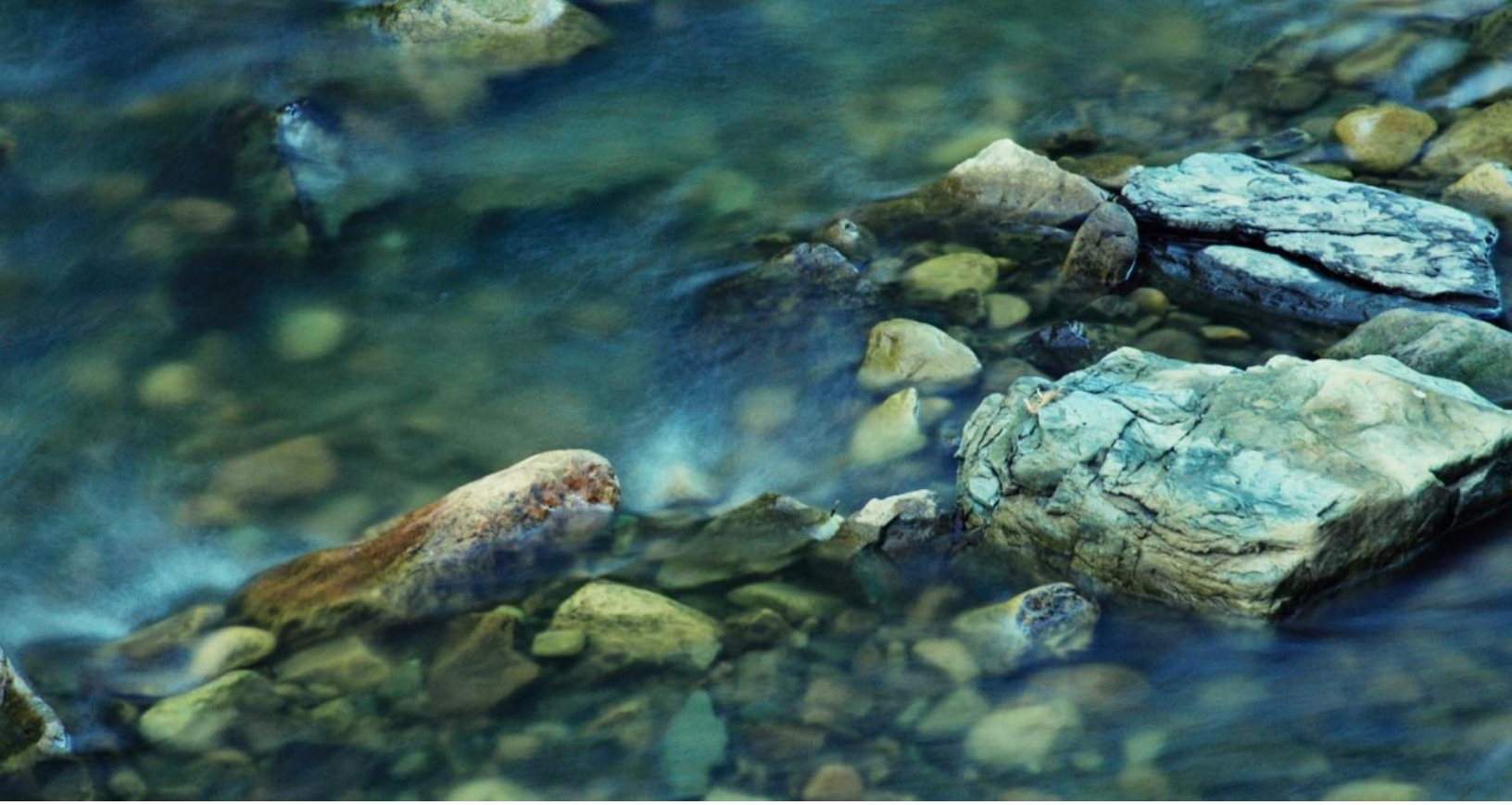

December 2019

ANCHOR QEA

Semi-Annual Remedy Selection and Design Progress Report
Plant Barry Ash Pond

Prepared for Alabama Power Company

December 2019

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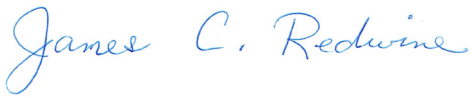

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ABBREVIATIONS

ACM	Assessment of Corrective Measures
ADEM	Alabama Department of Environmental Management
CCR	coal combustion residuals
CFR	Code of Federal Regulations
COI	constituent of interest
CSM	conceptual site model
MNA	monitored natural attenuation
SEM	scanning electron microscopy
Site	Ash Pond at Plant Barry
SSE	selective sequential extraction
SSL	statistically significant level
XRD	X-ray diffraction
XRF	X-ray fluorescence

1 Introduction

In accordance with the U.S. Environmental Protection Agency's coal combustion residuals (CCR) rule 40 CFR 257.97(a) and the Alabama Department of Environmental Management's (ADEM's) Admin. Code r. 335-13-15-.06(8)(a), this *Semi-Annual Remedy Selection and Design Progress Report* has been prepared for the Ash Pond at Plant Barry (Site). Specifically, this *Semi-Annual Remedy Selection and Design Progress Report* has been prepared to describe the progress made in evaluating the selected remedy and alternative remedies and designing a remedy plan in the second semiannual period of 2019.

On June 12, 2019, Plant Barry completed an Assessment of Corrective Measures (ACM; Anchor QEA 2019) to address the occurrence of arsenic and cobalt in groundwater at statistically significant levels (SSLs). The ACM was submitted to ADEM pursuant to Administrative Order No. 18-094-GW, placed in the Site's operating record, and posted to the Site's CCR Rule Compliance website.

Pursuant to 40 CFR 257.97 and ADEM Admin. Code r. 335-13-15-.06(8), Plant Barry is evaluating the selected and potential remedies presented in the ACM to identify a plan incorporating the remedy, or combination of remedies, as soon as feasible.

As discussed in the ACM, the following corrective measures are potentially feasible for use at the Site:

- Monitored natural attenuation (MNA)
- Hydraulic containment (pump-and-treat)
- Permeable reactive barriers
- Subsurface barrier walls
- Geochemical manipulation (in situ injection)

Any data obtained during on-site investigations, or to evaluate corrective action alternatives, in 2019 will be included in the Annual Groundwater Monitoring and Corrective Action Report, on January 31, 2020, as required by 40 CFR 257.90(e) and ADEM Admin. Code r. 335-13-15-.06(1)(f).

2 Summary of Work Completed

Site investigations and preliminary design work have continued at the Site to support remedy selection and design. As discussed in the ACM (Anchor QEA 2019), completing a final long-term corrective action plan is often a multi-year process. Additional assessment work has been completed since June 2019, and work plans have been developed to support MNA and geochemical manipulation. These technologies are both geochemically based, such that site-specific geochemical data and analyses can be applied to both technologies.

ACM-related activities completed since the Administrative Order was issued are summarized in Table 1. Detailed planning for soil, precipitate, and groundwater investigations have been completed and are discussed in Section 3.

Table 1
Timeline of Completed Activities

Date	Activity
August 2018	ADEM issued Administrative Order
December 2018 to January 2019	Additional delineation wells installed
January 2019	Annual Groundwater Monitoring and Corrective Action Report finalized
January to March 2019	Collected groundwater samples from wells installed between December 2018 and January 2019
March 2019	Performed site characterization borings
May 2019	Conducted groundwater assessment sampling event
May 2019	Submitted a preliminary Groundwater Investigation Technical Memo to ADEM
June 2019	ACM completed to address occurrence of arsenic and cobalt in groundwater
July 2019	Additional delineation wells installed
July to August 2019	Collected groundwater samples from wells installed July 2019
November to December 2019	Detailed plans made for additional soil, precipitate, and groundwater sampling and analysis to support MNA and geochemical manipulation

2.1 Nature and Extent Delineation

Since this is the first semi-annual status report for remedy selection, the following summarizes activities that have been completed at the Site since November 2018 to determine the nature and delineate the extent of arsenic and cobalt SSLs in Site groundwater. Details regarding these activities will be presented in a forthcoming Site Investigation Report:

- Installed six vertical delineation wells, three horizontal delineation wells, and three ash porewater piezometers between December 11, 2018, and January 4, 2019. The remaining

scope of well installations (horizontal and vertical delineation) described in the Facility Plan (SCS 2018) could not be achieved at the time due to flooded or wet conditions.

- Collected nine ash samples for waste characterization analyses.
- Developed each newly installed delineation well between December 20, 2018, and January 8, 2019. Horizontal delineation well MW-18H could not be developed until March 20, 2019, due to persistent flood conditions over low-lying areas.
- Collected samples from each delineation and characterization well between January 7, 2019, and March 21, 2019.
- Performed five additional site characterization borings between March 19, 2019, and March 21, 2019.
- Submitted a preliminary Groundwater Investigation Technical Memorandum to ADEM on May 13, 2019. This was a partial report of findings because most horizontal delineation wells were not yet installed due to the site conditions.
- Completed an Assessment of Corrective Measures for the Ash Pond on June 12, 2019.
- Installed additional horizontal delineation wells and one vertical delineation well in July 2019. The area south of the Ash Pond (south of BY-AP-MW-14) still exhibited flood conditions and, therefore, could not be safely accessed to install BY-AP-MW-21H as planned. These wells were sampled between July 29 and August 2. Laboratory results were received in September and November 2019.

Pursuant to 40 CFR 257.96 and ADEM Admin. Code r. 335-13-15-.06(7), groundwater in the vicinity of the Ash Pond continues to be monitored during the remedy design phase. In addition, during the remedy selection phase, the additional groundwater monitoring wells installed to characterize the extent of arsenic and cobalt will continue be sampled semi-annually as part of assessment monitoring.

2.2 Remedy Selection Data Collection

Activities completed in 2019 have focused on completing the horizontal and vertical delineation of arsenic and cobalt SSLs. Two phases of delineation investigation have been completed at the Site to substantially define the nature and extent of arsenic and cobalt SSLs. Work plans for the delineation have been submitted to ADEM (SCS 2018). Since substantial delineation is complete, remedy-specific data collection is planned for the first half of 2020, as described in Section 3.

Additional hydrogeologic and geochemical data collected during delineation investigations are being used to refine the conceptual site model (CSM) and to further evaluate the feasibility of each proposed corrective measure. When feasible, data needed to refine the CSM will be collected concurrent with the routine assessment monitoring events.

3 Planned Activities and Anticipated Schedule

Laboratory analysis for soil, precipitates (attenuating solids), and groundwater is planned to support MNA and geochemical manipulation. The major rationale for these investigations includes the following:

- Identifying attenuating mechanisms
- Gaining an understanding of the permanence of the attenuating mechanisms
- Identifying potential geochemical manipulation approaches for constituents of interest (COIs) based on site geochemical conditions and attenuation processes already occurring naturally

In addition, analysis using existing groundwater data will be performed to determine if MNA is occurring and to assess attenuation rates.

3.1 Analysis of Existing Groundwater Data

Groundwater data collected during previous monitoring events will be analyzed to assess natural attenuation occurrence and rates, including the following:

- Concentration versus distance (from impoundment) graphs, including ash porewater data, to show attenuation in space
- Concentration versus time graphs to show attenuation in time
- In concentration versus distance, and concentration versus time graphs, boron can be plotted as a conservative tracer to demonstrate physical attenuation and to compare to COI, which may be undergoing chemical attenuation in addition to physical attenuation
- Calculation of first-order decay rate constants, from the concentration versus time graphs

3.2 Soil and Precipitate Analysis

Soil and aquifer media have the ability to sorb COI, and their geochemistry can indicate if natural attenuation is occurring or has the potential to occur. Laboratory analysis is planned for soil samples collected during the delineation investigations to support geochemically based corrective action. Laboratory tasks include the following:

- Sample interval selection, preparation, and grain size fractionation
- Bulk chemical analysis and cation exchange tests on select samples
- Determination of mineralogy by optical methods and scanning electron microscopy (SEM)
- Selective sequential extraction (SSE) on samples of the fine fractions
- Bulk chemical analysis, X-ray fluorescence (XRF), X-ray diffraction (XRD), SEM, and SSE on the solid precipitates

Precipitation and coprecipitation may be major mechanisms for natural attenuation. If precipitates are forming, and incorporating COI, then natural attenuation is occurring. Similarly, if precipitates are

forming and incorporating COI, this suggests attenuation mechanisms that can be enhanced by geochemical manipulation under existing site conditions. If present, precipitates will be collected from monitoring wells with SSLs of Appendix IV constituents. Precipitate samples will be analyzed as follows:

- Chemical analysis by XRF and/or conventional wet methods to determine the chemical composition of the matrix (e.g., iron compounds) and presence of COI
- XRD to determine mineral phases
- SEM and associated electron diffraction to confirm mineral phases and attenuating mechanisms
- SSE to determine association of COI with attenuating phases, relative strength of attenuation, and relative permanence

To assess potential attenuating mechanisms, and to gain insight into the permanence of the mechanisms, SSE will be performed on select precipitate samples. In SSE, samples are leached with increasingly aggressive solutions to determine the chemical associations as follows (or similar):

- F1, Soluble – elevated ionic strength, pH neutral
- F2, Exchangeable (adsorbed) – mildly acidic phosphate
- F3, Reducible (iron and/or manganese oxide bound) – acidified reductant
- F4, Oxidizable (sulfide or organic matter bound) – strong acid
- F5, Residual (contained in mineral matrices) – strong acid plus strong oxidant

Generally, each successive step represents stronger attenuation than the previous step, and corresponding greater permanence for the attenuating mechanism.

3.3 Groundwater Collection, Analysis, and Geochemical Modeling

Additional groundwater sample collection and analysis will be performed to evaluate MNA and geochemical manipulation. Groundwater will be sampled from background monitoring wells and wells with SSLs. Groundwater will be analyzed for major cations, anions, and related parameters (Table 2) to perform geochemical modeling using PHREEQC or Geochemists' Workbench.

Geochemical modeling will be performed to determine which species of the COI should be mobile, and which should be attenuated under existing site geochemical conditions. For example, PHREEQC can accommodate the solids in the groundwater-aquifer system and can be used to evaluate sorption/desorption, ion exchange, precipitation/coprecipitation, and related processes.

Table 2
Groundwater Sample Analyte List

Sample Analytes		
Iron	Alkalinity, Total	Dissolved Organic Carbon
Iron, Dissolved	Chloride	Field Parameters (below)
Manganese	Fluoride	Temperature (°C)
Manganese, Dissolved	Nitrate as N	Specific Conductivity (µS/cm)
Calcium	Orthophosphate as P	Dissolved Oxygen (mg/L)
Magnesium	SiO_2, Silica	Turbidity (NTUs)
Potassium	Sulfate	ORP (mV)
Sodium	Sulfide	pH (SU)

Notes:
Units are milligrams per liter unless otherwise noted.
µS/cm: microsiemens per centimeter
mV: millivolt
NTU: nephelometric turbidity unit
ORP: oxidation-reduction potential
SU: standard unit

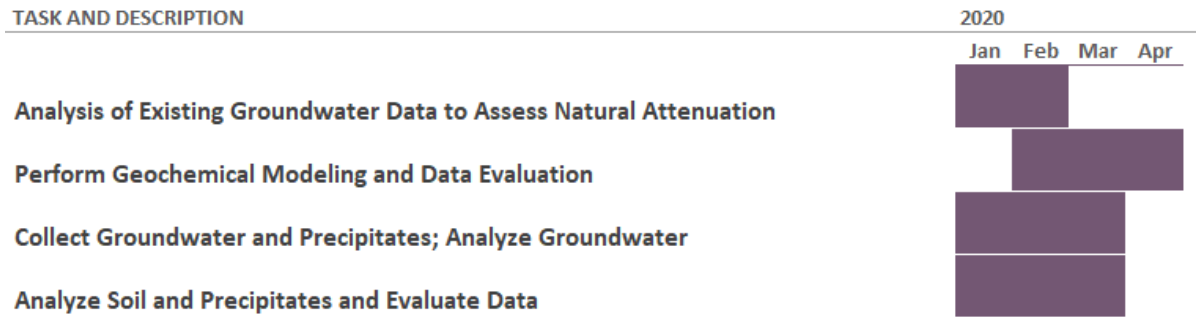
3.4 Schedule

Groundwater and precipitate collection and laboratory analysis, geochemical modeling, and data evaluation is expected to begin in January 2020 and be completed within 4 months. The anticipated schedule for these activities is included in Figure 1.

Alabama Power Company will continue groundwater monitoring at the Site. In addition to performing the work described here, the following will also be completed:

- December 15, 2019 – Submit the Groundwater Delineation Report to ADEM.
- January 3, 2020 – Provide response to ADEM comment letter regarding previous groundwater submittals.
- January 31, 2020 – Submit the Annual Groundwater Monitoring and Corrective Action Report to ADEM.
- March 30, 2020 – Submit semi-annual progress report required by Part E of the Administrative Order.
- June 15, 2020 – Complete the next semi-annual Remedy Selection Status Report and place it in the Operating Record.

Figure 1
Planned Schedule



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