REPORT ON

CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

by
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for
Southern Indiana Gas and Electric Company
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Overview

Southern Indiana Gas and Electric Company (SIGECO) retained Haley & Aldrich, Inc. (Haley & Aldrich) to prepare this Corrective Measures Assessment (CMA) for the Coal Combustion Residual (CCR) management unit, referred to as the Ash Pond, located at A.B. Brown Generating Station (ABB) in Mount Vernon, Indiana. ABB is a coal-fired power plant located in Posey County near the community of West Franklin, in Posey County, Indiana. The CMA was completed in accordance with requirements stated in the U.S. Environmental Protection Agency's (USEPA) rule entitled *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities*. 80 Fed. Reg. 21302 (Apr. 17, 2015) (promulgating 40 CFR §257.61); 83 Fed. Reg. 36435 (July 30, 2018) (amending 40 CFR §257.61) (CCR Rule).

SIGECO implemented groundwater monitoring under the CCR Rule through a phased approach to allow for a graduated response and evaluation of steps to address groundwater quality. Assessment monitoring completed in 2018 evaluated the presence and concentration of Appendix IV constituents in groundwater specified in the CCR Rule. Of the 23 CCR parameters evaluated, only two Appendix IV constituents, lithium and molybdenum, are present at concentrations above the Groundwater Protection Standards (GWPS) established for the Ash Pond.

SIGECO completed a detailed environmental evaluation of the Ash Pond and surrounding area in preparing this CMA. In 2019, a risk evaluation was undertaken to identify whether current groundwater conditions pose an unacceptable risk to human health and the environment. The risk evaluation, presented in **Section 3**, concluded that there are **no adverse effects on human health or the environment currently or under reasonably anticipated future uses** from groundwater due to CCR management practices at the Ash Pond.

Recognizing that SIGECO has entered into a long-term contract to beneficially use the CCR materials stored in the Ash Pond, the remedial alternatives presented in this CMA focus on varying groundwater remediation alternatives as the source will be removed through the beneficial use project, including:

- Alternative 1: Monitored Natural Attenuation (MNA) with Closure by Removal (CBR);
- Alternative 2: Hydraulic Containment with No Treatment, CBR, and MNA; and
- Alternative 3: Hydraulic Containment with Treatment, CBR, and MNA.

These three alternatives were developed to meet the threshold criteria provided in the CCR rule at § 257.97 as discussed in **Section 4**, which are:

- Be protective of human health and the environment;
- Attain the groundwater protection standard as specified pursuant to §257.95(h);
- Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in appendix IV to this part into the environment;
- Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems;
- Comply with standards for management of wastes as specified in §257.98(d).

The alternatives were then compared to three of the four balancing criteria stated in the CCR Rule at §257.97. The four balancing criteria consider:

1. The long- and short-term effectiveness and protectiveness of the potential remedy(s), along with the degree of certainty that the remedy will prove successful;
2. The effectiveness of the remedy in controlling the source to reduce further releases;
3. The ease or difficulty of implementing a potential remedy; and
4. The degree to which community concerns are addressed by a potential remedy.

Balancing criteria four, which considers community concerns, will be evaluated following a public information session to be conducted at least 30 days prior to remedy selection by SIGECO.

The following observations are made regarding beneficial use and groundwater remedial alternatives for the Ash Pond and are described more fully in this report:

- **Groundwater Compliance**: Under current conditions there is no risk to human health and the environment associated with the Ash Pond. Upon completion of the beneficial use project, lithium and molybdenum concentrations in groundwater are expected to decline below their GWPS through the chemical, physical, and biological processes of natural attenuation. Additional, or supplemental, remedial alternatives are included in this document for consideration in addition to MNA.

- **Groundwater Treatment:** In order to implement a groundwater alternative that includes treatment, laboratory testing would be required to demonstrate effective treatment of lithium and molybdenum using ex-situ treatment methods, such as ion exchange or reverse osmosis. Following laboratory-scale testing, pilot-scale treatment evaluations for the constituents would also be required if such remedies were selected as part of the Corrective Action process.

- **Beneficial Use Timeframe:** The Ash Pond at ABB contains approximately 6 million cubic yards of CCR material to be removed under the beneficial use plan. Removal of large volumes of CCR stored at the Ash Pond could take as much as 13 years to complete, during which time the impoundment would remain open (although not receiving CCR) and would be subject to ongoing infiltration from precipitation. However, this time frame would not pose a risk as the risk evaluation concludes that there is currently no risk to human health or the environment from the Ash Pond.

In accordance with §257.98, SIGECO will implement a groundwater monitoring program to document the effectiveness of the selected remedial alternative. Corrective measures are considered complete when monitoring reflects concentrations of lithium and molybdenum in groundwater downgradient of the Ash Pond are not above GWPS for three consecutive years.

USEPA is in the process of modifying certain CCR Rule requirements and, depending upon the nature of such changes, assessments made herein could be modified or supplemented to reflect such future regulatory revisions. See *Federal Register (March 15, 2018; 83 FR 11584*).

Table of Contents

Table of Contents

List of Tables

List of Figures

List of Acronyms and Abbreviations

Abbreviation	Definition
ABB	A.B. Brown Generating Station
Ash Pond	CCR Management Unit
CBR	Closure by Removal
CCR	Coal Combustion Residual
COC	Constituent of Concern
CMA	Corrective Measures Assessment
CSM	Conceptual Site Model
GMP	Groundwater Monitoring Plan
GWPS	Groundwater Protection Standards
Haley & Aldrich	Haley & Aldrich, Inc.
MNA	Monitored Natural Attenuation
msl	Mean Sea Level
N&E	Nature and Extent
SIGECO	Southern Indiana Gas and Electric Company
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
USEPA	United States Environmental Protection Agency

1. Introduction

Haley & Aldrich, Inc. (Haley & Aldrich) was retained by Southern Indiana Gas and Electric Company (SIGECO) to prepare this Corrective Measures Assessment (CMA) for the Coal Combustion Residual (CCR) management unit "Ash Pond" located at the A.B. Brown Generating Station (ABB), herein referred to as the "Site", in Posey County, Indiana. SIGECO has conducted detailed geologic and hydrogeologic investigations under the U.S. Environmental Protection Agency (USEPA) rule entitled *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities*. 80 Fed. Reg. 21302 (Apr. 17, 2015) (promulgating 40 CFR §257.61); 83 Fed. Reg. 36435 (July 30, 2018) (amending 40 CFR §257.61) (CCR Rule). These investigations were, in part, related to determination of requirements related to the potential for both Ash Pond closure and groundwater corrective action.

This CMA includes a summary of the groundwater monitoring results for Appendix IV constituents, a summary of the evaluation of the Appendix III constituents for statistically significant increases (SSI) compared to background, and a comparison of the Appendix IV constituents detected in assessment monitoring to the Groundwater Protection Standards (GWPS). These evaluations identified statistically significant levels (SSL) of lithium and molybdenum at two monitoring locations in groundwater downgradient of the Ash Pond. This report evaluates potential corrective measures to remediate groundwater for the exceedance of the GWPS.

1.1 FACILITY DESCRIPTION/BACKGROUND

The Site is located approximately 0.5 miles north of the Ohio River (**Figure 1-1**). The Site began operations in 1978 with the construction of a 250-megawatt generating unit. In 1985, an additional generating unit was added. Both units use Illinois Basin coal. SIGECO currently owns the land and operates the station for supplying electric power to industrial, commercial, and residential customers in its service territory. The Ash Pond was constructed and commissioned in 1978 by building an earthen dam across an existing valley. In 2003, a second dam was constructed east of the original dam and further up the valley to increase the storage capacity. This temporarily created an upper pond and a lower pond. The upper and lower ponds were operated separately until 2016 when the upper dam was decommissioned. A 10-foot-wide breach was cut into the upper embankment and the normal pool elevation was lowered. Currently, the upper pool and the lower pool act as one CCR unit referred to as the Ash Pond, which has a surface area of approximately 159 acres. Site features are shown on **Figure 1-2**.

1.2 SITE CHARACTERIZATION WORK SUMMARY

Three significant subsurface geotechnical and/or hydrogeological investigations have been completed at the Site dating back to 1993, after the construction of the generating station and CCR units and continuing through 2015. These studies generated subsurface data characterizing the Site geology and hydrogeology which were used to support the development of a hydrogeologic Conceptual Site Model (CSM). The CSM has been further enhanced with ongoing CCR groundwater monitoring and supplemental subsurface investigation activities performed by Haley & Aldrich. Findings from these investigations have added to the CSM that supports the CMA activities discussed in this report.

1.3 GROUNDWATER MONITORING

Groundwater monitoring under the CCR Rule occurs through a phased approach to allow for a graduated response (i.e., baseline, detection, and assessment monitoring as applicable) and evaluation of steps to address groundwater quality. Haley & Aldrich prepared a *Groundwater Monitoring Plan* (GMP) as required by the CCR Rule. The GMP presents the design of the groundwater monitoring system, groundwater sampling and analysis procedures, and groundwater statistical analysis methods.

To establish baseline groundwater quality results, monitoring wells were installed in March 2016, and July 2016. The monitoring well network includes two background wells (CCR-BK-1R and CCR-BK-2) and seven downgradient monitoring wells (CCR-AP-1R, CCR-AP-2R, CCR-AP-3R, CCR-AP-4R, CCR-AP-5, CCR-AP-6, CCR-AP-7R) located around the perimeter of the Ash Pond. Monitoring well locations are shown on **Figure 1-3**.

Detection monitoring events occurred in 2016 and 2017. The results of the sampling events were then compared to background using statistical methods to determine if Appendix III constituents are present at concentrations above background, called SSIs downgradient of the Ash Pond. The result of the statistical analysis identified SSIs that triggered Assessment Monitoring and respective notification of the same.

During the Assessment Monitoring phase, two rounds of groundwater samples were collected in accordance with 40 CFR §257.95(b) and 40 CFR §257.95(d)(1) of the CCR Rule. Groundwater samples were collected during June, and August 2018. Concurrent with the second assessment sampling round, and as required by 40 CFR §257.95(h), GWPS were established for the detected Appendix IV constituents. The assessment monitoring sampling results were compared statistically to the GWPS to determine if SSLs of Appendix IV constituents were present downgradient of the Ash Pond. The results of this evaluation indicated that lithium and molybdenum were present in groundwater at SSLs above the GWPS. Appendix IV analytical results are summarized in **Table 1A**.

As a result of this determination, and in accordance with 40 CFR §257.95(g)(3), a field investigation was initiated to demonstrate that a source other than the Ash Pond caused the lithium and molybdenum contamination. The field investigation included sampling and analysis of naturally occurring coal identified near monitoring well CCR-AP-2R as an alternative source of molybdenum and lithium and surface water sampling from the Coal Pile Runoff Pond and lower pool of the Ash Pond to evaluate the effluent from the coal pile runoff as an alternate source of the Appendix IV SSLs detected at CCR-AP-3R. While this investigation showed that the naturally occurring coal and the coal pile runoff were contributing sources, they did not contribute lithium and molybdenum at levels that resulted in a determination of an alternative source. Therefore, the Ash Pond at ABB is moving forward with a CMA for lithium and molybdenum.

1.4 CORRECTIVE MEASURES ASSESSMENT PROCESS

The CMA process involves development of groundwater remediation technologies that will result in meeting the following threshold criteria: protection of human health and the environment, attainment of GWPS, source control, constituent removal, and compliance with standards for waste management. Once these technologies are demonstrated to meet these criteria, they are then compared to one another with respect to the following balancing criteria: long- and short-term effectiveness, source control, and ease or difficulty of implementation. Input from the community on such proposed measures will occur as part of a public meeting to be conducted at least 30 days prior to remedy selection by SIGECO.

1.5 RISK REDUCTION AND REMEDY

The CCR Rule (§257.97(b)(1) - Selection of Remedy) requires that remedies must be protective of human health and the environment. Further, §257.97(c) of the CCR Rule requires that in selecting a remedy, the owner or operator of the CCR unit must consider specific evaluation factors, including the risk reduction achieved by each of the proposed corrective measures. Each of the following evaluation factors listed here from §257.97 and discussed in **Section 4** are those that are directly related to human health and environmental risk:

- (c)(1)(i) Magnitude of reduction of existing risks;
- (c)(1)(ii) Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy;
- (c)(1)(iv) Short-term risks that might be posed to the community or the environment during implementation of such a remedy, including potential threats to human health and the environment associated with excavation, transportation, and re-disposal of contaminant;
- (c)(1)(vi) Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment;

The following are additional factors related to risk that are considered when developing the schedule for implementing and completing remedial activities once a remedy is selected (§257.97(d)):

- (d)(4) Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy[1];
- (d)(5)(i) Current and future uses of the aquifer;
- (d)(5)(ii) Proximity and withdrawal rate of users; and
- (d)(5)(iv) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to CCR constituents.

[1] Factors (d)(4) and (d)(5) are not part of the CMA evaluation process as described in §257.97(d)(4), §257.97(d)(5)(i)(ii)(iv); rather they are factors the owner or operator must consider as part of the schedule for remedy implementation.

2. Groundwater Conceptual Site Model

The Site geology and hydrogeology was initially described in the *Groundwater Monitoring Plan* prepared by Haley & Aldrich in October 2017. The CSM presented in this section of the CMA has been updated to reflect information gathered to comply with the CCR Rule.

2.1 SITE SETTING

The Site is located in Posey County near the community of West Franklin, Indiana. The Site is located approximately 0.5 miles north of the Ohio River (**Figure 1-1**). The Site varies in elevation with natural ground surface, with elevations varying from 380 to 520-feet above msl. The higher elevations are generally to the north of the Site with surface topography dominated by a series of ridges separated by ravines. In general, surface topography across the Site generally slopes to the west towards the western property boundary then to the south toward the Ohio River. Surface water runoff occurs via sheet flow to low lying areas or ravines which eventually lead to the Ohio River.

2.2 GEOLOGY AND HYDROGEOLOGY

The Ohio River valley contains fill and loess (windblown) deposits derived indirectly from continental ice sheets. These were deposited from meltwater heavily loaded with entrained sediments accumulated in the area on the Pennsylvanian age shale, limestone and sandstone bedrock. Westerly winds simultaneously deposited silty sediments that cap the upland areas north of the river.

Logs from soil borings drilled at the Site indicate that the uppermost geologic unit is comprised of unconsolidated alluvial deposits consisting of primarily silts and clays with discontinuous layers of sand. This unit overlies Pennsylvanian age sandstone which is commonly identified as the Inglefield Sandstone. Underlying the Inglefield Sandstone is low-permeability weathered shale and siltstone. The sandstone and shale unit has been eroded on the north side of the property where the underlying limestone unit was encountered.

The Site is located in the vicinity of the Wabash Valley and New Madrid seismic zones. The largest earthquake recorded (magnitude 5.2) proximal to the Site occurred in April 18, 2008 approximately fifty miles northwest of the facility.

Hydrogeologic units are defined based on their ability to transmit groundwater or serve as confining units between zones of groundwater saturation. The uppermost aquifer at the Site occurs within unconsolidated alluvial deposits which consist primarily of silty clay containing discontinuous layers of sand. Beneath upland areas, or ridgelines the uppermost aquifer occurs in weathered sandstone, shale, or siltstone. Recharge to the surficial aquifer occurs through direct surface infiltration.

Piezometric data recorded from the monitoring wells installed on-Site show that the configuration of the uppermost aquifer mimics surface topography with groundwater flow from the ridges into the ravines where groundwater discharges into small perennial streams. Groundwater flow in the vicinity of the Ash Pond is predominantly to the west with a component of flow to the northwest from the northern portion of the Ash Pond beneath the Landfill. Groundwater elevations vary seasonally but the groundwater flow patterns remain consistent.

Groundwater flow velocity in the uppermost aquifer beneath the CCR units was estimated using site-specific hydraulic conductivity obtained from slug testing and hydraulic gradients, and an assumed effective porosity of 25 percent. Hydraulic conductivity is approximately $3E^{-4}$ cm/sec in the vicinity of the Ash Pond. The hydraulic gradient downgradient of the Ash Pond is 0.04 feet/foot. Using the site-specific hydraulic conductivity and hydraulic gradients, and assuming an effective porosity of 25 percent the groundwater flow velocity in the vicinity of the Ash Pond is 50 feet/year at the Ash Pond.

2.3 GROUNDWATER PROTECTION STANDARDS

Haley & Aldrich completed a statistical evaluation of groundwater samples using the methods and procedures outlined in the Groundwater Monitoring Plan's *Statistical Analysis Plan* (Haley & Aldrich 2017) to develop site-specific GWPS for each Appendix IV constituent, as required by the CCR Rule.

Groundwater results were compared to the site-specific GWPS. SSLs above the GWPS are limited to samples collected from two monitoring wells (CCR-AP-2R and CCR-AP-3R) and for two Appendix IV constituents (molybdenum and lithium). Monitoring well locations with SSLs above the GWPS are illustrated on **Figure 2-1**.

2.4 NATURE AND EXTENT OF GROUNDWATER IMPACTS

As outlined in **Section 1.3** of this CMA, SSLs for lithium and molybdenum were identified from the assessment monitoring results. Because of the compressed schedule in the CCR Rule, SIGECO decided to initiate an evaluation of the nature and extent of molybdenum and lithium based on preliminary statistical analysis of the assessment monitoring results, while simultaneously evaluating the potential for sources other than the Ash Pond to be the source of lithium and molybdenum. Haley & Aldrich initiated an investigation to define the horizontal and vertical nature and extent (N&E) of Appendix IV SSLs, as required by the CCR Rule, in November 2018 by installing five new monitoring wells (CCR-AP-2I, CCR-AP-3I, CCR-AP-8, CCR-AP-9, and CCR-AP-10). Monitoring wells CCR-AP-8, CCR-AP-9, and CCR-AP-10 were installed to horizontally delineate the Appendix IV SSLs detected in samples collected from CCR-AP-2R and CCR-AP-3R, and CCR-AP-2I and CCR-AP-3I were installed to vertically delineate the SSLs at these same locations. The location of the new monitoring wells is shown on **Figure 2-1**.

Analytical results from the N&E wells indicate that molybdenum and lithium concentrations are limited to the shallow aquifer at CCR-AP-2R and CCR-AP-3R. Lithium and molybdenum have been vertically and horizontally delineated by the newly installed wells. Appendix IV analytical results for the nature and extent monitoring wells are summarized in **Table 1B**.

3. Risk Assessment and Exposure Evaluation

The purpose of the risk evaluation is to provide the information needed to interpret and meaningfully understand the groundwater monitoring data collected and published for the ABB Ash Pond under the CCR Rule.

The risk evaluation was completed by developing a conceptual site model (CSM) to identify the potential for human or ecological exposure to constituents that may have been released to the environment. The CSM was used to resolve questions such as: Is there a source? Are constituents released from the source? Are environmental media (soil, groundwater, surface water, sediments and air) affected by the constituent release? Do constituents travel within and between media? Is there a point where a receptor (human or ecological) could contact the constituents in the medium? If the answers to these questions are 'Yes', then the risk evaluation resolves the question "Are the constituent concentrations high enough to potentially have a toxic effect?" by comparing constituent concentrations in groundwater to risk-based screening levels.

Based on the investigation results, SSLs for lithium and molybdenum were detected in the groundwater monitoring wells at the waste boundary, indicating that a migration pathway between the ABB Ash Pond and groundwater beneath the Ash Pond exists. However, analytical results from the Nature & Extent wells indicate that statistically significant molybdenum and lithium concentrations are limited to the shallow aquifer at CCR-AP-2R and CCR-AP-3R, which are located on the facility property (**Figure 2-2**). There are no statistically significant concentrations in further downgradient wells (e.g., CCR-AP-9; **Figure 2-2**), thereby indicating that concentrations of molybdenum and lithium are not elevated beyond the property boundary. Furthermore, groundwater downgradient of the ABB Ash Pond is not used as a source of drinking water and is not flowing toward locations where receptors could contact it. Specifically:

- Groundwater flow is towards the west and northwest. There are no groundwater supply wells within one-half mile to the west and northwest of the ABB Ash Pond.
- Groundwater does not flow from the ABB Ash Pond south toward the Ohio River.

Therefore, there is not a point where a receptor (human or ecological) could contact the CCR constituents in groundwater. Without the ability for a receptor to contact the CCR constituents, the risk is negated.

This risk evaluation demonstrates that there are no adverse impacts on human health or ecological receptors from groundwater resulting from coal ash management practices at the A.B. Brown Generating Station Ash Pond.

Therefore, because no adverse risk currently exists, any of the remedies considered in this CMA are all protective of human health and the environment, and implementation of any of the remedial alternatives will not result in a meaningful reduction in risk to groundwater-related exposures or risk.

4. Corrective Measures Alternatives

4.1 CORRECTIVE MEASURES ASSESSMENT GOALS

The overall goal of this CMA is to identify and evaluate the appropriateness of potential corrective measures to prevent further releases of Appendix IV constituents to groundwater above their GWPS, to remediate releases of Appendix IV constituents detected during groundwater monitoring above their GWPS that have already occurred, and to restore groundwater in the affected area to conditions where Appendix IV constituents are present at concentrations below the GWPS. The corrective measures evaluation that is discussed below and subsequent sections provides an analysis of the effectiveness of the three potential corrective measures in meeting the requirements and objectives of remedies as described under §257.97 (also shown graphically on **Figure 4-1**). Additional remedial alternatives were considered but were determined to not be viable for remediating groundwater at this Site. By meeting these requirements, this assessment also meets the requirements promulgated in §257.96 which include an evaluation of:

- The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to residual contamination;
- The time required to complete the remedy; and
- The institutional requirements, such as state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy.

The criteria listed above are included in the balancing criteria considered during the corrective measures evaluation, described in **Section 5**.

4.2 GROUNDWATER FATE AND TRANSPORT MODELING

Groundwater at the Site was modeled utilizing Groundwater Vista Version 7 for flow and solute transport. The model was constructed, calibrated, and subsequent simulations run to evaluate remedy alternatives for Appendix IV constituents above the GWPS. Site-specific parameters (i.e., groundwater elevations and hydraulic conductivity) were utilized for model preparation. MODFLOW 2005, a finite difference three-dimensional solver, was utilized for groundwater flow estimation. Modeled groundwater elevations were compared to observed values from the on-site well network (February 2019) to achieve a calibration of less than 10% scaled root mean squared (RMS) of measured water levels. Once groundwater flow was calibrated in the model, solute transport was completed using MT3DMS, a three-dimensional solute transport modeling program. Parameters affecting transport such as advection, diffusion, dispersion, and adsorption are utilized within the MT3DMS package to estimate solute transport within the model domain.

The calibrated flow models were used to simulate the different remediation alternatives and the effects they have on groundwater quality through time. These simulations are incorporated into the discussion on remediation alternatives provided below.

4.3 CORRECTIVE MEASURES ALTERNATIVES

Corrective measures are considered complete when Appendix IV constituents are present in groundwater at the Ash Pond at concentrations below the Appendix IV GWPS for three consecutive years of groundwater monitoring. In accordance with §257.97, the groundwater corrective measures to be considered must meet, at a minimum, the following threshold criteria:

1. Be protective of human health and the environment;
2. Attain the GWPS;
3. Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of COCs to the environment;
4. Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, considering factors such as avoiding inappropriate disturbance of sensitive ecosystems; and
5. Comply with standards (regulations) for waste management.

Each of the remedial alternatives assembled as part of this CMA meet the requirements of the threshold criteria listed above.

Due to the existence of long-term contracts for the beneficial use of CCR materials contained in the Ash Pond, the remedial alternatives presented below contemplate Closure by Removal (CBR) of the Ash Pond only.

4.3.1 Alternative 1 – Monitored Natural Attenuation (MNA) with Closure by Removal (CBR) with Beneficial Use

This alternative consists of removal of the Ash Pond CCR material followed by natural attenuation of lithium and molybdenum in groundwater. This alternative would eliminate the source (through beneficial use/removal), and over time, allow the concentrations of these constituents in downgradient groundwater to attenuate. Through the beneficial use of reclaimed CCR materials, the amount of material contained in the Ash Pond will be reduced over time. The existence of long-term contracts for the beneficial use of these products makes the option of CBR extremely viable.

Technical and logistical challenges of implementing a large-scale ash removal project have already been addressed by SIGECO through the planning and development of the beneficial use program. Removal activities require dewatering and temporary staging/stockpiling of material for drying prior to transportation, which may affect productivity and extend the timeframe to complete removal. Additionally, the rate of use is subject to fluctuations that are driven by market conditions and the receiving industry. During periods of rain and inclement weather, the removal schedule will be negatively impacted. Excavation and construction safety during the removal duration is another schedule factor due to heavy equipment (e.g., bulldozers, excavators, front end loaders, and off-road trucks) and dump truck operation within the active ABB Site.

Groundwater would be addressed through MNA. MNA is a viable remedial technology recognized by both state and federal regulators that is applicable to inorganic compounds in groundwater. The USEPA defines MNA as “the reliance on natural attenuation processes to achieve site-specific remediation objectives within a time frame that is reasonable compared to that offered by other more active methods.” The ‘natural attenuation processes’ that are at work in such a remediation approach include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. These in-situ processes include biodegradation; dispersion; dilution; sorption; volatilization; radioactive decay; and chemical or biological stabilization, transformation, or destruction of contaminants (USEPA, 2015). When combined with removal for beneficial use, MNA can reduce concentrations of molybdenum and lithium in groundwater at the Ash Pond boundary, although the time required to achieve the GWPS would be lengthy due to the low groundwater velocity and flux.

SIGECO would implement post-closure care activities that includes long-term groundwater monitoring.

4.3.2 Alternative 2 – Hydraulic Containment with No Treatment, Close by Removal (CBR) with Beneficial Use

Similar to Alternative 1, the Ash Pond would be closed by removal; however, under this alternative, lithium and molybdenum detected in groundwater at concentrations above GWPS would be addressed through groundwater pumping to hydraulically control the migration of those constituents downgradient. Pumping would be undertaken in the shallow groundwater at the boundary of the Ash Pond since lithium and molybdenum have not been detected above GWPS in the bedrock aquifer or in the shallow monitoring wells downgradient.

Implementation of a large-scale hydraulic containment system would require a detailed and lengthy design effort. Pilot testing, such as pumping tests and additional groundwater modeling, would be needed to verify the hydraulic capture zone.

The pumping well effluent would be discharged directly to a receiving water body in accordance with a National Pollutant Discharge Elimination System (NPDES) Permit. Under this alternative, no treatment would be used prior to discharge. The construction of a conveyance system from the Ash Pond to the receiving water body would require engineering design, permitting, and site construction. In order for the effluent to be discharged to a receiving water body, the existing ABB NPDES Operating Permit may be modified, or a new permit issued. Either option would require effluent testing or modeling to support a permit application. The anticipated timeline for engineering, procurement, permit modification, and construction of this option is estimated to be one year.

Following CCR removal, lithium and molybdenum concentrations would decrease through active pumping and natural attenuation, and pumping would eventually cease. Further reduction of lithium and molybdenum concentrations, if required, would occur through natural attenuation until concentrations decrease to levels below the GWPS. Because active groundwater pumping along the boundary of the Ash Pond would reduce the hydraulic gradient and, therefore, the groundwater flux, the time period for active pumping would be greater than MNA alone.

SIGECO would implement post-closure care activities that include groundwater monitoring.

4.3.3 Alternative 3 – Hydraulic Containment with Treatment and Close by Removal (CBR) with Beneficial Use

Similar to Alternative 1, the Ash Pond would be closed by removal; however, under this alternative lithium and molybdenum detected in groundwater at concentrations above GWPS would be addressed with hydraulic containment through groundwater pumping to hydraulically control the migration of those constituents downgradient. In addition, pumping well effluent would be treated ex-situ, likely with an ion exchange or a reverse osmosis (RO) treatment system. Both systems would have on-going operation and maintenance and would generate a secondary waste stream – including regeneration/replacement of the ion exchange media or concentration of reject water from the RO system.

The design and construction of an ion exchange or RO system would require additional development of a treatment system enclosure, equipment, and space, all of which adds complexity to this alternative. As noted in the previous option, implementation of a large-scale hydraulic containment system would require a detailed and lengthy design effort. Pilot testing, such as pumping tests and additional groundwater modeling, would be needed to verify the hydraulic capture zone. The timeline for engineering, procurement, permit modification, including the ex-situ treatment component and construction of this option is an estimated 2 years.

Following CCR removal, lithium and molybdenum concentrations in groundwater would decrease through active pumping and natural attenuation downgradient of the pumping system. The timeline for active treatment is expected to be 13 years. Further reduction of lithium and molybdenum concentrations, if required, would occur through natural attenuation until concentrations attenuate to levels less than the GWPS. Because active groundwater pumping along the boundary of the Ash Pond would decrease hydraulic gradient and therefore the groundwater flux, the time period for active pumping and treatment will be greater than MNA alone.

Following the installation of the groundwater pumping well network and ex-situ treatment system, SIGECO would implement post-closure care activities that include operation and maintenance of the hydraulic containment system, operation and maintenance of the treatment system, and long-term groundwater monitoring to assess hydraulic control system performance.

5. Comparison of Corrective Measures Alternatives

The purpose of this section is to evaluate, compare, and rank the three corrective measures alternatives using the balancing criteria described in §257.97.

5.1 EVALUATION CRITERIA

In accordance with §257.97, remedial alternatives that satisfy the threshold criteria are then compared to four balancing (evaluation) criteria. The balancing criteria allow a comparative analysis for each corrective measure, thereby providing the basis for final corrective measure selection. The four balancing criteria include the following:

1. The long- and short-term effectiveness and protectiveness of the potential remedy(s), along with the degree of certainty that the remedy will prove successful;
2. The effectiveness of the remedy in controlling the source to reduce further releases;
3. The ease or difficulty of implementing a potential remedy; and
4. The degree to which community concerns are addressed by a potential remedy.

Public input and feedback will be considered following a public information session to be conducted at least 30 days prior to remedy selection by SIGECO.

5.2 COMPARISON OF ALTERNATIVES

This section compares the alternatives to each other based on evaluation of the balancing criteria listed above. Each of the balancing criteria consists of several sub criteria listed in the CCR Rule which have been considered in this assessment. The goal of this analysis is to identify the alternative that is technologically feasible, relevant, and readily implementable, provides adequate protection of human health and the environment, and minimizes impacts to the community.

A color-coded graphic which is part of a comprehensive visual comparison tool (see **Table 2**) is presented within each subsection below. These graphics provide a visual snapshot of the favorability of each alternative compared to the other alternatives, where green represents “most favorable”, yellow represents “less favorable”, and red represents “least favorable”.

5.2.1 Balancing Criterion 1 - The Long- and Short-Term Effectiveness and Protectiveness of the Potential Remedy, along with the Degree of Certainty that the Remedy Will Prove Successful

This balancing criterion takes into consideration the relative long-term and short-term effectiveness of the remedy, along with the anticipated success of the remedy.

5.2.1.1 Magnitude of reduction of existing risks

As indicated by the N&E evaluation and the most recent groundwater sampling results, no unacceptable risk to human health and the environment exists with respect to the Ash Pond. Therefore, none of the remedial alternatives are necessary to reduce risks because no such unacceptable risk to lithium or molybdenum currently exists. However, other types of impacts may be posed by the various remedial alternatives considered herein. Alternative 1 (Closure by Removal and MNA) is the most favorable option because the source is completely removed from the environment, the beneficial use program will reduce the volume of material in the Pond over time until CCR is removed. In addition, this concept has been proven to be a viable option for this location. Alternatives 2 and 3, which incorporate hydraulic containment, are less favorable due to the installation of pumping wells and long-term operation, with Alternative 3 being the least favorable due to the operation, maintenance, and monitoring of an ex-situ treatment system and generation of secondary waste streams.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 1 - Subcriteria i) Magnitude of reduction of risks			

5.2.1.2 Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy

The alternatives being considered for the ABB Ash Pond, which include closure by removal for beneficial use, all have a low long-term residual risk because the CCR materials are being removed from the Ash Pond. Alternative 1 (CBR with MNA) has the lowest residual risk because groundwater is being addressed through natural processes. Alternative 2 is considered only slightly less favorable due to the operation of the hydraulic containment system. Alternative 3 which includes a pumping component with ex-situ treatment of effluent is considered less favorable due to the operation of the ex-situ treatment system and the generation of secondary waste streams. Additionally, ABB is located within a seismic hazard area with potential for liquification and as such the alternatives being considered have a significantly lower risk than leaving the material in place.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 1 - Subcriteria ii) Magnitude of residual risk in terms of likelihood of further release			

5.2.1.3 The type and degree of long-term management required, including monitoring, operation, and maintenance

Alternative 1 (CBR with MNA) is the most favorable alternative with respect to this criterion because it requires the least amount of long-term management and involves no mechanical systems as part of the remedy. Alternative 2 (CBR with hydraulic containment and direct discharge) is slightly less favorable because it requires long-term maintenance of a groundwater recovery system. Alternative 3 is the least favorable due to the O&M of groundwater treatment systems and the generation of secondary waste streams.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 1 - Subcriteria iii) Type and degree of long-term management required			

5.2.1.4 Short-term risks that might be posed to the community or the environment during implementation of such a remedy

Community impacts include general impacts to the community due to increased truck traffic on public roads during construction and operation of the remedies, along with generation of secondary waste streams with transportation and off-site disposal of waste streams. The beneficial use project is common to all the alternatives so the increased truck traffic and material shipped by barge would be the same for all options. As a result, Alternative 3, which includes ex-situ treatment and the generation of secondary waste streams with off-site disposal, is the least favorable alternative with respect to this criterion.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 1 - Subcriteria iv) Short term risk to community or environment during implementation			

5.2.1.5 Time until full protection is achieved

As previously stated, there is currently no unacceptable exposure to groundwater impacted by lithium and molybdenum associated with the Ash Pond; therefore, protection is already achieved. The timeframes to achieve GWPS were evaluated using a predictive model as described in **Section 4.2**. Based upon predictive modeling, the timeframe to achieve GWPS for all the alternatives is long. Alternatives 2 and 3, which incorporate hydraulic containment would attain GWPS in the shortest amount of time. Closure by removal with MNA is predicted to take more time to achieve GWPS due to the low groundwater flow velocities and is, therefore, less favorable.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 1 - Subcriteria v) Time until full protection is achieved			

5.2.1.6 Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment

Because the extent of groundwater impacted by the Ash Pond is limited to the shallow aquifer, Alternative 1 (CBR with MNA) has the lowest potential for exposure to human and environmental receptors and is considered most favorable with respect to this criterion. Alternative 2 is only slightly less favorable than Alternative 1 because it pumps groundwater without treatment which creates some potential exposure. Alternative 3, which includes hydraulic containment with ex-situ treatment, has a potential risk associated with the generation and management of secondary waste streams and is considered less favorable.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 1 - Subcriteria vi) Potential for exposure of humans and environmental receptors to remaining wastes			

5.2.1.7 Long-term reliability of the engineering and institutional controls

Alternative 1 (CBR with MNA) is expected to have high long-term reliability and is considered most favorable with respect to this criteria. Hydraulic containment (Alternatives 2 and 3) are considered reliable, proven technologies and would have high long-term reliability, but require field pilot studies and bench scale testing, and rely on installation of electrical infrastructure, and mechanical systems (groundwater pumping and/or treatment systems) to operate and maintain. Alternative 3 is considered less favorable with respect to this criteria because it includes treatment systems that reduce reliability.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 1 - Subcriteria vii) Long-term reliability of engineering and institutional controls			

5.2.1.8 Potential need for replacement of the remedy

The alternatives being evaluated are all considered reliable due to the removal of the source. Alternative 1, which includes CBR with MNA, is considered the most favorable since it relies on natural processes to reduce the concentrations of lithium and molybdenum in groundwater.

Should monitoring results indicate that the selected remedial alternative is not effective at reducing the concentration of the SSL constituents over time, alternate and/or additional active remedial methods for groundwater may be considered in the future. From the perspective of needing to replace the remedy, the alternatives that rely on operating systems (Alternatives 2 and 3) are considered more likely to require replacement and, therefore, are considered less reliable.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 1 - Subcriteria viii) Potential need for replacement of the remedy			

5.2.1.9 Long- and short-term effectiveness and protectiveness criterion summary

The graphic below provides a summary of the long- and short-term effectiveness and protectiveness of the potential remedy, along with the degree of certainty that the remedy would prove successful.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
CATEGORY 1 Long- and Short Term Effectiveness, Protectiveness, and Certainty of Success			

5.2.2 Balancing Criterion 2 - The Effectiveness of the Remedy in Controlling the Source to Reduce Further Releases

This balancing criterion takes into consideration the ability of the remedy to control a future release, and the degree of complexity of treatment technologies that would be required.

5.2.2.1 The extent to which containment practices will reduce further releases

For Alternatives 1 through 3, the source would be controlled by removing the CCR material from the Ash Pond, thereby minimizing or eliminating the potential for lithium and/or molybdenum to enter groundwater over time.

Alternative 1 (CBR with MNA) would rely on natural attenuation to decrease the downgradient concentration of the constituents over time and was shown by predictive modeling to require the longest timeframe to achieve GWPS.

Alternatives 2 and 3 rely on hydraulic containment to achieve the performance criterion at the waste boundary and are also considered less favorable with respect to this criterion. Under Alternative 2 pumping system effluent would be discharged elsewhere on the property without treatment. Under Alternative 3, which includes ex-situ treatment, additional waste streams would be generated and would require management on- and off-site.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 2 - Subcriteria i) Extent to which containment practices will reduce further releases			

5.2.2.2 The extent to which treatment technologies may be used

In-situ groundwater treatment technologies have not been identified that would successfully treat the combination of lithium and molybdenum and, as a result, in-situ treatment alternatives were not considered in this comparative analysis. With respect to Alternative 1, natural attenuation would be the groundwater treatment technology. Alternative 2 would rely on one technology (hydraulic containment) to address groundwater with the effluent being directly discharged elsewhere on the property. For Alternative 3, which includes hydraulic containment with ex-situ treatment, two technologies, hydraulic containment and ex-situ treatment, would be utilized. The operation of an ex-situ treatment system would create a secondary waste stream, such as concentrated reject water (from RO) requiring off-site disposal, or depleted resin (from ion exchange), requiring regeneration or off-site disposal.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 2 - Subcriteria ii) Extent to which treatment technologies may be used			

5.2.2.3 Effectiveness of the remedy in controlling the source to reduce further releases summary

The graphic below provides a summary of the effectiveness of the remedial alternatives to control the source to reduce further releases. Alternative 1 (CBR with MNA) is the most favorable, while Alternatives 2 and 3 are less favorable.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
CATEGORY 2 Effectiveness in controlling the source to reduce further releases			

5.2.3 Balancing Criterion 3 - The Ease or Difficulty of Implementing a Potential Remedy

This balancing criterion takes into consideration the following technical and logistical challenges required to implement a remedy:

1. Degree of difficulty associated with constructing the technology;
2. Expected operational reliability of the technologies;
3. Need to coordinate with and obtain necessary approvals and permits from other agencies;
4. Availability of necessary equipment and specialists; and
5. Available capacity and location of needed treatment, storage, and disposal services.

5.2.3.1 *Degree of difficulty associated with constructing the technology*

All alternatives use removal through beneficial use. Given that the project is driven by considerations beyond groundwater remedy selection, the degree of difficulty is not relevant to the removal portion of the remedy. For Alternative 1 (CBR with MNA), the concept already has been evaluated and shown to be viable through the beneficial use project evaluation. The most favorable remedy alternative for this criterion is MNA because it is not difficult to implement.

Alternatives 2 and 3, which both incorporate hydraulic containment, would be more difficult to construct and would require additional treatability testing, field scale pilot studies, and permitting. Alternative 3 would be the most difficult due to the O&M of ex-situ treatment systems.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 3 - Subcriteria i) Degree of difficulty associated with constructing the technology	(green)	(yellow)	(red)

5.2.3.2 *Expected operational reliability of the technologies*

Alternative 1 (CBR with MNA) is considered the most favorable from an operational perspective because removal of the source followed by MNA has a proven track record and only requires long-term monitoring following implementation. While Alternatives 2 and 3, which include hydraulic containment, are also expected to be reliable, these alternatives would utilize additional groundwater treatment technologies which would require treatability studies and O&M and, therefore, are considered less favorable when compared to Alternative 1.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 3 - Subcriteria ii) Expected operational reliability of the technologies	(green)	(yellow)	(yellow)

5.2.3.3 *Need to coordinate with and obtain necessary approvals and permits from other agencies*

Alternative 1 (CBR with MNA) is the most favorable since the implementation of the remedy is straightforward and only includes MNA. The remaining alternatives would require additional permitting and approvals for treatability testing, field scale pilot testing, groundwater discharge, groundwater treatment, and disposal of secondary waste streams.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 3 - Subcriteria iii) Need to coordinate with and obtain necessary approvals and permits from other agencies			

5.2.3.4 Availability of necessary equipment and specialists

Alternative 1 (CBR with MNA) is the most favorable since specialty equipment and specialists would not be required to implement the MNA remedy. Alternative 2 would require equipment for pumping and is slightly less favorable than Alternative 1, but the equipment required should not present a great challenge. Alternative 3, which includes an ex-situ treatment component, is less favorable since it would require construction, and O&M of ex-situ treatment systems.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 3 - Subcriteria iv) Availability of necessary equipment and specialists			

5.2.3.5 Available capacity and location of needed treatment, storage, and disposal services

The alternatives being considered, which include closure by removal, require adequate capacity, storage, and disposal service for on-site and off-site receiving facilities. This would be addressed through the beneficial use of CCR combined with disposal of CCR materials in a permitted disposal facility (if necessary). The majority of the CCR material would be excavated and transported off-site under a beneficial use contract. Non-marketable materials would be excavated and moved to a permitted disposal facility.

For Alternative 3, the ex-situ treatment system may generate a concentrated waste stream which would require off-site transportation and disposal that the other alternatives would not require and is, therefore, considered the less favorable.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 3 - Subcriteria v) Available capacity and location of needed treatment, storage, and disposal services			

5.2.3.6 Ease or difficulty of implementation summary

The graphic below provides a summary of the ease or difficulty of implementation of each alternative. Alternative 1 (CBR with MNA) is considered the most favorable, while the remaining alternatives that include a hydraulic containment component are considered less favorable.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
CATEGORY 3 Ease of implementation			

6. Summary

This Corrective Measures Assessment has evaluated the following alternatives:

- Alternative 1: MNA with CBR;
- Alternative 2: Hydraulic Containment with No Treatment, CBR, and MNA; and
- Alternative 3: Hydraulic Containment with Treatment, CBR, and MNA.

In accordance with §257.97, each of these alternatives has been confirmed to meet the following threshold criteria:

- Be protective of human health and the environment;
- Attain the GWPS;
- Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of COCs to the environment;
- Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, considering factors such as avoiding inappropriate disturbance of sensitive ecosystems; and
- Comply with standards (regulations) for waste management.

In addition, in accordance with §257.97, each of the alternatives has been evaluated in the context of the following balancing criteria:

- The long- and short-term effectiveness and protectiveness of the potential remedy(s), along with the degree of certainty that the remedy will prove successful;
- The effectiveness of the remedy in controlling the source to reduce further releases;
- The ease or difficulty of implementing a potential remedy; and
- The degree to which community concerns are addressed by a potential remedy.

This Corrective Measures Assessment, and the input received during the public comment period, will be used to identify and select a final corrective measure for implementation at the Ash Pond.

References

1. USEPA. 2015a. Final Rule: Disposal of Coal Combustion Residuals (CCRs) for Electric Utilities. 80 FR 21301-21501. U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.govinfo.gov/content/pkg/FR-2015-04-17/pdf/2015-00257.pdf

2. USEPA. 2015b. Use of Monitored Natural Attenuation for Inorganic Contaminants in Groundwater at Superfund Sites.

3. USEPA. 2018a. USEPA Regional Screening Levels. November 2018, values for tapwater. U.S. Environmental Protection Agency. Available at: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

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TABLES

TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-1 CCR-AP-1-20160607 06/07/2016	CCR-AP-1 CCR-AP-1-20160810 08/10/2016	CCR-AP-1R CCR-AP-1-20161026 10/26/2016	CCR-AP-1R CCR-AP-1R-20161205 12/05/2016	CCR-AP-1R CCR-AP-1R-20170206 02/06/2017	CCR-AP-1R CCR-AP-1R-20170404 04/04/2017	CCR-AP-1R CCR-AP-1R-20170605 06/05/2017	CCR-AP-1R CCR-AP-1R-20170926 09/26/2017
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	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, Total	0.01	**0.0052**	**0.0012 J+**	**0.0008 J**	**0.00039 J**	0.001 U	**0.00033 J**	**0.00031 J**	R
Barium, Total	2	**0.041**	**0.022**	**0.018 J-**	**0.018 J-**	**0.019**	**0.017 J-**	**0.016**	**0.012 J-**
Beryllium, Total	0.004	**0.000065 J**	0.001 U	**0.00019 J**	**0.00019 J**	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.005	0.001 U	**0.00028 J**	**0.00017 J**	**0.00016 J**	**0.00019 J**	0.001 U	0.001 U	0.001 U
Chromium, Total	0.1	**0.0011 J**	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 UJ
Cobalt, Total	0.006	**0.011**	**0.0077**	**0.0025**	**0.0019**	**0.0012**	**0.00071**	**0.0006**	**0.00042 J**
Fluoride	4	**0.22**	0.5 U	5 U	**0.73**	0.5 U	**0.25 J**	**0.41 J**	**0.46 J+**
Lead, Total	0.015	**0.0013**	**0.00031 J**	**0.00015 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium, Total	0.04	**0.012 J**	**0.0099 J**	**0.016 J**	**0.015 J**	**0.066**	0.05 U	0.05 U	0.05 U
Mercury, Total	0.002	0.0002 U	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum, Total	0.1	**0.005**	**0.0049 J**	**0.0031 J**	**0.0039 J**	0.005 U	**0.0024 J**	**0.0032 J**	**0.0024 J**
Selenium, Total	0.05	0.005 U	**0.00049 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.002	**0.000038 J**	**0.000075 J**	**0.00013 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Radiological (pCi/L)									
Radium-226	NA	0.0602 U ± 0.087	**0.411 ± 0.108**	**0.717 J ± 0.337**	R	**0.292 ± 0.12**	**0.193 ± 0.0909**	**0.211 J ± 0.087**	R
Radium-228	NA	0.229 U ± 0.397	0.300 UJ ± 0.262	0.320 U ± 0.247	**0.493 ± 0.246**	**0.513 ± 0.252**	**0.391 ± 0.255**	0.247 U ± 0.265	**0.673 ± 0.28**
Radium-226 & 228	5	0.289 U ± 0.406	**0.711 J ± 0.284**	**1.04 J ± 0.418**	R	**0.805 ± 0.279**	**0.583 ± 0.27**	**0.458 J ± 0.278**	**1.05 J+ ± 0.303**

ABBREVIATIONS AND NOTES:

Statistically significant level (SSL) concentration.
CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
su: standard units.
USEPA: United States Environmenta.l Protection Agency
J: Value is estimated
J-: Value is estimated, biased low
J+: Value is estimated, biased high
R: Rejected during validation
U: Not detected, value is the laboratory reporting limit

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257. https://www.epa.gov/coalash/coal-ash-rule

TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-1R CCR-AP-1R-20171114 11/14/2017	CCR-AP-1R CCR-AP-1R-20180606 06/06/2018	CCR-AP-1R CCR-AP-1R-20180822 08/22/2018	CCR-AP-1R CCR-AP-1R-20181114 11/14/2018	CCR-AP-1R CCR-AP-1R-20190524 05/24/2019	CCR-AP-2 CCR-AP-2-20160811 08/11/2016	CCR-AP-2 DUP-1-20160811 08/11/2016	CCR-AP-2R CCR-AP-2-20161025 10/25/2016
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	0.002 U	0.002 U	-	0.002 U	0.002 U	0.002 U	0.002 U	0.02 U
Arsenic, Total	0.01	0.001 U	0.001 U	**0.00099 J**	**0.00059 J**	**0.00047 J**	**0.0024**	**0.0026**	0.01 U
Barium, Total	2	**0.017 J-**	**0.015 J-**	**0.02 J**	**0.016 B**	**0.025 J+**	**0.041**	**0.036**	**0.035 J**
Beryllium, Total	0.004	0.001 U	0.001 UJ	-	0.001 U	0.001 U	**0.00027 J**	**0.00017 J**	0.01 U
Cadmium, Total	0.005	0.001 U	0.001 UJ	0.001 U	0.001 U	0.001 U	**0.0003 J**	**0.00031 J**	0.01 U
Chromium, Total	0.1	0.002 U	0.002 U	0.0023 U	**0.0023**	0.002 U	**0.0036**	**0.0039**	0.02 U
Cobalt, Total	0.006	**0.00084**	**0.00021 J**	**0.0014**	**0.00024 J**	**0.00021 J**	**0.0079**	**0.0056**	**0.0022 J**
Fluoride	4	**0.2 J**	**0.49**	**0.2 J+**	-	**0.57 J+**	0.5 U	0.5 U	**0.58 J**
Lead, Total	0.015	0.001 U	0.001 UJ	**0.00015 J**	0.001 U	0.001 U	**0.0052 J**	**0.003 J**	0.01 U
Lithium, Total	0.04	0.05 U	0.005 U	**0.032**	0.005 U	**0.0036 J**	**0.054**	**0.054**	**0.06**
Mercury, Total	0.002	0.0002 UJ	**0.000085 J-**	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum, Total	0.1	**0.0036 J**	**0.0028 J**	**0.0074**	**0.0037 J**	**0.0042 J**	**1.2**	**1.4**	**1.6**
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.00079 J**	**0.00061 J**	0.05 U
Thallium, Total	0.002	0.001 U	0.001 U	-	0.001 U	0.001 U	**0.000041 J**	**0.000048 J**	0.01 U
Radiological (pCi/L)									
Radium-226	NA	**0.256 ± 0.0859**	**0.360 ± 0.209**	R	-	0.0879 U ± 0.0697	**0.703 ± 0.205**	**0.520 ± 0.175**	**0.434 J ± 0.28**
Radium-228	NA	**0.594 ± 0.243**	0.0870 U ± 0.21	0.192 U ± 0.271	-	-0.0354 U ± 0.241	0.675 UJ ± 0.622	**1.41 J ± 0.736**	0.352 U ± 0.249
Radium-226 & 228	5	**0.849 ± 0.258**	**0.447 J ± 0.296**	0.372 UJ ± 0.282	-	0.0879 U ± 0.251	**1.38 J ± 0.655**	**1.93 J ± 0.757**	**0.786 J ± 0.374**

ABBREVIATIONS AND NOTES:

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CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
su: standard units.
USEPA: United States Environmenta.l Protection Agency
J: Value is estimated
J-: Value is estimated, biased low
J+: Value is estimated, biased high
R: Rejected during validation
U: Not detected, value is the laboratory reporting limit

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residua
  from Electric Utilities. July 26. 40 CFR Part 257.
  https://www.epa.gov/coalash/coal-ash-rule

TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-2R CCR-AP-2R-20161107 11/07/2016	CCR-AP-2R CCR-AP-2R-20161206 12/06/2016	CCR-AP-2R CCR-AP-2R-20170207 02/07/2017	CCR-AP-2R CCR-AP-2R-20170404 04/04/2017	CCR-AP-2R CCR-AP-2R-20170606 06/06/2017	CCR-AP-2R CCR-AP-2R-20170927 09/27/2017	CCR-AP-2R CCR-AP-2R-20171115 11/15/2017	CCR-AP-2R CCR-AP-2R-20180606 06/06/2018
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	**0.00011 J**	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	**0.0011 J+**	**0.00071 J**	0.001 U	**0.00043 J**	**0.00034 J**	R	0.001 U	0.001 U
Barium, Total	2	**0.037 J-**	**0.051 J-**	**0.049**	**0.045 J-**	**0.046**	**0.035 J-**	**0.043 J-**	**0.043 J-**
Beryllium, Total	0.004	0.001 U	**0.0002 J**	0.001 U	**0.00015 J**	0.001 U	**0.00013 J**	0.001 U	0.001 UJ
Cadmium, Total	0.005	**0.00056 J**	**0.00031 J**	**0.0008 J**	**0.0003 J**	**0.00032 J**	**0.00063 J**	**0.00038 J**	**0.00045 J**
Chromium, Total	0.1	**0.00071 J**	0.002 U	**0.00087 J**	0.002 U	0.002 U	0.002 UJ	0.002 U	0.002 U
Cobalt, Total	0.006	**0.0025**	**0.0032**	**0.003**	**0.0021**	**0.0023**	**0.0019 J+**	**0.0026**	**0.0022 J**
Fluoride	4	**0.5 J**	**0.7**	0.5 U	**0.9**	**0.51 J**	**0.5 J+**	**0.27 J**	**0.49 J**
Lead, Total	0.015	**0.00019 J**	**0.000083 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.00022 J**
Lithium, Total	0.04	**0.062**	**0.067**	**0.011 J**	**0.056**	**0.061**	**0.062**	**0.058**	**0.044 J**
Mercury, Total	0.002	0.0002 U	0.0002 UJ	**0.00008 J**	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 UJ
Molybdenum, Total	0.1	**1.8**	**1.5**	**1.6**	**1.4**	**1.5**	**1.6**	**1.7**	**1.9 J**
Selenium, Total	0.05	**0.00042 J**	**0.0004 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.00083 J+**
Thallium, Total	0.002	**0.00015 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Radiological (pCi/L)									
Radium-226	NA	0.261 U ± 0.223	0.0875 U ± 0.213	**0.188 ± 0.108**	**0.141 ± 0.0848**	**0.233 J ± 0.0901**	**0.409 J ± 0.118**	**0.217 ± 0.0813**	0.139 U ± 0.15
Radium-228	NA	**0.394 ± 0.241**	**0.647 ± 0.271**	**0.373 ± 0.236**	0.291 U ± 0.229	**0.403 ± 0.224**	R	**0.620 ± 0.256**	**0.393 ± 0.226**
Radium-226 & 228	5	R	R	**0.562 ± 0.259**	**0.432 J ± 0.244**	**0.636 ± 0.241**	**1.09 J+ ± 0.311**	**0.837 ± 0.269**	**0.532 J ± 0.271**

ABBREVIATIONS AND NOTES:
Statistically significant level (SSL) concentration.
CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
su: standard units.
USEPA: United States Environmenta.l Protection Agency
J: Value is estimated
J-: Value is estimated, biased low
J+: Value is estimated, biased high
R: Rejected during validation
U: Not detected, value is the laboratory reporting limit

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residua
from Electric Utilities. July 26. 40 CFR Part 257.
https://www.epa.gov/coalash/coal-ash-rule

TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-2R CCR-AP-2R-20180821 08/21/2018	CCR-AP-2R CCR-AP-2R-20181113 11/13/2018	CCR-AP-2R CCR-AP-2R-20190524 05/24/2019	CCR-AP-3 CCR-AP-3-20160815 08/15/2016	CCR-AP-3R CCR-AP-3-20161027 10/27/2016	CCR-AP-3R IND DUPLICATE-201611 11/07/2016	CCR-AP-3R CCR-AP-3R-20161108 11/08/2016	CCR-AP-3R CCR-AP-3R-20161206 12/06/2016
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	-	0.002 U	0.002 U	0.00022 U	0.02 U	0.002 UJ	**0.000092 J**	0.002 U
Arsenic, Total	0.01	0.001 U	**0.00071 J**	**0.00053 J**	**0.00044 J**	0.01 U	0.001 UJ	0.001 U	**0.00036 J**
Barium, Total	2	**0.047 J**	**0.05 B**	**0.042 J+**	**0.015**	**0.016 J**	**0.021 J-**	**0.02 J-**	**0.024 J-**
Beryllium, Total	0.004	-	0.001 U	0.001 U	0.001 U	0.01 U	0.001 UJ	0.001 U	**0.00021 J**
Cadmium, Total	0.005	**0.0004 J**	**0.00035 J**	**0.00059 J**	**0.00017 J**	0.01 U	**0.00024 J**	**0.00024 J**	**0.0003 J**
Chromium, Total	0.1	0.002 U	**0.0025**	0.002 U	**0.0008 J**	0.02 U	**0.00072 J**	**0.00085 J**	**0.00051 J**
Cobalt, Total	0.006	**0.0021**	**0.0019**	**0.0026**	**0.00035 J**	0.005 U	**0.00009 J**	**0.00011 J**	0.0005 U
Fluoride	4	**0.39 J**	-	**0.47 J+**	**0.95**	**0.96 J**	**0.96 J**	**0.96 J**	**1.1**
Lead, Total	0.015	**0.00015 J**	0.001 U	**0.00016 J**	**0.00028 J**	0.01 U	0.001 UJ	0.001 U	**0.00014 J**
Lithium, Total	0.04	**0.053**	**0.04**	**0.033**	**0.071**	**0.077**	**0.083 J**	**0.083**	**0.08**
Mercury, Total	0.002	0.0002 U	0.0002 U	0.0002 U	**0.000071 J**	**0.000082 J**	**0.000074 J**	0.0002 U	**0.000094 J-**
Molybdenum, Total	0.1	**1.7**	**1.6**	**1.9**	**0.94**	**0.91**	**1 J**	**1**	**0.93**
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	**0.021**	**0.017 J**	**0.023 J**	**0.024**	**0.016**
Thallium, Total	0.002	-	0.001 U	0.001 U	0.001 U	0.01 U	**0.000057 J**	**0.00014 J**	0.001 U
Radiological (pCi/L)									
Radium-226	NA	R	-	**0.264 ± 0.102**	**0.199 ± 0.0723**	0.173 U ± 0.202	R	R	0.0963 U ± 0.229
Radium-228	NA	0.309 U ± 0.215	-	**0.448 ± 0.291**	**0.523 ± 0.314**	**0.431 ± 0.281**	0.455 UJ ± 0.331	0.162 U ± 0.254	**1.06 ± 0.285**
Radium-226 & 228	5	R	-	**0.713 ± 0.308**	**0.722 ± 0.322**	**0.603 J ± 0.346**	R	R	R

ABBREVIATIONS AND NOTES:

(green shading) Statistically significant level (SSL) concentration.
CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
su: standard units.
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J: Value is estimated
J-: Value is estimated, biased low
J+: Value is estimated, biased high
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https://www.epa.gov/coalash/coal-ash-rule

TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-3R DUP 1-20170206 02/06/2017	CCR-AP-3R CCR-AP-3R-20170207 02/07/2017	CCR-AP-3R CCR-AP-3R-20170405 04/05/2017	CCR-AP-3R DUP 1-20170405 04/05/2017	CCR-AP-3R CCR-AP-3R-20170606 06/06/2017	CCR-AP-3R CCR-AP-3R-20170927 09/27/2017	CCR-AP-3R DUP1-20170927 09/27/2017	CCR-AP-3R CCR-AP-3R-20171115 11/15/2017
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	0.002 UJ	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	0.001 UJ	0.001 U	**0.00029 J**	**0.00026 J**	0.001 U	R	**0.011 J+**	0.001 U
Barium, Total	2	**0.017 J**	**0.017**	**0.017 J-**	**0.016 J-**	**0.017**	**0.016 J-**	**0.017 J-**	**0.017 J-**
Beryllium, Total	0.004	0.001 UJ	0.001 U	**0.00017 J**	**0.00016 J**	0.001 U	0.001 U	**0.00017 J**	0.001 U
Cadmium, Total	0.005	**0.00034 J**	**0.0002 J**	**0.00013 J**	**0.00015 J**	**0.00018 J**	**0.00029 J**	**0.0019 J**	**0.0002 J**
Chromium, Total	0.1	**0.0004 J**	0.002 U	0.002 U	0.002 U	0.002 U	0.002 UJ	R	0.002 U
Cobalt, Total	0.006	**0.00022 J**	**0.00017 J**	0.0005 U	0.0005 U	**0.00015 J**	R	R	**0.00021 J**
Fluoride	4	**0.82 J+**	**0.82 J+**	**1.1**	**0.92**	**0.87 J**	**1 J+**	**0.96 J+**	**0.72 J**
Lead, Total	0.015	0.001 UJ	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium, Total	0.04	**0.064 J**	**0.065**	**0.062**	**0.06**	**0.077**	**0.087**	**0.091**	**0.09**
Mercury, Total	0.002	**0.00053 J**	**0.00053**	**0.00012 J**	**0.00012 J**	**0.000085 J**	**0.00018 J**	**0.00017 J**	**0.00016 J-**
Molybdenum, Total	0.1	**0.72 J**	**0.72**	**0.74**	**0.73**	**0.82**	**0.81**	**0.95**	**0.86**
Selenium, Total	0.05	**0.0041 J**	**0.0041 J**	**0.0017 J**	**0.002 J**	**0.0028 J**	**0.0043 J+**	**0.0057 J+**	**0.0031 J**
Thallium, Total	0.002	0.001 UJ	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Radiological (pCi/L)									
Radium-226	NA	0.0275 UJ ± 0.0814	**0.172 ± 0.104**	0.0894 U ± 0.0714	**0.184 ± 0.0978**	**0.116 J ± 0.0696**	R	R	**0.138 ± 0.07**
Radium-228	NA	**0.561 J ± 0.291**	0.393 U ± 0.263	**0.429 ± 0.253**	**0.392 ± 0.242**	0.367 U ± 0.248	R	R	**0.509 ± 0.277**
Radium-226 & 228	5	**0.588 J ± 0.303**	**0.565 J ± 0.283**	**0.518 J ± 0.263**	**0.576 ± 0.261**	**0.484 J ± 0.257**	**1.24 J+ ± 0.32**	**1.16 J+ ± 0.27**	**0.647 ± 0.286**

ABBREVIATIONS AND NOTES:

Statistically significant level (SSL) concentration.
CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
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TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-3R CCR-AP-3R-20180606 06/06/2018	CCR-AP-3R BLIND DUPLICATE 1-20180606 06/06/2018	CCR-AP-3R CCR-AP-3R-20180821 08/21/2018	CCR-AP-3R BLIND DUPLICATE 1-20180821 08/21/2018	CCR-AP-3R CCR-AP-3R-20181113 11/13/2018	CCR-AP-3R CCR-AP-3R-20190522 05/22/2019	CCR-AP-4 CCR-AP-4-20160607 06/07/2016
Appendix IV Constituents (mg/L)								
Antimony, Total	0.006	0.002 U	0.002 U	-	-	0.002 U	0.02 U	0.002 U
Arsenic, Total	0.01	0.001 U	0.001 U	0.001 U	0.001 U	**0.0006 J**	0.01 U	**0.00029 J**
Barium, Total	2	**0.016 J-**	**0.015 J-**	**0.013 J**	**0.013 J**	**0.015 B**	**0.16 J-**	**0.12**
Beryllium, Total	0.004	0.001 UJ	0.001 UJ	-	-	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.005	**0.00025 J**	**0.00023 J**	**0.00022 J**	**0.0002 J**	**0.00028 J**	0.01 U	0.001 U
Chromium, Total	0.1	0.002 U	0.002 U	0.002 U	0.002 U	**0.0024**	0.02 U	**0.0022**
Cobalt, Total	0.006	**0.00016 J**	**0.00015 J**	0.0005 U	0.0005 U	**0.0015**	**0.0017 J**	**0.00026 J**
Fluoride	4	**1.6**	**1.5**	**1.3**	**1.6**	-	**1.3 J+**	**0.44**
Lead, Total	0.015	0.001 UJ	0.001 UJ	**0.00015 J**	0.001 U	0.001 U	0.01 U	**0.000085 J**
Lithium, Total	0.04	**0.076 J**	**0.073 J**	**0.087**	**0.082**	**0.064**	**0.062**	0.05 U
Mercury, Total	0.002	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum, Total	0.1	**1 J**	**0.99 J**	**1**	**0.98**	**1**	**0.89**	**0.0016 J**
Selenium, Total	0.05	**0.011 J+**	**0.01 J+**	**0.019 J**	**0.019 J**	**0.0078**	0.05 U	0.005 U
Thallium, Total	0.002	0.001 U	0.001 U	-	-	0.001 U	0.01 U	**0.000021 J**
Radiological (pCi/L)								
Radium-226	NA	0.136 U ± 0.153	**0.336 ± 0.201**	R	R	-	**0.283 J ± 0.0999**	**0.157 ± 0.0919**
Radium-228	NA	0.223 U ± 0.179	0.125 U ± 0.191	**0.400 ± 0.232**	0.364 U ± 0.238	-	0.163 UJ ± 0.283	0.127 U ± 0.259
Radium-226 & 228	5	**0.359 ± 0.235**	**0.461 J ± 0.277**	**0.738 J+ ± 0.259**	**0.639 J+ ± 0.257**	-	-	0.285 U ± 0.275

ABBREVIATIONS AND NOTES:

[green shading]: Statistically significant level (SSL) concentration.
CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
su: standard units.
USEPA: United States Environmenta.l Protection Agency
J: Value is estimated
J-: Value is estimated, biased low
J+: Value is estimated, biased high
R: Rejected during validation
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TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-4 CCR-AP-4-20160811 08/11/2016	CCR-AP-4R CCR-AP-4-20161026 10/26/2016	CCR-AP-4R DUP 1-20161026 10/26/2016	CCR-AP-4R CCR-AP-4R-20161205 12/05/2016	CCR-AP-4R CCR-AP-4R-20170206 02/06/2017	CCR-AP-4R CCR-AP-4R-20170425 04/25/2017	CCR-AP-4R CCR-AP-4R-20170605 06/05/2017	CCR-AP-4R CCR-AP-4R-20170926 09/26/2017
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	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, Total	0.01	**0.00059 J**	**0.00032 J**	**0.00047 J**	**0.00032 J**	0.001 U	**0.0003 J**	**0.00026 J**	R
Barium, Total	2	**0.089**	**0.11 J-**	**0.11 J-**	**0.063 J-**	**0.051**	**0.043**	**0.069**	**0.042 J-**
Beryllium, Total	0.004	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, Total	0.005	**0.00018 J**	0.001 U	0.001 U	0.001 U	**0.000084 J**	0.001 U	0.001 U	0.001 U
Chromium, Total	0.1	**0.0016 J**	**0.0022**	**0.002**	**0.0018 J**	**0.0015 J**	**0.0018 J**	**0.0022**	R
Cobalt, Total	0.006	**0.0033**	**0.00081**	**0.00073**	0.0005 U	**0.0002 J**	**0.00011 J**	0.0005 U	0.0005 U
Fluoride	4	**0.41**	**0.4**	**0.4**	**0.48**	**0.33 J+**	**0.41**	**0.39**	**0.39 J+**
Lead, Total	0.015	**0.00023 J**	**0.00017 J**	**0.000068 J**	**0.00009 J**	0.001 U	0.001 U	0.001 U	0.001 U
Lithium, Total	0.04	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Mercury, Total	0.002	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum, Total	0.1	**0.0088**	**0.0033 J**	**0.0032 J**	**0.0046 J**	0.005 U	**0.0019 J**	**0.0028 J**	**0.002 J**
Selenium, Total	0.05	**0.001 J**	**0.00057 J+**	**0.00076 J+**	**0.00051 J**	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.002	0.001 U	0.001 U	0.001 U	0.001 U	**0.00022 J**	0.001 U	0.001 U	0.001 U
Radiological (pCi/L)									
Radium-226	NA	**0.327 ± 0.108**	0.116 U ± 0.206	0.281 U ± 0.282	R	0.0779 U ± 0.0791	0.126 U ± 0.0996	**0.185 J ± 0.0926**	R
Radium-228	NA	**7.60 J ± 1.03**	0.369 U ± 0.307	0.291 U ± 0.271	**0.370 ± 0.239**	0.199 U ± 0.251	-0.0800 U ± 0.296	0.144 U ± 0.215	-0.0756 U ± 0.212
Radium-226 & 228	5	**7.93 J ± 1.04**	0.485 U ± 0.37	**0.572 ± 0.391**	R	0.277 U ± 0.263	0.126 U ± 0.313	0.329 UJ ± 0.234	0.11 UJ ± 0.223

ABBREVIATIONS AND NOTES:

Statistically significant level (SSL) concentration.
CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
su: standard units.
USEPA: United States Environmenta.l Protection Agency
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https://www.epa.gov/coalash/coal-ash-rule

TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-4R CCR-AP-4R-20171114 11/14/2017	CCR-AP-4R CCR-AP-4R-20180606 06/06/2018	CCR-AP-4R CCR-AP-4R-20180821 08/21/2018	CCR-AP-4R CCR-AP-4R-20181114 11/14/2018	CCR-AP-4R CCR-AP-4R-20190522 05/22/2019	CCR-AP-5 CCR-AP-5-20160606 06/06/2016	CCR-AP-5 CCR-AP-5-20160811 08/11/2016	CCR-AP-5 CCR-AP-5-20161027 10/27/2016
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	0.002 U	0.002 U	-	0.002 U	0.002 U	0.002 U	0.002 U	0.02 U
Arsenic, Total	0.01	0.001 U	0.001 U	0.001 U	**0.00051 J**	**0.00038 J**	**0.00057 J**	**0.0003 J**	0.01 U
Barium, Total	2	**0.045 J-**	**0.098 J-**	**0.094 J**	**0.051 B**	**0.094 J-**	**0.019**	**0.016**	**0.015 J**
Beryllium, Total	0.004	0.001 U	0.001 UJ	-	0.001 U	0.001 U	**0.000052 J**	0.001 U	0.01 U
Cadmium, Total	0.005	0.001 U	0.001 UJ	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.01 U
Chromium, Total	0.1	**0.0027 J+**	**0.0036 J+**	**0.0038 J+**	**0.0043**	**0.0035**	**0.00062 J**	0.002 U	0.02 U
Cobalt, Total	0.006	**0.0003 J**	**0.00013 J**	0.0005 U	**0.000096 J**	**0.00017 J**	**0.00081**	**0.00011 J**	0.005 U
Fluoride	4	**0.41**	**0.43**	**0.34**	-	**0.41 J+**	**0.26 J**	0.5 U	**0.31 J**
Lead, Total	0.015	0.001 U	0.001 UJ	0.001 U	0.001 U	0.001 U	**0.00024 J**	0.001 U	**0.0007 J**
Lithium, Total	0.04	0.05 U	0.005 U	0.05 U	0.005 U	0.0067 U	**0.014 J**	**0.015 J**	**0.018 J**
Mercury, Total	0.002	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum, Total	0.1	**0.0017 J**	**0.0016 J**	**0.0015 J**	**0.0014 J**	**0.0014 J**	**0.022**	**0.019**	**0.016 J**
Selenium, Total	0.05	0.005 U	**0.0014 J+**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.05 U
Thallium, Total	0.002	0.001 U	0.001 U	-	0.001 U	0.001 U	**0.000076 J**	0.001 U	0.01 U
Radiological (pCi/L)									
Radium-226	NA	**0.159 ± 0.0794**	0.216 U ± 0.173	R	-	0.0797 UJ ± 0.0791	**0.107 ± 0.0697**	**0.179 ± 0.0827**	0.293 U ± 0.242
Radium-228	NA	**0.488 ± 0.307**	**0.354 ± 0.224**	0.414 U ± 0.284	-	0.412 UJ ± 0.361	0.214 U ± 0.278	0.161 UJ ± 0.287	0.0785 U ± 0.226
Radium-226 & 228	5	**0.647 ± 0.317**	**0.569 J ± 0.283**	**0.743 J+ ± 0.3**	-	-	0.321 U ± 0.287	0.339 UJ ± 0.298	0.372 U ± 0.332

ABBREVIATIONS AND NOTES:

Statistically significant level (SSL) concentration.
CCR: Coal Combustion Residuals.
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TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-5 CCR-AP-5-20161206 12/06/2016	CCR-AP-5 CCR-AP-5-20170207 02/07/2017	CCR-AP-5 CCR-AP-5-20170405 04/05/2017	CCR-AP-5 CCR-AP-5-20170606 06/06/2017	CCR-AP-5 DUP1-20170606 06/06/2017	CCR-AP-5 CCR-AP-5-20170927 09/27/2017	CCR-AP-5 CCR-AP-5-20171115 11/15/2017	CCR-AP-5 CCR-AP-5-20180606 06/06/2018
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	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, Total	0.01	**0.00016 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Barium, Total	2	**0.016 J-**	**0.016**	**0.016 J-**	**0.015**	**0.015**	**0.012**	**0.015 J-**	**0.016 J-**
Beryllium, Total	0.004	**0.00016 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UJ
Cadmium, Total	0.005	0.001 U	**0.00012 J**	0.001 U	**0.00012 J**	0.001 U	0.001 U	0.001 U	0.001 UJ
Chromium, Total	0.1	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, Total	0.006	0.0005 U	**0.000098 J**	0.0005 U	0.0005 U	0.0005 U	0.0005 U	**0.00016 J**	**0.00012 J**
Fluoride	4	**0.54**	0.5 U	**0.23 J**	**0.34 J**	1 U	**0.2 J+**	**0.32 J**	**0.4**
Lead, Total	0.015	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UJ
Lithium, Total	0.04	**0.023 J**	**0.022 J**	**0.014 J**	**0.017 J**	**0.015 J**	**0.019 J**	**0.016 J**	**0.013 J**
Mercury, Total	0.002	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 UJ
Molybdenum, Total	0.1	**0.038**	**0.049**	**0.044**	**0.059**	**0.059**	**0.055**	**0.067**	**0.054 J**
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.00085 J+**
Thallium, Total	0.002	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Radiological (pCi/L)									
Radium-226	NA	-0.0341 U ± 0.18	**0.130 ± 0.0873**	**0.145 ± 0.084**	0.0962 UJ ± 0.0743	**0.181 J ± 0.0794**	R	**0.100 ± 0.0637**	**0.234 ± 0.173**
Radium-228	NA	**0.743 ± 0.259**	0.294 U ± 0.22	0.208 U ± 0.204	0.222 U ± 0.289	**0.329 ± 0.28**	0.198 U ± 0.226	0.330 U ± 0.233	0.225 U ± 0.222
Radium-226 & 228	5	R	**0.424 J ± 0.236**	**0.354 J ± 0.221**	0.318 U ± 0.298	**0.510 J ± 0.291**	**0.522 J+ ± 0.249**	**0.430 J ± 0.242**	**0.459 J ± 0.281**

ABBREVIATIONS AND NOTES:

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TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-5 CCR-AP-5-20180821 08/21/2018	CCR-AP-5 CCR-AP-5-20181112 11/12/2018	CCR-AP-5 CCR-AP-5-20190522 05/22/2019	CCR-AP-5 BLIND DUPLICATE 2-20190522 05/22/2019	CCR-AP-6 CCR-AP-6-20160607 06/07/2016	CCR-AP-6 DUP 1-20160607 06/07/2016	CCR-AP-6 CCR-AP-6-20160810 08/10/2016
Appendix IV Constituents (mg/L)								
Antimony, Total	0.006	-	0.002 U	0.02 U	0.02 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	0.001 U	**0.00048 J**	0.01 U	0.01 U	**0.0053**	**0.0052**	**0.0045**
Barium, Total	2	**0.015 J**	**0.016 B**	**0.018 J**	**0.02 J**	**0.028**	**0.029**	**0.019**
Beryllium, Total	0.004	-	0.001 U	0.001 U	0.001 U	**0.0001 J**	**0.000095 J**	0.001 U
Cadmium, Total	0.005	0.001 U	0.001 U	0.01 U	0.01 U	**0.00021 J**	**0.00022 J**	0.001 U
Chromium, Total	0.1	0.002 U	**0.0021**	0.02 U	0.02 U	**0.0012 J**	**0.0013 J**	0.002 U
Cobalt, Total	0.006	0.0005 U	**0.00018 J**	0.005 U	0.005 U	**0.0068**	**0.0069**	**0.0038**
Fluoride	4	**0.26 J+**	-	**0.31 J+**	**0.31 J+**	**0.12**	**0.12**	0.1 U
Lead, Total	0.015	0.001 U	0.001 U	0.01 U	0.01 U	**0.0011**	**0.0013**	**0.00023 J**
Lithium, Total	0.04	**0.023 J**	**0.012**	0.05 U	0.05 U	**0.043 J**	**0.044 J**	**0.04 J**
Mercury, Total	0.002	0.0002 U	0.0002 U	0.0002 U	0.0002 U	**0.000055 J**	**0.000057 J**	0.0002 U
Molybdenum, Total	0.1	**0.052**	**0.044**	**0.059**	**0.053**	**0.021**	**0.022**	**0.015**
Selenium, Total	0.05	0.005 U	0.005 U	0.05 U	0.05 U	**0.00065 J**	0.005 U	0.005 U
Thallium, Total	0.002	-	0.001 U	0.01 U	0.01 U	**0.00006 J**	**0.000056 J**	0.001 U
Radiological (pCi/L)								
Radium-226	NA	R	-	0.0606 UJ ± 0.0578	0.153 U ± 0.196	**0.162 ± 0.0727**	0.0847 U ± 0.0641	**0.177 ± 0.0778**
Radium-228	NA	**0.371 ± 0.222**	-	-0.0634 UJ ± 0.257	0.254 U ± 0.27	-0.0541 U ± 0.342	-0.0238 U ± 0.214	-0.0414 UJ ± 0.239
Radium-226 & 228	5	**0.552 J+ ± 0.235**	-	-	-	0.108 U ± 0.35	0.0609 U ± 0.223	0.136 UJ ± 0.251

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TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-6 CCR-AP-6-20161026 10/26/2016	CCR-AP-6 CCR-AP-6-20161206 12/06/2016	CCR-AP-6 DUP 1-20161206 12/06/2016	CCR-AP-6 CCR-AP-6-20170207 02/07/2017	CCR-AP-6 CCR-AP-6-20170404 04/04/2017	CCR-AP-6 CCR-AP-6-20170605 06/05/2017	CCR-AP-6 CCR-AP-6-20170926 09/26/2017	CCR-AP-6 CCR-AP-6-20171116 11/16/2017
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	**0.00068 J**
Arsenic, Total	0.01	**0.0041**	**0.0039**	**0.0031**	**0.0029 J+**	**0.0021**	**0.002**	**0.0032 J+**	**0.0044 J**
Barium, Total	2	**0.022 J-**	**0.021 J-**	**0.02 J-**	**0.021**	**0.018 J-**	**0.018**	**0.026 J-**	**0.04 J-**
Beryllium, Total	0.004	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.00051 J**	**0.00042 J**
Cadmium, Total	0.005	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.00013 J**
Chromium, Total	0.1	**0.001 J**	**0.00048 J**	**0.00058 J**	0.002 U	0.002 U	0.002 U	R	**0.0072 J+**
Cobalt, Total	0.006	**0.0032**	**0.0023**	**0.0023**	**0.0013**	**0.001**	**0.00099**	**0.0033**	**0.0054**
Fluoride	4	**0.18**	**0.24**	**0.24**	**0.2 J+**	**0.2**	**0.19 J**	**0.21 J+**	**0.21**
Lead, Total	0.015	**0.00061 J**	**0.00028 J**	**0.00014 J**	0.001 U	0.001 U	0.001 U	**0.005**	**0.0036 J**
Lithium, Total	0.04	**0.042 J**	**0.041 J**	**0.041 J**	**0.04 J**	**0.036 J**	**0.039 J**	**0.042 J**	**0.043 J**
Mercury, Total	0.002	0.0002 UJ	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Molybdenum, Total	0.1	**0.012**	**0.011**	**0.01**	**0.01**	**0.0086**	**0.009**	**0.0066**	**0.0089**
Selenium, Total	0.05	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, Total	0.002	**0.000039 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.00018 J**	**0.000097 J**
Radiological (pCi/L)									
Radium-226	NA	0.195 U ± 0.228	0.278 U ± 0.281	0.174 U ± 0.256	0.0398 U ± 0.086	**0.120 ± 0.0878**	0.0399 UJ ± 0.0601	**1.10 J ± 0.398**	**0.122 ± 0.0669**
Radium-228	NA	0.394 U ± 0.274	**0.641 ± 0.284**	**0.732 ± 0.337**	0.0520 U ± 0.252	-0.0275 U ± 0.213	**0.0246 ± 0.242**	**3.67 ± 1.2**	**0.406 ± 0.244**
Radium-226 & 228	5	**0.589 ± 0.356**	R	R	0.0918 U ± 0.266	0.12 UJ ± 0.23	0.0646 U ± 0.25	**4.77 ± 1.26**	**0.528 ± 0.253**

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TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-6 DUP 1-20171116 11/16/2017	CCR-AP-6 CCR-AP-6-20180607 06/07/2018	CCR-AP-6 CCR-AP-6-20180822 08/22/2018	CCR-AP-6 CCR-AP-6-20181113 11/13/2018	CCR-AP-6 CCR-AP-6-20190521 05/21/2019	CCR-AP-7 CCR-AP-7-20160609 06/09/2016	CCR-AP-7 CCR-AP-7-20160810 08/10/2016	CCR-AP-7R CCR-AP-7-20161026 10/26/2016
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	**0.00046 J**	0.002 U	-	0.002 U	0.02 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	**0.0023 J+**	R	**0.00046 J**	**0.00089 J**	0.01 U	**0.00067 J**	R	**0.00061 J**
Barium, Total	2	**0.026 J-**	**0.022 J-**	**0.015 J**	**0.02 B**	0.1 UJ	**0.024 J-**	**0.039**	**0.032 J-**
Beryllium, Total	0.004	**0.00027 J**	0.001 UJ	-	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.005	**0.00021 J**	0.001 UJ	0.001 U	0.001 U	0.01 U	0.001 U	**0.00032 J**	**0.00019 J**
Chromium, Total	0.1	**0.0029 J+**	0.002 U	0.002 U	**0.0025**	0.02 U	**0.0016 J**	**0.00093 J**	**0.00076 J**
Cobalt, Total	0.006	**0.0046**	**0.0011 J**	**0.00017 J**	**0.00081**	**0.0013 J**	**0.0002 J**	**0.0039**	**0.0012**
Fluoride	4	**0.23**	**0.23**	**0.44**	-	0.17 U	R	0.25 U	**0.17 J**
Lead, Total	0.015	**0.0023 J**	**0.00013 J**	0.001 U	0.001 U	0.01 U	R	**0.00041 J**	**0.00022 J**
Lithium, Total	0.04	**0.042 J**	**0.026 J**	0.005 U	**0.034**	**0.034 J+**	**0.011 J**	**0.02 J**	**0.024 J**
Mercury, Total	0.002	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 U	0.0002 UJ
Molybdenum, Total	0.1	**0.0084**	**0.0064 J**	**0.0032 J**	**0.0074**	**0.0067 J**	**0.0016 J**	**0.0011 J**	0.005 U
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U	0.05 U	0.005 U	**0.0007 J**	0.005 U
Thallium, Total	0.002	**0.00016 J**	0.001 U	-	0.001 U	0.01 U	0.001 U	0.001 U	0.001 U
Radiological (pCi/L)									
Radium-226	NA	**0.251 ± 0.115**	0.0628 U ± 0.107	**0.438 J ± 0.119**	-	0.0195 UJ ± 0.0643	**0.0958 J ± 0.0549**	**0.324 ± 0.149**	0.284 U ± 0.252
Radium-228	NA	R	R	R	-	0.237 UJ ± 0.234	-0.0103 U ± 0.186	0.127 UJ ± 0.584	0.157 U ± 0.248
Radium-226 & 228	5	R	R	R	-	-	0.0856 U ± 0.194	0.451 UJ ± 0.603	**0.441 ± 0.353**

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TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-7R CCR-AP-7R-20161205 12/05/2016	CCR-AP-7R CCR-AP-7R-20170206 02/06/2017	CCR-AP-7R CCR-AP-7R-20170425 04/25/2017	CCR-AP-7R CCR-AP-7R-20170605 06/05/2017	CCR-AP-7R CCR-AP-7R-20170926 09/26/2017	CCR-AP-7R CCR-AP-7R-20171114 11/14/2017	CCR-AP-7R CCR-AP-7R-20180606 06/06/2018
Appendix IV Constituents (mg/L)								
Antimony, Total	0.006	0.002 U	0.002 U	**0.00059 J**	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	**0.00051 J**	**0.0016 J+**	**0.0032**	**0.0017**	R	**0.0014 J+**	0.001 U
Barium, Total	2	**0.033 J-**	**0.039**	**0.063**	**0.05**	**0.048 J-**	**0.039 J-**	**0.032 J-**
Beryllium, Total	0.004	0.001 U	0.001 U	**0.00024 J**	0.001 U	**0.00013 J**	0.001 U	0.001 UJ
Cadmium, Total	0.005	**0.00015 J**	**0.00014 J**	**0.00015 J**	**0.0002 J**	0.001 U	**0.00011 J**	0.001 UJ
Chromium, Total	0.1	**0.00093 J**	**0.0016 J**	**0.0063**	**0.0033**	R	**0.0029 J+**	0.002 U
Cobalt, Total	0.006	**0.0012**	**0.0015**	**0.004**	**0.0023**	**0.0019**	**0.0013**	**0.00037 J**
Fluoride	4	**0.25**	0.25 U	**0.2 J**	**0.19 J**	R	**0.094 J**	**0.15 J**
Lead, Total	0.015	**0.00014 J**	**0.00062 J**	**0.0033**	**0.0017**	**0.0018 J+**	**0.0011**	**0.00013 J**
Lithium, Total	0.04	**0.025 J**	**0.023 J**	**0.03 J**	**0.021 J**	**0.025 J**	**0.022 J**	**0.02 J**
Mercury, Total	0.002	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 UJ
Molybdenum, Total	0.1	0.005 U	0.005 U	0.005 U	**0.00062 J**	**0.00065 J**	0.005 U	0.005 U
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.002	0.001 U	0.001 U	0.001 U	0.001 U	**0.000054 J**	0.001 U	0.001 U
Radiological (pCi/L)								
Radium-226	NA	0.0965 U ± 0.221	**0.164 ± 0.0985**	**0.350 ± 0.13**	**0.248 J ± 0.093**	R	**0.217 ± 0.0812**	0.186 U ± 0.169
Radium-228	NA	0.347 U ± 0.251	0.193 U ± 0.275	0.0871 U ± 0.274	**0.202 ± 0.223**	0.450 U ± 0.305	**0.559 ± 0.268**	0.0364 U ± 0.199
Radium-226 & 228	5	R	0.357 UJ ± 0.292	0.437 UJ ± 0.303	**0.451 J ± 0.242**	R	**0.776 ± 0.28**	0.222 U ± 0.261

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U: Not detected, value is the laboratory reporting limit

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residua
  from Electric Utilities. July 26. 40 CFR Part 257.
  https://www.epa.gov/coalash/coal-ash-rule

TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-7R CCR-AP-7R-20180822 08/22/2018	CCR-AP-7R CCR-AP-7R-20181113 11/13/2018	CCR-AP-7R CCR-AP-7R-20190521 05/21/2019
Appendix IV Constituents (mg/L)				
Antimony, Total	0.006	-	0.002 U	0.02 U
Arsenic, Total	0.01	**0.00077 J**	**0.00076 J**	0.01 U
Barium, Total	2	**0.031 J**	**0.025 B**	**0.029 J**
Beryllium, Total	0.004	-	0.001 U	0.001 U
Cadmium, Total	0.005	0.001 U	0.001 U	0.01 U
Chromium, Total	0.1	**0.0033 J+**	**0.0024**	0.02 U
Cobalt, Total	0.006	**0.00049 J**	**0.00026 J**	0.005 U
Fluoride	4	**0.19 J+**	-	0.17 U
Lead, Total	0.015	**0.00031 J**	**0.000095 J**	0.01 U
Lithium, Total	0.04	**0.019 J+**	**0.017**	0.05 U
Mercury, Total	0.002	0.0002 U	0.0002 U	0.0002 U
Molybdenum, Total	0.1	0.005 U	0.005 U	0.05 U
Selenium, Total	0.05	**0.00099 J**	0.005 U	0.05 U
Thallium, Total	0.002	-	0.001 U	0.01 U
Radiological (pCi/L)				
Radium-226	NA	R	-	-0.0773 U ± 0.198
Radium-228	NA	R	-	0.307 U ± 0.26
Radium-226 & 228	5	R	-	-

ABBREVIATIONS AND NOTES:

Statistically significant level (SSL) concentration.
CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
su: standard units.
USEPA: United States Environmenta.l Protection Agency
J: Value is estimated
J-: Value is estimated, biased low
J+: Value is estimated, biased high
R: Rejected during validation
U: Not detected, value is the laboratory reporting limit

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residua
from Electric Utilities. July 26. 40 CFR Part 257.
https://www.epa.gov/coalash/coal-ash-rule

TABLE 1B
NATURE AND EXTENT GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name / Sample Name / Sample Date	Groundwater Protection Standard	CCR-AP-2I CCR-AP-2I-20190214 02/14/2019	CCR-AP-2I CCR-AP-2I-20190614 06/14/2019	CCR-AP-3I CCR-AP-3I-20190214 02/14/2019	CCR-AP-3I CCR-AP-3I-20190614 06/14/2019	CCR-AP-8 CCR-AP-8-20190212 02/12/2019	CCR-AP-8 CCR-AP-8-20190617 06/17/2019
Appendix IV Constituents (mg/L)							
Antimony, Total	0.006	-	**0.00053 J**	-	**0.00045 J**	-	0.002 U
Arsenic, Total	0.01	**0.0035**	**0.0022**	**0.0014**	**0.0018**	**0.0016**	**0.0013**
Barium, Total	2	**0.09**	**0.11**	**0.11**	**0.17**	**0.06**	**0.066**
Beryllium, Total	0.004	-	0.001 U	-	**0.00026 J**	-	0.001 U
Cadmium, Total	0.005	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	0.1	0.002 U	0.004 U	**0.0018 J**	0.0046 U	0.002 U	0.0039 U
Cobalt, Total	0.006	**0.00022 J**	0.0005 U	**0.00024 J**	**0.0013**	**0.0009**	**0.0046**
Fluoride	4	**1.1**	**0.83**	**1.3**	**1.1**	**0.27**	**0.29 J+**
Lead, Total	0.015	0.001 U	0.001 U	**0.00047 J**	0.0011 U	0.001 U	0.001 U
Lithium, Total	0.04	**0.027**	**0.024**	**0.019**	**0.025**	**0.009**	**0.011**
Mercury, Total	0.002	-	0.0002 U	-	0.0002 U	0.0002 U	0.0002 U
Molybdenum, Total	0.1	**0.037**	**0.0092**	**0.012**	**0.0061**	**0.00094 J**	**0.001 J**
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.002	-	0.001 U	-	**0.00013 J**	-	0.001 U
Radiological (pCi/L)							
Radium-226	NA	**0.301 ± 0.108**	0.07 U ± 0.11	**0.192 ± 0.096**	**0.43 ± 0.25**	**0.111 ± 0.0784**	**0.35 ± 0.23**
Radium-228	NA	0.307 U ± 0.206	0.53 U ± 0.37	0.290 U ± 0.224	0.56 U ± 0.39	0.0610 U ± 0.19	0.67 U ± 0.44
Radium-226 & 228	5	**0.608 ± 0.233**	0.60 U ± 0.386	**0.483 ± 0.244**	**0.99 J ± 0.463**	0.172 U ± 0.206	**1.02 J ± 0.496**

ABBREVIATIONS AND NOTES:

Statistically significant level (SSL) concentration.
CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
su: standard units.
USEPA: United States Environmenta.l Protection Agency
J: Value is estimated
J-: Value is estimated, biased low
J+: Value is estimated, biased high
R: Rejected during validation
U: Not detected, value is the laboratory reporting limit

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257. https://www.epa.gov/coalash/coal-ash-rule

TABLE 1B
NATURE AND EXTENT GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-9 CCR-AP-9-20190214 02/14/2019	CCR-AP-9 CCR-AP-9-20190617 06/17/2019	CCR-AP-9 BLIND DUPLICATE-20190617 06/17/2019	CCR-AP-10 CCR-AP-10-20190213 02/13/2019	CCR-AP-10 CCR-AP-10-20190617 06/17/2019
Appendix IV Constituents (mg/L)						
Antimony, Total	0.006	-	0.02 U	0.02 U	-	0.002 U
Arsenic, Total	0.01	**0.0056**	**0.023**	**0.023**	**0.0037**	**0.0011**
Barium, Total	2	**0.051 F1F2**	**0.086 J**	**0.074 J**	**0.039**	**0.019**
Beryllium, Total	0.004	-	0.01 U	0.01 U	-	**0.00021 J**
Cadmium, Total	0.005	0.001 U	0.01 U	0.01 U	**0.00015 J**	0.001 U
Chromium, Total	0.1	0.002 U	0.02 U	0.02 U	**0.0061**	0.0038 U
Cobalt, Total	0.006	**0.0069**	0.005 U	0.005 U	**0.0051**	**0.0016**
Fluoride	4	**0.45 J**	**0.33 J+**	**0.33 J+**	**0.53**	**0.45 J+**
Lead, Total	0.015	**0.00037 JF1**	0.01 U	0.01 U	**0.0036**	0.001 U
Lithium, Total	0.04	**0.026**	0.05 U	0.05 U	**0.0066**	**0.0059**
Mercury, Total	0.002	-	0.0002 U	0.0002 U	-	0.0002 U
Molybdenum, Total	0.1	**0.04**	**0.021 J**	**0.021 J**	**0.012**	**0.0039 J**
Selenium, Total	0.05	0.005 U	0.05 U	0.05 U	**0.011**	**0.015**
Thallium, Total	0.002	-	0.01 U	0.01 U	-	**0.00013 J**
Radiological (pCi/L)						
Radium-226	NA	**0.149 ± 0.0782**	**0.58 ± 0.38**	**0.61 ± 0.38**	**0.238 ± 0.115**	0.32 U ± 0.27
Radium-228	NA	0.146 U ± 0.214	**0.76 ± 0.41**	0.63 U ± 0.38	0.277 U ± 0.328	0.66 U ± 0.38
Radium-226 & 228	5	0.295 U ± 0.228	**1.34 ± 0.559**	**1.24 J ± 0.537**	0.515 U ± 0.348	**0.98 ± 0.466**

ABBREVIATIONS AND NOTES:

Statistically significant level (SSL) concentration.
CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
su: standard units.
USEPA: United States Environmenta.l Protection Agency
J: Value is estimated
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J+: Value is estimated, biased high
R: Rejected during validation
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- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257. https://www.epa.gov/coalash/coal-ash-rule

TABLE 2

SUMMARY OF CORRECTIVE MEASURES

CORRECTIVE MEASURES ASSESSMENT

A.B. BROWN GENERATING STATION

MOUNT VERNON, INDIANA

Alternative Number	Remedial Alternative Description	THRESHOLD CRITERIA: Be protective of human health and the environment	Attain the groundwater protective standard	Control the source of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of Appendix IV constituents into the environment	Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems	Management of waste to comply with all applicable RCRA requirements
1	Monitored Natural Attenuation (MNA) with Closure by Removal (CBR)	✓	✓	✓	✓	✓
2	Hydraulic Containment with No Treatment, CBR, and MNA	✓	✓	✓	✓	✓
3	Hydraulic Containment with Treatment, CBR, and MNA	✓	✓	✓	✓	✓

BALANCING CRITERIA

Alternative Number	CATEGORY 1 Long- and Short-Term Effectiveness, Protectiveness, and Certainty of Success that the remedy will prove successful	Sub-Category 1: 1 Magnitude of reduction of existing risks	2 Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy	3 Type and degree of long-term management required including monitoring, operation and maintenance	4 Short-term risk to community or environment during implementation of remedy	5 Time until full protection is achieved	6 Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment	7 Long-term reliability of engineering and institutional controls	8 Potential need for replacement of the remedy
1	Green	Green	Green	Green	Green	Yellow	Green	Green	Green
2	Green	Yellow	Green	Yellow	Green	Green	Green	Green	Yellow
3	Yellow	Yellow	Yellow	Red	Yellow	Green	Yellow	Yellow	Yellow

Alternative Number	CATEGORY 2 Effectiveness in controlling the source to reduce further releases	Sub-Cat. 2: 1 Extent to which containment practices will reduce further releases	2 Extent to which treatment technologies may be used	CATEGORY 3 The ease or difficulty of implementation	Sub-Category 3: 1 Degree of difficulty associated with constructing the technology	2 Expected operational reliability of the technologies	3 Need to coordinate with and obtain necessary approvals and permits from other agencies	4 Availability of necessary equipment and specialists	5 Available capacity and location of needed treatment, storage, and disposal services
1	Green	Green	Green	Green	Green	Green	Green	Green	Green
2	Yellow	Yellow	Green	Yellow	Yellow	Yellow	Yellow	Green	Green
3	Yellow	Yellow	Green	Red	Red	Yellow	Yellow	Yellow	Yellow

COLOR LEGEND

- Green: **Most favorable when compared to other alternatives**
- Yellow: **Less favorable when compared to other alternatives**
- Red: **Least favorable when compared to other alternatives**

1. For context, this a relative comparison of remedial options for this site. Site conditions, weather, and site-specific considerations are made in this table. This is not a comparison to all options at all sites.

FIGURES

MAP SOURCE: ESRI
SITE COORDINATES: 37°54'21"N, 87°42'30"W

HALEY ALDRICH

CORRECTIVE MEASURES ASSESSMENT
SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

SITE LOCATION MAP

APPROXIMATE SCALE: 1 IN = 2000 FT
SEPTEMBER 2019

FIGURE 1-1

GIS FILE PATH: \\haleyaldrich.com\share\boi_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2019_08\A.B. BROWN\129420_001_0001-1_SITE_LOCUS.mxd — USER: hwachholz — LAST SAVED: 8/28/2019 10:03:15 AM

LEGEND

CCR UNIT BOUNDARY

APPROXIMATE PROPERTY BOUNDARY

ASH POND UNIT BOUNDARY

NOTES

1. AERIAL IMAGERY SOURCE: ESRI
2. LOCATIONS DERIVED FROM THREE I DESIGN DATA.

0 500 1,000 1,500 2,000 2,500 3,000 3,500

SCALE IN FEET

HALEY ALDRICH

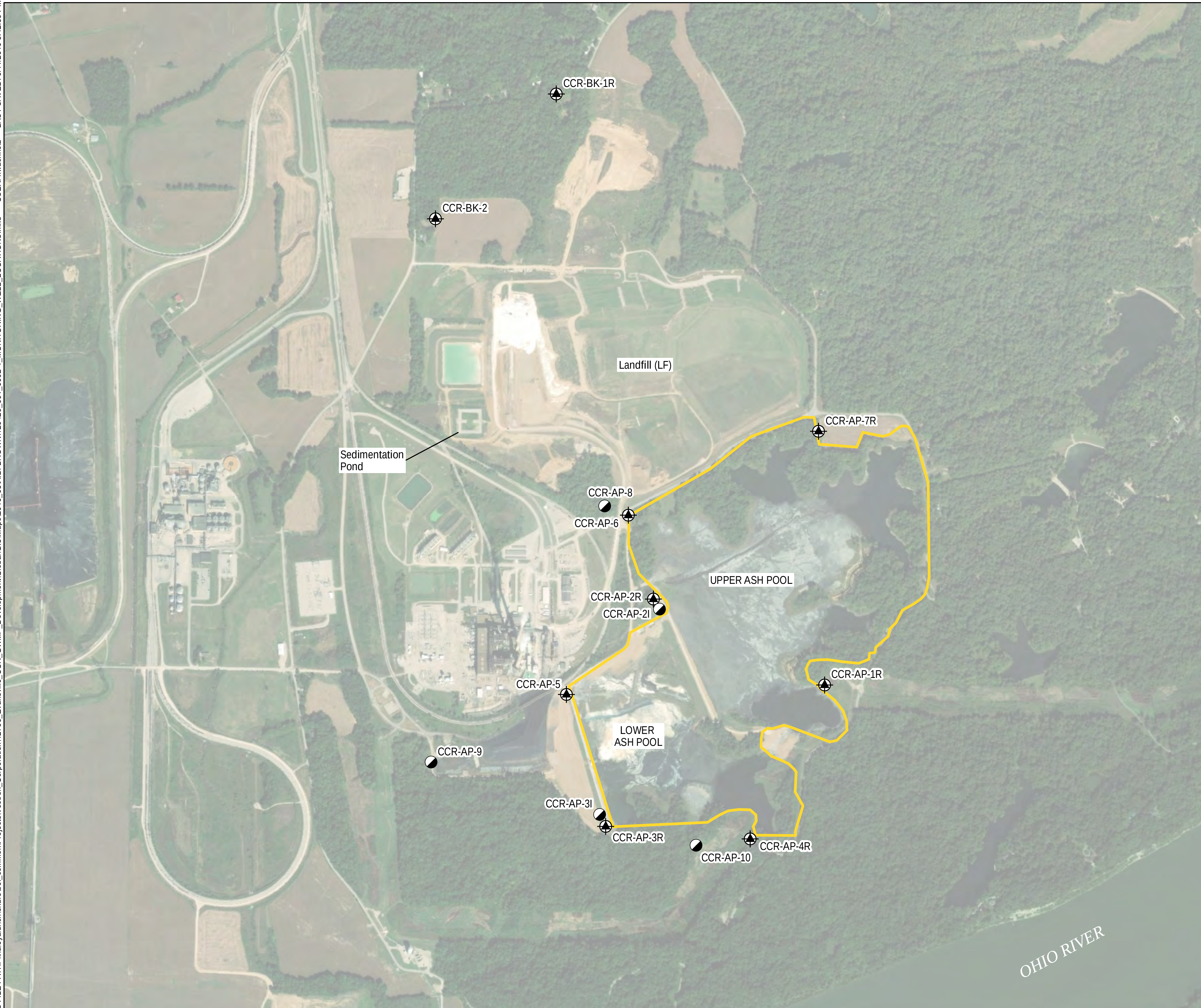
CORRECTIVE MEASURES ASSESSMENT
SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

SITE FEATURES MAP

SEPTEMBER 2019

FIGURE 1-2

GIS FILE PATH: \\haleyaldrich\share\boi_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2019_08\A.B. BROWN\129420_001_0001-2_SITE_FEATURES_MAP.mxd — USER: hwachholz — LAST SAVED: 9/11/2019 3:40:26 PM



LEGEND

- CCR MONITORING WELL
- NATURE AND EXTENT MONITORING WELL
- ASH POND UNIT BOUNDARY
- CCR UNIT BOUNDARY

NOTES

1. AERIAL IMAGERY SOURCE: ESRI
2. LOCATIONS DERIVED FROM THREE I DESIGN DATA.

0 1,000 2,000
SCALE IN FEET

HALEY ALDRICH

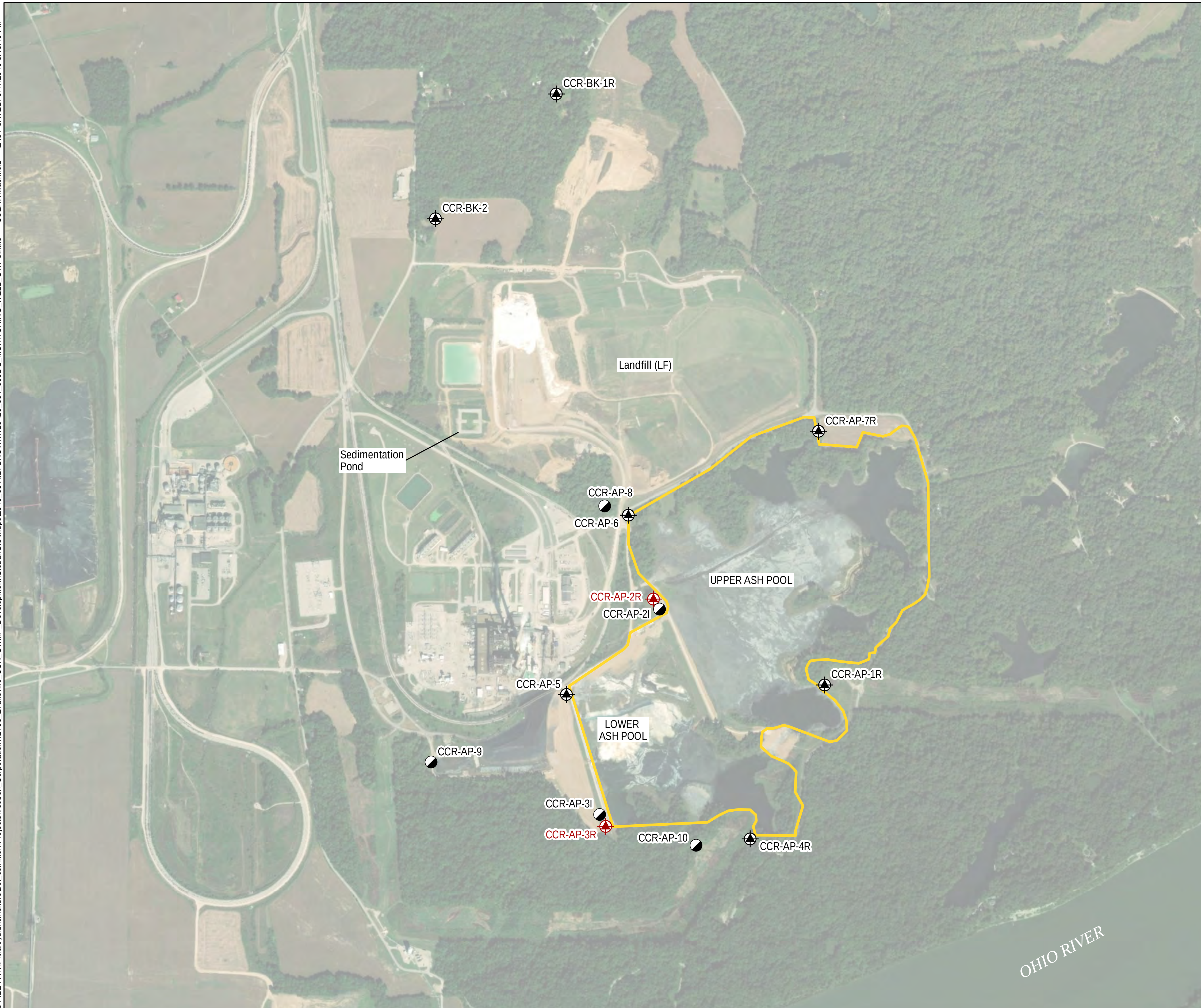
CORRECTIVE MEASURES ASSESSMENT
SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

MONITORING WELL LOCATIONS

SEPTEMBER 2019

FIGURE 1-3

GIS FILE PATH: \\haleyaldrich\share\boi_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2019_08\A.B. BROWN\129420_001_0002-1_MONITORING_WELL_LOCATIONS.mxd — USER: hwachholz — LAST SAVED: 9/11/2019 3:42:59 PM



LEGEND

CCR MONITORING WELL WITH NO CONSTITUENTS ABOVE GWPS

CCR-AP-2R — MONITORING WELL WITH LITHIUM AND MOLYBDENUM CONCENTRATION ABOVE THE GWPS

CCR-AP-8 — NATURE AND EXTENT MONITORING WELL

APPROXIMATE UNIT BOUNDARY

NOTES

1. LOCATIONS DERIVED FROM THREE I DESIGN DATA.
2. GWPS = GROUNDWATER PROTECTION STANDARDS
3. REFER TO TABLE 1 FOR GROUNDWATER ANALYTICAL RESULTS.
4. AERIAL IMAGERY SOURCE: ESRI

N

0 1,000 2,000
SCALE IN FEET

HALEY ALDRICH

CORRECTIVE MEASURES ASSESSMENT
SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

MONITORING WELL LOCATIONS WITH STATISTICALLY SIGNIFICANT LEVELS ABOVE GWPS

SEPTEMBER 2019

FIGURE 2-1

GIS FILE PATH: \\haleyaldrich\share\boi_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2019_08\A.B. BROWN\129420_001_0002-2_MONITORING_WELL_GWPS.mxd — USER: hwachholz — LAST SAVED: 9/11/2019 3:46:16 PM

FIGURE 4-1
REMEDIAL ALTERNATIVE ROADMAP
CORRECTIVE MEASURES ASSESSMENT
SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN GENERATING STATION - ASH POND
MOUNT VERNON, INDIANA

Alternative Number	Remedial Alternative Description	Ash Pond Closure Method	Interim Measure Options for Groundwater	Post-Closure Options for Groundwater
1	**Monitored Natural Attenuation (MNA) with Closure by Removal (CBR)**	**Closure by Removal with Beneficial Use**	**Natural Attenuation with Monitoring** Mitigate migration of groundwater with CCR constituents above Groundwater Protection Standards (GWPS) through processes of natural attenuation	**MNA** Post-closure groundwater monitoring to confirm reduction of CCR constituents following removal
2	**Hydraulic Containment with No Treatment, CBR, and MNA**		**Hydraulic Containment with No Treatment** Mitigate migration of groundwater with CCR constituents above GWPS using extraction wells, direct discharge of effluent	
3	**Hydraulic Containment with Treatment, CBR, and MNA**		**Hydraulic Containment with Ex-Situ Treatment** Mitigate migration of groundwater with CCR constituents above GWPS using extraction wells, ex-situ treatment of effluent prior to discharge	

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