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REPORT ON

CORRECTIVE MEASURES ASSESSMENT
WINYAH GENERATING STATION
GEORGETOWN, SOUTH CAROLINA

by
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for
Santee Cooper
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File No. 132892-013
September 2019

Overview

Santee Cooper retained Haley & Aldrich, Inc. (Haley & Aldrich) to prepare this Corrective Measures Assessment (CMA) for the Coal Combustion Residual (CCR) management unit, referred to as Ash Pond A and Ash Pond B, located at Winyah Generating Station (WGS) in Georgetown, South Carolina. While these CCR management units have been monitored as individual impoundments, for the purpose of this CMA, Ash Pond A and Ash Pond B will be evaluated as a multi-unit system. The Site is a coal-fired power plant located in Georgetown County near the city of Georgetown, South Carolina. 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).

Assessment Monitoring conducted in 2018 identified the presence of arsenic, lithium and molybdenum in one or more downgradient wells at statistically significant levels (SSL) exceeding the established groundwater protection standards (GWPS). The SSLs detected at Ash Pond A is arsenic and lithium and at Ash Pond B the SSLs detected is arsenic, lithium and molybdenum. In accordance with the CCR Rule update, published on July 30, 2018, the GWPS was set as the Maximum Contaminant Level (MCL) of 0.01 mg/L for arsenic and the EPA Regional Screening Levels (RSL) of 0.1 mg/L for molybdenum and 0.04 mg/L for lithium. The MCL is a health-based standard for drinking water, whereas the RSL is a drinking water standard based on aesthetics (i.e., color, taste, or odor). As a result, and in accordance with the CCR Rule, Santee Cooper initiated an evaluation of the horizontal and vertical nature and extent of arsenic, lithium and molybdenum downgradient of Ash Pond A and B. Groundwater sampling from the newly installed monitoring wells showed that the extent of arsenic, lithium and molybdenum does not extend north and east of the Cooling Water Pond. Lithium has been detected in one of the intermediate monitoring wells north of Ash Pond A. Vertical delineation of molybdenum is not complete at this time and will be addressed with supplemental sampling and is discussed in section 2.4.

In performing this CMA, Haley & Aldrich considered the following: presence and distribution of arsenic, lithium, and molybdenum, Ash Pond A and B configuration and operational history, hydrogeologic setting, and the results of the evaluation of the nature and extent available at this time.

The remedial alternatives evaluated in this CMA include the following:

- Alternative 1: Cap and close-in-place (CIP) plus monitored natural attenuation (MNA);
- Alternative 2: Cap and CIP plus hydraulic containment with direct discharge;
- Alternative 3: Cap and CIP plus hydraulic containment with ex-situ groundwater treatment;
- Alternative 4: Closure by removal (CBR) plus MNA;
- Alternative 5: CBR plus hydraulic containment with direct discharge; and
- Alternative 6: CBR plus hydraulic containment with ex-situ groundwater treatment.

These six alternatives were evaluated based on the threshold criteria provided in §257.97(b) of the CCR Rule and then compared to three of the four balancing criteria listed in §257.97(c)(1) of the CCR Rule. The threshold criteria must:

1. Be protective of human health and the environment;
2. Attain the GWPS as specified in § 257.95(h);
3. 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;
4. 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; and
5. Comply with standards for management of wastes as specified in § 257.98(d).

The four balancing criteria shall 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 number four, above (consideration of community concerns), cannot be evaluated until after a public meeting is held and public input is obtained. Accordingly, a remedy cannot be selected until thirty days after the public meeting is held.

Observations and/or expectations associated with the groundwater remedial alternatives for Ash Pond A and B are provided below and described more fully in this report:

- **Groundwater Compliance**: Under current conditions there is not a risk to human health and the environment associated with Ash Pond A and B. Upon closure of Ash Pond A and B arsenic, lithium and molybdenum concentrations are expected to decline below their GWPS through the chemical, physical, and biological processes of natural attenuation that occur without human intervention. 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 treatability of arsenic, lithium and molybdenum using either ex-situ treatment methods, such as ion exchange or reverse osmosis. Following laboratory-scale testing, pilot-scale treatment evaluations for the contaminants would also be required if such remedies were selected as part of the CMA process.

Groundwater Modeling: Groundwater and solute transport modeling was conducted using lithium as a surrogate for arsenic and molybdenum to evaluate the timeframes to achieve GWPS for the various alternatives. Lithium was chosen as the surrogate for the Winyah Ash Pond A and B because it was detected above GWPS at both units and it has a higher degree of mobility when compared to arsenic. Molybdneum was not considered because it was only detected at one location above GWPS. As a result, remediation timeframes for lithium represent a worse case senario. While Santee Cooper has been monitoring groundwater downgradient of the Winyah Ash Pond A and B under a South Carolina Department of Health and Environmental Control (SC DHEC) approved groundwater monitoring program, to the extent necessary and appropriate and in accordance with §257.98 of the CCR Rule, Santee Cooper may modify or expand the groundwater monitoring program to document the effectiveness of the selected remedial alternative. Corrective measures are considered complete when monitoring reflects groundwater downgradient of the Winyah Ash Pond A and Ash Pond B has fallen to below Appendix IV GWPS for three consecutive years. The corrective measures alternatives evaluated in this CMA are based on the data available at this time. Weather events and lack of availability to qualified drilling subcontractors has delayed completion of the nature and extent determination and as a result, a 60-day extension was required to complete the CMA.

In addition, EPA 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)*.

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List of Acronyms and Abbreviations

Abbreviation	Definition
WGS	Winyah Generating Station
Ash Pond A AND B	CCR Management Unit
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.
msl	Mean Sea Level
N&E	Nature and Extent
ORP	Oxidation Reduction Potential
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
USEPA	United States Environmental Protection Agency

1. Introduction

Haley & Aldrich, Inc. (Haley & Aldrich) was retained by Santee Cooper to prepare Corrective Measures Assessments (CMA) for the Coal Combustion Residual (CCR) management units (Ash Pond A and Ash Pond B) located at the Winyah Generating Station (WGS), herein referred to as the "Site", in Georgetown County, South Carolina (see Figure 1). Santee Cooper 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 A and Ash Pond B closure and groundwater corrective action.

While Ash Pond A and Ash Pond B have been monitored as individual impoundments, for the purpose of this CMA, Ash Pond A and Ash Pond B will be evaluated as a multi-unit system. This CMA includes a summary of the results of groundwater monitoring and site investigations at the Site. Groundwater impacted by Ash Pond A and B exceed Groundwater Protection Standards (GWPS) for three constituents: arsenic, lithium and molybdenum at five monitoring locations. This report evaluates potential corrective measures to address these limited exceedances of the GWPS.

1.1 FACILITY DESCRIPTION/BACKGROUND

WGS is a fossil fuel fired electric generating facility which utilizes coal as the primary fuel source. Santee Cooper currently owns the land and operates the station for supplying electric power to the industrial, commercial, and residential customers in its service territory. WGS consists of four subcritical coal-fired units. Winyah Unit 1 began commercial operation in 1975, Unit 2 was constructed in 1977, Unit 3 in 1980, and Unit 4 in 1981. The original ash management areas and the focus of this CMA (Ash Pond A and B were constructed in 1975. A site index map is provided as Figure 2.

1.2 SITE CHARACTERIZATION WORK SUMMARY

The Site geology and hydrogeology is described in the *Preliminary Site Hydrogeologic Characterization Study Report* prepared by Geosyntec in March 2015 and in the *NPDES Groundwater Monitoring Plan* prepared by Santee Cooper in December 2010.

These studies generated subsurface data characterizing the Site geology and hydrogeology 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 individually monitor Ash Pond A and Ash Pond B, downgradient wells were installed along the perimeter of the Units. Haley & Aldrich concluded that the two existing downgradient monitoring wells (WAP-9 and WAP-10), located at the boundary of the unit, and screened in the uppermost aquifer, adequately monitor the release and migration of ash constituents from Ash Ponds A and B, should that occur. To supplement these wells and comply with the Rule, three additional wells were installed around Ash Pond A (WAP-17, WAP-18, and WAP-19) and two additional wells were installed around Ash Pond B (WAP-20 and WAP-21) (see Figure 3). Well placement was determined based on interpretations of site-specific hydrogeology including groundwater flow direction and rate of groundwater movement.

Detection monitoring sampling events occurred in 2015 and 2017. The results of the sampling events were compared to background, or natural groundwater values, using statistical methods to determine if Appendix III constituents downgradient of the ash ponds were present at concentrations above background, called statistically significant increases (SSI). The result of the statistical analysis identified SSIs of Appendix III constituents triggering initiation of an Assessment Monitoring Program and respective notification of the same. The location of the Appendix III SSI's is shown on Figure 4 and Detection monitoring analytical results are summarized in Table 1.

During the Assessment Monitoring phase, CCR groundwater samples were collected in June, and September 2018 and subsequently analyzed for the Appendix III and Appendix IV constituents in accordance with 40 CFR §257.95(b) and 40 CFR §257.95(d)(1) . Appendix IV analytical results for the baseline and Assessment Monitoring events are summarized in Table 2. After establishing groundwater protection standards (GWPS) for the Appendix IV constituents, a statistical analysis of the Assessment Monitoring results was conducted to determine if the detected Appendix IV constituents were present in groundwater at statistically significant levels (SSLs) above the GWPS. This analysis produced SSLs for arsenic (WAP-9, WAP-17, WAP-18, WAP-19 and WAP-20), molybdenum (WAP-20) and lithium (WAP-9, WAP-17, WAP-18, WAP-19 and WAP-20). The GWPS was set as the Maximum Contaminant Level (MCL) of 0.01 mg/L for arsenic and the EPA Regional Screening Level (RSL) of 0.1 mg/L for molybdenum and 0.04 mg/L for lithium as shown on Figure 5. Following the identification of SSLs for arsenic, lithium and molybdenum an evaluation of the nature and extent of the three contaminants was initiated as required by §257.95(g). A CMA was also initiated in accordance with §257.96.

1.4 CORRECTIVE MEASURES ASSESSMENT PROCESS

The CMA process involves development of groundwater remediation technologies that will achieve the following threshold criteria: protection of human health and the environment, attainment of GWPS, source control, COC 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 long- and short-term effectiveness, source control, and implementability. Input from the community on such proposed measures will occur as part of a public meeting scheduled for the fall of 2019.

1.5 RISK REDUCTION AND REMEDY

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

(1)(i) Magnitude of reduction of existing risks;

(1)(ii) Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy;

(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;

(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;

(4) Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy[1];

(5)(i) Current and future uses of the aquifer;

(5)(ii) Proximity and withdrawal rate of users; and

(5)(iv) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to CCR constituents.

[1] Factors 4 and 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

To evaluate the magnitude of risk reduction, the degree of existing risk must first be identified. Prior risk evaluations and data collected are summarized below.

2.1 SITE SETTING

The WGS is located approximately ten miles from the Atlantic Ocean between Pennyroyal Creek, west of the generating station and Turkey Creek, to the east. The location of the WGS is shown on Figure 1. WGS is located within the Lower Coastal Plain of the Atlantic Coastal Plain physiographic province in South Carolina. The Site and surrounding area is relatively flat with natural ground surface elevations between 15 and 30 feet above mean sea level (msl). The lower lying areas are typically marshy year-round.

Extensive earthwork across the site such as road and dike building, and foundation preparation has altered much of the original grade in the vicinity of the plant and CCR management units. Nearly all surface water on the Site is collected and directed to the industrial cooling pond for reuse. All other runoff ultimately flows to the Sampit River, located approximately two miles north of the Site. Pennyroyal Creek is a tributary to the Sampit River and borders the western boundary of the Site. Another tributary, Turkey Creek, located north and east of the plant flows north and joins Pennyroyal Creek about one mile north of the Site. During plant construction, a portion of Turkey Creek was relocated to a man-made channel along the east side of the Industrial Cooling Pond.

2.2 GEOLOGY AND HYDROGEOLOGY

In descending order, the subsurface soils at the WGS and its surrounding areas are classified into, fill soils (Fill), unconsolidated Pleistocene sediments (Pleistocene), Chicora Member (Chicora) of the Williamsburg Formations and Williamsburg Formation (Williamsburg) sediments. The three geologic units encountered beneath the Site are described below for reference, with emphasis on the unconsolidated Pleistocene sediments and Chicora Member of the Williamsburg Formation, which make up the uppermost aquifer and, as required by the Rule, is the focus of the groundwater monitoring program. Beginning at ground surface and continuing downward from youngest to oldest, the geologic units beneath the site are described as follows:

Formation Name	Age	Hydrogeologic Unit	Description	Thickness
Unconsolidated Sediments	Pleistocene	Uppermost Aquifer	Estuarine and barrier island deposits containing moderately to well-sorted sand, well-sorted clayey sand and sandy clay with broken shells and reworked Williamsburg Formation sediments, including cemented pieces of sand and dark grey to black silt and clay	1-50

Chicora Member	Pleistocene	Uppermost Aquifer	The upper section of the Williamsburg Formation consisting of a carbonate mud with fine to coarse quartz sand and silt with some fossiliferous clayey sand and mollusk-rich, limestone	0-10
Williamsburg Formation	Pleistocene	Lower Aquifer	Laterally continuous and competent stiff, dense, low permeability, black to dark gray clay with very fine quartz sand extending to a minimum elevation of at least -60 feet (NGVD29), which is the deepest penetration of the site investigations.	>30

The uppermost aquifer at WGS includes saturated portions of the unconsolidated Pleistocene sediments and the Chicora Member of the Williamsburg Formation. The Chicora Member overlies the dense, low permeability clay of the Williamsburg Formation and varies in thickness at the Site from 0- to 10-feet. The dense clay deposits of the Williamsburg Formation are laterally continuous and competent separating the uppermost aquifer from deeper saturated units.

Groundwater flow within the surficial aquifer and Chicora Member is affected by the onsite ponds and regional topography. Recharge to the surficial aquifer occurs by direct surface infiltration as well as from surface water in the upper reaches of the discharge channel to the cooling pond adjacent to Ash Pond A. Regionally, groundwater flow is toward Pennyroyal Creek, Turkey Creek, and the Sampit River. In the vicinity of the ash ponds potentiometric data recorded from the on-site monitoring network as presented in Table 3, suggests that groundwater flow in the unconfined, uppermost aquifer is radial as shown in Figure 6.

2.3 GROUNDWATER PROTECTION STANDARDS

Haley & Aldrich completed a statistical evaluation of groundwater analytical results 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.

Groundwater results were compared to the site-specific GWPS. Statistically significant levels (SSLs) above the GWPS are limited to five monitoring wells (WAP-9, WAP-17, WAP-18, WAP-19 and WAP-20) and for three parameters (arsenic, lithium and molybdenum).

2.4 NATURE AND EXTENT OF GROUNDWATER IMPACTS

Santee Cooper initiated a nature and extent (N&E) investigation as required by the CCR Rule in 2019 by installing 5 monitoring wells (N&E wells). Of the five monitoring wells installed, two were constructed downgradient of Ash Pond B, one was constructed downgradient of Ash Pond A and two were constructed on the perimeter of the Cooling Water Pond. The new monitoring wells installed around the perimeter of the Ash Ponds were desgned to vertically delineate the SSLs identified in the shallow portion of the uppermost aquifer and the two wells installed along the perimeter of the Cooling Water Pond were designed to horizontally delineate the SSLs to the north and east of the Ash Ponds.

Analytical results from the N&E monitoring wells constructed downgradient of Ash Pond A indicate horizontal delineation for lithium and arsenic is complete. However, lithium was detected above GWPS in monitoring well WAP-22 suggesting that the vertical extent of lithium may not be defined. Confirmatory samples will be collected to determine if the slightly elevated concentrations of lithium seen in WAP-22 is representative or is an artifact of the drilling and well installation process. Additional delineation for lithium will be considered should the concentration of lithium remain elevated.

Analyical results for the N&E wells constructed downgradient of Ash Pond B indicate that the horizontal and vertical extent of arsenic, lithium and molybdnenum has been delineated.Arsenic, lithium and molybdenum was not detected above GWPS in the newly installed shallow and intermediate N&E wells.Boring logs are provided as Appendix A and laboratory analytical reports are provided as Appendix B.

3. Corrective Measures Alternatives

3.1 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 arsenic, lithium and molybdenum above the GWPS, to remediate releases above the GWPS that have already occurred, and to restore groundwater in the affected area to a condition that is below the GWPS. The CMA provides an analysis of the effectiveness of six potential corrective measures in meeting the requirements and objectives of remedies as described under §257.97 (also shown graphically on Tables 5 and 6. This assessment also meets the requirements in §257.96 by evaluating the following:

- 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 as described herein.

3.2 GROUNDWATER FATE AND TRANSPORT

A groundwater flow and solute transport model was constructed to evaluate and compare potential corrective measures in support of the CMA for the Site. The numerical model MODFLOW-2005 (Harbaugh, 2005) was selected for the modeling effort and is a three-dimensional, finite difference groundwater flow model capable of simulating the groundwater conditions under various scenarios including pumping and changes to infiltration over time. A description of the model construction, calibration, and subsequent simulations of remedy alternatives for Appendix IV constituents above the GWPS is provided as Appendix C.

Model calibration is the process of refining the model representation of the hydrogeologic framework, hydraulic properties, and boundary conditions to minimize the difference between the simulated heads and fluxes to the measured data. The RMS error is the square root of the average of the squares of the residuals. The RMS adds additional weight to points where the residual is greatest. If the residuals at all points are very similar, the RMS will be close to the mean absolute error. Alternatively, a few points with high errors can add significantly to the RMS for an otherwise well calibrated model. For all three of these criteria the optimal value is zero. The numerical goals for the groundwater flow model calibration are to (1) minimize the ME and MAE errors and (2) achieve the ratio of the root mean square (RMS) error of the head residuals to the range of observed heads (i.e., normalized RMS error) to be at least less than 10 percent (Anderson and Woessner, 1992). Once the groundwater flow model was calibrated to the determined criteria, the model was set-up for solute transport. Outputs from the groundwater model from the various CMA options are presented in Figure 7.

Contaminant fate and transport modeling was conducted utilizing the three-dimensional, numerical model MT3DMS (Version 5 of MT3D) (Zheng, 1990). MT3DMS simulates advection, dispersion, adsorption and decay of dissolved constituents in groundwater using a modular structure similar to MODFLOW to permit simulation of transport components independently or jointly. MT3D interfaces directly with MODFLOW for the head solution and supports all the hydrologic and discretization features of MODFLOW. The MT3D code has a comprehensive set of solution options, including the method of characteristics (MOC), the modified method of characteristics (MMOC), a hybrid of these two methods (HMOC), and the standard finite-difference method (FDM). MT3D was originally released in 1990 as a public domain code from the USEPA and has been widely used and accepted by federal and state regulatory agencies.

For this modeling effort, the MT3DMS model utilized the flow regime from the steady-state, calibrated Site groundwater flow model presented above to simulate transport of arsenic, lithium and molybdenum. The steady state model was transformed into a transient model so various CMA options could be evaluated with respect to time. The strength and locations of the potential lithium and molybdenum sources specified in the transport models were based on current dissolved-phase concentration distributions from groundwater monitoring data at the Site. To support the modeling effort, Haley & Aldrich evaluated the groundwater geochemistry to develop site-specific attenuation/degradation factors. The groundwater flow and solute transport model is being used to simulate the risks and remediation timeframes that can be predicted under each of the remedial alternatives so that each of the alternatives can be compared to one another.

As shown on Figure 7, CBR with direct discharge achieves GWPS in the shorteset timeframe followed closely by CIP with direct discharge. The timeframe to address the source is shorter with CBR than it would be for CIP. Because of the high estimated linear adsorption coefficient value and low potentiometric gradients, lithium is relatively immobile in groundwater at the Site. In all four scenarios, modeled lithium concentrations for the 100 year duration of run remained negligible at any significant distance outside the present day footprint of Ash Pond A and B.

3.3 CORRECTIVE MEASURES ALTERNATIVES

Corrective measures may be terminated when groundwater impacted by Ash Pond A and B does not exceed the GWPS for three consecutive years of groundwater monitoring. In accordance with §257.97, the groundwater corrective measures alternatives evaluated herein meet the following threshold criteria:

1. Protect human health and the environment;
2. Attain the GWPS;
3. Control the source(s) of releases 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.

Because arsenic, lithium and molybdenum are delineated on the Site and confined to the uppermost aquifer there is no current risk to human health and the environment therefore each of the remedial alternatives assembled as part of this CMA meet the requirements of the threshold criteria listed above. Groundwater monitoring will continue to document that off-site groundwater is not adversely impacted in the future.

This CMA includes an evaluation of six groundwater remediation alternatives described below and presented on Table 5 and evaluated against the threshold and balancing criteria on Table 6, including:

- Alternative 1: Cap and close-in-place (CIP) plus monitored natural attenuation (MNA);
- Alternative 2: CIP plus hydraulic containment with direct discharge;
- Alternative 3: CIP plus hydraulic containment with ex-situ groundwater treatment;
- Alternative 4: Closure by removal (CBR) plus monitored natural attenuation (MNA);
- Alternative 5: CBR plus hydraulic containment with direct discharge; and
- Alternative 6: CBR plus hydraulic containment with ex-situ groundwater treatment.

This CMA, and the input received during the public comment period, will be used to identify a final corrective measure for implementation at Ash Pond A and B.

3.3.1 Alternative 1: Cap and Close-in-Place (CIP) plus Monitored Natural Attenuation (MNA)

Ash Pond A and B would be closed in-place with a low-permeability cap to reduce infiltration of surface water to groundwater. This cap selection would exceed regulatory requirements by more than two orders of magnitude ($<1x10^{-7}$ centimeters per second (cm/sec) planned versus $1x10^{-5}$ cm/sec required by the CCR Rule). Over time, depletion of Appendix IV constituents in CCR would allow the concentration of these constituents in downgradient groundwater to decline and overall groundwater concentrations to attenuate.

Closure-in-place (CIP) with MNA can be completed safely, in compliance with applicable federal and state regulations, and be protective of public health and the environment. In general, CIP consists of installing a cap/cover designed to significantly reduce infiltration from surface water or rainwater, resist erosion, contain CCR materials, and prevent exposures to CCR. CIP will require the mounding of the remaining CCRs within the pond in order to create a surface with adequate slope to construct a cap and prevent the mounding and ponding of stormwater. This will require extensive excavation and transferring of the material within the pond. Excavation and construction safety during closure is another concern due to heavy equipment (e.g., bulldozers, excavators, front end loaders, and off-road trucks) and dump truck operation within the active WGS site. Additionally, the stormwater runoff will need to be managed, requiring additional time to design and construct a stormwater runoff pond.

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 a low-permeability cap to address the source by limiting the infiltration of precipitation into and through the CCR, MNA can reduce concentrations of arsenic, lithium and molybdenum in groundwater at the Ash Pond A and B boundary. Following the installation of the cap system, Santee Cooper would implement post-closure care activities. Post-closure care includes cap system maintenance and long-term groundwater monitoring until such time that groundwater conditions return to below GWPS. Future development of the capped surface could be used for solar photovoltaic arrays or other site staging/ancillary operational needs.

3.3.2 Alternative 2: CIP with Capping and Hydraulic Containment Through Groundwater Pumping and Direct Discharge

Ash Pond A and B would be closed in-place as described in Section 3.3.1 to reduce infiltration of surface water to groundwater. Arsenic, lithium and molybdenum in groundwater would be addressed with hydraulic containment through groundwater pumping to hydraulically control the migration of those constituents downgradient. Pumping would be limited to the uppermost aquifer since the vertical extent of arsenic, lithium and molybdenum is limited to the shallow groundwater. If possible, the pumping well effluent would be discharged directly to surface water under existing or future discharge permits. No treatment would be used prior to discharge. Verification that the effluent could be discharged under current permits or application for and approval of a new permit would be required.

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

The pumping well effluent would be discharged directly into the Cooling Water Pond in accordance with a National Pollutant Discharge Elimination System (NPDES) Permit (i.e. the Discharge Canal). No treatment would be used prior to discharge. The construction of a transport system from the Ash Pond A and B to the Cooling Water Pond will require engineering design, permitting, and site construction. In order for the effluent to be discharged to the Water Cooling Pond, the existing WGS NPDES Operating Permit may need to be modified or a new permit issued. Either option will require wastewater testing or modeling to support a permit application. The anticipated timeline for permitting and construction of this option is one year.

Following the installation of the groundwater pumping well network, Santee Cooper would implement post-closure care activities that includes operation and maintenance of the hydraulic containment system, long-term groundwater sampling to monitor hydraulic control system performance, and cap and cover system maintenance. Over time, processes of MNA would decrease source concentrations of cobalt to values less than the GWPS and operation of the hydraulic containment system would cease. Future development of the capped surface could be used for solar photovoltaic arrays or other site staging/ancillary operational needs.

3.3.3 Alternative 3: CIP with Capping and Hydraulic Containment Through Groundwater Pumping and Ex-Situ Treatment

Ash Pond A AND B would be closed in-place as described in Section 3.3.1 to reduce infiltration of surface water to groundwater. Arsenic, molybdneum and lithium detected at the boundary of the unit at concentrations above the GWPS would be addressed with hydraulic containment through groundwater pumping to hydraulically control the migration of those constituents downgradient. Pumping would be limited to the uppermost aquifer since the vertical extent of arsenic, lithium and molybdenum is limited to the shallow groundwater. Pumping well effluent would be treated ex-situ, likely with an ion exchange or a reverse osmosis (RO) treatment system. Both systems would have ongoing operation and maintenance and would generate a secondary waste stream – including regeneration/replacement of the ion exchange media or accumulation of reject water from the RO system.

The design and construction of an ion exchange or RO system would require development of additional land at WGS, which could trigger the need for a wetlands permit. Most of the undeveloped property near Ash Ponds A and B is wetlands. The time to obtain a 401 certification, a 404 Army Corps of Engineers permit, and Ocean Coastal Resource Management (OCRM) approval is typically one year, which will extend the closure schedule by the time required for applicable permit approvals. Additionally, a 404 permit will not be granted if there are more favorable options available that have less environmental impacts, such as Alternative 1.

As noted in the previous option, implementation of a large-scale hydraulic containment system will require a detailed and lengthy design effort. Pilot testing, such as pumping tests and additional groundwater modeling, will be needed to verify the hydraulic capture zone. The timeline for permitting and construction of this option is estimated to be 2 years.

Following the installation of the low-permeability cap, groundwater pumping well network, and ex-situ treatment system, Santee Cooper would implement post-closure care activities that includes operation and maintenance of the hydraulic containment system, long-term groundwater sampling to monitor hydraulic containment system performance, and cover system maintenance. Over time, processes of MNA would decrease source concentrations of cobalt to values less than the GWPS and operation of the hydraulic containment system would cease. Future development of the capped surface could be used for solar photovoltaic arrays or other site staging/ancillary operational needs.

3.3.4 Alternative 4: Closure by Removal (CBR) with MNA

This alternative consists of removal of Ash Pond A and B CCR material followed by natural attenuation of arsenic, molybdenum, and lithium in groundwater. This alternative would eliminate the source (through removal), and over time, allow the concentrations of these constituents in downgradient groundwater to attenuate. Through on-going beneficial use of reclaimed bottom ash and gypsum, the amount of material that will need to be removed from the Pond continues to be reduced. The existence of long term contracts with the agricultural and cement industries for beneficial use of these materials along with the proven success of Santee Cooper's beneficial use program makes the option of CBR extremely viable.

Since the Class 3 Landfill exists at WGS, on-site disposal options are available for non-marketable CCR material from the pond. The Class 3 Landfill was designed and constructed to store existing and future CCRs from WGS and any residual CCR material from Ash Pond A and B. Additionally, the on-going beneficial use program minimizes the use of the on-site landfill in this CBR scenario.

Technical and logistical challenges of implementing a large-scale ash removal project have already been addressed by Santee Cooper through their ongoing beneficial use program. Removal activities may require dewatering and temporary staging/stockpiling of material for drying prior to transportation, which may affect productivity and extend the timeframes anticipated to complete removal. During periods of rain and inclement weather, the removal schedule will also be negatively impacted. Excavation and construction safety during the removal duration is another concern due to heavy equipment (e.g., bulldozers, excavators, front end loaders, and off-road trucks) and dump truck operation within the active WGS site. Following removal of the CCRs residual materials from the Pond will be evaluated. If residual CCR contamination is identified those materials will be disposed of in either the on-site Class 3 landfill, assuming permit approval by SC DHEC, or in an off-site permitted landfill.

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 a low-permeability cap to address the source by limiting the infiltration of precipitation into and through the CCR, MNA can reduce concentrations of arsenic, molybdenum, and lithium in groundwater at the Ash Pond A and B boundary.

Long-term, Santee Cooper would implement post-closure care activities that includes long-term groundwater sampling.

3.3.5 Alternative 5: CBR with Hydraulic Containment Through Groundwater Pumping and Direct Discharge

Similar to Alternative 4, Ash Pond A and B would be closed by removal. However, under this alternative, arsenic, molybdenum, and lithium 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 limited to the uppermost aquifer since the vertical extent of arsenic, lithium and molybdenum is limited to the shallow groundwater.

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

The pumping well effluent would be discharged directly to the Cooling Water Pond in accordance with a National Pollutant Discharge Elimination System (NPDES) Permit(i.e.,) . No treatment would be used prior to discharge. The construction of a transport system from Ash Pond A and B to the receiving water body will require engineering design, permitting, and site construction. In order for the effluent to be discharged to a receiving water body, the existing WGS NPDES Operating Permit may be modified or a new permit issued. Either option will require wastewater testing or modeling to support a permit application. The anticipated timeline for permitting and construction of this option is one year. Following CCR removal, arsenic, molybdneum, and lithium concentrations would decrease through active pumping and natural attenuation and pumping would eventually cease. Further reduction of arsenic, molybdenum, and lithium 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 Ash Pond A and B would reduce groundwater flux, the time period for active pumping will be greater than MNA alone.

Long-term, Santee Cooper would implement post-closure care activities that includes long-term groundwater sampling.

3.3.6 Alternative 6: CBR with Hydraulic Containment Through Groundwater Pumping and Ex-Situ Treatment

Similar to Alternative 4, Ash Pond A and B would be closed by removal; however, under this alternative, arsenic, molybdenum, and lithium 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. 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 development of additional land at WGS, which would likely trigger the need for a wetlands permit. Most of the undeveloped property near Ash Ponds A ad B is wetlands. The time to obtain a 401 certification, a 404 Army Corps of Engineers permit, and OCRM approval is typically one year, which will extend the closure schedule by the time required for applicable permit approvals. Additionally, a 404 permit will not be granted if there are more favorable options available that have less environmental impacts, such as Alternative 4.

As noted in the previous option, implementation of a large-scale hydraulic containment system will require a detailed and lengthy design effort. Pilot testing, such as pumping tests and additional groundwater modeling, will be needed to verify the hydraulic capture zone. The timeline for permitting and construction of this option is an estimated 2 years.

Following CCR removal, arsenic molybendum, and lithium concentrations in groundwater would decrease through active pumping and natural attenuation. The timeline for active treatment is expected to be 8-years. Further reduction of arsenic, molybdneum and lithium 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 Ash Pond A and B would decrease groundwater flux, the time period for active pumping and treatment will be greater than MNA alone.

Long-term, Santee Cooper would implement post-closure care activities that includes long-term groundwater sampling.

4. Comparison of Corrective Measures Alternatives

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

4.1 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 held in the fall of 2019.

4.2 COMPARISON OF ALTERNATIVES

This section compares the alternatives to each other based on evaluation of the balancing criteria listed above. The goal of this analysis is to identify the alternative that is technologically feasible, relevant and readily implementable, provides adequate protection to human health and the environment, and minimizes impacts to the community.

A graphic is provided within each subsection below to provide a visual snapshot of the favorability of each alternative, where green represents favorable, yellow represents less favorable, and red represents least favorable.

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

As summarized in the following sections, this balancing criterion takes into consideration the following sub-criteria relative to the long-term and short-term effectiveness of the remedy, along with the anticipated success of the remedy:

1. Magnitude of reduction of risks;
2. Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy;
3. The type and degree of long-term management required, including monitoring, operation, and maintenance;

4. Short-term risks that might be posed to the community or the environment during implementation of such a 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 the engineering and institutional controls; and
8. Potential need for replacement of the remedy.

4.2.1.1 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 Ash Pond A and B. Therefore, none of the remedial alternatives are necessary to reduce risks because no such exposure to arsenic, molybdenum, or lithium currently exists. However, other types of impacts may be posed by the various remedial alternatives considered here. Alternative 4 (Closure by Removal and MNA) is the most favorable option because the source is completely removed from the environment, the ongoing beneficial use program has already reduced the volume of material in Pond A, long term contracts are in place for the remaining CCRs, and the concept has been proven to be a viable option for this location. Alternative 1 is considered less favorable because the source is left in place. Alternatives 3 and 6, which incorporate hydraulic containment and ex--situ treatment have the highest potential impact due to the installation of pumping wells, construction of treatment systems, long-term operation, and generation of secondary waste streams.

	Alternative 1 Cap with CIP & MNA	**Alternative 2** Cap with CIP & Hydraulic Containment & Direct Discharge	**Alternative 3** Cap with CIP & Hydraulic Containment & Ex-Situ Treatment	**Alternative 4** CBR with MNA	**Alternative 5** CBR with Hydraulic Containment & Direct Discharge	**Alternative 6** CBR with Hydraulic Containment & Ex-Situ Treatment
Category 1 - Subcriteria i) Magnitude of reduction of risks						

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

Alternatives 4 through 6, which include closure by removal, have the lowest long-term residual risk because the CCR materials are being removed from the environment and are either being beneficially used or being placed in an on-site lined Class 3 landfill with secondary leachate collection. Alternative 4 (CBR with MNA) has the lowest residual risk because groundwater is being addressed in-situ through natural processes as opposed to Alternatives 5 and 6 which include a pumping component with direct discharge or ex-situ treatment of effluent. For Alternatives 1 through 3, which include closure in-place with a cap and cover system, the source is controlled through the installation of a low permeability cap which will significantly reduce the amount of infiltration through the CCR material. Alternative 3 (CIP plus hydraulic containment with ex-situ treatment) has the highest long-term residual risk because the CCR material will be closed in-place and the groundwater treatment system will require long-term O&M and generate secondary waste streams. Additionally, the WGS is located within a seismic hazard area with potential for liquification, Alternatives 4 through 6 are lower risk than leaving the material in place in Alternatives 1 through 3.

	Alternative 1 Cap with CIP & MNA	Alternative 2 Cap with CIP & Hydraulic Containment & Direct Discharge	Alternative 3 Cap with CIP & Hydraulic Containment & Ex-Situ Treatment	Alternative 4 CBR with MNA	Alternative 5 CBR with Hydraulic Containment & Direct Discharge	Alternative 6 CBR with Hydraulic Containment & Ex-Situ Treatment
Category 1 - Subcriteria ii) Magnitude of residual risk in terms of likelihood of further release						

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

Alternative 4 (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 1 (CIP with capping and MNA) is slightly less favorable because it requires maintenance of a cap and cover system. The remaining alternatives, which all include hydraulic containment require long-term O&M, and those alternatives that contain ex-situ treatment (Alternatives 3 and 6) are the least favorable due to the O&M of groundwater treatment systems and the generation of secondary waste streams.

	Alternative 1 Cap with CIP & MNA	Alternative 2 Cap with CIP & Hydraulic Containment & Direct Discharge	Alternative 3 Cap with CIP & Hydraulic Containment & Ex-Situ Treatment	Alternative 4 CBR with MNA	Alternative 5 CBR with Hydraulic Containment & Direct Discharge	Alternative 6 CBR with Hydraulic Containment & Ex-Situ Treament
Category 1 - Subcriteria iii) Type and degree of long-term management required						

4.2.1.4 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. Because of the current beneficial use and use of the existing Class 3 landfill, there will be temporary and relatively minimal increase in truck traffic for all options.

	Alternative 1 Cap with CIP & MNA	Alternative 2 Cap with CIP & Hydraulic Containment & Direct Discharge	Alternative 3 Cap with CIP & Hydraulic Containment & Ex-Situ Treatment	Alternative 4 CBR with MNA	Alternative 5 CBR with Hydraulic Containment & Direct Discharge	Alternative 6 CBR with Hydraulic Containment & Ex-Situ Treament
Category 1 - Subcriteria iv) Short term risk to community or environment during implementation						

4.2.1.5 Time until full protection is achieved

As previously stated, there is currently no exposure to groundwater impacted by arsenic, molybdneum, and lithium associated with Ash Pond A and B; therefore, protection is already achieved. The timeframes to achieve GWPS were evaluated using a predictive model as described in Section 3.2. Based upon predictive modeling, Alternatives 2 and 5 (CIP plus hydraulic containment with direct discharge and CBR with MNA) which assume no continuing source, arsenic, lithium and molybdenum concentrations will attain GWPS in the shortest amount of time (see Figure 7). Closure by removal with MNA is predicted to take slightly more time to achieve GWPS due to the longer period of time required to implement the remedy. CIP with MNA is predicted to take the longest to achive GWPS but is negligible when compared to CBR and MNA.

	Alternative 1 Cap with CIP & MNA	**Alternative 2** Cap with CIP & Hydraulic Containment & Direct Discharge	**Alternative 3** Cap with CIP & Hydraulic Containment & Ex-Situ Treatment	**Alternative 4** CBR with MNA	**Alternative 5** CBR with Hydraulic Containment & Direct Discharge	**Alternative 6** CBR with Hydraulic Containment & Ex-Situ Treament
Category 1 - Subcriteria v) Time until full protection is achieved						

4.2.1.6 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 Ash Pond A and B is limited to the uppermost aquifer in the vicinity pf Ash Ponds A and B, Alternative 1 (CIP with MNA) has the lowest potential for exposure to human and environmental receptors and is considered most favorable with respect to this criteria. Alternatives 4 through 6, which all include excavation, transportation with beneficial use, and disposal of none-marketable CCR material on-site have potential risk for exposure to humans and environmental receptors due to long-term construction and transportation. Alternatives that include hydraulic containment with ex-situ treatment also have a potential risk associated with the generation and management of secondary waste streams and are considered less favorable.

	Alternative 1 Cap with CIP & MNA	**Alternative 2** Cap with CIP & Hydraulic Containment & Direct Discharge	**Alternative 3** Cap with CIP & Hydraulic Containment & Ex-Situ Treatment	**Alternative 4** CBR with MNA	**Alternative 5** CBR with Hydraulic Containment & Direct Discharge	**Alternative 6** CBR with Hydraulic Containment & Ex-Situ Treatment
Category 1 - Subcriteria vi) Potential for exposure of humans and environmental receptors to remaining wastes						

4.2.1.7 Long-term reliability of the engineering and institutional controls

Alternative 4 (CBR with MNA) is expected to have high long-term reliability and is considered most favorable with respect to this criteria. Alternative 1 (CIP with MNA) is considered slightly less reliable due to the long-term maintenance of the cap and cover system. Hydraulic containment (Alternatives 2, 3, 5 and 6) are considered reliable, proven technologies and would have high long-term reliability, but require field pilot studies and bench scale testing and rely on mechanical systems (groundwater pumping and/or treatment systems) to operate and maintain. Alternatives 3 and 6 are considered least favorable with respect to this criteria.

	Alternative 1 Cap with CIP & MNA	**Alternative 2** Cap with CIP & Hydraulic Containment & Direct Discharge	**Alternative 3** Cap with CIP & Hydraulic Containment & Ex-Situ Treatment	**Alternative 4** CBR with MNA	**Alternative 5** CBR with Hydraulic Containment & Direct Discharge	**Alternative 6** CBR with Hydraulic Containment & Ex-Situ Treament
Category 1 - Subcriteria vii) Long-term reliability of engineering and institutional controls						

4.2.1.8 Potential need for replacement of the remedy

Alternative 4, which includes closure by removal with MNA is considered the most reliable due to the removal of the source of contaminants and the reliance of natural processes to address constituents in groundwater. Alternative 1, which includes closure in-place with MNA is considered slightly less favorable since it relies on the cap and cover system to reduce infiltration and control the source and natural processes to reduce the concentrations of arsenic, lithium and molybdenum in groundwater. Should monitoring results indicate that the selected remedial alternative is not effective at reducing the concentration of COCs 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, 3, 5, and 6) are considered less reliable. Alternative 3 is considered being the least reliable due to the O&M of an ex-situ treatment and the cap/cover system.

	Alternative 1 Cap with CIP & MNA	**Alternative 2** Cap with CIP & Hydraulic Containment & Direct Discharge	**Alternative 3** Cap with CIP & Hydraulic Containment & Ex-Situ Treatment	**Alternative 4** CBR with MNA	**Alternative 5** CBR with Hydraulic Containment & Direct Discharge	**Alternative 6** CBR with Hydraulic Containment & Ex-Situ Treament
Category 1- Subcriteria viii) Potential need for replacement of the remedy						

4.2.1.9 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 will prove successful.

	Alternative 1 Cap with CIP & MNA	**Alternative 2** Cap with CIP & Hydraulic Containment & Direct Discharge	**Alternative 3** Cap with CIP & Hydraulic Containment & Ex-Situ Treatment	**Alternative 4** CBR with MNA	**Alternative 5** CBR with Hydraulic Containment & Direct Discharge	**Alternative 6** CBR with Hydraulic Containment & Ex-Situ Treament
CATEGORY 1 Long- and Short Term Effectiveness, Protectiveness, and Certainty of Success						

4.2.2 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 will be required.

4.2.2.1 The extent to which containment practices will reduce further releases

For Alternatives 1-3, the source will be controlled by the construction of a low-permeability cap which will significantly reduce the infiltration of surface water into the pond and therefore decrease the potential for arsenic, lithium and molybdenum to enter groundwater over time. Alternative 1 (CIP plus hydraulic containment with MNA) relies on natural attenuation to decrease the downgradient concentration of the contaminants over time. For alternatives 1 through 3, predictive modeling indicates that Alternative 2 (CIP plus hydraulic containment with direct dicharge) will achieve GWPS in the shortest timeframe. However, if the concentration of arsenic, lithium, and/or molybdenum are not decreasing over time additional active remedial options will be considered.

For Alternatives 4-6, the source will be controlled by removing the CCR material from the environment by beneficial use of the CCR material or by placing it in a lined on-site landfill thereby minimizing or eliminating the potential for arsenic, lithium, and/or molybdenum to enter groundwater over time.

Alternative 5 (CBR plus hydraulic containment with direct discharge) was shown by predictive modeling to achieve GWPS in the shortest timeframe of the closure by removal alternatives.

Alternatives 2, 3, 5, and 6 rely on hydraulic containment to achieve the performance criteria at the waste boundary addressing arsenic, molybdenum, and lithium in groundwater migrating downgradient and are considered less favorable with respect to this criteria. Under Alternatives 2 and 5 pumping system effluent is discharged elsewhere on the property without treatment. Alternatives 3 and 6, which include ex-situ treatment, additional waste streams requiring management on and off site will be generated.

	Alternative 1 Cap with CIP & MNA	**Alternative 2** Cap with CIP & Hydraulic Containment & Direct Discharge	**Alternative 3** Cap with CIP & Hydraulic Containment & Ex-Situ Treatment	**Alternative 4** CBR with MNA	**Alternative 5** CBR with Hydraulic Containment & Direct Discharge	**Alternative 6** CBR with Hydraulic Containment & Ex-Situ Treatment
Category 2 - Subcriteria i) Extent to which containment practices will reduce further releases						

4.2.2.2 The extent to which treatment technologies may be used

In-situ groundwater treatment technologies have not been identified that will successfully treat the combination of arsenic, lithium and molybdenum, and as a result in-situ treatment alternatives were not considered in this comparative analysis. With respect to Alternatives 1 and 4, no groundwater treatment technologies, other than natural attenuation will be used. Alternatives 2 and 5 will rely on one technology (hydraulic containment) to address groundwater with the effluent being directly discharge elsewhere on the property. For Alternatives 3 and 6, which include hydraulic containment with ex-situ treatment, two technologies, hydraulic containment and ex-situ treatment, will be utilized. The operation of an ex-situ treatment system will 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 Cap with CIP & MNA	**Alternative 2** Cap with CIP & Hydraulic Containment & Direct Discharge	**Alternative 3** Cap with CIP & Hydraulic Containment & Ex-Situ Treatment	**Alternative 4** CBR with MNA	**Alternative 5** CBR with Hydraulic Containment & Direct Discharge	**Alternative 6** CBR with Hydraulic Containment & Ex-Situ Treatment
Category 2 - Subcriteria ii) Extent to which treatment technologies may be used						

4.2.2.3 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. Alternatives 1 and 4 (CBR with MNA and CIP with MNA) are the most favorable, while Alternatives 2, 3, 5, and 6 are less favorable.

	Alternative 1 Cap with CIP & MNA	**Alternative 2** Cap with CIP & Hydraulic Containment & Direct Discharge	**Alternative 3** Cap with CIP & Hydraulic Containment & Ex-Situ Treatment	**Alternative 4** CBR with MNA	**Alternative 5** CBR with Hydraulic Containment & Direct Discharge	**Alternative 6** CBR with Hydraulic Containment & Ex-Situ Treament
CATEGORY 2 Effectiveness in controlling the source to reduce further releases						

4.2.3 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.

4.2.3.1 Degree of difficulty associated with constructing the technology

For Alternative 4 (CBR with MNA), excavation and transportation of CCR is already in progress at WGS with the on-going beneficial use of reclaimed gypsum and bottom ash from the Winyah Ash Pond A and B, with over 350,000 tons of CCR material being removed each year. To facilitate closure within 5 years, this volume will likely increase. For Alternative 1 (CIP with MNA), CCR contained in the Winyah Ash Pond A and B will be addressed by constructing a low-permeability cap which will reduce the infiltration of surface water into the pond and the potential for arsenic, molybdenum, and lithium to reach groundwater over time.

Alternatives 2, 3, 5, and 6, which all incorporate hydraulic containment, will be more difficult to implement and will require additional treatability testing, field scale pilot studies, and permitting, and Alternatives 3 and 6 will be the most difficult due to the O&M of ex-situ treatment systems.

	Alternative 1 Cap with CIP & MNA	**Alternative 2** Cap with CIP & Hydraulic Containment & Direct Discharge	**Alternative 3** Cap with CIP & Hydraulic Containment & Ex-Situ Treatment	**Alternative 4** CBR with MNA	**Alternative 5** CBR with Hydraulic Containment & Direct Discharge	**Alternative 6** CBR with Hydraulic Containment & Ex-Situ Treatment
Category 3 - Subcriteria i) Degree of difficulty associated with constructing the technology						

4.2.3.2 Expected operational reliability of the technologies

Alternative 4 (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. Alternative 1 (CIP with MNA) is considered slightly less favorable because it relies on construction and long-term maintenance of the cap and cover system to control the source. While Alternatives 2, 3, 5, and 6, which include hydraulic containment, are also expected to be reliable, these alternatives will utilize additional groundwater treatment technologies which will require treatability studies and operations and maintenance and therefore are considered the least favorable when compared to the other alternatives.

	Alternative 1 Cap with CIP & MNA	**Alternative 2** Cap with CIP & Hydraulic Containment & Direct Discharge	**Alternative 3** Cap with CIP & Hydraulic Containment & Ex-Situ Treatment	**Alternative 4** CBR with MNA	**Alternative 5** CBR with Hydraulic Containment & Direct Discharge	**Alternative 6** CBR with Hydraulic Containment & Ex-Situ Treatment
Category 3 - Subcriteria ii) Expected operational reliability of the technologies						

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

Alternative 4 (CBR with MNA) is the most favorable since the implementation of the remedy is straightforward and only includes MNA. The remaining alternatives will require additional extensive permitting and approvals for treatability testing, field scale pilot testing, groundwater discharge, groundwater treatment, and disposal of secondary waste streams. Alternatives 1 through 3, which all include CIP, are considered the least favorable due to the lack of separation between CCR materials and groundwater and the uncertainty associated with obtaining permit approval from SC DHEC.

	Alternative 1 Cap with CIP & MNA	**Alternative 2** Cap with CIP & Hydraulic Containment & Direct Discharge	**Alternative 3** Cap with CIP & Hydraulic Containment & Ex-Situ Treatment	**Alternative 4** CBR with MNA	**Alternative 5** CBR with Hydraulic Containment & Direct Discharge	**Alternative 6** CBR with Hydraulic Containment & Ex-Situ Treatment
Category 3 - Subcriteria iii) Need to coordinate with and obtain necessary approvals and permits from other agencies						

4.2.3.4 Availability of necessary equipment and specialists

Alternative 1 (CIP with capping and MNA) and Alternative 4 (CBR with MNA) are the most favorable since specialty equipment and specialists will not be required to implement the MNA remedy. Alternatives 2 and 5 will require equipment for pumping and are less favorable than Alternatives 1 and 4 but equipment required should not present a great challenge. Alternatives 3 and 6 which include an ex-situ treatment component are the least favorable since they will require construction, operation, and maintenance of ex-situ treatment systems.

	Alternative 1 Cap with CIP & MNA	**Alternative 2** Cap with CIP & Hydraulic Containment & Direct Discharge	**Alternative 3** Cap with CIP & Hydraulic Containment & Ex-Situ Treatment	**Alternative 4** CBR with MNA	**Alternative 5** CBR with Hydraulic Containment & Direct Discharge	**Alternative 6** CBR with Hydraulic Containment & Ex-Situ Treatment
Category 3 - Subcriteria iv) Availability of necessary equipment and specialists						

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

Alternatives 4, 5, and 6 which include closure by removal require adequate capacity, storage, and disposal service for on-site and off-site receiving facilities. This will be addressed through the beneficial use of CCR combined with both on and potentially off-site disposal of marketable CCR material. The 3.2 million cubic yards of CCR will be excavated and transported for beneficial use. Additionally, the ex-situ treatment system may generate a concentrated waste stream which would require onsite treatment or off-site transportation and disposal that the other alternatives would not require and is therefore considered the least favorable.

Except for Alternatives 3 and 6, which include hydraulic containment with ex-situ treatment the remaining alternatives would not generate a waste stream and therefore would not require treatment, storage, or disposal services. For Alternatives 3 and 6, 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 are therefore considered the least favorable.

	Alternative 1 Cap with CIP & MNA	**Alternative 2** Cap with CIP & Hydraulic Containment & Direct Discharge	**Alternative 3** Cap with CIP & Hydraulic Containment & Ex-Situ Treatment	**Alternative 4** CBR with MNA	**Alternative 5** CBR with Hydraulic Containment & Direct Discharge	**Alternative 6** CBR with Hydraulic Containment & Ex-Situ Treatment
Category 3 - Subcriteria v) Available capacity and location of needed treatment, storage, and disposal services						

4.2.3.6 *Ease or difficulty of implementation summary*

The graphic below provides a summary of the ease or difficulty that will be needed to implement each alternative. Alternative 1 (CIP with capping and MNA) and Alternative 4 (CBR with MNA) are considered the most favorable, while the remaining alternatives that include a hydraulic containment component are considered less favorable with alternative 3 being the least favorable.

	Alternative 1 Cap with CIP & MNA	**Alternative 2** Cap with CIP & Hydraulic Containment & Direct Discharge	**Alternative 3** Cap with CIP & Hydraulic Containment & Ex-Situ Treatment	**Alternative 4** CBR with MNA	**Alternative 5** CBR with Hydraulic Containment & Direct Discharge	**Alternative 6** CBR with Hydraulic Containment & Ex-Situ Treatment
CATEGORY 3 Ease of implementation						

5. Summary

This CMA has evaluated the following alternatives:

- Alternative 1: CIP with capping and MNA
- Alternative 2: CIP with capping and hydraulic containment through groundwater pumping and direct discharge;
- Alternative 3: CIP with capping and hydraulic containment through groundwater pumping and ex-situ treatment;
- Alternative 4: CBR with MNA;
- Alternative 5: CBR with hydraulic containment through groundwater pumping and direct discharge; and
- Alternative 6: CBR with hydraulic containment through groundwater pumping and ex-situ treatment

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

- Protect human health and the environment;
- Attain the GWPS;
- Control the source(s) of releases 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 §257.96, each of the alternatives has been evaluated in the context of the following balancing criteria:

- 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.

This CMA, and the input received during the public comment period, will be used to select a final corrective measure for implementation at Ash Pond A and B.

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 1
DETECTION MONITORING ANALYTICAL RESULTS
WINYAH GENERATING STATION - ASH POND A & B
SANTEE COOPER
GEORGETOWN, SOUTH CAROLINA

			Chemical Group	Detection Monitoring - EPA Appendix III Constituents						Field Parameters					
			Chemical Name	Boron, Total	Calcium, Total	Chloride	Fluoride	Sulfate	Total Dissolved Solids (TDS)	Conductivity	Dissolved Oxygen	ORP	pH	Temperature	Turbidity
			MCL/RSL	-	-	-	4	-	-	-	-	-	-	-	-
			Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	uS/cm	mg/L	mv	pH units	Deg C	NTU
Impound-ment	**Location**	**Sample Date**	**Sample Type**												
Background	WAP-1	11/10/2015	N	**0.0269**	**1**	**5.1**	< 0.1	**9.2**	**27.5**	**58**	**1.78**	**358**	**4.14**	**19.88**	**0**
Background	WAP-1	01/11/2016	N	**0.0289**	**0.61**	**5.17**	< 0.1	**9.57**	**30**	**58**	**1.5**	**380**	**3.68**	**15.33**	**9.6**
Background	WAP-1	04/26/2016	N	**0.0222**	**0.555**	**4.39**	< 0.1	**9.14**	< 100	**51**	**0.42**	**264**	**4.15**	**18.94**	**0**
Background	WAP-1	06/20/2016	N	**0.0348**	**26.9**	**7.93**	**0.14**	< 2	**234**	**326**	**0.84**	**-170**	**7.61**	**19.09**	**0**
Background	WAP-1	10/18/2016	N	**0.0269**	**0.507**	**4.91**	< 0.1	**15.5**	**98.33**	**53**	**0.97**	**99**	**4.31**	**21.87**	**0**
Background	WAP-1	01/09/2017	N	**0.0284**	< 0.5	**4.98**	< 0.1	**8.3**	**51.25**	**60**	**1.45**	**321**	**4.11**	**12.74**	**8.8**
Background	WAP-1	04/10/2017	N	**0.023**	< 0.5	**6.13**	< 0.1	**7.26**	**36.25**	**56**	**0.89**	**105**	**4.39**	**20.64**	**0.4**
Background	WAP-1	07/18/2017	N	-	**2.8**	**11.6**	-	**4.62**	**18**	**71**	**0.86**	**88**	**4.84**	**22.52**	**0**
Background	WAP-1	09/18/2017	N	**0.037**	**2.6**	**9.7**	< 0.1	**3.77**	**42**	**63**	**0.79**	**90**	**4.7**	**24.91**	**0**
Background	WAP-1	10/02/2017	N	**0.03**	**2.1**	**9.9**	< 0.1	**3.54**	**40**	**61**	**0.82**	**90**	**4.83**	**22.28**	**2.5**
Background	WAP-1	01/30/2018	N	-	**2**	**8.31**	-	< 2	**68.57**	**51**	**0.95**	**88**	**5.25**	**17.3**	**2.4**
Background	WBW-1	11/10/2015	N	< 0.03	< 0.5	**2.71**	< 0.1	**4.95**	**8**	**38**	**4.85**	**294**	**4.08**	**19.58**	**0**
Background	WBW-1	01/11/2016	N	< 0.03	< 0.5	**3.07**	< 0.1	**6.38**	**15.83**	**40**	**4.39**	**323**	**3.55**	**14.07**	**1.8**
Background	WBW-1	04/26/2016	N	**0.0153**	< 0.5	**2.44**	< 0.1	**5.35**	< 33.3	**38**	**3.18**	**179**	**4.07**	**19.59**	**0**
Background	WBW-1	06/20/2016	N	< 0.015	< 0.5	**2.57**	< 0.1	**5.14**	**22.5**	**40**	**3.69**	**241**	**4**	**22.3**	**0**
Background	WBW-1	10/17/2016	N	< 0.015	< 0.5	**2.72**	< 0.1	**5.3**	**30**	**36**	**2.42**	**318**	**4.15**	**25.1**	**0**
Background	WBW-1	01/09/2017	N	< 0.075	< 0.5	**3.45**	< 0.1	**4.86**	**45**	**49**	**3.09**	**252**	**3.83**	**9.96**	**17**
Background	WBW-1	04/10/2017	N	**0.023**	< 0.5	**4.96**	**0.1**	**4.26**	**52.5**	**48**	**3.84**	**95**	**4.08**	**17.85**	**0**
Background	WBW-1	09/18/2017	N	**0.019**	< 0.5	**6.77**	< 0.1	**4.4**	**158**	**55**	**2.16**	**166**	**4**	**25.27**	**0**
Background	WBW-1	10/02/2017	N	**0.022**	**0.3**	**6.47**	< 0.1	**5.34**	**40**	**57**	**1.94**	**112**	**4.17**	**24.58**	**0**
Ash Pond A	WAP-8	01/31/2018	N	-	**447**	**560**	-	**1090**	**2570**	**3490**	**1.04**	**-94**	**7.05**	**19.04**	**6.6**
Ash Pond A	WAP-9	11/11/2015	N	**5.39**	**200**	**205**	< 0.1	**234**	**1018**	**1062**	**0.36**	**-141**	**5.76**	**22.48**	**0**
Ash Pond A	WAP-9	01/19/2016	N	**5.72**	**170**	**229**	< 0.1	**357**	**927.5**	**1460**	**1.1**	**-164**	**5.84**	**14.91**	**5.9**
Ash Pond A	WAP-9	01/19/2016	FD	**5.63**	**160**	**172**	< 0.1	**251**	**942.5**	-	-	-	-	-	-
Ash Pond A	WAP-9	04/26/2016	N	**4.92**	**165**	**141**	< 0.1	**201**	**915**	**1280**	**0.29**	**-107**	**5.84**	**21.86**	**0**
Ash Pond A	WAP-9	06/20/2016	N	**5.26**	**138**	**167**	< 0.1	**252**	**888**	**1240**	**0.49**	**-139**	**5.82**	**23.49**	**0**
Ash Pond A	WAP-9	10/18/2016	N	**5.16**	**453**	**120**	< 0.1	**170**	**875**	**1280**	**0.52**	**-184**	**5.71**	**22.51**	**0**
Ash Pond A	WAP-9	01/10/2017	N	**5.46**	**143**	**117**	< 0.1	**132**	**858.8**	**1210**	**0.66**	**-117**	**5.88**	**16.24**	**0**
Ash Pond A	WAP-9	04/10/2017	N	**5.8**	**133**	**109**	**0.11**	**103**	**792.5**	**1130**	**0.57**	**-69**	**5.96**	**23.14**	**2.7**
Ash Pond A	WAP-9	06/19/2017	N	-	**147**	**108**	-	**118**	**803.8**	**1230**	**0.79**	**31**	**5.85**	**19.86**	**0**
Ash Pond A	WAP-9	09/18/2017	N	**5.2**	**157**	**99.2**	< 0.1	**126**	**790**	**1180**	**0.9**	**11**	**5.95**	**23.86**	**0.7**
Ash Pond A	WAP-9	10/02/2017	N	**5.1**	**130**	**100**	< 0.1	**133**	**782**	**1220**	**0.64**	**-37**	**6.03**	**22.93**	**6**
Ash Pond A	WAP-9	01/31/2018	N	-	**148**	**108**	-	**119**	**838.6**	**1210**	**0.81**	**-114**	**6.03**	**15.93**	**0**
Ash Pond A	WAP-17	11/11/2015	N	**14.2**	**580**	**769**	< 0.1	**1140**	**3140**	**4018**	**0.44**	**5**	**5.92**	**27.72**	**8.1**
Ash Pond A	WAP-17	01/19/2016	N	**9.43**	**330**	**377**	**0.25**	**740**	**1735**	**2620**	**1.23**	**-94**	**6.01**	**15.77**	**1.6**
Ash Pond A	WAP-17	04/26/2016	N	**5.45**	**325**	**329**	**0.1**	**787**	**1615**	**2340**	**0.37**	**-11**	**6.03**	**23.26**	**0**
Ash Pond A	WAP-17	04/26/2016	FD	**5.76**	**326**	**332**	**0.1**	**791**	**1735**	-	-	-	-	-	-
Ash Pond A	WAP-17	06/20/2016	N	**5.61**	**309**	**311**	**0.11**	**757**	**1722**	**2340**	**0.75**	**-35**	**6.02**	**27.93**	**0**
Ash Pond A	WAP-17	06/20/2016	FD	**5.21**	**319**	**302**	**0.17**	**730**	**1696**	-	-	-	-	-	-
Ash Pond A	WAP-17	10/18/2016	N	**6.79**	**424**	**416**	**0.14**	**900**	**1952**	**2930**	**0.52**	**-135**	**5.9**	**25.94**	**0**
Ash Pond A	WAP-17	10/18/2016	FD	**6.7**	**429**	**421**	**0.14**	**911**	**2038**	-	-	-	-	-	-
Ash Pond A	WAP-17	01/10/2017	N	**6.66**	**379**	**347**	**0.14**	**844**	**1856**	**2580**	**0.7**	**-69**	**6.04**	**19.8**	**9.7**
Ash Pond A	WAP-17	01/10/2017	FD	**5.63**	**368**	**357**	**0.17**	**878**	**1920**	-	-	-	-	-	-
Ash Pond A	WAP-17	04/10/2017	N	**4.9**	**359**	**614**	**0.17**	**1810**	**1840**	**2480**	**0.72**	**-2**	**6.1**	**24.08**	**6.8**
Ash Pond A	WAP-17	04/10/2017	FD	**4.7**	**364**	**339**	**0.17**	**939**	**1794**	-	-	-	-	-	-
Ash Pond A	WAP-17	09/18/2017	N	**6**	**361**	**332**	< 0.1	**965**	**1986**	**2560**	**0.68**	**17**	**6.14**	**26.16**	**0**
Ash Pond A	WAP-17	10/02/2017	N	**5.7**	**350**	**326**	< 0.1	**973**	**1856**	**2610**	**0.85**	**10**	**6.1**	**26.31**	**0**
Ash Pond A	WAP-17	10/02/2017	FD	**5.6**	**350**	**332**	< 0.1	**989**	**1820**	-	-	-	-	-	-
Ash Pond A	WAP-18	11/11/2015	N	**4.81**	**460**	**81**	< 0.1	**960**	**1692**	**1089**	**0.43**	**-25**	**6.15**	**23.97**	**0**
Ash Pond A	WAP-18	01/12/2016	N	**1.85**	**370**	**15.3**	**1.06**	**903**	**1452**	**1790**	**0.86**	**-68**	**6.28**	**18.8**	**15.1**
Ash Pond A	WAP-18	01/12/2016	FD	**2.51**	**360**	**15.3**	**1.1**	**902**	**1452**	-	-	-	-	-	-
Ash Pond A	WAP-18	04/27/2016	N	**1.21**	**448**	**49**	**0.71**	**1060**	**1760**	**1810**	**0.66**	**34**	**6.27**	**24.57**	**3.4**

TABLE 1
DETECTION MONITORING ANALYTICAL RESULTS
WINYAH GENERATING STATION - ASH POND A & B
SANTEE COOPER
GEORGETOWN, SOUTH CAROLINA

			Chemical Group	Detection Monitoring - EPA Appendix III Constituents						Field Parameters					
			Chemical Name	Boron, Total	Calcium, Total	Chloride	Fluoride	Sulfate	Total Dissolved Solids (TDS)	Conductivity	Dissolved Oxygen	ORP	pH	Temperature	Turbidity
			MCL/RSL	-	-	-	4	-	-	-	-	-	-	-	-
			Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	uS/cm	mg/L	mv	pH units	Deg C	NTU
Impound-ment	Location	Sample Date	Sample Type												
Ash Pond A	WAP-18	06/21/2016	N	2.5	488	92.6	0.8	1160	2182	2160	0.54	-33	6.31	23.24	63.7
Ash Pond A	WAP-18	10/20/2016	N	3.75	509	70.2	0.85	1020	1793	2020	0.55	-63	6.26	23.4	0
Ash Pond A	WAP-18	01/12/2017	N	3.9	493	67	0.91	941	1711	1930	0.41	-74	6.48	20.79	0
Ash Pond A	WAP-18	03/13/2017	RS	-	-	-	-	-	-	2230	3.67	-80	6.66	17.58	2.5
Ash Pond A	WAP-18	04/12/2017	N	5.8	463	260	1.5	845	2016	2440	0.74	-8	6.55	22.46	0.2
Ash Pond A	WAP-18	09/21/2017	N	8.2	422	231	1.2	962	2018	2370	1.02	31	6.54	28.11	0
Ash Pond A	WAP-18	09/21/2017	FD	7.8	427	223	1.3	950	1970	-	-	-	-	-	-
Ash Pond A	WAP-18	10/04/2017	N	7.7	360	149	2	754	1666	2210	0.74	-69	6.63	24.28	4.4
Ash Pond B	WAP-10	11/12/2015	N	8.6	620	769	< 0.1	816	3118	4050	0.58	-62	6.55	21.74	0
Ash Pond B	WAP-10	01/19/2016	N	8.2	560	807	< 0.1	867	2770	4310	1.47	-94	6.52	15	27.9
Ash Pond B	WAP-10	01/19/2016	FD	8.93	560	779	< 0.1	826	2870	-	-	-	-	-	-
Ash Pond B	WAP-10	04/26/2016	N	8.3	575	802	< 0.1	795	3435	3860	0.39	-55	6.5	22.24	0
Ash Pond B	WAP-10	04/26/2016	FD	8.58	593	859	< 0.1	875	3305	-	-	-	-	-	-
Ash Pond B	WAP-10	06/20/2016	N	8.68	566	782	< 0.1	774	3172	4010	0.81	-64	6.57	25	0
Ash Pond B	WAP-10	06/20/2016	FD	9.3	546	763	< 0.1	747	3342	-	-	-	-	-	-
Ash Pond B	WAP-10	10/18/2016	N	9.15	574	748	< 0.1	737	1763	3990	0.77	-92	6.41	20.16	0
Ash Pond B	WAP-10	01/10/2017	N	9.59	544	734	0.15	734	3135	4050	2.37	-77	6.55	15.7	7.7
Ash Pond B	WAP-10	01/10/2017	FD	9.96	541	734	< 0.1	737	3112	-	-	-	-	-	-
Ash Pond B	WAP-10	04/10/2017	N	8.8	547	722	0.12	707	2874	3720	0.77	-65	6.56	21.61	0.8
Ash Pond B	WAP-10	04/10/2017	FD	9.2	559	715	0.12	702	2835	-	-	-	-	-	-
Ash Pond B	WAP-10	06/19/2017	N	-	539	722	-	659	2995	3710	3.42	-44	6.5	20.91	0
Ash Pond B	WAP-10	09/18/2017	N	8.6	58.8	747	< 0.1	727	3018	3580	0.65	5	6.54	24.04	0.2
Ash Pond B	WAP-10	10/02/2017	N	8.7	500	727	< 0.1	733	2936	3840	5.65	-38	6.44	22.4	0
Ash Pond B	WAP-10	10/02/2017	FD	8.6	500	729	< 0.1	743	2932	-	-	-	-	-	-
Ash Pond B	WAP-10	01/31/2018	N	-	529	738	-	691	2847	3900	1.02	-63	6.67	15.27	1.7
Ash Pond B	WAP-19	11/11/2015	N	6.19	480	375	< 0.1	874	2128	2075	0.5	-2	6.14	24.19	0
Ash Pond B	WAP-19	11/11/2015	FD	6.77	470	380	< 0.1	879	2132	-	-	-	-	-	-
Ash Pond B	WAP-19	01/12/2016	N	3.9	320	233	< 0.1	674	1526	2080	0.73	-37	6.43	20.13	9.3
Ash Pond B	WAP-19	04/27/2016	N	1.99	360	155	0.17	880	1525	1870	1.47	47	6.31	21.81	0
Ash Pond B	WAP-19	06/21/2016	N	2.65	350	134	< 0.1	841	1684	1770	0.65	47	6.18	25.61	19.1
Ash Pond B	WAP-19	10/20/2016	N	4.61	396	240	0.11	837	1612	2190	0.6	11	5.97	24.59	0
Ash Pond B	WAP-19	01/12/2017	N	4.3	315	227	0.19	658	1571	1940	0.7	12	6.18	20.95	0
Ash Pond B	WAP-19	03/13/2017	RS	-	-	-	-	-	-	2020	0.81	-18	6.43	16	6.2
Ash Pond B	WAP-19	04/12/2017	N	3.3	321	222	0.34	716	1570	2020	0.71	26	6.38	20.73	11
Ash Pond B	WAP-19	09/21/2017	N	4.6	371	212	< 0.1	960	1776	2260	1.18	54	6.16	25.83	2
Ash Pond B	WAP-19	10/04/2017	N	4.6	340	193	0.18	954	1736	2210	0.81	52	6.08	23.97	2.5
Ash Pond B	WAP-20	11/12/2015	N	4.97	130	161	0.51	237	722	1120	0.55	-11	5.99	24.33	164
Ash Pond B	WAP-20	11/12/2015	FD	5.1	120	161	0.52	235	726	-	-	-	-	-	-
Ash Pond B	WAP-20	01/13/2016	N	2.74	180	248	0.42	378	897.5	1660	0.86	4	5.94	19.59	16.6
Ash Pond B	WAP-20	01/13/2016	FD	2.85	180	251	0.43	373	945	-	-	-	-	-	-
Ash Pond B	WAP-20	04/27/2016	N	2.25	177	200	0.34	358	945	1400	0.7	26	6	20.68	109
Ash Pond B	WAP-20	06/21/2016	N	3.43	211	263	0.4	745	1290	1370	0.54	29	5.95	27.9	289
Ash Pond B	WAP-20	10/20/2016	N	2.29	59.4	32.6	0.73	99.4	255	472	0.86	24	5.82	22.69	5.9
Ash Pond B	WAP-20	01/12/2017	N	2.36	97.7	74.2	0.57	158	480	7200	0.58	-6	6.09	21.05	3.6
Ash Pond B	WAP-20	03/13/2017	RS	-	-	-	-	-	-	1350	3.29	-10	6.1	17.51	58.1
Ash Pond B	WAP-20	04/13/2017	N	2.6	122	87.1	0.58	247	645	962	0.79	88	6.04	19.75	16.4
Ash Pond B	WAP-20	09/21/2017	N	1.1	69.3	31.3	0.46	135	420	587	0.87	50	5.96	24.54	3.2
Ash Pond B	WAP-20	10/04/2017	N	1.5	61	27.1	0.72	117	368	511	0.99	40	6.03	24.81	6.8
Ash Pond B	WAP-21	11/11/2015	N	13.4	610	802	< 0.1	1070	3096	4005	0.48	-55	5.95	21.83	8.6
Ash Pond B	WAP-21	11/11/2015	FD	13	620	803	< 0.1	67.4	3222	-	-	-	-	-	-
Ash Pond B	WAP-21	01/13/2016	N	8.21	380	718	< 0.1	1180	1865	3080	1.25	19	6.05	19.97	2.4
Ash Pond B	WAP-21	04/27/2016	N	6.08	341	375	< 0.1	707	1820	2440	0.51	35	6.21	21.76	4.6

TABLE 1
DETECTION MONITORING ANALYTICAL RESULTS
WINYAH GENERATING STATION - ASH POND A & B
SANTEE COOPER
GEORGETOWN, SOUTH CAROLINA

			Chemical Group	Detection Monitoring - EPA Appendix III Constituents						Field Parameters					
			Chemical Name	Boron, Total	Calcium, Total	Chloride	Fluoride	Sulfate	Total Dissolved Solids (TDS)	Conductivity	Dissolved Oxygen	ORP	pH	Temperature	Turbidity
			MCL/RSL	-	-	-	4	-	-	-	-	-	-	-	-
			Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	uS/cm	mg/L	mv	pH units	Deg C	NTU
Impound-ment	**Location**	**Sample Date**	**Sample Type**												
Ash Pond B	WAP-21	06/21/2016	N	**7**	**325**	**350**	< 0.1	**764**	**2052**	**2200**	**0.5**	**70**	**5.59**	**27.03**	**164**
Ash Pond B	WAP-21	10/19/2016	N	**7.31**	**363**	**359**	< 0.1	**748**	**1745**	**2270**	**0.62**	**21**	**5.9**	**26.21**	**6.5**
Ash Pond B	WAP-21	10/19/2016	FD	**6.45**	**353**	**358**	< 0.1	**757**	**1730**	-	-	-	-	-	-
Ash Pond B	WAP-21	01/10/2017	N	**7.47**	**293**	**333**	< 0.1	**838**	**1566**	**2210**	**0.8**	**-24**	**6.23**	**17.58**	**0**
Ash Pond B	WAP-21	04/13/2017	N	**5.9**	**334**	**297**	< 0.1	**721**	**1776**	**2190**	**0.66**	**68**	**6.17**	**22.74**	**1.1**
Ash Pond B	WAP-21	09/21/2017	N	**6.2**	**341**	**317**	< 0.1	**882**	**1766**	**2290**	**0.8**	**48**	**5.97**	**23.77**	**6**
Ash Pond B	WAP-21	09/21/2017	FD	**6.1**	**337**	**314**	< 0.1	**884**	**1762**	-	-	-	-	-	-
Ash Pond B	WAP-21	10/04/2017	N	**5.6**	**300**	**298**	< 0.1	**811**	**1658**	**2260**	**0.88**	**55**	**5.82**	**23.11**	**3.3**

ABBREVIATIONS AND NOTES:
mg/L: milligram per liter
uS/cm: microSiemen per centimeter
mv: millivolt
NTU: Nephelometric Turbidity Units
< 0.005: Analyte not detected above detection limit
-: Not Analyzed
MCL/RSL: The applicable Maximum Contaminant Level (MCL) or Regional Screening Level (RSL) is shown. Dashed where a standard is not provided.
FD: Field duplicate
RS: Resample
N: Normal sample

- Highlighted where a result exceeds the applicable MCL/RSL.
- Criteria used for cobalt, lithium, and molybdenum are RSL for Tapwater where THQ=1.0 (May 2018).
- 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

QUALIFIERS:
J: Estimated result

TABLE 2
ASSESSMENT MONITORING ANALYTICAL RESULTS
WINYAH GENERATING STATION - ASH POND A & B
SANTEE COOPER
GEORGETOWN, SOUTH CAROLINA

			Chemical Group	Assessment Monitoring - EPA Appendix IV Constituents														Radiological		
			Chemical Name	Antimony, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Chromium, Total	Cobalt, Total	Fluoride	Lead, Total	Lithium, Total	Mercury, Total	Molybdenum, Total	Selenium, Total	Thallium, Total	Radium-226	Radium-228	Radium-226 & 228
			MCL/RSL	0.006	0.01	2	0.004	0.005	0.1	0.006	4	0.015	0.04	0.002	0.1	0.05	0.002	-	-	5
			Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	pCi/L	pCi/L
Impound-ment	**Location**	**Sample Date**	**Sample Type**																	
Background	WAP-1	06/04/2018	N	< 0.025	< 0.005	**0.025**	< 0.0005	< 0.0005	< 0.005	< 0.0005	**0.13**	< 0.001	< 0.01	< 0.0002	< 0.01	< 0.01	< 0.0001	1 U	3 U	4 U
Background	WAP-1	09/10/2018	N	-	< 0.005	**0.0455**	-	-	-	< 0.0005	< 0.1	-	< 0.01	-	< 0.01	-	-	1 U	3 U	4 U
Background	WAP-1	09/21/2018	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Background	WAP-1	01/23/2019	N	< 0.005	< 0.005	**0.0437**	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.001	< 0.01	< 0.0002	< 0.01	< 0.01	< 0.001	1 U	3 U	**1.67**
Background	WAP-1	05/30/2019	N	-	< 0.005	**0.0399**	-	< 0.0005	< 0.005	**0.00059**	< 0.1	< 0.01	< 0.01	-	< 0.01	< 0.01	-	**0.742**	-	**1.37**
Background	WBW-1	06/04/2018	N	< 0.025	< 0.005	**0.008**	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.001	< 0.01	< 0.0002	< 0.01	< 0.01	< 0.001	1 U	3 U	4 U
Background	WBW-1	09/10/2018	N	-	< 0.005	**0.0103**	-	-	-	< 0.0005	< 0.1	-	< 0.01	-	< 0.05	-	-	**1.26**	3 U	**4.26 J**
Background	WBW-1	01/23/2019	N	< 0.005	< 0.005	**0.0095**	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.001	< 0.01	< 0.0002	< 0.01	< 0.01	< 0.001	1 U	3 U	**1.43**
Background	WBW-1	05/30/2019	N	-	< 0.005	**0.0124**	-	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.01	< 0.01	-	< 0.01	< 0.01	-	-	-	**0.564**
Background	WBW-A1-1	06/12/2018	N	< 0.025	< 0.005	**0.076**	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.001	< 0.01	< 0.0002	< 0.01	< 0.01	< 0.001	1 U	3 U	4 U
Background	WBW-A1-1	07/11/2018	N	< 0.005	< 0.005	**0.108**	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.001	< 0.01	< 0.0002	< 0.05	< 0.01	< 0.001	1 U	3 U	4 U
Background	WBW-A1-1	07/17/2018	N	< 0.005	< 0.005	**0.111**	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.001	< 0.01	< 0.0002	< 0.01	< 0.01	< 0.001	**1.74**	3 U	**4.74 J**
Background	WBW-A1-1	07/26/2018	N	< 0.005	< 0.005	**0.0941**	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.001	< 0.01	< 0.0002	< 0.01	< 0.01	< 0.001	1 U	3 U	4 U
Background	WBW-A1-1	07/31/2018	N	< 0.005	< 0.005	**0.087**	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.001	< 0.01	< 0.0002	< 0.01	< 0.01	< 0.001	**1.83**	3 U	**4.83 J**
Background	WBW-A1-1	08/07/2018	N	< 0.005	< 0.005	**0.0771**	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.001	< 0.01	< 0.0002	< 0.01	< 0.01	< 0.001	**1.16**	3 U	**4.16 J**
Background	WBW-A1-1	08/15/2018	N	< 0.005	< 0.005	**0.0803**	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.001	< 0.01	< 0.0002	< 0.01	< 0.01	< 0.001	**1.24**	3 U	**4.24 J**
Background	WBW-A1-1	08/22/2018	N	< 0.005	< 0.005	**0.098**	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.001	< 0.01	< 0.0002	< 0.01	< 0.01	< 0.001	**2.07**	3 U	**5.07 J**
Background	WBW-A1-1	01/22/2019	N	-	-	-	-	-	-	-	< 0.1	-	-	-	-	-	-	-	-	-
Ash Pond A	WAP-8	06/06/2018	N	-	**0.492**	**0.22**	-	< 0.0005	< 0.005	-	-	**0.001**	-	-	-	< 0.01	-	-	-	-
Ash Pond A	WAP-9	06/05/2018	N	< 0.025	**0.145**	**0.066**	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.001	**0.055**	< 0.0002	< 0.01	< 0.01	< 0.001	**1.1**	3 U	**4.1 J**
Ash Pond A	WAP-9	09/10/2018	N	-	**0.113**	**0.0623**	-	-	-	-	< 0.1	-	**0.065**	-	< 0.01	-	-	1 U	3 U	4 U
Ash Pond A	WAP-9	02/05/2019	N	< 0.005	**0.172**	**0.0683**	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.001	**0.07**	< 0.0002	< 0.01	< 0.01	< 0.001	**1.42**	3 U	**2.77**
Ash Pond A	WAP-9	05/30/2019	N	-	**0.189 / 0.19**	**0.079 / 0.077**	-	< 0.002 / < 0.004	< 0.01 / < 0.01	-	< 0.1	< 0.002 / < 0.05	**0.062**	-	< 0.01	< 0.005 / < 0.05	-	**1.07**	-	**1.07**
Ash Pond A	WAP-17	06/05/2018	N	< 0.025	**0.094**	**0.043**	< 0.0005	< 0.0005	< 0.005	< 0.0005	**0.16**	< 0.001	**0.22**	< 0.0002	**0.04**	< 0.01	< 0.001	1 U	3 U	4 U
Ash Pond A	WAP-17	06/05/2018	FD	< 0.025	**0.096**	**0.044**	< 0.0005	< 0.0005	< 0.005	< 0.0005	**0.16**	< 0.001	**0.22**	< 0.0002	**0.038**	< 0.01	< 0.001	1 U	3 U	4 U
Ash Pond A	WAP-17	09/11/2018	N	-	**0.108**	**0.0448**	-	-	-	-	< 0.1	-	**0.24**	-	**0.069**	-	-	1 U	3 U	4 U
Ash Pond A	WAP-17	09/11/2018	FD	-	**0.107**	**0.0427**	-	-	-	-	< 0.1	-	**0.23**	-	**0.067**	-	-	1 U	3 U	4 U
Ash Pond A	WAP-17	02/05/2019	N	< 0.005	**0.138**	**0.0439**	< 0.0005	< 0.0005	< 0.005	< 0.0005	**0.17**	< 0.001	**0.29**	< 0.00024	**0.058**	< 0.01	< 0.001	1 U	3 U	**1.55**
Ash Pond A	WAP-17	02/05/2019	FD	< 0.005	**0.143**	**0.0438**	< 0.0005	< 0.0005	< 0.005	< 0.0005	**0.18**	< 0.001	**0.28**	< 0.0002	**0.06**	< 0.01	< 0.001	1 U	3 U	**1.78**
Ash Pond A	WAP-17	05/30/2019	N	-	**0.119 / 0.11**	**0.052 / 0.048**	-	-	-	-	**0.23**	-	**0.25**	-	-	-	-	-	-	**0.475**
Ash Pond A	WAP-17	05/30/2019	FD	-	**0.117 / 0.11**	**0.051 / 0.048**	-	-	-	-	**0.14**	-	**0.24**	-	-	-	-	-	-	**0.65**
Ash Pond A	WAP-18	06/06/2018	N	< 0.025	**1.32**	**0.091**	< 0.0005	< 0.0005	< 0.005	< 0.0005	**1.57**	< 0.001	**0.32**	< 0.0002	**0.27**	< 0.01	< 0.001	1 U	3 U	4 U
Ash Pond A	WAP-18	09/17/2018	N	-	**1**	**0.0992**	-	-	-	-	**1.46**	-	**0.4**	-	**1.3**	-	-	1 U	3 U	4 U
Ash Pond A	WAP-18	02/07/2019	N	< 0.005	**0.835**	**0.0934**	< 0.0005	< 0.0005	< 0.005	< 0.0005	**1.88**	< 0.001	**0.36**	< 0.0002	**0.71**	< 0.01	< 0.001	1 U	3 U	**1.05**
Ash Pond A	WAP-18	06/05/2019	N	-	**0.492**	**0.0945**	-	-	-	-	**0.12**	-	**0.33**	-	-	-	-	-	-	**1.38**
Ash Pond B	WAP-10	06/05/2018	N	< 0.025	< 0.005	**0.247**	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.001	**0.022**	< 0.0002	< 0.01	< 0.01	< 0.001	**2.66**	3 U	**5.66 J**
Ash Pond B	WAP-10	06/05/2018	FD	< 0.025	< 0.005	**0.248**	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.001	**0.022**	< 0.0002	< 0.01	< 0.01	< 0.001	**2.55**	3 U	**5.55 J**
Ash Pond B	WAP-10	09/10/2018	N	-	< 0.005	**0.254**	-	-	-	< 0.0005	< 0.1	-	**0.022**	-	< 0.01	-	-	**3.7**	3 U	**6.7 J**
Ash Pond B	WAP-10	09/10/2018	FD	-	< 0.005	**0.246**	-	-	-	< 0.0005	< 0.1	-	**0.023**	-	< 0.01	-	-	**1.22**	3 U	**4.22 J**
Ash Pond B	WAP-10	02/05/2019	N	< 0.005	**0.0535**	**0.234**	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.001	**0.03**	< 0.0002	< 0.01	< 0.01	< 0.001	**2.56**	3 U	**3.22**
Ash Pond B	WAP-10	02/05/2019	FD	< 0.005	**0.0561**	**0.218**	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.001	**0.032**	< 0.0002	< 0.01	< 0.01	< 0.001	**1.76**	3 U	**2.09**
Ash Pond B	WAP-10	05/30/2019	N	-	**0.0059**	**0.254**	-	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.01	**0.021**	-	< 0.01	< 0.01	-	**2.27**	-	**3.47**
Ash Pond B	WAP-10	05/30/2019	FD	-	**0.0066**	**0.235**	-	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.01	**0.022**	-	< 0.01	< 0.01	-	**2.01**	-	**3.59**
Ash Pond B	WAP-19	06/06/2018	N	< 0.025	**0.231**	**0.055**	< 0.0005	< 0.0005	< 0.005	< 0.0005	**0.36**	< 0.001	**0.25**	< 0.0002	**0.055**	< 0.01	< 0.001	1 U	3 U	4 U
Ash Pond B	WAP-19	09/17/2018	N	-	**0.0199**	**0.051**	-	-	-	-	**0.12**	-	**0.23**	-	< 0.05	-	-	1 U	3 U	4 U
Ash Pond B	WAP-19	02/07/2019	N	< 0.005	**0.0978**	**0.0397**	< 0.0005	< 0.0005	< 0.005	< 0.0005	**0.35**	< 0.001	**0.26**	< 0.0002	**0.057**	< 0.01	< 0.001	1 U	3 U	**1.61**
Ash Pond B	WAP-19	06/06/2019	N	-	**0.123**	**0.0401**	-	-	-	-	**0.23**	-	**0.24**	-	-	-	-	**1.5**	-	**2.18**
Ash Pond B	WAP-20	06/06/2018	N	< 0.025	**0.071**	**0.064**	< 0.0005	< 0.0005	< 0.005	**0.001**	**0.53**	< 0.001	**0.35**	< 0.0002	**0.049**	< 0.01	< 0.001	1 U	3 U	4 U
Ash Pond B	WAP-20	09/17/2018	N	-	**0.0249**	**0.0362**	-	-	-	**0.00089**	**0.62**	-	**0.25**	-	**0.3**	-	-	1 U	3 U	4 U
Ash Pond B	WAP-20	02/07/2019	N	< 0.005	**0.0635**	**0.0254**	< 0.0005	< 0.0005	< 0.005	**0.0012**	**0.79**	< 0.001	**0.23**	< 0.0002	**0.13**	< 0.01	< 0.001	1 U	3 U	**1.42**
Ash Pond B	WAP-20	06/05/2019	N	-	**0.0625**	**0.0389**	-	-	-	< 0.001	**0.66**	-	**0.15**	-	**0.0366**	-	-	-	-	**1.68**
Ash Pond B	WAP-21	06/06/2018	N	< 0.025	< 0.005	**0.062**	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.001	< 0.01	< 0.0002	< 0.01	< 0.01	< 0.001	1 U	3 U	4 U
Ash Pond B	WAP-21	09/17/2018	N	-	< 0.005	**0.0506**	-	-	-	< 0.0005	< 0.1	-	< 0.01	-	< 0.05	-	-	1 U	3 U	4 U
Ash Pond B	WAP-21	02/06/2019	N	< 0.005	< 0.005	**0.0358**	< 0.0005	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.001	< 0.01	< 0.0002	< 0.01	< 0.01	< 0.001	1 U	3 U	**1.06**
Ash Pond B	WAP-21	06/11/2019	N	-	< 0.005	**0.043**	-	-	-	< 0.01	< 0.1	-	< 0.01	-	< 0.01	-	-	-	-	**0.845**

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MCL/RSL: The applicable Maximum Contaminant Level (MCL) or Regional Screening Level (RSL) is shown. Dashed where a standard is not provided.
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/: Multiple results reported due to multiple methods

- Highlighted where a result exceeds the applicable MCL/RSL.
- Criteria used for cobalt, lithium, and molybdenum are RSL for Tapwater where THQ=1.0 (May 2018).
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QUALIFIERS:
J: Estimated result

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ASSESSMENT MONITORING ANALYTICAL RESULTS
WINYAH GENERATING STATION - ASH POND A & B
SANTEE COOPER
GEORGETOWN, SOUTH CAROLINA

			Chemical Group	**Field Parameters**					
			Chemical Name	Conductivity	Dissolved Oxygen	ORP	pH	Temperature	Turbidity
			MCL/RSL	-	-	-	-	-	-
			Units	uS/cm	mg/L	mv	pH units	Deg C	NTU
Impound-ment	**Location**	**Sample Date**	**Sample Type**						
Background	WAP-1	06/04/2018	N	**97**	**6.65**	**-3**	**6.19**	**27.99**	**0**
Background	WAP-1	09/10/2018	N	**71**	**0.72**	**80**	**4.63**	**28.86**	**0**
Background	WAP-1	09/21/2018	N	-	-	-	-	-	-
Background	WAP-1	01/23/2019	N	**95**	**0.91**	**80**	**4.63**	**19.25**	**0**
Background	WAP-1	05/30/2019	N	**73**	**0.78**	**164**	**4.58**	**28.25**	**0.4**
Background	WBW-1	06/04/2018	N	**47**	**1.5**	**78**	**4.35**	**24.13**	**0**
Background	WBW-1	09/10/2018	N	**48**	**0.98**	**86**	**4.14**	**26.67**	**0**
Background	WBW-1	01/23/2019	N	**40**	**1.16**	**78**	**4.4**	**17.48**	**0**
Background	WBW-1	05/30/2019	N	**37**	**0.57**	**173**	**4.02**	**28.26**	**0**
Background	WBW-A1-1	06/12/2018	N	**269**	**0.74**	**95**	**4.7**	**24.91**	**3.7**
Background	WBW-A1-1	07/11/2018	N	**418**	**0.75**	**100**	**4.47**	**25.12**	**0**
Background	WBW-A1-1	07/17/2018	N	**432**	**0.96**	**77**	**4.52**	**26.08**	**4**
Background	WBW-A1-1	07/26/2018	N	**369**	**0.84**	**147**	**4.4**	**22.82**	**0**
Background	WBW-A1-1	07/31/2018	N	**280**	**0.77**	**124**	**4.58**	**26.38**	**0**
Background	WBW-A1-1	08/07/2018	N	**308**	**0.88**	**66**	**4.46**	**23.84**	**0**
Background	WBW-A1-1	08/15/2018	N	**280**	**0.77**	**124**	**4.58**	**26.38**	**0**
Background	WBW-A1-1	08/22/2018	N	**376**	**0.84**	**89**	**4.38**	**24.58**	**0**
Background	WBW-A1-1	01/22/2019	N	**423**	**1.01**	**99**	**4.28**	**16.7**	**0**
Ash Pond A	WAP-8	06/06/2018	N	**3230**	**0.66**	**-86**	**7.02**	**27.9**	**0**
Ash Pond A	WAP-9	06/05/2018	N	**1030**	**0.65**	**29**	**5.96**	**27.1**	**0**
Ash Pond A	WAP-9	09/10/2018	N	**1090**	**0.69**	**0**	**5.89**	**28.26**	**0**
Ash Pond A	WAP-9	02/05/2019	N	**1130**	**0.74**	**-98**	**5.96**	**23.77**	**0**
Ash Pond A	WAP-9	05/30/2019	N	**1070**	**0.69**	**39**	**5.85**	**26.71**	**0.5**
Ash Pond A	WAP-17	06/05/2018	N	**2170**	**0.88**	**133**	**6.04**	**22.75**	**0**
Ash Pond A	WAP-17	06/05/2018	FD	-	-	-	-	-	-
Ash Pond A	WAP-17	09/11/2018	N	**1940**	**0.64**	**99**	**6.03**	**26.46**	**0**
Ash Pond A	WAP-17	09/11/2018	FD	-	-	-	-	-	-
Ash Pond A	WAP-17	02/05/2019	N	**2090**	**1.1**	**46**	**6.11**	**22.2**	**2**
Ash Pond A	WAP-17	02/05/2019	FD	-	-	-	-	-	-
Ash Pond A	WAP-17	05/30/2019	N	**2210**	**0.84**	**30**	**6.03**	**27.38**	**0**
Ash Pond A	WAP-17	05/30/2019	FD	-	-	-	-	-	-
Ash Pond A	WAP-18	06/06/2018	N	**2280**	**0.64**	**26**	**6.8**	**27.62**	**0**
Ash Pond A	WAP-18	09/17/2018	N	**2060**	**0.75**	**103**	**6.35**	**25.82**	**0**
Ash Pond A	WAP-18	02/07/2019	N	**1720**	**0.99**	**25**	**6.73**	**23.68**	**7.9**
Ash Pond A	WAP-18	06/05/2019	N	**1860**	**0.86**	**-69**	**6.57**	**21.33**	**57.6**
Ash Pond B	WAP-10	06/05/2018	N	**3470**	**0.74**	**7**	**6.49**	**25.56**	**0**
Ash Pond B	WAP-10	06/05/2018	FD	-	-	-	-	-	-
Ash Pond B	WAP-10	09/10/2018	N	**3460**	**0.77**	**19**	**6.38**	**27.12**	**0**
Ash Pond B	WAP-10	09/10/2018	FD	-	-	-	-	-	-
Ash Pond B	WAP-10	02/05/2019	N	**3660**	**0.99**	**-50**	**6.53**	**19.67**	**7**
Ash Pond B	WAP-10	02/05/2019	FD	-	-	-	-	-	-
Ash Pond B	WAP-10	05/30/2019	N	**3700**	**0.87**	**-45**	**6.46**	**23.32**	**0.1**
Ash Pond B	WAP-10	05/30/2019	FD	-	-	-	-	-	-
Ash Pond B	WAP-19	06/06/2018	N	**2210**	**0.83**	**82**	**6.27**	**22.5**	**49.4**
Ash Pond B	WAP-19	09/17/2018	N	**1980**	**0.82**	**114**	**5.79**	**24.47**	**0**
Ash Pond B	WAP-19	02/07/2019	N	**1600**	**0.9**	**70**	**6.34**	**24.41**	**5.8**
Ash Pond B	WAP-19	06/06/2019	N	**2000**	**0.47**	**-16**	**6.37**	**22.46**	**1.5**
Ash Pond B	WAP-20	06/06/2018	N	**1320**	**0.81**	**75**	**6.01**	**25.95**	**3.8**
Ash Pond B	WAP-20	09/17/2018	N	**585**	**0.96**	**95**	**5.63**	**23.31**	**0**
Ash Pond B	WAP-20	02/07/2019	N	**446**	**1.62**	**87**	**6.09**	**21.42**	**6**
Ash Pond B	WAP-20	06/05/2019	N	**783**	**0.87**	**-42**	**6.07**	**24.63**	**151**
Ash Pond B	WAP-21	06/06/2018	N	**2140**	**0.9**	**110**	**5.91**	**21.01**	**0**
Ash Pond B	WAP-21	09/17/2018	N	**1940**	**0.88**	**106**	**5.81**	**23.01**	**0**
Ash Pond B	WAP-21	02/06/2019	N	**1480**	**1.04**	**25**	**6.22**	**20.66**	**0**
Ash Pond B	WAP-21	06/11/2019	N	**1400**	**0.5**	**-1**	**6.1**	**20.05**	**8.7**

ABBREVIATIONS AND NOTES:
mg/L: milligram per liter
uS/cm: microSiemen per centimeter
mv: millivolt
NTU: Nephelometric Turbidity Units
< 0.005: Analyte not detected above detection limit
-: Not Analyzed
MCL/RSL: The applicable Maximum Contaminant Level (MCL) or Regional Screening Level (RSL) is shown. Dashed where a standard is not provided.
FD: Field duplicate
N: Normal sample
/: Multiple results reported due to multiple methods

- Highlighted where a result exceeds the applicable MCL/RSL.
- Criteria used for cobalt, lithium, and molybdenum are RSL for Tapwater where THQ=1.0 (May 2018).
- 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

QUALIFIERS:
J: Estimated result

TABLE 3
SUMMARY OF GROUNDWATER MEASUREMENTS
WINYAH GENERATING STATION - ASH POND A & B
SANTEE COOPER
GEORGETOWN, SOUTH CAROLINA

Location	Measurement Date	Depth to Water	Groundwater Elevation
WBW-1	11/10/2015	3.96	28.01
WBW-1	1/11/2016	6.04	25.93
WBW-1	4/26/2016	6.69	25.28
WBW-1	6/20/2016	6.58	25.39
WBW-1	10/17/2016	4.99	26.98
WBW-1	1/9/2017	5.95	26.02
WBW-1	4/10/2017	6.24	25.73
WBW-1	9/18/2017	5.02	26.95
WBW-1	10/2/2017	5.85	26.12
WBW-1	6/4/2018	5.45	26.52
WBW-1	9/10/2018	6.70	25.27
WBW-1	1/23/2019	5.65	26.32
WBW-1	5/30/2019	5.34	26.63
WAP-1	11/10/2015	3.00	26.44
WAP-1	1/11/2016	4.84	24.60
WAP-1	4/26/2016	5.89	23.55
WAP-1	6/20/2016	5.90	23.54
WAP-1	10/18/2016	4.21	25.23
WAP-1	1/9/2017	4.42	25.02
WAP-1	4/10/2017	4.61	24.83
WAP-1	7/18/2017	4.88	24.56
WAP-1	9/18/2017	6.12	23.32
WAP-1	10/2/2017	7.45	21.99
WAP-1	1/30/2018	13.14	16.30
WAP-1	6/4/2018	12.66	16.78
WAP-1	9/10/2018	11.02	18.42
WAP-1	1/23/2019	6.86	22.58
WAP-1	5/30/2019	6.76	22.68
WAP-2	11/10/2015	2.28	21.41
WAP-2	1/11/2016	3.45	20.24
WAP-2	4/28/2016	4.09	19.60
WAP-2	6/20/2016	3.21	20.48
WAP-2	10/18/2016	3.10	20.59
WAP-2	1/9/2017	3.38	20.31
WAP-2	4/10/2017	3.75	19.94
WAP-2	6/19/2017	3.79	19.90
WAP-2	9/20/2017	3.00	20.69
WAP-2	10/2/2017	3.04	20.65
WAP-2	1/30/2018	3.41	20.28
WAP-2	6/4/2018	3.09	20.60
WAP-2	9/10/2018	4.25	19.44
WAP-2	1/23/2019	3.32	20.37
WAP-2	6/20/2019	3.51	20.18
WAP-3	11/11/2015	5.20	14.23
WAP-3	1/11/2016	6.17	13.26
WAP-3	4/26/2016	6.99	12.44
WAP-3	6/22/2016	7.51	11.92
WAP-3	10/19/2016	6.48	12.95
WAP-3	1/12/2017	6.50	12.93
WAP-3	4/12/2017	6.81	12.62
WAP-3	6/19/2017	7.05	12.38
WAP-3	9/20/2017	6.64	12.79
WAP-3	10/3/2017	7.12	12.31
WAP-3	2/6/2018	6.71	12.72
WAP-3	6/4/2018	7.12	12.31
WAP-3	9/11/2018	8.16	11.27
WAP-3	2/6/2019	6.82	12.61
WAP-3	6/24/2019	6.70	12.73
WAP-4	11/12/2015	6.78	13.56
WAP-4	1/14/2016	8.49	11.85

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Location	Measurement Date	Depth to Water	Groundwater Elevation
WAP-4	5/2/2016	9.21	11.13
WAP-4	6/22/2016	8.65	11.69
WAP-4	10/17/2016	6.99	13.35
WAP-4	1/11/2017	7.35	12.99
WAP-4	4/11/2017	7.62	12.72
WAP-4	6/19/2017	7.88	12.46
WAP-4	9/19/2017	7.03	13.31
WAP-4	10/3/2017	8.02	12.32
WAP-4	2/5/2018	7.35	12.99
WAP-4	6/7/2018	7.24	13.10
WAP-4	9/17/2018	4.96	15.38
WAP-4	1/22/2019	7.21	13.13
WAP-4	6/18/2019	7.02	13.32
WAP-7	1/14/2016	9.21	20.73
WAP-7	6/22/2016	10.70	19.24
WAP-7	1/17/2017	9.87	20.07
WAP-7	6/19/2017	9.93	20.01
WAP-7	1/31/2018	10.14	19.80
WAP-7	6/13/2018	9.99	19.95
WAP-7	7/11/2018	10.10	19.84
WAP-7	7/17/2018	10.16	19.78
WAP-7	7/26/2018	8.82	21.12
WAP-7	7/31/2018	8.79	21.15
WAP-7	8/7/2018	8.52	21.42
WAP-7	8/13/2018	8.79	21.15
WAP-7	8/22/2018	8.92	21.02
WAP-7	1/22/2019	9.58	20.36
WAP-7	6/24/2019	9.47	20.47
WAP-9	11/11/2015	6.91	19.27
WAP-9	1/19/2016	8.12	19.92
WAP-9	4/26/2016	6.10	20.08
WAP-9	6/20/2016	8.91	19.13
WAP-9	10/18/2016	7.82	20.22
WAP-9	1/10/2017	8.56	19.48
WAP-9	4/10/2017	9.64	18.40
WAP-9	6/19/2017	9.22	18.82
WAP-9	9/18/2017	8.40	19.64
WAP-9	10/2/2017	8.87	19.17
WAP-9	1/31/2018	9.89	18.15
WAP-9	6/5/2018	9.63	18.41
WAP-9	9/10/2018	9.09	18.95
WAP-9	2/5/2019	8.76	19.28
WAP-9	5/30/2019	9.48	18.56
WAP-10	11/12/2015	3.20	22.91
WAP-10	1/19/2016	3.84	22.27
WAP-10	4/26/2016	5.13	20.98
WAP-10	6/20/2016	4.18	21.93
WAP-10	10/18/2016	3.52	22.59
WAP-10	1/10/2017	3.85	22.26
WAP-10	4/10/2017	4.65	21.46
WAP-10	6/19/2017	4.25	21.86
WAP-10	9/18/2017	3.68	22.43
WAP-10	10/2/2017	4.04	22.07
WAP-10	1/31/2018	4.67	21.44
WAP-10	6/5/2018	4.52	21.59
WAP-10	9/10/2018	4.45	21.66
WAP-10	2/5/2019	4.57	21.54
WAP-10	5/30/2019	5.15	20.96
WAP-12	11/10/2015	5.87	24.97
WAP-12	1/12/2016	6.78	24.06

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Location	Measurement Date	Depth to Water	Groundwater Elevation
WAP-12	4/26/2016	7.26	23.58
WAP-12	6/20/2016	7.09	23.75
WAP-12	10/19/2016	6.32	24.52
WAP-12	1/11/2017	6.95	23.89
WAP-12	4/12/2017	7.37	23.47
WAP-12	9/20/2017	6.56	24.28
WAP-12	10/3/2017	6.81	24.03
WAP-12	6/5/2018	7.22	23.62
WAP-12	9/11/2018	7.06	23.78
WAP-12	2/5/2019	7.16	23.68
WAP-12	6/20/2019	7.02	23.82
WAP-13	11/10/2015	4.08	17.89
WAP-13	1/12/2016	4.88	17.09
WAP-13	4/28/2016	6.57	15.40
WAP-13	6/22/2016	4.18	17.79
WAP-13	10/19/2016	5.79	16.18
WAP-13	1/12/2017	5.91	16.06
WAP-13	4/12/2017	5.94	16.03
WAP-13	9/20/2017	5.57	16.40
WAP-13	10/3/2017	6.00	15.97
WAP-13	6/4/2018	5.84	16.13
WAP-13	9/11/2018	6.41	15.56
WAP-13	2/6/2019	5.72	16.25
WAP-13	6/24/2019	5.53	16.44
WAP-14	11/12/2015	3.40	11.29
WAP-14	1/14/2016	4.09	10.60
WAP-14	5/2/2016	5.17	9.52
WAP-14	6/21/2016	4.51	10.18
WAP-14	10/17/2016	3.85	10.84
WAP-14	1/11/2017	4.06	10.63
WAP-14	4/11/2017	4.63	10.06
WAP-14	9/19/2017	4.21	10.48
WAP-14	10/3/2017	5.41	9.28
WAP-14	6/7/2018	4.65	10.04
WAP-14	9/21/2018	3.91	10.78
WAP-14	1/22/2019	4.14	10.55
WAP-14	6/18/2019	4.65	10.04
WAP-14A	6/18/2019	3.18	10.77
WAP-14B	6/19/2019	5.26	3.97
WAP-14C	6/18/2019	9.95	3.93
WAP-15	11/12/2015	6.04	14.37
WAP-15	1/13/2016	7.16	13.25
WAP-15	5/2/2016	7.78	12.63
WAP-15	6/22/2016	7.43	12.98
WAP-15	10/17/2016	7.02	13.39
WAP-15	1/11/2017	7.09	13.32
WAP-15	4/11/2017	7.24	13.17
WAP-15	9/19/2017	7.07	13.34
WAP-15	10/4/2017	7.79	12.62
WAP-15	6/7/2018	7.21	13.20
WAP-15	9/17/2018	5.68	14.73
WAP-15	1/22/2019	6.98	13.43
WAP-15	6/11/2019	6.74	13.67
WAP-16	11/12/2015	5.52	19.56
WAP-16	1/13/2016	5.90	19.18
WAP-16	5/2/2016	6.04	19.04
WAP-16	6/22/2016	5.90	19.18
WAP-16	10/17/2016	5.68	19.40
WAP-16	1/11/2017	5.88	19.20
WAP-16	4/11/2017	7.38	17.70

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Location	Measurement Date	Depth to Water	Groundwater Elevation
WAP-16	9/21/2017	7.11	17.97
WAP-16	10/3/2017	7.34	17.74
WAP-16	6/7/2018	6.78	18.30
WAP-16	9/21/2018	6.47	18.61
WAP-16	1/22/2019	6.95	18.13
WAP-16	6/19/2019	6.91	18.17
WAP-17	11/11/2015	3.99	25.28
WAP-17	1/19/2016	5.15	24.12
WAP-17	4/26/2016	6.46	22.81
WAP-17	6/20/2016	5.45	23.82
WAP-17	10/18/2016	4.42	24.85
WAP-17	1/10/2017	5.71	23.56
WAP-17	4/10/2017	6.44	22.83
WAP-17	9/18/2017	5.14	24.13
WAP-17	10/2/2017	5.62	23.65
WAP-17	6/5/2018	6.15	23.12
WAP-17	9/11/2018	6.39	22.88
WAP-17	2/5/2019	6.54	22.73
WAP-17	5/30/2019	7.18	22.09
WAP-18	11/11/2015	14.31	28.74
WAP-18	1/12/2016	14.26	28.79
WAP-18	4/27/2016	17.09	25.96
WAP-18	6/21/2016	16.36	26.69
WAP-18	10/20/2016	14.47	28.58
WAP-18	1/12/2017	16.58	26.47
WAP-18	4/12/2017	18.54	24.51
WAP-18	9/21/2017	17.42	25.63
WAP-18	10/4/2017	18.69	24.36
WAP-18	6/6/2018	20.18	22.87
WAP-18	9/17/2018	17.28	25.77
WAP-18	2/7/2019	21.15	21.90
WAP-18	6/5/2019	24.46	18.59
WAP-19	11/11/2015	15.15	28.24
WAP-19	1/12/2016	16.51	26.88
WAP-19	4/27/2016	19.45	23.94
WAP-19	6/21/2016	17.45	25.94
WAP-19	10/20/2016	15.77	27.62
WAP-19	1/12/2017	18.25	25.14
WAP-19	4/12/2017	19.87	23.52
WAP-19	9/21/2017	18.50	24.89
WAP-19	10/4/2017	18.91	24.48
WAP-19	6/6/2018	19.41	23.98
WAP-19	9/17/2018	17.77	25.62
WAP-19	2/7/2019	20.25	23.14
WAP-19	6/6/2019	22.46	20.93
WAP-20	11/12/2015	13.51	29.57
WAP-20	1/13/2016	15.76	27.32
WAP-20	4/27/2016	19.59	23.49
WAP-20	6/21/2016	19.10	23.98
WAP-20	10/20/2016	16.08	27.00
WAP-20	1/12/2017	18.40	24.68
WAP-20	4/13/2017	19.03	24.05
WAP-20	9/21/2017	17.01	26.07
WAP-20	10/4/2017	18.18	24.90
WAP-20	6/6/2018	19.84	23.24
WAP-20	9/17/2018	16.01	27.07
WAP-20	2/7/2019	19.72	23.36
WAP-20	6/5/2019	20.76	22.32
WAP-21	11/11/2015	14.46	28.60
WAP-21	1/13/2016	15.51	27.55

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Location	Measurement Date	Depth to Water	Groundwater Elevation
WAP-21	4/27/2016	19.51	23.55
WAP-21	6/21/2016	16.50	26.56
WAP-21	10/19/2016	15.11	27.95
WAP-21	1/10/2017	15.81	27.25
WAP-21	4/13/2017	17.66	25.40
WAP-21	9/21/2017	15.34	27.72
WAP-21	10/4/2017	16.24	26.82
WAP-21	6/6/2018	15.74	27.32
WAP-21	9/17/2018	16.47	26.59
WAP-21	2/6/2019	19.61	23.45
WAP-21	6/11/2019	20.55	22.51
WAP-22	6/5/2019	24.71	18.66
WAP-23	6/5/2019	21.56	21.67
WAP-24	6/19/2019	6.44	22.33
WAP-25	6/6/2019	8.95	18.15
WAP-26	6/11/2019	7.97	19.59
WBW-A1-1	6/12/2018	7.28	20.86
WBW-A1-1	7/11/2018	6.71	21.43
WBW-A1-1	7/17/2018	7.27	20.87
WBW-A1-1	7/26/2018	5.31	22.83
WBW-A1-1	7/31/2018	6.36	21.78
WBW-A1-1	8/7/2018	5.81	22.33
WBW-A1-1	8/15/2018	6.36	21.78
WBW-A1-1	8/22/2018	6.80	21.34
WBW-A1-1	1/22/2019	5.88	22.26
WBW-A1-1	6/24/2019	6.05	22.09
WLF-A1-1	6/13/2018	17.74	23.61
WLF-A1-1	7/11/2018	18.77	22.58
WLF-A1-1	7/17/2018	18.12	23.33
WLF-A1-1	7/26/2018	16.21	25.14
WLF-A1-1	8/1/2018	16.41	24.94
WLF-A1-1	8/8/2018	16.14	25.21
WLF-A1-1	8/13/2018	16.41	25.04
WLF-A1-1	8/22/2018	16.79	24.56
WLF-A1-1	1/22/2019	16.67	24.68
WLF-A1-1	6/26/2019	17.37	23.98
WLF-A1-2	6/12/2018	6.53	22.68
WLF-A1-2	7/11/2018	6.21	23.00
WLF-A1-2	7/17/2018	6.81	22.40
WLF-A1-2	7/26/2018	2.61	26.60
WLF-A1-2	7/31/2018	4.11	25.10
WLF-A1-2	8/7/2018	2.96	26.25
WLF-A1-2	8/15/2018	4.11	25.10
WLF-A1-2	8/23/2018	4.88	24.33
WLF-A1-2	1/23/2019	4.50	24.71
WLF-A1-2	6/25/2019	5.55	23.66
WLF-A1-3	6/12/2018	6.14	22.17
WLF-A1-3	7/11/2018	6.35	21.96
WLF-A1-3	7/18/2018	7.81	20.50
WLF-A1-3	7/26/2018	3.27	25.04
WLF-A1-3	7/31/2018	4.01	24.30
WLF-A1-3	8/7/2018	3.19	25.12
WLF-A1-3	8/15/2018	4.01	22.15
WLF-A1-3	8/23/2018	4.51	23.80
WLF-A1-3	1/22/2019	4.63	23.68
WLF-A1-3	6/25/2019	5.45	22.86
WLF-A1-4	6/12/2018	5.64	22.60
WLF-A1-4	7/11/2018	5.76	22.48
WLF-A1-4	7/18/2018	6.22	22.02
WLF-A1-4	7/26/2018	2.30	25.94

TABLE 3
SUMMARY OF GROUNDWATER MEASUREMENTS
WINYAH GENERATING STATION - ASH POND A & B
SANTEE COOPER
GEORGETOWN, SOUTH CAROLINA

Location	Measurement Date	Depth to Water	Groundwater Elevation
WLF-A1-4	7/31/2018	3.51	24.73
WLF-A1-4	8/7/2018	3.11	25.13
WLF-A1-4	8/15/2018	3.51	22.52
WLF-A1-4	8/23/2018	4.21	24.03
WLF-A1-4	1/22/2019	4.46	23.78
WLF-A1-4	6/25/2019	5.39	22.85
WLF-A1-5	6/13/2018	15.91	21.73
WLF-A1-5	7/11/2018	15.82	21.82
WLF-A1-5	7/17/2018	16.00	21.64
WLF-A1-5	7/26/2018	13.66	23.98
WLF-A1-5	8/1/2018	14.11	23.53
WLF-A1-5	8/8/2018	13.82	23.82
WLF-A1-5	8/15/2018	14.11	21.05
WLF-A1-5	8/22/2018	14.96	22.68
WLF-A1-5	1/22/2019	15.96	21.68
WLF-A1-5	6/26/2019	15.95	21.69

Notes and Abbreviations:

TABLE 4
SUMMARY OF GROUNDWATER ANALYTICAL RESULTS FOR NATURE AND EXTENT
WINYAH GENERATING STATION - ASH POND A & B
SANTEE COOPER
GEORGETOWN, SOUTH CAROLINA

			Chemical Group	Detection Monitoring - EPA Appendix III Constituents						Assessment Monitoring - EPA Appendix IV Constituents												Radiological		
			Chemical Name	Boron, Total	Calcium, Total	Chloride	Fluoride	Sulfate	Total Dissolved Solids (TDS)	Arsenic, Total	Barium, Total	Cadmium, Total	Chromium, Total	Cobalt, Total	Fluoride	Lead, Total	Lithium, Total	Molybdenum, Total	Selenium, Total	Radium-226	Radium-228	Radium-226 & 228
			MCL/RSL	-	-	-	4	-	-	0.01	2	0.005	0.1	0.006	4	0.015	0.04	0.1	0.05	-	-	5
			Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	pCi/L	pCi/L
Impound-ment	**Location**	**Sample Date**	**Sample Type**																			
Background	WAP-1	05/30/2019	N	**0.054**	**1.9**	**5.08**	< 0.1	**16**	**43.75**	< 0.005	**0.0399**	< 0.0005	< 0.005	**0.00059**	< 0.1	< 0.01	< 0.01	< 0.01	< 0.01	**0.742**	-	**1.37**
Background	WBW-1	05/30/2019	N	**0.085**	< 0.5	**2.71**	< 0.1	**5.64**	**21.25**	< 0.005	**0.0124**	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.01	< 0.01	< 0.01	< 0.01	-	-	**0.564**
Ash Pond A	WAP-9	05/30/2019	N	**5.6**	**130**	**92.3**	< 0.1	**82.2**	**737.5**	**0.189 / 0.19**	**0.079 / 0.077**	< 0.002 / < 0.004	< 0.01 / < 0.01	-	< 0.1	< 0.002 / < 0.05	**0.062**	< 0.01	< 0.005 / < 0.05	**1.07**	-	**1.07**
Ash Pond A	WAP-17	05/30/2019	N	**3.7**	**340**	**249**	**0.23**	**739**	**1656**	**0.119 / 0.11**	**0.052 / 0.048**	-	-	-	**0.23**	-	**0.25**	-	-	-	-	**0.475**
Ash Pond A	WAP-17	05/30/2019	FD	**3.8**	**340**	**262**	**0.14**	**790**	**1632**	**0.117 / 0.11**	**0.051 / 0.048**	-	-	-	**0.14**	-	**0.24**	-	-	-	-	**0.65**
Ash Pond A	WAP-18	06/05/2019	N	-	**302**	**7.63**	**0.12**	**6.69**	**1532**	**0.492**	**0.0945**	-	-	-	**0.12**	-	**0.33**	-	-	-	-	**1.38**
Ash Pond A	WAP-22	06/05/2019	N	-	**270**	**330**	-	**415**	**1611**	**0.0146**	-	-	-	-	-	-	**0.051**	-	-	-	-	-
Ash Pond A	WAP-26	06/11/2019	N	-	**22.5**	**7.8**	-	**73.2**	**165**	< 0.005	-	-	-	-	-	-	< 0.01	-	-	-	-	-
Ash Pond B	WAP-10	05/30/2019	N	**8.6**	**490**	**745**	< 0.1	**670**	**3309**	**0.0059**	**0.254**	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.01	**0.021**	< 0.01	< 0.01	**2.27**	-	**3.47**
Ash Pond B	WAP-10	05/30/2019	FD	**8.8**	**472**	**747**	< 0.1	**676**	**3338**	**0.0066**	**0.235**	< 0.0005	< 0.005	< 0.0005	< 0.1	< 0.01	**0.022**	< 0.01	< 0.01	**2.01**	-	**3.59**
Ash Pond B	WAP-19	06/06/2019	N	-	**250**	**213**	**0.23**	**588**	**1411**	**0.123**	**0.0401**	-	-	-	**0.23**	-	**0.24**	-	-	**1.5**	-	**2.18**
Ash Pond B	WAP-20	06/05/2019	N	-	**78.3**	**24.8**	**0.66**	**172**	**443.8**	**0.0625**	**0.0389**	-	-	< 0.001	**0.66**	-	**0.15**	**0.0366**	-	-	-	**1.68**
Ash Pond B	WAP-21	06/11/2019	N	**4.2**	**178**	**172**	< 0.1	**468**	**995**	< 0.005	**0.043**	-	-	< 0.01	< 0.1	-	< 0.01	< 0.01	-	-	-	**0.845**
Ash Pond B	WAP-23	06/05/2019	N	-	**140**	**70.9**	-	**105**	**642.5**	< 0.005	-	-	-	-	-	-	**0.034**	< 0.01	-	-	-	-
Ash Pond B	WAP-24	06/19/2019	N	-	**43**	**28.5**	-	< 2	**277.5**	< 0.005	-	-	-	-	-	-	< 0.01	< 0.01	-	-	-	-
Ash Pond B	WAP-25	06/06/2019	N	-	**59.2**	**11.1**	-	**2.69**	**260**	< 0.005	-	-	-	-	-	-	< 0.01	**0.00147**	-	-	-	-

ABBREVIATIONS AND NOTES:
mg/L: milligram per liter
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mv: millivolt
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< 0.005: Analyte not detected above detection limit
-: Not Analyzed
MCL/RSL: The applicable Maximum Contaminant Level (MCL) or Regional Screening Level (RSL) is shown. Dashed where a standard is not provided.
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QUALIFIERS:
J: Estimated result

TABLE 4
SUMMARY OF GROUNDWATER ANALYTICAL RESULTS FOR NATURE AND EXTENT
WINYAH GENERATING STATION - ASH POND A & B
SANTEE COOPER
GEORGETOWN, SOUTH CAROLINA

			Chemical Group	Field Parameters						Dissolved Metals											Total Me			
			Chemical Name	Conductivity	Dissolved Oxygen	ORP	pH	Temperature	Turbidity	Arsenic, Dissolved	Barium, Dissolved	Calcium, Dissolved	Cobalt, Dissolved	Iron, Dissolved	Lithium, Dissolved	Magnesium, Dissolved	Manganese, Dissolved	Molybdenum, Dissolved	Potassium, Dissolved	Sodium, Dissolved	Aluminum, Total	Copper, Total	Iron, Total	Magnesium, Total
			MCL/RSL	-	-	-	-	-	-	0.01	2	-	0.006	-	0.04	-	-	0.1	-	-	-	1.3	-	-
			Units	uS/cm	mg/L	mv	pH units	Deg C	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Impound-ment	**Location**	**Sample Date**	**Sample Type**																					
Background	WAP-1	05/30/2019	N	73	0.78	164	4.58	28.25	0.4	< 0.005	-	1.7	-	1.53	< 0.01	0.55	0.0083	< 10	< 0.5	4.1	1.3	< 0.005	1.71	0.62
Background	WBW-1	05/30/2019	N	37	0.57	173	4.02	28.26	0	< 0.005	-	< 0.5	-	0.215	< 0.01	0.24	0.006	< 10	< 0.5	2	< 0.5	< 0.005	0.303	0.24
Ash Pond A	WAP-9	05/30/2019	N	1070	0.69	39	5.85	26.71	0.5	0.192 / 0.19	-	130	-	1.05	0.063	28 / 29	0.185 / 0.19	-	18.4 / 16	60	0.677 / 0.72	< 0.01 / < 0.01	1.21 / 1.1	28.1 / 29
Ash Pond A	WAP-17	05/30/2019	N	2210	0.84	30	6.03	27.38	0	0.114 / 0.1	-	330	-	0.8	0.24	46 / 49	0.086 / 0.084	-	12.7 / 11	85	-	-	0.906 / 0.88	45.7 / 48
Ash Pond A	WAP-17	05/30/2019	FD	-	-	-	-	-	-	0.114 / 0.11	-	330	-	0.78	0.24	46.8 / 48	0.081 / 0.081	-	12.5 / 12	85	-	-	0.853 / 0.85	47.4 / 49
Ash Pond A	WAP-18	06/05/2019	N	1860	0.86	-69	6.57	21.33	57.6	0.383	0.0845	310	-	0.991	0.31	24	0.7	-	11.5	37.6	-	-	1.51	29.4
Ash Pond A	WAP-22	06/05/2019	N	2230	3.25	-64	6.73	25.4	87.1	< 0.005	-	267	-	2.57	0.051	21.2	0.33	-	8.45	144	-	-	5.54	22.6
Ash Pond A	WAP-26	06/11/2019	N	240	0.45	-19	5.49	22.26	0	< 0.005	-	20.4	-	2.38	< 0.01	1.64	0.048	-	1.29	15	-	-	2.4	1.61
Ash Pond B	WAP-10	05/30/2019	N	3700	0.87	-45	6.46	23.32	0.1	0.0054	-	488	-	16	0.021	62.7	0.545	< 10	20	135	< 0.5	< 0.005	19.3	72.8
Ash Pond B	WAP-10	05/30/2019	FD	-	-	-	-	-	-	0.0062	-	493	-	16.1	0.022	64	0.563	< 10	21	137	< 0.5	< 0.005	19.1	71.9
Ash Pond B	WAP-19	06/06/2019	N	2000	0.47	-16	6.37	22.46	1.5	0.0787	0.0354	237	-	2.07	0.23	34.6	0.44	-	12.9	72.9	-	-	0.00356	43.1
Ash Pond B	WAP-20	06/05/2019	N	783	0.87	-42	6.07	24.63	151	0.0224	0.0435	65.8	< 0.001	16.4	0.1	13.2	0.119	0.0208	7.2	18.9	-	-	11.8	12.2
Ash Pond B	WAP-21	06/11/2019	N	1400	0.5	-1	6.1	20.05	8.7	< 0.005	-	178	-	4.32	< 0.01	30	0.244	< 10	13.8	60.6	-	-	6.38	28.9
Ash Pond B	WAP-23	06/05/2019	N	987	0.52	-72	6.52	22.53	111	0.00562	-	144	-	1.32	0.032	6.74	0.201	-	2.01	45.4	-	-	2.74	7.09
Ash Pond B	WAP-24	06/19/2019	N	327	0.48	-203	7.55	23.8	85.7	-	-	-	-	-	-	-	-	-	-	-	-	-	0.228	3.99
Ash Pond B	WAP-25	06/06/2019	N	400	0.35	-125	6.86	20.62	14.5	< 0.005	-	55.6	-	0.285	< 0.01	3.43	0.125	0.00369	2.56	12.2	-	-	1.59	2.83

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QUALIFIERS:
J: Estimated result

TABLE 4
SUMMARY OF GROUNDWATER ANALYTICAL RESULTS FOR NATURE AND EXTENT
WINYAH GENERATING STATION - ASH POND A & B
SANTEE COOPER
GEORGETOWN, SOUTH CAROLINA

			Chemical Group	tals				Other				
			Chemical Name	Manganese, Total	Potassium, Total	Sodium, Total	Zinc, Total	Alkalinity, Bicarbonate	Alkalinity, Total (as CaCO3)	Dissolved Organic Carbon (DOC)	Sulfide	Total Organic Carbon (TOC)
			MCL/RSL	-	-	-	-	-	-	-	-	-
			Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Impound-ment	**Location**	**Sample Date**	**Sample Type**									
Background	WAP-1	05/30/2019	N	0.0084	< 0.5	4.7	< 0.01	< 4	< 4	2.64	< 0.1	2.62
Background	WBW-1	05/30/2019	N	0.0064	< 0.5	2.1	0.0101	< 4	< 4	1.13	< 0.1	1.02
Ash Pond A	WAP-9	05/30/2019	N	0.19 / 0.19	18.8 / 16	59	0.028 / 0.017	327	327	56.9	< 0.1	48.5
Ash Pond A	WAP-17	05/30/2019	N	0.085 / 0.084	12.8 / 12	85	-	35.8	35.8	9.63	< 0.1	9.53
Ash Pond A	WAP-17	05/30/2019	FD	0.082 / 0.082	12.4 / 12	86	-	35.4	35.4	10.1	< 0.1	10.1
Ash Pond A	WAP-18	06/05/2019	N	0.868	13.9	42.6	-	199	199	16.5	< 0.1	17.5
Ash Pond A	WAP-22	06/05/2019	N	0.35	8.98	145	-	358	358	4.77	< 0.1	5.04
Ash Pond A	WAP-26	06/11/2019	N	0.047	1.24	16.2	-	14.7	14.7	2.61	< 0.1	2.41
Ash Pond B	WAP-10	05/30/2019	N	0.568	22.9	151	< 0.01	261	261	1.73	< 0.1	1.79
Ash Pond B	WAP-10	05/30/2019	FD	0.568	22.4	151	< 0.01	263	263	1.46	< 0.1	1.83
Ash Pond B	WAP-19	06/06/2019	N	0.547	15.7	77.1	-	209	209	5.27	< 0.1	5.81
Ash Pond B	WAP-20	06/05/2019	N	0.119	8.24	12.4	-	110	110	5.13	< 0.1	5.44
Ash Pond B	WAP-21	06/11/2019	N	0.239	13.6	69	-	135	135	8.3	< 0.1	9.37
Ash Pond B	WAP-23	06/05/2019	N	0.211	2.08	44.2	-	312	312	2.24	< 0.1	2.41
Ash Pond B	WAP-24	06/19/2019	N	0.01	2.61	17	-	135	135	1.12	< 0.1	1.02
Ash Pond B	WAP-25	06/06/2019	N	0.108	2.19	11.7	-	198	198	2.94	< 0.1	2.92

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QUALIFIERS:
J: Estimated result

TABLE 5
REMEDIAL ALTERNATIVE ROADMAP
WINYAH GENERATING STATION - ASH POND A AND B
SANTEE COOPER
GEORGETOWN, SOUTH CAROLINA

Alternative Number	Remedial Alternative Description	Winyah Ash Pond A&B	Groundwater Remedy Components		
			1. Groundwater Remedy Approach	2. Groundwater Treatment Method	3. Long-Term Monitoring Actions
1	**Closure In Place (CIP) with Capping and Monitored Natural Attenuation (MNA)**	**CIP with Synthetic Cap**	**Natural Attenuation with Monitoring** Mitigate off-site migration of groundwater with CCR constituents above GWPS through process of natural attenuation	**No Active Treatment** No active treatment technologies for groundwater to address CCR constituents	**MNA** Long-term groundwater monitoring to confirm reduction of CCR constituents
2	**CIP with Capping and Hydraulic Containment through Groundwater Pumping and Direct Discharge**	**CIP with Synthetic Cap**	**Hydraulic Containment** Mitigate off-site migration of groundwater with CCR constituents above GWPS using extraction wells pumped directly to surface water	**No Active Treatment** No active treatment technologies for groundwater to address CCR constituents	**Pump Long-Term** Continue to operate hydraulic containment system to maintain reduction of CCR constituents in groundwater
3	**CIP with Capping and Hydraulic Containment through Groundwater Pumping and Ex-Situ Treatment**	**CIP with Synthetic Cap**	**Hydraulic Containment** Mitigate off-site migration of groundwater with CCR constituents above GWPS using extraction wells	**Ex-Situ Treatment** Treatment system (ion exchange or reverse osmosis) to remove CCR constituents from groundwater and discharge under applicable permits	**Pump & Treat Long-Term** Continue to operate hydraulic containment system to maintain reduction of CCR constituents in groundwater
4	**Closure by Removal (CBR) with MNA**	**CBR**	**Natural Attenuation with Monitoring** Mitigate off-site migration of groundwater with CCR constituents above GWPS through process of natural attenuation	**No Active Treatment** No active treatment technologies for groundwater to address CCR constituents	**MNA** Long-term groundwater monitoring to confirm reduction of CCR constituents
5	**CBR with Capping and Hydraulic Containment through Groundwater Pumping and Direct Discharge**	**CBR**	**Hydraulic Containment** Mitigate off-site migration of groundwater with CCR constituents above GWPS using extraction wells pumped directly to surface water	**No Active Treatment** No active treatment technologies for groundwater to address CCR constituents	**Pump Long-Term** Continue to operate hydraulic containment system to maintain reduction of CCR constituents in groundwater
6	**CBR with Capping and Hydraulic Containment through Groundwater Pumping and Ex-Situ Treatment**	**CBR**	**Hydraulic Containment** Mitigate off-site migration of groundwater with CCR constituents above GWPS using extraction wells	**Ex-Situ Treatment** Treatment system (ion exchange or reverse osmosis) to remove CCR constituents from groundwater and discharge under applicable permits	**Pump & Treat Long-Term** Continue to operate hydraulic containment system to maintain reduction of CCR constituents in groundwater

Alternative	Remedial Alternative Synopsis	THRESHOLD CRITERIA					BALANCING CRITERIA		
		§ 257.97(b)(1) Be Protective of Human Health and the Environment	§ 257.97(b)(2) Attain the groundwater protective standard	§ 257.97(b)(3) Control the Source of Releases	§ 257.97(b)(4) Remove as much material from the environment released from the CCR unit as is feasible	§ 257.97(b)(5) Management of waste all applicable RCRA requirements	§ 257.97(c)(1) Long- and Short Term Effectiveness, Protectiveness, and Certainty of Success[1]	§ 257.97(c)(2) Effectiveness to Control Further Releases[2]	§ 257.97(c)(3) Difficulty of Implementation[3]
1	**Capping with CIP with and MNA.** Complete a low permeability cap to limit infiltration of surface water to groundwater. Continue to monitor groundwater until natural attenuation reduces concentrations downgradient.	**Meets criteria.** No current unacceptable risk to human health or the environment. Closure by capping will reduce constituents of concern entering the subsurface and MNA will reduce constituents of concern in groundwater over time.	**Meets criteria.** High degree of ability to attain the GWPS. Relies on MNA to attain the GWPS with time.	**Meets criteria.** The source of releases of groundwater constituents from the regulated unit should decrease after capping due to a reduction in infiltration of surface water and leaching via precipitation infiltration. Contaminants in concern will diminish due to MNA and source depletion.	**Meets criteria.** Isolation of mass at the waste boundary followed by in place closure of regulated unit will result in reduction of groundwater constituents migrating downgradient of the regulated unit over time.	**Meets criteria.** Regulated unit will be closed in place; RCRA wastes resulting from alternative will not be generated.	**Effective short-term** due to containing the source of contaminants and groundwater through capping. The low permeability cap will reduce the flux of water moving through source material. **Effective long-term** as natural attenuation, which requires limited management, will address groundwater contamination, after the unit is capped, through processes of CCR source leaching and depletion. **Full protection** already achieved under existing conditions, risk to community during construction will be minimal, and periodic MNA sampling poses no risk. Institutional controls can be easily enforced because Ash Pond A&B located on property owned by Santee Cooper. CIP is considered permanent but to **demonstrate success,** groundwater monitoring will be used to verify MNA. Potential exists for the need to replace remedy if CIP with MNA isn't successful long-term.	**Moderate degree of effectiveness to control further releases** due to isolation of the waste through capping. Capping expected to reduce infiltration of surface water and concentrations of constituents of concern in groundwater. Leaching and depletion of CCR constituents expected to reduce groundwater concentrations longer-term. **No groundwater treatment technologies,** other than natural attenuation, will be used.	**Remedy easy to implement** assuming cap materials readily available and since capping construction is common industry practice. **Remedy will be considered reliable** because closure in place and monitored natural attenuation are acceptable and reliable practices for long-term waste management. **Permitting** is expected to be straightforward and easily obtained. **No specialty contractors, laboratories, or equipment required.** Because Ash Pond A&B will be closed in place, **treatment, storage, and disposal services will not be needed**.
2	**Capping with CIP and Hydraulic Containment through Groundwater Pumping.** Hydraulic containment with direct discharge to surface water as an interim remediation measure, then close unit in place by capping. Continue to operate hydraulic control with pumping until concentrations are reduced downgradient.	**Meets criteria.** No current unacceptable risk to human health or the environment. Capping and hydraulic containment will reduce additional leaching of constituents to groundwater and downgradient migration.	**Meets criteria**. Attainment of the GWPS will be achieved because groundwater constituents will be removed through extraction, followed by closure in place by constructing a cap over CCR material, which will result in reducing the ability for constituents to enter the groundwater system. Downgradient concentrations will decrease to below the GWPS over time.	**Meets criteria.** The source of releases of groundwater constituents from the regulated unit should decrease after capping due to a reduction in infiltration of surface water and leaching via precipitation infiltration. Constituents in groundwater will be further addressed by hydraulic containment and pumping well effluent discharged directly to surface water.	**Meets criteria.** Removal of mass at the waste boundary followed by in place closure of regulated units will result in reduction of groundwater constituents migrating downgradient of the regulated unit over time.	**Meets criteria.** Regulated unit will be closed in place; RCRA wastes resulting from alternative will not be generated.	**Effective short-term** due to containing the source of constituents and groundwater. The low permeability cap will reduce the flux of water moving through source material. Treatment system would require **long-term operation and maintenance. Full protection** already achieved under existing conditions, **risk to community** during construction will be minimal, and periodic sampling poses no risk. Once completed, the **long-term reliability** of the hydraulic containment and direct discharge is expected to be high because this is proven technology. **Institutional controls** can be easily enforced because Ash Pond A and B is located on property owned by Santee Cooper. Potential exists for the need to replace remedy if hydraulic containment isn't successful long-term.	**Moderate degree of effectiveness to control further releases** due to isolation of the waste through capping, hydraulic containment, and direct discharge to surface water. The hydraulic containment system with direct discharge will direct contaminents to surface water, however, capping is expected to reduce infiltration of surface water and concentrations of constituents of concern in groundwater. **Treatment technology** will include groundwater pumping wells, associated pipework, and a direct discharge system.	Hydraulic containment remedy **easy to implement** because hydraulic control technology is readily available, well understood and construction is relatively straightforward. **Easy to implement** cap assuming cap materials readily available and since capping construction is common industry practice. More difficult to implement than passive remedies. **Remedy will be considered reliable** because technology known and accepted. **Permitting** will likely be required for groundwater discharge. **No specialty contractors, laboratories, or equipment required.** Because Ash Pond A and B will be closed in place, **treatment, storage, and disposal services will not be needed for CCR material**.
3	**Capping with CIP and Hydraulic Containment through Groundwater Pumping.** Hydraulic containment with ex-situ treatment as an interim remediation measure, then close unit in place by capping. Continue to operate hydraulic control with treatment until concentrations are reduced downgradient.	**Meets criteria.** No current unacceptable risk to human health or the environment. Capping and hydraulic containment will reduce additional leaching of constituents to groundwater and downgradient migration.	**Meets criteria**. Attainment of the GWPS will be achieved because groundwater constituents will be removed through extraction, followed by closure in place by constructing a cap over CCR material, which will result in reducing the ability for constituents to enter the groundwater system. Downgradient concentrations will decrease to below the GWPS over time.	**Meets criteria.** The source of releases of groundwater constituents from the regulated unit should decrease after capping due to a reduction in infiltration of surface water and leaching via precipitation infiltration. Constituents in groundwater will be further addressed by hydraulic containment and ex-situ treatment.	**Meets criteria.** Removal of mass at the waste boundary followed by in place closure of regulated units will result in reduction of groundwater constituents migrating downgradient of the regulated unit over time.	**Meets criteria.** Regulated unit will be closed in place; RCRA wastes resulting from alternative will not be generated.	**Effective short-term** due to containing the source of constituents and groundwater. The low permeability cap will reduce the flux of water moving through source material. Treatment system would require **long-term operation and maintenance. Full protection** already achieved under existing conditions, **risk to community** during construction will be minimal, and periodic sampling poses no risk. Once completed, the **long-term reliability** of the hydraulic containment and ex-situ treatment system is expected to be high because this is proven technology. **Institutional controls** can be easily enforced because Ash Pond A&B is located on property owned by Santee Cooper. Potential exists for the need to replace remedy if hydraulic containment isn't successful long-term.	**Moderate degree of effectiveness to control further releases** due to isolation of the waste through capping, hydraulic containment, and ex-situ treatment. Capping expected to reduce infiltration of surface water and concentrations of constituents of concern in groundwater, and hydraulic containment with ex-situ treatment will treat groundwater at the unit boundary. **Treatment technology** will include groundwater pumping wells, associated pipework, and an ex-situ treatment system.	Hydraulic containment remedy **easy to implement** because hydraulic control technology is readily available, well understood and construction is relatively straightforward. Easy to implement cap assuming cap materials readily available and since capping construction is common industry practice. More difficult to implement than passive remedies. **Remedy will be considered reliable** because technology known and accepted. **Permitting** will likely be required for treated groundwater discharge. **No specialty contractors, laboratories, or equipment required.** Because Ash Pond A and B will be closed in place, **treatment, storage, and disposal services will not be needed for CCR material**. The ex-situ treatment system may generate a concentrated waste stream which would likely require off-site transportation and disposal.

Alternative	Remedial Alternative Synopsis	THRESHOLD CRITERIA					BALANCING CRITERIA		
		§ 257.97(b)(1) Be Protective of Human Health and the Environment	§ 257.97(b)(2) Attain the groundwater protective standard	§ 257.97(b)(3) Control the Source of Releases	§ 257.97(b)(4) Remove as much material from the environment released from the CCR unit as is feasible	§ 257.97(b)(5) Management of waste all applicable RCRA requirements	§ 257.97(c)(1) Long- and Short Term Effectiveness, Protectiveness, and Certainty of Success[1]	§ 257.97(c)(2) Effectiveness to Control Further Releases[2]	§ 257.97(c)(3) Difficulty of Implementation[3]
4	**CBR with MNA.** Continue to monitor groundwater until natural attenuation reduces concentrations downgradient.	**Meets criteria.** No current unacceptable risk to human health or the environment. Remedy by removal will eliminate constituents of concern from entering the subsurface.	**Meets criteria**. High degree of ability to attain the groundwater protection standard (GWPS). Removing CCR material will eliminate additional constituents of concern entering the subsurface longer-term. Relies on MNA to address the existing plume and attain the GWPS with time.	**Meets criteria.** High degree of ability to control source because the remedy includes removal of the source of contaminants.	**Meets criteria.** High ability to remove material from the environment. Following removal of source, contamination to surrounding environment not expected.	**Meets criteria.** High degree of ability to meet RCRA waste management requirements during implementation.	Remedy by removal provides a **high degree of long- term effectiveness** due to eliminating the source of contamination; **success of remedy certain**. **Moderate degree of short-term** risk to the community associated with removal project due to design, permitting, and construction, but eliminates source material and therefore constituents of concern will not migrate beyond waste boundary longer-term. **Full protection** already achieved under existing conditions and periodic MNA sampling poses no risk. **Institutional controls** can be easily enforced because Ash Pond A and B located on property owned by Santee Cooper. CBR is considered permanent but requires groundwater monitoring to verify MNA. Potential exists for the need to replace remedy if CBR with MNA isn't successful long-term.	**Moderate degree of effectiveness short-term** since beneficial reuse has already begun. **High degree of effectiveness to control further releases long-term** due to removal of the source of contaminants once construction is complete. No groundwater treatment technologies, other than natural attenuation, will be used.	**Not Difficult to implement remedy** by removal due to estimated haul volume (3.2 MM tons) of CCR. Logistical and safety challenges of extracting and transporting waste material for beneficial reuse or to an existing third-party landfill.P**ermitting** anticipated to be straight forward for completing the closure by removal and **specialty remediation/dewatering contractors** are not anticipated.
5	**CBR with Hydraulic Containment through Groundwater Pumping.** Hydraulic containment with direct discharge to surface water as an interim remediation measure, then close unit. Continue to operate hydraulic control with pumping until concentrations are reduced downgradient.	**Meets criteria.** No current unacceptable risk to human health or the environment. Remedy by removal will eliminate constituents of concern from entering the subsurface. Hydraulic containment will reduce additional leaching of constituents to groundwater and downgradient migration.	**Meets criteria**. High degree of ability to attain the groundwater protection standard (GWPS). Removing CCR material will eliminate additional constituents of concern entering the subsurface longer-term. Attainment of the GWPS will be achieved because groundwater constituents will be removed through extraction. Downgradient concentrations will decrease to below the GWPS over time.	**Meets criteria.** High degree of ability to control source because the remedy includes removal of the source of contaminants. The source of releases of groundwater constituents from the regulated unit should decrease after capping due to a reduction in infiltration of surface water and leaching via precipitation infiltration. Constituents in groundwater will be further addressed by hydraulic containment and pumping well effluent discharged directly to surface water.	**Meets criteria.** High ability to remove material from the environment. Following removal of source, contamination to surrounding environment not expected. Removal of mass at the waste boundary will result in reduction of groundwater constituents migrating downgradient of the regulated unit over time.	**Meets criteria.** High degree of ability to meet RCRA waste management requirements during implementation.	Remedy by removal provides a **high degree of long- term effectiveness** due to eliminating the source of contamination; **success of remedy certain**. **Moderate degree of short-term** risk to the community associated with removal project due to design, permitting, and construction, but eliminates source material and therefore constituents of concern will not migrate beyond waste boundary longer-term. **Full protection** already achieved under existing conditions and periodic MNA sampling poses no risk. **Institutional controls** can be easily enforced because Ash Pond A and B located on property owned by Santee Cooper. CBR is considered permanent but requires groundwater monitoring to verify MNA. Potential exists for the need to replace remedy if CBR with hydraulic containment isn't successful long-term.	**Moderate degree of effectiveness short-term** since beneficial reuse has already begun. **High degree of effectiveness to control further releases long-term** due to removal of the source of contaminants once construction is complete. In addition, hydraulic containment with direct discharge to surface water treatment will be used.	**Moderate difficulty to implement remedy** by removal due to estimated haul volume (3.2 MM tons) of CCR. Logistical and safety challenges of extracting and transporting waste material for beneficial reuse or to an existing third-party landfill.**Permitting** anticipated to be straight forward for completing the closure by removal and s**pecialty remediation/dewatering contractors** are not anticipated.
6	**CBR with Hydraulic Containment through Groundwater Pumping.** Hydraulic containment with ex-situ treatment as an interim remediation measure, then close unit in place. Continue to operate hydraulic control with treatment until concentrations are reduced downgradient.	**Meets criteria.** No current unacceptable risk to human health or the environment. Remedy by removal will eliminate constituents of concern from entering the subsurface. Hydraulic containment will reduce additional leaching of constituents to groundwater and downgradient migration.	**Meets criteria**. High degree of ability to attain the groundwater protection standard (GWPS). Removing CCR material will eliminate additional constituents of concern entering the subsurface longer-term. Attainment of the GWPS will be achieved because groundwater constituents will be removed through extraction. Downgradient concentrations will decrease to below the GWPS over time.	**Meets criteria.** High degree of ability to control source because the remedy includes removal of the source of contaminants. The source of releases of groundwater constituents from the regulated unit should decrease after capping due to a reduction in infiltration of surface water and leaching via precipitation infiltration. Constituents in groundwater will be further addressed by hydraulic containment and ex-situ treatment.	**Meets criteria.** High ability to remove material from the environment. Following removal of source, contamination to surrounding environment not expected. Removal of mass at the waste boundary will result in reduction of groundwater constituents migrating downgradient of the regulated unit over time.	**Meets criteria.** High degree of ability to meet RCRA waste management requirements during implementation.	Remedy by removal provides a **high degree of long- term effectiveness** due to eliminating the source of contamination; **success of remedy certain**. **Moderate degree of short-term** risk to the community due to transporation, but eliminates source material. Once completed, the **long-term reliability** of the hydraulic containment and ex-situ treatment is expected to be high because this is proven technology. **Full protection** already achieved under existing conditions and periodic MNA sampling poses no risk. **Institutional controls** can be easily enforced. CBR is considered permanent but requires groundwater monitoring to verify MNA. Potential exists for the need to replace remedy if CIP with MNA isn't successful long-term.	**Moderate degree of effectiveness short-term** since beneficial reuse has already begun. **High degree of effectiveness to control further releases long-term** due to removal of the source of contaminants once construction is complete. In addition, hydraulic containment with ex-situ treatment will be used.	**Moderate Difficulty to implement remedy** by removal due to estimated haul volume (3.2 MM tons) of CCR. Logistical and safety challenges of extracting and transporting waste material for beneficial reuse or to an existing third-party landfill.P**ermitting** anticipated to be straight forward for completing the closure by removal and s**pecialty remediation/dewatering contractors** are not anticipated.

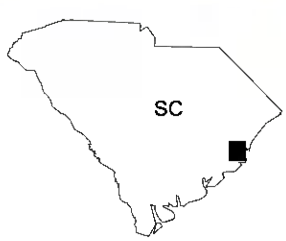
Most favorable when compared to other alternatives (green)
Less favorable when compared to other alternatives (yellow)
Least favorable when compared to other alternatives (red)

1 The long- and short- term effectiveness evaluation considered the following criteria:
(i) Magnitude of reduction of existing risks;
(ii) Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy;
(iii) The type and degree of long-term management required, including monitoring, operation, and maintenance;
(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;
(v) Time until full protection is achieved;
(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;
(vii) Long-term reliability of the engineering and institutional controls; and
(viii) Potential need for replacement of the remedy.

2. The effectivness in centrolling the source ot reduce further releases considered the following criteria:
(i)The extent to which containment practices will reduce further releases.
(ii)The extent to which treatment technologies may be used.

3. The ease or difficulty of implmentation considered the following criteria:
(i)Degree of difficulty associated with constructing the technology.
(ii)Expected operational reliability of the technologies.
(iii)Need to coordinate with and obtain necessary approvals and permits from other agencies.
(iv) Availability of necessary equipment and specialists.
(v) Available capacity and location of needed treatment, storage, and disposal services.

FIGURES



N

MAP SOURCE: ESRI
SITE COORDINATES: 33°19'25"N, 79°21'14"W

HALEY ALDRICH

SANTEE COOPER
WINYAH GENERATING STATION
GEORGETOWN, SOUTH CAROLINA

SITE LOCATION MAP

APPROXIMATE SCALE: 1 IN = 1 MILE
AUGUST 2019

FIGURE 1

GIS FILE PATH: \\haleyaldrich.com\share\gm_common\131539 - Santee Cooper\GIS\Maps\2019_08\132892_000_0001_PROJECT_LOCUS.mxd — USER: hwachholz — LAST SAVED: 8/28/2019 4:47:38 PM

LEGEND

PROPERTY BOUNDARY

N

0 1,400 2,800
SCALE IN FEET

NOTE
1. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

SANTEE COOPER
WINYAH GENERATING STATION
GEORGETOWN, SOUTH CAROLINA

SITE INDEX MAP

SEPTEMBER 2019

FIGURE 2

GIS FILE PATH: \\haleyaldrich\share\grn_common\131539 - Santee Cooper\GIS\Maps\2019_09\132892_000_0002_SITE_INDEX.mxd — USER: hwachholz — LAST SAVED: 9/10/2019 2:42:48 PM

LEGEND

CCR MONITORING WELL

NATURE AND EXTENT MONITORING WELL

PROPERTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

2. AERIAL IMAGERY SOURCE: ESRI

N

0 580 1,160

SCALE IN FEET

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SANTEE COOPER
WINYAH GENERATING STATION
GEORGETOWN, SOUTH CAROLINA

LOCATION OF GROUNDWATER MONITORING WELLS FOR CCR COMPLIANCE - ASH POND A AND B

SEPTEMBER 2019

FIGURE 3

GIS FILE PATH: \\haleyaldrich\share\gn_common\131539 - Santee Cooper\GIS\Maps\2019_09\132892_006_0003_MONITORING_WELL_LOCATIONS.mxd — USER: hwachholz — LAST SAVED: 9/10/2019 2:47:05 PM

LEGEND

- CCR MONITORING WELL
- NATURE AND EXTENT MONITORING WELL
- LOCATION WITH SSI
- PROPERTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI

N

0 580 1,160
SCALE IN FEET

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WINYAH GENERATING STATION
GEORGETOWN, SOUTH CAROLINA

LOCATION OF APPENDIX III SSIS

SEPTEMBER 2019

FIGURE 4

GIS FILE PATH: \\haleyaldrich\share\gn_common\131539 - Santee Cooper\GIS\Maps\2019_09\132892_006_0004_MONITORING_WELL_LOCATIONS_SSI.mxd — USER: hwachholz — LAST SAVED: 9/10/2019 2:49:52 PM

LEGEND

- CCR MONITORING WELL
- NATURE AND EXTENT MONITORING WELL
- LOCATION WITH SSL
- PROPERTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI

N

0 580 1,160
SCALE IN FEET

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WINYAH GENERATING STATION
GEORGETOWN, SOUTH CAROLINA

LOCATION OF APPENDIX IV SSLS

SEPTEMBER 2019

FIGURE 5

GIS FILE PATH: \\haleyaldrich\share\gn_common\131539 - Santee Cooper\GIS\Maps\2019_09\132892_006_0005_MONITORING_WELL_LOCATIONS_SSL.mxd — USER: hwachholz — LAST SAVED: 9/10/2019 2:53:06 PM

LEGEND

MONITORING WELLS WITH GROUNDWATER ELEVATIONS INDICATED IN FEET

- CCR MONITORING WELL
- NEWLY ADDED MONITORING WELL
- OTHER MONITORING WELL
- GROUNDWATER ELEVATION CONTOUR, 1-FT INTERVAL
- INFERRED GROUNDWATER ELEVATION CONTOUR, 1-FT INTERVAL
- PROPERTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. WATER LEVELS MEASURED BETWEEN 30 MAY AND 29 JUNE 2019.
3. AERIAL IMAGERY SOURCE: ESRI

N

0 580 1,160
SCALE IN FEET

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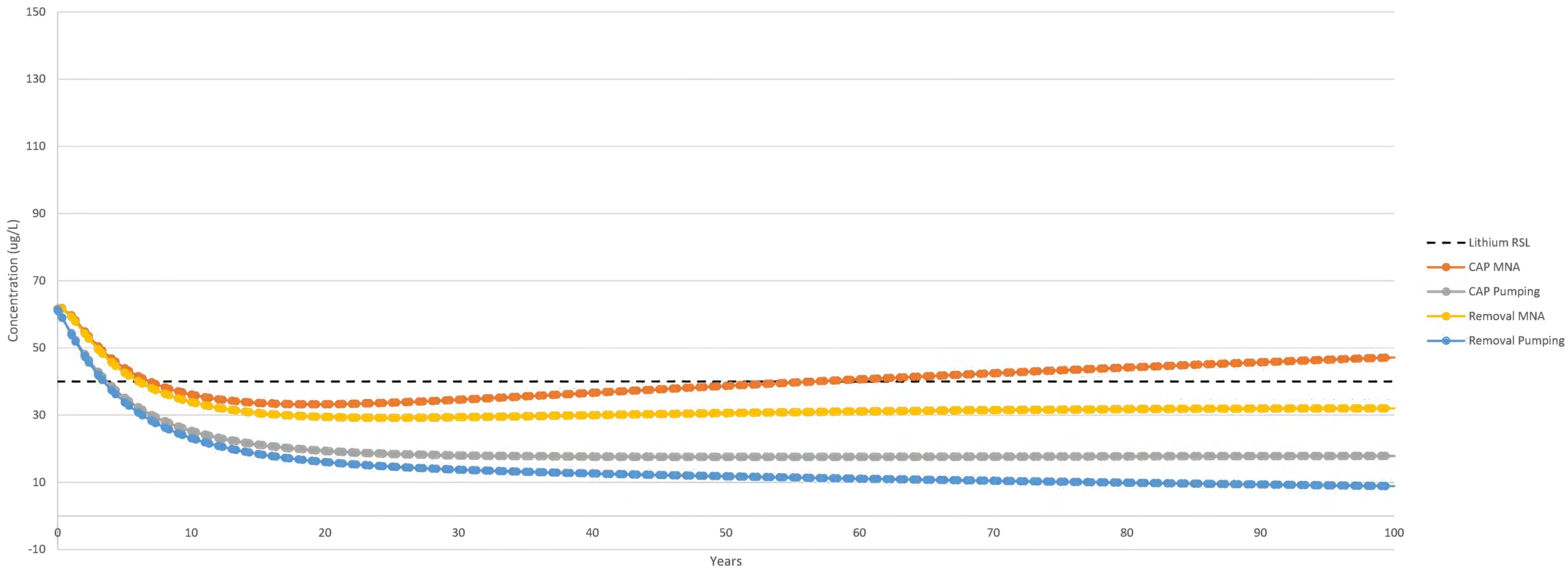
WINYAH GENERATING STATION
GEORGETOWN, SOUTH CAROLINA

WATER TABLE CONFIGURATION MAP

SEPTEMBER 2019

FIGURE 6

Modeled Lithium Concentrations Following Remedy Implementation - Ash Pond A and B
Winyah Generating Station - Georgetown, South Carolina



NOTES:
1.) ug/L - Micrograms per liter
2.) GWPS - Groundwater Protection Standard.
3.) Concentrations are representative of monitoring point at the boundary of the waste

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WINYAH GENERATING STATION
GEORGETOWN, SOUTH CAROLINA

MODELED LITHIUM CONCENTRATIONS FOLLOWING REMEDY IMPLEMENTATION - ASH POND A AND B

September 2019

Figure 7

APPENDIX A

Boring Logs

TEST BORING REPORT

Boring No. WAP-22

Project	Nature and Extent, Winyah Generating Station
Client	Santee Cooper
Contractor	Saedacco

File No.	132892-018
Sheet No.	1 of 2
Start	May 22, 2019
Finish	May 22, 2019
Driller	Richy Lemire
H&A Rep.	J. Yonts
Elevation	
Datum	
Location	7-ft East of WAP-18

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1 3/8	--
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)	-	30	-

Drilling Equipment and Procedures

- Rig Make & Model: Diedrich D-50 Turbo
- Bit Type: Cutting Head
- Drill Mud: None
- Casing: Spun
- Hoist/Hammer: Winch Automatic Hammer
- PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size[†], structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0				SM			Brown silty SAND (SM), no odor, mps 1.0mm, dry, 1/4-in thick and 8-in long metal wire and plastic trash in cuttings					70	30				
5				SM			Dark brown silty SAND (SM), no odor, mps 1.0mm, moist, abundant wood and roots					60	40				
10				SM			Similar to above					60	40				
15				SM		16.0	Tan silty SAND (SM), no odor, mps 1.0mm, moist, no wood in cuttings					65	35				
20	10 17 24 28	S1 18	20.0 22.0	SM			Dense dark brown silty SAND (SM), no odor, no structure, moist				5	60	35				
25																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

- O - Open End Rod
- T - Thin Wall Tube
- U - Undisturbed Sample
- S - Split Spoon Sample

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (ft)	54
Rock Cored (ft)	-
Samples	8S

Boring No. WAP-22

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

[†]Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

HALEY ALDRICH

Boring No. WAP-22
File No. 132892-018
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	11 7 7 7	S2 12	25.0 27.0	SM		Similar to above except wet										
				SM	26.0	Medium dense red-brown silty SAND (SM), no odor, wet, less cohesion than soil above, 2-in thick wood separating layer from above				5	75	20				
30	7 3 3 4	S3 4	30.0 32.0	SM		No soil recovery, 4-in long wood stuck in shoe										
						Cuttings turn dark brown with abundant wood										
35	5 4 4 6	S4 20	35.0 37.0	SM	35.0	Loose brown silty SAND (SM), no odor, wet				5	70	25				
				SM	36.8	Loose gray silty SAND (SM), no odor, wet				10	70	20				
40																
	2 3 3 7	S5 12	41.0 43.0	SC	41.0	Loose blue-gray and gray clayey SAND (SC), mps 3.0mm, no odor, wet, abundant shell fragments		5	20	45	15	15				
45																
	2 5 3 5	S6 24	46.0 48.0	SM	46.0	Loose brown and gray-brown silty SAND (SM), no odor, wet				40	30	30				
						Similar to above except abundant shell fragments										
50	9 7 8 10	S7 19	50.0 52.0	GP-GC	50.0	Medium dense blue-gray poorly-graded GRAVEL with clay and sand (GP-GC), no odor, mps 28mm, abundant shell fragments	25	25	20	10	10	10				
	16 36 10 50/2"	S8 24	55.0 57.0	GP-GC		Similar to above except abundant wood										
				GP-GC		Similar to above										
					57.0	BOTTOM OF EXPLORATION 57.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

HALEY ALDRICH

Boring No. WAP-23

Project	Nature and Extent, Winyah Generating Station
Client	Santee Cooper
Contractor	Saedacco
File No.	132892-018
Sheet No.	1 of 2
Start	May 23, 2019
Finish	May 23, 2019
Driller	Richy Lemire
H&A Rep.	J. Yonts
Elevation	
Datum	
Location	8-ft South of WAP-20

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1 3/8	--
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)	-	30	-

Drilling Equipment and Procedures

Rig Make & Model: Diedrich D-50 Turbo
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size[†], structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0				SC			Orange and orange-brown clayey SAND (SC), no odor, mps 1.0 mm, moist				10	50	40				
5				SC			Cuttings become dark brown				5	60	35				
				SC			Cuttings become dark brown to black				10	60	30				
				SC			Cuttings become dark gray to gray-brown				10	55	35				
10				SM		11.0	Cuttings become brown silty SAND (SM), no odor, moist, mps 2.0 mm, moist				15	50	35				
15				SM			Cuttings become brown to gray-brown silty SAND (SM), no odor, moist, mps 2.0 mm, moist				15	60	25				
20	2 6 5 6	S1 12	20.0 22.0	SM			Medium dense gray-brown silty SAND (SM), no odor, mps 2.0 mm, wet				10	60	30				
							Note: Rig chatter at ~24.0 ft bgs.										
25																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 49
Rock Cored (ft) -
Samples 7S

Boring No. WAP-23

Field Tests: **Dilatancy:** R - Rapid S - Slow N - None **Toughness:** L - Low M - Medium H - High **Plasticity:** N - Nonplastic L - Low M - Medium H - High **Dry Strength:** N - None L - Low M - Medium H - High V - Very High

[†]**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV 132892_HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT G:\131539 - SANTEE COOPER\WINYAH GENERATING STATION\PROJECT DATA\GINT\2019_0606_HAI_N&E WGS_D1.GPJ Sep 5, 19

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	0 3 5 5	S2 12	25.0 27.0	SC		25.0	Loose gray clayey SAND (SC), no odor, mps 2.0 mm, wet				20	50	30				
							Note: Rig chatter 26.0 ft bgs to 27.5 ft bgs										
30	10 6 3 4	S3 15	30.0 32.0				Similar to above										
				SC		30.5	Loose brown and tan clayey SAND (SC), mps 3.0 mm, wet, wood at 31.0 ft			15	55	15	15				
				SM		31.3	Loose tan silty SAND (SM), no structure, no odor, mps 2.0 mm, wet, subrounded quartz sand with trace mica				20	50	30				
35	6 7 6 10	S4 13	35.0 37.0	SP-SM		35.0	Medium dense tan and gray poorly-graded SAND with silt (SP-SM), no odor, mps 8.0 mm, wet, spoon filled with 6-in of wood		10	40	20	10	10				
40	5 5 5 5	S5 14	40.0 42.0	SP-SM			Similar to above with wood and shell fragments	5	15	30	20	10	10				
				SC		41.0	Loose gray clayey SAND (SC), no odor, mps 2.0 mm, wet, trace wood and shell fragments				10	50	40				
45	3 2 5 4	S6 20	45.0 47.0	SC			Loose gray clayey SAND (SC) with abundant shell fragments, no odor, mps 5.0 mm, wet		5	15	45	20	15				
							Note: Rig chatter ~49.0 ft bgs										
50	7 7 10 22	S7 20	50.0 52.0	SC			Similar to above except more consolidated										
						52.0	BOTTOM OF EXPLORATION 52.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. WAP-24

Project	Nature and Extent, Winyah Generating Station	File No.	132892-018
Client	Santee Cooper	Sheet No.	1 of 2
Contractor	Saedacco	Start	May 23, 2019
		Finish	May 23, 2019
		Driller	Richy Lemire
		H&A Rep.	J. Yonts
		Elevation	
		Datum	
		Location	Between WAP-9 and WAP-10

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	--	Rig Make & Model: Diedrich D-50 Turbo
Inside Diameter (in.)	4.25	1 3/8	--	Bit Type: Cutting Head Drill Mud: None
Hammer Weight (lb)	-	140	-	Casing: Spun
Hammer Fall (in.)	-	30	-	Hoist/Hammer: Winch Automatic Hammer PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size[†], structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Toughness	Plasticity	Strength
0				SM			Dark brown and gray silty SAND (SM), no odor, mps 1.5 mm, moist, abundant roots and wood				5	55	40				
5																	
10																	
							Cuttings become wet										
15																	
20	1 1 2 4	S1 8	20.0 22.0	SM		20.0	Very loose interbedded brown silty SAND (SM) and gray clayey SAND (SC), no odor, wet, trace wood Sample rod wet at 9 ft bgs				10	55	35				
25																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
- O - Open End Rod
- T - Thin Wall Tube
- U - Undisturbed Sample
- S - Split Spoon Sample

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary
- Overburden (ft) 45
- Rock Cored (ft) -
- Samples 6S

Boring No. WAP-24

Field Tests: Dilatancy: R - Rapid S - Slow N - None; Toughness: L - Low M - Medium H - High; Plasticity: N - Nonplastic L - Low M - Medium H - High; Dry Strength: N - None L - Low M - Medium H - High V - Very High

[†]Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

HALEY ALDRICH

Boring No. WAP-24
File No. 132892-018
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	1 5 7 9	S2 12	25.0 27.0	SM		25.0	Medium dense gray and green silty SAND (SM) with abundant shell fragments, no odor, mps 3.0 mm, wet, shell fragments up to 10.0 mm and compose 40 to 50% of sample			30	25	25	20				
30	4 4 4 5	S3 24	30.0 32.0	SM		30.0	Loose gray and green silty SAND (SM), no odor, mps 2.0 mm, wet, no shell and trace wood				15	50	35				
				SC		31.6	Loose green and gray clayey SAND (SC), no odor, mps 3.0 mm, wet, abundant shell fragments, no wood, shell fragments up to 8.0 mm			20	25	35	20				
35	6 9 20 50/6"	S4 15	35.0 37.0	SC		35.0	Medium dense green and gray clayey SAND (SC), no odor, mps 3.0 mm, wet			10	30	40	20				
				CL		36.4	Dense gray sandy CLAY (CL), no structure, no odor, mps 1.0 mm, wet					30	70				
40	6 11 14 19	S5 20	40.0 42.0	CL			Similar to above except frequent shell fragments				5	30	65				
45	50/2"	S6 2	45.0 47.0			45.2	Note: Rig chatter at ~45.0 ft bgs. Similar to above except consolidated Refusal at 45.2 ft.										

BOTTOM OF EXPLORATION 45.2 FT

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. WAP-24

TEST BORING REPORT

Boring No. WAP-25

Project	Nature and Extent, Winyah Generating Station
Client	Santee Cooper
Contractor	Saedacco

File No.	132892-018
Sheet No.	1 of 2
Start	May 21, 2019
Finish	May 21, 2019
Driller	Richy Lemire
H&A Rep.	J. Yonts
Elevation	
Datum	
Location	See Plan; East side of Cooling Water Pond

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1 3/8	--
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)	-	30	-

Drilling Equipment and Procedures
- Rig Make & Model: Diedrich D-50 Turbo
- Bit Type: Cutting Head
- Drill Mud: None
- Casing: Spun
- Hoist/Hammer: Winch Automatic Hammer
- PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0				SM		Tan silty SAND (SM), no odor, moist				25	45	30				
5				SM	5.0	Light tan to yellow silty SAND (SM), no odor, moist			5	20	50	25				
				SM		Cuttings become light tan										
10																
				SM	13.5	Cuttings become gray										
15	1 1 0 1	S1 24	15.0 17.0	CH	15.0	Very soft gray fat CLAY (CH), no structure, no odor, mps <0.075mm, moist to wet						100				
20	1 1 1 2	S2 24	20.0 22.0													
25																

Well Diagram: Grout from 0 to approximately 22.5 ft; Bentonite Seal below to 25 ft.

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
- O - Open End Rod
- T - Thin Wall Tube
- U - Undisturbed Sample
- S - Split Spoon Sample

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary
- Overburden (ft) 37
- Rock Cored (ft) -
- Samples 4S

Boring No. WAP-25

Field Tests: **Dilatancy:** R - Rapid S - Slow N - None **Toughness:** L - Low M - Medium H - High **Plasticity:** N - Nonplastic L - Low M - Medium H - High **Dry Strength:** N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	2 7 8 9	S3 23	25.0 27.0	CH			Similar to above										
				SM		26.3	Medium dense gray silty SAND (SM), no odor, mps 1.0 mm, <1.0 in. broken shell layer separating gray clay and gray sand				10	65	25				
30	1 2 4 4	S4 24	30.0 32.0	SM			Loose gray silty SAND (SM), no odor, mps 2.0 mm, wet				55	20	25				
35						37.0	BOTTOM OF EXPLORATION 37.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY ALDRICH

TEST BORING REPORT

Boring No. WAP-26

Project	Nature and Extent, Winyah Generating Station
Client	Santee Cooper
Contractor	Saedacco

File No. 132892-018
Sheet No. 1 of 1
Start May 21, 2019
Finish May 2, 2019
Driller Richy Lemire
H&A Rep. J. Yonts
Elevation
Datum
Location See Plan; NW corner of Cooling Water Pond

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1 3/8	--
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)	-	30	-

Drilling Equipment and Procedures
Rig Make & Model: Diedrich D-50 Turbo
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Toughness	Plasticity	Strength
0				SM			Brown and orange silty SAND (SM), no odor, mps 1.0 mm, moist				10	60	30				
5							Cutting become dark brown										
10							Cutting become wet										
15	4 3 3 4	S1 8	15.0 17.0				Loose brown and dark brown silty SAND (SM), stratified, no odor, mps 1.0 mm, wet, red root at 16.5-ft				15	50	25				
20	1 1 1 0	S2 0	20.0 22.0				No recovery										
						22.0	BOTTOM OF EXPLORATION 22.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 22
Rock Cored (ft) -
Samples 2S

Boring No. WAP-26

Field Tests: **Dilatancy:** R - Rapid S - Slow N - None **Toughness:** L - Low M - Medium H - High **Plasticity:** N - Nonplastic L - Low M - Medium H - High **Dry Strength:** N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV 132892_HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT G:\131539 - SANTEE COOPER\WINYAH GENERATING STATION\PROJECT DATA\GINT\2019_0606_HAI_N&E WGS_D1.GPJ Sep 5, 19

APPENDIX B

Analytical Data

santee cooper

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Moncks Corner, SC 29461-2901
(843) 761-8000

SANTEE COOPER ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE43953 **Location:** GW Well WBW-1 **Date:** 05/30/2019 **Sample Collector:** ATH/JCT

Loc. Code WBW-1 **Time:** 11:44

Analysis	Result	Units	Test Date	Analyst	Method
Aluminum	<0.50	mg/L	06/10/2019	SJHATCHE	EPA 6020B
Alkalinity	<4.00	mg/L	06/05/2019	GEL	SM 2320B
Bicarbonate Alkalinity	<4.00	mg/L	06/05/2019	GEL	SM 2320B
Arsenic	<5.0	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Arsenic Dissolved	<5.0	ug/L	06/09/2019	SJHATCHE	EPA 6020B
Boron	85	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Barium	12.4	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Calcium	<0.50	mg/L	06/10/2019	SJHATCHE	EPA 6020B
Calcium Dissolved	<0.50	mg/L	06/09/2019	SJHATCHE	EPA 6020B
Cadmium	<0.50	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Chloride	2.71	mg/L	06/04/2019	KCWELLS	EPA 300.0
Cobalt	<0.50	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Spec. Cond.	37.0	uS	05/29/2019	MG, AH	
Chromium	<5.0	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Copper	<5.0	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Depth	5.34	Feet	05/29/2019	MG, AH	
Dissolved Oxygen	0.570	ppm	05/29/2019	MG, AH	
Dissoloved Organic Carbon	1.13	mg/L	06/07/2019	GEL	SM 5310B
Elevation	26.63	Feet	05/29/2019	MG, AH	
Iron	303	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Iron - Dissolved	215	ug/L	06/09/2019	SJHATCHE	EPA 6020B
Fluoride	<0.10	mg/L	06/04/2019	KCWELLS	EPA 300.0
Potassium	<0.50	mg/L	06/10/2019	SJHATCHE	EPA 6020B
Potassium Dissolved	<0.50	mg/L	06/09/2019	SJHATCHE	EPA 6020B
Lithium	<10	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Lithium Dissolved	<10	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Magnesium	0.24	mg/L	06/10/2019	SJHATCHE	EPA 6020B
Magnesium Dissolved	0.24	mg/L	06/09/2019	SJHATCHE	EPA 6020B
Manganese	6.4	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Manganese Dissolved	6.0	ug/L	06/09/2019	SJHATCHE	EPA 6020B
Molybdenum	<10	ug/L	06/05/2019	ROGERSNCALLC	EPA 6020B
Molybdenum Dissolved	<10	mg/L	06/05/2019	ROGERSNCALLC	EPA 6020B
Sodium	2.1	mg/L	06/10/2019	SJHATCHE	EPA 6020B
Sodium Dissolved	2.0	mg/L	06/09/2019	SJHATCHE	EPA 6020B
Oxidation Reduction Potential	173	mv	05/29/2019	MG, AH	SM2580
Lead	<10.0	ug/L	06/10/2019	SJHATCHE	EPA 6020B
pH	4.02	SU	05/29/2019	MG, AH	
Radium 226	<1.00	pCi/L	06/25/2019	GEL	EPA 903.1 Mod
Radium 228	<3.00	pCi/L	06/27/2019	GEL	EPA 904.0
Radium 226/228 Combined Calculation	0.564	pCi/L	07/02/2019	LCWILLIA	EPA 903.1 Mod
Selenium	<10.0	ug/L	06/11/2019	SJHATCHE	EPA 6020B
Sulfate	5.64	mg/L	06/04/2019	KCWELLS	EPA 300.0
Sulfide	<0.100	mg/L	06/04/2019	GEL	EPA 9034

santee cooper

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SANTEE COOPER ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE43953 **Location:** GW Well WBW-1 **Date:** 05/30/2019 **Sample Collector:** ATH/JCT

Loc. Code WBW-1 **Time:** 11:44

Analysis	Result	Units	Test Date	Analyst	Method
Total Dissolved Solids	21.25	mg/L	06/07/2019	KLMORAN	SM 2540C
Temp	28.26	C	05/29/2019	MG, AH	
Total Organic Carbon	1.02	mg/L	06/07/2019	GEL	SM 5310B
Turbidity	0	NTU	05/29/2019	MG, AH	
Zinc	10.1	ug/L	06/11/2019	SJHATCHE	EPA 6020B

Comments:

Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated: *Linda Williams*

Linda Williams - Supervisor Analytical Services

santee cooper

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Moncks Corner, SC 29461-2901
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SANTEE COOPER ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE43954 **Location:** GW Well WAP-1 **Date:** 05/30/2019 **Sample Collector:** ATH/JCT

Loc. Code WAP-1 **Time:** 13:28

Analysis	Result	Units	Test Date	Analyst	Method
Aluminum	1.3	mg/L	06/10/2019	SJHATCHE	EPA 6020B
Alkalinity	<4.00	mg/L	06/05/2019	GEL	SM 2320B
Bicarbonate Alkalinity	<4.00	mg/L	06/05/2019	GEL	SM 2320B
Arsenic	<5.0	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Arsenic Dissolved	<5.0	ug/L	06/09/2019	SJHATCHE	EPA 6020B
Boron	54	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Barium	39.9	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Calcium	1.9	mg/L	06/10/2019	SJHATCHE	EPA 6020B
Calcium Dissolved	1.7	mg/L	06/09/2019	SJHATCHE	EPA 6020B
Cadmium	<0.50	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Chloride	5.08	mg/L	05/31/2019	KCWELLS	EPA 300.0
Cobalt	0.59	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Spec. Cond.	73.0	uS	05/29/2019	MG, AH	
Chromium	<5.0	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Copper	<5.0	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Depth	6.76	Feet	05/29/2019	MG, AH	
Dissolved Oxygen	0.780	ppm	05/29/2019	MG, AH	
Dissoloved Organic Carbon	2.64	mg/L	06/08/2019	GEL	SM 5310B
Elevation	22.68	Feet	05/29/2019	MG, AH	
Iron	1710	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Iron - Dissolved	1530	ug/L	06/09/2019	SJHATCHE	EPA 6020B
Fluoride	<0.10	mg/L	05/31/2019	KCWELLS	EPA 300.0
Potassium	<0.50	mg/L	06/10/2019	SJHATCHE	EPA 6020B
Potassium Dissolved	<0.50	mg/L	06/09/2019	SJHATCHE	EPA 6020B
Lithium	<10	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Lithium Dissolved	<10	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Magnesium	0.62	mg/L	06/10/2019	SJHATCHE	EPA 6020B
Magnesium Dissolved	0.55	mg/L	06/09/2019	SJHATCHE	EPA 6020B
Manganese	8.4	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Manganese Dissolved	8.3	ug/L	06/09/2019	SJHATCHE	EPA 6020B
Molybdenum	<10	ug/L	06/05/2019	ROGERSNCALLC	EPA 6020B
Molybdenum Dissolved	<10	mg/L	06/05/2019	ROGERSNCALLC	EPA 6020B
Sodium	4.7	mg/L	06/11/2019	SJHATCHE	EPA 6020B
Sodium Dissolved	4.1	mg/L	06/09/2019	SJHATCHE	EPA 6020B
Oxidation Reduction Potential	164	mv	05/29/2019	MG, AH	SM2580
Lead	<10.0	ug/L	06/10/2019	SJHATCHE	EPA 6020B
pH	4.58	SU	05/29/2019	MG, AH	
Radium 226	0.742	pCi/L	06/25/2019	GEL	EPA 903.1 Mod
Radium 228	<3.00	pCi/L	06/27/2019	GEL	EPA 904.0
Radium 226/228 Combined Calculation	1.37	pCi/L	07/02/2019	LCWILLIA	EPA 903.1 Mod
Selenium	<10.0	ug/L	06/11/2019	SJHATCHE	EPA 6020B
Sulfate	16.0	mg/L	05/31/2019	KCWELLS	EPA 300.0
Sulfide	<0.100	mg/L	06/04/2019	GEL	EPA 9034
Total Dissolved Solids	43.75	mg/L	06/07/2019	KLMORAN	SM 2540C
Temp	28.25	C	05/29/2019	MG, AH	

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CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE43954 **Location:** GW Well WAP-1 **Date:** 05/30/2019 **Sample Collector:** ATH/JCT

Loc. Code WAP-1 **Time:** 13:28

Analysis	Result	Units	Test Date	Analyst	Method
Total Organic Carbon	2.62	mg/L	06/07/2019	GEL	SM 5310B
Turbidity	0.400	NTU	05/29/2019	MG, AH	
Zinc	<10.0	ug/L	06/11/2019	SJHATCHE	EPA 6020B

Comments:

Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated: Linda Williams

Linda Williams - Supervisor Analytical Services

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CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE43955 **Location:** GW Well WAP-10 **Date:** 05/30/2019 **Sample Collector:** ATH/JCT

Loc. Code WAP-10 **Time:** 15:01

Analysis	Result	Units	Test Date	Analyst	Method
Aluminum	<0.50	mg/L	06/10/2019	SJHATCHE	EPA 6020B
Alkalinity	261	mg/L	06/05/2019	GEL	SM 2320B
Bicarbonate Alkalinity	261	mg/L	06/05/2019	GEL	SM 2320B
Arsenic	5.9	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Arsenic Dissolved	5.4	ug/L	06/09/2019	SJHATCHE	EPA 6020B
Boron	8600	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Barium	254	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Calcium	490	mg/L	06/11/2019	SJHATCHE	EPA 6020B
Calcium Dissolved	488	mg/L	06/09/2019	SJHATCHE	EPA 6020B
Cadmium	<0.50	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Chloride	745	mg/L	06/06/2019	KCWELLS	EPA 300.0
Cobalt	<0.50	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Spec. Cond.	3700	uS	05/29/2019	MG, AH	
Chromium	<5.0	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Copper	<5.0	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Depth	5.15	Feet	07/12/2019	MJABSHER	
Dissolved Oxygen	0.87	ppm	07/12/2019	MJABSHER	
Dissoloved Organic Carbon	1.73	mg/L	06/08/2019	GEL	SM 5310B
Elevation	20.96	Feet	07/12/2019	MJABSHER	
Iron	19300	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Iron - Dissolved	16000	ug/L	06/09/2019	SJHATCHE	EPA 6020B
Fluoride	<0.10	mg/L	06/06/2019	KCWELLS	EPA 300.0
Potassium	22.9	mg/L	06/10/2019	SJHATCHE	EPA 6020B
Potassium Dissolved	20.0	mg/L	06/09/2019	SJHATCHE	EPA 6020B
Lithium	21	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Lithium Dissolved	21	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Magnesium	72.8	mg/L	06/10/2019	SJHATCHE	EPA 6020B
Magnesium Dissolved	62.7	mg/L	06/09/2019	SJHATCHE	EPA 6020B
Manganese	568	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Manganese Dissolved	545	ug/L	06/09/2019	SJHATCHE	EPA 6020B
Molybdenum	<10	ug/L	06/05/2019	ROGERSNCALLC	EPA 6020B
Molybdenum Dissolved	<10	mg/L	06/05/2019	ROGERSNCALLC	EPA 6020B
Sodium	151	mg/L	06/11/2019	SJHATCHE	EPA 6020B
Sodium Dissolved	135	mg/L	06/09/2019	SJHATCHE	EPA 6020B
Oxidation Reduction Potential	-45.0	mv	05/29/2019	MG, AH	SM2580
Lead	<10.0	ug/L	06/10/2019	SJHATCHE	EPA 6020B
pH	6.46	SU	05/29/2019	MG, AH	
Radium 226	2.27	pCi/L	06/25/2019	GEL	EPA 903.1 Mod
Radium 228	<3.00	pCi/L	06/27/2019	GEL	EPA 904.0
Radium 226/228 Combined Calculation	3.47	pCi/L	07/02/2019	LCWILLIA	EPA 903.1 Mod
Selenium	<10.0	ug/L	06/11/2019	SJHATCHE	EPA 6020B
Sulfate	670	mg/L	06/06/2019	KCWELLS	EPA 300.0
Sulfide	<0.100	mg/L	06/04/2019	GEL	EPA 9034
Total Dissolved Solids	3309	mg/L	06/03/2019	KCWELLS	SM 2540C
Temp	23.32	C	05/29/2019	MG, AH	

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CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE43955 **Location:** GW Well WAP-10 **Date:** 05/30/2019 **Sample Collector:** ATH/JCT

Loc. Code WAP-10 **Time:** 15:01

Analysis	Result	Units	Test Date	Analyst	Method
Total Organic Carbon	1.79	mg/L	06/07/2019	GEL	SM 5310B
Turbidity	0.100	NTU	05/29/2019	MG, AH	
Zinc	<10.0	ug/L	06/11/2019	SJHATCHE	EPA 6020B

Comments:

Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated: Linda Williams

Linda Williams - Supervisor Analytical Services

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CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE43956 **Location:** GW Well WAP-10 DUP **Date:** 05/30/2019 **Sample Collector:** ATH/JCT

Loc. Code WAP-10 **Time:** 15:06

Analysis	Result	Units	Test Date	Analyst	Method
Aluminum	<0.50	mg/L	06/10/2019	SJHATCHE	EPA 6020B
Alkalinity	263	mg/L	06/05/2019	GEL	SM 2320B
Bicarbonate Alkalinity	263	mg/L	06/05/2019	GEL	SM 2320B
Arsenic	6.6	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Arsenic Dissolved	6.2	ug/L	06/09/2019	SJHATCHE	EPA 6020B
Boron	8800	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Barium	235	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Calcium	472	mg/L	06/11/2019	SJHATCHE	EPA 6020B
Calcium Dissolved	493	mg/L	06/09/2019	SJHATCHE	EPA 6020B
Cadmium	<0.50	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Chloride	747	mg/L	06/06/2019	KCWELLS	EPA 300.0
Cobalt	<0.50	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Spec. Cond.	***	uS	05/29/2019	MG, AH	
Chromium	<5.0	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Copper	<5.0	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Depth	***	Feet	05/29/2019	MG, AH	
Dissolved Oxygen	***	ppm	05/29/2019	MG, AH	
Dissoloved Organic Carbon	1.46	mg/L	06/08/2019	GEL	SM 5310B
Elevation	20.96	Feet	07/03/2019	MJABSHER	
Iron	19100	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Iron - Dissolved	16100	ug/L	06/09/2019	SJHATCHE	EPA 6020B
Fluoride	<0.10	mg/L	06/06/2019	KCWELLS	EPA 300.0
Potassium	22.4	mg/L	06/10/2019	SJHATCHE	EPA 6020B
Potassium Dissolved	21.0	mg/L	06/09/2019	SJHATCHE	EPA 6020B
Lithium	22	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Lithium Dissolved	22	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Magnesium	71.9	mg/L	06/10/2019	SJHATCHE	EPA 6020B
Magnesium Dissolved	64.0	mg/L	06/09/2019	SJHATCHE	EPA 6020B
Manganese	568	ug/L	06/10/2019	SJHATCHE	EPA 6020B
Manganese Dissolved	563	ug/L	06/09/2019	SJHATCHE	EPA 6020B
Molybdenum	<10	ug/L	06/05/2019	ROGERSNCALLC	EPA 6020B
Molybdenum Dissolved	<10	mg/L	06/05/2019	ROGERSNCALLC	EPA 6020B
Sodium	151	mg/L	06/11/2019	SJHATCHE	EPA 6020B
Sodium Dissolved	137	mg/L	06/09/2019	SJHATCHE	EPA 6020B
Oxidation Reduction Potential	***	mv	05/29/2019	MG, AH	SM2580
Lead	<10.0	ug/L	06/10/2019	SJHATCHE	EPA 6020B
pH	***	SU	05/29/2019	MG, AH	
Radium 226	2.01	pCi/L	06/25/2019	GEL	EPA 903.1 Mod
Radium 228	<3.00	pCi/L	06/27/2019	GEL	EPA 904.0
Radium 226/228 Combined Calculation	3.59	pCi/L	07/02/2019	LCWILLIA	EPA 903.1 Mod
Selenium	<10.0	ug/L	06/11/2019	SJHATCHE	EPA 6020B
Sulfate	676	mg/L	06/06/2019	KCWELLS	EPA 300.0
Sulfide	<0.100	mg/L	06/04/2019	GEL	EPA 9034
Total Dissolved Solids	3338	mg/L	06/03/2019	KCWELLS	SM 2540C
Temp	***	C	05/29/2019	MG, AH	

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CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE43956 **Location:** GW Well WAP-10 **Date:** 05/30/2019 **Sample Collector:** ATH/JCT

Loc. Code WAP-10 DUP **Time:** 15:06

Analysis	Result	Units	Test Date	Analyst	Method
Total Organic Carbon	1.83	mg/L	06/07/2019	GEL	SM 5310B
Turbidity	***	NTU	05/29/2019	MG, AH	
Zinc	<10.0	ug/L	06/11/2019	SJHATCHE	EPA 6020B

Comments:

Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated: Linda Williams

Linda Williams - Supervisor Analytical Services

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CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE44100 **Location:** GW Well WAP-9 **Date:** 05/30/2019 **Sample Collector:** ATH/JCT

Loc. Code WAP-9 **Time:** 10:57

Analysis	Result	Units	Test Date	Analyst	Method
Alkalinity	327	mg/L	06/05/2019	GEL	SM 2320B
Bicarbonate Alkalinity	327	mg/L	06/05/2019	GEL	SM 2320B
Boron	5600	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Chloride	92.3	mg/L	06/06/2019	KCWELLS	EPA 300.0
Dissoloved Organic Carbon	56.9	mg/L	06/11/2019	GEL	SM 5310B
Fluoride	<0.10	mg/L	06/06/2019	KCWELLS	EPA 300.0
Lithium	62	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Lithium Dissolved	63	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Molybdenum	<10	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Radium 226	1.07	pCi/L	06/25/2019	GEL	EPA 903.1 Mod
Radium 228	<3.00	pCi/L	06/27/2019	GEL	EPA 904.0
Sulfate	82.2	mg/L	06/06/2019	KCWELLS	EPA 300.0
Sulfide	<0.100	mg/L	06/04/2019	GEL	EPA 9034
Total Dissolved Solids	737.5	mg/L	06/03/2019	KCWELLS	SM 2540C
Total Organic Carbon	48.5	mg/L	06/11/2019	GEL	SM 5310B

Comments:

Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated: Linda Williams

Linda Williams - Supervisor Analytical Services

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SANTEE COOPER ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE44100 **Location:** GW Well WAP-9 **Date:** 05/30/2019 **Sample Collector:** ATH/JCT

Loc. Code WAP-9 **Time:** 10:57

Analysis	Result	Units	Test Date	Analyst	Method
Aluminum	0.72	mg/L	06/05/2019	ROGERSNCALLC	EPA 6010C
Aluminum	0.677	mg/L	07/10/2019	ROGERSNCALLC	EPA 6020B
Arsenic	190	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Arsenic	189	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Arsenic Dissolved	190	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010C
Arsenic Dissolved	192	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Barium	77	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Barium	79	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Calcium	130	mg/L	06/24/2019	ROGERSNCALLC	EPA 6010D
Calcium Dissolved	130	mg/L	06/24/2019	ROGERSNCALLC	EPA 6010D
Cadmium	<4.0	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Cadmium	<2	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Spec. Cond.	1070	uS	06/28/2019	MG, AH	
Chromium	<10	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Chromium	<10	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Copper	<10	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Copper	<10	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Depth	9.48	Feet	06/28/2019	MG, AH	
Dissolved Oxygen	0.690	ppm	06/28/2019	MG, AH	
Elevation	18.56	Feet	06/28/2019	MG, AH	
Iron	1100	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Iron	1210	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Iron - Dissolved	1100	ug/L	06/05/2019	ROGERSNCALLC	EPA 6020B
Iron - Dissolved	1050	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Potassium	16	mg/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Potassium	18.8	mg/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Potassium Dissolved	16	mg/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Potassium Dissolved	18.4	mg/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Magnesium	29	mg/L	06/24/2019	ROGERSNCALLC	EPA 6010D
Magnesium	28.1	mg/L	07/03/2019	ROGERSNCALLC	EPA 6020B
Magnesium Dissloved	29	mg/L	06/24/2019	ROGERSNCALLC	EPA 200.7
Magnesium Dissolved	28.0	mg/L	07/03/2019	ROGERSNCALLC	EPA 6020B
Manganese	190	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Manganese	190	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Manganese - Dissolved	190	ug/L	06/05/2019	ROGERSNCALLC	EPA 200.7
Manganese Dissolved	185	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Sodium	59	mg/L	06/24/2019	ROGERSNCALLC	EPA 6010D
Sodium Dissolved	60	mg/L	06/24/2019	ROGERSNCALLC	EPA 6010D
Oxidation Reduction Potential	39.0	mv	06/28/2019	MG, AH	SM2580
Lead	<50	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Lead	<2	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
pH	5.85	SU	06/28/2019	MG, AH	
Radium 226/228 Combined Calculation	1.07	pCi/L	07/01/2019	LCWILLIA	EPA 903.1 Mod
Selenium	<50	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Selenium	<5	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B

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CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE44100 **Location:** GW Well WAP-9 **Date:** 05/30/2019 **Sample Collector:** ATH/JCT

Loc. Code WAP-9 **Time:** 10:57

Analysis	Result	Units	Test Date	Analyst	Method
Temp	26.71	C	06/28/2019	MG, AH	
Turbidity	0.500	NTU	06/28/2019	MG, AH	
Zinc	17	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Zinc	28	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B

Comments:

Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated: *Linda Williams*

Linda Williams - Supervisor Analytical Services

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CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE44101 **Location:** GW Well WAP-17 **Date:** 05/30/2019 **Sample Collector:** ATH/JCT

Loc. Code WAP-17 **Time:** 12:29

Analysis	Result	Units	Test Date	Analyst	Method
Alkalinity	35.8	mg/L	06/05/2019	GEL	SM 2320B
Bicarbonate Alkalinity	35.8	mg/L	06/05/2019	GEL	SM 2320B
Arsenic	110	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Arsenic	119	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Arsenic Dissolved	100	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010C
Arsenic Dissolved	114	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Boron	3700	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Barium	48	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Barium	52	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Calcium	340	mg/L	06/24/2019	ROGERSNCALLC	EPA 6010D
Calcium Dissolved	330	mg/L	06/24/2019	ROGERSNCALLC	EPA 6010D
Chloride	249	mg/L	06/06/2019	KCWELLS	EPA 300.0
Spec. Cond.	2210	uS	06/28/2019	MG, AH	
Depth	7.18	Feet	06/28/2019	MG, AH	
Dissolved Oxygen	0.840	ppm	06/28/2019	MG, AH	
Dissoloved Organic Carbon	9.63	mg/L	06/07/2019	GEL	SM 5310B
Elevation	22.09	Feet	06/28/2019	MG, AH	
Iron	880	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Iron	906	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Iron - Dissolved	800	ug/L	06/05/2019	ROGERSNCALLC	EPA 6020B
Iron - Dissolved	879	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Fluoride	0.23	mg/L	06/06/2019	KCWELLS	EPA 300.0
Potassium	12	mg/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Potassium	12.8	mg/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Potassium Dissolved	11	mg/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Potassium Dissolved	12.7	mg/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Lithium	250	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Lithium Dissolved	240	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Magnesium	48	mg/L	06/24/2019	ROGERSNCALLC	EPA 6010D
Magnesium	45.7	mg/L	07/03/2019	ROGERSNCALLC	EPA 6020B
Magnesium Dissloved	49	mg/L	06/24/2019	ROGERSNCALLC	EPA 200.7
Magnesium Dissolved	46.0	mg/L	07/03/2019	ROGERSNCALLC	EPA 6020B
Manganese	84	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Manganese	85	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Manganese - Dissolved	84	ug/L	06/05/2019	ROGERSNCALLC	EPA 200.7
Manganese Dissolved	86	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Sodium	85	mg/L	06/24/2019	ROGERSNCALLC	EPA 6010D
Sodium Dissolved	85	mg/L	06/24/2019	ROGERSNCALLC	EPA 6010D
Oxidation Reduction Potential	30.0	mv	06/28/2019	MG, AH	SM2580
pH	6.03	SU	06/28/2019	MG, AH	
Radium 226	<1.00	pCi/L	06/25/2019	GEL	EPA 903.1 Mod
Radium 228	<3.00	pCi/L	06/27/2019	GEL	EPA 904.0
Radium 226/228 Combined Calculation	0.475	pCi/L	07/01/2019	LCWILLIA	EPA 903.1 Mod
Sulfate	739	mg/L	06/06/2019	KCWELLS	EPA 300.0
Sulfide	<0.100	mg/L	06/04/2019	GEL	EPA 9034

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SANTEE COOPER ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE44101 **Location:** GW Well WAP-17 **Date:** 05/30/2019 **Sample Collector:** ATH/JCT

Loc. Code WAP-17 **Time:** 12:29

Analysis	Result	Units	Test Date	Analyst	Method
Total Dissolved Solids	1656	mg/L	06/03/2019	KCWELLS	SM 2540C
Temp	27.38	C	06/28/2019	MG, AH	
Total Organic Carbon	9.53	mg/L	06/07/2019	GEL	SM 5310B
Turbidity	0	NTU	06/28/2019	MG, AH	

Comments:

Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated: Linda Williams

Linda Williams - Supervisor Analytical Services

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SANTEE COOPER ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE44102 **Location:** GW Well WAP-17 **Date:** 05/30/2019 **Sample Collector:** ATH/JCT

Loc. Code WAP-17 DUP **Time:** 12:34

Analysis	Result	Units	Test Date	Analyst	Method
Alkalinity	35.4	mg/L	06/05/2019	GEL	SM 2320B
Bicarbonate Alkalinity	35.4	mg/L	06/05/2019	GEL	SM 2320B
Arsenic	110	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Arsenic	117	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Arsenic Dissolved	110	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010C
Arsenic Dissolved	114	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Boron	3800	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Barium	48	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Barium	51	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Calcium	340	mg/L	06/24/2019	ROGERSNCALLC	EPA 6010D
Calcium Dissolved	330	mg/L	06/24/2019	ROGERSNCALLC	EPA 6010D
Chloride	262	mg/L	06/06/2019	KCWELLS	EPA 300.0
Spec. Cond.	***	uS	06/28/2019	MG, AH	
Depth	***	Feet	06/28/2019	MG, AH	
Dissolved Oxygen	***	ppm	06/28/2019	MG, AH	
Dissoloved Organic Carbon	10.1	mg/L	06/07/2019	GEL	SM 5310B
Elevation	22.09	Feet	07/12/2019	MJABSHER	
Iron	850	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Iron	853	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Iron - Dissolved	780	ug/L	06/05/2019	ROGERSNCALLC	EPA 6020B
Iron - Dissolved	831	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Fluoride	0.14	mg/L	06/06/2019	KCWELLS	EPA 300.0
Potassium	12	mg/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Potassium	12.4	mg/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Potassium Dissolved	12	mg/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Potassium Dissolved	12.5	mg/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Lithium	240	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Lithium Dissolved	240	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Magnesium	49	mg/L	06/24/2019	ROGERSNCALLC	EPA 6010D
Magnesium	47.4	mg/L	07/03/2019	ROGERSNCALLC	EPA 6020B
Magnesium Dissloved	48	mg/L	06/24/2019	ROGERSNCALLC	EPA 200.7
Magnesium Dissolved	46.8	mg/L	07/03/2019	ROGERSNCALLC	EPA 6020B
Manganese	82	ug/L	06/05/2019	ROGERSNCALLC	EPA 6010D
Manganese	82	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Manganese - Dissolved	81	ug/L	06/05/2019	ROGERSNCALLC	EPA 200.7
Manganese Dissolved	81	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Sodium	86	mg/L	06/24/2019	ROGERSNCALLC	EPA 6010D
Sodium Dissolved	85	mg/L	06/24/2019	ROGERSNCALLC	EPA 6010D
Oxidation Reduction Potential	***	mv	06/28/2019	MG, AH	SM2580
pH	***	SU	06/28/2019	MG, AH	
Radium 226	<1.00	pCi/L	06/25/2019	GEL	EPA 903.1 Mod
Radium 228	<3.00	pCi/L	06/27/2019	GEL	EPA 904.0
Radium 226/228 Combined Calculation	0.650	pCi/L	07/01/2019	LCWILLIA	EPA 903.1 Mod
Sulfate	790	mg/L	06/06/2019	KCWELLS	EPA 300.0
Sulfide	<0.100	mg/L	06/04/2019	GEL	EPA 9034

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SANTEE COOPER ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE44102 **Location:** GW Well WAP-17 DUP **Date:** 05/30/2019 **Sample Collector:** ATH/JCT

Loc. Code WAP-17 **Time:** 12:34

Analysis	Result	Units	Test Date	Analyst	Method
Total Dissolved Solids	1632	mg/L	06/03/2019	KCWELLS	SM 2540C
Temp	***	C	06/28/2019	MG, AH	
Total Organic Carbon	10.1	mg/L	06/07/2019	GEL	SM 5310B
Turbidity	***	NTU	06/28/2019	MG, AH	

Comments:

Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated: *Linda Williams*

Linda Williams - Supervisor Analytical Services

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SANTEE COOPER ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE44780 **Location:** GW Well WAP-18 **Date:** 06/05/2019 **Sample Collector:** ATH/MJA

Loc. Code WAP-18 **Time:** 09:24

Analysis	Result	Units	Test Date	Analyst	Method
Alkalinity	199	mg/L	06/08/2019	GEL	SM 2320B
Bicarbonate Alkalinity	199	mg/L	06/08/2019	GEL	SM 2320B
Arsenic	492	ug/L	06/12/2019	GEL	EPA 6020B
Arsenic Dissolved	383	ug/L	06/12/2019	GEL	EPA 6020B
Barium	94.5	ug/L	06/15/2019	GEL	EPA 6020B
Barium Dissolved	84.5	ug/L	06/15/2019	GEL	EPA 6020B
Calcium	302	mg/L	06/15/2019	GEL	EPA 6020B
Calcium Dissolved	310	mg/L	06/15/2019	GEL	EPA 6020B
Chloride	7.63	mg/L	06/06/2019	KCWELLS	EPA 300.0
Spec. Cond.	1860	uS	06/05/2019	MG, JA	
Depth	24.46	Feet	06/05/2019	MG, JA	
Dissolved Oxygen	0.860	ppm	06/05/2019	MG, JA	
Dissoloved Organic Carbon	16.5	mg/L	06/11/2019	GEL	SM 5310B
Elevation	18.59	Feet	06/05/2019	MG, JA	
Iron	1510	ug/L	06/12/2019	GEL	EPA 6020B
Iron - Dissolved	991	ug/L	06/12/2019	GEL	EPA 6020B
Fluoride	0.12	mg/L	06/06/2019	KCWELLS	EPA 300.0
Potassium	13.9	mg/L	06/12/2019	GEL	EPA 6020B
Potassium Dissolved	11.5	mg/L	06/12/2019	GEL	EPA 6020B
Lithium	330	ug/L	06/11/2019	ROGERSNCALLC	EPA 6010D
Lithium Dissolved	310	ug/L	06/11/2019	ROGERSNCALLC	EPA 6010D
Magnesium	29.4	mg/L	06/12/2019	GEL	EPA 6020B
Magnesium Dissolved	24	mg/L	06/12/2019	GEL	EPA 6020B
Manganese	868	ug/L	06/12/2019	GEL	EPA 6020B
Manganese Dissolved	700	ug/L	06/12/2019	GEL	EPA 6020B
Sodium	42.6	mg/L	06/15/2019	GEL	EPA 6020B
Sodium Dissolved	37.6	mg/L	06/15/2019	GEL	EPA 6020B
Oxidation Reduction Potential	-69.0	mv	06/05/2019	MG, JA	SM2580
pH	6.57	SU	06/05/2019	MG, JA	
Radium 226	<1.00	pCi/L	06/18/2019	GEL	EPA 903.1 Mod
Radium 228	<3.00	pCi/L	06/26/2019	GEL	EPA 904.0
Radium 226/228 Combined Calculation	1.38	pCi/L	06/28/2019	GEL	EPA 903.1 Mod
Sulfate	6.69	mg/L	06/06/2019	KCWELLS	EPA 300.0
Sulfide	<0.100	mg/L	06/12/2019	GEL	EPA 9034
Total Dissolved Solids	1532	mg/L	06/13/2019	SJBROWN	SM 2540C
Temp	21.33	C	06/05/2019	MG, JA	
Total Organic Carbon	17.5	mg/L	06/12/2019	GEL	SM 5310B
Turbidity	57.6	NTU	06/05/2019	MG, JA	

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SANTEE COOPER ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Comments:

Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated: Linda Williams

Linda Williams - Supervisor Analytical Services

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SANTEE COOPER ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE44878 **Location:** GW Well WAP-20 **Date:** 06/05/2019 **Sample Collector:** ATH/MJA

Loc. Code WAP-20 **Time:** 15:10

Analysis	Result	Units	Test Date	Analyst	Method
Alkalinity	110	mg/L	06/08/2019	GEL	SM 2320B
Bicarbonate Alkalinity	110	mg/L	06/08/2019	GEL	SM 2320B
Arsenic	62.5	ug/L	06/12/2019	GEL	EPA 6020B
Arsenic Dissolved	22.4	ug/L	06/12/2019	GEL	EPA 6020B
Barium	38.9	ug/L	06/15/2019	GEL	EPA 6020B
Barium Dissolved	43.5	ug/L	06/15/2019	GEL	EPA 6020B
Calcium	78.3	mg/L	06/15/2019	GEL	EPA 6020B
Calcium Dissolved	65.8	mg/L	06/15/2019	GEL	EPA 6020B
Chloride	24.8	mg/L	06/11/2019	KCWELLS	EPA 300.0
Cobalt	<1.00	ug/L	06/12/2019	GEL	EPA 6020B
Cobalt Dissolved	<1.00	ug/L	06/12/2019	GEL	EPA 6020B
Spec. Cond.	783	uS	06/05/2019	MA, AH	
Depth	20.76	Feet	06/05/2019	MA, AH	
Dissolved Oxygen	0.870	ppm	06/05/2019	MA, AH	
Dissoloved Organic Carbon	5.13	mg/L	06/11/2019	GEL	SM 5310B
Elevation	22.32	Feet	06/05/2019	MA, AH	
Iron	11800	ug/L	06/12/2019	GEL	EPA 6020B
Iron - Dissolved	16400	ug/L	06/12/2019	GEL	EPA 6020B
Fluoride	0.66	mg/L	06/11/2019	KCWELLS	EPA 300.0
Potassium	8.24	mg/L	06/12/2019	GEL	EPA 6020B
Potassium Dissolved	7.2	mg/L	06/12/2019	GEL	EPA 6020B
Lithium	150	ug/L	06/13/2019	ROGERSNCALLC	EPA 6010D
Lithium Dissolved	100	ug/L	06/13/2019	ROGERSNCALLC	EPA 6010D
Magnesium	12.2	mg/L	06/12/2019	GEL	EPA 6020B
Magnesium Dissolved	13.2	mg/L	06/12/2019	GEL	EPA 6020B
Manganese	119	ug/L	06/12/2019	GEL	EPA 6020B
Manganese Dissolved	119	ug/L	06/12/2019	GEL	EPA 6020B
Molybdenum	36.6	ug/L	06/12/2019	GEL	EPA 6020B
Molybdenum Dissolved	0.0208	mg/L	06/12/2019	GEL	EPA 6020B
Sodium	12.4	mg/L	06/15/2019	GEL	EPA 6020B
Sodium Dissolved	18.9	mg/L	06/15/2019	GEL	EPA 6020B
Oxidation Reduction Potential	-42.0	mv	06/05/2019	MA, AH	SM2580
pH	6.07	SU	06/05/2019	MA, AH	
Radium 226	<1.00	pCi/L	06/18/2019	GEL	EPA 903.1 Mod
Radium 228	<3.00	pCi/L	06/26/2019	GEL	EPA 904.0
Radium 226/228 Combined Calculation	1.68	pCi/L	06/28/2019	GEL	EPA 903.1 Mod
Sulfate	172	mg/L	06/11/2019	KCWELLS	EPA 300.0
Sulfide	<0.100	mg/L	06/12/2019	GEL	EPA 9034
Total Dissolved Solids	443.8	mg/L	06/13/2019	SJBROWN	SM 2540C
Temp	24.63	C	06/05/2019	MA, AH	
Total Organic Carbon	5.44	mg/L	06/12/2019	GEL	SM 5310B
Turbidity	151	NTU	06/05/2019	MA, AH	

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CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Comments:

Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated: Linda Williams

Linda Williams - Supervisor Analytical Services

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SANTEE COOPER ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE44879 **Location:** GW Well WAP-19 **Date:** 06/06/2019 **Sample Collector:** ATH/MJA

Loc. Code WAP-19 **Time:** 11:29

Analysis	Result	Units	Test Date	Analyst	Method
Alkalinity	209	mg/L	06/08/2019	GEL	SM 2320B
Bicarbonate Alkalinity	209	mg/L	06/08/2019	GEL	SM 2320B
Arsenic	123	ug/L	06/12/2019	GEL	EPA 6020B
Arsenic Dissolved	78.7	ug/L	06/12/2019	GEL	EPA 6020B
Barium	40.1	ug/L	06/15/2019	GEL	EPA 6020B
Barium Dissolved	35.4	ug/L	06/15/2019	GEL	EPA 6020B
Calcium	250	mg/L	06/15/2019	GEL	EPA 6020B
Calcium Dissolved	237	mg/L	06/15/2019	GEL	EPA 6020B
Chloride	213	mg/L	06/11/2019	KCWELLS	EPA 300.0
Spec. Cond.	2000	uS	06/06/2019	MA, AH	
Depth	22.46	Feet	06/06/2019	MA, AH	
Dissolved Oxygen	0.470	ppm	06/06/2019	MA, AH	
Dissoloved Organic Carbon	5.27	mg/L	06/11/2019	GEL	SM 5310B
Elevation	20.93	Feet	06/06/2019	MA, AH	
Iron	3.56	ug/L	06/12/2019	GEL	EPA 6020B
Iron - Dissolved	2070	ug/L	06/12/2019	GEL	EPA 6020B
Fluoride	0.23	mg/L	06/11/2019	KCWELLS	EPA 300.0
Potassium	15.7	mg/L	06/12/2019	GEL	EPA 6020B
Potassium Dissolved	12.9	mg/L	06/12/2019	GEL	EPA 6020B
Lithium	240	ug/L	06/13/2019	ROGERSNCALLC	EPA 6010D
Lithium Dissolved	230	ug/L	06/13/2019	ROGERSNCALLC	EPA 6010D
Magnesium	43.1	mg/L	06/12/2019	GEL	EPA 6020B
Magnesium Dissolved	34.6	mg/L	06/12/2019	GEL	EPA 6020B
Manganese	547	ug/L	06/12/2019	GEL	EPA 6020B
Manganese Dissolved	440	ug/L	06/12/2019	GEL	EPA 6020B
Sodium	77.1	mg/L	06/15/2019	GEL	EPA 6020B
Sodium Dissolved	72.9	mg/L	06/15/2019	GEL	EPA 6020B
Oxidation Reduction Potential	-16.0	mv	06/06/2019	MA, AH	SM2580
pH	6.37	SU	06/06/2019	MA, AH	
Radium 226	1.50	pCi/L	06/18/2019	GEL	EPA 903.1 Mod
Radium 228	<3.00	pCi/L	06/26/2019	GEL	EPA 904.0
Radium 226/228 Combined Calculation	2.18	pCi/L	06/28/2019	GEL	EPA 903.1 Mod
Sulfate	588	mg/L	06/11/2019	KCWELLS	EPA 300.0
Sulfide	<0.100	mg/L	06/12/2019	GEL	EPA 9034
Total Dissolved Solids	1411	mg/L	06/13/2019	SJBROWN	SM 2540C
Temp	22.46	C	06/06/2019	MA, AH	
Total Organic Carbon	5.81	mg/L	06/12/2019	GEL	SM 5310B
Turbidity	1.50	NTU	06/06/2019	MA, AH	

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SANTEE COOPER ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Comments:

Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated: Linda Williams

Linda Williams - Supervisor Analytical Services

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CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE44880 **Location:** GW Well WAP-25 **Date:** 06/06/2019 **Sample Collector:** ATH/MJA

Loc. Code WAP-25 **Time:** 14:55

Analysis	Result	Units	Test Date	Analyst	Method
Alkalinity	198	mg/L	06/08/2019	GEL	SM 2320B
Bicarbonate Alkalinity	198	mg/L	06/08/2019	GEL	SM 2320B
Arsenic	<5.00	ug/L	06/12/2019	GEL	EPA 6020B
Arsenic Dissolved	<5.00	ug/L	06/12/2019	GEL	EPA 6020B
Calcium	59.2	mg/L	06/15/2019	GEL	EPA 6020B
Calcium Dissolved	55.6	mg/L	06/15/2019	GEL	EPA 6020B
Chloride	11.1	mg/L	06/11/2019	KCWELLS	EPA 300.0
Spec. Cond.	400	uS	06/05/2019	MA, AH	
Depth	8.95	Feet	06/05/2019	MA, AH	
Dissolved Oxygen	0.350	ppm	06/05/2019	MA, AH	
Dissoloved Organic Carbon	2.94	mg/L	06/11/2019	GEL	SM 5310B
Elevation	18.15	Feet	07/12/2019	LCWILLIA	
Iron	1590	ug/L	06/12/2019	GEL	EPA 6020B
Iron - Dissolved	285	ug/L	06/12/2019	GEL	EPA 6020B
Potassium	2.19	mg/L	06/12/2019	GEL	EPA 6020B
Potassium Dissolved	2.56	mg/L	06/12/2019	GEL	EPA 6020B
Lithium	<10	ug/L	06/13/2019	ROGERSNCALLC	EPA 6010D
Lithium Dissolved	<10	ug/L	06/13/2019	ROGERSNCALLC	EPA 6010D
Magnesium	2.83	mg/L	06/12/2019	GEL	EPA 6020B
Magnesium Dissolved	3.43	mg/L	06/12/2019	GEL	EPA 6020B
Manganese	108	ug/L	06/12/2019	GEL	EPA 6020B
Manganese Dissolved	125	ug/L	06/12/2019	GEL	EPA 6020B
Molybdenum	1.47	ug/L	06/12/2019	GEL	EPA 6020B
Molybdenum Dissolved	0.00369	mg/L	06/12/2019	GEL	EPA 6020B
Sodium	11.7	mg/L	06/15/2019	GEL	EPA 6020B
Sodium Dissolved	12.2	mg/L	06/15/2019	GEL	EPA 6020B
Oxidation Reduction Potential	-125	mv	06/05/2019	MA, AH	SM2580
pH	6.86	SU	06/05/2019	MA, AH	
Sulfate	2.69	mg/L	06/11/2019	KCWELLS	EPA 300.0
Sulfide	<0.100	mg/L	06/12/2019	GEL	EPA 9034
Total Dissolved Solids	260.0	mg/L	06/13/2019	SJBROWN	SM 2540C
Temp	20.62	C	06/05/2019	MA, AH	
Total Organic Carbon	2.92	mg/L	06/12/2019	GEL	SM 5310B
Turbidity	14.5	NTU	06/05/2019	MA, AH	

Comments:

Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated: Linda Williams

Linda Williams - Supervisor Analytical Services

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SANTEE COOPER ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE45379 **Location:** GW Well WAP-21 **Date:** 06/11/2019 **Sample Collector:** MA/CT

Loc. Code WAP-21 **Time:** 09:23

Analysis	Result	Units	Test Date	Analyst	Method
Alkalinity	135	mg/L	06/20/2019	GEL	SM 2320B
Bicarbonate Alkalinity	135	mg/L	06/20/2019	GEL	SM 2320B
Arsenic	<5	ug/L	06/28/2019	ROGERSNCALLC	EPA 6020B
Arsenic Dissolved	<5	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Boron	4200	ug/L	06/17/2019	ROGERSNCALLC	EPA 6010D
Barium	43	ug/L	06/28/2019	ROGERSNCALLC	EPA 6020B
Calcium	178	mg/L	06/25/2019	ROGERSNCALLC	EPA 6020B
Calcium Dissolved	178	mg/L	06/25/2019	ROGERSNCALLC	EPA 6020B
Chloride	172	mg/L	06/14/2019	KCWELLS	EPA 300.0
Cobalt	<10	ug/L	06/28/2019	ROGERSNCALLC	EPA 6020B
Spec. Cond.	1400	uS	06/11/2019	MA, CT	
Depth	20.55	Feet	06/11/2019	MA, CT	
Dissolved Oxygen	0.500	ppm	06/11/2019	MA, CT	
Dissoloved Organic Carbon	8.30	mg/L	06/19/2019	GEL	SM 5310B
Elevation	22.51	Feet	06/11/2019	MA, CT	
Iron	6380	ug/L	06/28/2019	ROGERSNCALLC	EPA 6020B
Iron - Dissolved	4320	ug/L	07/03/2019	ROGERSNCALLC	EPA 6020B
Fluoride	<0.10	mg/L	06/14/2019	KCWELLS	EPA 300.0
Potassium	13.6	mg/L	06/28/2019	ROGERSNCALLC	EPA 6020B
Potassium Dissolved	13.8	mg/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Lithium	<10	ug/L	06/17/2019	ROGERSNCALLC	EPA 6010D
Lithium Dissolved	<10	ug/L	06/17/2019	ROGERSNCALLC	EPA 6010D
Magnesium	28.9	mg/L	06/28/2019	ROGERSNCALLC	EPA 6020B
Magnesium Dissolved	30.0	mg/L	07/03/2019	ROGERSNCALLC	EPA 6020B
Manganese	239	ug/L	06/28/2019	ROGERSNCALLC	EPA 6020B
Manganese Dissolved	244	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Molybdenum	<10	ug/L	06/17/2019	ROGERSNCALLC	EPA 6020B
Molybdenum Dissolved	<10	mg/L	06/17/2019	ROGERSNCALLC	EPA 6020B
Sodium	69.0	mg/L	07/01/2019	ROGERSNCALLC	EPA 6020B
Sodium Dissolved	60.6	mg/L	06/25/2019	ROGERSNCALLC	EPA 6020B
Oxidation Reduction Potential	-1.00	mv	06/11/2019	MA, CT	SM2580
pH	6.10	SU	06/11/2019	MA, CT	
Radium 226	<1.00	pCi/L	07/10/2019	GEL	EPA 903.1 Mod
Radium 228	<3.00	pCi/L	07/09/2019	GEL	EPA 904.0
Radium 226/228 Combined Calculation	0.845	pCi/L	07/10/2019	GEL	EPA 903.1 Mod
Sulfate	468	mg/L	06/14/2019	KCWELLS	EPA 300.0
Sulfide	<0.100	mg/L	06/18/2019	GEL	EPA 9034
Total Dissolved Solids	995.0	mg/L	06/20/2019	SJBROWN	SM 2540C
Temp	20.05	C	06/11/2019	MA, CT	
Total Organic Carbon	9.37	mg/L	06/18/2019	GEL	SM 5310B
Turbidity	8.70	NTU	06/11/2019	MA, CT	

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SANTEE COOPER ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Comments:

Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated: Linda Williams

Linda Williams - Supervisor Analytical Services

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SANTEE COOPER ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE45380 **Location:** GW Well WAP-26 **Date:** 06/11/2019 **Sample Collector:** MA/CT

Loc. Code WAP-26 **Time:** 11:04

Analysis	Result	Units	Test Date	Analyst	Method
Alkalinity	14.7	mg/L	06/20/2019	GEL	SM 2320B
Bicarbonate Alkalinity	14.7	mg/L	06/20/2019	GEL	SM 2320B
Arsenic	<5	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Arsenic Dissolved	<5	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Calcium	22.5	mg/L	06/25/2019	ROGERSNCALLC	EPA 6020B
Calcium Dissolved	20.4	mg/L	06/25/2019	ROGERSNCALLC	EPA 6020B
Chloride	7.8	mg/L	06/14/2019	KCWELLS	EPA 300.0
Spec. Cond.	240	uS	06/11/2019	MA, CT	
Depth	7.97	Feet	06/11/2019	MA, CT	
Dissolved Oxygen	0.450	ppm	06/11/2019	MA, CT	
Dissoloved Organic Carbon	2.61	mg/L	06/19/2019	GEL	SM 5310B
Elevation	19.59	Feet	07/12/2019	MJABSHER	
Iron	2400	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Iron - Dissolved	2380	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Potassium	1.24	mg/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Potassium Dissolved	1.29	mg/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Lithium	<10	ug/L	06/17/2019	ROGERSNCALLC	EPA 6010D
Lithium Dissolved	<10	ug/L	06/17/2019	ROGERSNCALLC	EPA 6010D
Magnesium	1.61	mg/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Magnesium Dissolved	1.64	mg/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Manganese	47	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Manganese Dissolved	48	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Sodium	16.2	mg/L	07/09/2019	ROGERSNCALLC	EPA 6020B
Sodium Dissolved	15.0	mg/L	06/25/2019	ROGERSNCALLC	EPA 6020B
Oxidation Reduction Potential	-19.0	mv	06/11/2019	MA, CT	SM2580
pH	5.49	SU	06/11/2019	MA, CT	
Sulfate	73.2	mg/L	06/14/2019	KCWELLS	EPA 300.0
Sulfide	<0.100	mg/L	06/18/2019	GEL	EPA 9034
Total Dissolved Solids	165.0	mg/L	06/20/2019	SJBROWN	SM 2540C
Temp	22.26	C	06/11/2019	MA, CT	
Total Organic Carbon	2.41	mg/L	06/18/2019	GEL	SM 5310B
Turbidity	0	NTU	06/11/2019	MA, CT	

Comments:

Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated: *Linda Williams*

Linda Williams - Supervisor Analytical Services

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CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE44781 **Location:** GW Well WAP-22 **Date:** 06/05/2019 **Sample Collector:** ATH/MJA

Loc. Code WAP-22 **Time:** 13:01

Analysis	Result	Units	Test Date	Analyst	Method
Bicarbonate Alkalinity	358	mg/L	06/08/2019	GEL	SM 2320B
Arsenic	14.6	ug/L	06/12/2019	GEL	EPA 6020B
Arsenic Dissolved	<5.00	ug/L	06/12/2019	GEL	EPA 6020B
Calcium	270	mg/L	06/15/2019	GEL	EPA 6020B
Calcium Dissolved	267	mg/L	06/15/2019	GEL	EPA 6020B
Elevation	18.66	Feet	07/12/2019	LCWILLIA	
Potassium	8.98	mg/L	06/12/2019	GEL	EPA 6020B
Potassium Dissolved	8.45	mg/L	06/12/2019	GEL	EPA 6020B
Lithium	51	ug/L	06/11/2019	ROGERSNCALLC	EPA 6010D
Lithium Dissolved	51	ug/L	06/11/2019	ROGERSNCALLC	EPA 6010D
Sodium	145	mg/L	06/15/2019	GEL	EPA 6020B
Sodium Dissolved	144	mg/L	06/15/2019	GEL	EPA 6020B

Comments:

Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated: Linda Williams

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SANTEE COOPER ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE44781 **Location:** GW Well WAP-22 **Date:** 06/05/2019 **Sample Collector:** ATH/MJA

Loc. Code WAP-22 **Time:** 13:01

Analysis	Result	Units	Test Date	Analyst	Method
Alkalinity	358	mg/L	06/08/2019	GEL	SM 2320B
Chloride	330	mg/L	06/17/2019	KCWELLS	EPA 300.0
Spec. Cond.	2230	uS	06/05/2019	MG, AH	
Depth	24.71	Feet	06/05/2019	MG, AH	
Dissolved Oxygen	3.25	ppm	06/05/2019	MG, AH	
Dissoloved Organic Carbon	4.77	mg/L	06/11/2019	GEL	SM 5310B
Iron	5540	ug/L	06/12/2019	GEL	EPA 6020B
Iron - Dissolved	2570	ug/L	06/12/2019	GEL	EPA 6020B
Magnesium	22.6	mg/L	06/12/2019	GEL	EPA 6020B
Magnesium Dissolved	21.2	mg/L	06/12/2019	GEL	EPA 6020B
Manganese	350	ug/L	06/12/2019	GEL	EPA 6020B
Manganese Dissolved	330	ug/L	06/12/2019	GEL	EPA 6020B
Oxidation Reduction Potential	-64.0	mv	06/05/2019	MG, AH	SM2580
pH	6.73	SU	06/05/2019	MG, AH	
Sulfate	415	mg/L	06/11/2019	KCWELLS	EPA 300.0
Sulfide	<0.100	mg/L	06/12/2019	GEL	EPA 9034
Total Dissolved Solids	1611	mg/L	06/13/2019	SJBROWN	SM 2540C
Temp	25.40	C	06/05/2019	MG, AH	
Total Organic Carbon	5.04	mg/L	06/12/2019	GEL	SM 5310B
Turbidity	87.1	NTU	07/12/2019	MJABSHER	

Comments:

Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated: *Linda Williams*

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CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE44782 **Location:** GW Well WAP-23 **Date:** 06/05/2019 **Sample Collector:** ATH/MJA

Loc. Code WAP-23 **Time:** 14:50

Analysis	Result	QUAL	Units	Test Date	Analyst	Method
Alkalinity	312		mg/L	06/08/2019	GEL	SM 2320B
Bicarbonate Alkalinity	312		mg/L	06/08/2019	GEL	SM 2320B
Arsenic	<5.00	J	ug/L	06/12/2019	GEL	EPA 6020B
Arsenic Dissolved	5.62		ug/L	06/12/2019	GEL	EPA 6020B
Calcium	140		mg/L	06/15/2019	GEL	EPA 6020B
Calcium Dissolved	144		mg/L	06/15/2019	GEL	EPA 6020B
Chloride	70.9		mg/L	06/11/2019	KCWELLS	EPA 300.0
Spec. Cond.	987		uS	06/05/2019	MG, AH	
Depth	21.56		Feet	06/05/2019	MG, AH	
Dissolved Oxygen	0.520		ppm	06/05/2019	MG, AH	
Dissoloved Organic Carbon	2.24		mg/L	06/11/2019	GEL	SM 5310B
Elevation	21.67		Feet	07/12/2019	LCWILLIA	
Iron	2740		ug/L	06/12/2019	GEL	EPA 6020B
Iron - Dissolved	1320		ug/L	06/12/2019	GEL	EPA 6020B
Potassium	2.08		mg/L	06/12/2019	GEL	EPA 6020B
Potassium Dissolved	2.01		mg/L	06/12/2019	GEL	EPA 6020B
Lithium	34		ug/L	06/11/2019	ROGERSNCALLC	EPA 6010D
Lithium Dissolved	32		ug/L	06/11/2019	ROGERSNCALLC	EPA 6010D
Magnesium	7.09		mg/L	06/12/2019	GEL	EPA 6020B
Magnesium Dissolved	6.74		mg/L	06/12/2019	GEL	EPA 6020B
Manganese	211		ug/L	06/12/2019	GEL	EPA 6020B
Manganese Dissolved	201		ug/L	06/12/2019	GEL	EPA 6020B
Molybdenum	<10	ND	ug/L	09/04/2019	ROGERSNCALLC	EPA 6010D
Sodium	44.2		mg/L	06/15/2019	GEL	EPA 6020B
Sodium Dissolved	45.4		mg/L	06/15/2019	GEL	EPA 6020B
Oxidation Reduction Potential	-72.0		mv	06/05/2019	MG, AH	SM2580
pH	6.52		SU	06/05/2019	MG, AH	
Sulfate	105		mg/L	06/11/2019	KCWELLS	EPA 300.0
Sulfide	<0.100	U	mg/L	06/12/2019	GEL	EPA 9034
Total Dissolved Solids	642.5		mg/L	06/13/2019	SJBROWN	SM 2540C
Temp	22.53		C	06/05/2019	MG, AH	
Total Organic Carbon	2.41		mg/L	06/12/2019	GEL	SM 5310B
Turbidity	111		NTU	06/05/2019	MG, AH	

Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010

Analysis Validated: Linda Williams

Linda Williams - Supervisor, Analytical Services

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CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE45991 **Location:** GW Well WAP-24 **Date:** 06/19/2019 **Sample Collector:** MA/CT

Loc. Code WAP-24 **Time:** 11:39

Analysis	Result	QUAL	Units	Test Date	Analyst	Method
Alkalinity	135		mg/L	06/25/2019	GEL	SM 2320B
Bicarbonate Alkalinity	135		mg/L	06/25/2019	GEL	SM 2320B
Arsenic	<5	ND	ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Calcium	43		mg/L	06/26/2019	ROGERSNCALLC	EPA 6010D
Chloride	28.5		mg/L	06/20/2019	KCWELLS	EPA 300.0
Spec. Cond.	327		uS	06/05/2019	MA, AH	
Depth	6.44		Feet	06/05/2019	MA, AH	
Dissolved Oxygen	0.480		ppm	06/05/2019	MA, AH	
Dissoloved Organic Carbon	1.12		mg/L	06/26/2019	GEL	SM 5310B
Elevation	22.33		Feet	07/12/2019	LCWILLIA	
Iron	228		ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Potassium	2.61		mg/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Lithium	<10	ND	ug/L	06/26/2019	ROGERSNCALLC	EPA 6010D
Magnesium	3.99		mg/L	07/03/2019	ROGERSNCALLC	EPA 6020B
Manganese	10		ug/L	07/04/2019	ROGERSNCALLC	EPA 6020B
Molybdenum	<10	ND	ug/L	06/26/2019	ROGERSNCALLC	EPA 6010D
Sodium	17		mg/L	06/26/2019	ROGERSNCALLC	EPA 6010D
Oxidation Reduction Potential	-203		mv	06/05/2019	MA, AH	SM2580
pH	7.55		SU	06/05/2019	MA, AH	
Sulfate	<2.0		mg/L	06/20/2019	KCWELLS	EPA 300.0
Sulfide	<0.100	U	mg/L	06/26/2019	GEL	EPA 9034
Total Dissolved Solids	277.5		mg/L	06/28/2019	SJBROWN	SM 2540C
Temp	23.80		C	06/05/2019	MA, AH	
Total Organic Carbon	1.02		mg/L	06/24/2019	GEL	SM 5310B
Turbidity	85.7		NTU	06/05/2019	MA, AH	

Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010

Analysis Validated: Linda Williams

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LAB CERTIFICATION #08552

Sample # AE43650 **Location:** GW Well WAP-22 **Date:** 05/22/2019 **Sample Collector:** AY

Loc. Code WAP-22 SOIL **Time:** 16:00

Analysis	Result	Units	Test Date	Analyst	Method
Arsenic	3.58	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Arsenic	<0.3	mg/L	06/03/2019	GEL	SW846 1312/6010D
Calcium	122000	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Calcuim	24	mg/L	06/03/2019	GEL	SW846 1312/6010D
Iron	6260	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Iron	<1.0	mg/L	06/03/2019	GEL	SW846 1312/6010
Potassium	548	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Potassium	<1.5	mg/L	06/04/2019	GEL	SW846 1312/6010D
Lithium	25	mg/kg	06/06/2019	TESTAMERICA	SW846 6010D
SPLP Lithium	<0.050	mg/L	06/06/2019	TESTAMERICA	SW846 1312/6010D
Magnesium	2930	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Magnesium	<3.0	mg/L	06/03/2019	GEL	SW846 1312/6010D
Manganese	82	mg/Kg	06/04/2019	GEL	SW846 6010D
SPLP Manganese	<0.1	mg/L	06/03/2019	GEL	SW846 1312/6010D
Sodium	869	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Sodium	5.74	mg/L	06/03/2019	GEL	SW846 1312/6010D
Total Organic Carbon	73200	mg/L	06/04/2019	GEL	SM 5310B

Comments:

Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated: Linda Williams

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CERTIFICATE OF ANALYSIS

LAB CERTIFICATION #08552

Sample # AE43651 **Location:** GW Well WAP-26 **Date:** 05/21/2019 **Sample Collector:** AY

Loc. Code WAP-26 SOIL **Time:** 13:42

Analysis	Result	Units	Test Date	Analyst	Method
Arsenic	5.9	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Arsenic	<0.3	mg/L	06/03/2019	GEL	SW846 1312/6010D
Calcium	203	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Calcuim	5.19	mg/L	06/03/2019	GEL	SW846 1312/6010D
Iron	2240	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Iron	<1.0	mg/L	06/03/2019	GEL	SW846 1312/6010
Potassium	64.9	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Potassium	<1.5	mg/L	06/04/2019	GEL	SW846 1312/6010D
Lithium	<5.4	mg/kg	06/06/2019	TESTAMERICA	SW846 6010D
SPLP Lithium	<0.050	mg/L	06/06/2019	TESTAMERICA	SW846 1312/6010D
Magnesium	101	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Magnesium	<3.0	mg/L	06/03/2019	GEL	SW846 1312/6010D
Manganese	8.94	mg/Kg	06/04/2019	GEL	SW846 6010D
SPLP Manganese	<0.1	mg/L	06/03/2019	GEL	SW846 1312/6010D
Sodium	<33.8	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Sodium	26.4	mg/L	06/03/2019	GEL	SW846 1312/6010D
Total Organic Carbon	9980	mg/L	06/04/2019	GEL	SM 5310B

Comments:
Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated:

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LAB CERTIFICATION #08552

Sample # AE43652 **Location:** GW Well WAP-23 **Date:** 05/23/2019 **Sample Collector:** AY

Loc. Code WAP-23 SOIL **Time:** 10:05

Analysis	Result	Units	Test Date	Analyst	Method
Arsenic	<3.64	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Arsenic	<0.3	mg/L	06/03/2019	GEL	SW846 1312/6010D
Calcium	107000	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Calcuim	45.1	mg/L	06/03/2019	GEL	SW846 1312/6010D
Iron	4040	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Iron	<1.0	mg/L	06/03/2019	GEL	SW846 1312/6010
Potassium	282	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Potassium	<1.5	mg/L	06/04/2019	GEL	SW846 1312/6010D
Lithium	6.0	mg/kg	06/06/2019	TESTAMERICA	SW846 6010D
SPLP Lithium	<0.050	mg/L	06/06/2019	TESTAMERICA	SW846 1312/6010D
Magnesium	800	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Magnesium	<3.0	mg/L	06/03/2019	GEL	SW846 1312/6010D
Manganese	30.3	mg/Kg	06/04/2019	GEL	SW846 6010D
SPLP Manganese	<0.1	mg/L	06/03/2019	GEL	SW846 1312/6010D
Molybdenum	1.36	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Molybdenum	<0.1	mg/L	06/03/2019	GEL	SW846 1312/6010D
Sodium	1100	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Sodium	29.5	mg/L	06/03/2019	GEL	SW846 1312/6010D
Total Organic Carbon	35500	mg/L	06/04/2019	GEL	SM 5310B

Comments:
Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated:

Linda Williams - Supervisor Analytical Services

santee cooper

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Moncks Corner, SC 29461-2901
(843) 761-8000

SANTEE COOPER ANALYTICAL SERVICES
CERTIFICATE OF ANALYSIS
LAB CERTIFICATION #08552

Sample # AE43653 **Location:** GW Well WAP-24 **Date:** 05/23/2019 **Sample Collector:** AY

Loc. Code WAP-24 SOIL **Time:** 17:30

Analysis	Result	Units	Test Date	Analyst	Method
Arsenic	<3.61	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Arsenic	<0.3	mg/L	06/03/2019	GEL	SW846 1312/6010D
Calcium	92200	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Calcuim	39.6	mg/L	06/03/2019	GEL	SW846 1312/6010D
Iron	9350	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Iron	<1.0	mg/L	06/03/2019	GEL	SW846 1312/6010
Potassium	2390	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Potassium	<1.5	mg/L	06/04/2019	GEL	SW846 1312/6010D
Lithium	46	mg/kg	06/06/2019	TESTAMERICA	SW846 6010D
SPLP Lithium	<0.050	mg/L	06/06/2019	TESTAMERICA	SW846 1312/6010D
Magnesium	3300	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Magnesium	<3.0	mg/L	06/03/2019	GEL	SW846 1312/6010D
Manganese	48.7	mg/Kg	06/04/2019	GEL	SW846 6010D
SPLP Manganese	<0.1	mg/L	06/03/2019	GEL	SW846 1312/6010D
Molybdenum	1.22	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Molybdenum	<0.1	mg/L	06/03/2019	GEL	SW846 1312/6010D
Sodium	261	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Sodium	<3.0	mg/L	06/03/2019	GEL	SW846 1312/6010D
Total Organic Carbon	68200	mg/L	06/05/2019	GEL	SM 5310B

Comments:
Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

Analysis Validated:

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SANTEE COOPER ANALYTICAL SERVICES
CERTIFICATE OF ANALYSIS
LAB CERTIFICATION #08552

Sample # AE43654 **Location:** GW Well WAP-25 **Date:** 05/21/2019 **Sample Collector:** AY

Loc. Code WAP-25 SOIL **Time:** 17:00

Analysis	Result	Units	Test Date	Analyst	Method
Arsenic	<3.91	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Arsenic	<0.3	mg/L	06/03/2019	GEL	SW846 1312/6010D
Calcium	17800	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Calcium	23.2	mg/L	06/03/2019	GEL	SW846 1312/6010D
Iron	1010	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Iron	9.25	mg/L	06/03/2019	GEL	SW846 1312/6010
Potassium	57.3	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Potassium	<1.5	mg/L	06/04/2019	GEL	SW846 1312/6010D
Lithium	<5.3	mg/kg	06/06/2019	TESTAMERICA	SW846 6010D
SPLP Lithium	<0.050	mg/L	06/06/2019	TESTAMERICA	SW846 1312/6010D
Magnesium	72.8	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Magnesium	<3.0	mg/L	06/03/2019	GEL	SW846 1312/6010D
Manganese	8.15	mg/Kg	06/04/2019	GEL	SW846 6010D
SPLP Manganese	<0.1	mg/L	06/03/2019	GEL	SW846 1312/6010D
Molybdenum	<1.3	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Molybdenum	<0.1	mg/L	06/03/2019	GEL	SW846 1312/6010D
Sodium	200	mg/kg	06/04/2019	GEL	SW846 6010D
SPLP Sodium	3.61	mg/L	06/03/2019	GEL	SW846 1312/6010D
Total Organic Carbon	2790	mg/L	06/05/2019	GEL	SM 5310B

Comments:
Independent Laboratory Results: "GEL" - GEL Laboratories LLC - Lab ID # 10120; "Test America" - TestAmerica Laboratories, Inc. - Lab ID# 98001; "DavisBrown"- Davis & Brown Lab ID # 21117; "Shealy"- Shealy Environmental Services, Inc.- Lab ID# 32010, "ROGERSNCALLC"- Rogers & Callcott, Inc. - Lab ID: 23105001

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Customer/Send Report To: Melanie Goings / A203

Need Results By (Date Needed): 2 weeks

Project/Task/Unit # 121607 JM02.09.G01/97130

Contract Lab Due Date (Lab Only): ______

Temperature Checks: Internal Use Only

TEMP (°C)	INIT
3.1	SJB

Labworks ID Number	Sample Location / Description	Collection Date	Collection Time	By	Sample Type: Grab/Comp	Matrix	Number of Containers	Total metals, TOC *, SCLP metals	Total metals, TOC **, SCLP metals	Total metals, TOC ***, SCLP metals				Comments
					Preservative			1						
					Bottle Type (Glass/Plastic)			G						
AE43647	WAP-14C *	5/20/19	1625	AY	G	Soil	2	2						metals for 3/4 Slurry *
48	WAP-14A *	5/21/19	815					2						As + Li
49	WAP-14B *	5/21/19	1020					2						
50	WAP-22 **	5/22/19	1600						2					Metals for A Ash Pond **
51	WAP-26 **	5/21/19	1342						2					Fe, Mg, Mn, Ca, Na, K, As, Li
52	WAP-23 ***	5/23/19	1005							2				metals for B Ash Pond ***
53	WAP-24 ***	5/23/15	1730							2				Fe, Mg, Mn, Ca, Na,
54	WAP-25 ***	5/21/19	1700							2				K, As, Mo + Li

Fill in the Number of Containers for each Test

Matrix Code: GW-Groundwater, DW-Drinking Water, SW-Surface Water, WW-Wastewater, BW-Boiler Water, L-Limestone, O-Oil, S-Soil, SL-Solid, C-Coal, G-Gypsum, FA-Fly Ash, BA-Bottom Ash, M-Misc (Describe in Comments)

Preservation used: 1-<4°C, 2-HNO$_3$, 3-H$_2$SO$_4$, 4-HCL 5-Na$_2$S$_2$O$_3$, 6-Other (Specify) | Bottle Type: (G) Glass (P) Plastic | Sample Type: (G) Grab, (C) Composite

Composite Samples:
Start Date/Time:
End Date/Time:

Preservative Record	Correct pH: Yes No	If preserved, Lot#		Date/Time/Int			
Relinquished by: (To Person / Lockbox)	Employee #	Date	Time	Received by: (From Person / Lockbox)	Employee #	Date	Time
Melanie D Goings	32927	5/24/19	1350	SJMoore	35694	5/24/19	1350
Relinquished by: (To Person / Lockbox)	Employee #	Date	Time	Received by: (From Person / Lockbox)	Employee #	Date	Time
Relinquished by: (To Person / Lockbox)	Employee #	Date	Time	Received by: (From Person / Lockbox)	Employee #	Date	Time

Available Analyses:

TOC / DOC
TP, TPO4, NH3-N
F, Cl, NO2, Br, NO3, SO4, OPO4
TDS, TSS
Sulfide
BTEX, Napthalene, MTBE, VOC
Rad 226, Rad 228
Oil & Grease
E.coli, Total Coliform

Metals: Ag, Al, As, B, Be, Ba, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Li, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Sn, Tl, V, Zn, P, S, SiO2, Sr, Ti, CrVI

Dissolved Metals: As, Fe

pH

Wallboard Gyp: AIM, TOC, Total and Soluble Metals, Purity, % Moisture, Sulfites, pH, Chloride, Particle Size
Daily Gyp: Free Moisture, Purity (CaSO4)
Limestone Analysis: Acid Insoluble Matter, Total Metals, LOI, Purity (CaCO3), % Moisture
Flyash: Ammonia, LOI, % Carbon, Free CaO, Mineral Analysis

Coal Short Prox: % Moisture, Ash, Sulfur, BTUs
Coal Ultimate: % Moisture, Ash, Sulfur, BTUs, Volatile Matter, CHN
XRF Scan — Hardgrove Grindability Index
Sieve Analysis — Pulverizer Fineness — Particulate Matter Analysis

Oil Quality: % Moisture, Color, Acidity, Dielectric Strength, Interfacial Tension, Density
Togas: Dissolved Gases in Oil
Metals (Oil): As, Cd, Cr, Ni, Pb, Hg
Flash point, Total Halogens, PCB
Gofer Oil:#GOFER **Used Oil:**#USED OIL

APPENDIX C

Groundwater Model Output

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APPENDIX A:
GROUNDWATER FLOW MODELING SANTEE COOPER ASH POND A/B WINYAH GENERATION STATION

by
Haley & Aldrich of New York
Rochester, New York

for
Santee Cooper
Georgetown, South Carolina

File No. 131539-003
September 2019

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\\haleyaldrich.com\share\grn_common\131539 - Santee Cooper\Winyah Generating Station\Ash_Pond_AB\Groundwater_Model\Groundwater_Model_Report\Text\2019_0909_Santee Cooper_Winyah_Groundwater Flow Modeling_F.docx

1. Groundwater Flow Modeling

A groundwater flow and solute transport model was constructed to evaluate and compare potential corrective measures in support of the Corrective Measures Assessment (CMA) for the Santee Cooper Ash Ponds A and B at the Winyah Generation Station in Georgetown, South Carolina. The following text describes the model construction, calibration and subsequent simulations of remedy alternatives for Appendix IV constituents above the Groundwater Protection Standard (GWPS).

The numerical model MODFLOW-2005 (Harbaugh, 2005) was selected for the modeling effort and is a three-dimensional, finite difference groundwater flow model capable of simulating the groundwater conditions under various scenarios including pumping and changes to infiltration over time.

1.1 MODEL DOMAIN

The model domain was established to encompass the Santee Cooper Winyah generating station (Site) and surrounding areas that represented model boundaries including creeks and other unnamed drains.

MODFLOW uses a rectangular grid within the domain and allows for establishing irregular groundwater flow boundary conditions that represent actual and Site-specific features in the study area. The setup is facilitated by assigning boundary types and values to specific grid cells. Figure A-1 depicts the model domain boundary overlain on an aerial photograph of the Site.

The three-dimensional finite difference groundwater flow model domain covers a length of 11,840 feet in the x-direction (west to east), 9,200 feet in the y-direction (north to south), and approximately 75 feet in the z-direction (vertical). The grid layers were set to a minimum thickness of 2 feet to avoid model inconsistencies associated with pinch outs and rapid cell drying. The model consists of 460 rows 592 columns, and 5 layers for a total of 1,361,600 cells covering an approximate area of 2500 acres. In MODFLOW, the groundwater-flow system is subdivided laterally and vertically into rectilinear blocks called cells. The hydraulic properties of the material in each cell are assigned and assumed to be uniform within each cell. The row and column dimensions of each cell is constant at 20 feet.

A Digital Elevation Model (DEM) was obtained from the USGS website to create the surface of the model for the Site. Lithologic descriptions contained in the boring logs generated during various phases of environmental investigations as well as cross-sections prepared as part of the 2015 Draft Preliminary Site Hydrogeologic Characterization Study Report (from Geosyntec) were used to develop formation geometry and hydraulic properties. The Site was divided into three lithologic units to represent geologic conditions underlying the Site and to account for vertical heterogeneities within the model.

A summary of each geologic unit is as follows:

- Construction Fill – Reworked Pamlico and Silver Bluff Units soils (see below).
- Pamlico and Silver Bluff Units – Estuarine and barrier island facies: sands, clayey sands and sandy clay.
- Williamsburg Formation – Stiff clays and very fine quartz sands. This low conductivity unit is considered to be an aquitard and is represented by the base of the flow model.

Elevations used in the model were determined from digital elevation models for the area. The topography of the ground surface is mimicked in the subsequent lower layers; however, the elevation has been reduced by the layer thickness. Layer thicknesses were determined through the review of the above-mentioned Site geology.

Figure A-2 depicts the two-dimensional views of the model layer elevations. The surfaces shown in Figure A-2 represent the model top (i.e., land surface), model bottom, and all the lithologic interfaces between.

1.2 BOUNDARY CONDITIONS

Boundary conditions define the locations and manner in which water enters and exits the active model domain. The conceptual model for the groundwater system that forms the basis for the model boundaries are as follows:

1. The Cooling Water Pond at the southeast of the site is treated as a river boundary condition with stage at a representative elevation for water in the Pond,
2. Recharge from water impounded in the three ash ponds,
3. Drain boundary conditions representing Pennyroyal Creek, cooling water inflow and outflow canals, and drainage ditches separating the three ash ponds.

The locations of these boundary conditions in the model are illustrated in Figure A-1.

1.2.1 Specified Head Boundaries

The MODFLOW Time Variant Specified Head Package (Harbaugh, 2005), also known as the Constant Head Package, was used to simulate boundaries. The package is used to fix the head values in selected grid cells regardless of the conditions in the surrounding grid cells. The cell with the assigned constant head acts either as a source of water entering or a sink of water leaving the system. The values for this boundary are referenced to datum NAVD 88. A constant head boundary condition at 5 feet ASL is applied along the western edge of the model domain.

1.2.2 River Boundaries

River boundaries in MODFLOW are a special form of the head-dependent boundary condition. In a head-dependent boundary, the model computes the difference in head between the boundary and the model cell to calculate the amount of water flowing into or out of the model through the boundary. Figure A-1 shows the river boundary condition representing the Cooling Water Pond. The head assigned to this boundary was calibrated based on the water levels observed in nearby wells.

1.3 HYDRAULIC MODEL PROPERTIES

Hydraulic properties were initially assigned consistent with data presented in the 2015 Draft Preliminary Site Hydrogeologic Characterization Study Report (from Geosyntec). Values were assigned for horizontal hydraulic conductivity and vertical hydraulic conductivity. These parameters were iteratively varied during model calibration to achieve the best fit to observed hydraulic patterns including head elevations, hydraulic gradients, and flow directions. For calibration, uniform hydraulic properties were applied within discrete model layers.

1.3.1 Calibrated Horizontal and Vertical Hydraulic Conductivity

The calibrated horizontal (K_X and K_Y) and vertical (K_Z) hydraulic conductivity values in Model layers 1 through 5 were distributed uniformly across the model domain in individual layers. Vertical hydraulic conductivity values were estimated at 1/10th of the horizontal hydraulic conductivity values. Results of the calibration indicated that hydraulic conductivities in the range of those values determined from slug tests were representative with regard to groundwater flow observed at the Site. The hydraulic conductivity values used in the calibrated model are presented below for the three hydrogeologic units underlying at the Site:

- Fill – 2.3 feet per day (ft/day) or 8.1 x 10^{-4} centimeters per second (cm/s)
- Pamlico and Silver Bluff Units – 2.3 ft/day or 8.1 x 10^{-4} cm/s
- Williamsburg Formation – Effectively Impermeable
- Coal Combustion Residuals (CCR) – 1.0 ft/day or 3.5 x 10^{-4} cm/s

1.3.2 Porosity, Storage, and Yield

Effective porosity values are needed for particle tracking and solute transport simulations. The effective porosity values were conservatively estimated based on the soil type through the examination of boring logs. Due to the generally sandy aquifer make-up a porosity of 0.3 was utilized for the model.

1.4 METHODS OF EVALUATING MODEL CALIBRATION QUALITY

Model calibration is the process of refining the model representation of the hydrogeologic framework, hydraulic properties, and boundary conditions to minimize the difference between the simulated heads and fluxes to the measured data. Construction of a complex model with more parameters than the data support may reduce the residuals (difference between measured and simulated values) but does not ensure a more accurate model. Therefore, calibrated model parameters also need to be checked for their validity. Throughout the calibration process, no adjustments were made that conflicted with the general understanding of the groundwater system and previously documented information.

The iterative calibration process of "trial and error" was used for model calibration. It involves making changes to the input values, running MODFLOW, and assessing the impact of the changes.

The quality of model fit can be assessed from many statistical and graphical methods. One method is based on the difference between simulated and observed heads and flows, or residuals. The overall magnitude of the residuals is considered, but the distribution of those residuals, both statistically and spatially, can be equally important. The magnitude of residuals can initially point to gross errors in the model, the data (measured quantity), or how the measured quantity is simulated (Hill, 1998). A useful graphical analysis is a simple scatter plot of all simulated values as a function of all observed values.

For the flow calibration, the statistics of the mean error (ME), mean absolute error (MAE), and the root mean square (RMS) error were used to assess the calibration quality. They are defined as follows:

$$ME = \frac{\sum_{i=1}^{n}(O_i - C_i)}{n}$$

$$MAE = \frac{\sum_{i=1}^{n}|O_i - C_i|}{n}$$

$$RMS = \frac{\sum_{i=1}^{n}(O_i - C_i)^2}{n}$$

Where:
Oi = Observed head at observation point i
Ci = Calculated head at observation point i
n = Number of observation points

The mean error is the average of the differences between the observed and calculated heads (or residuals) and can indicate the overall comparison between computed and observed data. Negative and positive residuals can cancel each other out, resulting in a mean error close to zero even when the calibration is not good. The sign of the mean error is an indication of the overall comparison of the model to the data (e.g. a positive mean error indicates the model is generally computing heads that are too high).

The mean absolute error is the average of the absolute values of the residuals. The absolute value prevents positive and negative residuals from canceling each other, providing a clearer picture of the magnitude of errors across the model, without an indication of the direction (high or low) of the errors. The RMS error is the square root of the average of the squares of the residuals. The RMS adds additional weight to points where the residual is greatest. If the residuals at all points are very similar, the RMS will be close to the mean absolute error. Alternatively, a few points with high errors can add significantly to the RMS for an otherwise well calibrated model. For all three of these criteria the optimal value is zero.

The numerical goals for the groundwater flow model calibration are to (1) minimize the ME and MAE errors and (2) achieve the ratio of the root mean square (RMS) error of the head residuals to the range of observed heads (i.e., normalized RMS error) to be at least less than 10 percent.[1]

Groundwater flow field calibration for the Site has been conducted to provide a reasonable representation of the groundwater flow field in the vicinity of the Site, which forms the basis of assessing lithium migration potential through the fate and transport process. To accomplish this objective, a MODFLOW numerical model was developed to simulate observed groundwater conditions at the Site through calibrating a representative steady-state flow field. The decision of using a steady-state flow field for the flow model calibration was made through an evaluation of the available groundwater elevation data for the Site. Most importantly is that historical flow patterns have been relatively consistent at the Site; therefore, a steady-state flow model was deemed reasonable to represent average flow conditions.

The evaluation of gauging data resulted in the selection of 30 May – 19 June 2019 as the observed heads for the flow model calibration for representing Site conditions (Table 1).

The numerical calibration goals have been achieved. The mean error in head was 0.23; the mean absolute residual is 1.45 feet. The RMS error for the calibrated model was +1.72 feet and the normalized RMS error was 9.15%. Presented below is the scatter plot of the observed versus simulated heads, which generally fall along the theoretical slope of 1 to 1. Groundwater elevations for the calibrated model are shown in Figure A-3. Table 1 provides the observed heads on 30 May – 19 June 2019, as discussed above, used to generate the plot below (Figure A-4). The quality of the flow model calibration meets the calibration goals as described herein.

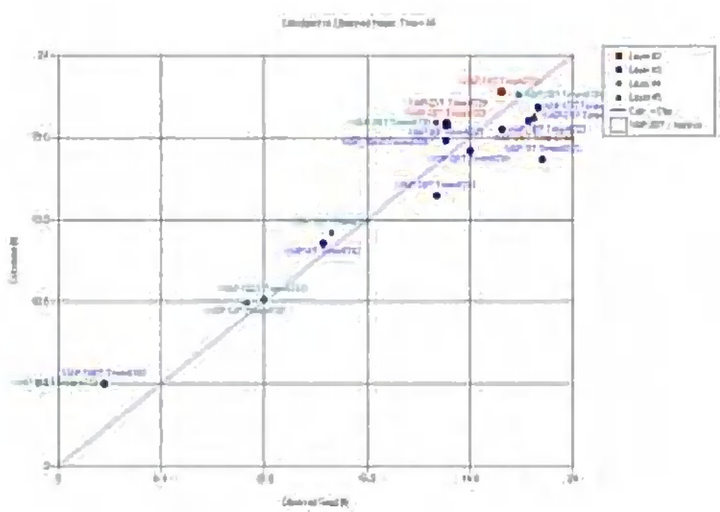

Figure A-4: Calibration scatter plot.

Because the calibration has met the acceptable calibration goals, the groundwater flow model is considered to be usable for the development of the lithium fate and transport models described in Section 2.0.

[1] Anderson, M.P., Woessner. WW (1992) Applied Groundwater Modeling. Simulation of Flow and Advective Transport.

2. Fate and Transport Modeling

Contaminant fate and transport modeling was conducted utilizing the three-dimensional, numerical model MT3DMS (Version 5 of MT3D) (Zheng, 1990). MT3DMS simulates advection, dispersion, adsorption and decay of dissolved constituents in groundwater using a modular structure similar to MODFLOW to permit simulation of transport components independently or jointly. MT3D interfaces directly with MODFLOW for the head solution and supports all the hydrologic and discretization features of MODFLOW. The MT3D code has a comprehensive set of solution options, including the method of characteristics (MOC), the modified method of characteristics (MMOC), a hybrid of these two methods (HMOC), and the standard finite-difference method (FDM). MT3D was originally released in 1990 as a public domain code from the United State Environmental Protection Agency (USEPA) and has been widely used and accepted by federal and state regulatory agencies.

For this modeling effort, the MT3DMS model utilized the flow regime from the steady-state, calibrated Site groundwater flow model presented in Section 1.0 to simulate transport of lithium. The steady state model was transformed into a transient model so various CMA options could be evaluated with respect to time. The strength and locations of the potential lithium sources specified in the transport models were based on current dissolved-phase concentration distributions from groundwater monitoring data at the Site.

In addition to the MODFLOW groundwater flow field discussed in Section 1.0, the fate and transport models require inputs of effective porosity values, dispersivity coefficients, and adsorption rate constants for lithium. In the modeling effort, input parameter values were defined from Site data, whenever possible, or through the use of conservative literature values.

2.1 TRANSPORT MODELING APPROACH

The solute transport portion of the modeling effort focused mainly on the future flow pathway for lithium at the Site. As such, the initial concentration was set based on the current plume extent. The location and initial concentrations for lithium within the model (layer 2) is shown in Figure A-1.

The calibrated flow model was allowed to run for 100 years following implementation of the groundwater remedy. Calibration of the concentrations through time was not performed; the starting concentrations used for the predictive model are based on a conservatively estimated concentration distribution using the observed concentrations at the Site, which is likely an overestimate of lithium mass in groundwater.

2.2 KEY PARAMETERS FOR TRANSPORT MODELING

The following sections describe the key input parameters of the transport model, and how they were derived. Note that these parameters were selected for the purpose of comparative evaluation of relative benefits of various corrective measures. The parameters and conditions used for the modeling are selected based on the data available to date. Therefore, simulated remedial timeframes using the parameters described in this section should not be construed as absolute predictions of remedial time frames for various corrective measures.

2.2.1 Effective Porosity

The effective porosities used in the model were presented in previous Section 1.3.2.

2.2.2 Dispersivity

Dispersion incorporates the effects of fluid mixing that result from heterogeneities within the groundwater system and molecular diffusion, which is the random movement of ions or molecules. If the molecules of water and dissolved constituents traveled at the average seepage velocity, there would be an abrupt interface and dispersion would be negligible. However, in natural systems water molecules and dissolved contaminants do not all travel at the same rate; some travel faster and some slower. Dispersion in the model accounts for the spreading of the dissolved plume. Diffusion is time dependent and is significant at low velocities. In general, dispersion acts to decrease the contaminant concentration on the leading edge of the plume, while increasing the size and rate of transport of the dissolved plume. Longitudinal dispersion occurs in the direction of advective groundwater flow, while transverse dispersion occurs perpendicular to groundwater flow.

The groundwater modeling generally accepted longitudinal dispersity value (α_L) estimate is 1 to 100. The horizontal transverse dispersivity (α_T) can be estimated as approximately one-tenth of the α_L, and vertical transverse (α_v) dispersivity can be estimated as one-hundredth of the α_L. The values utilized for dispersivity values are as follows:

- α_L - 100 ft,
- α_T – 10 ft, and
- α_V - 1 ft

2.2.3 First-Order Degradation Rate Constant – Lambda (λ)

Another input parameter for the fate and transport model is the first order degradation rate constant (λ) for lithium. This rate constant only takes into account degradation of the dissolved constituent during transport, as it leaves the source. This rate constant does not factor in effects of advection, sorption or dispersivity (dispersion). The field-scale degradation rate constant usually can be expressed as a first order decay process. Due to the general lack of decay for lithium within the groundwater system, a first-order decay rate was not specified for model simulations.

2.2.4 Retardation Effects

Chemical retardation occurs when a solute (contaminant) reacts with the porous media and its rate of movement is retarded relative the advective groundwater velocity. Retardation can occur by a variety of processes including adsorption and mass transfer in porous media. The effects of retardation are often related to site-specific adsorption isotherms. For this modeling purpose, a liner adsorption isotherm is used to account for the effects of transport retardation that may occur for Site-related contaminants. The effects of retardation on contaminant mobility is usually expressed in terms of a retardation factor (R), which is the ratio of the groundwater velocity to contaminant transport velocity.[2] When a linear adsorption isotherm is used to characterize contaminant mobility, the linear adsorption coefficient (K_d) can be linked to the retardation factor with the mathematical relationship below:

$$R = \frac{v_{gw}}{v_c} = 1 + \frac{\rho_b}{n} \times K_d$$

[2] Bedient, P.B., Rifai, H.S. and Newell, C.J., 1994. *Ground water contamination: transport and remediation*. Prentice-Hall International, Inc.

where R is the retardation factor, v_{gw} is the groundwater velocity, v_c is contaminant transport, ρ_b is the aquifer solid bulk density, n is the effective transport porosity of the medium, and K_d is the linear adsorption coefficient.

The following describe the adsorption effects of lithium based on its geochemical properties and the published empirical data, as well as the choice of the linear adsorption coefficient for each contaminant used for transport modeling.

2.2.5 Adsorption of Lithium on Aquifer Solids

Lithium is the lightest of all metals, with an atomic weight of 6.939, and an atomic number of 3, and having a density of only half that of water. It does not occur in the metalic state in nature, but it is a common element of nearly all igneous rocks. Lithium is concentrated in the silicates and alumino-silicates of acidic igneous rocks where it often replaces magnesium, ferrous iron, or aluminum. Lithium is also concentrated in clays, in which it correlates strongly with aluminum.[3] Under most pH and redox conditions in groundwater environments, lithium is generally present in the form of a cation. The extent of adsorption increases with pH.

2.2.5.1 Empirical data on lithium adsorption onto aquifer solids

The cation exchange characteristics of a soil are also influential in retaining lithium. This factor is a function of the clay mineral and organic content of the soil material, as well as the chemistry of other mineral components of the soil system. Any lithium attached as an exchangeable cation will be very weakly held.[6] Based on published results for lithium transport field studies[6,4,5,6], K_d may range from 0.03 to 5 L/Kg. Sediments with a higher fine-grained content typically exhibit a higher K_d value.

2.2.5.2 K_d value used for lithium transport modeling

Because fine-grained silt and clay are a significant component of the Site aquifer solids and the geochemical conditions for Site groundwater is only slightly acidic or neutral, a K_d value of 1 L/Kg is considered to be a representative, yet conservative value (in terms of not underestimating its mobility) for evaluation of lithium transport in the saturated zone.

2.2.6 Source Initial Concentration Data

To conservatively predict the transport of lithium and preserve the mass transported through the Site, the source area was defined utilizing initial concentration. The current extent of the groundwater plume for lithium was generated based on current groundwater concentrations in the monitoring well network. Temporal lithium mass inputs into the model domain were implemented using recharge boundary cells within the plume footprint; the recharge rates for these model cells are based on future Site conditions and the recharge concentrations are based on the initial lithium concentrations specified at these cell locations.

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[3] Crawley, M.E., 1977. A geochemical model for lithium and boron (Doctoral dissertation, Texas Tech University).

[4] Mojid, M.A. and Vereecken, H., 2005. On the physical meaning of retardation factor and velocity of a nonlinearly sorbing solute. Journal of hydrology, 302(1-4), pp.127-136.

[5] Garabedian, S.P., 1987. Large-scale dispersive transport in aquifers: Field experiments and reactive transport theory (Doctoral dissertation, Massachusetts Institute of Technology).

[6] Akhtar, M.S., Steenhuis, T.S., Richards, B.K. and McBride, M.B., 2003. Chloride and lithium transport in large arrays of undisturbed silt loam and sandy loam soil columns. Vadose Zone Journal, 2(4), pp.715-727.

In May and June of 2019, lithium was detected in the shallow unconfined aquifer beneath Ash Ponds A and B at a maximum concentration of 0.31 mg/L at the northern end of the ponds and 0.032 mg/L at the southern end. To model the most conservative assumptions, initial lithium concentrations were assigned to model layers 1, 2 and 3 using the average of lithium concentrations observed in the pond footprint. Initial lithium concentrations are show in Figure A-1.

2.3 TRANSPORT MODEL RESULTS- LITHIUM

Closure options considered include capping in place, CCR excavation, Monitored Natural Attenuation (MNA), and containment by groundwater extraction (GWE). To evaluate the fate and transport of the lithium plume, four scenarios were modeled:

Scenario 1.	Cap in place with MNA
Scenario 2.	Cap in place with GWE
Scenario 3.	Excavation with MNA
Scenario 4.	Excavation with GWE

Groundwater elevations, monitoring points and hypothetical groundwater extraction wells for these scenarios are shown in Figure A-6. It is assumed that closure will remove the current water impoundment. This is modeled by reducing the recharge rate in the impoundment from 6 to 1 inch per year, which adequately represents all scenarios. Excavation is modeled by reducing the lithium recharge concentration within the pond footprint from 0.15 mg/L to zero. GWE is modeled using 5 wells, extracting 10 gallons per minute each from the undisturbed portion of the Pamlico and Silver Bluff units directly beneath the pond.

Calibrated Model | Scenario 1 and 3 | Scenario 2 and 4

Figure A-5. Model scenarios. The MP well (in orange) is the monitoring points discussed in the text; PW-points (in red) are hypothetical groundwater extraction wells. Turquoise contours are groundwater elevations.

Because of the high estimated K_d value and low potentiometric gradients, lithium is relatively immobile in groundwater at the Site. In all four scenarios, modeled lithium concentrations for the 100 year duration of run remained negligible at any significant distance outside the present day pond footprint.

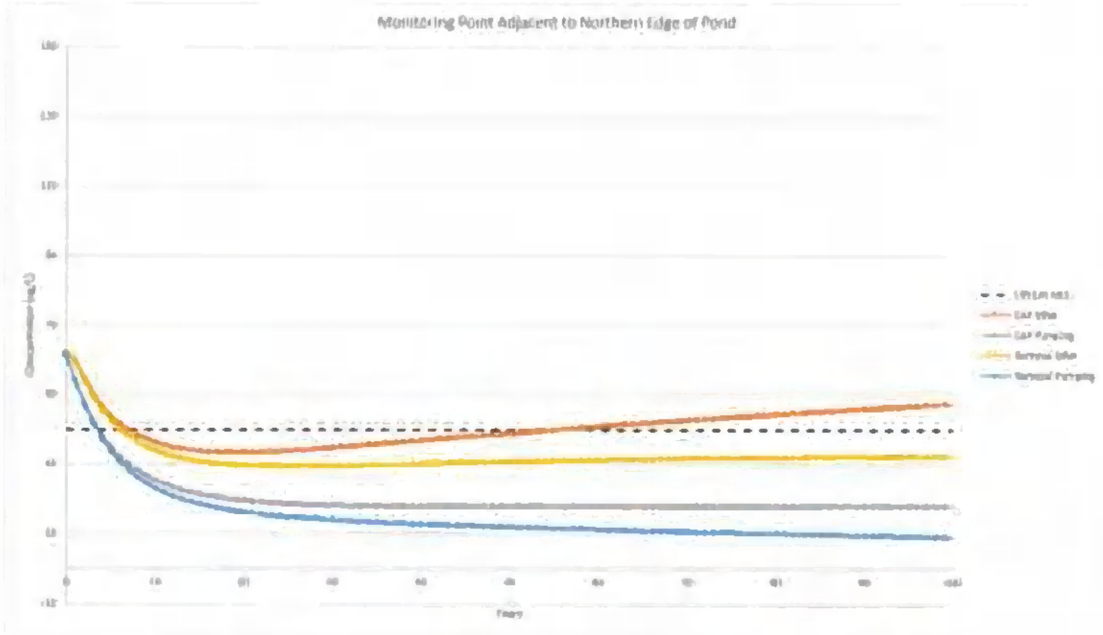


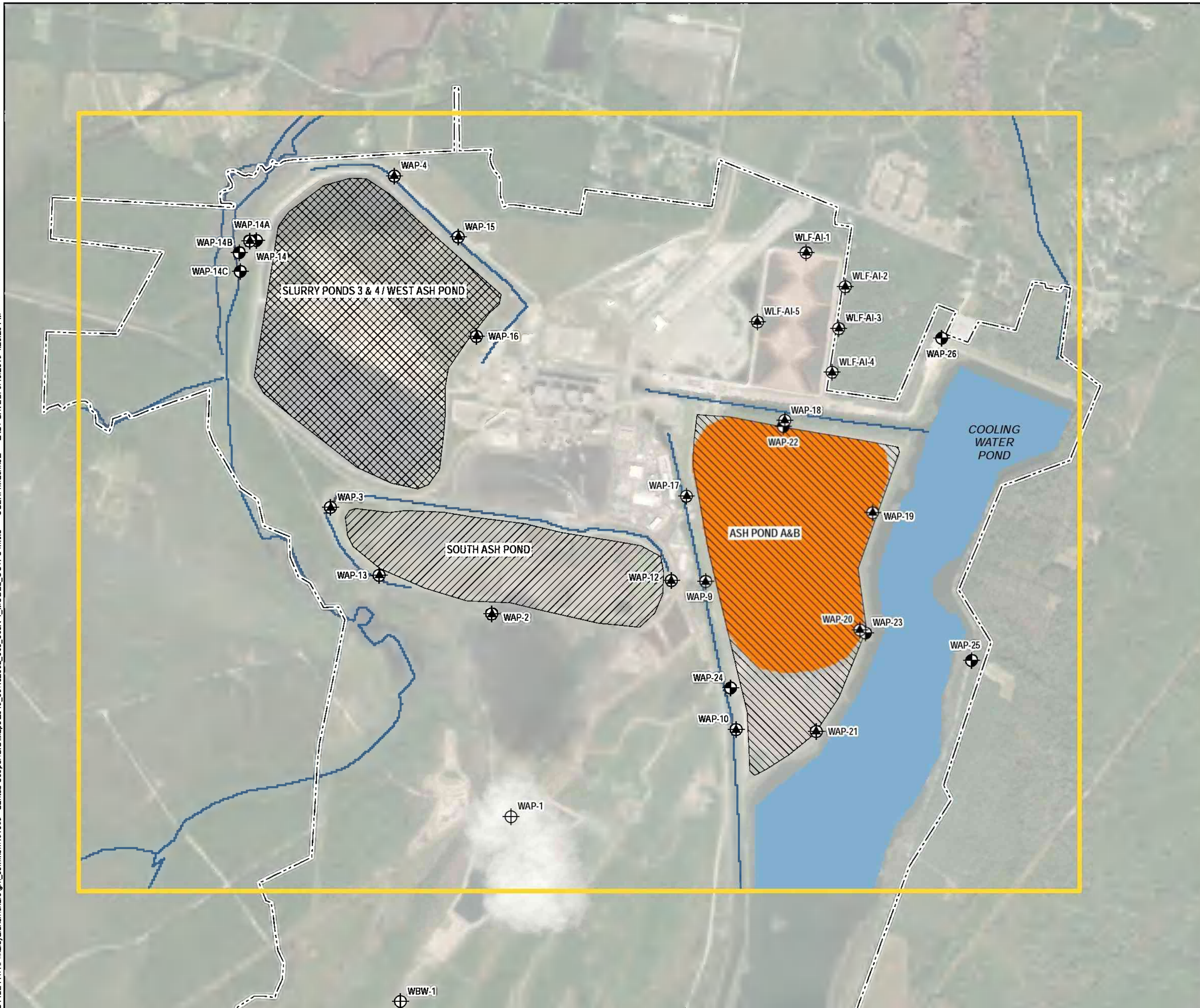
Figure A-6. Concentration trends for model scenarios.

TABLES

Table 1
May-June Groundwater Elevations, 2019
Santee Cooper Winyah Generation Station
Georgetown, South Carolina

Well	**Easting Feet**	**Northing Feet**	**Groundwater Elevation Feet (NAVD88)**
WAP-1	2500771.17	543682.98	22.68
WBW-1	2499451.325	541482.322	26.63
WAP-9	2502703.95	546418.073	18.56
WAP-17	2502893.42	547466.287	22.09
WAP-18	2503990.092	548294.812	18.59
WAP-19	2505120.534	547263.199	20.93
WAP-10	2503434.74	544711.4	20.96
WAP-20	2504972.626	545862.624	22.32
WAP-21	2504412.953	544669.44	22.51
WAP-23	2504968.674	545853.669	21.67
WAP-24	2503370.679	545202.519	22.33
WAP-22	2503996.429	548293.725	18.66
WAP-25	2506222.554	545528.975	18.15
WAP-26	2505867.416	549335.968	19.59
WAP-4	2499390.74	551258.7	13.32
WAP-14	2497729.965	550297.582	10.04
WAP-14A	2497762.155	550498.123	10.77
WAP-14B	2497558.016	550352.283	3.97
WAP-14C	2497568.371	550131.788	3.93
WAP-15	2500159.907	550537.844	13.67
WAP-16	2500459.567	549293.465	18.17

FIGURES



LEGEND

- CCR MONITORING WELL
- NATURE AND EXTENT MONITORING WELL
- OTHER MONITORING WELL
- ASH POND A&B
- ASH POND 3&4
- SOUTH ASH POND
- RIVER
- STREAM OR DRAIN
- MODEL AREA
- PROPERTY BOUNDARY

LITHIUM CONCENTRATION

- 0.15 mg/L

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI

N

0 1,200 2,400
SCALE IN FEET

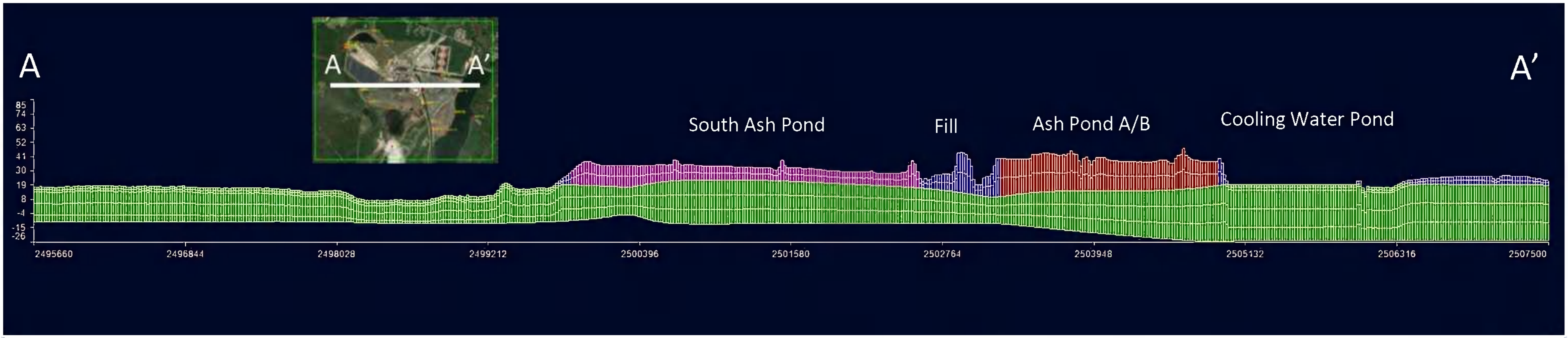
HALEY ALDRICH

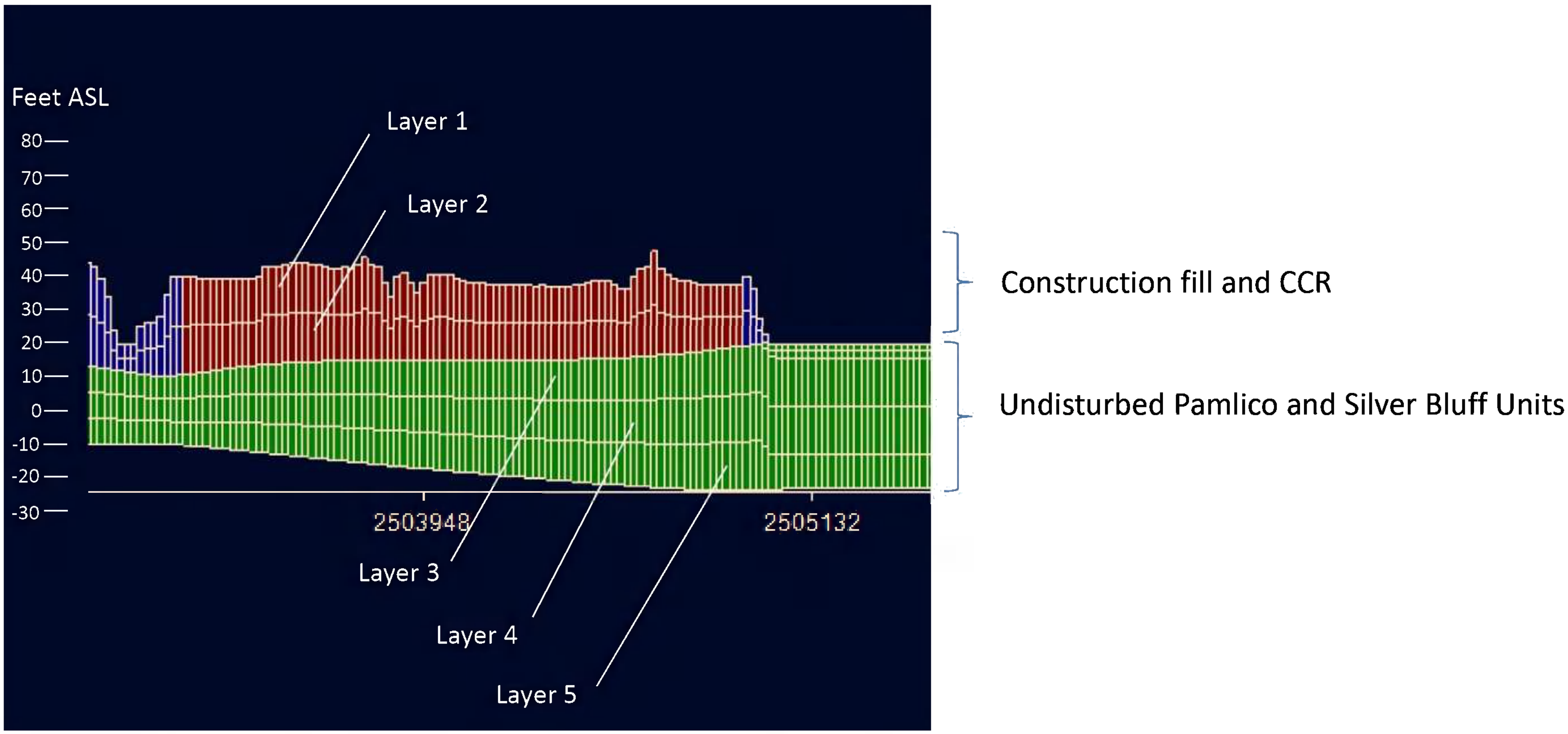
SANTEE COOPER
WINYAH GENERATING STATION
GEORGETOWN, SOUTH CAROLINA

SITE PLAN WITH MODEL DOMAIN

SEPTEMBER 2019

FIGURE A-1





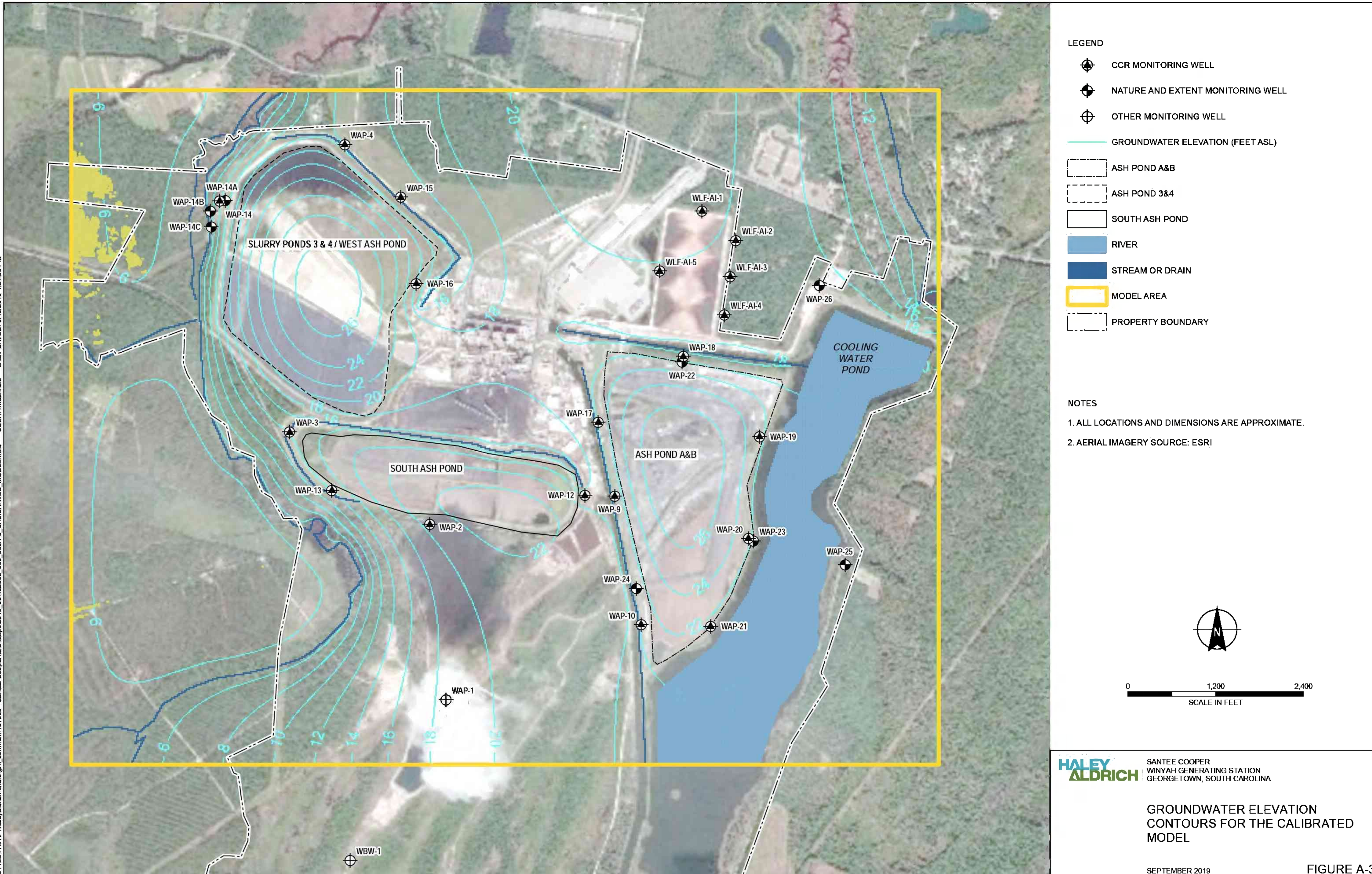
HALEY ALDRICH

Notes:

SANTEE COOPER
WINYAH GENERATING STATION
GEORGETOWN, SOUTH CAROLINA

Model Layers

FIGURE A-2



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