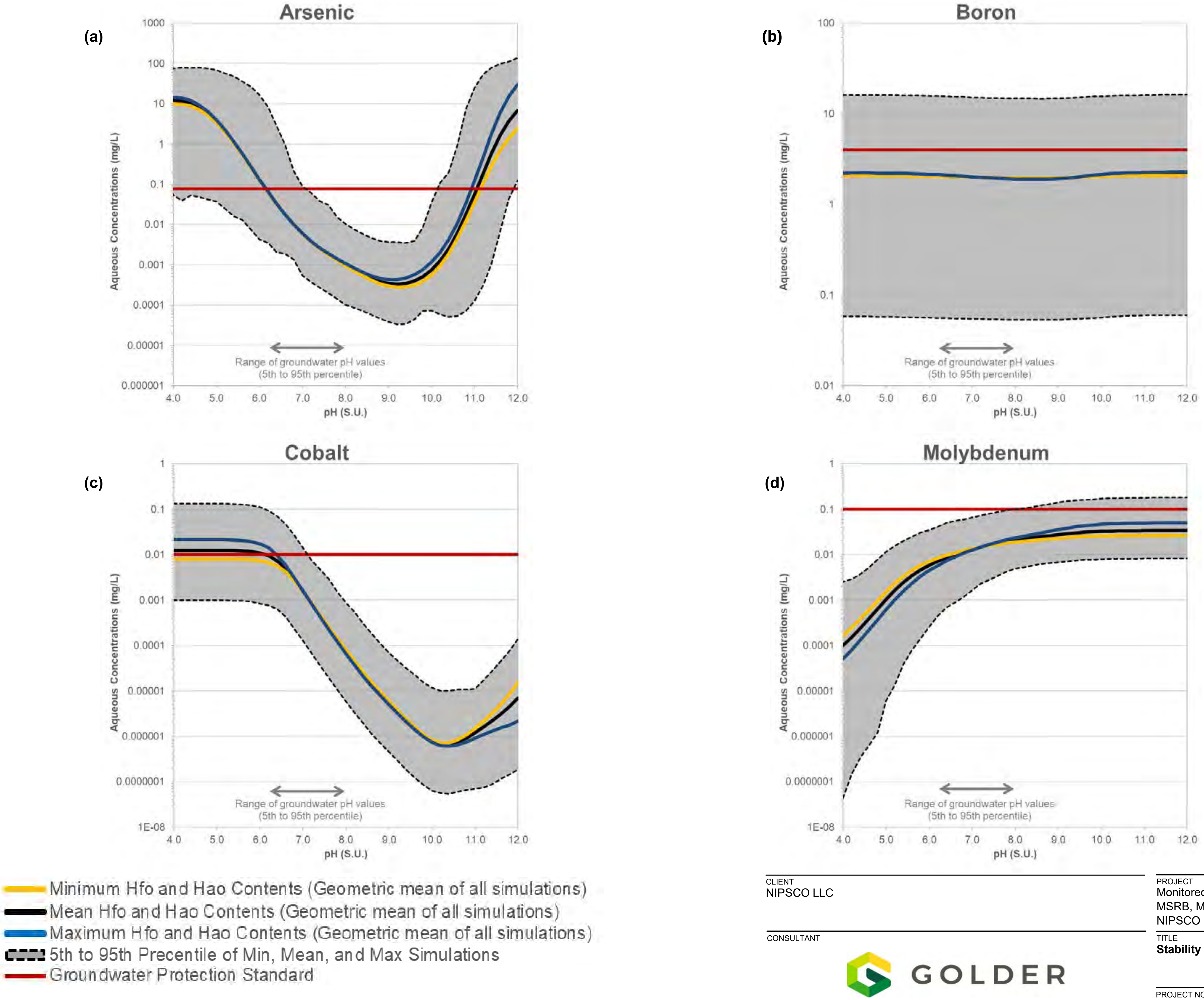
PROJECT
Monitored Natural Attenuation Evaluation
MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station

TITLE
Capacity of Soils to Adsorb Constituents: Aqueous Concentrations Prior to Equilibrating with Hfo and Hao versus Aqueous Concentrations After Equilibrating

PROJECT NO.	PHASE	REV.	FIGURE
19121567	192	A	15



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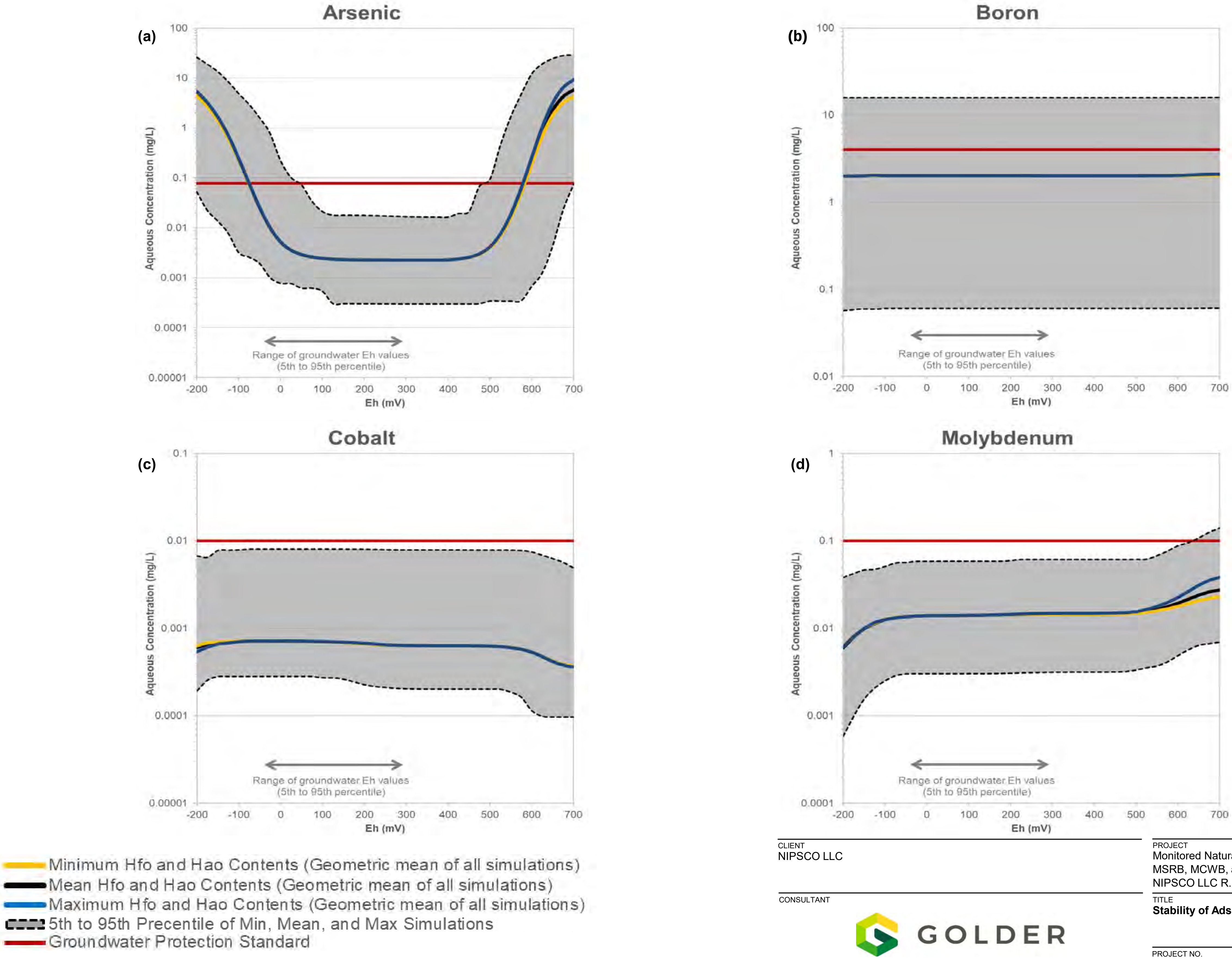
PROJECT
Monitored Natural Attenuation Evaluation
MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station

TITLE
Stability of Adsorbed Constituents Versus pH

PROJECT NO.	PHASE	REV.	FIGURE
19121567	192	A	16



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NIPSCO LLC

CONSULTANT
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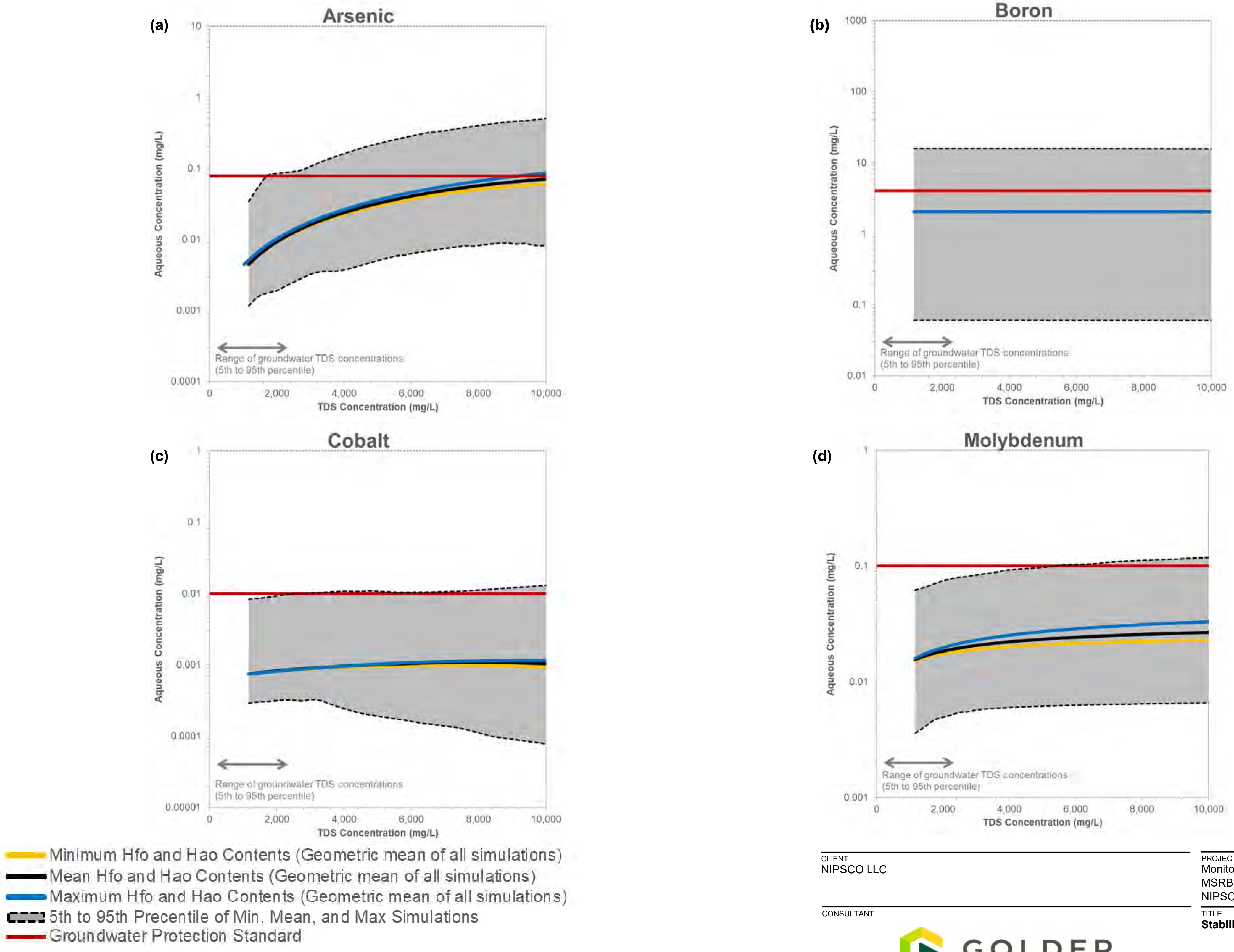
PROJECT
Monitored Natural Attenuation Evaluation
MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station

TITLE
Stability of Adsorbed Constituents Versus Eh

PROJECT NO.	PHASE	REV.	FIGURE
19121567	192	A	17



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PROJECT
Monitored Natural Attenuation Evaluation
MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station

TITLE
Stability of Adsorbed Constituents Versus TDS

PROJECT NO.	PHASE	REV.	FIGURE
19121567	192	A	18

APPENDIX A

Groundwater and Porewater Monitoring Data

Appendix A-1: Groundwater Analytical Data
CCR Unit Schahfer MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station
Wheatfield, Indiana

Location		GAMW04																
Sample Date		2016-07-12	2016-09-08	2016-11-09	2017-01-10		2017-03-01	2017-04-26	2017-06-28	2017-08-22	2017-10-04	2018-03-13		2018-04-20		2018-10-25	2019-04-23	2019-11-07
Sample Type		N	N	N	FD	N	N	N	N	N	N	FD	N	FD	N	N	N	N
Chemical Name	Unit																	
CCR Appendix III																		
Boron	mg/L	0.48	1.4	2.4	1.1	1	1.2	0.74	0.92	1.2	0.54			0.74	0.72	0.78	0.74	1.3
Calcium	mg/L	110	230	300	270	240	230	220	200	200	140			140	140	210	130	190
Chloride	mg/L	2.2	27	69	13	14	13	5.4	12	13	4.5			3.7 J	4.4	10	3.7	9.5
Fluoride	mg/L	0.92 J+	0.2 J	10 U	0.19 J	0.17 J	5 U	5 U	0.19 J	0.21 J	0.24 J	0.15 J	5 U	5 U	0.17 J-	0.26	0.16 J+	0.23
pH	SU	7.22	6.83	6.75		6.93	7.01	6.76	6.88	7.21	7.28		6.95		7.2	6.39	7	7.14
Sulfate	mg/L	140 J-	460	480	460	470	390	470	370	440	250			220	210	530	260	490
Total Dissolved Solids	mg/L	420	990	1400	1000	1000	890	870	880	920	610			580 J	580	980	600	900
CCR Appendix IV																		
Antimony	mg/L	0.002 U	0.002 U	0.00027 J	0.002 U	0.00057 J	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U	0.002 U			0.002 U	0.00065 J	0.00092 J
Arsenic	mg/L	0.0059	0.013	0.0052	0.0058	0.0072	0.005 U	0.0099	0.012	0.012		0.004 J	0.0054			0.014	0.0023 J	0.0018 J
Barium	mg/L	0.041	0.077	0.11	0.095	0.079	0.089	0.069	0.084	0.09		0.11	0.077			0.074	0.068	0.066
Beryllium	mg/L	0.00027 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U			0.00048 J	0.00053 J	0.001 U
Cadmium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U			0.001 U	0.001 U	0.001 U
Chromium	mg/L	0.002 U	0.002 U	0.00036 J	0.00036 J	0.0052 J	0.002 U	0.002 U	0.002 U	0.002 U		0.0011 J	0.0012 J			0.002 U	0.002 U	0.002 U
Cobalt	mg/L	0.001 U	0.00031 J	0.00064 J	0.0061	0.0058	0.0038	0.0049	0.003	0.0023		0.0028	0.0031			0.0026	0.0011	0.00043 J
Fluoride	mg/L	0.92 J+	0.2 J	10 U	0.19 J	0.17 J	5 U	5 U	0.19 J	0.21 J	0.24 J	0.15 J	5 U	5 U	0.17 J-	0.26	0.16 J+	0.23
Lead	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U			0.001 U	0.001 U	0.001 U
Lithium	mg/L	0.0018 J	0.008 U	0.008 U	0.0021 J	0.0023 J	0.0033 J	0.0033 J	0.0062 J	0.0062 J		0.008 U	0.008 U			0.0023 J	0.0045 J	0.0028 J
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U	0.0002 U			0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L	0.0075 J	0.023	0.073	0.037	0.038	0.034	0.016	0.02	0.034		0.0048 J	0.024			0.039	0.024	0.055
Radium, Total	pci/L	5 U	0.583	0.697	0.804	0.515 U	0.362 U	0.379 U	0.364 U	0.352 U		1.35 J+	0.778 J+			0.473	0.591	
Radium-226	pci/L	1 U	0.138 U	0.346 U	0.301 U	0.242 U	0.121 U	0.117 U	0.119 J+	0.118		0.177	0.0881			0.306	0.311 U	
Radium-228	pci/L	1 U	0.498 U	0.495 U	0.677 J+	0.515 U	0.362 U	0.379 U	0.364 U	0.352 U		1.17 J+	0.69 J+			0.462 U	0.405	
Selenium	mg/L	0.005 U	0.005 U	0.00064 J	0.0017 J	0.0021 J	0.005 U	0.005 U	0.005 U	0.005 U		0.001 J	0.001 J			0.005 U	0.0013 J	0.0052
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U			0.001 U	0.001 U	0.001 U
Supplemental Parameters																		
Alkalinity, Bicarbonate (HCO3)	mg/L																	
Alkalinity, Carbonate (CO3)	mg/L																	
Alkalinity, Hydroxide (OH)	mg/L																	
Alkalinity, Total	mg/L															230	190	270
Ferric Iron	mg/L															6.9		
Ferrous Iron	mg/L															3.1 J		
Iron	mg/L																2.3	0.083 J
Magnesium	mg/L															31	18	31
Manganese	mg/L																0.012 J-	0.0078 J
Nitrate as N	mg/L																0.1 U	0.1 U
Nitrite as N	mg/L																	
Nitrogen, Nitrate-Nitrite	mg/L															0.39		
Phosphorus (as phosphate)	mg/L															0.9	0.31 U	0.31 UJ
Potassium	mg/L															3.3 J	3.1 J	3.2 J
Sodium	mg/L															13	12	36
Sample Parameters																		
Dissolved Oxygen	mg/L	0.09	0.58	0.37		1.82	1.47	0.12	0.3	0.52	0.09		0.66		2.3	0.15	7.08	2.55
Oxidation Reduction Potential	mV	59.6	-24	-6.9		-31.7	14	-57.8	-45	-27	-105.8		-181.8		-81.2	-58.1	19	-60.7
Eh	mV	259.6	176.0	193.1		168.3	214.0	142.2	155.0	173.0	94.2		18.2		118.8	141.9	219.0	139.3
pH	SU	7.22	6.83	6.75		6.93	7.01	6.76	6.88	7.21	7.28		6.95		7.2	6.39	7	7.14
Specific Conductance	uS/cm	595	1345	1681		1109	910	1137	911	1153	813		562		770	1311	549	866
Temperature	deg C	13	17.3	16.3		10.5	8.05	10.2	13.1	15.9	16.1		7.55		3.5	15.5	4.2	13.2
Turbidity	NTU	4.04	1.48	2.21		2.28	4.26	4.04	4.88	1.65	0.51		4.92		3.12	1.92	4.48	1.38

Notes:
CCR = coal combustion residual
mg/L = milligrams per liter
mV= millivolts
pci/L= picoCuries per liter
uS/cm = micro Siemens per centimeter
deg C = degrees Celsius
NTU = Nephelometric Turbidity Units
SU = Standard Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J+" = Indicates the result is estimated and may be biased high.
"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.
"R"= Result was rejected during data validation.

Appendix A-1: Groundwater Analytical Data
CCR Unit Schahfer MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station
Wheatfield, Indiana

	Location	GAMW07															GAMW07B			
	Sample Date	2016-07-12	2016-09-08	2016-11-09	2017-01-10	2017-03-01	2017-04-26	2017-06-29	2017-08-23	2017-10-03		2018-03-15	2018-04-23	2018-10-26	2019-05-02	2019-11-08	2018-09-06	2018-10-26	2019-05-02	2019-11-12
	Sample Type	N	N	N	N	N	N	N	N	FD	N	N	N	N	N	N	N	N	N	N
Chemical Name	Unit																			
CCR Appendix III																				
Boron	mg/L	1.2	1	0.91	0.91	1	0.68	0.67	0.68	0.71	0.72		1.2	1.3	0.85	0.85	20	23	18	15
Calcium	mg/L	170	190	200	170	170	190	220	190	220	220		210	230	220	180	370	430	380	400
Chloride	mg/L	7.8	6.6	5.3	6	7.6	2.8	3 J	3.2 J	3 J	3.6 J		4.7 J	6.3	6.5	4.8	10 U	250	170	150
Fluoride	mg/L	0.72 J+	0.91 J	0.8 J	0.85 J	0.66 J	0.76 J	0.79 J	0.66 J	1.1 J	0.93 J	0.58 J	0.57 J	0.73	0.97	0.88	10 U	1.5	1.3	1.2
pH	SU	7.03	7.27	7.04	7.15	7.2	7.17	6.57	7.2		7.1	7.28	7.35	5.71	7.2	7.44	8.29	6.78	7.58	7.13
Sulfate	mg/L	310 J-	330	320	320	290	310	360	380	460	450		450	530	500	480	10 U	1600	1500	1400
Total Dissolved Solids	mg/L	770	830	840	750	710	810	970	910	970	1000		900	970	1100	940	2700	2600	920	2300
CCR Appendix IV																				
Antimony	mg/L	0.00035 J	0.00039 J	0.00035 J	0.00028 J	0.002 U	0.002 U	0.002 U	0.002 U			0.002 U		0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic	mg/L	0.0013 J	0.0016 J	0.0018 J	0.0028 J	0.005 U	0.0028 J	0.0025 J	0.0016 J			0.005 U		0.0012 J	0.0019 J	0.0011 J	0.0028 J	0.0015 J	0.0019 J	0.0017 J
Barium	mg/L	0.052	0.055	0.056	0.042	0.05	0.05	0.059	0.059			0.056		0.064	0.053	0.043	0.072	0.063	0.053	0.043
Beryllium	mg/L	0.00011 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U			0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0003 J	0.00022 J			0.001 U		0.00047 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chromium	mg/L	0.002 U	0.002 U	0.00047 J	0.00046 J	0.002 U	0.002 U	0.002 U	0.002 U			0.002 U		0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt	mg/L	0.0056	0.0077	0.0055	0.0038	0.0044	0.0063	0.01	0.0095			0.006		0.01	0.0074	0.0049	0.00074 J	0.001 U	0.001 U	0.001 U
Fluoride	mg/L	0.72 J+	0.91 J	0.8 J	0.85 J	0.66 J	0.76 J	0.79 J	0.66 J	1.1 J	0.93 J	0.58 J	0.57 J	0.73	0.97	0.88	10 U	1.5	1.3	1.2
Lead	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0007 J			0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium	mg/L	0.0034 J	0.008 U	0.008 U	0.0035 J	0.0031 J	0.0041 J	0.0037 J	0.0038 J			0.0024 J		0.0054 J	0.0041 J	0.0033 J	0.0043 J	0.0045 J	0.004 J	0.0035 J
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ			0.0002 U		0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L	0.0084 J	0.0098 J	0.0095 J	0.01 U	0.01 U	0.0083 J	0.0081 J	0.007 J			0.0066 J		0.0087 J	0.0097 J	0.0087 J	0.015	0.017	0.025	0.026
Radium, Total	pci/L	1.59	0.696	0.548	0.412 U	0.42 U	0.371 U	0.45	0.588			0.749 J+		0.823 J+	0.37 U		2.63	2.6 J+	2.31	
Radium-226	pci/L	0.667 J+	0.289	0.374	0.237 U	0.186	0.155	0.232 J+	0.3			0.163		0.483 J+	0.305 U		1.16	1.56 J+	1.17	
Radium-228	pci/L	0.923	0.406	0.462 U	0.412 U	0.42 U	0.371 U	0.262 U	0.413 U			0.585 J+		0.365 U	0.37 U		1.47	1.04	1.14	
Selenium	mg/L	0.005 U	0.005 U	0.003 J	0.003 J	0.005 U	0.008	0.0054	0.005			0.0028 J		0.0016 J	0.0045 J	0.0019 J	0.0012 J	0.005 U	0.005 U	0.005 U
Thallium	mg/L	0.00011 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U			0.001 U		0.00024 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Supplemental Parameters																				
Alkalinity, Bicarbonate (HCO3)	mg/L																180			
Alkalinity, Carbonate (CO3)	mg/L																5 U			
Alkalinity, Hydroxide (OH)	mg/L																5 U			
Alkalinity, Total	mg/L													260	270	250	180	180	170	170
Ferric Iron	mg/L													0.035 J			6.7 J	6.8		
Ferrous Iron	mg/L													0.05 UJ			0.1 R	1.1 J		
Iron	mg/L														0.067 J	0.09 J			5.3	5.5
Magnesium	mg/L													39	41	38	72	87	73	72
Manganese	mg/L														0.46	0.61			0.46	0.49
Nitrate as N	mg/L														3.3	1.6	0.05 R		0.1 U	0.1 U
Nitrite as N	mg/L																0.05 R			
Nitrogen, Nitrate-Nitrite	mg/L													0.53				0.049 J		
Phosphorus (as phosphate)	mg/L													0.31 U	0.31 U	0.31 U	0.031 U	0.31 U	0.31 U	0.31 U
Potassium	mg/L													6.6	5.5	6.5	12	13	13	13
Sodium	mg/L													14	14	9.9	290	240	230	120
Sample Parameters																				
Dissolved Oxygen	mg/L	0.6	1.81	0.59	0.52	0.51	1.96	1.02	0.84		0.48	0.8	3.52	2.64	0.81	0.38	0.13	0.67	0.19	0.2
Oxidation Reduction Potential	mV	111.2	64.2	-6.4	71.3	65.3	76.9	291.1	8.5		95.4	-55	-98.7	-233.3	135.1	-131.8	-197.6	-230.2	34.9	-196.7
Eh	mV	311.2	264.2	193.6	271.3	265.3	276.9	491.1	208.5		295.4	145.0	101.3	-33.3	335.1	68.2	2.4	-30.2	234.9	3.3
pH	SU	7.03	7.27	7.04	7.15	7.2	7.17	6.57	7.2		7.1	7.28	7.35	5.71	7.2	7.44	8.29	6.78	7.58	7.13
Specific Conductance	uS/cm	966	1072	1106	928	832	1121	1151	1157		1273	760	1060	1240	975	828	5178	3237	2357	1686
Temperature	deg C	14.4	19.2	16.7	12.9	10.63	11.8	14.6	16.5		18	10	10	16.95	10.3	15.3	15.03	13.86	12.4	12.9
Turbidity	NTU	4.6	4.51	1.26	3.2	4.76	2.17	2.87	0.9		0.49	1.3	1.75	1.08	2.72	4.58	4.48	3.01	2.86	1.11

Notes:
CCR = coal combustion residual
mg/L = milligrams per liter
mV= millivolts
pci/L= picoCuries per liter
uS/cm = micro Siemens per centimeter
deg C = degrees Celsius
NTU = Nephelometric Turbidity Units
SU = Standard Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.
"R"= Result was rejected during data validation.

Appendix A-1: Groundwater Analytical Data
CCR Unit Schahfer MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station
Wheatfield, Indiana

Location		GAMW08														GAMW08B					
Sample Date		2016-07-13	2016-09-08	2016-11-09	2017-01-10	2017-03-02	2017-04-27	2017-06-29	2017-08-23	2017-10-04	2018-03-14	2018-04-23	2018-10-26	2019-05-08	2019-11-07	2018-09-07		2018-10-26		2019-05-03	2019-11-07
Sample Type		N	N	N	N	N	N	N	N	N	N	N	N	N	N	FD	N	FD	N	N	N
Chemical Name	Unit																				
CCR Appendix III																					
Boron	mg/L	3.5	3.9	3.2	3.4	3.3	3.2	2.9	2.2	3.7		2.4	1.8	1.4	2.5		18		15	14	13
Calcium	mg/L	310	310	300	260	270	310	340	270	290		360	230	250	280		380		370	350	340
Chloride	mg/L	88	71	89	99	110	86	83	39	87		64	56	49	66		240		180	160	180
Fluoride	mg/L	1 J+	1.2 J	0.73 J	0.87 J	0.94 J	0.92 J	1.3 J	2 J	0.68 J	1.2 J	1.3 J-	1.6	2.2	1.9		1.6 J		1.5	1.9	1.7
pH	SU	6.92	7.03	6.85	7.02	7.09	6.93	7	7.27	6.89	7.41	7.41	6.99	7.37	7.5		7.7		7.45	7.57	7.85
Sulfate	mg/L	770 J-	690	680	610	630	770	800	640	670		800	460	540	670		1500		1500	1400	1300
Total Dissolved Solids	mg/L	1600	1500	1600	1300	1400	1700	2000	1400	1500		1700	1100	1300	1300		1900 J+		2300	2300	2200
CCR Appendix IV																					
Antimony	mg/L	0.00073 J	0.00069 J	0.0014 J	0.00041 J	0.00043 J	0.002 U	0.00059 J	0.00075 J		0.002 U		0.00082 J	0.00076 J	0.00077 J		0.002 U		0.002 U	0.002 U	0.002 U
Arsenic	mg/L	0.0018 J	0.0019 J	0.0018 J	0.0027 J	0.0016 J	0.0031 J	0.0027 J	0.0023 J		0.005 U		0.0011 J	0.0015 J	0.0016 J		0.005 U		0.005 U	0.005 U	0.005 U
Barium	mg/L	0.068	0.065	0.065	0.05	0.055	0.064	0.074	0.077		0.066	0.069	0.053	0.058	0.066		0.042		0.03	0.025	0.023
Beryllium	mg/L	0.00017 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.0004 J	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U
Cadmium	mg/L	7.4E-05 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.00037 J	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U
Chromium	mg/L	0.002 U	0.002 U	0.002 U	0.00029 J	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U
Cobalt	mg/L	0.036	0.034	0.059	0.047	0.05	0.037	0.047	0.02		0.022	0.027	0.011	0.0079	0.011		0.00066 J		0.001 U	0.001 U	0.001 U
Fluoride	mg/L	1 J+	1.2 J	0.73 J	0.87 J	0.94 J	0.92 J	1.3 J	2 J	0.68 J	1.2 J	1.3 J-	1.6	2.2	1.9		1.6 J		1.5	1.9	1.7
Lead	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U
Lithium	mg/L	0.0098	0.012	0.009	0.0098	0.0093	0.012	0.011	0.012		0.0089	0.009	0.011	0.015	0.0091		0.0098		0.0073 J	0.0063 J	0.0058 J
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U		0.0002 U	0.0002 U	0.0002 U		0.0002 U		0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L	0.034	0.036	0.024	0.02	0.019	0.038	0.049	0.083		0.058	0.058	0.059	0.08	0.068		0.037		0.039	0.057	0.044
Radium, Total	pci/L	1.07	1.08	1.09	0.581	0.777	0.632	1.11	0.762		1.13 J+	0.99	1 J+	0.473			1.67 J+		1.02 J+	0.704	
Radium-226	pci/L	0.501 J+	0.469	0.557	0.375	0.368	0.383	0.613 J+	0.591		0.267	0.437	0.582 J+	0.312 U			1.09 J+		0.596 J+	0.438	
Radium-228	pci/L	1 U	0.609	0.533	0.43 U	0.423 U	0.365 U	0.499	0.341 U		0.865 J+	0.552	0.423	0.456 U			0.579		0.454 U	0.518 U	
Selenium	mg/L	0.005 U	0.0065	0.0033 J	0.0014 J	0.0032 J	0.011	0.0088	0.0081		0.024	0.022	0.0021 J	0.016	0.0036 J		0.0014 J		0.005 U	0.005 U	0.005 U
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.00045 J	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U
Supplemental Parameters																					
Alkalinity, Bicarbonate (HCO3)	mg/L															160	160				
Alkalinity, Carbonate (CO3)	mg/L															5 U	5 U				
Alkalinity, Hydroxide (OH)	mg/L															5 U	5 U				
Alkalinity, Total	mg/L												350	380	380	160	160	160	160	130	160
Ferric Iron	mg/L												0.083 J			6.1 J	6.9 J	6.5	6.2		
Ferrous Iron	mg/L												0.05 UJ			0.1 R	0.1 R	0.79 J	0.98 J		
Iron	mg/L													0.2 U	0.2 U					5.6	5.1
Magnesium	mg/L												44	53	56	58	66	63	62	45	42
Manganese	mg/L													0.22	0.37					0.49	0.45
Nitrate as N	mg/L													7.7	0.25	0.05 R	0.05 R			0.075 J	0.43
Nitrite as N	mg/L															0.05 R	0.05 R				
Nitrogen, Nitrate-Nitrite	mg/L												0.06					0.05 U	0.05 U		
Phosphorus (as phosphate)	mg/L												0.31 U	0.15 J	0.11 J-	0.028 J	0.031 U	0.31 U	0.31 U	0.31 U	0.19 J-
Potassium	mg/L												12	13	12	5.6	6.4	5.5	5.5	5.6	5.3
Sodium	mg/L												45	45	51	260	300	200	200	240	200
Sample Parameters																					
Dissolved Oxygen	mg/L	1.9	0.38	1.62	1.27	0.96	0.63	1.96	0.93	0.21	0.97	5.09	0.21	0.44	4.2		0.42		0.12	0.13	2.61
Oxidation Reduction Potential	mV	159.7	64.6	-8	58.4	49.9	60.4	242.5	61.9	-15.9	110.1	-106.4	27.7	62.2	44.1		-185.5		-67	7.9	-67
Eh	mV	359.7	264.6	192.0	258.4	249.9	260.4	442.5	261.9	184.1	310.1	93.6	227.7	262.2	244.1		14.5	200.0	133.0	207.9	133.0
pH	SU	6.92	7.03	6.85	7.02	7.09	6.93	7	7.27	6.89	7.41	7.41	6.99	7.37	7.5		7.7		7.45	7.57	7.85
Specific Conductance	uS/cm	1925	1807	1664	1517	1494	2098	1834	1713	1840	1121	1732	1440	1102	1322		2538		2375	2190	1896
Temperature	deg C	15.5	18.78	17.75	12.2	10.06	11.1	15.8	18.5	18.3	9.6	10.2	17.2	11	10.84		14.6		14.5	12.8	8.05
Turbidity	NTU	2.3	3.22	0.58	1.26	1.56	1.1	2.41	0.68	4.38	1.11	1.54	1.4	1.81	0.31		3.4		1.63	1.72	2.89

Notes:
CCR = coal combustion residual
mg/L = milligrams per liter
mV= millivolts
pci/L= picoCuries per liter
uS/cm = micro Siemens per centimeter
deg C = degrees Celsius
NTU = Nephelometric Turbidity Units
SU = Standard Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J+" = Indicates the result is estimated and may be biased high.
"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.
"R"= Result was rejected during data validation.

Appendix A-1: Groundwater Analytical Data
CCR Unit Schahfer MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station
Wheatfield, Indiana

	Location	GAMW09																	
	Sample Date	2016-07-13	2016-09-08	2016-11-09	2017-01-10	2017-03-01		2017-04-26		2017-06-28	2017-08-23	2017-10-03	2018-03-14	2018-04-23	2018-10-25	2019-05-02		2019-11-07
	Sample Type	N	N	N	N	FD	N	FD	N	N	N	N	N	N	N	FD	N	N
Chemical Name	Unit																	
CCR Appendix III																		
Boron	mg/L	5.7	4.7	7.3	5.3	7.7	7.6	5.9	6.1	4.9	7.9	7.3		4.9	6.3	3	3	2.7
Calcium	mg/L	320	240	210	210	200	200	220	240	270	280	220		220	220	200	200	150
Chloride	mg/L	63	55	58	58	75	73	71	67	53	39	64		58	82	46	46	39
Fluoride	mg/L	0.15 J+	10 U	10 U	0.22 J	0.13 J	0.14 J	0.16 J	0.13 J	0.18 J	2 J	0.21 J	5 U	0.26 J-	0.28	0.27	0.27	0.33
pH	SU	7.27	7.25	7.12	6.68		7.44		7.15	7.25	7.31	7.3	7.28	6.87	6.88		7.1	7.06
Sulfate	mg/L	910 J-	570	360	500	440	420	460	460	600	740	540		510	510 J-	530	530	380
Total Dissolved Solids	mg/L	1500	1100	880	980	1000	990	1000	960	1300	1400	1100		930	1100	970	980	770
CCR Appendix IV																		
Antimony	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U	0.002 U
Arsenic	mg/L	0.0015 J	0.0013 J	0.00076 J	0.0031 J	0.005 U	0.005 U	0.0028 J	0.0029 J	0.002 J	0.0027 J		0.005 U		0.005 U	0.005 U	0.005 U	0.005 U
Barium	mg/L	0.059	0.043	0.036	0.039	0.035	0.037	0.039	0.042	0.047	0.054		0.041	0.039	0.039	0.041	0.041	0.036
Beryllium	mg/L	0.00012 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.00036 J	0.001 U	0.001 U	0.001 U		0.001 U		0.00092 J	0.00058 J	0.00052 J	0.00049 J
Cadmium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.00033 J	0.001 U	0.001 U	0.001 U
Chromium	mg/L	0.0036	0.002 U	0.00062 J	0.0013 J	0.002 U	0.002 U	0.002 U	0.002 U	0.0011 J	0.0015 J		0.0016 J		0.002 U	0.0012 J	0.0012 J	0.002 U
Cobalt	mg/L	0.001 U	0.00018 J	0.0002 J	0.0002 J	0.001 U	0.001 U	0.00029 J	0.00025 J	0.001 U	0.001 U		0.001 U		0.00038 J	0.00049 J	0.00055 J	0.00035 J
Fluoride	mg/L	0.15 J+	10 U	10 U	0.22 J	0.13 J	0.14 J	0.16 J	0.13 J	0.18 J	2 J	0.21 J	5 U	0.26 J-	0.28	0.27	0.27	0.33
Lead	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U
Lithium	mg/L	0.0019 J	0.008 U	0.008 U	0.0016 J	0.0011 J	0.0012 J	0.008 U	0.008 U	0.0017 J	0.0018 J		0.008 U		0.008 U	0.008 U	0.008 U	0.008 U
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U		0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L	0.02	0.017	0.029	0.023	0.027	0.027	0.021	0.021	0.028	0.032		0.025	0.035	0.04	0.043	0.043	0.035
Radium, Total	pci/L	1.5	0.568	0.477 U	0.467 U	0.55	0.469	0.593	0.414	0.707	0.803		1.45 J+	0.096	0.679	0.505	0.427 U	
Radium-226	pci/L	0.506 J+	0.231	0.397 U	0.257	0.134	0.166	0.194	0.205	0.255 J+	0.357		0.188	0.204	0.446	0.33	0.355 U	
Radium-228	pci/L	0.994	0.349 U	0.477 U	0.467 U	0.427 U	0.432 U	0.398	0.36 U	0.452	0.446		1.26 J+	-0.108	0.361 U	0.428 U	0.427 U	
Selenium	mg/L	0.014	0.0091	0.0049 J	0.011	0.014	0.014	0.019	0.02	0.013	0.027		0.0082	0.011	0.0098	0.012	0.012	0.0077
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U
Supplemental Parameters																		
Alkalinity, Bicarbonate (HCO3)	mg/L																	
Alkalinity, Carbonate (CO3)	mg/L																	
Alkalinity, Hydroxide (OH)	mg/L																	
Alkalinity, Total	mg/L														150	110	100	110
Ferric Iron	mg/L														0.042 J			
Ferrous Iron	mg/L														0.05 UJ			
Iron	mg/L															0.027 J	0.038 J	0.037 J
Magnesium	mg/L														21	21	19	16
Manganese	mg/L															0.011 J	0.013 J	0.0083 J
Nitrate as N	mg/L															5.6	5.6	7.1
Nitrite as N	mg/L																	
Nitrogen, Nitrate-Nitrite	mg/L														1.4			
Phosphorus (as phosphate)	mg/L														0.31 U	0.31 U	0.31 U	0.31 UJ
Potassium	mg/L														9	7.2	7.1	5.6
Sodium	mg/L														38	35	33	28
Sample Parameters																		
Dissolved Oxygen	mg/L	3.59	6.69	1.98	6.1		3.41		3.92	5.27	3.24	5.98	6.71	5.43	0.22		5.82	5.54
Oxidation Reduction Potential	mV	-1.4	75.7	27.6	236		90.5		152.6	280.8	58.9	139.5	-116.3	-90.8	-48.8		53.6	-25.7
Eh	mV	198.6	275.7	227.6	436.0		290.5		352.6	480.8	258.9	339.5	83.7	109.2	151.2		253.6	174.3
pH	SU	7.27	7.25	7.12	6.68		7.44		7.15	7.25	7.31	7.3	7.28	6.87	6.88		7.1	7.06
Specific Conductance	uS/cm	1671	736	1110	822		1041		1209	702	1542	1331	600	1156	1274		888	685
Temperature	deg C	14.4	18.4	16.9	11.9		10.75		11.9	14.7	17.2	18.2	10.2	10.6	17.9		11.4	15.9
Turbidity	NTU	1.59	3.92	1.15	1.34		3.12		1.88	1.91	0.91	0.39	0.82	2.44	2.41		3.41	1.55

Notes:
CCR = coal combustion residual
mg/L = milligrams per liter
mV= millivolts
pci/L= picoCuries per liter
uS/cm = micro Siemens per centimeter
deg C = degrees Celsius
NTU = Nephelometric Turbidity Units
SU = Standard Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.
"R"= Result was rejected during data validation.

Appendix A-1: Groundwater Analytical Data
CCR Unit Schahfer MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station
Wheatfield, Indiana

	Location	GAMW09B																	
	Sample Date	2016-07-13		2016-09-08	2016-11-09	2017-01-10	2017-03-01	2017-04-26	2017-06-28	2017-08-23		2017-10-03	2018-03-14	2018-04-23	2018-09-06	2018-10-26	2019-05-08		2019-11-07
	Sample Type	FD	N	N	N	N	N	N	N	FD	N	N	N	N	N	N	FD	N	N
Chemical Name	Unit																		
CCR Appendix III																			
Boron	mg/L	24	25	25	16	11	11	11	12	16	16	16		14	12	12		14	8
Calcium	mg/L	260	280	270	190	200	170	170	180	180	180	160		160	150	180		150	150
Chloride	mg/L	210	180	190	130	110	120	130	150	170	160	140		150	180	150		140	110
Fluoride	mg/L	0.54 J+	0.55 J+	0.67 J	0.68 J	0.1 J	1.3 J	1.2 J	1.4 J	1.2 J	0.37 J	1.5 J	1.4 J	1.6 J	1.8 J	1.6		1.6	1.5
pH	SU		7.08	7.15	6.96	7.36	7.44	7.29	7.36		7.46	7.36	7.56	7.43	7.32	7.46		7.49	7.56
Sulfate	mg/L	970 J-	1000 J-	960	740	670 J+	550	570	640	630	650	550		430	570	580		520	440
Total Dissolved Solids	mg/L	2100	2000	2100	1700	1300	1200	1200	1500	1500	1500	1300		990	1300	1200		1200	990
CCR Appendix IV																			
Antimony	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U		0.002 U	0.002 U
Arsenic	mg/L	0.0024 J	0.0026 J	0.002 J	0.0014 J	0.0027 J	0.005 U	0.004 J	0.004 J	0.0031 J	0.0031 J		0.0054	0.0064	0.0044 J	0.004 J		0.0057	0.0042 J
Barium	mg/L	0.069	0.071	0.076	0.062	0.048	0.04	0.046	0.055	0.062	0.058		0.045	0.04	0.049	0.047		0.041	0.029
Beryllium	mg/L	0.00012 J	9.1E-05 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U		0.001 U	0.001 U
Cadmium	mg/L	0.00027 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U		0.001 U	0.001 U
Chromium	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U		0.002 U	0.002 U
Cobalt	mg/L	0.001 U	0.001 U	0.00069 J	0.00028 J	0.00045 J	0.001 U	0.00028 J	0.00045 J	0.00041 J	0.00041 J		0.001 U		0.00058 J	0.00028 J		0.00025 J	0.001 U
Fluoride	mg/L	0.54 J+	0.55 J+	0.67 J	0.68 J	0.1 J	1.3 J	1.2 J	1.4 J	1.2 J	0.37 J	1.5 J	1.4 J	1.6 J	1.8 J	1.6		1.6	1.5
Lead	mg/L	0.001 U	0.001 U	0.001 U	0.00017 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U		0.001 U	0.001 U
Lithium	mg/L	0.0055 J	0.0065 J	0.008 U	0.008 U	0.0049 J	0.0045 J	0.0056 J	0.0054 J	0.0047 J	0.0042 J		0.0031 J		0.0037 J	0.0052 J		0.0055 J	0.0033 J
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U		0.0002 U	0.0002 U		0.0002 U	0.0002 U
Molybdenum	mg/L	0.01 U	0.0079 J	0.0075 J	0.0097 J	0.013	0.015	0.015	0.013	0.0094 J	0.01		0.014	0.012	0.01	0.011		0.012	0.0096 J
Radium, Total	pci/L	1.12	1.86	1.65	1.14	0.453	1.09	0.774	1.85	1.01	1.27		1.18 J+	0.868	1.04	1.24 J+		1.01	
Radium-226	pci/L	0.809 J+	0.947 J+	0.907	0.579	0.476	0.585	0.316	0.781 J+	0.585	0.709		0.482	0.301	0.653	0.69 J+		0.449	
Radium-228	pci/L	1 U	0.913	0.743	0.559	0.41 U	0.508	0.458	1.07	0.422	0.563		0.699 J+	0.567	0.386	0.546		0.564	
Selenium	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.002 J	0.005 U	0.0014 J	0.001 J	0.0015 J	0.0016 J		0.005 U		0.002 J	0.0019 J		0.005 U	0.0011 J
Thallium	mg/L	0.0003 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U		0.0002 J	0.001 U
Supplemental Parameters																			
Alkalinity, Bicarbonate (HCO3)	mg/L														190				
Alkalinity, Carbonate (CO3)	mg/L														5 U				
Alkalinity, Hydroxide (OH)	mg/L														5 U				
Alkalinity, Total	mg/L														190	200	200	200	170
Ferric Iron	mg/L														2.5 J	2.1			
Ferrous Iron	mg/L														0.1 R	0.55 J			
Iron	mg/L																3.2	3.2	3
Magnesium	mg/L														57	60	64	63	54
Manganese	mg/L																1.2	1.2	1.2
Nitrate as N	mg/L														0.05 R		0.1 U	0.1 U	0.12
Nitrite as N	mg/L														0.05 R				
Nitrogen, Nitrate-Nitrite	mg/L															0.077			
Phosphorus (as phosphate)	mg/L														0.09	0.31 U	0.31 U	0.31 U	0.31 UJ
Potassium	mg/L														4 J	3.8 J	4 J	4 J	2.4 J
Sodium	mg/L														150	94	110	110	46
Sample Parameters																			
Dissolved Oxygen	mg/L		0.44	1.06	0.43	0.38	0.44	0.61	0.71		0.57	0.45	0.1	0.04	0.61	0.28		0.04	0.35
Oxidation Reduction Potential	mV		-57.7	67.3	-76.4	-100.1	-80.6	-102.6	68.2		19.7	-46.8	-121.6	-130.5	-100.5	-101.1		-16.8	-131.8
Eh	mV		142.3	267.3	123.6	99.9	119.4	97.4	268.2		219.7	153.2	78.4	69.5	99.5	98.9		183.2	68.2
pH	SU		7.08	7.15	6.96	7.36	7.44	7.29	7.36		7.46	7.36	7.56	7.43	7.32	7.46		7.49	7.56
Specific Conductance	uS/cm		2356	2435	2088	1559	1352	1592	1561		1922	1722	1053	1301	1556	1693		1165	9.24
Temperature	deg C		14.1	14.7	15.1	13.6	13.45	14.5	14.8		15.5	16	14	14.4	16.1	16		14.2	14.4
Turbidity	NTU		3.48	4.29	2.17	0.99	2.58	1.88	1.69		2.54	1.96	4.18	4.11	2.96	1.39		4.7	3.36

Notes:
CCR = coal combustion residual
mg/L = milligrams per liter
mV= millivolts
pci/L= picoCuries per liter
uS/cm = micro Siemens per centimeter
deg C = degrees Celsius
NTU = Nephelometric Turbidity Units
SU = Standard Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.
"R"= Result was rejected during data validation.

Appendix A-1: Groundwater Analytical Data
CCR Unit Schahfer MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station
Wheatfield, Indiana

	Location	GAMW15														
	Sample Date	2016-07-13	2016-09-08		2016-11-09	2017-01-11	2017-03-02	2017-04-27	2017-06-29	2017-08-23	2017-10-03	2018-03-15	2018-04-24	2018-10-26	2019-05-06	2019-11-08
	Sample Type	N	FD	N	N	N	N	N	N	N	N	N	N	N	N	N
Chemical Name	Unit															
CCR Appendix III																
Boron	mg/L	0.75	0.45 J	1 J	1.1	0.6	0.44	0.45	0.87	0.91	0.66		0.72	0.76	0.71	0.73
Calcium	mg/L	100	130	120	100	82	81	95	160	150	77		170	120	140	100
Chloride	mg/L	28	31	31	27	28	27	27	27	25	19		24	21	22	28
Fluoride	mg/L	1.2 J+	0.85 J	0.85 J	0.74 J	0.8 J	0.77 J	0.74 J	0.82 J	0.82 J	0.93 J	0.67 J	0.76 J	0.69	0.52	0.73
pH	SU	6.88		6.98	6.83	6.96	6.99	6.76	6.61	6.96	6.88	6.95	6.89	5.2	7.1	7.34
Sulfate	mg/L	160 J-	260	260	150	140	140	160	300	330	260		410	240	380	260
Total Dissolved Solids	mg/L	570	660	630	520	400	400	420	780	750	660		790	5900	740	640
CCR Appendix IV																
Antimony	mg/L	0.002 U	0.00041 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U
Arsenic	mg/L	0.056	0.072	0.069	0.078	0.076	0.054	0.062	0.059	0.066		0.058		0.091	0.081	0.075
Barium	mg/L	0.044	0.053	0.053	0.039	0.032	0.031	0.034	0.054	0.058		0.047		0.046	0.047	0.037
Beryllium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U
Cadmium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U
Chromium	mg/L	0.002 U	0.002 U	0.002 U	0.00027 J	0.00028 J	0.00029 J	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U
Cobalt	mg/L	0.0019	0.0022	0.0022	0.0021	0.0019	0.0018	0.0022	0.0029	0.0027		0.0025		0.0023	0.0035	0.0017
Fluoride	mg/L	1.2 J+	0.85 J	0.85 J	0.74 J	0.8 J	0.77 J	0.74 J	0.82 J	0.82 J	0.93 J	0.67 J	0.76 J	0.69	0.52	0.73
Lead	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U
Lithium	mg/L	0.0053 J	0.008 U	0.008 U	0.008 U	0.004 J	0.0024 J	0.0041 J	0.0058 J	0.005 J		0.0023 J		0.0054 J	0.0053 J	0.0027 J
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U		0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L	0.02	0.027	0.026	0.023	0.022	0.022	0.026	0.017	0.019		0.029		0.016	0.017	0.029
Radium, Total	pci/L	5 U	0.479	0.513	0.646 U	0.555 J+	0.339 U	0.463 U	0.335	0.342 U		0.657 J+		0.858 J+	0.476 U	
Radium-226	pci/L	1 U	0.202	0.145	0.337 U	0.38	0.127 U	0.1	0.0965 J+	0.104		0.0817		0.527 J+	0.28 U	
Radium-228	pci/L	1 U	0.397 U	0.382 U	0.646 U	0.401 U	0.339 U	0.463 U	0.278 U	0.342 U		0.576 J+		0.407 U	0.476 U	
Selenium	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U		0.005 U		0.005 U	0.005 U	0.005 U
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U
Supplemental Parameters																
Alkalinity, Bicarbonate (HCO3)	mg/L															
Alkalinity, Carbonate (CO3)	mg/L															
Alkalinity, Hydroxide (OH)	mg/L															
Alkalinity, Total	mg/L													180	180	170
Ferric Iron	mg/L													4.3		
Ferrous Iron	mg/L													5.2 J		
Iron	mg/L														11	5.4
Magnesium	mg/L													24	30	24
Manganese	mg/L														0.089	0.055
Nitrate as N	mg/L														0.1 U	0.1 U
Nitrite as N	mg/L															
Nitrogen, Nitrate-Nitrite	mg/L													0.05 U		
Phosphorus (as phosphate)	mg/L													4	1.4	1.3
Potassium	mg/L													2.6 J	3.2 J	3.3 J
Sodium	mg/L													24	32	30
Sample Parameters																
Dissolved Oxygen	mg/L	0.48		0.48	0.14	0.25	0.16	0.19	1	0.32	0.29	0.06	0.02	1.97	0.15	0.12
Oxidation Reduction Potential	mV	-79.2		-60.1	-111	-114.3	-104.1	-104.4	-46.9	-43.7	-13.8	-56.8	-99.1	-254.7	-27.5	-100
Eh	mV	120.8		139.9	89.0	85.7	95.9	95.6	153.1	156.3	186.2	143.2	100.9	-54.7	172.5	100.0
pH	SU	6.88		6.98	6.83	6.96	6.99	6.76	6.61	6.96	6.88	6.95	6.89	5.2	7.1	7.34
Specific Conductance	uS/cm	779		909	733	594	584	674	9.32	1004	901	581	933	855	730	598
Temperature	deg C	15.3		20.3	19.9	14.6	12.1	11.6	14.6	16.6	18.1	10.8	10.6	17.1	8.3	15.8
Turbidity	NTU	4.48		2.96	3.41	3.98	4.4	4.92	4.2	3.1	4.11	3.98	4.29	3.1	4.9	6.9

Notes:
CCR = coal combustion residual
mg/L = milligrams per liter
mV= millivolts
pci/L= picoCuries per liter
uS/cm = micro Siemens per centimeter
deg C = degrees Celsius
NTU = Nephelometric Turbidity Units
SU = Standard Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.
"R"= Result was rejected during data validation.

Appendix A-1: Groundwater Analytical Data
CCR Unit Schahfer MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station
Wheatfield, Indiana

	Location	GAMW15B																
	Sample Date	2016-07-13	2016-09-08	2016-11-09	2017-01-11	2017-03-02	2017-04-27	2017-06-29	2017-08-24	2017-10-03	2018-03-15	2018-04-24	2018-09-06		2018-10-26	2019-05-08	2019-11-08	
	Sample Type	N	N	N	N	N	N	N	N	N	N	N	FD	N	N	N	FD	N
Chemical Name	Unit																	
CCR Appendix III																		
Boron	mg/L	1.1	1.7	2	3.7	3.3	3.6	3.1	2.1	2.1		4.4		4.1	4.9	10		6.2
Calcium	mg/L	160	160	160	180	160	170	190	170	73		230		200	210	280		280
Chloride	mg/L	52	58	62	81	64	65	71	64	64		87		89	93	110		80
Fluoride	mg/L	0.65 J+	0.62 J	0.46 J	0.74 J	0.77 J	0.75 J	0.72 J	0.61 J	0.5 J	0.69 J	0.79 J		0.6 J	0.6	0.84 J+		0.89
pH	SU	7.81	7.49	7.04	7.52	7.48	7.11	7.26	7.37	7.42	7.45	7.36		7.8	6.74	7.43		7.57
Sulfate	mg/L	380 J-	390	340	500	390	460	530	540	500		790		720	770	1300		940
Total Dissolved Solids	mg/L	830	800	840	1000	890	980	1200	1100	1100		1400		1400	1400	2100		1600
CCR Appendix IV																		
Antimony	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U			0.002 U	0.002 U	0.002 U		0.002 U
Arsenic	mg/L	0.003 J	0.0011 J	0.0014 J	0.0022 J	0.0011 J	0.00098 J	0.00084 J	0.00081 J		0.005 U			0.005 U	0.005 U	0.00088 J		0.005 U
Barium	mg/L	0.054	0.053	0.056	0.056	0.051	0.052	0.064	0.069		0.068			0.07	0.064	0.081		0.054
Beryllium	mg/L	7.8E-05 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U			0.001 U	0.001 U	0.001 U		0.001 U
Cadmium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U			0.001 U	0.001 U	0.001 U		0.001 U
Chromium	mg/L	0.00062 J	0.002 U	0.002 U	0.00033 J	0.00034 J	0.002 U	0.002 U	0.002 U		0.002 U			0.002 U	0.002 U	0.002 U		0.002 U
Cobalt	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.00016 J	0.001 U	0.001 U	0.001 U		0.00029 J			0.00037 J	0.001 U	0.001 U		0.001 U
Fluoride	mg/L	0.65 J+	0.62 J	0.46 J	0.74 J	0.77 J	0.75 J	0.72 J	0.61 J	0.5 J	0.69 J	0.79 J		0.6 J	0.6	0.84 J+		0.89
Lead	mg/L	0.001 U	0.001 U	0.00023 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U			0.001 U	0.001 U	0.001 U		0.001 U
Lithium	mg/L	0.0069 J	0.008 U	0.008 U	0.0077 J	0.0053 J	0.0082	0.0082	0.0077 J		0.007 J			0.008	0.0096	0.012		0.0085
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U			0.0002 U	0.0002 U	0.0002 U		0.0002 U
Molybdenum	mg/L	0.011	0.013	0.01	0.012	0.015	0.014	0.014	0.012		0.011			0.01	0.011	0.012		0.01
Radium, Total	pci/L	1.26	0.594	0.61	1.14 J+	0.876	0.687	0.789	0.872		1.69 J+			1.31	1.51 J+	1.61		
Radium-226	pci/L	0.607 J+	0.442	0.361 U	0.785	0.441	0.442	0.537 J+	0.547		0.752			0.711	0.837 J+	1.07		
Radium-228	pci/L	1 U	0.389 U	0.498 U	0.502 U	0.435	0.378 U	0.329 U	0.363 U		0.94 J+			0.603	0.676	0.544		
Selenium	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U		0.005 U			0.0017 J	0.005 U	0.005 U		0.005 U
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U			0.001 U	0.001 U	0.0003 J		0.001 U
Supplemental Parameters																		
Alkalinity, Bicarbonate (HCO3)	mg/L												180	180				
Alkalinity, Carbonate (CO3)	mg/L												5 U	5 U				
Alkalinity, Hydroxide (OH)	mg/L												5 U	5 U				
Alkalinity, Total	mg/L												180	180	200	200	180	180
Ferric Iron	mg/L												2 J	2.1 J	1.8			
Ferrous Iron	mg/L												0.1 R	0.1 R	0.38 J			
Iron	mg/L															4.6	3	3.1
Magnesium	mg/L												36	39	39	62	43	45
Manganese	mg/L															0.59	0.54	0.57
Nitrate as N	mg/L												0.05 R	0.05 R		0.1 U	0.1 U	0.1 U
Nitrite as N	mg/L												0.05 R	0.05 R				
Nitrogen, Nitrate-Nitrite	mg/L														0.05 U			
Phosphorus (as phosphate)	mg/L												0.031 U	0.031 U	0.31 U	0.14 J	0.31 U	0.31 U
Potassium	mg/L												4.5 J	5	4.7 J	7.2	5.1	5.3
Sodium	mg/L												140	150	170	280	130	130
Sample Parameters																		
Dissolved Oxygen	mg/L	0.22	0.91	0.56	0.22	0.46	0.3	0.43	0.64	0.23	0.08	0.04		0.29	2.06	0.23		0.16
Oxidation Reduction Potential	mV	-129.7	-21.6	-94.6	-132.6	-81.7	-79.6	-21.3	-36.5	-42.6	-64	-102.4		-91.2	-256.1	46.3		-189.2
Eh	mV	70.3	178.4	105.4	67.4	118.3	120.4	178.7	163.5	157.4	136.0	97.6		108.8	-56.1	246.3		10.8
pH	SU	7.81	7.49	7.04	7.52	7.48	7.11	7.26	7.37	7.42	7.45	7.36		7.8	6.74	7.43		7.57
Specific Conductance	uS/cm	834	1049	1060	1237	940	1096	1099	1110	1294	1255	1612		2757	1889	1798		1384
Temperature	deg C	12.71	15.9	16.1	13.9	13.6	13	13.8	14.2	14.5	13.3	13		14.13	13.6	8.1		13.8
Turbidity	NTU	4.72	1.56	1.48	3.8	2.23	3.65	3.16	1.78	0.4	4.59	4.88		3.59	1.35	3.56		1.49

Notes:
CCR = coal combustion residual
mg/L = milligrams per liter
mV= millivolts
pci/L= picoCuries per liter
uS/cm = micro Siemens per centimeter
deg C = degrees Celsius
NTU = Nephelometric Turbidity Units
SU = Standard Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.
"R"= Result was rejected during data validation.

Appendix A-1: Groundwater Analytical Data
CCR Unit Schahfer MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station
Wheatfield, Indiana

Location		GAMW16															
Sample Date		2016-07-13	2016-09-08	2016-11-09	2017-01-11	2017-03-02	2017-04-27	2017-06-29	2017-08-24	2017-10-04	2018-03-15	2018-04-24	2018-10-29		2019-05-03	2019-11-08	
Sample Type		N	N	N	N	N	N	N	N	N	N	N	FD	N	N	FD	N
Chemical Name	Unit																
CCR Appendix III																	
Boron	mg/L	1.1	1.8	1.6	1.2	0.89	1.3	1	1.4	1.1		1.4	1.4	1.4	1.6		1.9
Calcium	mg/L	230	180	170	120	160	210	220	240	57		220	160	160	210		210
Chloride	mg/L	53	37	30	28	24	25	28	31	42		58	36	36	28		59
Fluoride	mg/L	1.4 J+	1.6 J	1.3 J	1.5	1.3 J	1.3 J	1.2 J	1.3 J	1.5 J	1 J	1.2 J	1.1	1.1	0.99		1.1
pH	SU	7.92	7.18	7.48	7.5	7.58	7.17	7.36	7.06	7.62	7.41	7.67		7.28	7.46		7.8
Sulfate	mg/L	530 J-	400	320	47	300	500	480	630	520		530	340	350	570		530
Total Dissolved Solids	mg/L	1100	810	790	570	670	930	1000	1100	980		1100	740	730	1100		1100
CCR Appendix IV																	
Antimony	mg/L	0.002 U	0.002 U	0.00028 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U		0.002 U
Arsenic	mg/L	0.011	0.0077	0.012	0.0084	0.0079	0.006	0.008	0.0096		0.002 J	0.0065	0.01	0.0098	0.005		0.0082
Barium	mg/L	0.049	0.042	0.035	0.024	0.029	0.043	0.044	0.054		0.057	0.045	0.035	0.035	0.034		0.034
Beryllium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U		0.001 U
Cadmium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U		0.001 U
Chromium	mg/L	0.00062 J	0.002 U	0.002 U	0.0031	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U		0.002 U
Cobalt	mg/L	0.001 U	0.00068 J	0.00051 J	0.00046 J	0.00055 J	0.00092 J	0.00094 J	0.0011		0.0013		0.00059 J	0.00061 J	0.00066 J		0.00061 J
Fluoride	mg/L	1.4 J+	1.6 J	1.3 J	1.5	1.3 J	1.3 J	1.2 J	1.3 J	1.5 J	1 J	1.2 J	1.1	1.1	0.99		1.1
Lead	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U		0.001 U
Lithium	mg/L	0.00043 J	0.008 U	0.008 U	0.00023 J	0.008 U	0.008 U	0.008 U	0.008 U		0.008 U		0.008 U	0.008 U	0.008 U		0.008 U
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U		0.0002 U	0.0002 U	0.0002 U		0.0002 U
Molybdenum	mg/L	0.024	0.036	0.045	0.044	0.03	0.027	0.023	0.024		0.027	0.031	0.033	0.033	0.027		0.028
Radium, Total	pci/L	1.68	0.543	0.527 U	0.629 U	0.648	0.392 U	0.339 U	0.429		0.862 J+	0.29	0.862 J+	1.32 J+	0.685 U		
Radium-226	pci/L	0.537 J+	0.249	0.363 U	0.256 U	0.129 U	0.094	0.106 J+	0.246		0.1	0.0822	0.214 J+	0.278 J+	0.277 U		
Radium-228	pci/L	1.14	0.395 U	0.527 U	0.629 U	0.528	0.392 U	0.339 U	0.322 U		0.762 J+	0.208	0.648 J+	1.04 J+	0.685 U		
Selenium	mg/L	0.005 U	0.005 U	0.0005 J	0.0005 J	0.005 U	0.0012 J	0.005 U	0.005 U		0.0015 J		0.005 U	0.005 U	0.005 U		0.0015 J
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U		0.001 U
Supplemental Parameters																	
Alkalinity, Bicarbonate (HCO3)	mg/L																
Alkalinity, Carbonate (CO3)	mg/L																
Alkalinity, Hydroxide (OH)	mg/L																
Alkalinity, Total	mg/L													180	200	5 U	210
Ferric Iron	mg/L													1.8			
Ferrous Iron	mg/L													0.19 J			
Iron	mg/L														1.4	1.6	1.7
Magnesium	mg/L													23	29	29	31
Manganese	mg/L														0.35	0.29	0.31
Nitrate as N	mg/L														0.042 J	0.1 U	0.1 U
Nitrite as N	mg/L																
Nitrogen, Nitrate-Nitrite	mg/L													0.056			
Phosphorus (as phosphate)	mg/L													1.2	0.55	0.47	0.42
Potassium	mg/L													4.3 J	4.2 J	4.9 J	5.2
Sodium	mg/L													41	41	36	38
Sample Parameters																	
Dissolved Oxygen	mg/L	0.16	0.27	0.48	0.31	0.36	0.14	0.5	0.14	0.06	0.22	0.22		1.27	0.29		4.02
Oxidation Reduction Potential	mV	-18.06	711.6	-124.8	-78.8	-136.9	-73.6	-114.2	9.6	-158.4	-55.9	-106.5		-216.8	8		-2
Eh	mV	181.9	911.6	75.2	121.2	63.1	126.4	85.8	209.6	41.6	144.1	93.5		-16.8	208.0		198.0
pH	SU	7.92	7.18	7.48	7.5	7.58	7.17	7.36	7.06	7.62	7.41	7.67		7.28	7.46		7.8
Specific Conductance	uS/cm	1331	1112	927	751	821	1257	1123	1406	1254	1029	1239		1046	1001		1014
Temperature	deg C	15.02	18.8	18.15	12.1	9.72	10.6	15.41	18	17.8	8.71	9.2		17.81	10.5		17.52
Turbidity	NTU	3.89	2.16	1.93	3.16	4.14	3.25	4.33	2.45	4.95	4.62	12.81		3.64	4.65		3.98

Notes:
CCR = coal combustion residual
mg/L = milligrams per liter
mV= millivolts
pci/L= picoCuries per liter
uS/cm = micro Siemens per centimeter
deg C = degrees Celsius
NTU = Nephelometric Turbidity Units
SU = Standard Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.
"R"= Result was rejected during data validation.

Appendix A-1: Groundwater Analytical Data
CCR Unit Schahfer MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station
Wheatfield, Indiana

Location		GAMW16B																
Sample Date		2016-07-13	2016-09-08	2016-11-09		2017-01-11	2017-03-02	2017-04-27	2017-06-29	2017-08-24	2017-10-04	2018-03-15	2018-04-24	2018-09-07	2018-10-29	2019-05-06	2019-11-08	
Sample Type		N	N	FD	N	N	N	N	N	N	N	N	N	N	N	N	FD	N
Chemical Name	Unit																	
CCR Appendix III																		
Boron	mg/L	1.8	1.6	1.4	1.4	1.4	1.4	1.1	3.4	6.5	2.9		4.1	7.6	9.7	12	11	10
Calcium	mg/L	230	190	180	180	210	210	270	220	260	100		250	310	350	350	300	280
Chloride	mg/L	63	56	57	55	57	47	71	71	120	78		140	160	150	190	220	210
Fluoride	mg/L	1.1 J+	1.1 J	0.84 J	0.73 J	0.99 J	0.87 J	0.83 J	0.76 J	0.78 J	1 J	0.8 J	0.76 J	0.73 J	0.64	0.76	1	1
pH	SU	7.76	7.47		7.41	7.57	7.55	7.3	7.51	7.28	7.54	7.6	7.65	7.97	7.02	7.49		7.85
Sulfate	mg/L	580 J-	480	500	440	50	470	730	720	640	580		690	760	890	940	1500	1500
Total Dissolved Solids	mg/L	1100	1000	1000	1000	1000	1000	1300	1200	1400	1200		1400	20 U	1600	1800	2400	2400
CCR Appendix IV																		
Antimony	mg/L	0.002 U	0.002 U	0.00057 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.00095 J		0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic	mg/L	0.0068	0.0064	0.011	0.011	0.012	0.0095	0.012	0.0096	0.0081		0.0099	0.0097	0.011	0.0088	0.0071	0.0079	0.0076
Barium	mg/L	0.072	0.04	0.036	0.035	0.038	0.039	0.055	0.043	0.046		0.053	0.058	0.068	0.071	0.079	0.055	0.054
Beryllium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.00022 J		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chromium	mg/L	0.002 U	0.002 U	0.00029 J	0.002 U	0.00026 J	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt	mg/L	0.001 U	0.00016 J	0.00019 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.0003 J		0.00054 J	0.001 U	0.001 U	0.001 U	0.001 U
Fluoride	mg/L	1.1 J+	1.1 J	0.84 J	0.73 J	0.99 J	0.87 J	0.83 J	0.76 J	0.78 J	1 J	0.8 J	0.76 J	0.73 J	0.64	0.76	1	1
Lead	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium	mg/L	0.0055 J	0.008 U	0.0032 J	0.0022 J	0.0058 J	0.0035 J	0.0072 J	0.006 J	0.0061 J		0.007 J		0.0059 J	0.0059 J	0.007 J	0.0054 J	0.0055 J
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U		0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L	0.013	0.012	0.012	0.012	0.012	0.013	0.023	0.016	0.013		0.016	0.015	0.012	0.011	0.014	0.02	0.019
Radium, Total	pci/L	1.31	1.05	0.866	0.794	0.998 J+	0.577	1.23	0.795	1.21		1.11 J+	0.99	1.17 J+	1.64 J+	0.984		
Radium-226	pci/L	0.651 J+	0.458	0.427	0.412 U	0.507	0.348	0.635	0.54 J+	0.559		0.443	0.535	0.724 J+	0.719 J+	0.753		
Radium-228	pci/L	0.66	0.59	0.467 U	0.435 U	0.491 J+	0.399 U	0.597	0.287 U	0.647		0.671 J+	0.455	0.522 U	0.919 J+	0.459 U		
Selenium	mg/L	0.005 U	0.005 U	0.00061 J	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U		0.005 U		0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Supplemental Parameters																		
Alkalinity, Bicarbonate (HCO3)	mg/L													200				
Alkalinity, Carbonate (CO3)	mg/L													5 U				
Alkalinity, Hydroxide (OH)	mg/L													5 U				
Alkalinity, Total	mg/L													200	210	190		200
Ferric Iron	mg/L													6 J	5.1			
Ferrous Iron	mg/L													0.1 R	1.8 J			
Iron	mg/L															9.2		7.5
Magnesium	mg/L													46	53	58		49
Manganese	mg/L															0.49		0.39
Nitrate as N	mg/L													0.05 R		0.018 J		0.1 U
Nitrite as N	mg/L													0.05 R				
Nitrogen, Nitrate-Nitrite	mg/L														0.063			
Phosphorus (as phosphate)	mg/L													0.19	0.28 J	0.22 J		0.17 J
Potassium	mg/L													4.9 J	5.2	5.5		6.3
Sodium	mg/L													84	84	97		380
Sample Parameters																		
Dissolved Oxygen	mg/L	1.23	1.63		0.39	0.3	0.21	0.12	0.32	0.16	0.15	0.28	0.25	1.02	4.23	0.33		3.41
Oxidation Reduction Potential	mV	-122.6	-89		-126.3	-148.5	-132.2	-130.2	-123.1	-32.7	-135.8	-75.5	-117.8	-101.5	-166.8	21.2		-99.5
Eh	mV	77.4	111.0	200.0	73.7	51.5	67.8	69.8	76.9	167.3	64.2	124.5	82.2	98.5	33.2	221.2		100.5
pH	SU	7.76	7.47		7.41	7.57	7.55	7.3	7.51	7.28	7.54	7.6	7.65	7.97	7.02	7.49		7.85
Specific Conductance	uS/cm	1147	1297		1158	1230	1192	1645	1333	1665	1461	1142	1653	3104	2098	1692		2340
Temperature	deg C	13.04	14.44		15.27	14.3	13.37	12.3	13.48	14.3	15	12.6	12.3	15	17.7	11.2		14.65
Turbidity	NTU	4.1	3.99		1.8	2.76	4.21	4.58	3.27	2.48	3.9	4.08	4.2	4.99	3.49	3.72		2.81

Notes:
CCR = coal combustion residual
mg/L = milligrams per liter
mV= millivolts
pci/L= picoCuries per liter
uS/cm = micro Siemens per centimeter
deg C = degrees Celsius
NTU = Nephelometric Turbidity Units
SU = Standard Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.
"R"= Result was rejected during data validation.

Appendix A-1: Groundwater Analytical Data
CCR Unit Schahfer MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station
Wheatfield, Indiana

	Location	GAMW17															
	Sample Date	2016-07-14	2016-09-08	2016-11-09	2017-01-10	2017-03-02	2017-04-27	2017-06-29	2017-08-24	2017-10-04	2018-03-14		2018-04-23		2018-10-29	2019-05-09	2019-11-08
	Sample Type	N	N	N	N	N	N	N	N	N	FD	N	FD	N	N	N	N
Chemical Name	Unit																
CCR Appendix III																	
Boron	mg/L	12	12	11	11	11	8.9	7.6	12	12			5.8	5.8	16	7.7	4.9
Calcium	mg/L	150	160	170	180	200	180	120	150	64			110	110	200	130	120
Chloride	mg/L	110	100	130	150	140	81	170	130	160			40	38	150	90	92
Fluoride	mg/L	1.8 J+	2.2 J	2 J	1.9 J	1.6 J	1.6 J	0.79 J	1.9 J	2.4 J	5 U	1.7 J	1.9 J	1.9 J-	1.7	1.6	1.7
pH	SU	7.56	7.27	7.21	7.33	7.54	7.23	7.4	7.16	7.22		7.62		7.82	6.85	7.53	7.75
Sulfate	mg/L	330 J-	330	360	390	390	390	520	250	350			240	220	430	300	290
Total Dissolved Solids	mg/L	940	920	940	1000	1100	950	1400	890	1000			630	620	1100	800	860
CCR Appendix IV																	
Antimony	mg/L	0.00034 J	0.00032 J	0.00032 J	0.002 U	0.00028 J	0.002 U	0.002 U	0.002 U		0.002 U	0.002 U			0.002 U	0.002 U	0.002 U
Arsenic	mg/L	0.0054	0.0056	0.0042 J	0.0069	0.0055	0.0054	0.0035 J	0.0028 J		0.005 U	0.0027 J			0.004 J	0.0021 J	0.0028 J
Barium	mg/L	0.047	0.056	0.054	0.05	0.054	0.048	0.044	0.06		0.041	0.058		0.029	0.073	0.041	0.052
Beryllium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U			0.001 U	0.00076 J	0.001 U
Cadmium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U			0.001 U	0.001 U	0.001 U
Chromium	mg/L	0.0015 J	0.002 U	0.0011 J	0.0011 J	0.0012 J	0.0012 J	0.002 U	0.002 U		0.0017 J	0.0014 J			0.002 U	0.002 U	0.002 U
Cobalt	mg/L	6.3E-05 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U			0.001 U	0.001 U	0.001 U
Fluoride	mg/L	1.8 J+	2.2 J	2 J	1.9 J	1.6 J	1.6 J	0.79 J	1.9 J	2.4 J	5 U	1.7 J	1.9 J	1.9 J-	1.7	1.6	1.7
Lead	mg/L	0.00018 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U			0.001 U	0.001 U	0.001 U
Lithium	mg/L	0.0047 J	0.008 U	0.0036 J	0.0047 J	0.0024 J	0.0045 J	0.0058 J	0.0076 J		0.008 U	0.0035 J			0.0066 J	0.0035 J	0.0052 J
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U	0.0002 U			0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L	0.015	0.012	0.011	0.01 U	0.01	0.011	0.018	0.024		0.024	0.024		0.02	0.017	0.017	0.012
Radium, Total	pci/L	0.569	0.451 U	0.447 U	0.553 U	0.428	0.477	0.403 U	0.71		0.816 J+	0.384 U		0.205	1.1 J+	0.518 U	
Radium-226	pci/L	1 U	0.331	0.415 U	0.246 U	0.222	0.23	0.191 J+	0.215		0.202	0.112		0.0399	0.315 J+	0.26 U	
Radium-228	pci/L	1 U	0.451 U	0.447 U	0.553 U	0.402 U	0.406 U	0.403 U	0.495		0.614 J+	0.384 U		0.166	0.783 J+	0.518 U	
Selenium	mg/L	0.019	0.03	0.018	0.023	0.028	0.026	0.0081	0.0032 J		0.0074	0.021		0.015	0.022	0.004 J	0.011
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U			0.001 U	0.00063 J	0.001 U
Supplemental Parameters																	
Alkalinity, Bicarbonate (HCO3)	mg/L																
Alkalinity, Carbonate (CO3)	mg/L																
Alkalinity, Hydroxide (OH)	mg/L																
Alkalinity, Total	mg/L														190	160	160
Ferric Iron	mg/L														0.1 U		
Ferrous Iron	mg/L														0.05 UJ		
Iron	mg/L															0.2 U	0.2 U
Magnesium	mg/L														67	49	40
Manganese	mg/L															0.015 U	0.015 U
Nitrate as N	mg/L															0.97	2
Nitrite as N	mg/L																
Nitrogen, Nitrate-Nitrite	mg/L														2.8		
Phosphorus (as phosphate)	mg/L														0.47	0.28 J	0.3 J
Potassium	mg/L														5.3	3.5 J	5
Sodium	mg/L														34	31	28
Sample Parameters																	
Dissolved Oxygen	mg/L	5.78	1.7	1.8	1.01	2.35	7.33	3.18	4.33	3.3		4.99		9	1.78	5.75	6.47
Oxidation Reduction Potential	mV	45.8	825.9	6.1	82.3	6.6	67.9	23.3	8	57.9		-90.2		-90.2	-237	53.1	35
Eh	mV	245.8	1025.9	206.1	282.3	206.6	267.9	223.3	208.0	257.9	200.0	109.8		109.8	-37.0	253.1	235.0
pH	SU	7.56	7.27	7.21	7.33	7.54	7.23	7.4	7.16	7.22		7.62		7.82	6.85	7.53	7.75
Specific Conductance	uS/cm	1059	1287	1141	1272	1541	1290	902	1151	1357		832		675	1513	894	798
Temperature	deg C	17.23	20.6	18.63	13.6	10.95	11.8	17.71	24.4	22.3		10.9		11.4	20	12.1	17.23
Turbidity	NTU	1.56	1.09	0.58	2.58	0.44	2.21	1.02	1.5	2.51		0.54		1.19	0.45	0.44	0.86

Notes:
CCR = coal combustion residual
mg/L = milligrams per liter
mV= millivolts
pci/L= picoCuries per liter
uS/cm = micro Siemens per centimeter
deg C = degrees Celsius
NTU = Nephelometric Turbidity Units
SU = Standard Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.
"R"= Result was rejected during data validation.

Appendix A-1: Groundwater Analytical Data
CCR Unit Schahfer MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station
Wheatfield, Indiana

	Location	GAMW17B														
	Sample Date	2016-07-13	2016-09-08	2016-11-09	2017-01-10	2017-03-02	2017-04-27	2017-06-29	2017-08-23	2017-10-04	2018-03-14	2018-04-23	2018-09-06	2018-10-29	2019-05-09	2019-11-08
	Sample Type	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Chemical Name	Unit															
CCR Appendix III																
Boron	mg/L	18	19	19	21	22	20	16	13	11		13	10	12	12	9.4
Calcium	mg/L	230	250	240	250	270	250	240	160	57		180	150	150	180	150
Chloride	mg/L	180	170	180	190	200	200	71	99	130		140	120	110	130	110
Fluoride	mg/L	0.9 J+	0.98 J	0.68 J	0.58 J	0.6 J	0.6 J	2.1 J	1.3 J	1.1 J	0.55 J	0.58 J	0.84 J	0.71	0.62	0.67
pH	SU	7.43	7.37	7.1	7.24	7.44	7.02	7.25	7.19	7.38	7.48	7.39	7.63	7.4	7.15	7.66
Sulfate	mg/L	710 J-	680	710	740	710	680	300	380	420		520	350	350	270	350
Total Dissolved Solids	mg/L	1500	1400	1400	1500	1700	1500	660	1000	960		1100	940	950	980	990
CCR Appendix IV																
Antimony	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U	0.002 U
Arsenic	mg/L	0.0024 J	0.0021 J	0.0024 J	0.0035 J	0.0023 J	0.0022 J	0.0023 J	0.0026 J		0.0011 J		0.0017 J	0.0023 J	0.0022 J	0.0019 J
Barium	mg/L	0.078	0.079	0.086	0.092	0.1	0.089	0.065	0.06		0.085	0.069	0.066	0.073	0.11	0.074
Beryllium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.00033 J	0.001 U
Cadmium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U
Chromium	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U		0.002 U	0.002 U	0.002 U	0.002 U
Cobalt	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.0003 J	0.001 U	0.001 U	0.001 U
Fluoride	mg/L	0.9 J+	0.98 J	0.68 J	0.58 J	0.6 J	0.6 J	2.1 J	1.3 J	1.1 J	0.55 J	0.58 J	0.84 J	0.71	0.62	0.67
Lead	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.001 U	0.001 U
Lithium	mg/L	0.0017 J	0.008 U	0.008 U	0.0019 J	0.00046 J	0.0021 J	0.0019 J	0.008 U		0.008 U		0.008 U	0.008 U	0.008 U	0.008 U
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ		0.0002 U		0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L	0.024	0.021	0.013	0.011	0.012	0.011	0.017	0.021		0.017	0.016	0.01	0.011	0.0073 J	0.01
Radium, Total	pci/L	1.79	1.84	2.53	2.58	1.25	1.94	1.03	2.4			1.21	1.47	2.48 J+	1.71	
Radium-226	pci/L	0.882 J+	0.864	1.28	1.4	1.01	1.09	0.639 J+	0.867			0.518	0.945	1.15 J+	0.964	
Radium-228	pci/L	0.913	0.98	1.25	1.17	0.423 U	0.846	0.395	1.53			0.696	0.524	1.33 J+	0.748	
Selenium	mg/L	0.005 U	0.005 U	0.005 U	0.00053 J	0.00051 J	0.005 U	0.005 U	0.005 U		0.005 U		0.0011 J	0.005 U	0.005 U	0.005 U
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U		0.001 U	0.001 U	0.00022 J	0.001 U
Supplemental Parameters																
Alkalinity, Bicarbonate (HCO3)	mg/L												210			
Alkalinity, Carbonate (CO3)	mg/L												5 U			
Alkalinity, Hydroxide (OH)	mg/L												5 U			
Alkalinity, Total	mg/L												210	230	300	190
Ferric Iron	mg/L												4.1 J	3		
Ferrous Iron	mg/L												0.1 R	1.5 J		
Iron	mg/L														6.8	5.1
Magnesium	mg/L												32	33	53	44
Manganese	mg/L														1	0.76
Nitrate as N	mg/L												0.05 R		0.1 U	0.1 U
Nitrite as N	mg/L												0.05 R			
Nitrogen, Nitrate-Nitrite	mg/L													0.23		
Phosphorus (as phosphate)	mg/L												0.46	0.17 J	0.31 U	0.31 U
Potassium	mg/L												5.7	6.2	9.5	6.1
Sodium	mg/L												83	110	39	42
Sample Parameters																
Dissolved Oxygen	mg/L	0.33	0.24	0.67	0.36	0.13	0.13	0.18	0.14	0.09	0.16	0.11	0.2	0.88	0.23	4.2
Oxidation Reduction Potential	mV	-115	654	-100.8	-119.6	-91.8	102.3	-98.6	-51.1	-129.4	-95.2	-131.9	-91.9	-244.5	11.8	-3.6
Eh	mV	85.0	854.0	99.2	80.4	108.2	302.3	101.4	148.9	70.6	104.8	68.1	108.1	-44.5	211.8	196.4
pH	SU	7.43	7.37	7.1	7.24	7.44	7.02	7.25	7.19	7.38	7.48	7.39	7.63	7.4	7.15	7.66
Specific Conductance	uS/cm	1525	1734	1568	171.9	2251	1950	1488	1244	1337	1235	1463	2077	1380	1060	890
Temperature	deg C	15.29	16.16	15.77	15	14.8	14.4	15.62	16.5	16.6	15.2	15.2	16.55	16.1	13.6	15.05
Turbidity	NTU	4.09	2.48	0.62	0.92	0.58	2.11	2.35	1.86	3.45	3.76	3.88	3.55	4.86	3.61	2.68

Notes:
CCR = coal combustion residual
mg/L = milligrams per liter
mV= millivolts
pci/L= picoCuries per liter
uS/cm = micro Siemens per centimeter
deg C = degrees Celsius
NTU = Nephelometric Turbidity Units
SU = Standard Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.
"R"= Result was rejected during data validation.

Appendix A-1: Groundwater Analytical Data
CCR Unit Schahfer MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station
Wheatfield, Indiana

Location		GAMW18																	GAMW18B				
Sample Date		2016-07-13	2016-09-08	2016-11-09		2017-01-10	2017-03-01	2017-04-26	2017-07-12		2017-08-23	2017-10-03		2018-03-14	2018-04-23	2018-10-25	2019-04-29	2019-11-07	2018-09-10	2018-10-25		2019-04-29	2019-11-07
Sample Type		N	N	FD	N	N	N	N	FD	N	N	FD	N	N	N	N	N	N	N	FD	N	N	N
Chemical Name	Unit																						
CCR Appendix III																							
Boron	mg/L	1.8	3.5	1.9	1.8	1.3	1	0.77	1.2	1.2	1.5	1.9	1.9		1.2	1.7	0.95	1.7	13	12	13	14	11
Calcium	mg/L	320	610	370	360	330	280	210	280	290	300	380 J	64 J		320	230	320	360	260	200	220	240	180
Chloride	mg/L	17	39	17	17	9.3	5	4.3	10	10	11	23	23		7.3	22	12	27	150	140	140	170	140
Fluoride	mg/L	0.047 J+	0.036 J	10 U	10 U	5 U	5 U	2 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.057	0.074	0.15	0.77 J	0.74	0.73	0.88	0.99
pH	SU	6.95	6.83		6.7	6.88	7.11	6.6		6.96	7.02		6.91	7.2	7.21	6.54	6.71	7.18	7.73		6.86	7.15	7.68
Sulfate	mg/L	760 J-	1400	850	830	640	540	370	600	610	690	960	950		670	550	780	920	1100	1000	1100	1100	840
Total Dissolved Solids	mg/L	1300	2200	1500	1500	1200	1000	730	1100	1100	1300	1600	1500		2400	1100	1400	1500	2100	2000	2000	2100	1500
CCR Appendix IV																							
Antimony	mg/L	0.002 U	0.002 U	0.00096 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U			0.002 U		0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic	mg/L	0.0014 J	0.0023 J	0.0014 J	0.00091 J	0.0014 J	0.005 U	0.0015 J	0.0021 J	0.0021 J	0.0011 J			0.005 U		0.005 U	0.00079 J	0.005 U	0.0018 J	0.0026 J	0.0028 J	0.0037 J	0.0041 J
Barium	mg/L	0.038	0.047	0.041	0.039	0.037	0.024	0.021	0.051	0.052	0.055			0.048	0.035	0.037	0.039	0.05	0.048	0.035	0.039	0.039	0.024
Beryllium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U			0.001 U		0.001 U	0.00094 U	0.001 U	0.001 U	0.001 U	0.001 U	0.00053 U	0.001 U
Cadmium	mg/L	8.1E-05 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U			0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chromium	mg/L	0.002 U	0.002 U	0.00067 J	0.00046 J	0.0005 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U			0.002 U		0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt	mg/L	0.001 U	0.00023 J	0.00047 J	0.0002 J	0.00024 J	0.001 U	0.00023 J	0.001 U	0.001 U	0.001 U			0.001 U		0.001 U	0.00028 J	0.001 U	0.00027 J	0.00026 J	0.00028 J	0.00024 J	0.00024 J
Fluoride	mg/L	0.047 J+	0.036 J	10 U	10 U	5 U	5 U	2 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.057	0.074	0.15	0.77 J	0.74	0.73	0.88	0.99
Lead	mg/L	0.001 U	0.001 U	0.00051 J	0.00025 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U			0.00067 J		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium	mg/L	0.00096 J	0.008 U	0.008 U	0.008 U	0.00042 J	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U			0.008 U		0.008 U	0.008 U	0.008 U	0.025	0.015	0.016	0.023	0.015
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ			0.0002 U		0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L	0.11	0.18	0.14	0.13	0.094	0.1	0.1	0.1	0.11	0.1			0.097	0.085	0.057	0.062	0.076	0.024	0.014	0.015	0.026	0.011
Radium, Total	pci/L	5 U	0.803	0.474	0.449	0.581 U	0.398 U	0.384 U	0.493	0.337 U	0.629			0.373 U	0.259	0.477	0.365 U		1.7	1.28	1.46		
Radium-226	pci/L	1 U	0.348	0.334 U	0.33 U	0.325	0.13	0.131 U	0.166 J+	0.179 J+	0.332			0.111	0.0715	0.291	0.325 U		0.773 J+	0.717	0.748	0.41	
Radium-228	pci/L	1 U	0.49 U	0.455 U	0.413 U	0.581 U	0.398 U	0.384 U	0.381 U	0.337 U	0.369 U			0.373 U	0.187	0.357 U	0.365 U		0.928	0.562	0.708	0.941	
Selenium	mg/L	0.01	0.018	0.0065	0.0052	0.0099	0.011	0.0053	0.012	0.012	0.006			0.009	0.0084	0.015	0.015	0.012	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U			0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Supplemental Parameters																							
Alkalinity, Bicarbonate (HCO3)	mg/L																		230				
Alkalinity, Carbonate (CO3)	mg/L																		5 U				
Alkalinity, Hydroxide (OH)	mg/L																		5 U				
Alkalinity, Total	mg/L															240	190	250	230		230	210	200
Ferric Iron	mg/L															0.032 J			6.8 J		2.9		
Ferrous Iron	mg/L															0.05 UJ			0.1 R		1.3 J		
Iron	mg/L																0.16 J	0.083 J				3.6	3
Magnesium	mg/L															16	17	23	66		58	67	51
Manganese	mg/L																0.0047 J	0.014 J				0.69	0.66
Nitrate as N	mg/L																0.19	0.51	0.05 UJ			0.1 U	0.1 U
Nitrite as N	mg/L																		0.05 UJ				
Nitrogen, Nitrate-Nitrite	mg/L															0.55					0.05 U		
Phosphorus (as phosphate)	mg/L															0.31 U	0.14 J	0.31 UJ	0.031 U		0.31 U	0.31 U	0.31 UJ
Potassium	mg/L															3.4 J	2 J	3.7 J	7.3		5.7	7.8	4.4 J
Sodium	mg/L															28	24	39	260		240	260	180
Sample Parameters																							
Dissolved Oxygen	mg/L	4.83	4.77		5.93	7.52	8.86	7.79		6.04	4.52		5.32	6.5	8.49	3.78	7.01	2.95	0.24		0.29	0.92	0.36
Oxidation Reduction Potential	mV	98.9	76.8		28.7	106.8	97.9	209.2		203.2	24.7		121.9	-129.6	-51.6	-36.6	129.2	-41.1	-140.7		-103.4	109.2	-144.8
Eh	mV	298.9	276.8		228.7	306.8	297.9	409.2	200.0	403.2	224.7		321.9	70.4	148.4	163.4	329.2	158.9	59.3		96.6	309.2	55.2
pH	SU	6.95	6.83		6.7	6.88	7.11	6.6		6.96	7.02		6.91	7.2	7.21	6.54	6.71	7.18	7.73		6.86	7.15	7.68
Specific Conductance	uS/cm	1474	2362		1740	1255	986	970		1299	1414		1760	905	1170	1230	1060	1338	3311		2147	1902	1475
Temperature	deg C	16.3	20.1		16.6	9.65	8.47	11.2		17.9	19.8		19.3	8.1	8.9	17.4	8.8	14.2	15.39		14.9	11.8	13.7
Turbidity	NTU	3.32	1.63		2.38	3.05	4.44	2.48		1.71	1.03		4.16	4.59	0.71	1.29	4.55	2.04	2.78		3.58	3.21	3.14

Notes:
CCR = coal combustion residual
mg/L = milligrams per liter
mV= millivolts
pci/L= picoCuries per liter
uS/cm = micro Siemens per centimeter
deg C = degrees Celsius
NTU = Nephelometric Turbidity Units
SU = Standard Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.
"R"= Result was rejected during data validation.

Appendix A-1: Groundwater Analytical Data
CCR Unit Schahfer MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station
Wheatfield, Indiana

	Location	GAMW46								GAMW46B								GAMW52					
	Sample Date	2018-06-13	2019-03-01	2019-04-17	2019-06-06	2019-07-18	2019-08-26	2019-10-04	2019-11-19	2018-06-13	2019-03-04	2019-04-17	2019-06-07	2019-07-18	2019-08-26	2019-10-04	2019-11-19	2018-09-10	2018-10-31		2019-05-09	2019-11-14	
	Sample Type	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	FD	N	N	FD	N
Chemical Name	Unit																						
CCR Appendix III																							
Boron	mg/L	0.055 J	0.1 U	0.033 J	0.1 U	0.032 J	0.053 J	0.043 J	0.049 J	0.05 J	0.05 J	0.037 J	0.047 J	0.03 J	0.05 J	0.047 J	0.046 J	0.34		0.17	0.077 J		0.13
Calcium	mg/L	56	14	28	25 J-	25	25	23	27	25	58	58	56	52	58	49	56	75		59	52		72
Chloride	mg/L	8.4	2.4	1.9		1.8	1.6	1.6	1.6	3	7.9	7.9		7.2	8	7.1	6.9	34		9.1	5.5		37
Fluoride	mg/L	0.052 J	0.068	0.063		0.065	0.06	0.079 J+	0.062	0.048 J	0.066	0.076		0.072	0.069	0.073 J+	0.072	0.36 J		0.3	0.25 J+		0.3
pH	SU	7.93	8.17	8.23	7.52	8.15	7.9	7.81	7.77	8.2	7.11	7.99	7.58	8.18	7.62	7.44	7.47	7.5		7.06	7.17		7.59
Sulfate	mg/L	55	34	30		28	29	30	27	29	64	64		64	68	65	64	86		39	24		67
Total Dissolved Solids	mg/L	260	160	150		130	150	140 J+	140	150	260	290		240	220 J	250	240	400		250	240		350
CCR Appendix IV																							
Antimony	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U	0.002 U		0.002 U
Arsenic	mg/L	0.0014 J	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.00086 J	0.005 U	0.0015 J	0.0012 J	0.00076 J	0.005 U	0.00091 J	0.00095 J	0.0013 J	0.001 J	0.005 U		0.005 U	0.005 U		0.005 U
Barium	mg/L	0.027	0.0028 J	0.0059	0.0065	0.0054	0.0054	0.0049 J	0.0059	0.0086	0.027	0.026	0.025	0.023	0.024	0.021	0.025	0.039		0.019	0.015		0.02
Beryllium	mg/L	0.001 U	0.005 U	0.001 U	0.001 U	0.001 U	0.001 U	0.00054 J	0.001 U	0.001 U	0.0011	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0011	0.001 U		0.001 U	0.001 U		0.001 U
Cadmium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.00024 J	0.001 U		0.001 U
Chromium	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.0014 J	0.002 U	0.002 U	0.0021	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U	0.002 U		0.002 U
Cobalt	mg/L	0.0002 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.00034 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.00058 J		0.00031 J	0.001 U		0.001 U
Fluoride	mg/L	0.052 J	0.068	0.063		0.065	0.06	0.079 J+	0.062	0.048 J	0.066	0.076		0.072	0.069	0.073 J+	0.072	0.36 J		0.3	0.25 J+		0.3
Lead	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U		0.001 U
Lithium	mg/L	0.008 U	0.04 U	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.008 U	0.0017 J	0.008 U	0.008 U	0.002 J	0.008 U	0.008 U	0.003 J	0.0017 J		0.008 U	0.008 U		0.0025 J
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U		0.0002 U	0.0002 U		0.0002 U
Molybdenum	mg/L	0.0031 J	0.01	0.01 U	0.01 U	0.01 U	0.01 U	0.0015 J	0.01 U	0.0018 J	0.0024 J	0.0022 J	0.0025 J	0.0028 J	0.0028 J	0.0025 J	0.003 J	0.005 J		0.0035 J	0.0016 J		0.0017 J
Radium, Total	pci/L	0.384 U	0.486 U	0.33 U		0.427 U	0.505 U	0.566		0.392 U	0.402 U	0.308 U		0.427 U	0.609 U	0.408 U		0.796		1 J+	0.53 U		
Radium-226	pci/L	0.244 U	0.103 U	0.0708 U		0.214 U	0.0925 UJ	0.179 J+		0.223 U	0.286	0.108		0.232 U	0.105 UJ	0.192 J+		0.46 J+		0.299 J+	0.436		
Radium-228	pci/L	0.384 U	0.486 U	0.33 U		0.427 U	0.505 UJ	0.481 U		0.392 U	0.402 U	0.308 U		0.427 U	0.609 UJ	0.408 U		0.392 U		0.706 J+	0.53 U		
Selenium	mg/L	0.001 J	0.025 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.0017 J	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.0014 J		0.0017 J	0.0014 J		0.0011 J
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.00059 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.00068 J	0.001 U		0.001 U	0.001 U		0.001 U
Supplemental Parameters																							
Alkalinity, Bicarbonate (HCO3)	mg/L																	210					
Alkalinity, Carbonate (CO3)	mg/L																	5 U					
Alkalinity, Hydroxide (OH)	mg/L																	5 U					
Alkalinity, Total	mg/L			82					73			140					130	210	180	190	170	190	190
Ferric Iron	mg/L																	0.2 J	0.1 U	0.1 U			
Ferrous Iron	mg/L																	0.1 R	0.05 J	0.05 UJ			
Iron	mg/L			0.054 J					0.2 U			1.5					1.6				0.2 U	0.2 U	0.2 U
Magnesium	mg/L			9.7					7.8			15					14	20	16	15	16	20	21
Manganese	mg/L			0.0066 J					0.015 U			0.26					0.23				0.0022 J	0.017	0.02
Nitrate as N	mg/L			0.58					0.48			0.1 U					0.1 U	1 J			1.9	1.1	1.1
Nitrite as N	mg/L																	0.089 J					
Nitrogen, Nitrate-Nitrite	mg/L																		1.3	1.3			
Phosphorus (as phosphate)	mg/L			0.16 J					0.31 U			0.15 J					0.31 U	0.031 U	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U
Potassium	mg/L			0.97 J					1 J			0.83 J					0.82 J	4.7	3 J	2.9 J	2.1 J	3.1 J	3.3 J
Sodium	mg/L			4.6 J					2.4 J			5.4					4.6 J	25	13	13	9.8	18	21
Sample Parameters																							
Dissolved Oxygen	mg/L	0.12	1.85	4.18	6.44	6.58	4.03	2.44	3.36	3.59	0.08	1.9	0.3	1.4	1.25	0.31	0.3	0.48		0.21	6.42		2.2
Oxidation Reduction Potential	mV	-171.4	1.9	7.7	157.6	25.5	40.6	9.16	-141.1	-29.4	111.9	-111.1	-133.1	-93.9	-119.9	33.7	-229.6	-30.3		85.1	108.2		-43.2
Eh	mV	28.6	201.9	207.7	357.6	225.5	240.6	209.2	58.9	170.6	311.9	88.9	66.9	106.1	80.1	233.7	-29.6	169.7		285.1	308.2	200.0	156.8
pH	SU	7.93	8.17	8.23	7.52	8.15	7.9	7.81	7.77	8.2	7.11	7.99	7.58	8.18	7.62	7.44	7.47	7.5		7.06	7.17		7.59
Specific Conductance	uS/cm	367	155	161	179	153	153	152	132	211	268	294	282	274	284	260	242	0.896		448	308		320
Temperature	deg C	11.4	8	9.1	11.1	13.2	14.2	14.8	11.7	11.3	9.6	10.8	11	11.9	12.3	12.3	11.3	19.97		17.6	14.2		15.3
Turbidity	NTU	3.96	1.91	1.33	0.51	0.82	0.69	0.89	0.66	3.45	3.26	4.3	3.25	3.11	1.15	4.16	2.84	0.45		0.83	0.42		0.74

Notes:
CCR = coal combustion residual
mg/L = milligrams per liter
mV= millivolts
pci/L= picoCuries per liter
uS/cm = micro Siemens per centimeter
deg C = degrees Celsius
NTU = Nephelometric Turbidity Units
SU = Standard Units
"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J+" = Indicates the result is estimated and may be biased high.
"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.
"R"= Result was rejected during data validation.

Appendix A-1: Groundwater Analytical Data
CCR Unit Schahfer MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station
Wheatfield, Indiana

Location		GAMW52B				GAMW53				GAMW53B					GAMW54				GAMW54B				
Sample Date		2018-09-11	2018-10-31	2019-05-09	2019-11-14	2018-09-11	2018-10-30	2019-04-30	2019-11-14	2018-09-11	2018-10-30		2019-04-30	2019-11-14	2018-09-10	2018-10-31	2019-04-30	2019-11-14	2018-09-10	2018-10-31		2019-05-01	2019-11-15
Sample Type		N	N	N	N	N	N	N	N	N	FD	N	N	N	N	N	N	N	N	FD	N	N	N
Chemical Name	Unit																						
CCR Appendix III																							
Boron	mg/L	0.75	0.8	1	1.3	0.19	0.25	0.056 J	0.13	2.5		3.1	2.2	0.73	0.84	0.77	0.39	0.37	5.6		6.5	5.9	6
Calcium	mg/L	160	160	110	130	45	53	17	25	180		190	150	140	93	88	93	81	210		220	200	240
Chloride	mg/L	530	470	380	370	4.9	4.6	1.9	3.6	90		85	81	74	15	10	10	4	100		95	110	120
Fluoride	mg/L	10 U	0.18	0.21 J+	0.23	0.17 J	0.17	0.05 U	0.05 U	0.52 J		0.46	0.51	0.7	0.18 J	0.17	0.14	0.28	0.41 J		0.52	0.59	0.58
pH	SU	8.3	7.1	7.42	7.34	6	6.47	5.93	6.21	7.3		7.35	7.41	7.52	6.24	7.92	6.82	7.08	6.95		8.71	7.27	7.2
Sulfate	mg/L	210	190	220	290	51	56	37	36	430		510	340	320	190	150	190	76	750		730	710	720
Total Dissolved Solids	mg/L	1500	1300	1100	1100	240	250	130	160	1100		1100	900	770	500	400	470	350	1600		1400	1500	1400
CCR Appendix IV																							
Antimony	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.00061 J	0.002 U		0.002 U	0.002 U	0.002 U	0.0011 J	0.00074 J	0.00078 J	0.001 J	0.002 U		0.002 U	0.002 U	0.002 U
Arsenic	mg/L	0.0013 J	0.0016 J	0.00083 J	0.0012 J	0.013	0.015	0.00097 J	0.0018 J	0.00079 J		0.00083 J	0.001 J	0.0016 J	0.0024 J	0.0028 J	0.0022 J	0.0045 J	0.0025 J		0.0032 J	0.0045 J	0.005
Barium	mg/L	0.32	0.31	0.25	0.28	0.027	0.028	0.019	0.026	0.052		0.054	0.044	0.072	0.043	0.039	0.031	0.031	0.098		0.093	0.08	0.084
Beryllium	mg/L	0.001 U	0.00042 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.00059 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U	0.001 U
Cadmium	mg/L	0.001 U	0.00029 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U	0.001 U
Chromium	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.0019 J	0.0018 J	0.0012 J	0.002 U	0.002 U		0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U	0.002 U	0.002 U
Cobalt	mg/L	0.001 U	0.00032 J	0.001 U	0.001 U	0.00084 J	0.00099 J	0.0005 J	0.001 U	0.001 U		0.001 U	0.001 U	0.001 U	0.00053 J	0.00052 J	0.00062 J	0.001 U	0.001 U		0.001 U	0.001 U	0.001 U
Fluoride	mg/L	10 U	0.18	0.21 J+	0.23	0.17 J	0.17	0.05 U	0.05 U	0.52 J		0.46	0.51	0.7	0.18 J	0.17	0.14	0.28	0.41 J		0.52	0.59	0.58
Lead	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.0014	0.00089 J	0.00057 J	0.00063 J	0.001 U		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U	0.001 U
Lithium	mg/L	0.0041 J	0.0031 J	0.0033 J	0.0071 J	0.008 U	0.008 U	0.008 U	0.0021 J	0.0042 J		0.0052 J	0.005 J	0.0066 J	0.008 U	0.008 U	0.008 U	0.0023 J	0.0048 J		0.0036 J	0.0048 J	0.0074 J
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U		0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U		0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L	0.014	0.015	0.0095 J	0.0086 J	0.012	0.015	0.0051 J	0.011	0.0083 J		0.0075 J	0.0098 J	0.02	0.043	0.044	0.023	0.03	0.018		0.019	0.0085 J	0.012
Radium, Total	pci/L	3.52	5.55 J+	2.63		0.547 U	1.45 J+	0.344 U		1.69		0.48 J+	1.26		0.5	1.08 J+	0.393 U		2.03		2.7 J+	1.82	
Radium-226	pci/L	2.11	2.76 J+	1.2		0.257	0.795 J+	0.316 U		0.789		0.238 J+	0.544		0.385 J+	0.237 J+	0.337 U		1.18 J+		1.35 J+	0.956	
Radium-228	pci/L	1.41	2.79 J+	1.44		0.547 U	0.658 J+	0.344 U		0.897		0.347 U	0.719		0.385 U	0.843 J+	0.393 U		0.849		1.35 J+	0.865	
Selenium	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U		0.005 U	0.005 U	0.005 U	0.0017 J	0.0012 J	0.0043 J	0.0035 J	0.005 U		0.005 U	0.005 U	0.005 U
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.00049 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U		0.001 U	0.001 U	0.001 U
Supplemental Parameters																							
Alkalinity, Bicarbonate (HCO3)	mg/L	220				120				250					150				240				
Alkalinity, Carbonate (CO3)	mg/L	5 U				5 U				5 U					5 U				5 U				
Alkalinity, Hydroxide (OH)	mg/L	5 U				5 U				5 U					5 U				5 U				
Alkalinity, Total	mg/L	220	230	220	200	120	140	53	73	250	240	250	260	190	150	160	160	230	240	230	230	250	260
Ferric Iron	mg/L	5 J	3.4			2 J	1			3.2 J	2.3	2.7			0.13 J	0.14			5.9 J	4.5	3.4		
Ferrous Iron	mg/L	0.1 R	0.32 J			0.1 R	0.5 J			0.1 R	0.56 J	1 J			0.1 R	0.029 J			0.1 R	0.94 J	1.6 J		
Iron	mg/L			2.7	2.5			0.25	0.28				3.1	2.4			0.14 J	0.31				5.4	5.4
Magnesium	mg/L	37	38	30	28	15	15	8.9	11	23	24	25	23	19	19	18	21	17	38	38	36	42	46
Manganese	mg/L			0.21	0.25			0.0079 J	0.015 U				0.4	0.32			0.0097 J	0.015 U				0.48	0.51
Nitrate as N	mg/L	0.05 UJ		0.1 U	0.1 U	1.3 J		1.4	0.4	0.05 UJ			0.1 U	0.1 U	0.028 J		0.49	0.15	0.05 UJ			0.1 U	0.1 U
Nitrite as N	mg/L	0.05 UJ				0.03 J				0.05 UJ					0.05 UJ				0.05 UJ				
Nitrogen, Nitrate-Nitrite	mg/L		0.052				0.05 U				0.099	0.74 J-				0.21				0.15	0.091		
Phosphorus (as phosphate)	mg/L	0.056	0.21 J	0.31 U	0.11 J	0.32	0.31 U	0.31 U	0.31 U	0.031 U	0.14 J	0.52	0.31 U	0.31 U	0.031 U	0.31 U	0.11 J	0.31 U	0.079	0.31 U	0.39	0.38	0.3 J
Potassium	mg/L	6	6.4	7	6.5	2.2	5 U	1.3 J	1.6 J	4.6	5.2	5.4	4.9 J	4.5 J	1.9	1.8 J	1.2 J	1.6 J	6.8	6.8	6.2	6.3	5.6
Sodium	mg/L	220	250	250	210	6.5	7.8	4.9 J	3.9 J	120	130	130	99	75	21	21	15	11	200	200	180	160	140
Sample Parameters																							
Dissolved Oxygen	mg/L	0.44	0.1	0.15	0.19	0.53	0.86	3.11	0.84	0.26		0.8	0.36	0.09	0.61	1.41	0.72	0.26	0.42		2.12	0.42	0.31
Oxidation Reduction Potential	mV	-214.9	-103.5	6.31	-102.9	-24.6	-199.5	43.7	-54.8	-183.2		-168	27.7	-75.3	107.8	-294.7	48.4	-69.5	-123.4		-315.7	-23.1	-43.3
Eh	mV	-14.9	96.5	206.3	97.1	175.4	0.5	243.7	145.2	16.8		32.0	227.7	124.7	307.8	-94.7	248.4	130.5	76.6	200.0	-115.7	176.9	156.7
pH	SU	8.3	7.1	7.42	7.34	6	6.47	5.93	6.21	7.3		7.35	7.41	7.52	6.24	7.92	6.82	7.08	6.95		8.71	7.27	7.2
Specific Conductance	uS/cm	1934	2005	1652	1353	307	400	125	155	1354		1620	1160	870	675	630	493	374	1816		1983	1636	1310
Temperature	deg C	17.26	16.6	15.3	16.1	21.3	20.1	11.4	17.5	20.89		20.4	18.7	19.7	21.2	18.53	10.5	15.3	17.6		17.29	15.5	15.8
Turbidity	NTU	1.6	0.88	2.35	1.01	9.93	5.17	4.76	4.8	2.43		3	3.45	2.5	2.03	1	3.24	2.31	4.2		1.64	4.49	1.67

Notes:
CCR = coal combustion residual
mg/L = milligrams per liter
mV= millivolts
pci/L= picoCuries per liter
uS/cm = micro Siemens per centimeter
deg C = degrees Celsius
NTU = Nephelometric Turbidity Units
SU = Standard Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.
"R"= Result was rejected during data validation.

Appendix A-1: Groundwater Analytical Data
CCR Unit Schahfer MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station
Wheatfield, Indiana

	Location	GAMW55				GAMW55R	GAMW55B					GAMW56				GAMW56B			
	Sample Date	2018-09-10		2018-10-29		2019-11-15	2018-09-11		2018-10-29	2019-05-01	2019-11-15	2018-09-11	2018-10-26	2019-04-29	2019-11-15	2018-09-11	2018-10-29	2019-04-29	2019-11-15
	Sample Type	FD	N	FD	N	N	FD	N	N	N	N	N	N	N	N	N	N	N	N
Chemical Name	Unit																		
CCR Appendix III																			
Boron	mg/L	1.9	1.9	1.8	1.8	1.1	7.1	7.4	8.2	9.1	11	0.26	0.28	0.21	0.2	1.2	1.2	2.3	3.2
Calcium	mg/L	260	250	270	260	180	250	250	260	210	210	130	110	91	120	140	140	150	150
Chloride	mg/L	58	59	69	70	61	220	220	190	170	150	3.1	2.4	3.2	2.1	50	36	55	64
Fluoride	mg/L	0.51 J	0.52 J	0.47	0.47	0.62	0.29 J	10 U	0.25	0.31	0.31	1.2 J	0.99	0.53	0.71	0.41 J	0.33	0.4	0.44
pH	SU		6.77		7.04	7.46	7.31		7.07	7.19	7.31	6.82	7.17	6.83	7.06	6.95	6.91	7.08	7.21
Sulfate	mg/L	590	600	630	620	480	820	820	910	790	750	57	63	54	56	170	130	260	360
Total Dissolved Solids	mg/L	1200	1300	1300	1300	950	1800	1900	1800	1700	1400	470	480	420	440	740	690	830	860
CCR Appendix IV																			
Antimony	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002	0.002 U
Arsenic	mg/L	0.00083 J	0.005 U	0.005 U	0.005 U	0.005 U	0.0014 J	0.0011 J	0.005 U	0.005 U	0.005 U	0.019	0.022	0.011	0.0097	0.005 U	0.005 U	0.005	0.005 U
Barium	mg/L	0.099	0.097	0.068	0.069	0.035	0.14	0.14	0.12	0.074	0.067	0.068	0.049	0.044	0.04	0.076	0.072	0.082	0.076
Beryllium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001	0.001 U
Cadmium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001	0.001 U
Chromium	mg/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002	0.002 U
Cobalt	mg/L	0.0065	0.0058	0.0044	0.0044	0.001 U	0.00034 J	0.00028 J	0.001 U	0.001 U	0.001 U	0.0017	0.0053	0.0084	0.0081	0.001 U	0.001 U	0.001	0.001 U
Fluoride	mg/L	0.51 J	0.52 J	0.47	0.47	0.62	0.29 J	10 U	0.25	0.31	0.31	1.2 J	0.99	0.53	0.71	0.41 J	0.33	0.4	0.44
Lead	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001	0.001 U
Lithium	mg/L	0.0021 J	0.0017 J	0.008 U	0.008 U	0.0035 J	0.0064 J	0.0064 J	0.0054 J	0.0055 J	0.0078 J	0.0034 J	0.0039 J	0.0023 J	0.0053 J	0.0051 J	0.0035 J	0.0044	0.0062 J
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002	0.0002 U
Molybdenum	mg/L	0.03	0.028	0.026	0.026	0.024	0.0057 J	0.0055 J	0.0055 J	0.0046 J	0.005 J	0.013	0.0094 J	0.0072 J	0.0079 J	0.004 J	0.003 J	0.0031	0.0064 J
Radium, Total	pci/L	1.4	0.802	0.922 J+	1.24 J+		3.35	3.18	3.66 J+	2.08		0.728	0.698 J+			1.26	1.28 J+		
Radium-226	pci/L	0.574 J+	0.474 J+	0.363 J+	0.447 J+		1.72	1.75	1.86 J+	1.15		0.504	0.357 J+	0.334 U		0.763	0.578 J+	0.506	
Radium-228	pci/L	0.824	0.403 U	0.559 J+	0.796 J+		1.63	1.43	1.79 J+	0.926		0.371 U	0.429 U	0.373 U		0.493	0.698 J+	0.571	
Selenium	mg/L	0.0037 J	0.0031 J	0.0027 J	0.0027 J	0.0046 J	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005	0.005 U
Thallium	mg/L	0.00021 J	0.001 U	0.00023 J	0.00022 J	0.00022 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001	0.001 U
Supplemental Parameters																			
Alkalinity, Bicarbonate (HCO3)	mg/L		240					230				370				370			
Alkalinity, Carbonate (CO3)	mg/L		5 U					5 U				5 U				5 U			
Alkalinity, Hydroxide (OH)	mg/L		5 U					5 U				5 U				5 U			
Alkalinity, Total	mg/L		240		240	230		230	220	230	230	370	370	300	330	370	410	330	270
Ferric Iron	mg/L		0.65 J		0.19			5.2 J	2.5			13 J	5.5			6.4 J	3.5		
Ferrous Iron	mg/L		0.1 R		0.058 J			0.1 R	2.8 J			0.1 R	6.5 J			0.1 R	1.7 J		
Iron	mg/L					0.044 J				4.2	4.1			10	3.9			5.7	4.3
Magnesium	mg/L		32		39	28		46	51	50	42	24	25	27	24	37	38	40	38
Manganese	mg/L					0.22				0.58	0.46			0.25	0.45			0.33	0.29
Nitrate as N	mg/L		0.68 J			1.4		0.05 UJ		0.1 U	0.1 U	0.05 UJ		1.5	0.13	0.05 UJ		0.1 U	0.1 U
Nitrite as N	mg/L		0.058 J					0.05 UJ				0.05 UJ				0.05 UJ			
Nitrogen, Nitrate-Nitrite	mg/L				0.44				0.05 U				0.062				0.05 U		
Phosphorus (as phosphate)	mg/L		0.031 U		0.31 U	0.31 U		2.1	0.7	0.31 U	0.16 J	0.031 U	0.31 U	0.12 J	0.31 U	0.045	0.15 J	0.14 J	0.31 U
Potassium	mg/L		8.3		9.5	7.2		6	6.6	6.2	4.8 J	2.6	2.4 J	1.6 J	1.9 J	3.3	3.6 J	3.7 J	3.6 J
Sodium	mg/L		58		72	79		200	230	200	180	11	12	6.3	5.5	50	49	58	62
Sample Parameters																			
Dissolved Oxygen	mg/L		1.73		0.33	0.17	0.72		0.37	0.17	0.11	0.99	0.28	1.3	0.34	0.29	0.26	0.79	0.18
Oxidation Reduction Potential	mV		21.6		-69.4	-137.9	-28.9		-129.5	-115.9	-57.5	-97.4	-95.4	64	-86.6	-102.8	-44.4	31.8	-105.7
Eh	mV		221.6	200.0	130.6	62.1	171.1		70.5	84.1	142.5	102.6	104.6	264.0	113.4	97.2	155.6	231.8	94.3
pH	SU		6.77		7.04	7.46	7.31		7.07	7.19	7.31	6.82	7.17	6.83	7.06	6.95	6.91	7.08	7.21
Specific Conductance	uS/cm		1493		1574	1491	1017		2109	2201	1967	749	835	460	466	928	1036	856	741
Temperature	deg C		21.1		19.4	17.9	16.7		19.2	18.5	18.1	17	15.7	8.7	14	13.9	13.8	11.6	12.9
Turbidity	NTU		1.74		0.66	3.92	2.26		4.38	1.74	4.77	2.91	2.99	2.31	2.01	2.96	1.45	4.77	1.4

Notes:
CCR = coal combustion residual
mg/L = milligrams per liter
mV= millivolts
pci/L= picoCuries per liter
uS/cm = micro Siemens per centimeter
deg C = degrees Celsius
NTU = Nephelometric Turbidity Units
SU = Standard Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.
"J" = Indicates the result is estimated.
"J+" = Indicates the result is estimated and may be biased high.

"UJ" = Indicates the result was not detected above the MDL, the estimated RL is provided.
"R"= Result was rejected during data validation.

Prepared by:	DFSC
Checked by:	KMC
Reviewed by	MAH

Appendix A-2: Porewater Analytical Data

CCR Unit Schafer MSRB, MCWB, and Drying Area
NIPSCO LLC R. M. Schahfer Generating Station
Wheatfield, Indiana

SYS_LOC_CODE		DAPZ-02A	DAPZ-02B	GAPIEZ06	GAPIEZ06	GAPIEZ06
SAMPLE_DATE_yyyy-MM-dd		2020-03-03	2020-03-03	2018-08-09	2018-09-13	2018-10-31
FRACTION		T	T	D	T	T
Chemical Name	Unit					
CCR Appendix III						
Boron	mg/L	7.4	13.8	9.6	8.6	8.3
Calcium	mg/L	489	175	210	210	210
Chloride	mg/L	21.9	119	56	58	55
Fluoride	mg/L	0.16	0.72	0.91	1.1 J	0.92
pH	SU	7.33	7.62	7.51	7.43	9.37
Sulfate	mg/L	1760	2420	750	720	740
Total Dissolved Solids	mg/L	2810	3830		1300	1300
CCR Appendix IV						
Antimony	mg/L	0.001 U	0.001 U	0.0014 J	0.002 U	0.002 U
Arsenic	mg/L	0.001 U	0.0018	0.011	0.011	0.012
Barium	mg/L	0.028	0.033	0.03	0.029	0.03
Beryllium	mg/L	0.0002 U	0.0002 U	0.001 U	0.00052 J	0.001 U
Cadmium	mg/L	0.00052	0.0002 U	0.001 U	0.001 U	0.001 U
Chromium	mg/L	0.002 U	0.0038	0.0023 J+	0.002 U	0.002 U
Cobalt	mg/L	0.0022	0.001 U	0.0004 J	0.00029 J	0.001 U
Fluoride	mg/L	0.16	0.72	0.91	1.1 J	0.92
Lead	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium	mg/L	0.008 U	0.016	0.0041 J	0.0038 J	0.0033 J
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L	0.81	0.063	0.079	0.094	0.11
Selenium	mg/L	0.011	0.001 U	0.001 J	0.005 U	0.005 U
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Supplemental Parameters						
Alkalinity, Bicarbonate (HCO3)	mg/L				170	
Alkalinity, Carbonate (CO3)	mg/L				5 U	
Alkalinity, Hydroxide (OH)	mg/L				5 U	
Alkalinity, Total	mg/L	99.6	224	170	170	160
Ferric Iron	mg/L			2.8 J	2.7 J	0.19
Ferrous Iron	mg/L			0.1 U	0.1 R	0.088 J
Iron	mg/L	0.61	14.2			
Magnesium	mg/L	48.9	18.4	53	51	45
Manganese	mg/L	0.12	0.7			
Nitrate	mg/L			0.031 J		
Nitrate as N	mg/L	0.75 J+	0.1 U		0.05 U	
Nitrite as N	mg/L				0.05 U	
Nitrogen, Nitrate-Nitrite	mg/L					0.038 J
Phosphorus (as phosphate)	mg/L			0.031 U	0.028 J	0.12 J
Potassium	mg/L	59.1	17.5	3.9 J	4.1	5 U
Sodium	mg/L	286	1050	100	110	99
Field Parameters						
Dissolved Oxygen	mg/L	0.61	0.00	1.33	0.7	0.80
Oxidation-Reduction Potential	mV	66.9	-197.4	-130.8	-118.2	-261
Eh	mV	266.9	2.6	69.2	81.8	-61
pH	SU	7.33	7.62	7.51	7.43	9.37
Specific Conductance	uS/cm	3025	4772	1518	1371	1672
Temperature	deg C	9.4	11.7	15.91	16.1	15.1
Turbidity	NTU	28.9	2.74	3.73	4.29	3.4

Notes:

CCR= coal combustion residual
mg/L = milligrams per liter
mV= millivolts
uS/cm = micro Siemens per centimeter
deg C = degrees Celsius
NTU = Nephelometric Turbidity Units
SU = Standard Units

"U" = Indicates the result was not detected above the method detection limit (MDL) for the sample; the quantitation limit (RL) is provided.

"J" = Indicates the result is estimated.

"J+" = Indicates the result is estimated and may be biased high.

"R"= Indicates the result was rejected during data validation.

Prepared by: DFSC
Checked by: KMC
Reviewed by: MAH

APPENDIX B

Groundwater Flow Model Technical Memorandum

TECHNICAL MEMORANDUM

DATE November 12, 2020

TO Danielle Sylvia Cofelice, PE and PJ Nolan, Ph.D.

CC Mark Haney, Joe Gormley, and Rens Verburg

FROM: Ross Bennett, PE(NH) and Brandon Poiencot, PE

GROUNDWATER FLOW MODEL TECHNICAL MEMORANDUM

R.M. SCHAHFER GENERATING STATION

1.0 GROUNDWATER MODELING

This Memorandum presents Golder's summary of groundwater modeling activities associated with the evaluation of hydrogeologic conditions and potential remedial designs at the R.M. Schahfer Generating Station in Wheatfield, Indiana (the Site).

A steady state groundwater flow model was developed and calibrated. This memorandum includes the following to document development of the groundwater flow model and includes:

1) Objectives;
2) Groundwater Flow Model Development
3) Model selection (numerical);
4) Model Geometry
5) Boundary Conditions
6) Input Parameters
7) Model Calibration and Verification
8) Parameter Sensitivity analysis
9) Design Simulations
10) Summary

The conceptual model (including geology, hydrology, lithology and analytical data) used to support numerical model development is described Section 2.0 of the CCR Assessment of Corrective Measures Report (Golder, 2019).

1.1 Objectives

The primary objective of the modeling was to simulate the groundwater flow conditions in the area surrounding R.M. Schahfer Generating Station to support evaluation of the remedy design including the feasibility of Monitored Natural Attenuation (MNA) as part of the assessment of corrective measures process for the Coal Combustion Residuals (CCR) surface impoundments for the Site.

The general scope of the groundwater modeling is to:

- Simulate the groundwater flow regimes on Site;
- Predict the travel times and flow paths of unattenuated particles originating at areas impacted by metals contamination;
- Inform remedy design (e.g., groundwater pump and treat design);
- Inform the groundwater monitored natural attenuation study.

2.0 GROUNDWATER FLOW MODEL DEVELOPMENT

2.1 Numerical Implementation

Golder developed the groundwater flow model for the site using the USGS MODFLOW-2005 Modular Three-Dimensional Finite-Difference Groundwater Flow Model (Harbaugh, 2005). The pre- and post-processing software used for the modeling was Groundwater Vistas (Vistas) Version 7.24 (Environmental Simulations Inc.).

Development of a numerical groundwater flow model involved the following steps:

- Definition of the model geometry including lateral and vertical extent, number and thickness of model layers, and grid spacing
- Definition and placement of model boundary conditions
- Selection of input parameters such as hydraulic conductivity (horizontal and vertical) and precipitation recharge

The following sections describe the steps used to develop the model.

2.2 Model Geometry

The finite-difference model grid location is shown on Attachment A. The model area (excluding no-flow cells) is approximately 10,800 feet (along x-axis) by 12,300 feet (along y-axis) at the widest points. The southwest corner of the model grid (model coordinates 0, 0) corresponds with Site coordinates 2165530.5N and 2962863.0 W (Indiana State Plane West). The model grid is oriented parallel with cardinal directions. The model grid contains 504 rows and 432 columns. The grid cell size in the XY direction is uniform, at 25 feet by 25 feet across the entire model domain. Based on geologic and hydrogeologic conditions discussed in Section 2.0 of the CCR Assessment of Corrective Measures Report (Golder, 2019), the model utilizes three layers, with the lowermost layer representing the medium to coarse sand and the upper two layers representing the fine sands. Layers 1 and 2 have the same hydraulic properties, but they were divided to focus boundary condition cells in the upper portion of the aquifer using Layer 1. The base of Layer 3 is the top of the shale bedrock surface and ranges from 597 to 624 feet mean sea level (MSL). The surface topography is based on publicly available lidar data and ranges from 646 to 723 feet MSL. A cross section of model geometry along model column 200 is shown on Attachment B.

2.3 Model Boundary Conditions

Boundary conditions in groundwater models consist of physical and hydraulic boundaries within the model area. Physical boundary conditions are well-defined geologic and hydrologic features that influence groundwater flow patterns. The following sections describe the boundary conditions used in the model.

2.3.1 Constant Head Boundaries

Constant head boundaries (CHB) were assigned along an unnamed stream in Layer 1 in the southwestern corner of the model to recreate the approximate constant hydraulic heads where long-term average stream water levels are expected to remain relatively constant. Constant heads were also used within the basins that are surrounded slurry walls to simulate the average surface water elevations in the basins. The modeled CHBs are shown on Attachment C and summarized on Table B-1.

2.3.2 River Boundary Conditions

River boundary conditions are a head-dependent boundary condition, where the model computes the difference in head between the boundary and the model cell where the boundary is defined. River Boundary condition cells were used for the Kankakee River, as shown in Attachment A. River heads were defined by two USGS gauging stations that fell within the model grid, downstream at USGS station 05517530 in Kouts and upstream at USGS 05517500 at Dunns Bridge. The river width was estimated from satellite imagery, the river bottom elevation was assumed to be three feet lower than the stage, and the bed thickness was assumed to be 10 feet. The hydraulic conductivity of the river was set through calibration at 64.5 feet/day which is slightly lower than aquifer hydraulic conductivities discussed in Section 1.1.2.4.1.

2.3.3 Stream Boundary Conditions

Stream boundary conditions are a simplified version of river boundary conditions where surface water flow is monitored by MODFLOW and water is added or removed from the model based on the stream stage. Stream boundary conditions were used in the Model for Davis Ditch and Stalbaum Ditch, as shown in Attachment C. The stream width was estimated from satellite imagery, the stream bottom elevation was assumed to be 0.5 to 2 feet lower than the stage depending on size of the stream, and the bed thickness was assumed to be 5 feet. The hydraulic conductivity of the river was set at 100 feet/day for Davis Ditch where loosing stream conditions were expected, and at 0.5 feet per day in Stalbaum ditch where perched conditions where assumed to exist. Stream stage was set off two gauging stations in Stalbaum, SW-04 and SW-10. Elsewhere stream stage was estimated from surface elevations and then refined through model calibration.

2.3.4 Drain Boundary Conditions

Drain boundary conditions are a version of river/stream boundary conditions that can only remove water from the model. Drain boundary conditions were used in the Model for intermittent streams and drainage ditches, as shown in Attachment C. The drain width was estimated from satellite imagery, the drain bottom elevation was assumed to be 1 to 2 feet lower than the stage depending on size of the drain, and the bed thickness was assumed to be 1 foot. The hydraulic conductivity of the drains was set at 100 feet/day. Drain stage was estimated from surface elevations and then refined through model calibration.

2.3.5 No Flow Boundaries

No flow boundaries were assigned to the northeast side of the Kankakee River, as shown in Attachment C.

2.3.6 Horizontal Flow Barriers

A hydraulic flow barrier (HFB) or wall is a condition that limits flow between adjacent cells based on an assigned thickness and hydrologic conductivity. To model the slurry walls that are present around ponds, Golder used the HFB boundary condition with an assigned thickness of 1 foot and a horizontal hydraulic conductivity (K) value of 0.0000001 to model slurry walls that surround the basins. The location of HFB boundaries are presented in Attachment C

2.4 Model Input Parameters

The following paragraphs describe the input parameter data used for the model. Golder simulated steady state conditions in the model. Transient dependent parameters such as porosity and storage/storativity were not included in the model calibration process.

2.4.1 Hydraulic Conductivity

Golder based hydraulic conductivity values for the Site model on pumping test analysis results as discussed in Section 6.0 of the AT-01 Aquifer Test Report (Golder, 2020) and summarized in Table B-2. Golder used these results to assign initial hydraulic conductivity values to the groundwater flow model, and to check that the hydraulic conductivity values resulting from model calibration were within the range of values observed. Golder assigned a uniform Kx/Ky hydraulic conductivity value of 215 feet/day and a Kz of 21.5 feet/day across the entire model area for Layers 1 and 2. Layer 3 had a slightly lower hydraulic conductivity of 200 feet/day and a Kz of 20.0 feet/day across the entire model area. These hydraulic conductivities are based on a best fit from model calibration, and are within range of measured conductivities.

2.4.2 Precipitation Recharge

Precipitation recharge is the amount of precipitation that recharges the aquifer, which is generally the precipitation rate minus losses due to runoff and evapotranspiration. Recharge rates calculated for the area were presented in Letsinger (2015) and used in the model. After model calibration a best fit recharge value of 7.1 inches per year (0.00162 feet/day) was established, which was similar to the published rates. A recharge rate of 0.04 inches/year (0.00001 ft/day) was used for the capped landfill areas. Precipitation recharge rates are shown in Attachment D.

2.4.3 Groundwater Extraction and Recharge Wells

Groundwater extraction or recharge wells are present on and adjacent to the Site and were modeled in all versions of the model, as shown in Attachment D. The well field located on the northeast corner of the model contains eight wells that remove a total of 55,343 cubic feet/day. In the central portion of the Site the 5 cooling tower wells and two Miox wells remove a total of 7,701 cubic feet/day, and just west of the Site on well on the adjacent property removes 9,625 cubic feet/day.

3.0 MODEL CALIBRATION AND VERIFICATION

Model calibration consists of successive refinement of the model property assignments and input data from initial assumptions/estimates to improve the fit between observed and model-predicted results. A solution of a groundwater flow model problem requires information including aquifer parameters such as hydraulic conductivity, spatial boundary conditions, and the location and magnitude of applied stresses, such as recharge and drainage.

A solution is attained only when the proper combination of the above parameters and inputs are selected such that the physical problem is accurately represented by the model. The calibrated model described below should be considered a limited hydrologic effort founded on the available information within the context of necessary simplifying assumptions.

The purpose of the calibration effort was to simulate "steady-state" groundwater flow conditions that approximate the general flow patterns inferred from September 2019 groundwater level measurements. The model was calibrated through trial-and-error adjustment of model parameter values and through use of Model-Independent PEST, developed by Watermark Computing, to refine aquifer parameters. PEST allows model input parameters to be adjusted automatically over a given range until the model predicted head matches the observed head with the lowest possible numerical difference, referred to as the calibration residual (Doherty, 2016). Golder set the allowable range of parameter adjustment in PEST to represent realistic values as determined by previously published literature for the region and aquifer tests at the Site.

At each well location, the head residuals were calculated in Groundwater Vistas as the difference between the measured and simulated head values. Positive residual values indicate simulated head values were lower than measured elevations, while negative residual values indicate simulated head values were higher than measured elevations.

As a measure of the accuracy of the model, Groundwater Vistas calculates summary statistics using calculated residuals, which are used as measures of error in the calibrated model. The residual mean (RM) is the arithmetic mean of all calculated residual values. The absolute residual mean (ARM) is the arithmetic mean of the absolute value of the residuals (i.e., all negative residuals are considered positive). The root mean square error (RMSE) is the square root of the mean of the squared value of target residuals. Other statistics such as the residual standard deviation (RSD) (i.e., the square root of the variance [the average of the squared deviations from the mean]), and the sum of squared residuals (SSR) (computed by squaring each residual and adding them together) can also be useful in evaluation of the calibration process. While calibrating the model, Golder selected parameters estimated by PEST that were within a valid range from published literature or Site-specific data that resulted in improved calibration summary statistics.

3.1 Simulated Heads Calibrated to September 2019 Conditions

Measured groundwater elevations for 112 monitoring points from September 2019 were used for calibration, as presented in Table B-3. The model files for September 2019 calibration simulation use the root file name *V12_2019.* The simulated heads and residuals for targets screened in Layer 1 are presented in Attachment F. Based on the simulated contours of groundwater elevation, groundwater flows from the south/southwest toward the Site before it travels to the Kankakee River in the north/northeast.

A comparison of model-predicted versus observed September 2019 potentiometric heads for the 112 selected calibration points resulted in a RM of -0.36 feet and a RMSE of 0.72 feet. The calibration statistics for the model are presented in Table B-4. The RM of -0.36 feet, represents 4.9 percent of the total measured head difference for the model area (approximately 7.41 feet). The absolute residual mean for the model run is 0.57 feet, which is 7.7 percent of the total hydraulic head difference for the entire modeling area. The residual mean and the absolute residual mean are within the generally accepted standard of 10 percent of the total hydraulic head difference for the modeling area.

3.1.1 Water Balance

An effective measure of model calibration is the analysis of the water budget calculated by MODFLOW. The model provides flows across boundaries, flows to and from all sources and sinks, and flows generated by storage. Inflows into the model include:

- Constant head boundaries: 16,716 ft^3/d,
- Rivers: 165,339 ft^3/d,
- Streams: 182,984 ft^3/d and
- Recharge: 545,949 ft^3/d.

Outflows in the model include

- Constant head boundaries: 5,640 ft^3/d,
- Wells: 70,469 ft^3/d,
- Rivers: 474,633 ft^3/d,
- Streams: 400,512 ft^3/d, and
- Drains: 45,574 ft^3/d.

The outflow deficit is 85,842 cubic feet per day (ft^3/d), which is equivalent to error between outflow and inflow estimates of approximately 8.9 percent.

3.1.2 Numerical Model Verification

Model verification was performed using a second water level calibration data set from October 2018. The model input parameter values defined in the September 2019 simulation were maintained. The verification data is presented in Table B-5. The model files for the October 2018 conditions use the root file name *V12.1_2019*. The verification results indicate a RM of 0.33 feet, which represents 4.1 percent of the total hydraulic head difference for the model area. The absolute residual mean for this simulation was 0.52 feet, which is 6.5 percent of the total hydraulic head difference for the entire model area. The verification statistics suggests that the model is calibrated and verified.

4.0 DESIGN SIMULATIONS

Using the calibrated model, Golder used MODPATH (Pollack, 1989) to simulate travel times for particles released from the metals cleaning basin. Particles were started in Layer 3 of the model to simulate the release of contaminants in the deeper part of the aquifer where Boron concentrations exceeded 10 micrograms/liter. Effective porosity of the aquifer was varied between 0.16, 0.3, and 0.46 to represent values within the expected range for medium to fine sand. The length of the particle traces produced by MODPATH along with travel time estimates were used to calculate average groundwater velocities. These travel time calculations are presented in Table B-6.

5.0 GROUNDWATER MODELING SUMMARY

Through standard numerical groundwater modeling procedures, Golder developed a steady state groundwater flow model for the Site that is considered calibrated and verified. This model was utilized to inform the groundwater monitored natural attenuation study by simulating travel times for particles released from the metals cleaning basin.

6.0 REFERENCES

Doherty, 2016. PEST, Model-Independent Parameter Estimation. User Manual 6th Edition.

Golder, 2019, CCR Assessment of Corrective Measures Northern Indiana Public Service Company Rollin M Schahfer Generating Station Wheatfield, Indiana. April 2019.

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Letsinger, S. L., 2015, Map of Indiana showing near-surface aquifer recharge: Indiana Geological Survey Miscellaneous Map 92, scale 1:500,000.

Pollock, D.W., 1989 Documentation of computer programs to compute and display pathlines using results from the U.S. Geological Survey modular three-dimensional finite-difference groundwater flow model. U.S. Geological Survey, Open File Report 89-381.

List of Attachments:

Attachment A	Model Grid
Attachment B	Cross Section of Model Grid
Attachment C	Boundary Conditions
Attachment D	Precipitation Recharge Zones
Attachment E	Active Pumping Wells
Attachment F	Model Calibration – September 2019

List of Tables

https://golderassociates.sharepoint.com/sites/nipscoccrgwmonitoring/shared documents/rmsgs/evs and gw models/2020 model memo/rmsgs gw modeling .docx

Table B-1: Boundary Conditions
Groundwater Flow Model Technical Memorandum
NIPSCO LLC R. M. Schahfer Generating Station

Constant Head Boundaries

Name	Layer	Reach	Starting Head (ft)	Ending Head (ft)
Intake Settling Basin	1	104	675.0	675.0
Final Settling Basin	1	101	675.0	675.0
Drying Area	1	100	672.0	672.0
Unnamed SW. Stream	1	1	663.17	661.20

Rivers

Name	Layer	Starting Stage (ft)	Starting Bed Elevation (ft)	Ending Stage (ft)	Ending Bed Elevation (ft)	Starting Width (ft)	Ending Width (ft)	Length (ft)	Thickness of Bed (ft)	Hydraulic Conductivity (ft/d)
Kakakanee River	1	651.82	649.10	646.72	644.01	135.28	159.88	24.0	10.0	64.41

Streams

Name	Layer	Starting Stage (ft)	Starting Bed Elevation (ft)	Ending Stage (ft)	Ending Bed Elevation (ft)	Starting Width (ft)	Ending Width (ft)	Length (ft)	Thickness of Bed (ft)	Hydraulic Conductivity (ft/d)	Slope of Channel (ft/ft)
Davis Ditch	1	661.99	659.99	650.29	646.31	20.05	74.80	50	10.0	63.41	0.001
Stalbaum Ditch	1	660.74	659.74	654.5	652.0	10.07	50	28	1.0	50	0.001
Fisher Ditch	1	661.49	659.49	660.88	658.88	30.04	32.08	51	5.0	100	0.001
Stalbaum South Ancillary Ditch	1	661.50	660.0	659.21	657.76	2.06	29.93	31	1.0	10	0.001
Stalbaum East Ancillary Ditch	1	661.0	655.36	657.17	655.21	18.80	30.36	13	5.0	0.1	0.001
Coal Yard Ditch	1	660.7	659.00	660.7	659	5.0	5.0	50	1.0	50	0.001

Drains

Name	Layer	Starting Stage (ft)	Ending Stage (ft)	Starting Width (ft)	Ending Width (ft)	Length (ft)	Thickness of Bed (ft)	Hydraulic Conductivity (ft/d)
Sands Ditch	1	662.0	654.1	1.0	5	38	1	50
W. Sands Drain	1	660.0	655.6	2	2	27	1	50
Hilliard St Ditch	1	659	659	2	2	24	1	10
N. LF Drain	1	661	661	8.8	8.8	50.0	1.0	62.0
S. LF Drain	1	661	661	8.8	8.8	50.0	1.0	62.0
W. LF Drain	1	661	661	5	5	50	2	100

Hydraulic Flow Barriers (Slurry Walls)

Name	First Layer	Last Layer	Thickness (ft)	Hydraulic Conductivity (ft/d)
Intake Settling Basin Slurry Wall	1	3	1	1.00E-07
Final Settling Basin Slurry Wall	1	3	1	1.00E-07
Drying Area Slurry Wall	1	3	1	1.00E-06

Table B-2: Site Pumping Test Results
Groundwater Flow Model Technical Memorandum
NIPSCO LLC R. M. Schahfer Generating Station

Pumping Test Results		Estimated Hydraulic Conductivity (ft/d)
SHALLOW WELLS	*Minimum:*	192
	Maximum:	363
	Arithmetic Mean:	266
DEEP WELLS	*Minimum:*	234
	Maximum:	320
	Arithmetic Mean:	268

Table B-3: Measured Groundwater Elevations - September 2019
Groundwater Flow Model Technical Memorandum
NIPSCO LLC R. M. Schahfer Generating Station

Well ID	Layer	Groundwater Elevation (ft msl)
GAMW01	1	658.89
GAMW01B	3	658.72
GAMW03	1	659.84
GAMW03B	3	659.26
GAMW07	1	660.74
GAMW07B	3	660.79
GAMW08	1	658.87
GAMW08B	3	658.98
GAMW09	1	659.27
GAMW09B	3	658.87
GAMW12	1	658.64
GAMW12B	3	658.66
GAMW13	1	658.35
GAMW13B	3	658.37
GAMW14	1	658.14
GAMW14B	3	658.12
GAMW15	1	660.35
GAMW15B	3	660.33
GAMW16	1	659.31
GAMW16B	3	659.46
GAMW17B	3	658.92
GAMW18	1	658.92
GAMW18B	3	659.17
GAMW20	1	658.21
GAMW24	1	658.66
GAMW24B	2	658.73
GAMW25	1	658.41
GAMW25B	2	658.41
GAMW26	1	658.33
GAMW26B	3	658.26
GAMW27	1	658.29
GAMW27B	3	658.32
GAMW29	1	657.48
GAMW29B	3	657.48
GAMW30	1	657.42
GAMW30B	3	657.51
GAMW31	1	657.24
GAMW31B	2	657.25
GAMW32	1	657.19
GAMW32B	3	657.15
GAMW33	1	657.04
GAMW33B	3	657.13
GAMW34	1	657.58

Table B-3: Measured Groundwater Elevations - September 2019
Groundwater Flow Model Technical Memorandum
NIPSCO LLC R. M. Schahfer Generating Station

Well ID	Layer	Groundwater Elevation (ft msl)
GAMW34B	3	657.59
GAMW35B	2	658.16
GAMW36	1	656.67
GAMW36B	3	656.69
GAMW37B	2	657.26
GAMW38	1	657.91
GAMW38B	3	657.91
GAMW39	2	657.88
GAMW39B	3	657.84
GAMW40	1	657.66
GAMW40B	3	657.65
GAMW42	1	658.12
GAMW42B	3	658.13
GAMW43	1	657.83
GAMW43B	3	657.83
GAMW44	1	657.71
GAMW44B	3	657.69
GAMW45B	3	654.52
GAMW46	1	655.22
GAMW46B	3	655.21
GAMW48	1	654.5
GAMW48B	3	654.51
GAMW49	1	656.26
GAMW49B	3	656.34
GAMW50	1	656.37
GAMW50B	3	656.35
GAMW51	1	658.07
GAMW51B	3	658.19
GAMW52	1	657.81
GAMW52B	3	657.82
GAMW53	1	658.04
GAMW53B	3	658.21
GAMW54	1	657.87
GAMW54B	3	657.82
GAMW55B	3	657.78
GAMW56	1	657.81
GAMW56B	3	657.77
GAMW02	1	660.14
GAMW05	1	658.17
GAMW06	1	659.65
GAMW10	1	657.63
GAMW11	1	657.37
GAMW20B	3	658.25

Table B-3: Measured Groundwater Elevations - September 2019
Groundwater Flow Model Technical Memorandum
NIPSCO LLC R. M. Schahfer Generating Station

Well ID	Layer	Groundwater Elevation (ft msl)
MW-1D	3	659.11
MW-1S	2	659.09
MW-2S	2	657.7
MW-3D	3	656.68
MW-4S	2	657.08
MW-5D	3	658.17
MW-5S	2	658.14
MW-6D	3	654.1
MW-6S	2	654.07
MW-7D	3	656.12
MW-7S	2	656.1
MW-8S	3	654.65
MW-9D	3	655.18
MW-9S	3	655.14
MW-10D	3	658.66
MW-10S	1	658.61
MW-11D	3	656.75
MW-11S	2	656.73
MW-12D	3	656.97
MW-12S	2	656.95
MW-13D	3	657.2
MW-13S	2	657.17
MW-14D	2	656.51
MW-14S	2	656.54
SW-4	1	661.48
SW-10	1	660

Table B-4: Calibration Residuals and Summary Statistics - September 2019
Groundwater Flow Model Technical Memorandum
NIPSCO LLC R. M. Schahfer Generating Station

Name	Observed Groundwater Elevation (ft msl)	Computed Groundwater Elevation (ft msl)	Residual (ft)
Layer 1			
GAMW01	658.89	658.87	0.02
GAMW03	659.84	660.22	-0.38
GAMW07	660.74	662.14	-1.40
GAMW08	658.87	658.87	0.00
GAMW09	659.27	659.05	0.22
GAMW12	658.64	658.58	0.06
GAMW13	658.35	658.50	-0.15
GAMW14	658.14	658.57	-0.43
GAMW15	660.35	662.08	-1.73
GAMW16	659.31	659.11	0.20
GAMW18	658.92	659.30	-0.38
GAMW20	658.21	658.72	-0.51
GAMW24	658.66	659.16	-0.50
GAMW25	658.41	658.67	-0.26
GAMW26	658.33	658.34	-0.01
GAMW27	658.29	658.09	0.20
GAMW29	657.48	658.19	-0.71
GAMW30	657.42	658.20	-0.78
GAMW31	657.24	658.12	-0.88
GAMW32	657.19	657.99	-0.80
GAMW33	657.04	657.92	-0.88
GAMW34	657.58	658.44	-0.86
GAMW36	656.67	657.59	-0.92
GAMW38	657.91	658.24	-0.33
GAMW40	657.66	658.27	-0.61
GAMW42	658.12	658.62	-0.50
GAMW43	657.83	658.54	-0.71
GAMW44	657.71	658.56	-0.85
GAMW46	655.22	654.39	0.83
GAMW48	654.5	654.25	0.25
GAMW49	656.26	656.37	-0.11
GAMW50	656.37	656.86	-0.49
GAMW51	658.07	658.84	-0.77
GAMW52	657.81	657.89	-0.08
GAMW53	658.04	658.21	-0.17
GAMW54	657.87	658.36	-0.49
GAMW56	657.81	658.51	-0.70
GAMW02	660.14	659.81	0.33
GAMW05	658.17	658.77	-0.60
GAMW06	659.65	660.42	-0.77

Table B-4: Calibration Residuals and Summary Statistics - September 2019
Groundwater Flow Model Technical Memorandum
NIPSCO LLC R. M. Schahfer Generating Station

Name	Observed Groundwater Elevation (ft msl)	Computed Groundwater Elevation (ft msl)	Residual (ft)
GAMW10	657.63	658.34	-0.71
GAMW11	657.37	658.19	-0.82
MW-10S	658.61	659.16	-0.55
SW-4	661.48	657.77	3.71
SW-10	660	659.21	0.79
Layer 2			
GAMW24B	658.73	659.16	-0.43
GAMW25B	658.41	658.67	-0.26
GAMW31B	657.25	658.12	-0.87
GAMW35B	658.16	659.00	-0.84
GAMW37B	657.26	658.24	-0.98
GAMW39	657.88	658.29	-0.41
MW-1S	659.09	659.72	-0.63
MW-2S	657.7	658.54	-0.84
MW-4S	657.08	657.79	-0.71
MW-5S	658.14	658.13	0.01
MW-6S	654.07	654.60	-0.53
MW-7S	656.1	656.26	-0.16
MW-11S	656.73	657.28	-0.55
MW-12S	656.95	657.48	-0.53
MW-13S	657.17	657.95	-0.78
MW-14S	656.54	657.27	-0.73
Layer 3			
GAMW01B	658.72	658.87	-0.15
GAMW03B	659.26	660.22	-0.96
GAMW07B	660.79	660.99	-0.20
GAMW08B	658.98	658.87	0.11
GAMW09B	658.87	659.05	-0.18
GAMW12B	658.66	658.58	0.08
GAMW13B	658.37	658.50	-0.13
GAMW14B	658.12	658.57	-0.45
GAMW15B	660.33	662.22	-1.89
GAMW16B	659.46	659.11	0.35
GAMW17B	658.92	659.55	-0.63
GAMW18B	659.17	659.30	-0.13
GAMW26B	658.26	658.34	-0.08
GAMW27B	658.32	658.13	0.19
GAMW29B	657.48	658.19	-0.71
GAMW30B	657.51	658.20	-0.69
GAMW32B	657.15	657.98	-0.83
GAMW33B	657.13	657.92	-0.79

Table B-4: Calibration Residuals and Summary Statistics - September 2019
Groundwater Flow Model Technical Memorandum
NIPSCO LLC R. M. Schahfer Generating Station

Name	Observed Groundwater Elevation (ft msl)	Computed Groundwater Elevation (ft msl)	Residual (ft)
GAMW34B	657.59	658.44	-0.85
GAMW36B	656.69	657.59	-0.90
GAMW38B	657.91	658.24	-0.33
GAMW39B	657.84	658.29	-0.45
GAMW40B	657.65	658.27	-0.62
GAMW42B	658.13	658.62	-0.49
GAMW43B	657.83	658.54	-0.71
GAMW44B	657.69	658.56	-0.87
GAMW45B	654.52	653.66	0.86
GAMW46B	655.21	654.39	0.82
GAMW48B	654.51	654.24	0.27
GAMW49B	656.34	656.36	-0.02
GAMW50B	656.35	656.86	-0.51
GAMW51B	658.19	658.84	-0.65
GAMW52B	657.82	657.88	-0.06
GAMW53B	658.21	658.21	0.00
GAMW54B	657.82	658.36	-0.54
GAMW55B	657.78	658.47	-0.69
GAMW56B	657.77	658.51	-0.74
GAMW20B	658.25	658.72	-0.47
MW-1D	659.11	659.72	-0.61
MW-3D	656.68	657.50	-0.82
MW-5D	658.17	658.13	0.04
MW-6D	654.1	654.61	-0.51
MW-7D	656.12	656.26	-0.14
MW-8S	654.65	654.32	0.33
MW-9D	655.18	654.27	0.91
MW-9S	655.14	654.28	0.86
MW-10D	658.66	659.16	-0.50
MW-11D	656.75	657.27	-0.52
MW-12D	656.97	657.48	-0.51
MW-13D	657.2	657.95	-0.75
MW-14D	656.51	657.27	-0.76

Calibration Parameter	Value
Residual Mean (ft)	-0.36
Redsidual Standard Deviation (ft)	0.63
Absolute Residual Mean (ft)	0.57
Residual Sum of Squares	59
RMS Error	0.72
Minimum Residual (ft)	-1.89
Maximum Residual (ft)	3.71

Table B-4: Calibration Residuals and Summary Statistics - September 2019
Groundwater Flow Model Technical Memorandum
NIPSCO LLC R. M. Schahfer Generating Station

Name	Observed Groundwater Elevation (ft msl)	Computed Groundwater Elevation (ft msl)	Residual (ft)
Range of Observations (ft)			7.41
Scaled Residual Standard Deviation			0.085
Scaled Absolute Mean			0.076
Scaled RMS (%)			9.8
Number of Observations			112

Table B-5: Verification Residuals and Summary Statistics – October 2018
Groundwater Flow Model Technical Memorandum
NIPSCO LLC R. M. Schahfer Generating Station

Name	Observed Groundwater Elevation (ft msl)	Computed Groundwater Elevation (ft msl)	Residual (ft)
Layer 1			
GAMW01	659.19	658.87	0.32
GAMW03	660.82	660.22	0.60
GAMW07	659.27	660.62	-1.35
GAMW08	659.06	658.87	0.19
GAMW09	660.34	659.05	1.29
GAMW12	658.84	658.58	0.26
GAMW13	658.72	658.50	0.22
GAMW14	659.55	658.57	0.98
GAMW15	659.10	660.00	-0.90
GAMW16	659.07	659.11	-0.04
GAMW18	659.57	659.30	0.27
GAMW20	659.81	658.72	1.09
GAMW24	659.90	659.16	0.74
GAMW25	659.67	658.67	1.00
GAMW26	659.73	658.34	1.39
GAMW27	659.67	658.09	1.58
GAMW29	658.28	658.19	0.09
GAMW30	658.62	658.20	0.42
GAMW31	658.13	658.12	0.01
GAMW32	657.99	657.99	0.00
GAMW33	657.84	657.92	-0.08
GAMW34	658.47	658.44	0.03
GAMW36	657.71	657.59	0.12
GAMW38	659.19	658.24	0.95
GAMW40	658.76	658.27	0.49
GAMW42	658.40	658.62	-0.22
GAMW43	658.16	658.54	-0.38
GAMW44	657.95	658.56	-0.61
GAMW46	655.25	654.39	0.86
GAMW48	654.68	654.25	0.43
GAMW49	656.86	656.37	0.49
GAMW50	657.22	656.86	0.36
GAMW51	658.42	658.84	-0.42
GAMW52	657.99	657.89	0.10
GAMW53	658.14	658.21	-0.07
GAMW54	658.47	658.36	0.11
GAMW56	658.86	658.51	0.35
GAMW02	660.52	659.81	0.71
GAMW05	658.53	658.77	-0.24
GAMW06	658.63	660.42	-1.79

Table B-5: Verification Residuals and Summary Statistics – October 2018
Groundwater Flow Model Technical Memorandum
NIPSCO LLC R. M. Schahfer Generating Station

Name	Observed Groundwater Elevation (ft msl)	Computed Groundwater Elevation (ft msl)	Residual (ft)
GAMW10	658.61	658.34	0.27
GAMW11	657.97	658.19	-0.22
MW-10S	659.83	659.16	0.67
SW-4	662.48	657.77	4.71
SW-10	660.45	659.21	1.24
Layer 2			
GAMW24B	659.95	659.16	0.79
GAMW25B	659.69	658.67	1.02
GAMW31B	658.14	658.12	0.02
GAMW35B	659.16	659.00	0.16
GAMW37B	658.42	658.24	0.18
GAMW39	659.08	658.29	0.79
MW-1S	659.76	659.72	0.04
MW-2S	658.58	658.54	0.04
MW-4S	657.62	657.79	-0.17
MW-5S	659.47	658.13	1.34
MW-6S	654.83	654.60	0.23
MW-7S	656.72	656.26	0.46
MW-11S	657.55	657.28	0.27
MW-12S	657.68	657.48	0.20
MW-13S	657.97	657.95	0.02
MW-14S	657.49	657.27	0.22
Layer 3			
GAMW01B	659.23	658.87	0.36
GAMW03B	660.31	660.22	0.09
GAMW07B	659.29	660.56	-1.27
GAMW08B	659.12	658.87	0.25
GAMW09B	659.94	659.05	0.89
GAMW12B	657.90	658.58	-0.68
GAMW13B	658.70	658.50	0.20
GAMW14B	658.50	658.57	-0.07
GAMW15B	659.13	660.03	-0.90
GAMW16B	659.14	659.11	0.03
GAMW17B	659.18	658.84	0.34
GAMW18B	660.15	659.30	0.85
GAMW26B	659.66	658.34	1.32
GAMW27B	659.70	658.13	1.57
GAMW29B	658.43	658.19	0.24
GAMW30B	658.71	658.20	0.51
GAMW32B	657.95	657.98	-0.03
GAMW33B	657.89	657.92	-0.03

Table B-5: Verification Residuals and Summary Statistics – October 2018
Groundwater Flow Model Technical Memorandum
NIPSCO LLC R. M. Schahfer Generating Station

Name	Observed Groundwater Elevation (ft msl)	Computed Groundwater Elevation (ft msl)	Residual (ft)
GAMW34B	658.46	658.44	0.02
GAMW36B	657.72	657.59	0.13
GAMW38B	659.21	658.24	0.97
GAMW39B	659.04	658.29	0.75
GAMW40B	658.68	658.27	0.41
GAMW42B	658.41	658.62	-0.21
GAMW43B	658.10	658.54	-0.44
GAMW44B	657.91	658.56	-0.65
GAMW45B	654.52	653.66	0.86
GAMW46B	655.24	654.39	0.85
GAMW48B	654.67	654.24	0.43
GAMW49B	656.94	656.36	0.58
GAMW50B	657.25	656.86	0.39
GAMW51B	658.58	658.84	-0.26
GAMW52B	658.00	657.88	0.12
GAMW53B	658.24	658.21	0.03
GAMW54B	658.42	658.36	0.06
GAMW55B	658.68	658.47	0.21
GAMW56B	658.87	658.51	0.36
GAMW20B	659.85	658.72	1.13
MW-1D	659.76	659.72	0.04
MW-3D	657.50	657.50	0.00
MW-5D	659.47	658.13	1.34
MW-6D	654.86	654.61	0.25
MW-7D	656.70	656.26	0.44
MW-8S	654.80	654.32	0.48
MW-9D	655.15	654.27	0.88
MW-9S	655.14	654.28	0.86
MW-10D	659.83	659.16	0.67
MW-11D	657.52	657.27	0.25
MW-12D	657.64	657.48	0.16
MW-13D	657.96	657.95	0.01
MW-14D	657.46	657.27	0.19

Calibration Parameter	Value
Residual Mean (ft)	0.33
Redsidual Standard Deviation (ft)	0.71
Absolute Residual Mean (ft)	0.52
Residual Sum of Squares	69
RMS Error	0.78
Minimum Residual (ft)	-1.79
Maximum Residual (ft)	4.71

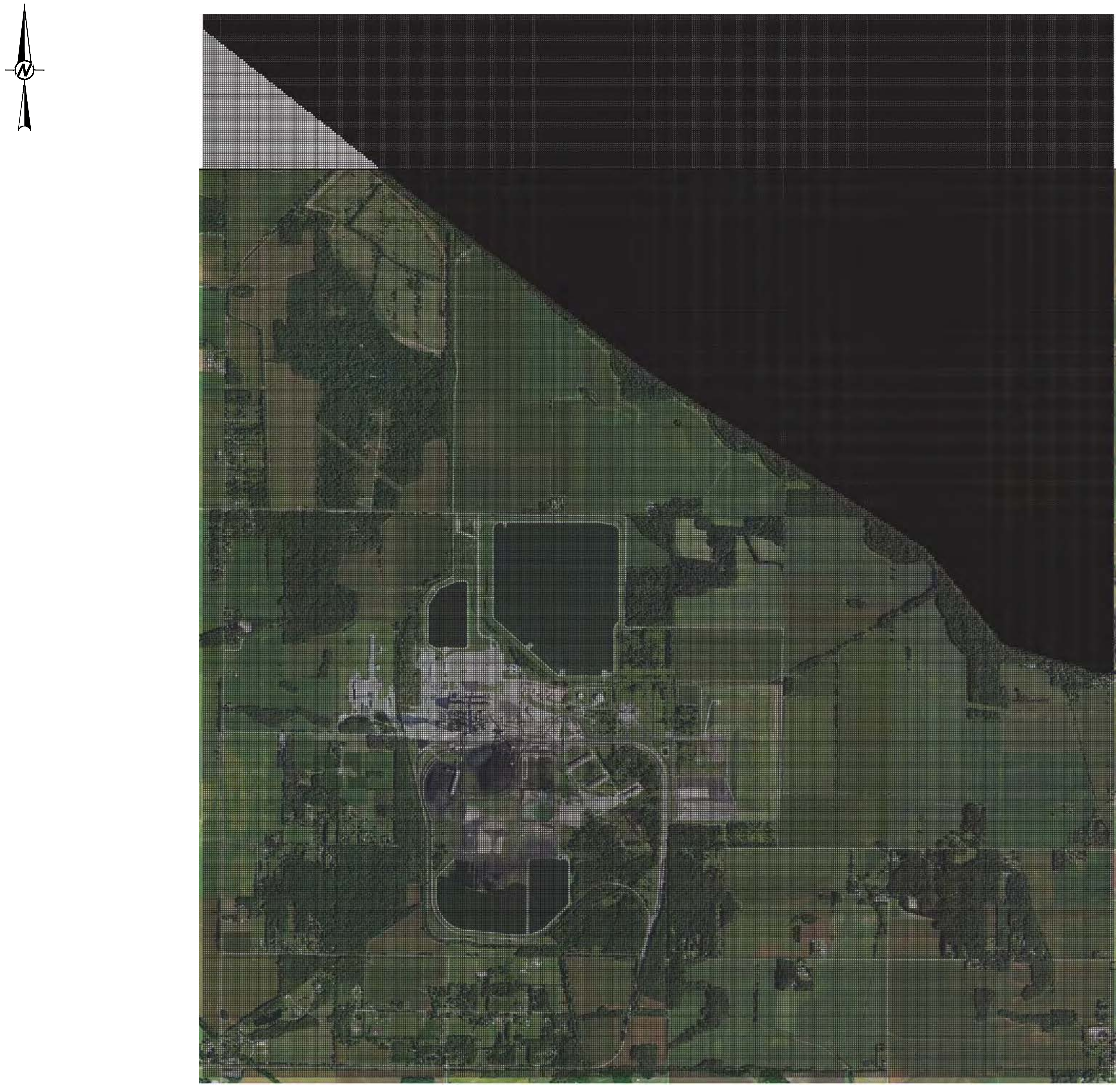
Table B-5: Verification Residuals and Summary Statistics – October 2018
Groundwater Flow Model Technical Memorandum
NIPSCO LLC R. M. Schahfer Generating Station

Name	Observed Groundwater Elevation (ft msl)	Computed Groundwater Elevation (ft msl)	Residual (ft)
Range of Observations (ft)			7.96
Scaled Residual Standard Deviation			0.09
Scaled Absolute Mean			0.066
Scaled RMS (%)			9.9
Number of Observations			112

Table B-6: Travel Time Simulations
Groundwater Flow Model Technical Memorandum
NIPSCO LLC R. M. Schahfer Generating Station

	Shallow Flow Paths				Deep Flow Paths			
Starting Well	**GAMW-16**	**GAMW-18**	**GAMW-17B**	**GAMW-09B**	**GAMW-16B**	**GAMW-18B**	**GAMW-17B**	**GAMW-09B**
Ending Well	**GAMW-53**	**GAMW-55**	**GAMW-54B**	**GAMW-54B**	**GAMW-53B**	**GAMW-55B**	**GAMW-54B**	**GAMW-54B**
Distance (ft)	**1521**	**1964**	**1200**	**1714**	**1521**	**1964**	**1200**	**1714**
Effective Porosity = 16%								
Travel Time (years)	4.8	11.0	4.5	8.9	5.0	11.0	5.5	9.0
Velocity (ft/year)	317	179	267	193	304	179	218	190
Time to Davis Ditch (years)	5.5	-	-	-	6	-	-	-
Time to property boundry near GAMW46B (years)	-	27	49	41	-	28.5	45	41
Effective Porosity = 30%								
Travel Time (years)	8.5	19.8	8.0	16.0	8.9	20.0	10.0	16.5
Velocity (ft/year)	179	99	150	107	171	98	120	104
Time to Davis Ditch (years)	10	-	-	-	9.9	-	-	-
Time to property boundry near GAMW46B (years)	-	49.8	79	75	-	51.5	80	76
Effective Porosity = 46%								
Travel Time (years)	13.0	31.0	12.0	25.0	13.5	29.0	15.0	25.0
Velocity (ft/year)	117	63	100	69	113	68	80	69
Time to Davis Ditch (years)	15	-	-	-	15	-	-	-
Time to property boundry near GAMW46B (years)	-	76.8	122	117	-	77	130	120

Notes:
ft = feet



LEGEND

NOTE(S)

1. BASED ON MODEL V12_2019.

REFERENCE(S)

1. COORDINATE SYSTEM: WGS 1984 WEB MERCATOR AUXILIARY SPHERE

CLIENT

NORTHERN INDIANA PUBLIC SERVICE COMPANY LLC

PROJECT

GROUNDWATER FLOW MODEL TECHNICAL MEMORANDUM
MSRB, MCWB, AND DRYING AREA
NIPSCO LLC R. M. SCHAHFER GENERATING STATION

TITLE

MODEL GRID

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-23
DESIGNED	RWB
PREPARED	SHL
REVIEWED	BP
APPROVED	RWB

PROJECT NO.	CONTROL	REV.	ATTACHMENT
19121567	-	-	A

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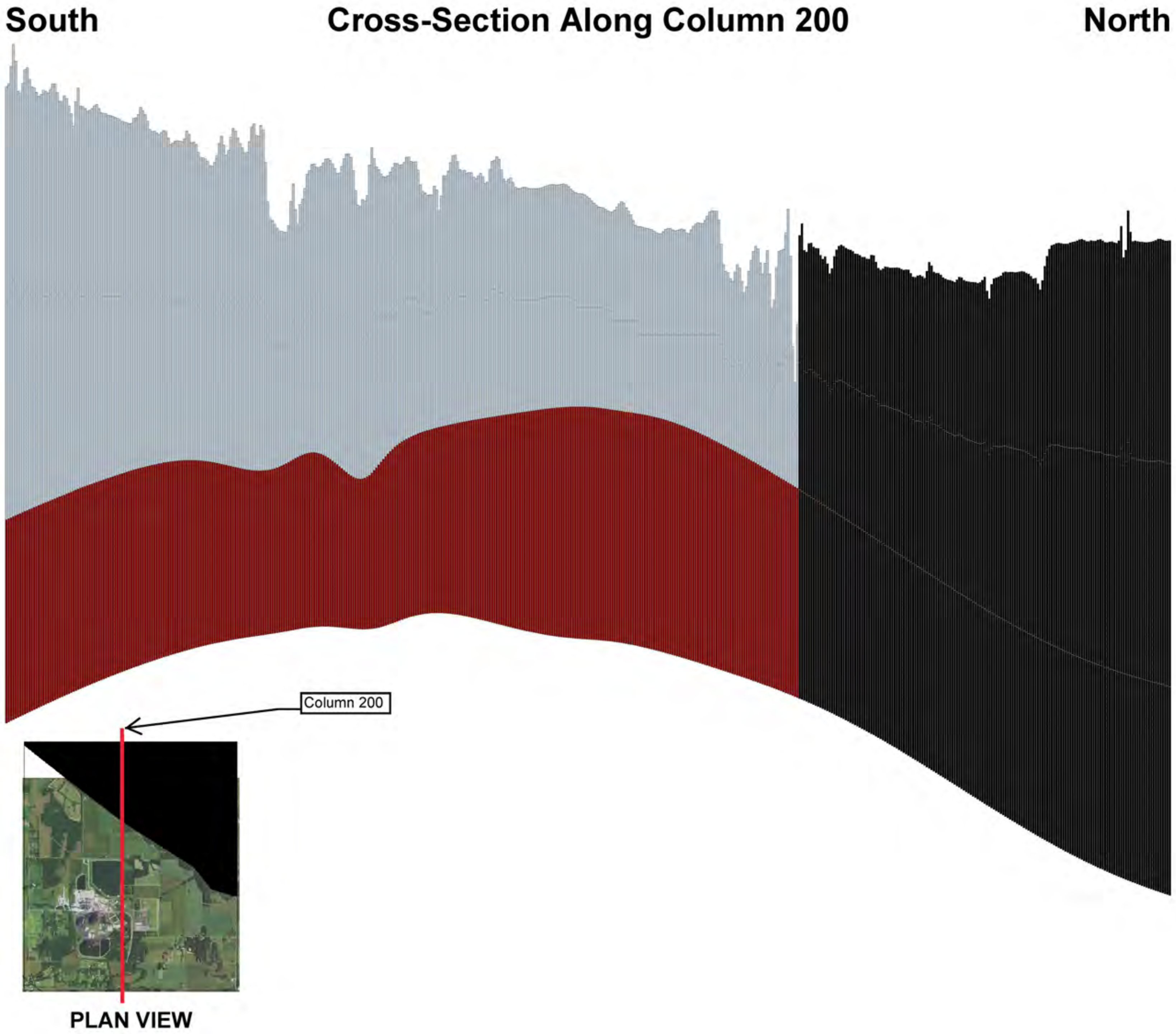

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NOTE(S)

1. BASED ON MODEL V12_2019.

REFERENCE(S)

1. COORDINATE SYSTEM: WGS 1984 WEB MERCATOR AUXILIARY SPHERE

CLIENT

NORTHERN INDIANA PUBLIC SERVICE COMPANY LLC

PROJECT

GROUNDWATER FLOW MODEL TECHNICAL MEMORANDUM
MSRB, MCWB, AND DRYING AREA
NIPSCO LLC R. M. SCHAHFER GENERATING STATION

TITLE

CROSS SECTION OF MODEL GRID

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-23
DESIGNED	RWB
PREPARED	SHL
REVIEWED	BP
APPROVED	RWB

PROJECT NO.	CONTROL	REV.	ATTACHMENT
19121567	-	-	B

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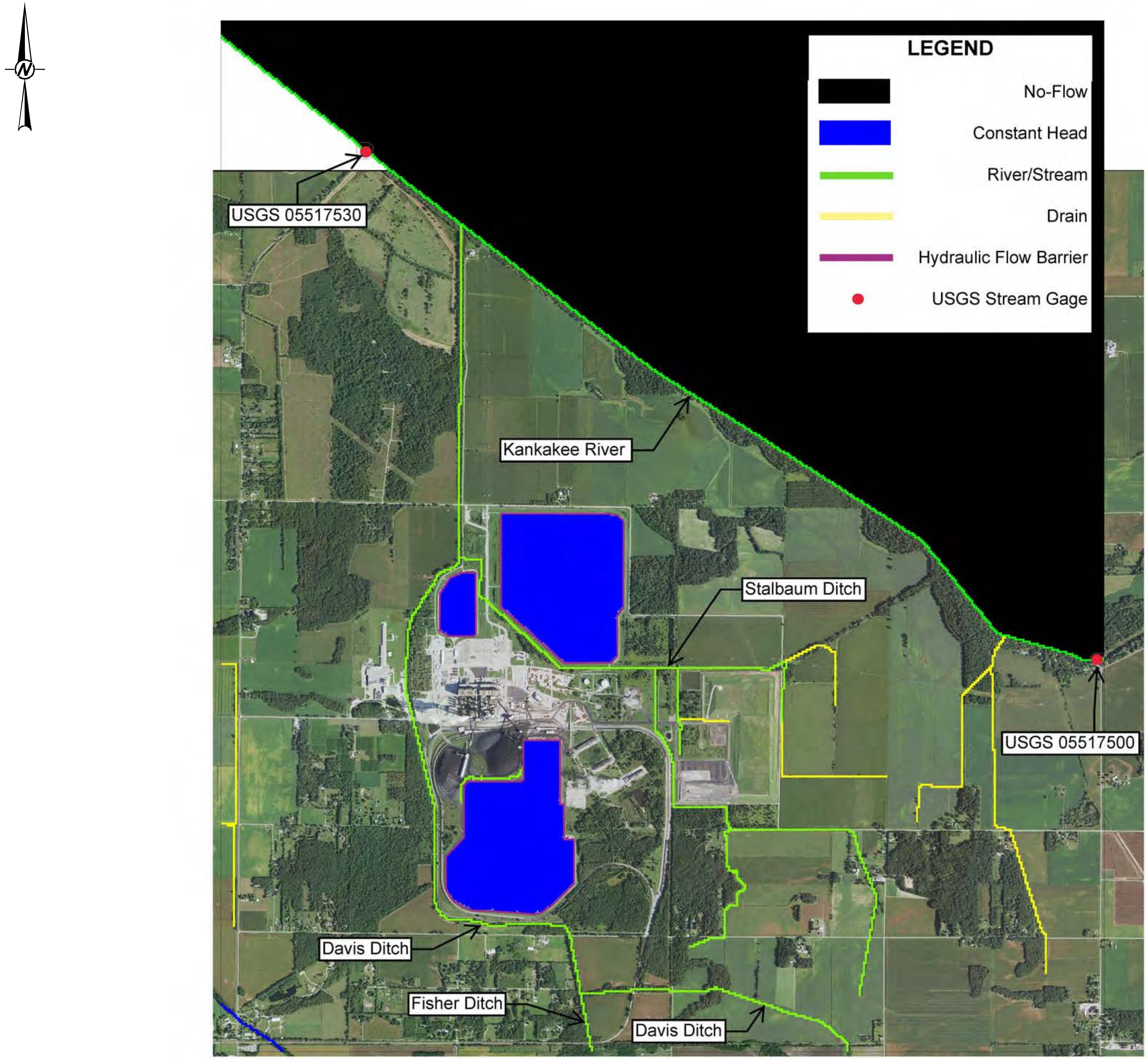

LEGEND

NOTE(S)
1. BASED ON MODEL V12_2019.

REFERENCE(S)
1. COORDINATE SYSTEM: WGS 1984 WEB MERCATOR AUXILIARY SPHERE

CLIENT

NORTHERN INDIANA PUBLIC SERVICE COMPANY LLC

PROJECT

GROUNDWATER FLOW MODEL TECHNICAL MEMORANDUM
MSRB, MCWB, AND DRYING AREA
NIPSCO LLC R. M. SCHAHFER GENERATING STATION

TITLE

BOUNDARY CONDITIONS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-23
DESIGNED	RWB
PREPARED	SHL
REVIEWED	BP
APPROVED	RWB

PROJECT NO.	CONTROL	REV.	ATTACHMENT
19121567	-	-	C

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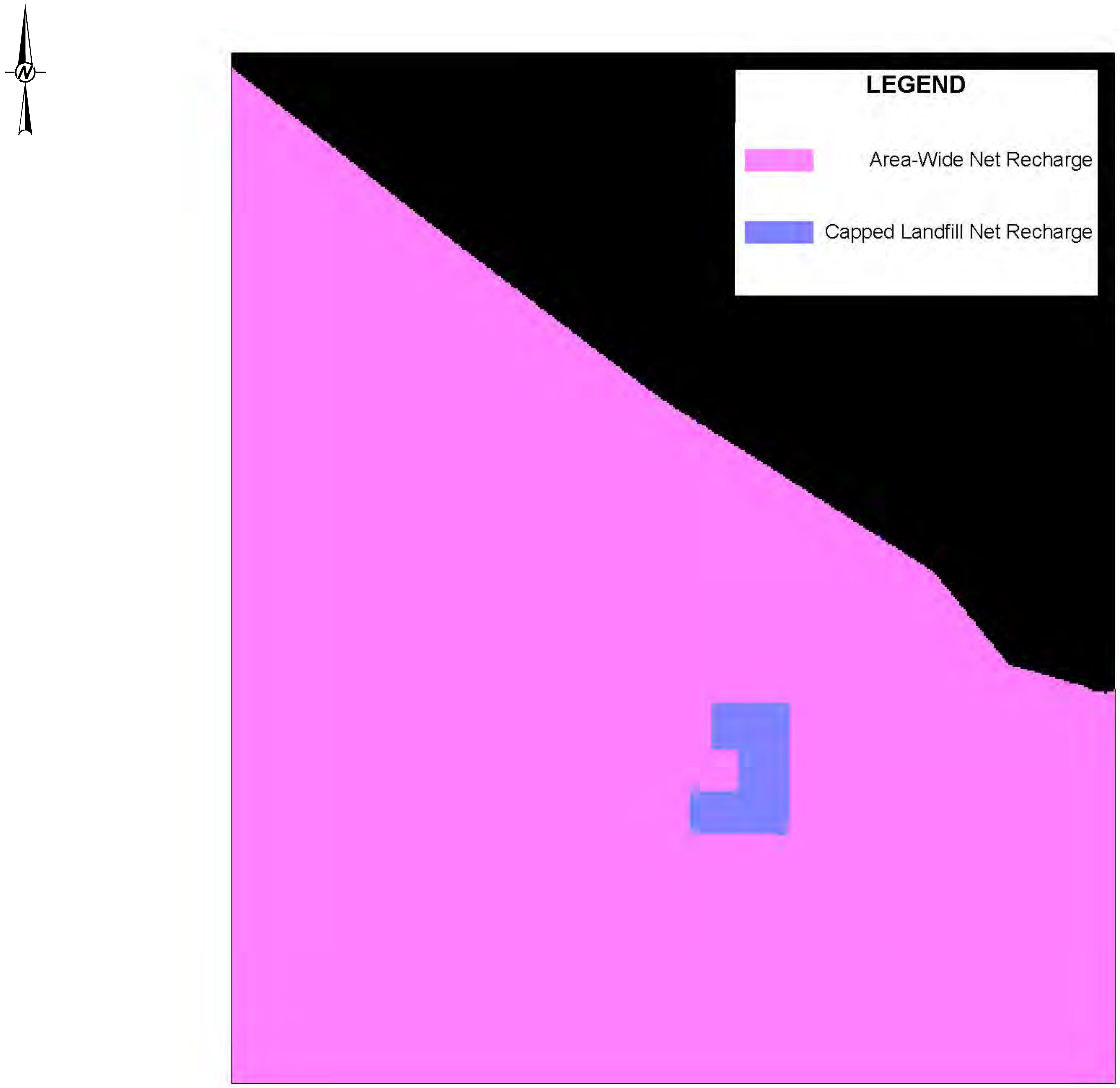

LEGEND

NOTE(S)
1. BASED ON MODEL V12_2019.

REFERENCE(S)
1. COORDINATE SYSTEM: WGS 1984 WEB MERCATOR AUXILIARY SPHERE

CLIENT

NORTHERN INDIANA PUBLIC SERVICE COMPANY LLC

PROJECT

GROUNDWATER FLOW MODEL TECHNICAL MEMORANDUM
MSRB, MCWB, AND DRYING AREA
NIPSCO LLC R. M. SCHAHFER GENERATING STATION

TITLE

PRECIPITATION RECHARGE ZONES

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-23
DESIGNED	RWB
PREPARED	SHL
REVIEWED	BP
APPROVED	RWB

PROJECT NO.	CONTROL	REV.	ATTACHMENT
19121567	-	-	D

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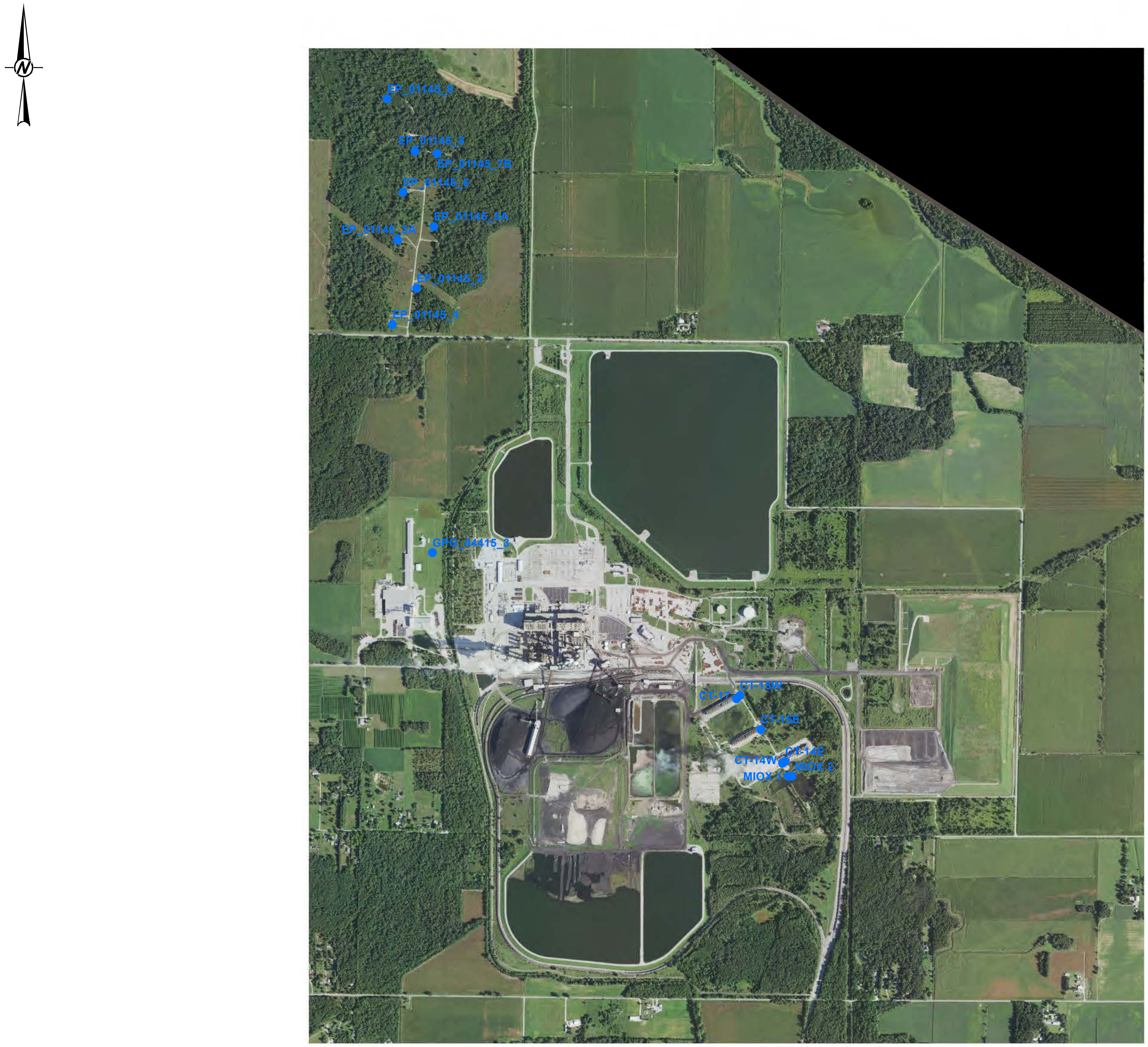

LEGEND

● Well Location

0 840 1,680

Feet

1 " = 1,667 feet

NOTE(S)

1. BASED ON MODEL V12_2019.

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1983 STATEPLANE INDIANA WEST FIPS 1302 FEET
2. 2016 NAIP IMAGERY SOURCED FROM AGOL ONLINE FEATURE SERVICE LAYER.

CLIENT

NORTHERN INDIANA PUBLIC SERVICE COMPANY LLC

PROJECT

GROUNDWATER FLOW MODEL TECHNICAL MEMORANDUM
MSRB, MCWB, AND DRYING AREA
NIPSCO LLC R. M. SCHAHFER GENERATING STATION

TITLE

ACTIVE PUMPING WELLS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-26
DESIGNED	RWB
PREPARED	SHL
REVIEWED	BP
APPROVED	RWB

PROJECT NO.	CONTROL	REV.	ATTACHMENT
19121567	-	-	E

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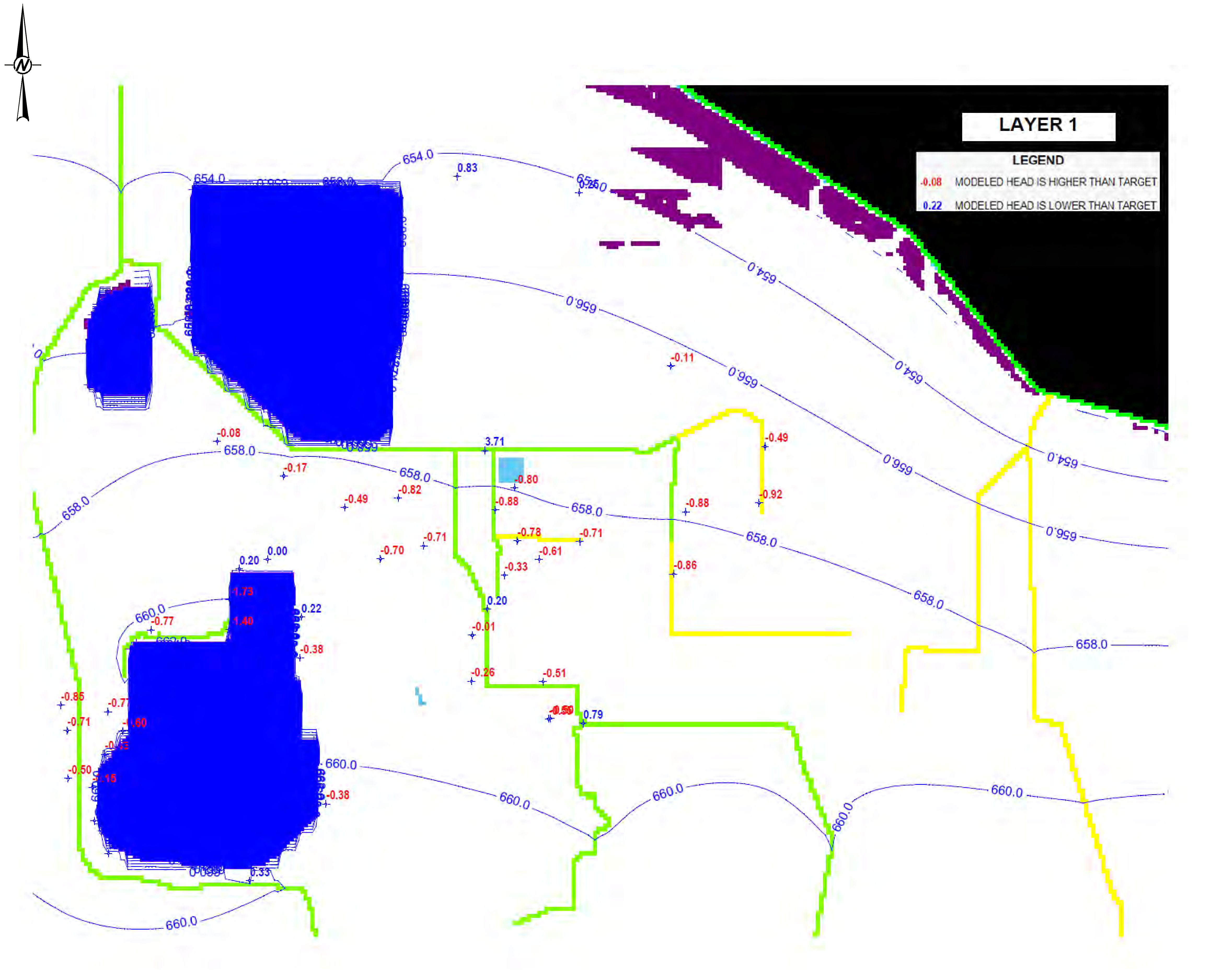

LEGEND

NOTE(S)
1. BASED ON MODEL V12_2019.

REFERENCE(S)
1. COORDINATE SYSTEM: WGS 1984 WEB MERCATOR AUXILIARY SPHERE

CLIENT
NORTHERN INDIANA PUBLIC SERVICE COMPANY LLC

PROJECT
GROUNDWATER FLOW MODEL TECHNICAL MEMORANDUM
MSRB, MCWB, AND DRYING AREA
NIPSCO LLC R. M. SCHAHFER GENERATING STATION

TITLE
MODEL CALIBRATION - SEPTEMBER 2019

CONSULTANT
GOLDER

YYYY-MM-DD	2020-10-23
DESIGNED	RWB
PREPARED	SHL
REVIEWED	BP
APPROVED	RWB

PROJECT NO.	CONTROL	REV.	ATTACHMENT
19121567	-	-	F

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