REPORT

REMEDY SELECTION REPORT

Byproduct Storage Area B

St. Johns River Power Park

Jacksonville, Florida

Submitted to:

JEA/St. Johns River Power Park
21 West Church Street
Jacksonville, FL 32202 USA

Submitted by:

Golder Associates USA Inc.
15851 South US 27, Suite 50
Lansing, MI 48906 USA

+1 904 363-3430

19-124481

January 2022

Distribution List

JEA

Stearns Weaver Miller

Golder Associates USA Inc.

REMEDY SELECTION
ST. JOHNS RIVER POWER PARK
BYPRODUCT STORAGE AREA B

The Coal Combustion Residuals (CCR) Rule, 40 Code of Federal Regulations (CFR) Parts 257 and 261, requires the owner or operator to select a remedy based on the results of the corrective measure assessment completed pursuant to §257.96. The Assessment of Corrective Measures report in June 2019 was prepared to address statistically significant levels of radium 226+228 at monitoring well CCR-6. The Assessment of Corrective Measures Addendum was prepared in December 2020 to address statistically significant levels of radium 226+228 at monitoring well CCR-7 and statistically significant levels of molybdenum at monitoring well CCR-6. A public meeting was held on December 17, 2020 to discuss the results of the corrective measures assessment in accordance with §257.96(e).

Monitored natural attenuation and source control is the remedy selected to address the radium 226+228 and molybdenum impacts associated with monitoring wells CCR-6 and CCR-7 at the Byproduct Storage Area B at the St. Johns River Power Park.

Professional Engineer Certification

I, Samuel F. Stafford, being a registered Professional Engineer in the state of Florida, do hereby certify that to the best of my knowledge, information, and belief, that the selected remedy meets the requirements of §257.97.

Samuel F. Stafford, PE
Florida Professional Engineer No. 78648
Authorization No. 35291

Samuel F Stafford
This item has been electronically signed and sealed by Samuel F. Stafford, PE using a Digitial Signature. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.
2022.01.04 16:32:54 -05'00'

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

Pursuant to the Coal Combustion Residual (CCR) Rule[1], this Remedy Selection Report has been prepared for the Byproduct Storage Area B (BSA-B or Area B) at the St. Johns River Power Park (SJRPP) on behalf of JEA. This Remedy Selection Report has been prepared to meet the requirements of §257.97.

1.1 Site Description

The SJRPP is located at 11201 New Berlin Road in Jacksonville, Florida. A site location map is provided as **Figure 1**. SJRPP consisted of two coal-fired steam electric generation units and associated facility. The facility began decommissioning and demolition in 2018. The primary CCRs generated at SJRPP included fly ash, bottom ash, and synthetic gypsum (flue gas desulfurization byproduct). Other small quantities of electric generation related wastes have been disposed of in BSA-B, including sedimentation pond solids, cooling tower packing, dewatered solids from the on-site wastewater treatment facility, and coal residuals (fines and pyrites).

Phase I of BSA-B consisted of an approximate 35-acre disposal facility footprint located approximately 1.5 miles northeast of the SJRPP main entrance, north of Island Drive, and southwest of Clapboard Creek. BSA-B was designed as an above-grade, unlined byproduct storage area. Base grades for BSA-B were designed to provide separation between the base of the BSA and the seasonal high groundwater table, including the settlement of foundation soils.

The construction of Phase I commenced in June 2008 and was completed in January 2009. SJRPP began operating BSA-B (originally designated as Area III/IV in the Site Certification Application) in January 2009 in accordance with the Conditions of Certification (COC) of SJRPP Units 1 and 2. Closure construction of BSA-B was initiated in December 2020.

1.2 Site Environmental Setting

A hydrogeological and geotechnical investigation was performed by Golder Associates USA Inc. (Golder) for the development of the SJRPP BSA-B site (Golder 2007). The site geology and hydrogeology are summarized in the sections below.

1.2.1 Geology

Three stratigraphic units were encountered in the hydrogeological and geotechnical site investigation, including: undifferentiated Pleistocene to recent deposits, upper Miocene and Pliocene unit, and the Hawthorn Group. The undifferentiated Pleistocene to recent deposits consist of loose to dense, gray/brown/white, fine sand commonly with trace to some clayey silt from ground surface to depths ranging to approximately 42 to 52 feet below ground surface (bgs). The upper Miocene and Pliocene unit was described as dense, coarse to fine sand with abundant shell fragments commonly with silty clay. Where fully penetrated, the thickness of this unit ranges from 25 to 40 feet across the site. The Hawthorn Group was encountered in the six deep borings and consisted of gray/dark green sand and silty clay commonly with black, sand-sized particles of phosphate. The top of Hawthorn Group was encountered at depths ranging from 98 to 106 feet bgs at the site. The Hawthorn Group is a relatively low permeability geologic unit extending throughout portions of southwest and northeast Florida. The estimated thickness of the Hawthorn Group in the site vicinity is 500 feet and is considered a regional confining unit and barrier to the Floridan Aquifer. Underlying the Hawthorn Group is Ocala Group limestone (late-Eocene). The Ocala

[1] 40 Code of Federal Regulations Part 257 (40 CFR 257), Subpart D – Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments, Published in Federal Register / Vol. 80, No. 74, April 17, 2015.

limestone in combination with the underlying carbonate units comprise the Floridan Aquifer system. The top of the Ocala limestone in the vicinity of the site is at an elevation of approximately 550 feet below sea level.

1.2.2 Hydrogeology

The main hydrogeologic units at Area B are an unconfined surficial aquifer system and the Floridan aquifer system (Golder 2007). The surficial aquifer system, which is the uppermost water-bearing unit at Area B, is subdivided into three zones: 1) upper, 2) intermediate, and 3) deep zones. The underlying Hawthorn Group consists of low-permeability sediments (i.e., silty clays, clayey silts, and sandy clays) that are confining units for the relatively deeper Floridan aquifer. The primary source of water in Duval County is the Floridan aquifer. This aquifer in Duval County is composed of the Ocala limestone, in combination with the underlying carbonate units.

The upper zone of the surficial aquifer is the most transmissive zone of the surficial aquifer (Golder 2007). The prevailing directions of groundwater flow in the upper zone of the surficial aquifer are generally easterly with southeastern components of flow. The groundwater flow velocity is approximately 17 feet/year. The average hydraulic conductivity, of the upper zone of the surficial aquifer, determined from slug tests of monitoring wells, is approximately 5 feet/day. The surficial aquifer is primarily recharged directly from local rainfall and discharge is primarily through evapotranspiration, withdrawals from shallow wells and seepage into surface water bodies (SJRWMD 2008).

1.3 CCR Groundwater Monitoring

1.3.1 CCR Monitoring Well Network

The CCR groundwater monitoring network for BSA-B at SJRPP consists of three background monitoring wells (CCR-1, CCR-2 and CCR-3) and four downgradient monitoring wells (CCR-4, CCR-5, CCR-6 and CCR-7) (Golder 2017a). Background and downgradient monitoring wells have been installed with screen intervals in the upper zone of the surficial aquifer (total depth of approximately 20 feet bgs). The background wells (CCR-1, CCR-2 and CCR-3) are located such that they represent background groundwater quality that has not been affected by a CCR unit and represent groundwater quality in the same zone as the downgradient monitoring wells. Downgradient monitoring wells (CCR-4 through CCR-7) have been installed as close as practical to the waste boundary to accurately represent the quality of groundwater passing the waste boundary. The monitoring wells have been encased in a manner that maintains the integrity of the monitoring well borehole. CCR groundwater monitoring well locations (CCR-1 through CCR-7) are shown on **Figure 2** and monitoring well construction data are provided in **Table 1**.

Additional monitoring points (piezometers) were installed downgradient of BSA-B as part of the nature and extent evaluation. The piezometers designated AW-1 through AW-8 were constructed using standard monitoring well procedures. Piezometer construction details are provided in **Table 1,** and locations are presented on **Figure 2**.

1.3.2 Status of CCR Groundwater Monitoring

Background monitoring (the collection of a minimum of eight independent samples prior to October 2017) began in November 2016 and was completed in June 2017. During the background monitoring period, samples were collected on a bimonthly basis and analyzed for Appendix III and Appendix IV constituents pursuant to §257.94(b). Background monitoring was performed to establish background concentrations of these constituents.

Detection monitoring for Appendix III constituents was initiated in October 2017. A statistically significant increase (SSI) analysis of the detection monitoring event performed October 11, 2017 indicated a number of SSIs of Appendix III constituents for downgradient wells above background concentrations (Golder 2018a). The SSI determination was made on January 15, 2018. Pursuant to §257.94(e)(1), an assessment monitoring program was established for Area B in March 2018. The initial annual assessment monitoring event was conducted on March 26, 2018 and subsequent semi-annual assessment monitoring events were conducted on June 27, 2018 and December 19, 2018.

A statistical analysis of the assessment monitoring results from June 2018 indicated that radium 226+228 was at a statistically significant level (SSL) above the groundwater protection standard (GWPS) at CCR-6 (Golder 2018c). Assessment of corrective measures was initiated January 13, 2019 in accordance with §257.96 (Golder 2019a) and completed June 12, 2019 (Golder 2019c).

A statistical analysis of the assessment monitoring results from December 2019 indicated that radium 226+228 was at an SSL above the GWPS at CCR-7 (Golder 2020b). A subsequent statistical analysis of the assessment monitoring results from June 2020 indicated that molybdenum was at a SSL above the GWPS at CCR-6 (Golder 2020f). An addendum to the assessment of corrective measures was completed December 1, 2020 in accordance with §257.96 (Golder 2020g).

2.0 ASSESSMENT OF CORRECTIVE MEASURES

The assessment of corrective measures (ACM) was performed to identify potential remedies to address the groundwater impacts detected through assessment monitoring.

2.1 Nature and Extent Evaluation

Soil, surface water and groundwater sampling has been conducted to evaluate the nature and extent of the radium 226+228 and molybdenum impacts in accordance with §257.95(g)(1).

The lateral extent of radium 226+228 impacts downgradient is generally between 100 to 200 feet to the east. The increasing concentrations of radium 226+228 at well CCR-7 may be attributed to the pumping events related to the cleanout of stormwater Pond A. Site personnel installed a temporary pump in the northern portion of Pond A to draw down surface water to excavate accumulated sediments and regrade the northern portion of the pond. The timing of the pumping events corresponds with a data shift in radium 226+228 results. An analysis of variance (ANOVA) test of the pre- and post-pumping radium concentrations indicate unequal means and equal variance. A trend analysis of the radium data, subtracting the difference in the means of the pre- and post-pumping data from the post-pumping data indicate stable concentrations with no statistically significant trends. Likewise, a trend analysis of the last 9 sampling events indicates a stable concentration with no statistically significant trend.

Molybdenum has only been detected above the GWPS at CCR-6. Beginning in June 2019, the molybdenum concentration at CCR-6 shifted upward. The molybdenum concentrations at CCR-6 correlate with increased pH and calcium concentrations. On July 28, 2020, Golder noted that the monitoring well was leaning eastward and upon further investigation found that the concrete pad in which the protective casing was set was broken. The well was subsequently repaired and redeveloped. It is not clear if the increase in pH and calcium in the well was due to the well damage.

The sampling results from the nature and extent evaluation indicates the following:

- Soil sampling results indicate likelihood of naturally occurring radium in soils (associated with uranium and phosphorus).
- Trend analyses indicate decreasing or stable trends for radium 226+228 and molybdenum concentrations.

- The lateral extent of radium 226+228 impacts is generally within 100 to 200 feet downgradient from the waste boundary.
- The lateral extent of molybdenum impacts is within 100 feet downgradient from the waste boundary.
- The vertical extent of radium 226+228 and molybdenum impacts is limited to the shallow surficial aquifer.
- Radium 226+228 and molybdenum impacts are limited to groundwater (no impacts detected in Pond A surface water).
- Radium 226+228 and molybdenum impacted groundwater is contained on-site.

2.2 Corrective Measure Evaluation

The potential corrective measures considered in the ACM included monitored natural attenuation (MNA), enhanced MNA, groundwater pump-and-treat, hydraulic barrier, permeable reactive barrier, and phytoremediation. Potential corrective measures were screened using the following criteria:

- Effectiveness of the potential remedy;
- Performance and reliability of the potential remedy;
- Ease or difficulty of implementation;
- Potential impacts of the remedy including safety, cross-media impacts and control of exposure to residual contamination;
- Timeframe to begin and complete the remedy; and
- Institutional requirements including those that may affect implementation of the remedy.

The corrective measure evaluation and screening is summarized in Table 2 and discussed in greater detail in the ACM. Based on the initial screening, MNA was retained for further evaluation and consideration. Soil and groundwater sampling indicated that the site was a good candidate for MNA, especially since effective source control measures were to be implemented.

A public meeting was held pursuant to §257.96(e) to discuss the results of the corrective measures assessment and subsequent addendum on December 17, 2020.

3.0 REMEDY SELECTION PROCESS

Semi-annual progress updates were prepared to document the remedy selection process which included:

- Additional nature and extent evaluations including installation of additional piezometers and supplemental groundwater monitoring.
- Submittal of the Closure Design Plan to the Florida Department of Environmental Protection.
- Preparation of construction documents for closure of BSA-B.
- Preparation of an addendum to the ACM to address SSLs of radium 226+228 at CCR-7 and molybdenum at CCR-6.

- Tiered evaluation of MNA:
  - Tier I – demonstrate that the groundwater plume is not expanding;
  - Tier II – Determine the mechanism and rate of the attenuation process; and
  - Tier III – Determine the capacity of the aquifer to sufficiently attenuate the constituent mass and resist remobilization.

4.0 SELECTION OF REMEDY

A combination of source control (closure of BSA-B) and MNA has been selected as the remedy to address the groundwater impacts at BSA-B.

Source control measures will reduce or eliminate further releases from BSA-B. Closure construction of BSA-B was initiated in December 2020 and was completed in October 2021. The closure construction included:

- Consolidation of CCRs within the eastern portion of the original Phase I footprint;
- Grading of existing materials for stormwater drainage;
- Installation of geomembrane;
- Placement of protective and final cover soils;
- Installation of stormwater management features; and
- Establishment of vegetative cover.

The closure of BSA-B is considered a significant source control measure. The cover system will substantially reduce the infiltration of precipitation through the CCR waste materials and into the underlying surficial aquifer; thereby reducing the mass flux of potential contaminants into the groundwater. The base grades of the BSA-B were designed to account of seasonal fluctuations in the groundwater table and for settlement of foundation soils, therefore the CCR waste materials should not be within groundwater.

MNA is a remedial measure that relies on a range of natural processes, including physical and chemical, to reduce groundwater contamination concentrations. Golder performed an evaluation of MNA to address radium 226+228 and molybdenum impacts at BSA-B (provided in **Appendix A**) and concluded:

> *"Therefore, based on the current radium 226+228 and molybdenum concentrations in the BSA-B, the current concentrations observed in downgradient monitoring wells, and the anticipated source control activities, it is concluded that the combined long-term attenuation from physical and chemical processes is sufficient to attenuate radium 226+228 and molybdenum in groundwater at the BSA-B to concentrations below their GWPS."*

Institutional controls will be implemented for BSA-B to restrict groundwater use at the site. Additionally, pursuant to §257.102(i), a notation on the deed to the BSA-B property will be recorded that notes the land has been used as a CCR unit and its use is restricted under the post-closure care requirements.

4.1 Remedy Requirements

Pursuant to §257.97(b), the selected remedy must meet the following requirements:

- Be protective to human health and the environment;
- Attain the GWPS;
- Control the source of release to reduce or eliminate further releases;
- Remove from the environment as much contaminated material as feasible; and
- Comply with relevant standards for management of waste materials generated by the remedy.

4.1.1 Human Health and the Environment

The extent of the groundwater impacted by radium 226+228 and molybdenum from the BSA is contained onsite and within the upper zone of the surficial aquifer. The upper zone of the surficial aquifer is not a potable water source. The nearest known supply water well is located approximately 5,500 feet northeast of the facility and is not downgradient. The nearest downgradient supply well is located approximately 10,000 feet to the southeast at the Pelotes Island Preserve.

No immediate significant risks associated with the groundwater impacts have been identified. There are no known impacts to drinking water from BSA-B. There are no impacts reported to surface water at the site. The radium 226+228 and molybdenum impacts at BSA-B are unlikely to pose an unacceptable risk to human health or the environment. No additional measures beyond implementation of the selected remedy are necessary to control exposures.

4.1.2 Attain Groundwater Protection Standard

The groundwater and geochemical modelling performed under the MNA evaluation indicate that the selected remedy will be able to attain the GWPS for radium 226+228 and molybdenum within 5 to 10 years. This timeframe is conservatively based on dispersion modelling only.

In accordance with §257.98(c), the remedy will be considered complete when:

- The GWPS is achieved at all points within the plume beyond the established CCR groundwater monitoring well network;
- The GWPS has not been exceeded for a period of three years using statistical and performance procedures; and
- All actions required to complete the remedy are complete.

4.1.3 Source Control and Removal of Contaminated Materials

The selected remedy must control the source of release to the “maximum extent feasible” in accordance with §257.97(b)(4) and remove from the environment as much contaminated as feasible in accordance with §257.97(b)(4). The closure construction included consolidation of CCRs within a smaller footprint and removal of accumulated CCRs sediments from ditches and ponds. The installation of the geomembrane cap will substantially reduce the infiltration of precipitation through the CCR waste materials and into the underlying surficial aquifer, thereby achieving source control.

4.1.4 Waste Management

No wastes will be generated by the remedy. If additional monitoring wells are required under the Tier IV evaluation, all investigative-derived waste will be characterized and properly disposed of at a properly licensed facility. Accumulated CCR sediments from ditches and ponds and CCRs from outside the final waste limits have been properly consolidated under the final cover system.

4.2 Remedy Evaluation

Pursuant to §257.97(c), the following evaluation factors were considered in the selection of the remedy.

4.2.1 Long- and Short-term Effectiveness and Protectiveness

Closure of BSA-B coupled with MNA is considered an effective remedial strategy. No immediate high risks have been identified with groundwater impacts at the site. Groundwater modelling indicates that the selected strategy will achieve GWPS at the site. Coupled with source control, the geochemical modelling indicates that the constituents at the site are expected to be relatively stable and attenuation mechanism reversal is unlikely.

4.2.2 Source Control Effectiveness

The basegrades of BSA-B were designed to be above the seasonal high groundwater table, post-settlement and CCR materials have been consolidated under the geomembrane cap, thereby effectively eliminating the potential for further releases.

4.2.3 Implementation Ease/Difficulty

The remedy implementation difficulty chiefly lies with the closure construction which has been completed. MNA had the lowest degree of difficulty of the corrective measures considered in the Assessment of Corrective Measures. Implementation of MNA will require designing a performance groundwater monitoring system (Tier IV) which will be incorporated into the corrective action groundwater monitoring program required under §257.98(a)(1).

4.2.4 Community Concerns

A public meeting open to the community was held on December 17, 2020. No community concerns have been raised as part of the assessment of corrective measures or remedy selection process.

4.3 Remedy Implementation

Implementation of the remedy can begin. Closure construction for BSA-B is scheduled to be completed in December 2021. MNA relies on natural processes that are already occurring onsite.

Pursuant to §257.97(d), the schedule for implementation of the remedy must consider the following factors:

1) **Extent and nature of contamination**: The nature and extent of radium 226+228 and molybdenum have been characterized in the ACM, ACM Addendum, and the attached MNA Evaluation.

2) **Reasonable probabilities of the remedy achieving GWPS**: Closure coupled with MNA is a well-established method for meeting remedial objectives. Groundwater and geochemical modelling indicate GWPS will be achieved onsite within a reasonable timeframe.

3) **Availability of treatment or disposal capacity for CCR managed during implementation**: CCRs onsite have been consolidated and capped as part of the selected remedy, no other CCRs will need to be managed as part of the remedial strategy.

4) **Potential risks to human health and environment prior to completion of remedy**: Risks to human health and the environment are expected to be low. No immediate significant risks associated with the groundwater impacts have been identified. CCRs are encapsulated in BSA-B under the geomembrane cap.

5) **Resource value of the aquifer**: The extent of the groundwater impacted by radium 226+228 and molybdenum from the BSA is contained onsite and within the upper zone of the surficial aquifer. The upper zone of the surficial aquifer is not a potable water source. The nearest known supply water well is located approximately 5,500 feet northeast of the facility and is not downgradient. The nearest downgradient supply well is located approximately 10,000 feet to the southeast at the Pelotes Island Preserve. No impacts to surface water near the site have been observed.

6) **Other relevant factors**: Approval of the closure construction by the Florida Department of Environmental Protection (FDEP) and approval of modifications of the site boundaries under the SJRPP Conditions of Certification by the FDEP Siting Office could impact the schedule for recording institutional controls for BSA-B. No other factors have been identified at this time that may impact the implementation of the selected remedy.

4.3.1 Remedy Implementation Schedule

The schedule for implementation of the selected remedy is as follows:

Table A: Remedy Implementation Schedule

Activity	Estimated Completion Timeframe
Closure of BSA-B	January 2022
Selection of Remedy	January 2022
Notification of Closure Completion	February 2022
Establish Corrective Action Monitoring Program	April 2022
Record Institutional Controls	July 2022
Annual Report	Due by January 31 of each year

4.3.2 Record Keeping Requirements

The owner or operator of the CCR unit must comply with the record keeping requirements specified in §257.105(h)(12), the notification requirement specified in §257.106(h)(9), and the Internet requirements specified in §257.107(h)(9). Therefore, this report and a notification of recording a notation on the deed will be posted on JEA's website and notifications will be sent to FDEP.

Signature Page

Golder Associates USA Inc.

Samuel F. Stafford, PE
Senior Engineer

Donald J. Miller
Principal and Practice Leader

SFS/DJM/ams

https://golderassociates.sharepoint.com/sites/110243/Project Files/6 Deliverables/Remedy Selection Report/Final/Remedy Selection Report_Jan2022.docx

TABLES

TABLE 1
SUMMARY OF CCR MONITORING WELL CONSTRUCTION DETAILS

St. Johns River Power Park
Byproduct Storage Area B
Jacksonville, Florida

Well ID	Date Installed	Northing (ft NAD83)	Easting (ft NAD83)	Ground Surface Elevation (ft NAVD83)	Top of Casing Elevation (ft NAVD83)	Stick-up Height (ft)	Well Depth (ft bgs)	Screen Interval Depth (ft bgs)
CCR-1	10/20/2015	2221016.34	485450.08	13.37	16.58	3.2	19.79	9.79-19.79
CCR-2	10/20/2015	2222219.71	485292.98	14.45	18.06	3.6	19.49	9.49-19.49
CCR-3	10/20/2015	2222897.83	485087.81	14.22	17.74	3.5	19.78	9.78-19.78
CCR-4	10/21/2015	2221065.31	486365.39	17.87	20.73	2.9	20.84	10.84-20.84
CCR-5	10/21/2015	2221064.27	486865.44	15.44	18.29	2.9	20.35	10.35-20.35
CCR-6	10/21/2015*	2221456.13	487055.97	13.08	16.03	3.0	20.1	10.1-20.1
CCR-7	10/22/2015	2221887.42	487053.83	12.44	15.72	3.3	20.12	10.12-20.12
AW-1	11/29/2018	2221266.24	487136.19	14.4	17.16	2.76	20.2	10.24-20.24
AW-2	11/29/2018	2221416.04	487138.12	13.3	16.14	2.84	20.2	10.16-20.16
AW-3	11/30/2018	2221699.22	487139.98	11.8	14.46	2.66	20.3	10.34-20.34
AW-4	2/8/2019	2221703.97	487052.84	10.5	13.49	2.99	20.0	10.01-20.01
AW-5	2/7/2019	2221677.18	487248.41	10.6	13.46	2.86	20.1	10.14-20.14
AW-6	2/7/2019	2221371.74	487620.88	10.8	13.76	2.96	20.0	10.04-20.04
AW-7	2/7/2019	2221217.37	488105.81	10.2	13.17	2.97	20.0	10.03-20.03
AW-8	10/21/2019	2221898.38	487253.86	10.7	13.16	2.42	20.1	10.08-20.08
AW-9	5/21/2020	2221969.03	487506.26	9.4	12.16	2.81	20.3	10.27-20.27

Notes:

* - Well CCR-6 was repaired 7/29/2020 and resurveyed on 8/6/2020.

ft bgs - feet below ground surface

ft TOC - feet below top of casing

NAD83 - Horizontal Control: North American Datum, State Plan Coordinate System Florida, East Zone

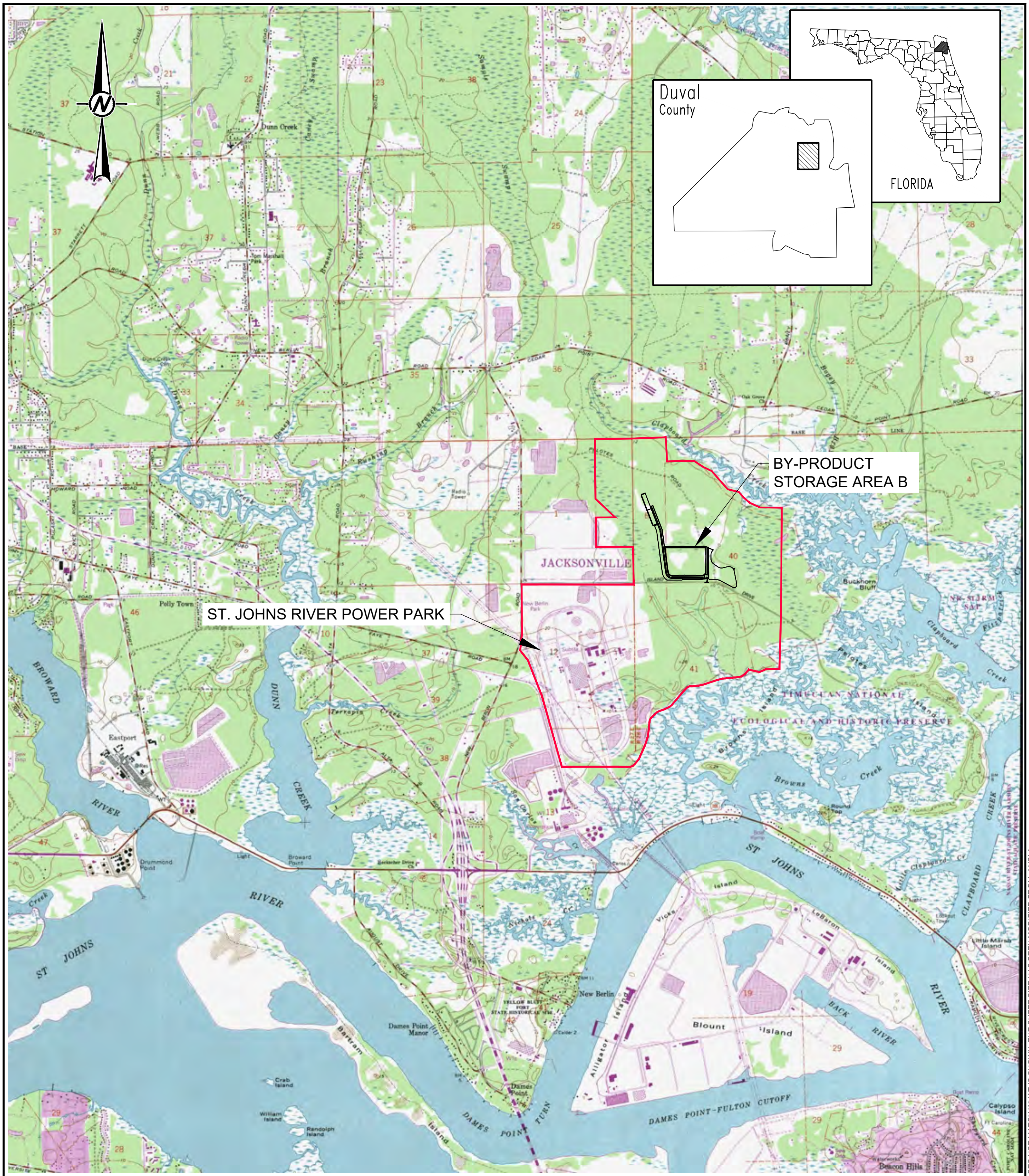
NAVD88 - Vertical Control: North American Vertical Datum of 1988

TABLE 2
CORRECTIVE MEASURES SCREENING EVALUATION

St. Johns River Power Park
Byproduct Storage Area B - SJRPP

Potential Corrective Measure	Screening Criteria					
	Performance	Reliability	Implementation Ease	Potential Impacts	Timeframe	Institutional Requirements
Monitored Natural Attenuation	Medium	High (Natural Processes, Little O&M Needs)	Easy (following site characterization, minimal infrastructure)	Minimal	Begin: 3 to 12 Months Complete: Varies (5+ years)	FDEP
Enhanced Monitored Natural Attenuation	Medium to High	Medium (Enhancements May Need to be Periodically Maintained)	Easy to Moderate (identify enhancement option, injection well, etc.)	Minimal to Low	Begin: 6 to 12 Months Complete: Varies (5+ years)	FDEP
Groundwater Pump-and-Treat	High (Contaminant Mass Removed and Migration Controlled)	Medium to High (Routine O&M Required)	Moderate (design & install system)	Low (Associated with Construction and O&M)	Begin: 12 to 24 Months Complete: Varies (1-10 years)	FDEP
Hydraulic Barrier	Medium to High (More Effective if Coupled with Groundwater Extraction or Other Remedies)	High	Moderate to Difficult (Depth)	Low (Associated with Construction)	Begin: 12 to 18 Months Complete: Varies (1-10 years)	FDEP
Permeable Reactive Barrier	Medium to High	Medium (Reactive Media Replacement)	Moderate to Difficult (Depth)	Low (Associated with Construction and Media Maintenance)	Begin: 12 to 24 Months Complete: Varies (1-10 years)	FDEP
Phytoremediation	Low to Medium	Low to Medium	Moderate	Minimal (Associated with Initial Planting)	Begin: 6 to 12 months Complete: Varies (10+ years)	FDEP

FIGURES



REFERENCE(S)

1.) USGS TOPOGRAPHIC MAP, 7.5 MIN. QUADRANGLE MAP SERIES: EASTPORT QUADRANGLE, DUVAL COUNTY, FLORIDA.

0 2500 5000

SCALE FEET

CLIENT
JEA

PROJECT
ST. JOHNS RIVER POWER PARK - CCR SUPPORT
JACKSONVILLE, DUVAL COUNTY, FLORIDA

CONSULTANT

GOLDER

YYYY-MM-DD	2021-01-21
DESIGNED	SFS
PREPARED	BCL
REVIEWED	SFS
APPROVED	DJM

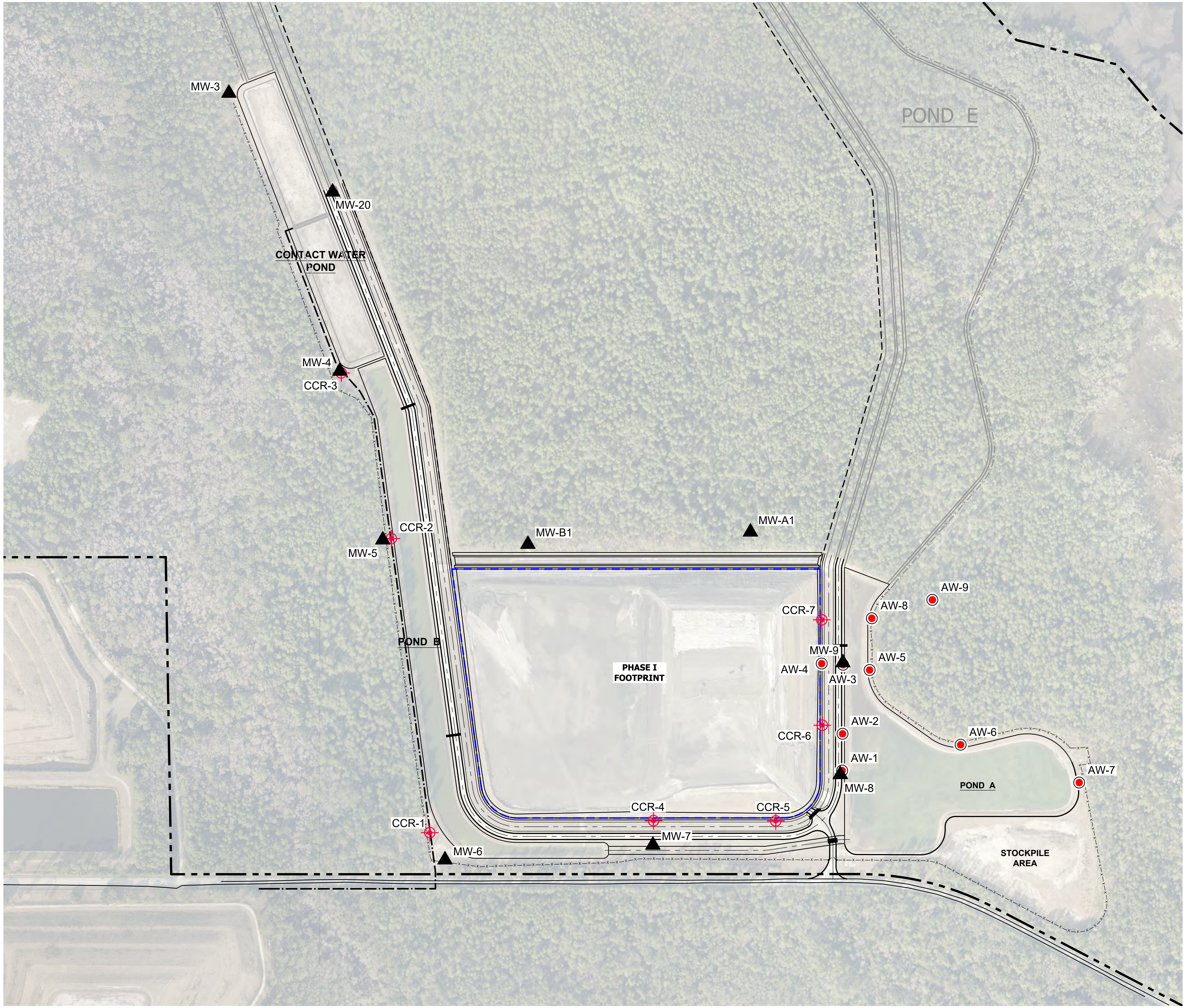
TITLE
SITE LOCATION MAP

PROJECT NO.	Phase	REV.	FIGURE
19-124481	19124481-M001		1

Path: \\golder.gds\complexdata\Office\Jacksonville\drafting\File\2019\19-124481 JEA-SJRPP CCR\M - 2020 GW Rpt\Active Drawings\ | File Name: 19124481-M001.dwg

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

0 1 in



LEGEND

— - — - —	PROPERTY BOUNDARY
— X — X — X — X —	CHAIN LINK FENCELINE
- - - - - - (blue)	PHASE I LIMIT OF WASTE
CCR-1	CCR GROUNDWATER MONITORING WELL LOCATIONS
AW-1	PIEZOMETER LOCATION
MW-B1	EXISTING MONITORING WELL

REFERENCE(S)

1.) CCR-SERIES MONITORING WELL AS-BUILT SURVEY PERFORMED BY B.V. & ASSOCIATES, INC. ON NOVEMBER 17, 2015.

2.) AERIAL IMAGE TAKEN FROM FDEP BUREAU OF SURVEY AND MAPPING (LAND BOUNDARY INFORMATION SYSTEM), YEAR 2013.

3.) AW-SERIES PIEZOMETERS FROM SURVEY PERFORMED BY R.E. HOLLAND & ASSOCIATES, INC. IN MARCH 2019.

SCALE 0 100 200 FEET

CLIENT
JEA

CONSULTANT
GOLDER

YYYY-MM-DD	2021-01-21
DESIGNED	SFS
PREPARED	BCL
REVIEWED	SFS
APPROVED	DJM

PROJECT
ST. JOHNS RIVER POWER PARK - CCR SUPPORT
JACKSONVILLE, DUVAL COUNTY, FLORIDA

TITLE
CCR GROUNDWATER MONITORING WELLS

PROJECT NO.	Phase	REV.	FIGURE
19-124481	19124481-M002		2

APPENDIX A

Monitored Natural Attenuation Evaluation

GOLDER
MEMBER OF WSP

REPORT

Monitored Natural Attenuation Evaluation

St. Johns River Power Park

Submitted to:

JEA/St. Johns River Power Park

21 West Church Street
Jacksonville, Florida 32202

Submitted by:

Golder Associates Inc.

7245 W Alaska Drive, Suite 200, Lakewood, Colorado, USA 80226

+1 303 980-0540

19124481

October 4, 2021

Distribution List

JEA

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 OVERVIEW

JEA operates the Byproduct Storage Area B (BSA-B or Area B or CCR Unit) at the St. Johns River Power Park (SJRPP) in Jacksonville, Florida. JEA manages coal combustion residuals (CCRs) formerly generated from the SJRPP in the BSA-B per the applicable requirements of 40 Code of Federal Regulations (CFR) Subpart D as amended (CCR Final Rule). A map of the BSA-B is provided in Figure 1.

Statistically significant levels (SSLs) of radium 226+228 above groundwater protection standards (GWPS) were identified in the uppermost aquifer downgradient of BSA-B during 2018 assessment monitoring. In response to the 2018 radium 226+228 SSL, an Assessment of Corrective Measures (ACM) report was completed in June 2019 for BSA-B as required by 40 CFR § 257.96 (Golder 2019). In December 2020, an addendum to the ACM for BSA-B was completed for molybdenum after the June 2020 sampling event identified molybdenum as an SSL above the GWPS (Golder 2020a).

The ACM identified monitored natural attenuation (MNA) as a potential groundwater response technology for radium 226+228 and molybdenum downgradient of BSA-B. To supplement the findings of the ACM, JEA retained Golder to further evaluate the overall feasibility of MNA as a groundwater remedial strategy for BSA-B in accordance with 40 CFR §257.97. Golder based the MNA feasibility evaluation on the United States Environmental Protection Agency (USEPA) guidance on using MNA as a remedial strategy (USEPA 2007a,b) and best practices from the Interstate Technology Regulatory Council (ITRC) document: “A Decision Framework for Applying Monitored Natural Attenuation Processes to Metals and Radionuclides in Groundwater” (ITRC 2010).

USEPA guidance recommends that the overall feasibility of MNA as a groundwater response technology be evaluated based on the following multi-tier approach (USEPA 2007a,b):

1) Demonstrate active constituent removal from groundwater and dissolved plume stability (Tier I).
2) Determine the mechanisms and rates of the operative attenuation processes (Tier II).
3) Determine the long-term capacity for attenuation and the stability of immobilized constituents (Tier III).

A Tier I Evaluation for the CCR Unit was completed in January 2020 (Golder 2020b). The Tier I evaluation concluded that sufficient evidence was present to satisfy the Tier I criteria for successful MNA implementation to address the radium 226+228 SSL. This report presents the findings of the Tier II and Tier III MNA Evaluation for the BSA-B area. Because a molybdenum SSL occurred after the completion of the Tier I evaluation for radium 226+228, this report also includes an update to the findings of the initial Tier I.

The results of the Tier II and Tier III evaluation will be used to further assess the performance and reliability of MNA as a potential remedial alternative as required by 40 CFR §257.97. Following completion of this multi-tier evaluation, the fourth and final tier of an MNA program, which involves the design of a performance monitoring program and the development of a contingency plan, will be conducted.

2.0 APPROACH

In 2019, Golder sampled overburden, groundwater, CCR materials, and Pond A water (located directly east of the CCR Unit) as part of a nature and extent evaluation and Tier I evaluation in accordance with the CCR Final Rule (Golder 2020b). Overburden samples were analyzed for metal content, and CCR materials were subjected to short-term leach testing by the synthetic precipitation leaching procedure (SPLP). Groundwater sampling and analysis of the monitoring well network at BSA-B continued throughout and after the completion of the Tier I evaluation, and the additional water quality results are used in the Tier II and Tier III site evaluation presented herein. The additional groundwater data collection consisted of five sampling events since the completion of the Tier 1 evaluation (December 2019, March 2020, June 2020, August 2020, and December 2020).

The Tier II and Tier III evaluation presented in this document build upon the results of the Tier I evaluation by undertaking the following:

- evaluation of temporal and geographical trends in groundwater quality data to estimate site-wide attenuation rates
- geochemical modeling to determine the aqueous speciation of radium 226+228 and molybdenum, and evaluation of saturation indices of minerals relevant to their attenuation
- determination of the capacity of different mechanisms to attenuate radium 226+228 and molybdenum, including adsorption, precipitation and coprecipitation, and physical attenuation (dilution/dispersion)
- geochemical modeling to assess the stability and reversibility of attenuation due to adsorption

Additionally, the results from the following analyses described in the Tier I evaluation for aquifer solids are used as part of the Tier II and Tier III evaluation:

- mineralogical analysis of aquifer solids to identify and quantify the major mineral components
- chemical analysis of aquifer solids to quantify the total metal content

The approach to and results of the Tier II and Tier III evaluation are presented in the next sections to establish a basis for the likely success of MNA at the BSA-B.

3.0 GEOCHEMICAL MODELING METHODS

3.1 Estimation of Attenuation Rates

To evaluate the attenuation of radium 226+228 and molybdenum in groundwater at BSA-B and to assess the rate of attenuation, the point decay method (USEPA 2007a; Newell et al. 2009) was applied. The point decay method is used to determine the rate at which a constituent's concentrations are increasing or decreasing in groundwater at a single well between sampling events. This method can thus be used to predict when the constituent's concentrations will fall back below regulatory limits.

Equation 1 describes first-order decay for a constituent:

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

where C_0 is the initial constituent concentration, C_t is the constituent concentration at time t, t is the amount of time in years that has passed since the initial measurement, and k is the first-order decay rate constant.

Equation 2 shows Equation 1 reorganized to solve for the decay rate constant:

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

Groundwater quality data from the upgradient and downgradient wells collected after January 2019 were used to determine the mean first-order decay rate for each constituent of interest. Due to variable detection limits, results that were reported as below detection were not used in the point decay analysis. Equation 1 and the mean first-order decay rate were used to calculate the number of years required for radium 226+228 and molybdenum concentrations to decrease below the GWPS thresholds (5 picocuries per liter [pCi/L] and 0.1 milligrams per liter [mg/L], respectively).

3.2 Geochemical Speciation Modeling

Baseline geochemical modeling was conducted to evaluate general groundwater and Pond A water quality, determine the potential for precipitation of sorbent media, evaluate the potential for mineral precipitation or adsorption in the aquifer, and determine the speciation of radium 226+228 and molybdenum. The geochemical computer code PHREEQC, developed by the United States Geological Survey (USGS), was used for these simulations (Parkhurst and Appelo 2013). PHREEQC version 3.4 is a general-purpose geochemical modeling code used to simulate reactions in water and between water and solid mineral phases (e.g., rocks and sediments). Reactions include aqueous equilibria, mineral dissolution and precipitation, ion exchange, surface complexation, solid solutions, gas–water equilibrium, and kinetic biogeochemical reactions. The widely accepted thermodynamic database Minteq.v4, 2017 edition, was used as a basis for the thermodynamic constants required for modeling (Allison et al. 1991). Radium sorption constants were added to the Minteq.v4 thermodynamic database from Sajih et al. (2014).

3.3 Groundwater Modeling

Golder developed a three-dimensional numerical groundwater model based on the MODFLOW groundwater-flow source code created by the USGS (McDonald and Harbaugh 1988) using Groundwater Vistas Version 7 (Golder 2020c). The groundwater model was developed based on the following:

- natural hydrologic boundaries, wherever possible
- ground surface topography and Pond A geometry
- geologic layers with representative structural properties based on boring logs
- hydraulic properties of geologic layers based on historical aquifer tests conducted at the site
- historical groundwater elevation measurements

For the purposes of the ACM, it was assumed that source control will be implemented for BSA-B, as one of the listed objectives in §257.97(b) for the corrective measures is to control the source of releases of Appendix IV constituents to the environment. The BSA-B closure will be completed by installation of a final cover system consisting of a 50-mil linear low-density polyethylene (LLDPE) liner with full stormwater and cover seepage controls, and a dedicated stormwater runoff routing and attenuation system (Golder 2020c). To simulate the groundwater potentiometric surfaces after completion of the BSA-B closure, a modified flow model was developed. Modification of the calibrated existing condition flow model included the following:

- Top elevations of the BSA-B area were updated using the final cover system design grading.
- Recharge rates within the closed BSA-B area were adjusted to zero to represent the liner cover to be installed.
- Recharge rates within southern and eastern swales were increased to the calibrated recharge value for Pond A, considering the increased runoff contributed to the stormwater system.

A final solute transport model was constructed based on the post-closure flow model to simulate the dilution of CCR Unit waters with background waters over a 20-year period. The solute transport model was constructed using the MT3D-USGS source code and used chloride, a conservative tracer, to model dilution. Chloride concentrations collected from groundwater wells (background and downgradient) and piezometers between February 2019 to June 2020 were used as initial conditions within the model.

The results of the solute transport groundwater flow model were incorporated into the dilution and dispersion model, discussed further in Section 3.4. Details on key parameters used to develop the groundwater models are presented in Appendix B.

3.4 Physical Attenuation Modeling – Dilution and Dispersion

Dilution and dispersion are physical mechanisms of attenuation by which a source water containing constituents at elevated concentrations mixes with cleaner upgradient and parallel groundwater flows, resulting in reduced concentrations in downgradient wells.

To assess the amount of dilution and dispersion that is expected downgradient of the CCR Unit, Golder used the modeled chloride concentration output of the groundwater model (Section 3.3; Golder 2020c). The modeling effort simulated chloride concentrations in groundwater downgradient from the CCR Unit using a solute transport model to simulate the relative degree of dilution and dispersion that occurs over the 20-year period after the final cover system is in place. A relative percentage of CCR seepage in groundwater was calculated at each timestep by dividing the modeled chloride value by the maximum observed concentration of chloride in groundwater at the site (446 mg/L; CCR-7 in June 2019). This is likely to be a conservative estimate (i.e., the calculated proportion of seepage is likely biased high), given that dilution and dispersion are likely to occur between the CCR Unit and CCR-7 (where the maximum chloride concentration was observed). The relative percentage of seepage was then used to calculate the dilution of radium 226+228 and molybdenum over the forecasted 20-year period by applying the maximum concentration of radium 226+228 (18.3 pCi/L; AW-3 in February 2019) and molybdenum (0.26 mg/L; CCR-6 in August 2020) observed in groundwater. Observed radium 226+228 and molybdenum concentrations in groundwater at the site are much lower than the forecasted concentrations at “Year 0,” which illustrates the conservative nature of the forecasts and indicates that chemical attenuation processes are also likely occurring.

3.5 Mineral Precipitation and Coprecipitation

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

$$SI = \log (IAP/K_{sp}) \qquad \text{(Equation 3)}$$

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

Coprecipitation was evaluated based on published literature and known association between minerals and the constituents of interest. For example, radium 226+228 is known to coprecipitate with sulfate minerals such as barite (Grundl and Cape 2006), and molybdenum is known to coprecipitate with iron hydroxide minerals (CCREM 1991). Therefore, minerals identified by PHREEQC to be at equilibrium and supersaturated (SI greater than -0.5) were evaluated for their potential to host radium 226+228 and molybdenum.

3.6 Capacity of Adsorption as an Attenuation Mechanism

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

Measurements of the HFO and HAO content in site geologic materials were not conducted. Thus, an estimation of HFO and HAO was completed by assuming a certain proportion of the total iron and aluminum concentrations in overburden soil samples was present as HFO and HAO, respectively. Three sensitivity analyses were run, where 5%, 10%, and 20% of the total iron and aluminum concentrations were assumed to be HFO and HAO. The HFO and HAO surface properties (i.e., surface area, site density, and types of sites) from Dzombak and Morel (1990) and Karamalidis and Dzombak (2011) were used to quantify the iron and aluminum adsorption sites per mol of mineral.

The calculation methodology of Appelo and Postma (2010) was used to determine the specific quantity of sites on each mineral surface type as a function of the amount of mineral available to participate in these reactions. The approach is summarized in Table 1. The methodology assumes the number of surface sites (sites) equals the product of the number of moles of iron (Fe) and the moles of surface sites per mole of iron (sites ÷ Fe = 0.2 mols of sites per mol of iron). For the amount of ferrihydrite available for sorption, the Appelo and Postma methodology further assumes the mass of ferrihydrite (M_{HFO}) in grams (g) available equals the product of the number of mols of iron and the molecular weight of ferrihydrite (MW_{HFO} = 88.85 grams per mol [g/mol]). The same approach was used to calculate the number of sites from gibbsite, assuming the sites ÷ Al is 0.41 mols of sites per mol of aluminum and the molecular weight of gibbsite is 78.003 g/mol.

The geochemical thermodynamic database Minteq V.4 was used to conduct adsorption modeling. However, new and updated thermodynamic data have been released in scientific literature. These new data are important to include in the geochemical modeling exercises for relevant elements or minerals as they allow further refinement of potential reactions, or for correction of previous data that may have been less accurate or more broadly defined. For groundwater modeling at the site, Golder made numerous updates to the Minteq V.4 database, including the addition of data relating to partitioning coefficients for metals on gibbsite, developed by Karamalidis and Dzombak (2011).

To quantify current levels of adsorption, the concentration of constituents that adsorb in soils (as milligram [mg] of constituent/kilogram [kg] of soil) was modeled for 5%, 10%, and 20% HFO and HAO contents when equilibrated with the range of groundwater qualities observed at the site. To quantify the capacity of soil to adsorb additional amounts of each constituent, Golder simulated a step-wise increase in radium 226+228 and molybdenum concentrations (similar in concept to a titration) to levels approximately 100 times higher than the average observed concentration in site groundwater into the range of observed groundwater qualities while allowing equilibration with the sorption surfaces in soils (5%, 10%, and 20% HFO and HAO). The model was then used to predict the quantity of each constituent that would adsorb due to this titration with additional radium 226+228 and molybdenum.

Table 1: Calculations of Ferrihydrite and Gibbsite Surface Parameters for Geochemical Modeling

Parameter	Units	Ferrihydrite			Gibbsite		
Percent available	%	5%	10%	20%	5%	10%	20%
Aquifer solids composition	mg/kg X	18.3	36.59	73.18	126.11	252.22	504.44
	mmol/kg X	0.33	0.66	1.31	4.67	9.35	18.7
	mol/kg X	3.3E-04	6.6E-04	1.31E-03	4.67E-03	9.35E-03	1.87E-02
Surface site concentration	mol weak sites / mol X	0.2	0.2	0.2	0.41	0.41	0.41
Surface sites	mol weak sites/kg	6.6E-05	1.3E-04	2.6E-04	1.9E-03	3.8E-03	7.7E-03
Mass of ferrihydrite or gibbsite	g/kg	0.03	0.06	0.12	0.36	0.73	1.46

Notes:
X = iron or aluminum depending on the mineral
Gibbsite only has one site “type.”

3.7 Long-Term Stability of Attenuated Constituents

Three sensitivity analyses were performed to assess the stability of adsorbed constituents under variable pH, reduction oxidation (redox), and ionic strength conditions. Variations in pH, redox, and ionic strength are the most likely types of changes that will occur in an aquifer over time affecting the stability of the constituents of interest (ITRC 2010). The sensitivity analyses were conducted applying the assumed range of HFO and HAO contents, equilibrated with the groundwater qualities observed at the site at the measured pH and redox conditions. For each sensitivity analysis, a single parameter was varied:

- pH: Hydrochloric acid or sodium hydroxide addition was simulated to vary the pH of water qualities observed at the site between 4 and 12 standard units (s.u.).
- Redox: Dissolved oxygen (DO) was used in the models to adjust redox potential (Eh) values between -200 and +700 millivolts (mV) based on the historical and anticipated range of Eh in the region (Section 4.1).
- Ionic strength: Total dissolved solids (TDS) concentrations were increased by titrating in calcium, magnesium, sodium, potassium, chloride, and sulfate in the proportions observed in the average groundwater concentrations at the site. TDS concentrations were evaluated up to 10,000 mg/L, which is approximately four times higher than the highest TDS concentration measured in groundwater at the CCR Unit.

3.8 Geochemical Modeling Assumptions and Data Handling

Geochemical modeling assumptions and data handling included the following:

1) Groundwater continuity: Groundwater quality data used in models were limited to samples collected during sampling events where the samples were analyzed for the full suite of parameters (February 2019, June 2019, October 2019, and August 2020). This dataset is assumed to provide a comprehensive overview of groundwater conditions. Temporal trend analysis for radium 226+228 and molybdenum made use of all available sampling events between November 2015 and December 2020.
2) CCR material: SPLP results (using the extraction fluid for samples collected east of the Mississippi River) (USEPA 2014) of two CCR samples (both collected in April 2019) were used to represent source water at the site (Golder 2020b).
3) Redox values: Oxidation-reduction potential (ORP) values measured in the field were converted to Eh by adding 200 millivolts (mV) to the field-measured values as per YSI Environmental (2015).
4) Non-detect values: Constituents with concentrations less than their respective method reporting limits were assumed to have a concentration equal to the reporting limit in model simulations.
5) Total recoverable concentrations: Total recoverable fraction results were used for geochemical modeling.
6) Charge balance: All groundwater samples with the full suite of cations and anions had charge balance errors less than 10% and were considered valid.

4.0 MODELING RESULTS

4.1 Groundwater and Pond Water Characterization

Groundwater quality data for background, downgradient or CCR monitoring wells, nature and extent (delineation) wells, and Pond A water samples used for this evaluation were collected from November 2015 to December 2020. Non-regulated (per the CCR Rule) groundwater parameters (e.g., alkalinity, potassium, sodium) are only available from February 2019 to November 2020. The assessment of trends in radium 226+228 and molybdenum concentrations included observations of all validated data collected during that time frame. Groundwater quality monitoring data are presented in Appendix A and can be summarized as follows:

- pH: The pH of groundwater collected from the CCR monitoring well network ranged from 4.0 to 6.8 across the site for the selected sampling events. Historically, the pH in the CCR monitoring well network has ranged from 3.9 to 9.5; however, only a single groundwater sample reported a pH value higher than 7 (CCR-5 in March 2018 at pH 9.5). The pH of pond water of Pond A was 6.8 in February 2019. Upgradient pH values have generally ranged between 4 and 5 since monitoring began in November 2015.
- ORP (Redox): Field-measured redox values, corrected to Eh (+200mV), ranged from -182 to +364 mV in the groundwater samples in the CCR monitoring and nature and extent well network. The redox of the pond water was measured at +241 mV in February 2019.
- TDS: Groundwater TDS concentrations were variable between 2015 and 2020 in the CCR monitoring well network, with several wells experiencing increasing TDS concentrations (i.e., upgradient wells CCR-1, CCR-2, and CCR-3; and downgradient wells CCR-5 and CCR-7). The lowest TDS concentration in groundwater (67 mg/L) was observed in groundwater from upgradient monitoring well CCR-3 and the highest

TDS value (3,633 mg/L) was reported in groundwater at monitoring well CCR-6. The TDS concentration of Pond A water in February 2019 was 1,584 mg/L, which is approximately half the TDS concentrations measured in groundwater immediately downgradient of the CCR Unit.

- Major ion chemistry: A Piper plot was generated for groundwater and pondwater samples to facilitate the identification of water types and source contributions (Figure 2a). Two distinct groupings of samples are apparent based on their major ion proportions. Nature and extent wells AW-6, AW-7, AW-8, and CCR well CCR-6 show close similarity with the water sample from Pond A, indicating potential influences of pond seepage in these locations. Additional evaluation of samples using the calcium, chloride, and sulfate ternary diagram (due to missing ions from other groundwater samples) further identified this grouping to include CCR-4 (side-gradient well), and CCR-3 (upgradient well) (Figure 2b). Groundwater samples from CCR-1 and CCR-2, which are also upgradient wells, more closely relate to the grouping formed with CCR-7, as well as AW-1 through AW-5. Groundwater at CCR-5 appears to be geochemically distinct from all other samples. The Piper plot indicates variability in upgradient groundwater at the site, which is relatively similar to downgradient groundwater and surface water in Pond A. This suggests that seepage from the CCR unit does not have a large influence on the proportions of major ions in downgradient groundwater.

- Nutrients: Nitrate plus nitrite (combined as N) was below detection (less than 0.05 mg/L as N) in all groundwater samples tested from February to October 2019, as well as in Pond A (Appendix A). Phosphate concentrations in groundwater ranged from non-detect (less than 0.2 mg/L as P) to 0.76 mg/L as P at CCR monitoring wells and nature and extent wells. Phosphate was the highest in Pond A water in February 2019 (0.09 mg/L). No spatial trend was apparent in the nitrate or phosphate distribution in groundwater.

- Radium 226+228: Historically, radium 226+288 levels have demonstrated variable trends (Figure 3). Radium 226+228 was not measured above the GWPS (5.0 pCi/L) at wells CCR-1, CCR-2, AW-6, or in Pond A over the monitoring period. Radium 226+228 was reported above the GWPS in multiple samples from wells CCR-3, CCR-7, AW-1, AW-3, AW-4, AW-7, and AW-8 over the monitoring period. Radium 226+228 in Pond A water was measured at 1.69 pCi/L. Radium is likely present in groundwater as the divalent cation Ra^{+2} under the pH and redox conditions present in groundwater (Figure 4a). Based on the SPLP results (Golder 2020b), leachable radium 226+228 was below detection from CCR samples AB-1 and AB-2, indicating that the CCR unit is an unlikely source of radium 226+228 in groundwater. From the Tier I evaluation, a correlation was observed between total radium 226+228 and phosphorus and uranium in overburden samples. Radium is a daughter product of uranium decay, while uranium frequently occurs in association with phosphate minerals (Rose et al. 1979), suggesting that there is likely a natural source of radium 226+228 (Figures 5a and 5b).

- Molybdenum: Molybdenum concentrations in monitoring and nature and extent wells ranged from non-detect (less than 0.00127 mg/L) to 0.26 mg/L (Figure 6). Although CCR-6 has reported historical levels of up to 0.26 mg/L, concentrations declined to the molybdenum GWPS (0.1 mg/L) during the most recent sample event (December 2020). No other CCR Unit monitoring wells reported concentrations exceeding 0.1 mg/L. The molybdenum concentration in Pond A water was measured at 0.034 mg/L in February 2019. Molybdenum is predominately present in the form of the divalent anionic molybdate (MoO_4^{-2}) species under the pH and redox conditions present in groundwater (Figure 4b). The SPLP leachates from CCR samples AB-1 and AB-2 reported low levels of leachable molybdenum (approximately 0.008 mg/L) (Golder 2020b).

- Iron and aluminum: Total iron concentrations in groundwater were variable, ranging from 0.04 mg/L at monitoring well AW-7 in August 2020 (Appendix A) to 38.13 mg/L in monitoring well AW-1 in February 2019.

Iron was present in Pond A water at 0.26 mg/L in February 2019. Pourbaix plots indicate that under the conditions found in the groundwater across the site, ferrihydrite was at equilibrium to slightly undersaturated in all groundwater samples and was oversaturated in Pond A water (Figures 4a and c). Aluminum speciation modeling indicates that gibbsite was stable in groundwater and Pond A samples (Figures 4b and d).

In summary, the groundwater radium 226+228 and molybdenum data at the BSA-B area indicate variable trends. The absence of leachable radium 226+228 and low levels of leachable molybdenum in CCR samples demonstrate that the CCR materials are unlikely to be a long-term source, if a source at all. As indicated by major ion compositions (Figures 2a and 2b), two types of groundwater are present on the site, with exceedances of the radium 226+228 and molybdenum GWPS occurring in both groups.

4.2 Evaluation of Attenuation Rates

The results of the point decay analysis for groundwater at background and downgradient wells (including nature and extent wells) for the period since January 2019 are provided in Table 2, as mean attenuation rates. This evaluation reveals that radium 226+228 concentrations in all upgradient and downgradient wells have decreased (negative point decay constants) over the last two years.

The mean downgradient decay rates can be used to estimate the number of years it would take for elevated groundwater concentrations to decrease to the GWPS. The maximum concentrations of radium 226+228 reported during the monitoring period (18.34 pCi/L at AW-3 in February 2019) would take approximately eight years to decrease below the GWPS (5 pCi/L) based on the decay rates observed since January 2019.

The positive mean point decay rate for molybdenum in upgradient and downgradient wells since January 2019 indicates that concentrations, on average, are increasing. In monitoring wells this increasing trend in the mean point decay rate was driven by the sudden increase in monitoring well CCR-6. Based on the strong dependence of molybdenum adsorption on pH, recent decreases in molybdenum concentrations at CCR-6 since the peak in August 2020, and planned source control for the CCR Unit, the increasing trend is unlikely to continue.

Table 2: Average Point Decay Rates in Background and Downgradient Wells

Constituents	Units	Mean Point Decay Rates			
		Background Wells	Monitoring Wells (CCR-)	Nature and Extent Wells (AW-)	All Downgradient Wells (CCR- and AW-)
Since January 2019					
Radium 226+228	yr-1	-0.20	-0.28	-0.26	-0.27
Molybdenum	yr-1	0.35	0.12	-0.03	0.06

4.3 Capacity of Attenuation Mechanisms

4.3.1 Physical Attenuation – Dilution and Dispersion

The dilution and dispersion simulations indicate that forecasted radium 226+228 and molybdenum concentrations in groundwater on the site would be diluted by upgradient and side-gradient groundwater and Pond A water. Concentrations are expected to decrease below their respective GWPS over the modeled 20-year period after source control is installed (Figures 7a and 7b). Concentrations of radium 226+228 and molybdenum are expected to initially increase in several wells (AW-5, AW-6, AW-7, AW-8, AW-9, CCR-6) at the beginning of the modeling period (between three to seven years after source control is in place) due to potentially impacted groundwater flowing out from beneath the CCR Unit followed by a steady decline in concentrations. The simulated increase in concentrations is likely an artifact of the assumptions needed for the groundwater model. The groundwater beneath the CCR Unit, the composition of which is unknown, was assumed to have a chloride content equal to the maximum concentration of chloride observed in groundwater at the site. The variable and lower chloride concentrations in wells around the CCR Unit suggest that the chloride concentration in groundwater underneath may not be that high. As such, the modeling makes use of a source groundwater chloride concentration that is likely biased high. Also, it should be noted that the use of conservative chloride to radium and chloride to molybdenum ratios resulted in predicted radium and molybdenum concentrations that were generally higher than the actual concentrations observed in groundwater at these wells, indicating the concentrations may decline faster than shown in Figures 7a and 7b. These results suggest that physical attenuation alone would be sufficient to reduce the concentrations of radium 226+228 and molybdenum to below their respective GWPS within approximately 5 to 10 years after full implementation of source control measures.

4.3.2 Mineral Precipitation and Coprecipitation

Saturation indices of the groundwater samples show supersaturation of barite across all groundwater samples, suggesting that precipitation of barite from solution may be occurring (Table 3). Coprecipitation of radium with barite has been well studied (e.g., Grundl and Cape 2006; Merkel et al. 2005). Thus, the attenuation of radium 226+228 through coprecipitation with barite is likely occurring. Site waters were also in equilibrium with gypsum, indicating that sulfate concentrations are sufficiently high for barite formation to continue.

In addition to coprecipitation, adsorption or the accumulation of trace metals such as molybdenum on a solid surface has been well studied in literature (e.g., Butt et al. 2000; Dzombak and Morel 1990; Smith 1999). Ferrihydrite was modeled to be close to equilibrium or slightly undersaturated in groundwater samples, indicating a low potential for coprecipitation of molybdenum and radium with iron hydroxide minerals, but ferrihydrite precipitation was indicated within Pond A.

4.3.3 Adsorption to Iron and Aluminum Oxyhydroxides

The HFO and HAO surface area and sorption site calculations for the 5%, 10%, and 20% iron and aluminum concentrations are presented in Table 1. Adsorption modeling in PHREEQC revealed a large range of adsorption capacities expected for the aluminum at the site, with minor amounts of iron adsorption capacity. Figures 8a and 8b display the predicted trajectories of aqueous radium and molybdenum concentrations, respectively, before and after adsorption onto HFO and HAO in soils (5%, 10%, and 20% HFO and HAO), as additional radium 226+228 and molybdenum are titrated into solution. The bold lines display the geometric means for the three HFO and HAO scenarios (5% [black], 10% [yellow], and 20% [blue]) and the grey area represents the range for the 5^{th} to 95^{th} percentile of all combined scenarios.

The predicted trajectories are compared against the GWPS concentrations. On the plots, the further the predicted trajectories are to the right of the 1:1 line, the larger the amounts of radium and molybdenum that have sorbed to HFO and HAO surface sites in soils and are no longer predicted to reside in the aqueous phase. For radium 226+228, little to no adsorption is predicted by the model, so aqueous concentrations before and after adsorption are almost identical. For molybdenum, the trajectories are located below and parallel to the 1:1 line, indicating that sorption is effective and that the sorption capacity is directly proportional to the concentration before adsorption. The modeling results suggest that adsorption has the capacity to reduce molybdenum concentrations below approximately 0.5 mg/L to less than the GWPS of 0.1 mg/L. The 95^{th} percentile (upper gray dashed line in Figure 7b) of modeled trajectories shows that a small proportion of groundwater samples collected at the site had pH and redox conditions that were less favorable for attenuating molybdenum, as seen by the proximity to the 1:1 line, but these samples were all collected from monitoring well CCR-6, where the elevated molybdenum concentrations were observed.

4.4 Evaluation of Attenuated Constituent Stability

The expected variations in dissolved concentration as a function of pH, Eh, and TDS are presented in Figures 9, 10, and 11, respectively. Results are presented along with GWPS values and the range of pH, Eh, or TDS values (5^{th} percentile to 95^{th} percentile) observed in groundwater at the site. Responses to changes in pH, Eh, and TDS vary between radium 226+228 and molybdenum and can be summarized as follows:

- Radium 226+228: The pH response of radium 226+228 (Figure 9a) was modeled to remain constant over the range of observed pH values; at pH values greater than 8, radium 226+228 attenuation increased slightly. Radium 226+228 was generally unresponsive to changes in redox conditions, with sorption of radium 226+228 not changing over the range of tested Eh conditions (Figure 10a). Radium 226+228 was also not responsive to increases in TDS concentrations (Figure 11a), with sorption remaining unchanged as TDS concentrations increased.
- Molybdenum: For molybdenum, lower pH values were generally more favorable for adsorption (Figure 9b). This is due to the anionic character of the aqueous molybdenum species, which favors sorption onto the positively charged surfaces present under more acidic conditions. At pH values greater than 7, nearly all molybdenum was desorbed and present in the dissolved phase. As groundwater at upgradient monitoring wells is generally below pH 5, adsorbed molybdenum is not expected to be remobilized, especially once source control is in place. Over the range of typical Eh values at site (Figure 10b), molybdenum sorption was relatively stable. Reducing conditions were predicted to slightly increase molybdenum adsorption due to decreased adsorption site availability. Oxidizing conditions were not predicted to affect adsorption. Molybdenum adsorption was generally insensitive to increases in TDS concentrations (Figure 11b), with TDS concentrations up to 10,000 mg/L less than doubling the aqueous concentrations due to desorption.

5.0 SUMMARY AND UPDATE OF TIER I ASSESSMENT

In 2019, overburden, groundwater, CCR materials, and pond water were sampled as part of a nature and extent evaluation and Tier I evaluation in accordance with the CCR Final Rule. Groundwater sampling and analysis of the monitoring well network at BSA-B continued throughout and after the completion of the Tier I evaluation, and the additional water quality results are used in the Tier II and Tier III evaluation presented herein. The additional groundwater data collection consisted of five sampling events (December 2019, March 2020, June 2020, August 2020, and December 2020). Data from those events are included in Appendix A.

The updated Tier I findings are as follows:

- Plume stability: Based on the water quality monitoring data presented in this assessment, groundwater concentrations of radium 226+228 vary over time while no clear relationship with water types and location is observed. Except for monitoring well CCR-6, the molybdenum concentrations in downgradient wells have remained stable below the GWPS (0.1 mg/L). The short-term leach test results of CCR materials (i.e., non-detect radium levels and low levels of molybdenum in SPLP leachates) indicate that the CCR materials are unlikely to be a long-term source, if a source at all.

- Magnitude of exceedances: Occasional exceedances of the radium 226+228 and molybdenum GWPS in some wells do not amount to levels that would be considered an SSL per the CCR Final Rule (Golder 2019). The highest level of radium 226+228 in groundwater (since monitoring began) at the BSA-B was observed at downgradient well AW-3 in February 2019 at 18.34 pCi/L. However, results from the subsequent sampling event (August 2020) at AW-3 indicated the radium 226+228 concentrations decreased substantially, to 9.67 pCi/L. Similar trends were observed for molybdenum in groundwater; the highest concentration of molybdenum in groundwater (since monitoring began) at the BSA-B was observed in downgradient well CCR-6 at 0.262 mg/L (in August 2020). During the next sampling round, molybdenum in groundwater from CCR-6 was measured at the molybdenum GWPS (0.1 mg/L).
- CCR material: Historical records are not available for ash additions to the BSA-B or the chemical composition of the CCRs over the lifespan of the storage area. However, radium 226+228 was not observed above its detection limit and molybdenum was only detected at very low levels (just above the detection limit; approximately 0.008 mg/L) in SPLP leachates generated from CCR material (Golder 2020b). This indicates that the ash is not likely to be a major long-term source of radium 226+228 or molybdenum to groundwater, if at all.
- Groundwater chemistry: The groundwater monitoring results and the findings of the geochemical modeling support the potential for natural attenuation of radium 226+228 and molybdenum. Equilibrium of groundwater with the mineral phase barite, capable of sequestering radium, was indicated in all groundwater samples. Molybdenum generally attenuates through sorption onto HFO and/or HAO under slightly acidic conditions (Hem 1992) and such conditions (pH values between 5.5 and 4.0) are observed in 12 of the 15 groundwater monitoring wells.
- Confirmation of attenuation/immobilization: Based on both geochemical and groundwater modeling paired with decreasing concentrations with increasing distance from the CCR Unit, it is likely that attenuation of radium 226+228 and molybdenum by aquifer materials is occurring. The ubiquitous presence of aluminum (Golder 2020b), in the form of clay minerals, provides a well-studied attenuation reservoir for radium 226+228 (Ames et al. 1983). Iron and aluminum, known to facilitate molybdenum attenuation (Dzombak and Morel 1990), also were identified in all overburden samples.

6.0 TIER II EVALUATION

The purpose of the Tier II evaluation is to “Identify mechanisms and rates of the operative attenuation process” (USEPA 2007a). Based on this definition, the following modeling results and observations support MNA as a viable corrective measure for the SJRPP CCR Unit:

- Adsorption capacity modeling: PHREEQC modeling results show that adsorption is likely attenuating molybdenum and, to a lesser degree, radium 226+228 downgradient of the CCR Unit. This is concluded from simulating equilibration of site-specific groundwater compositions with the range of HFO and HAO concentrations estimated from iron and aluminum concentrations in site soils. Attenuation modeling (Figures 8a and 8b) shows how the soil’s capacity to adsorb constituents responds if groundwater concentrations of radium 226+228 and molybdenum were to increase above current levels. Dissolved concentrations of radium 226+228 (Figure 3) and molybdenum (Figure 6) show little variation over a wide range of pH, Eh, and TDS values.
- Coprecipitation: Saturation indices of the groundwater samples show supersaturation of barite across all groundwater samples, suggesting that precipitation of barite from solution may be occurring. Coprecipitation

of radium with barite has been well studied in the literature (e.g., Grundl and Cape 2006; Merkel et al. 2005). Thus, the attenuation of radium 226+228 through coprecipitation with barite is likely. In the absence of clear evidence for significant formation of ferrihydrite in groundwater at the site, coprecipitation of molybdenum with this mineral is only expected within Pond A (Butt et al. 2000; Dzombak and Morel 1990; Smith 1999).

- Estimated site attenuation rates: Concentrations of radium 226+228 are generally decreasing in downgradient monitoring wells, resulting in negative calculated point decay rates since January 2019 (Table 2). A positive point decay rate for molybdenum since January 2019 suggests that its concentrations are increasing, but this trend appears to be largely driven by slightly elevated pH levels in well CCR-6. Using the mean decay rate since January 2019, maximum concentrations of radium 226+228 observed in downgradient monitoring wells would take approximate eight years to attenuate to below the GWPS.
- Dilution/dispersion (physical attenuation) modeling: Modeled chloride concentrations in downgradient wells were used as a conservative tracer for physical attenuation (i.e., dilution and dispersion). The results of this assessment suggest that radium 226+228 and molybdenum will attenuate below the GWPS in all downgradient wells in approximately 10 and 4 years, respectively (Figures 7a and 7b). These results are considered conservative in that attenuation processes other than dilution and dispersion (e.g., coprecipitation and adsorption) were not accounted for in this approach. As such, reductions in concentration below the GWPS may occur sooner than based on physical attenuation alone.

Based on these findings, radium 226+228 and molybdenum are considered to be candidates for MNA remedy application and deemed to meet the criteria for Tier II MNA in accordance with USEPA guidance (USEPA 2007a,b).

7.0 TIER III EVALUATION

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

- Adsorption capacity modeling: As discussed previously, radium 226+228 is likely coprecipitating with barite while little to no adsorption of radium 226+228 is predicted. Additionally, dilution and dispersion modeling suggests that dilution and dispersion alone are sufficient to reduce the radium 226+228 concentrations in groundwater below its GWPS within the next 10 to 15 years.

  Predictive modeling has demonstrated that the molybdenum concentration in source water could increase to 0.5 mg/L and concentrations of molybdenum at downgradient monitoring wells would still be expected to decline below its GWPS in a reasonable time frame (Figure 7b). A time frame is defined as “reasonable” when it is comparable to time frames associated with other active remediation options described in an assessment of corrective measures (Golder 2019; ITRC 2010). Recent decreases in molybdenum concentrations at CCR-6 indicate that groundwater concentrations are nearly back below the GWPS in all monitoring wells.

  Therefore, based on the current radium 226+228 and molybdenum concentrations in the BSA-B, the current concentrations observed in downgradient monitoring wells, and the anticipated source control activities, it is concluded that the combined long-term attenuation from physical and chemical processes is sufficient to attenuate radium 226+228 and molybdenum in groundwater at the BSA-B to concentrations below their GWPS.

- Stability of constituents: Stability modeling indicates that for the conditions observed in groundwater at the site (i.e., pH between 4 and 7, Eh between 0 and 200 mV, and TDS less than 3,000 mg/L), adsorbed molybdenum is relatively stable and likely to remain attenuated (Figures 9, 10, and 11). The modeling results further suggest that the adsorption of molybdenum is unlikely to be reversed even with large fluctuations in pH and Eh conditions. Based on groundwater monitoring data collected from the site, there is no historical basis to expect such fluctuations may occur.

  All site groundwater samples were modeled to be in equilibrium with gypsum, indicating that sulfate concentrations are sufficiently high that formation of barite will persist.

8.0 CONCLUSIONS

This report presents the results of a Tier I update, and Tier II and Tier III evaluation conducted to determine the feasibility of using MNA as a remedial strategy for radium 226+228 and molybdenum at BSA-B. This evaluation has been completed in accordance with guidance and best practices promulgated by the USEPA (2007a,b) and the ITRC (2010).

Based on the results of this evaluation, physical attenuation of radium 226+228 and molybdenum is occurring and is expected to increase after source control is in place. Chemical attenuation of radium 226+228 and molybdenum is taking place as well. Radium 226+228 and molybdenum concentrations are generally stable, and the aquifer has adequate capacity to attenuate radium 226+228 and molybdenum to concentrations below their GWPS in a reasonable timeframe. Modeling indicates that radium 226+228 and molybdenum attenuation by both physical and chemical attenuation will be efficient and stable in the long term. Radium 226+228 and molybdenum concentrations in SPLP leachates of CCR materials were low to very low, indicating that the CCR materials are an unlikely long-term source of these constituents, if at all.

In conclusion, radium 226+228 and molybdenum are considered viable candidates for MNA at BSA-B, and it is recommended that a Tier IV evaluation be completed to design a long-term MNA monitoring plan if MNA is selected as the final remedy for radium 226+228 and molybdenum.

Signature Page

Golder Associates Inc.

PJ Nolan, PhD
Senior Project Geochemist

Rens Verburg, PhD
Principal Geochemist

GL/PN/RV/af

https://golderassociates.sharepoint.com/sites/110243/project files/6 deliverables/monitored_na_eval/rev0/19124481-rpt-rev0-monitored_natural_attenuation_evaluation_04oct21.docx

9.0 REFERENCES

Allison JD, Brown DS, and Novo-Gradac KJ. 1991. MINTEQA2/PRODEFA2, A Geochemical Assessment Model for Environmental Systems: Version 3.0 User's Manual. EPA/600/3-91/021.

Ames LL, McGarrah JE, and Walker BA. 1983. Sorption of trace constituents from aqueous solutions onto secondary minerals. II. Radium. Clays and clay minerals, 31(5), pp.335–342.

Appelo CAJ and Postma D. 2010. Geochemistry, Groundwater and Pollution. 2nd Edition. Boca Raton, FL.

Butt C, Lintern M, and Anand R. 2000. Evolution of regoliths and landscapes in deeply weathered terrain—implications for geochemical exploration. Ore geology reviews, 16(3–4), pp.167–183.

CCREM (Canadian Council of Resource and Environment Ministers). 1991. Canadian Water Quality Guidelines.

Davis JA and Kent DB. 1990. Surface Complexation Modeling in Aqueous Geochemistry, Eds. M.F. Hochella and A.F. White, Mineral-Water Interface Geochemistry, Min. Soc. Am. Reviews in Minerology, 23, pp.177–260.

Dzombak DA and Morel F. 1990. Surface complexation modeling: hydrous ferric oxide. John Wiley & Sons.

Golder (Golder Associates Inc.). 2019. CCR Assessment of Corrective Measures, St. Johns River Power Park – Byproduct Storage Area B, Jacksonville, Florida.

Golder. 2020a. Assessment of Corrective Measures Addendum, St. Johns River Power Park – Byproduct Storage Area B, Jacksonville, Florida.

Golder. 2020b. Tier I MNA Evaluation, St. Johns River Power Park – Byproduct Storage Area B, Jacksonville, Florida.

Golder. 2020c. Groundwater Model Technical Memorandum, St. Johns River Power Park – Byproduct Storage Area B, Jacksonville, Florida.

Grundl T and Cape M. 2006. Geochemical Factors Controlling Radium Activity in a Sandstone Aquifer. Groundwater, 44(4), pp. 518–527.

Hem JD. 1992. Study and Interpretation of the Chemical Characteristics of Natural Water. US Geological Survey Water-Supply Paper 2254.

ITRC (Interstate Technology Regulatory Council). 2010. A Decision Framework for Applying Monitored Natural Attenuation Processes to Metals and Radionuclides in Groundwater. Technical/Regulatory Guidance.

Karamalidis A and Dzombak D. 2011. Surface complexation modeling: gibbsite. John Wiley & Sons.

Merkel BJ, Planer-Friedrich B, and Nordstrom DK. 2005. Groundwater Geochemistry. A practical guide to modeling natural and contaminated aquatic systems, Volume 2.

McDonald MG and Harbaugh AW. 1988. A Modular Three-Dimensional Finite-Difference Ground-Water Flow Model. U.S. Geological Survey, Techniques of Water-Resources Investigations, Book 6, Chapter A1.

Newell CJ, Rifai HS, Wilson JT, Connor JA, Aziz JJ, and Suarez MP. 2009. Calculation and Use of First-Order Rate Constants For Monitored Natural Attenuation Studies. USEPA Remedial Technology Fact Sheet. EPA/540/S-02/500. USEPA National Risk Management Research Laboratory, Cincinnati, OH, USA.

Parkhurst D and Appelo C. 2013. Description of input and examples for PHREEQC version 3: a computer program for speciation, batch-reaction, one-dimensional transport, and inverse geochemical calculations (No. 6-A43). US Geological Survey.

Rose AW, Hawkes HE, and Webb JS. 1979. Geochemistry in Mineral Exploration. Academic Press.

Sajih M, Bryan ND, Livens FR, Vaughan DJ, Descostes M, Phrommavanh V, Nos J, and Morris K. 2014. Adsorption of radium and barium on goethite and ferrihydrite: A kinetic and surface complexation modelling study. Geochimica et Cosmochimica Acta, 146, pp.150–163.

Smith K. 1999. Metal sorption on mineral surfaces: an overview with examples relating to mineral deposits. The Environmental Geochemistry of Mineral Deposits. Part B: Case Studies and Research Topics, 6, pp. 161–182.

USEPA (United States Environmental Protection Agency). 2007a. Monitored Natural Attenuation of Inorganic Contaminants in Ground Water. Volume 1. Technical Basis for Assessment. EPA/600/R-07/139.

USEPA. 2007b. Monitored Natural Attenuation of Inorganic Contaminants in Ground Water. Volume 2. Assessment for Non-Radionuclides Including Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Nitrate, Perchlorate, and Selenium. EPA/600/R-07/140.

USEPA. 2014. Method 1312: Synthetic precipitation leaching procedure. Test methods for evaluating solid waste, physical/chemical methods, SW-846. Sept. 1994.

YSI. 2015. Tech Note, Measuring ORP on YSI 6-Series Sondes: Tips, Cautions and Limitations.

Zhang T, Gregory K, Hammack RW, and Vidic RD. 2014. Co-precipitation of radium with barium and strontium sulfate and its impact on the fate of radium during treatment of produced water from unconventional gas extraction. Environmental science & technology, 48(8), pp. 4,596–4,603.

Tables

Table 3: Geochemical Modeling Results - SJRPP BSA-B

Mineral Phases - Saturation Indices[(a)]		AW-1		AW-2		AW-3		AW-4		AW-5		AW-6		
		02-20-2019	08-18-2020	02-20-2019	08-18-2020	02-20-2019	08-18-2020	10-29-2019	10-29-2019	10-29-2019	08-18-2020	02-20-2019	10-29-2019	08-18-2020
Otavite	$CdCO_3$							-6.64	-6.64	-6.56			-6.41	
Ferrihydrite	$Fe(OH)_3$	-5.94	-5.89	-5.18	-4.20	-4.85	-3.93	-2.35	-2.35	-2.69	-4.10	-3.46	-3.22	-7.04
Siderite	$FeCO_3$	-3.09	-3.22	-3.51	-3.18	-3.36	-3.32	-3.45	-3.45	-3.56	-3.19	-2.86	-4.15	-4.06
Melanterite	$FeSO_4\ 7H_2O$	-3.76	-4.03	-4.36	-4.33	-4.32	-4.59	-4.43	-4.43	-4.64	-4.48	-4.70	-5.38	-5.61
Anglesite	$PbSO_4$	-3.84	-4.56	-3.82	-4.71	-3.82	-4.87	-4.87	-4.87	-4.91	-4.88	-3.91	-4.93	-4.93
Gypsum	$CaSO_4{:}2H_2O$	**-0.37**	**-0.26**	**-0.35**	**-0.31**	**-0.19**	**-0.16**	**-0.18**	**-0.18**	-0.89	-0.70	**-0.44**	**-0.34**	**-0.32**
Jarosite-H	$(H_3O)Fe_3(SO_4)_2(OH)_6$	-17.74	-17.62	-16.38	-14.23	-15.98	-13.87	-7.96	-7.96	-8.72	-14.22	-14.56	-10.98	-23.75
Jarosite-K	$KFe_3(SO_4)_2(OH)_6$	-13.69	-13.55	-11.61	-9.47	-10.86	-8.79	-3.17	-3.17	-4.77	-9.75	-10.21	-7.33	-19.74
Jarosite-Na	$NaFe_3(SO_4)_2(OH)_6$	-15.91	-15.98	-14.26	-12.05	-13.74	-11.69	-6.01	-6.01	-7.25	-12.26	-12.58	-9.87	-22.23
Calcite	$CaCO_3$	-3.80	-3.63	-3.60	-3.33	-3.32	-3.07	-3.37	-3.37	-3.97	-3.57	-2.71	-3.28	-2.95
Magnesite	$MgCO_3$	-5.19	-5.16	-5.09	-4.98	-5.48	-5.53	-5.75	-5.75	-5.64	-5.25	-4.78	-5.39	-5.07
Barite	$BaSO_4$	**0.77**	**0.74**	**1.06**	**0.98**	**1.10**	**0.94**	**0.97**	**0.97**	**0.78**	**0.78**	**0.86**	**0.78**	**0.70**
Witherite	$BaCO_3$	-7.97	-7.90	-7.50	-7.32	-7.34	-7.24	-7.50	-7.50	-7.57	-7.36	-6.71	-7.44	-7.20
Fluorite	CaF_2	-2.33	-2.33	-2.64	-2.68	-2.45	-3.20	-2.49	-2.49	-3.69	-3.12	-3.14	-3.14	-3.06
$CoCO_3$	$CoCO_3$	-7.88	-7.81	-7.69	-7.46	-7.58	-7.35	-7.63	-7.63	-7.58	-7.32	-6.83	-7.46	-7.15
Cerrusite	$PbCO_3$	-5.76	-6.47	-5.55	-6.26	-5.43	-6.32	-6.59	-6.59	-6.52	-6.27	-4.68	-6.40	-6.10
Carbon dioxide	$pCO_2(g)$[(b)]	**0.08**	**0.08**	**-0.19**	**-0.40**	**-0.36**	-0.52	**-0.20**	**-0.20**	**0.04**	**-0.38**	-0.89	**-0.16**	-0.52

a. Saturation indices between -0.5 and 0.5 or > 0.5 identified by bold type and grey shading.

b. $pCO_2(g)$ values presented at 10^{value} atm.

GOLDER MEMBER OF WSP

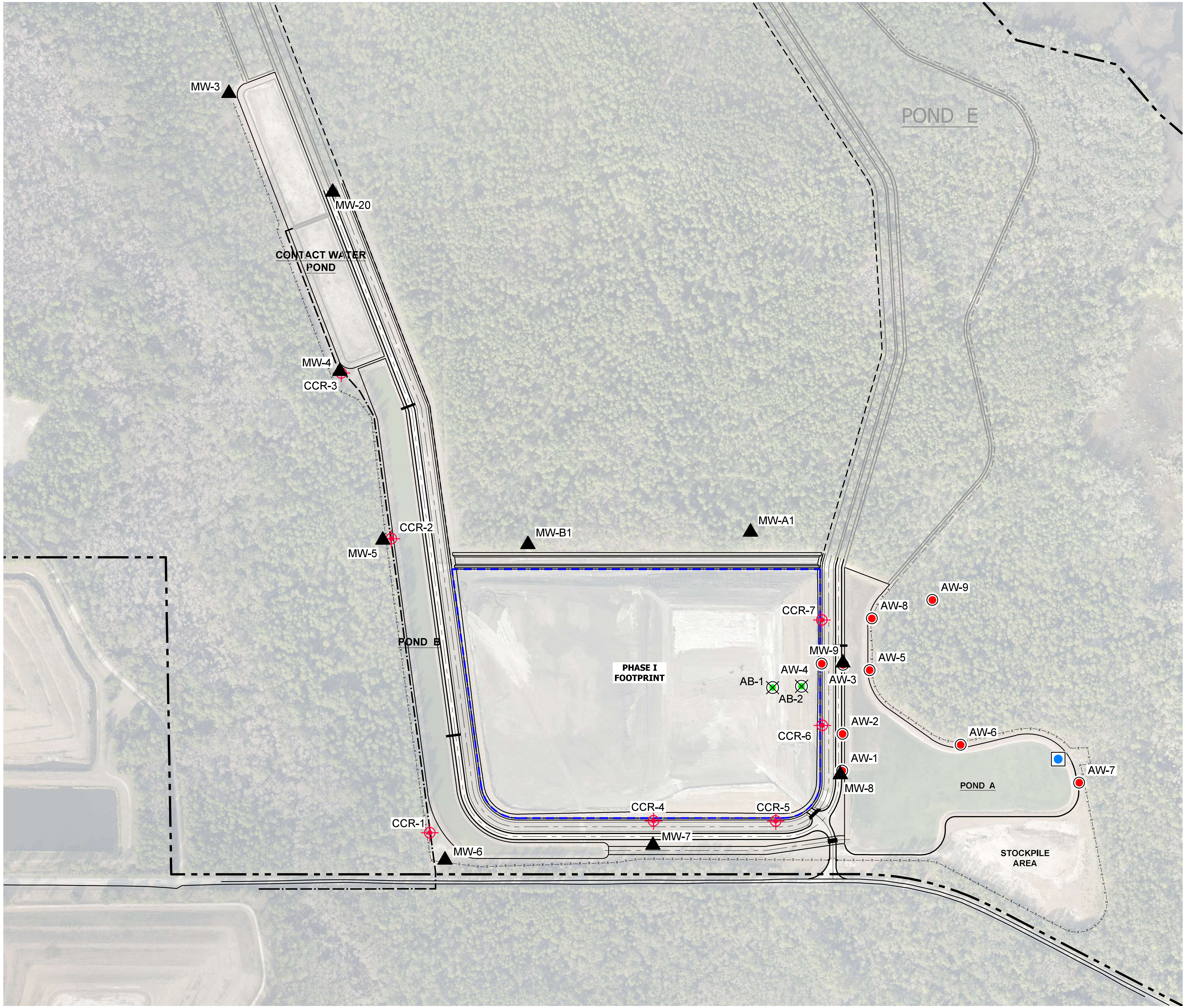
Table 3: Geochemical Modeling Results - SJRPP BSA-B

Mineral Phases - Saturation Indices[a]		AW-7		AW-8		CCR-6		CCR-7			SW
		02-20-2019	08-18-2020	10-29-2019	02-20-2019	10-29-2019	08-18-2020	02-20-2019	10-29-2019	08-18-2020	02-20-2019
Otavite	$CdCO_3$			-6.56		-3.74			-6.70		
Ferrihydrite	$Fe(OH)_3$	-2.58	-4.80	-2.62	-3.99	-1.62	-2.57	-6.25	-4.67	-5.50	**2.16**
Siderite	$FeCO_3$	-1.62	-3.18	-3.50	-1.80	-1.67	-1.15	-3.44	-3.38	-3.61	-2.33
Melanterite	$FeSO_4\ 7H_2O$	-4.99	-6.86	-4.54	-5.19	-5.54	-5.63	-4.36	-4.38	-4.76	-6.18
Anglesite	$PbSO_4$	-4.00	-5.03	-4.69	-4.01	-4.55	-5.25	-3.82	-4.61	-4.39	-4.04
Gypsum	$CaSO_4{:}2H_2O$	**-0.33**	**-0.20**	**-0.28**	**-0.20**	**-0.13**	**-0.18**	**-0.42**	**-0.45**	**-0.26**	**-0.33**
Jarosite-H	$(H_3O)Fe_3(SO_4)_2(OH)_6$	-16.06	-23.49	-8.62	-19.16	-13.32	-16.99	-19.97	-14.73	-17.91	-3.97
Jarosite-K	$KFe_3(SO_4)_2(OH)_6$	-10.46	-17.54	-4.65	-12.80	-6.86	-10.58	-15.01	-10.00	-13.09	**2.43**
Jarosite-Na	$NaFe_3(SO_4)_2(OH)_6$	-13.00	-20.18	-7.41	-15.86	-9.88	-13.70	-17.73	-12.87	-15.94	**-0.30**
Calcite	$CaCO_3$	-1.08	-0.70	-3.40	-0.90	**-0.42**	**0.10**	-3.58	-3.62	-3.30	-0.60
Magnesite	$MgCO_3$	-3.13	-2.78	-5.20	-2.17	-2.04	-1.25	-5.23	-5.26	-5.29	-2.54
Barite	$BaSO_4$	**0.70**	**0.97**	**0.78**	**0.88**	**0.81**	**0.62**	**1.15**	**1.07**	**1.02**	**0.86**
Witherite	$BaCO_3$	-5.35	-4.80	-7.63	-5.13	-4.77	-4.38	-7.32	-7.38	-7.29	-4.71
Fluorite	CaF_2	-2.28	-3.04	-2.46	-2.46	-2.36	-2.56	-2.66	-2.68	-2.67	-0.77
$CoCO_3$	$CoCO_3$	-5.31	-5.01	-7.61	-5.21	-4.82	-4.32	-7.42	-7.16	-7.21	-4.82
Cerrusite	$PbCO_3$	-3.25	-4.08	-6.34	-3.19	-3.37	-3.53	-5.46	-6.31	-5.98	-2.81
Carbon dioxide	$pCO_2(g)$[b]	-1.44	-1.63	**-0.05**	-0.81	-1.08	-0.94	**-0.28**	**-0.10**	**-0.32**	-2.04

a. Saturation indices between -0.5 and 0.5 or > 0.5 identified by bold type and grey shading.

b. $pCO_2(g)$ values presented at 10^{value} atm.

Figures



LEGEND

— · · — · · —	PROPERTY BOUNDARY
— X — X — X — X —	CHAIN LINK FENCELINE
— · — · — · —	PHASE I LIMIT OF WASTE
CCR-1	CCR GROUNDWATER MONITORING WELL LOCATIONS
AW-1	PIEZOMETER LOCATION
MW-B1	EXISTING MONITORING WELL
	BYPRODUCT SAMPLE LOCATION
	SURFACE WATER SAMPLE LOCATION

REFERENCE(S)

1.) CCR-SERIES MONITORING WELL AS-BUILT SURVEY PERFORMED BY B.V. & ASSOCIATES, INC. ON NOVEMBER 17, 2015.

2.) AERIAL IMAGE TAKEN FROM FDEP BUREAU OF SURVEY AND MAPPING (LAND BOUNDARY INFORMATION SYSTEM), YEAR 2013.

3.) AW-SERIES PIEZOMETERS FROM SURVEY PERFORMED BY R.E. HOLLAND & ASSOCIATES, INC. IN MARCH 2019.

0 100 200
SCALE FEET

CLIENT
JEA

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-10-01
DESIGNED	SFS
PREPARED	BCL
REVIEWED	SFS
APPROVED	DJM

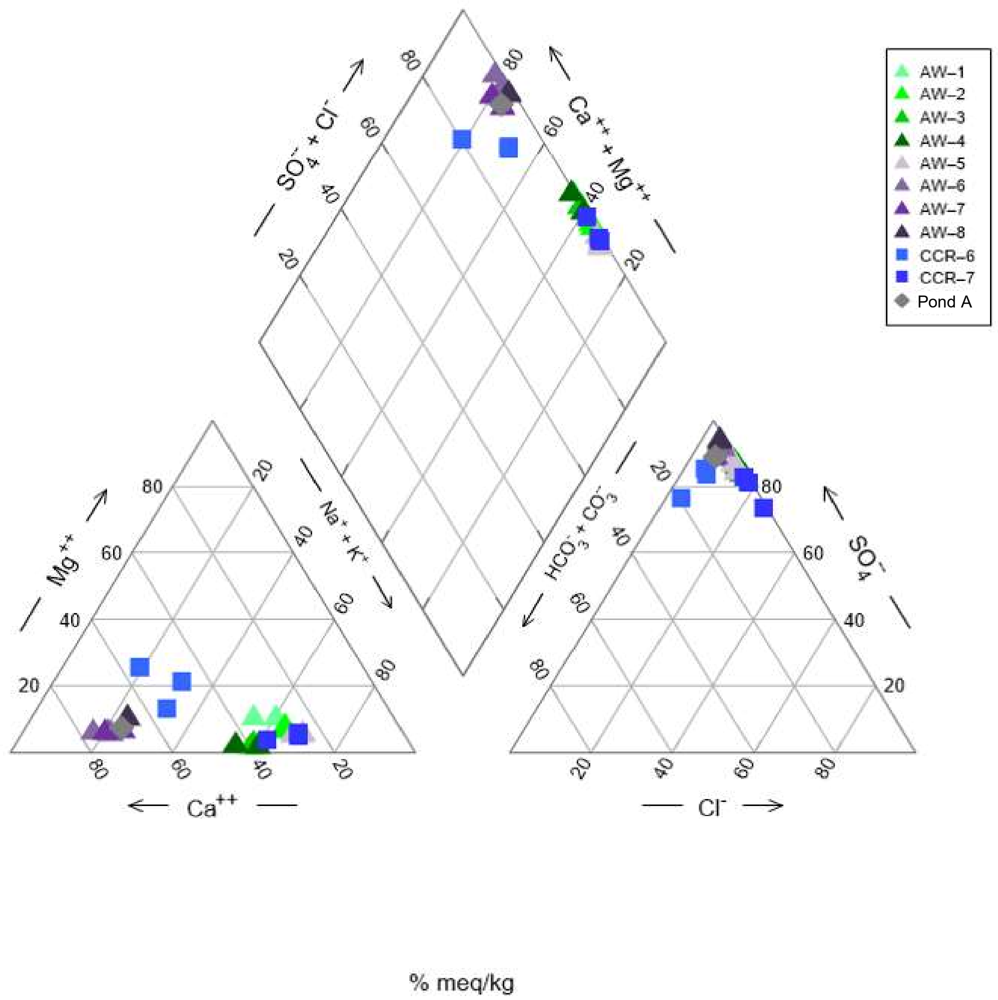
PROJECT
ST. JOHNS RIVER POWER PARK - CCR SUPPORT
JACKSONVILLE, DUVAL COUNTY, FLORIDA

TITLE
CCR GROUNDWATER MONITORING WELLS

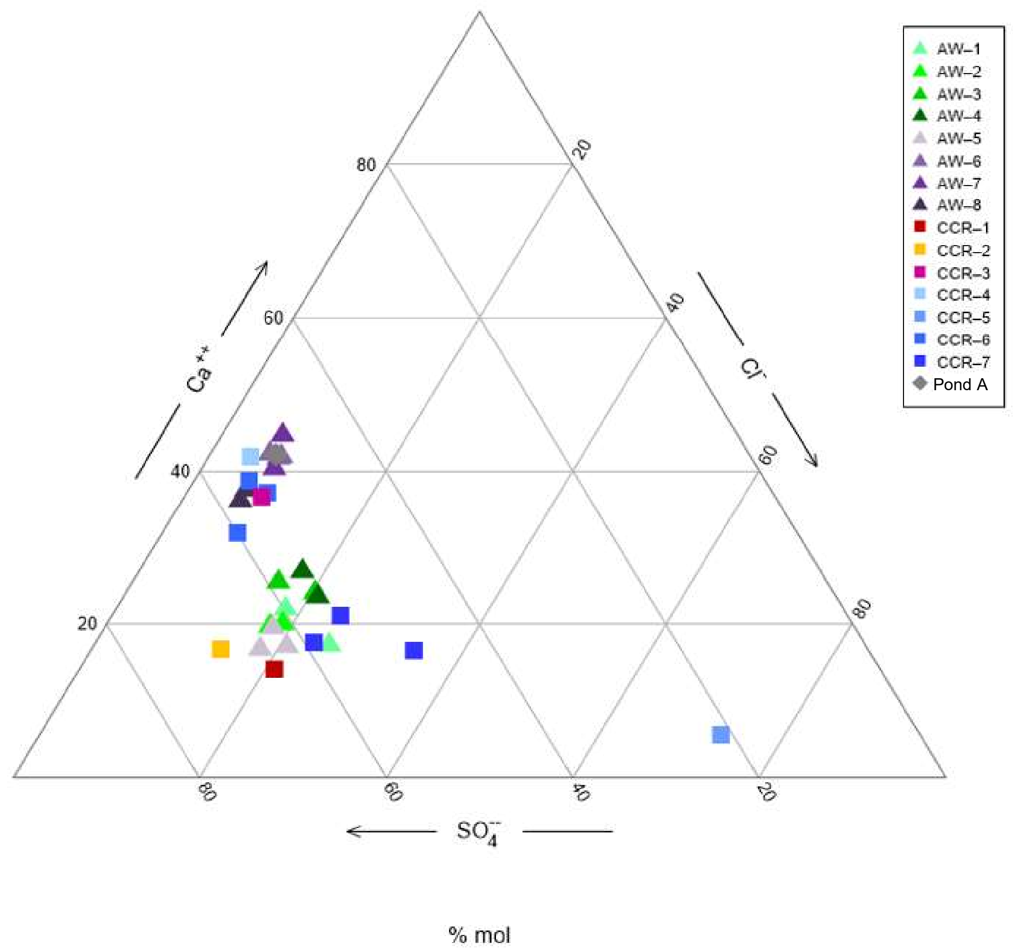
PROJECT NO.	Phase	REV.	FIGURE
19-124481	19124481-M002a		1

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

(a)



(b)



CLIENT
JEA
ST. Johns River Power Park
BSA-B

CONSULTANT

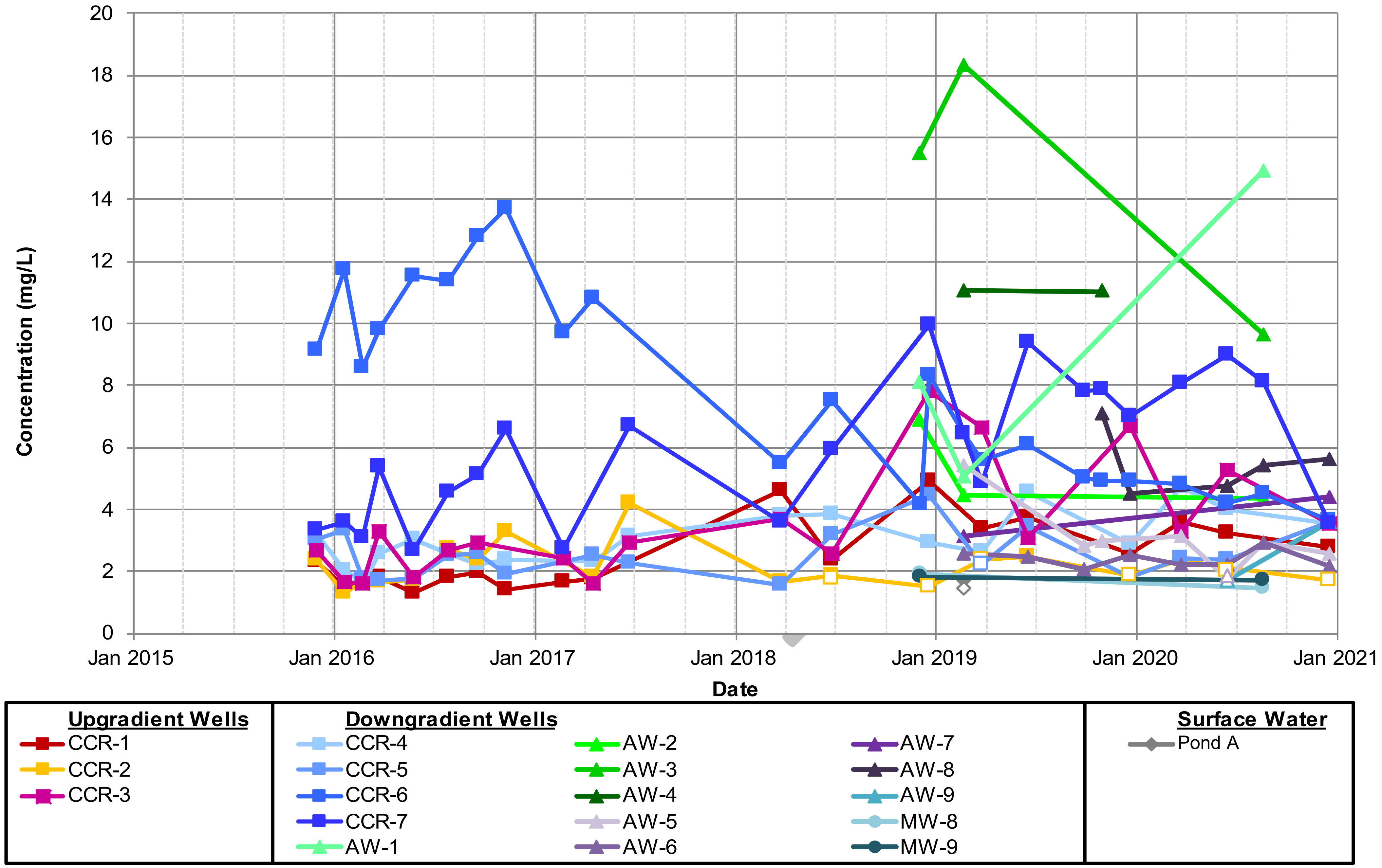
GOLDER
MEMBER OF WSP

PROJECT
TIER II AND TIER III MNA GEOCHEMICAL EVALUATION

TITLE
MAJOR GROUNDWATER CHEMISTRY (A) AND SELECT RELATIVE ION ABUNDANCE (B)

PROJECT NO.	PHASE	REV.	FIGURE
19124481	0010	0	2

PATH: https://golderassociates.sharepoint.com/sites/110243/Project Files/5 Technical Work/Tier II and III MNA/Final Report/Figures and Tables | FILE NAME: JAX Figures and Tables .xlsx



Non-detects are plotted at the practical quantitation limit with an open symbol.

CLIENT
JEA
ST. Johns River Power Park
BSA-B

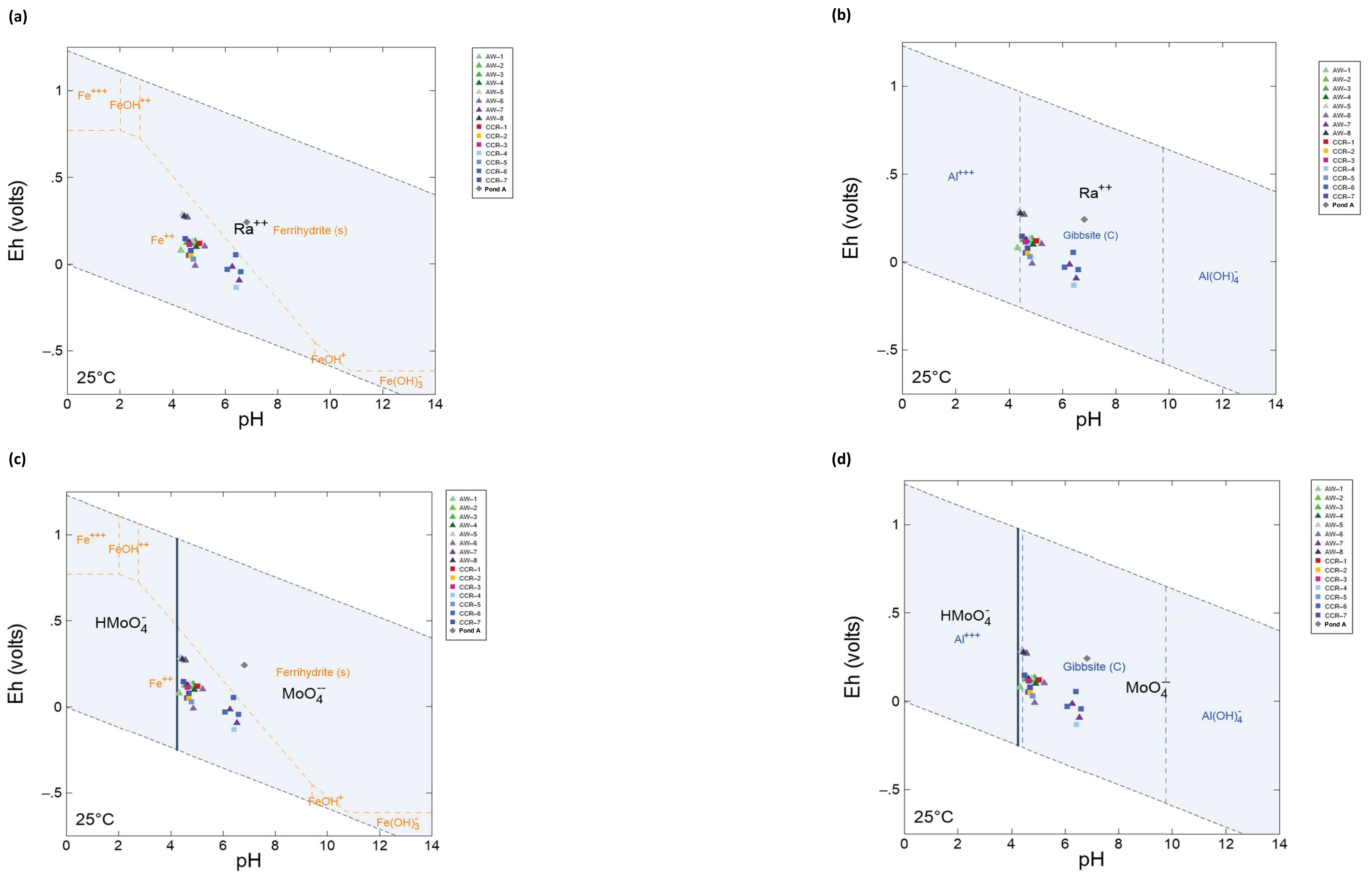
CONSULTANT
GOLDER
MEMBER OF WSP

PROJECT
TIER II AND TIER III MNA GEOCHEMICAL EVALUATION

TITLE
RADIUM 226+228 TIME SERIES FOR UPGRADIENT WELLS, DOWNGRADIENT WELLS, AND SURFACE WATER

PROJECT NO.	PHASE	REV.	FIGURE
19124481	0010		3

PATH: https://golderassociates.sharepoint.com/sites/110243/Project Files/5 Technical Work/Tier II and III MNA/Final Report/Figures and Tables | FILE NAME: JAX Figures and Tables .xlsx



CLIENT
JEA
ST. Johns River Power Park
BSA-B

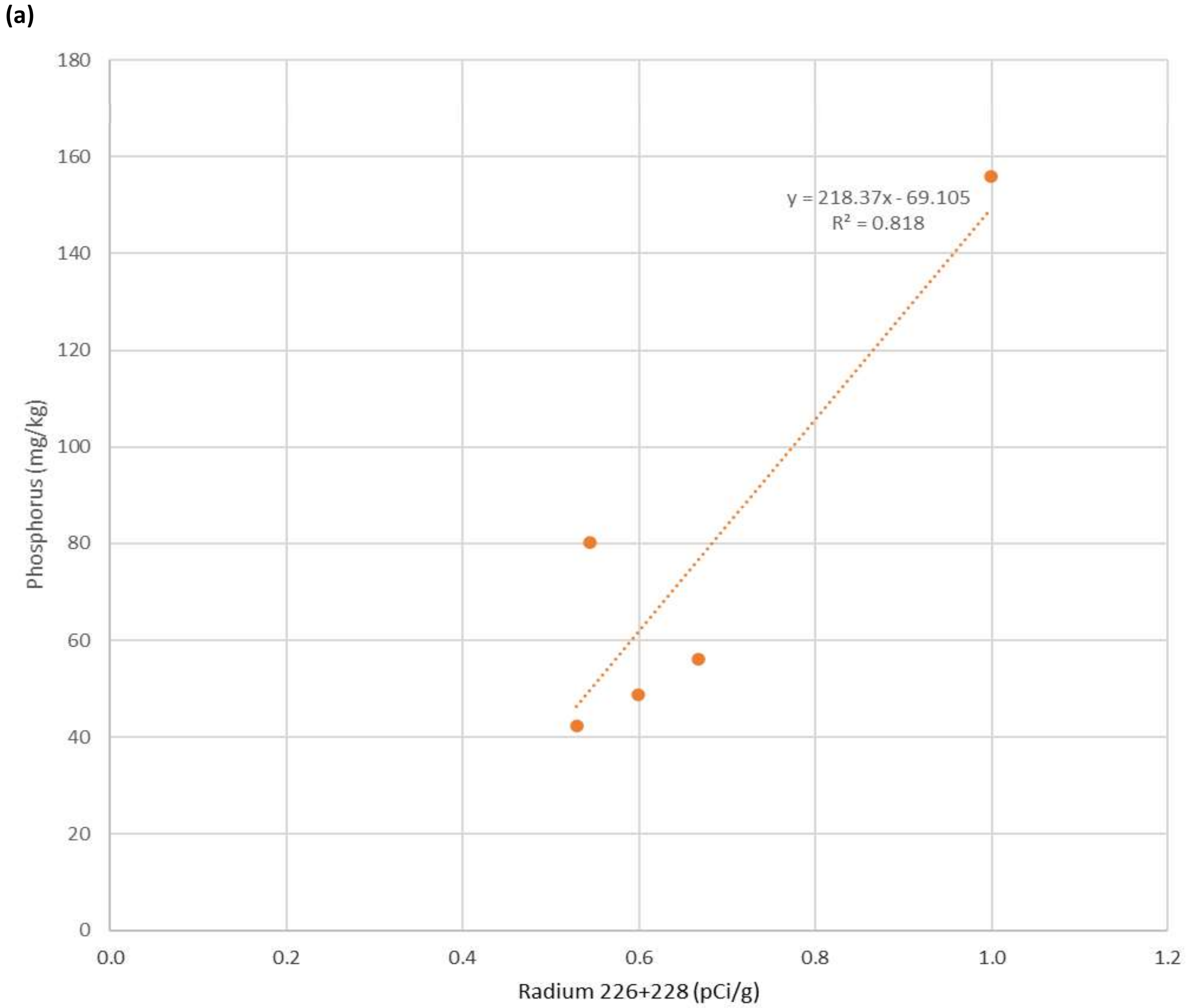
CONSULTANT

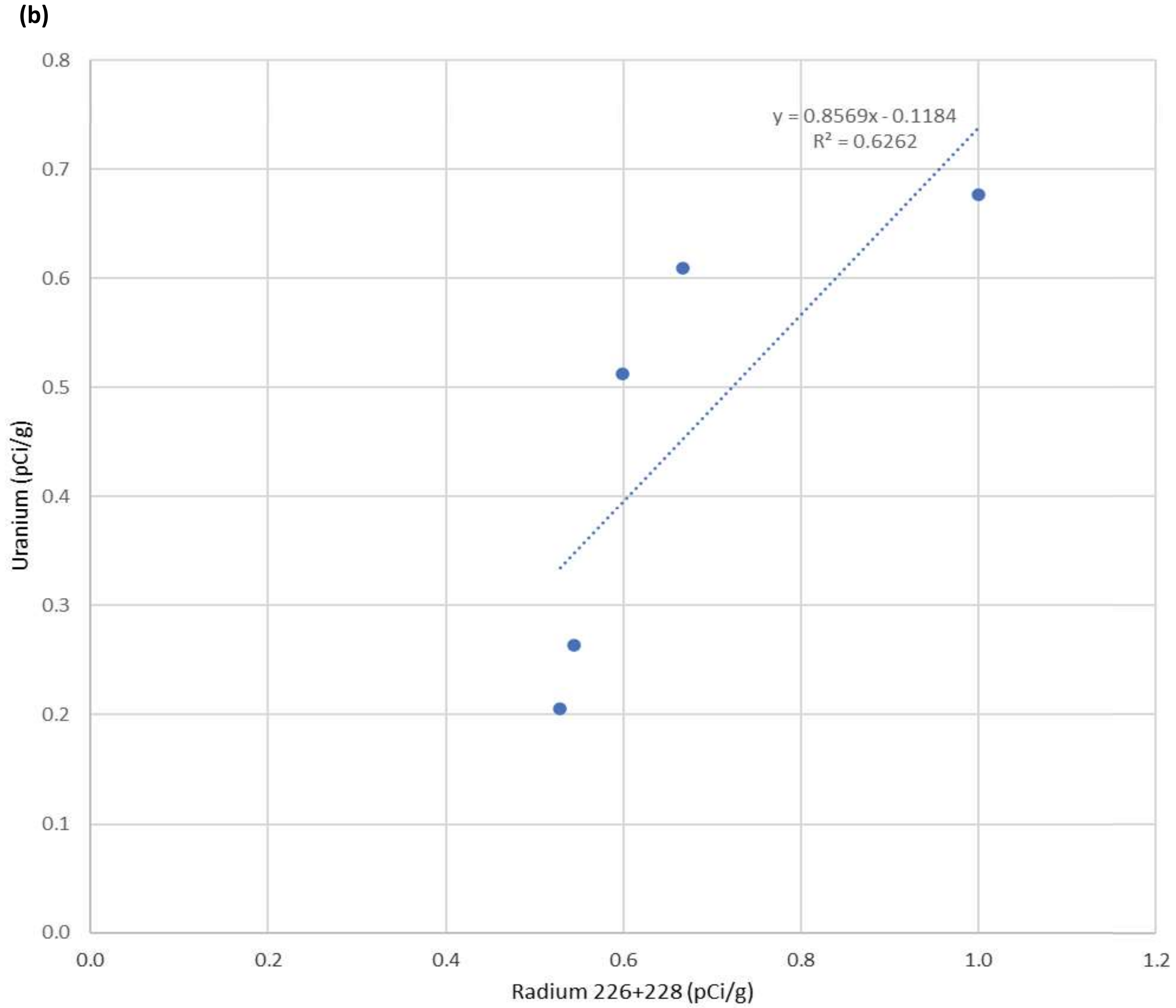
GOLDER
MEMBER OF WSP

PROJECT
TIER II AND TIER III MNA GEOCHEMICAL EVALUATION

TITLE
POURBAIX DIAGRAMS FOR RADIUM 226+228 (A AND B) AND MOLYBDENUM (C AND D), WITH SPECIATION OF IRON AND ALUMINUM

PROJECT NO.	PHASE	REV.	FIGURE
19124481	0010		4





CLIENT
JEA
ST. Johns River Power Park
BSA-B

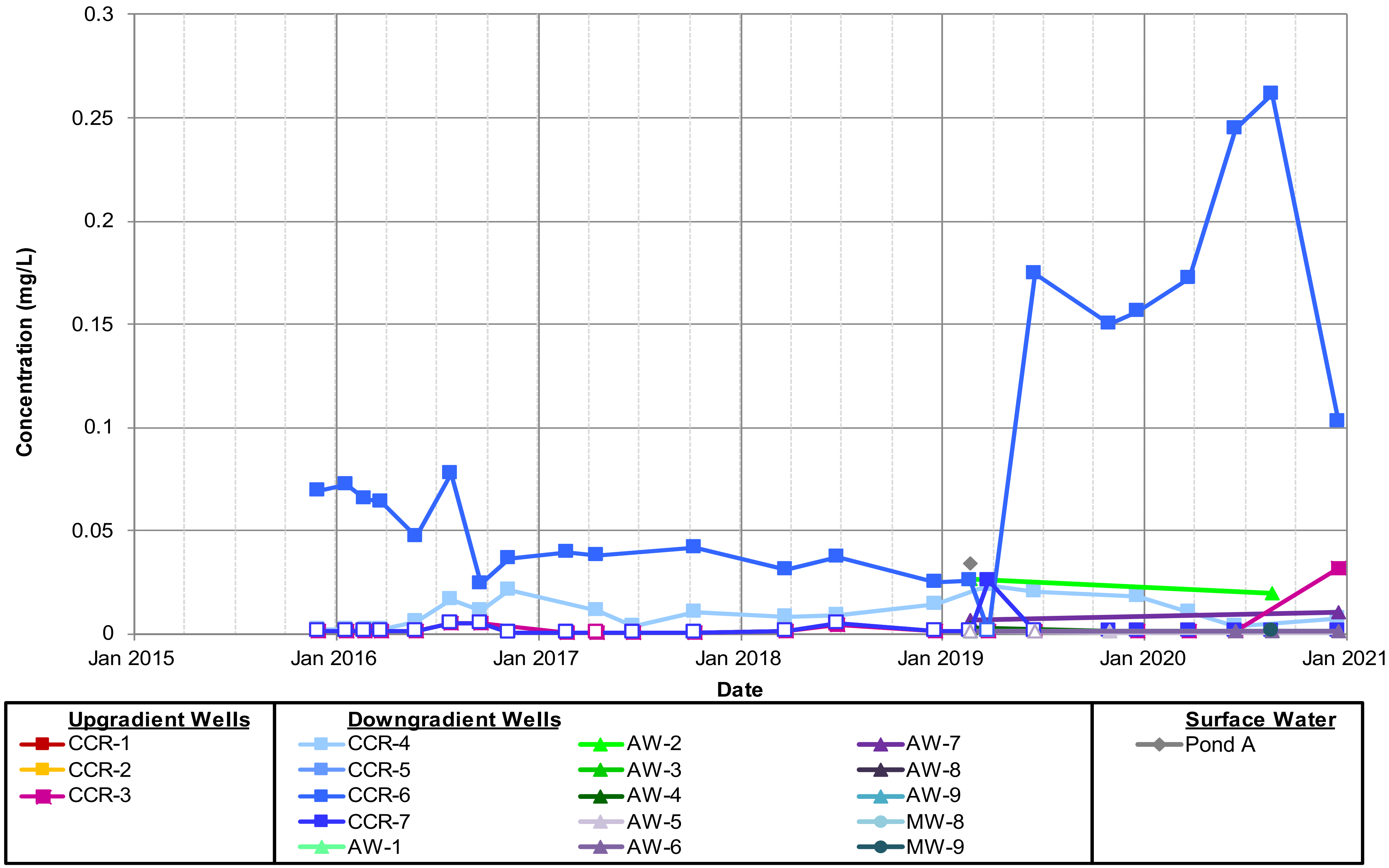
CONSULTANT
GOLDER
MEMBER OF WSP

PROJECT
TIER II AND TIER III MNA GEOCHEMICAL EVALUATION

TITLE
OCCURRENCE OF RADIONUCLIDES AND PHOSPHORUS IN SOIL SAMPLES

PROJECT NO.	PHASE	REV.	FIGURE
19124481	0010		5

PATH: https://golderassociates.sharepoint.com/sites/110243/Project Files/5 Technical Work/Tier II and III MNA/Final Report/Figures and Tables | FILE NAME: JAX Figures and Tables .xlsx



Non-detects are plotted at the practical quantitation limit with an open symbol.

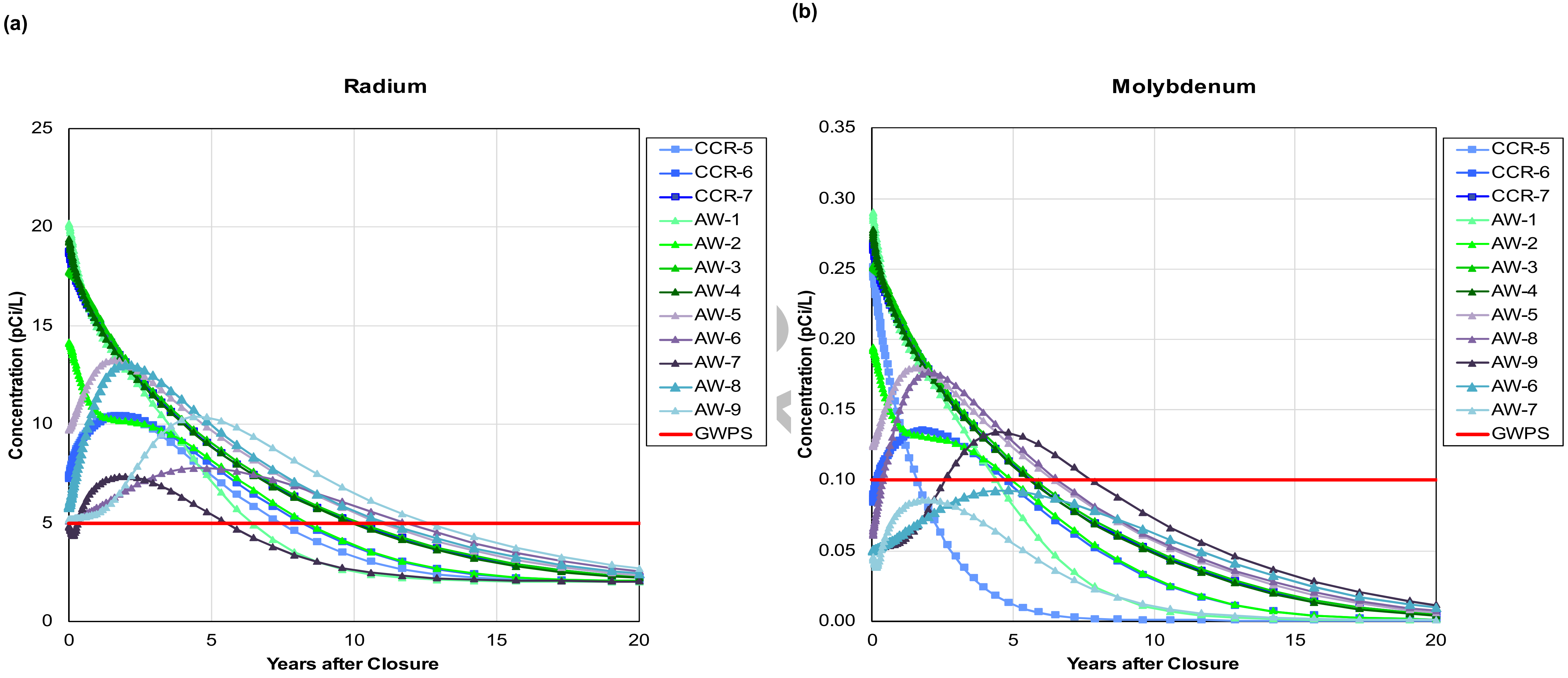
CLIENT
JEA
ST. Johns River Power Park
BSA-B

CONSULTANT
GOLDER
MEMBER OF WSP

PROJECT
TIER II AND TIER III MNA GEOCHEMICAL EVALUATION

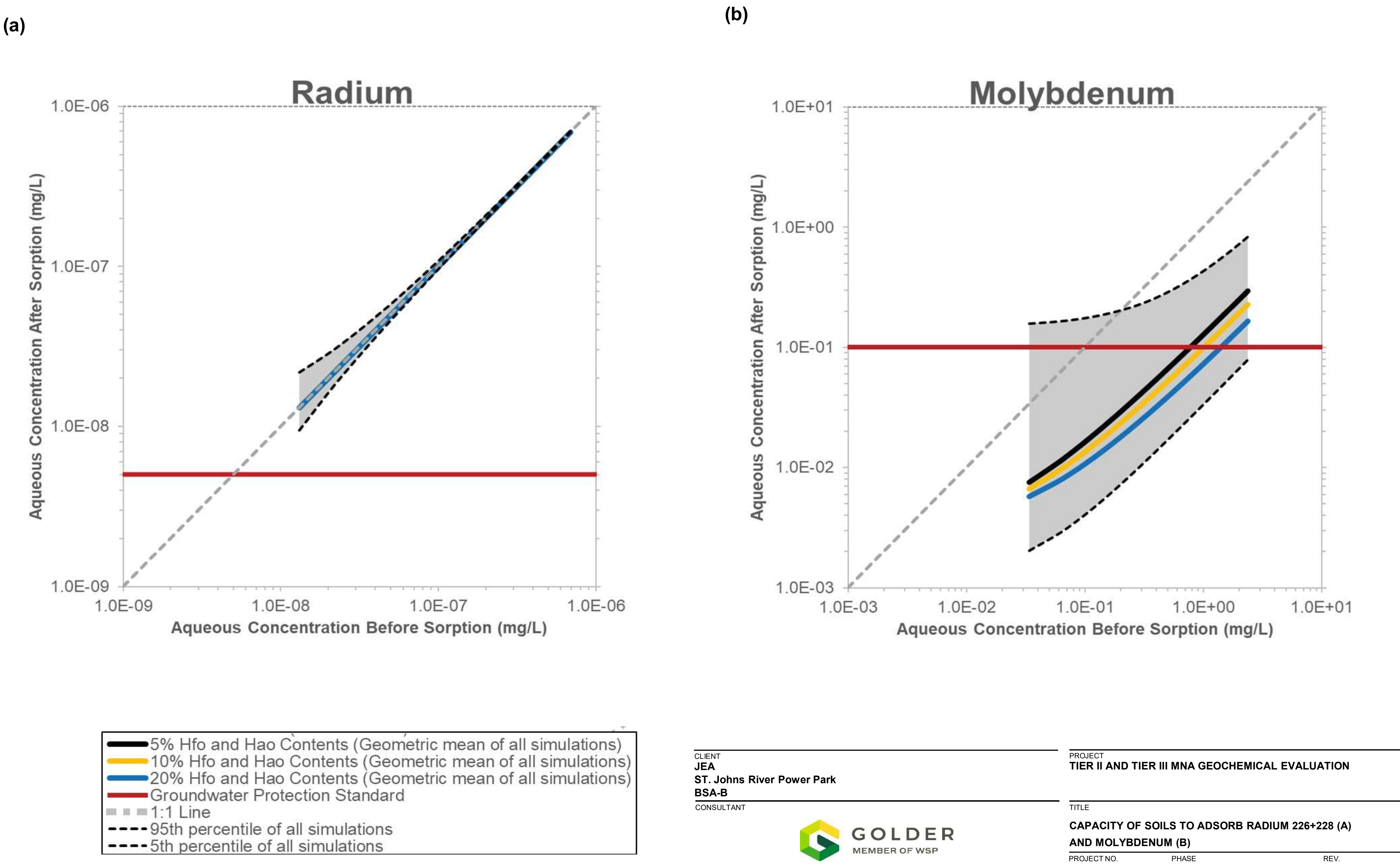
TITLE
MOLYBDENUM TIME SERIES FOR UPGRADIENT WELLS, DOWNGRADIENT WELLS, AND SURFACE WATER

PROJECT NO.	PHASE	REV.	FIGURE
19124481	0010		6



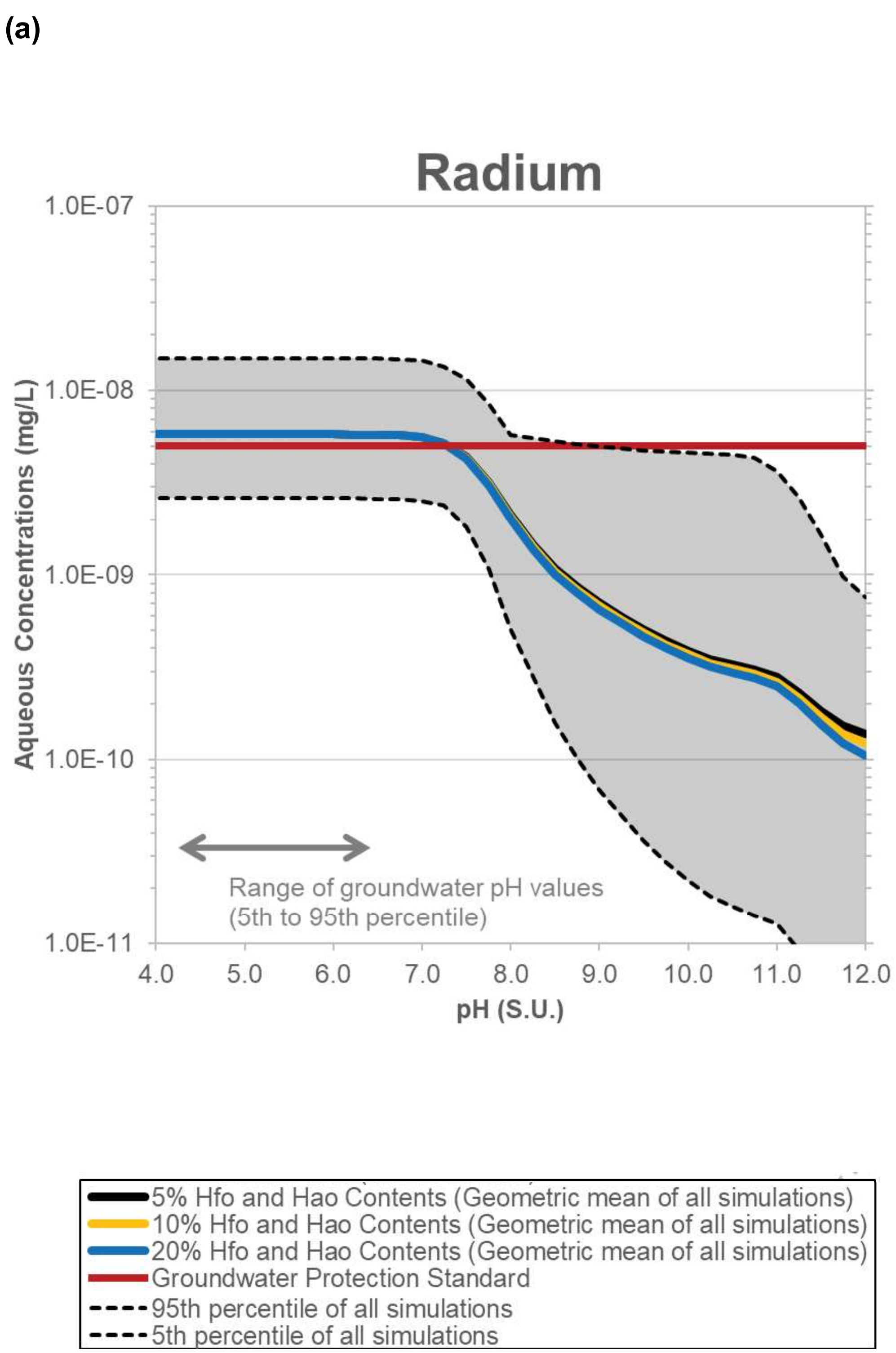
CLIENT	PROJECT
JEA **ST. Johns River Power Park** **BSA-B**	**TIER II AND TIER III MNA GEOCHEMICAL EVALUATION**
CONSULTANT	TITLE
GOLDER MEMBER OF WSP	**DILUTION MODELING FOR RADIUM 226+228 (A) AND MOLYBDENUM (B)**

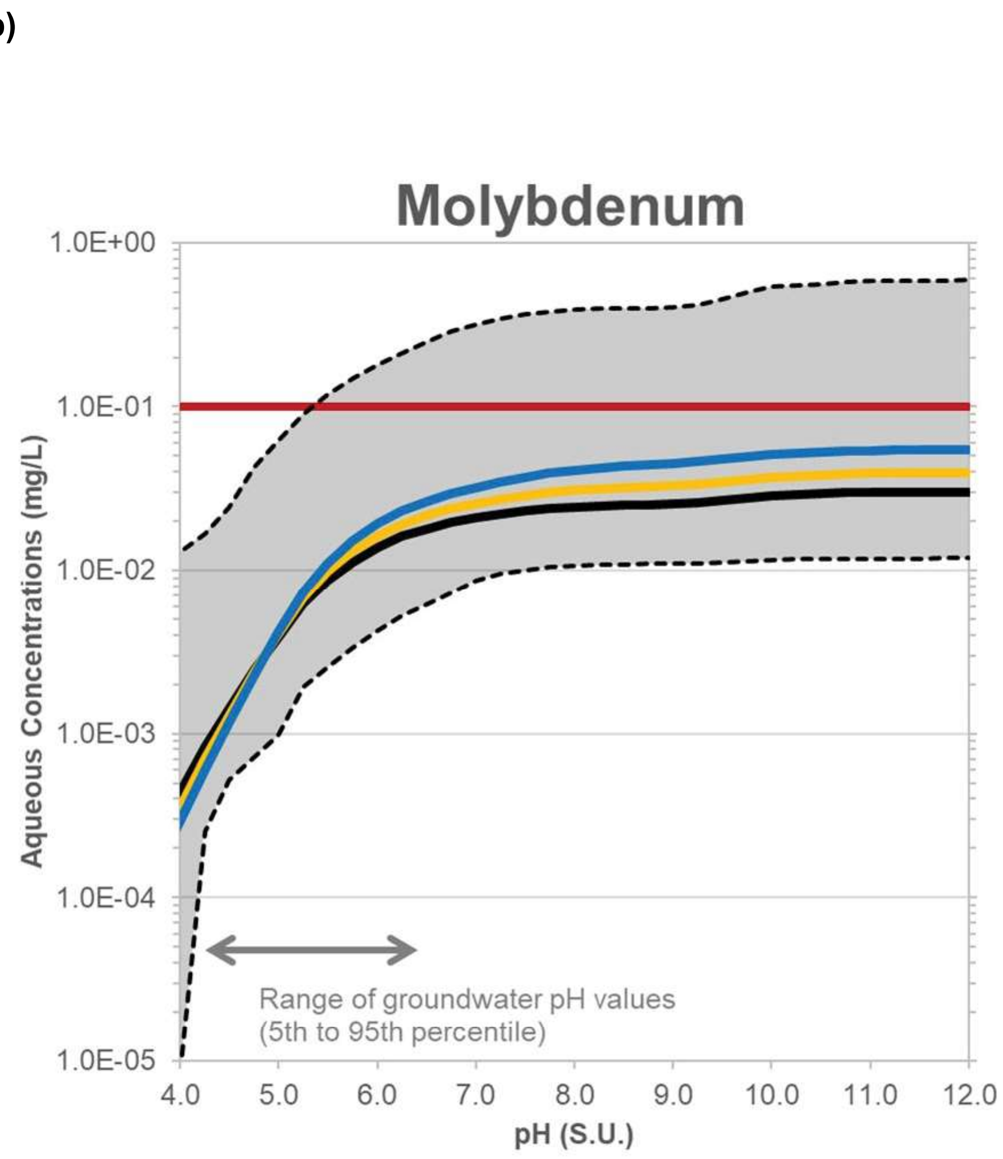
PROJECT NO.	PHASE	REV.	FIGURE
19124481	0010		7



CLIENT **JEA** **ST. Johns River Power Park** **BSA-B**	PROJECT **TIER II AND TIER III MNA GEOCHEMICAL EVALUATION**
CONSULTANT GOLDER MEMBER OF WSP	TITLE **CAPACITY OF SOILS TO ADSORB RADIUM 226+228 (A) AND MOLYBDENUM (B)**

PROJECT NO.	PHASE	REV.	FIGURE
19124481	0010		8





CLIENT
JEA
ST. Johns River Power Park
BSA-B

CONSULTANT
GOLDER
MEMBER OF WSP

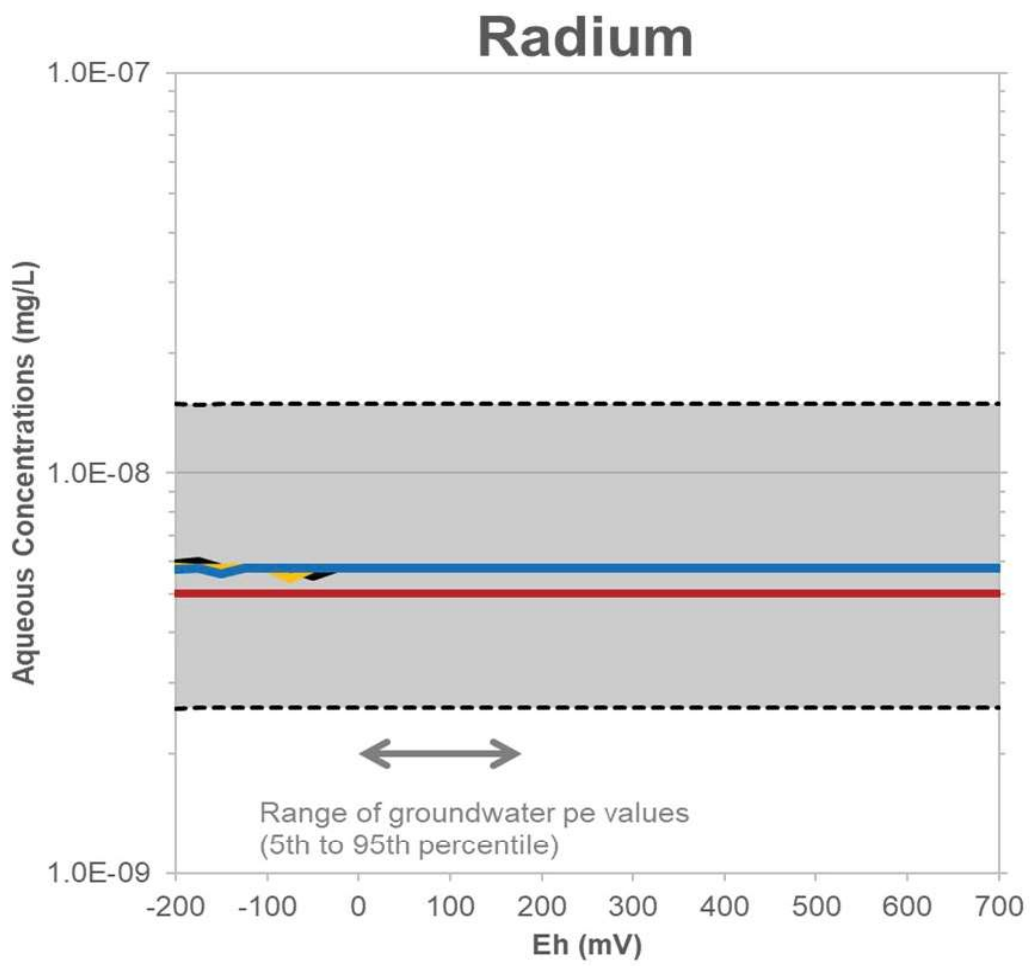
PROJECT
TIER II AND TIER III MNA GEOCHEMICAL EVALUATION

TITLE
STABILITY OF ADSORBED CONSTITUENTS OF RADIUM 226+228 (A) AND MOLYBDENUM (B) VERSUS pH

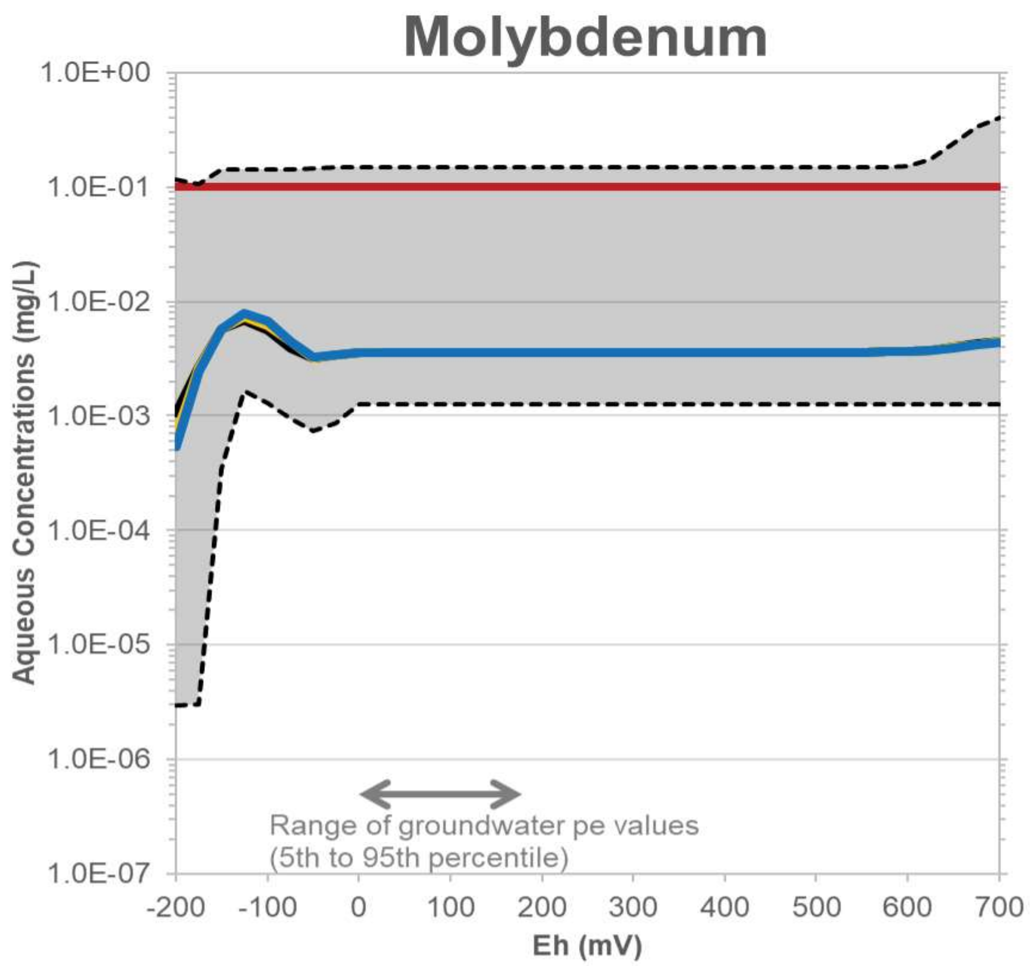
PROJECT NO.	PHASE	REV.	FIGURE
19124481	0010		9

PATH: https://golderassociates.sharepoint.com/sites/110243/Project Files/5 Technical Work/Tier II and III MNA/Final Report/Figures and Tables | FILE NAME: JAX Figures and Tables .xlsx

(a)



(b)



5% Hfo and Hao Contents (Geometric mean of all simulations)
10% Hfo and Hao Contents (Geometric mean of all simulations)
20% Hfo and Hao Contents (Geometric mean of all simulations)
Groundwater Protection Standard
95th percentile of all simulations
5th percentile of all simulations

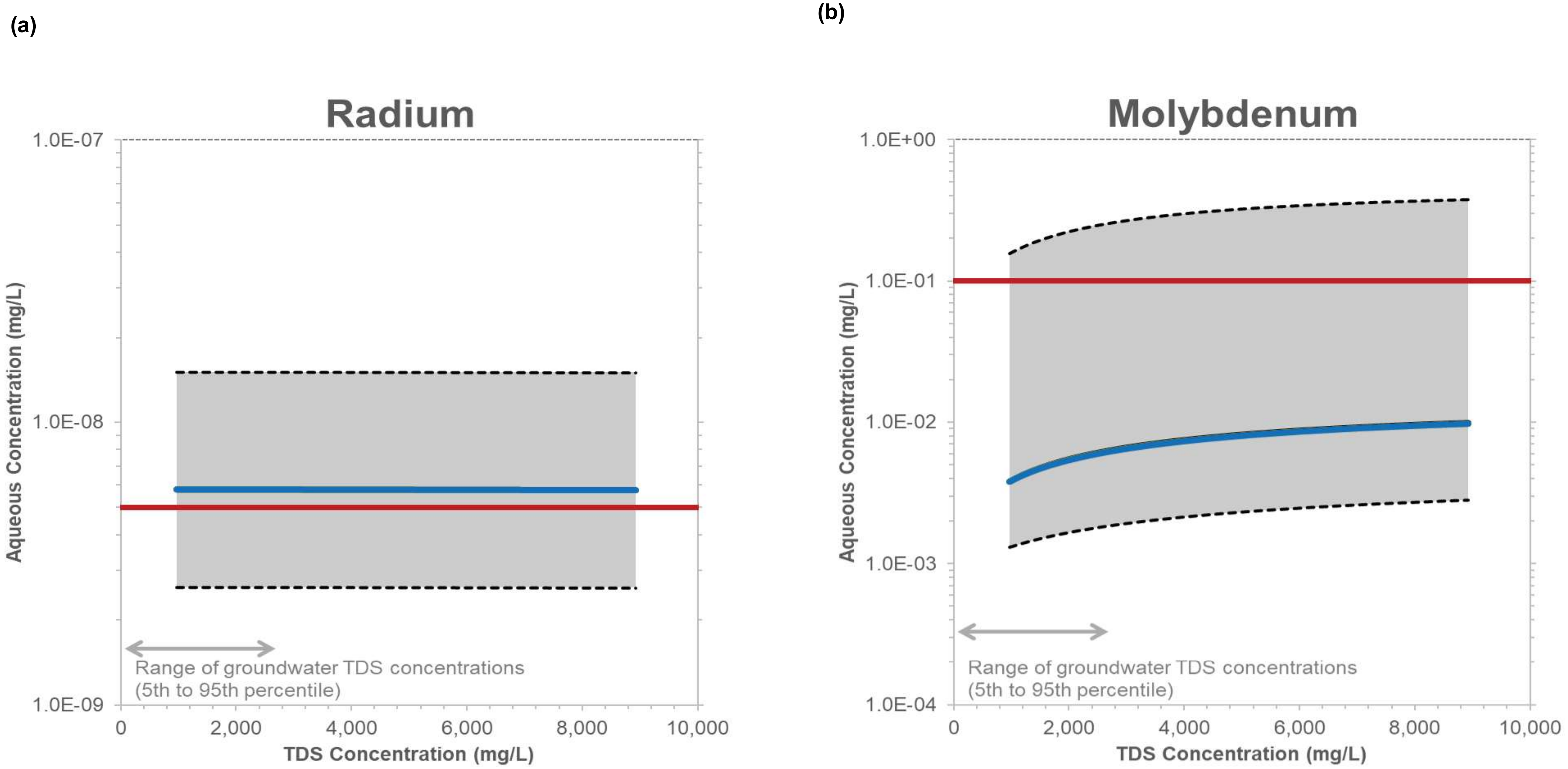
CLIENT
JEA
ST. Johns River Power Park
BSA-B

CONSULTANT
GOLDER
MEMBER OF WSP

PROJECT
TIER II AND TIER III MNA GEOCHEMICAL EVALUATION

TITLE
STABILITY OF ADSORBED CONSTITUENTS OF RADIUM 226+228 (A) AND MOLYBDENUM (B) VERSUS Eh

PROJECT NO.	PHASE	REV.	FIGURE
19124481	0010		10



- 5% Hfo and Hao Contents (Geometric mean of all simulations)
- 10% Hfo and Hao Contents (Geometric mean of all simulations)
- 20% Hfo and Hao Contents (Geometric mean of all simulations)
- Groundwater Protection Standard
- 95th percentile of all simulations
- 5th percentile of all simulations

CLIENT
JEA
ST. Johns River Power Park
BSA-B

CONSULTANT
GOLDER
MEMBER OF WSP

PROJECT
TIER II AND TIER III MNA GEOCHEMICAL EVALUATION

TITLE
STABILITY OF ADSORBED CONSTITUENTS OF RADIUM 226+228 (A) AND MOLYBDENUM (B) VERSUS TDS

PROJECT NO.	PHASE	REV.	FIGURE
19124481	0010		11

APPENDIX A

Groundwater Monitoring Data

Appendix A: Groundwater Sample Data

Well ID	Sample Date	DO (Field) Concentration	Specific Conductance (Field)	Temp (Field)	Residue, Filterable (TDS)	pH (Field)	Conductivity, Field Measured	Redox Potential (Field)	Calcium	Magnesium	Sodium	Potassium	Alkalinity (Total)	Sulfate
		%	µS/cm	degrees Celcius	mg/L	s.u.	µS/cm	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
AW-1	12/3/2018	0.4	3847	-	-	4.28	-	200.1	-	-	-	-	-	-
AW-1	2/20/2019	0.3	-	-	2982	4.31	3828	84.2	236.23	49.667	542.16	34.958	<20	1910
AW-1	8/18/2020	0.1	4228	-	3363	4.33	-	80	307.96	54.398	524.67	61.819	20	2020
AW-2	12/3/2018	0.9	4210	-	-	4.63	-	257.7	-	-	-	-	-	-
AW-2	2/20/2019	0.31	-	-	3050	4.54	4146	126.7	246.08	39.832	578.47	99.864	<20	1880
AW-2	8/18/2020	0.4	4483	-	3517	4.75	-	126.6	272.21	35.226	651.54	106.06	20	2000
AW-3	12/3/2018	0.4	4172	-	-	4.73	-	220.9	-	-	-	-	-	-
AW-3	2/20/2019	0.31	-	-	3158	4.69	4134	119.5	354.53	12.186	528.45	152.4	<20	1980
AW-3	8/18/2020	0.42	4398	-	3590	4.87	-	133.2	380.52	8.0389	533.17	189.79	20	2110
AW-4	2/20/2019	0.22	-	-	3106	4.9	4014	102.4	392.56	10.329	481.56	151.04	<20	1950
AW-4	10/29/2019	0.12	4660	-	3562	4.57	-	273.9	365.23	8.97	572	174	20	2080
AW-5	2/20/2019	0.28	-	-	2258	5.11	3108	123.2	176.77	19.625	452.96	73.111	<20	1360
AW-5	9/26/2019	0.22	1962	-	-	4.67	-	151.3	-	-	-	-	-	-
AW-5	10/29/2019	0.29	1937	-	1357	4.37	-	287.8	89.863	11.3	270	35.2	20	792
AW-5	12/19/2019	0.14	2051	-	-	4.62	-	93	-	-	-	-	-	-
AW-5	3/23/2020	0.32	2937	-	-	4.66	-	255.2	-	-	-	-	-	-
AW-5	6/15/2020	0.38	2733	-	2084	4.32	-	296.5	154.1	-	-	-	-	1190
AW-5	8/18/2020	0.31	2572	-	1852	4.75	-	134.7	122.15	14.706	357.62	49.816	20	1150
AW-5	12/17/2020	0.2	3184	-	2322	4.62	-	254	185.45	-	-	-	-	1410
AW-6	2/20/2019	0.35	-	-	1322	5.22	1642	103.6	278.2	12.809	94.348	8.7272	<20	814
AW-6	6/17/2019	0.69	-	-	1558	4.82	1839	7.3	340.72	-	-	-	-	1090
AW-6	9/26/2019	0.47	1843	-	-	4.86	-	56.4	-	-	-	-	-	-
AW-6	10/29/2019	0.23	1811	-	1551	4.54	-	268.8	331.34	15.2	82.7	12.1	20	969
AW-6	12/19/2019	0.16	1880	-	-	4.38	-	53	-	-	-	-	-	-
AW-6	3/23/2020	0.26	1854	-	-	4.37	-	217.5	-	-	-	-	-	-
AW-6	6/15/2020	0.17	1912	-	1612	4.16	-	286.9	332.52	-	-	-	-	1010
AW-6	8/18/2020	0.81	1973	-	1607	4.87	-	-6.4	346.58	16.379	110	15.034	20	999
AW-6	12/17/2020	0.3	2255	-	1838	4.56	-	239.4	370.98	-	-	-	-	1200
AW-7	2/20/2019	0.28	-	-	1558	6.27	1981	-13.2	352.57	17.143	104.7	14.661	65.6	927
AW-7	8/18/2020	1.26	2515	-	2160	6.53	-	-91.3	426.43	22.284	159.42	31.365	75.9	1320
AW-7	12/17/2020	0.2	1802	-	1474	6.81	-	-79.4	296.9	-	-	-	-	853
AW-8	10/29/2019	0.33	2209	-	1943	4.44	-	278.7	345.73	32	128	32.1	20	1250
AW-8	12/19/2019	0.17	2269	-	-	4.76	-	81.5	-	-	-	-	-	-
AW-8	3/23/2020	0.28	2284	-	-	4.45	-	201.4	-	-	-	-	-	-
AW-8	6/15/2020	0.18	2403	-	2106	4.13	-	279.6	361.2	-	-	-	-	1350
AW-8	8/18/2020	0.22	2314	-	1930	4.64	-	129.5	357.89	32.173	128.88	36.653	20	1370
AW-8	12/17/2020	0.4	2321	-	1954	4.4	-	265.1	333.44	-	-	-	-	1330
AW-9	6/15/2020	0.32	314.2	-	192	4.63	-	369.6	15.227	-	-	-	-	43.8
AW-9	8/18/2020	0.21	404.6	-	190	5.06	-	146	13.597	8.1988	39.14	1.3868	20	78.3
AW-9	12/17/2020	0.2	503.9	-	318	4.64	-	304.7	25.577	-	-	-	-	148
CCR-1	11/30/2015	0.48	150	-	106	5	-	-	3.0634	-	-	-	-	<2.5
CCR-1	1/21/2016	0.35	143	-	121	5.06	-	-	3.019	-	-	-	-	<2.5
CCR-1	2/23/2016	1.96	140	-	120	4.95	-	-	2.8001	-	-	-	-	<2.5
CCR-1	3/23/2016	0.31	140	-	164	5.1	-	-	2.811	-	-	-	-	<2.5
CCR-1	5/25/2016	0.53	-	-	94	4.89	135	-	2.8129	-	-	-	-	6.3

Appendix A: Groundwater Sample Data

Well ID	Sample Date	DO (Field) Concentration	Specific Conductance (Field)	Temp (Field)	Residue, Filterable (TDS)	pH (Field)	Conductivity, Field Measured	Redox Potential (Field)	Calcium	Magnesium	Sodium	Potassium	Alkalinity (Total)	Sulfate
		%	µS/cm	degrees Celcius	mg/L	s.u.	µS/cm	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
CCR-1	7/27/2016	0.8	-	-	76	4.91	127	-	2.63	-	-	-	-	<2.5
CCR-1	9/20/2016	1.54	-	-	126	4.91	174	-	4.22	-	-	-	-	27.3
CCR-1	11/8/2016	1.11	-	-	80	5.04	123	-	2.2132	-	-	-	-	<2.5
CCR-1	2/22/2017	1.23	-	-	79	4.99	119	-	2.243	-	-	-	-	2.8
CCR-1	4/18/2017	0.62	-	-	93	5.02	121	-	2.4131	-	-	-	-	3.6
CCR-1	6/22/2017	0.98	-	-	320	4.6	460	-	14.632	-	-	-	-	-
CCR-1	10/11/2017	2.1	-	-	90	4.71	142	-	2.6596	-	-	-	-	10.2
CCR-1	3/26/2018	0.7	-	-	-	4.96	386.9	-	13.244	-	-	-	-	-
CCR-1	6/27/2018	0.2	-	-	193	4.65	317.9	217.8	8.14	-	-	-	-	91.8
CCR-1	12/19/2018	0.4	-	-	411	4.83	597	163.1	30.705	-	-	-	-	234
CCR-1	3/25/2019	0.53	-	-	-	4.64	485	364	-	-	-	-	-	-
CCR-1	6/17/2019	0.12	-	-	364	5.02	530	119.2	17.75	-	-	-	-	197
CCR-1	12/19/2019	0.34	581	-	405	4.4	-	67.9	47.617	-	-	-	-	225
CCR-1	3/23/2020	0.27	552	-	-	4.03	-	327.6	-	-	-	-	-	-
CCR-1	6/15/2020	6.91	567	-	377	4.47	-	162	50.372	-	-	-	-	220
CCR-1	12/17/2020	0.4	549	-	416	4.64	-	71	32.856	-	-	-	-	251
CCR-2	11/30/2015	0.34	182	-	137	5.04	-	-	3.6842	-	-	-	-	23.7
CCR-2	1/21/2016	0.78	172	-	134	4.91	-	-	2.2516	-	-	-	-	24.9
CCR-2	2/23/2016	0.52	174	-	141	4.79	-	-	2.0677	-	-	-	-	25.4
CCR-2	3/23/2016	0.21	175	-	100	4.81	-	-	2.118	-	-	-	-	26.2
CCR-2	5/25/2016	0.41	-	-	107	4.59	167	-	2.1938	-	-	-	-	26.4
CCR-2	7/27/2016	1.08	-	-	98	4.74	160	-	1.87	-	-	-	-	24.3
CCR-2	9/20/2016	1.96	-	-	113	4.47	170	-	2.66	-	-	-	-	28
CCR-2	11/8/2016	1.33	-	-	122	4.68	185	-	2.4026	-	-	-	-	37.4
CCR-2	2/22/2017	1.29	-	-	143	4.7	241	-	4.02	-	-	-	-	61.9
CCR-2	4/18/2017	0.29	-	-	151	4.82	245	-	4.7138	-	-	-	-	64.7
CCR-2	6/22/2017	1.21	-	-	148	4.59	228	-	4.4145	-	-	-	-	169
CCR-2	10/11/2017	1.56	-	-	193	4.26	293	-	6.2452	-	-	-	-	86
CCR-2	3/26/2018	0.8	-	-	-	4.57	410.5	-	10.785	-	-	-	-	-
CCR-2	6/27/2018	0.2	-	-	315	4.4	459.3	136.9	12.8	-	-	-	-	170
CCR-2	12/19/2018	0.43	-	-	386	4.62	563	148.4	21.087	-	-	-	-	212
CCR-2	3/25/2019	0.28	-	-	-	4.36	558	315.1	-	-	-	-	-	-
CCR-2	6/17/2019	0.11	-	-	410	4.7	563	48.9	23.724	-	-	-	-	238
CCR-2	12/19/2019	0.24	449.8	-	360	4.6	-	37.9	19.953	-	-	-	-	184
CCR-2	3/23/2020	0.44	420.4	-	-	4.49	-	293.3	-	-	-	-	-	-
CCR-2	6/15/2020	8.15	346	-	232	4.72	-	123	12.389	-	-	-	-	111
CCR-2	12/17/2020	0.2	315	-	252	4.59	-	27	14.306	-	-	-	-	127
CCR-3	11/30/2015	0.56	146	-	87	4.45	-	-	4.1399	-	-	-	-	31.8
CCR-3	1/21/2016	1	125	-	88	4.45	-	-	4.6518	-	-	-	-	24.3
CCR-3	2/23/2016	0.18	143	-	118	4.36	-	-	4.4407	-	-	-	-	30.7
CCR-3	3/23/2016	0.43	183	-	164	4.55	-	-	4.062	-	-	-	-	45.2
CCR-3	5/25/2016	0.59	-	-	81	4.47	147	-	4.5524	-	-	-	-	35.5
CCR-3	7/27/2016	0.63	-	-	108	4.25	193	-	4.26	-	-	-	-	51.1
CCR-3	9/20/2016	1.57	-	-	88	4.53	146	-	4.74	-	-	-	-	34
CCR-3	11/8/2016	1.37	-	-	92	4.44	169	-	5.1304	-	-	-	-	42.5
CCR-3	2/22/2017	1.03	-	-	109	4.23	174	-	5.7731	-	-	-	-	43.5

Appendix A: Groundwater Sample Data

Well ID	Sample Date	DO (Field) Concentration	Specific Conductance (Field)	Temp (Field)	Residue, Filterable (TDS)	pH (Field)	Conductivity, Field Measured	Redox Potential (Field)	Calcium	Magnesium	Sodium	Potassium	Alkalinity (Total)	Sulfate
		%	µS/cm	degrees Celcius	mg/L	s.u.	µS/cm	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
CCR-3	4/18/2017	1.89	-	-	78	4.5	156	-	5.9144	-	-	-	-	32.5
CCR-3	6/22/2017	1.1	-	-	90	4.25	127	-	4.6565	-	-	-	-	27.5
CCR-3	10/11/2017	1.55	-	-	78	4.05	125	-	5.5918	-	-	-	-	31.1
CCR-3	3/26/2018	0.8	-	-	-	3.93	196.2	-	7.5757	-	-	-	-	-
CCR-3	6/27/2018	0.3	-	-	67	4.32	105.8	271.2	4.22	-	-	-	-	17.2
CCR-3	12/19/2018	0.44	-	-	1137	4.48	1400	177.6	221.99	-	-	-	-	786
CCR-3	3/25/2019	0.33	-	-	-	4.23	1539	329	-	-	-	-	-	-
CCR-3	6/17/2019	0.11	-	-	658	4.63	913	112.5	122.95	-	-	-	-	445
CCR-3	12/19/2019	0.22	2210	-	1900	4.39	-	83.8	433.72	-	-	-	-	1210
CCR-3	3/23/2020	0.19	2100	-	-	4.48	-	314	-	-	-	-	-	-
CCR-3	6/15/2020	7.36	2005	-	861	4.63	-	157	397.36	-	-	-	-	1120
CCR-3	12/17/2020	0.3	1663	-	1654	4.5	-	72	421.5	-	-	-	-	842
CCR-4	11/30/2015	0.25	2776	-	2609	4.76	-	-	389.91	-	-	-	-	1550
CCR-4	1/21/2016	0.54	3000	-	2684	5.34	-	-	398.73	-	-	-	-	1590
CCR-4	2/25/2016	0.09	2985	-	2720	5.4	-	-	437	-	-	-	-	1590
CCR-4	3/23/2016	0.28	3015	-	2696	5.57	-	-	456.15	-	-	-	-	1570
CCR-4	5/25/2016	0.26	-	-	2586	5.57	2907	-	445.22	-	-	-	-	1430
CCR-4	7/27/2016	0.76	-	-	2468	5.38	2724	-	426	-	-	-	-	1360
CCR-4	9/20/2016	1.8	-	-	2671	5.57	2795	-	485	-	-	-	-	1530
CCR-4	11/8/2016	1.11	-	-	2490	5.24	2762	-	484.45	-	-	-	-	1480
CCR-4	2/21/2017	0.91	-	-	2344	5.39	2548	-	439.02	-	-	-	-	1330
CCR-4	4/18/2017	3.39	-	-	2404	5.07	2519	-	500.17	-	-	-	-	1330
CCR-4	6/22/2017	1.32	-	-	2390	5.14	2514	-	454.52	-	-	-	-	1450
CCR-4	10/11/2017	0.51	-	-	2412	5.15	2748	-	399.3	-	-	-	-	1290
CCR-4	12/13/2017	-	-	-	2240	-	-	-	420.71	-	-	-	-	1320
CCR-4	3/26/2018	0.3	-	-	-	6.19	2980	-	415.57	-	-	-	-	-
CCR-4	6/27/2018	0.6	-	-	2595	5.99	3015	-52.6	529	-	-	-	-	1650
CCR-4	12/19/2018	0.23	-	-	2863	6.28	3047	-85.7	500.54	-	-	-	-	1490
CCR-4	3/25/2019	0.42	-	-	-	6.27	3530	12.7	-	-	-	-	-	-
CCR-4	6/17/2019	0.14	-	-	3195	6.42	3674	-135.2	611.22	-	-	-	-	1880
CCR-4	12/19/2019	0.17	3457	-	3198	6.26	-	-182	566.47	-	-	-	-	1570
CCR-4	3/23/2020	0.23	3612	-	-	6.28	-	17.6	-	-	-	-	-	-
CCR-4	6/15/2020	9.87	2961	-	2890	6.2	-	-45	586.34	-	-	-	-	1460
CCR-4	12/17/2020	0.3	3051	-	3124	6.36	-	-95	531.29	-	-	-	-	1850
CCR-5	11/30/2015	0.2	1919	-	1420	4.83	-	-	87.113	-	-	-	-	663
CCR-5	1/21/2016	0.21	1202	-	891	4.76	-	-	45.056	-	-	-	-	373
CCR-5	2/23/2016	0.18	1174	-	856	4.85	-	-	42.843	-	-	-	-	354
CCR-5	3/23/2016	0.34	1068	-	776	4.74	-	-	36.251	-	-	-	-	281
CCR-5	5/25/2016	0.62	-	-	534	4.46	769	-	26.353	-	-	-	-	174
CCR-5	7/27/2016	0.53	-	-	504	4.51	791	-	22.1	-	-	-	-	137
CCR-5	9/20/2016	0.9	-	-	427	4.48	703	-	20.6	-	-	-	-	89.6
CCR-5	11/8/2016	0.76	-	-	422	4.53	741	-	16.152	-	-	-	-	96.4
CCR-5	2/22/2017	1.89	-	-	473	4.61	801	-	21.071	-	-	-	-	93.5
CCR-5	4/18/2017	2.62	-	-	478	4.51	819	-	22.401	-	-	-	-	74
CCR-5	6/22/2017	1.27	-	-	472	4.44	846	-	19.124	-	-	-	-	76.6
CCR-5	10/11/2017	1.05	-	-	490	4.29	851	-	18.947	-	-	-	-	98.3

Appendix A: Groundwater Sample Data

Well ID	Sample Date	DO (Field) Concentration	Specific Conductance (Field)	Temp (Field)	Residue, Filterable (TDS)	pH (Field)	Conductivity, Field Measured	Redox Potential (Field)	Calcium	Magnesium	Sodium	Potassium	Alkalinity (Total)	Sulfate
		%	µS/cm	degrees Celcius	mg/L	s.u.	µS/cm	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
CCR-5	12/13/2017	-	-	-	426	-	-	-	15.387	-	-	-	-	49.6
CCR-5	3/26/2018	0.5	-	-	-	9.52	838	-	17.311	-	-	-	-	-
CCR-5	6/27/2018	0.5	-	-	478	4.71	922	157.4	17.3	-	-	-	-	63.7
CCR-5	12/19/2018	0.3	-	-	746	4.78	1339	123.4	22.229	-	-	-	-	164
CCR-5	3/25/2019	0.4	-	-	-	4.55	1353	92.4	-	-	-	-	-	-
CCR-5	6/17/2019	0.14	-	-	908	4.79	1555	29.6	26.998	-	-	-	-	250
CCR-5	12/19/2019	0.15	1768	-	1058	4.63	-	7.1	28.151	-	-	-	-	298
CCR-5	3/23/2020	0.24	1791	-	-	4.77	-	186	-	-	-	-	-	-
CCR-5	6/15/2020	10.7	1889	-	1146	4.89	-	194	31.972	-	-	-	-	366
CCR-5	12/17/2020	0.4	1697	-	1224	4.7	-	70	37.621	-	-	-	-	507
CCR-6	11/30/2015	0.35	4021	-	3633	4.76	-	-	362.75	-	-	-	-	2320
CCR-6	1/21/2016	0.22	4091	-	3144	4.85	-	-	306.95	-	-	-	-	2030
CCR-6	2/23/2016	0.41	4095	-	3325	4.95	-	-	330	-	-	-	-	1940
CCR-6	3/23/2016	0.37	4128	-	3324	5.04	-	-	336.54	-	-	-	-	1960
CCR-6	5/25/2016	0.38	-	-	3023	4.95	3943	-	280.12	-	-	-	-	1730
CCR-6	7/27/2016	0.58	-	-	3060	4.98	4163	-	292	-	-	-	-	1840
CCR-6	9/20/2016	1.08	-	-	3036	4.88	4017	-	312	-	-	-	-	1950
CCR-6	11/8/2016	1.38	-	-	2910	4.97	3906	-	318.99	-	-	-	-	1750
CCR-6	2/21/2017	1.43	-	-	3060	5.16	3695	-	290.39	-	-	-	-	1640
CCR-6	4/18/2017	1.79	-	-	3008	4.95	3712	-	383.48	-	-	-	-	1740
CCR-6	6/22/2017	0.78	-	-	2800	4.97	3629	-	290.92	-	-	-	-	1840
CCR-6	10/11/2017	0.8	-	-	2753	4.73	3417	-	287.73	-	-	-	-	1690
CCR-6	12/14/2017	-	-	-	2646	-	-	-	290.76	-	-	-	-	1700
CCR-6	3/26/2018	0.7	-	-	-	5.51	3651	-	277.57	-	-	-	-	-
CCR-6	6/27/2018	0.2	-	-	2817	5.82	3514	22.3	373	-	-	-	-	1740
CCR-6	12/4/2018	0.9	3314	-	-	5.92	-	77.8	-	-	-	-	-	-
CCR-6	12/19/2018	0.27	-	-	2718	6.02	3299	16.5	342.76	-	-	-	-	1740
CCR-6	2/20/2019	0.24	-	-	2654	6.09	3289	-31.9	381.89	104.35	239.31	104.11	196	1730
CCR-6	3/25/2019	0.37	-	-	-	4.6	3930	140	-	-	-	-	-	-
CCR-6	6/17/2019	0.57	-	-	3024	6.45	3506	-75.9	427.86	-	-	-	-	1860
CCR-6	9/26/2019	0.13	3680	-	-	6.49	-	-74.9	-	-	-	-	-	-
CCR-6	10/29/2019	0.18	3495	-	3194	6.4	-	51.8	482.92	68.5	258	117	206	1690
CCR-6	12/19/2019	0.19	3578	-	3058	6.58	-	-58.5	458.55	-	-	-	-	1800
CCR-6	3/23/2020	0.21	3318	-	-	6.44	-	139.7	-	-	-	-	-	-
CCR-6	6/15/2020	5.99	3350	-	2988	6.74	-	-24	460.93	-	-	-	-	1630
CCR-6	8/18/2020	0.09	3253	-	2983	6.59	-	-44	471.23	131.7	142.17	85.555	433	1620
CCR-6	12/17/2020	0.2	2707	-	2718	6.75	-	-70	524.77	-	-	-	-	1450
CCR-7	11/30/2015	0.24	1645	-	1146	4.48	-	-	56.316	-	-	-	-	608
CCR-7	1/21/2016	0.17	1759	-	1159	4.54	-	-	55.568	-	-	-	-	644
CCR-7	2/23/2016	0.11	1764	-	1195	4.57	-	-	45.234	-	-	-	-	642
CCR-7	3/23/2016	0.33	2053	-	1400	4.65	-	-	72.585	-	-	-	-	819
CCR-7	5/25/2016	0.73	-	-	1088	4.57	1573	-	43.85	-	-	-	-	605
CCR-7	7/27/2016	0.69	-	-	1124	4.53	1669	-	58	-	-	-	-	675
CCR-7	9/20/2016	0.8	-	-	1216	4.42	1710	-	67.2	-	-	-	-	684
CCR-7	11/8/2016	1.18	-	-	1496	4.6	2207	-	110.23	-	-	-	-	902
CCR-7	2/22/2017	1.91	-	-	1242	4.61	1740	-	69.717	-	-	-	-	619

Appendix A: Groundwater Sample Data

Well ID	Sample Date	DO (Field) Concentration	Specific Conductance (Field)	Temp (Field)	Residue, Filterable (TDS)	pH (Field)	Conductivity, Field Measured	Redox Potential (Field)	Calcium	Magnesium	Sodium	Potassium	Alkalinity (Total)	Sulfate
		%	µS/cm	degrees Celcius	mg/L	s.u.	µS/cm	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
CCR-7	4/18/2017	2.85	-	-	1714	4.46	2413	-	112.51	-	-	-	-	977
CCR-7	6/22/2017	0.84	-	-	2068	4.51	2774	-	140.97	-	-	-	-	1170
CCR-7	10/11/2017	1.14	-	-	2022	4.25	2766	-	134.13	-	-	-	-	1150
CCR-7	12/14/2017	-	-	-	2196	-	-	-	154.87	-	-	-	-	1350
CCR-7	3/26/2018	0.3	-	-	-	4.7	2430	-	103.19	-	-	-	-	-
CCR-7	6/27/2018	0.3	-	-	1882	4.09	2794	59.2	119	-	-	-	-	1220
CCR-7	12/19/2018	0.45	-	-	2660	4.72	3301	101.9	185.08	-	-	-	-	809
CCR-7	2/20/2019	0.29	-	-	2816	4.62	3847	51.6	211.75	23.258	566.27	113.28	<20	1720
CCR-7	3/25/2019	0.46	-	-	-	6.29	3265	72.1	-	-	-	-	-	-
CCR-7	6/17/2019	0.9	-	-	3166	4.73	4420	179.6	227.76	-	-	-	-	1940
CCR-7	9/26/2019	0.16	4686	-	-	4.66	-	12.4	-	-	-	-	-	-
CCR-7	10/29/2019	0.29	4479	-	3240	4.48	-	145.1	221.84	29.4	563	179	20	1570
CCR-7	12/19/2019	0.48	4630	-	3347	4.65	-	36.3	267.81	-	-	-	-	1780
CCR-7	3/23/2020	0.4	4415	-	-	4.88	-	136.4	-	-	-	-	-	-
CCR-7	6/15/2020	9.19	4291	-	3340	4.77	-	103	298.96	-	-	-	-	1930
CCR-7	8/18/2020	0.5	4459	-	3183	4.69	-	78	312.58	19.757	541	171.92	20	1950
CCR-7	12/17/2020	0.5	4001	-	3420	4.57	-	-47	297.86	-	-	-	-	1940
MW-8	12/4/2018	1.6	78.6	-	-	5.24	-	321.7	-	-	-	-	-	-
MW-8	8/18/2020	0.2	87	-	72	5.02	-	228	3.4152	1.0411	10.011	0.87836	28.2	14.3
MW-9	12/4/2018	1.2	160.7	-	-	5.45	-	213	-	-	-	-	-	-
MW-9	8/18/2020	0.25	149	-	72	5.33	-	178	12.035	1.6442	12.561	0.84377	31.7	<2.5
SW	2/20/2019	8.61	-	-	1584	6.82	2039	241.2	341.38	21.473	120.81	26.75	59.1	991

Appendix A: Groundwater Sample Data

Well ID	Sample Date	Chloride	Total Dissolved Solids	Alkalinity (Bicarbonate)	Alkalinity (Carbonate)	T Hardness (as $CaCO_3$)	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Antimony	Arsenic	Lead	Selenium	Thallium
		mg/L	mg/L	mg as $CaCO_3$/L	mg as $CaCO_3$/L	mg as $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
AW-1	12/3/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AW-1	2/20/2019	312	-	<20	0	-	0.0258	0.00229	19.405	-	0.00226	<0.0011	<0.0000946	0.0024	<0.00046	0.00567	<0.000428
AW-1	8/18/2020	229	-	20	0	-	0.0276	0.00214	23.7	-	0.00243	0.0011	0.000153	0.00245	0.000092	0.0049	0.000268
AW-2	12/3/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AW-2	2/20/2019	197	-	<20	0	-	0.0485	0.000722	19.984	-	0.000661	<0.0011	<0.0000946	0.00123	<0.00046	0.00303	<0.000428
AW-2	8/18/2020	230	-	20	0	-	0.0464	0.00098	23.669	-	0.000773	0.0011	0.000153	0.0009	0.000064	0.00439	0.000183
AW-3	12/3/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AW-3	2/20/2019	270	-	<20	0	-	0.0526	<0.0000627	27.495	-	0.00285	<0.0011	<0.0000946	0.000531	<0.00046	0.00424	<0.000428
AW-3	8/18/2020	211	-	20	0	-	0.0429	0.000292	32.958	-	0.0025	0.0011	0.000153	0.000615	0.0000448	0.00331	0.000183
AW-4	2/20/2019	229	-	<20	0	-	0.0523	<0.0000627	26.893	-	0.00334	<0.0011	<0.0000946	0.00266	<0.00046	0.00362	<0.000428
AW-4	10/29/2019	291	-	-	-	-	0.0449	0.000292	36.016	0.000224	0.0022	0.0011	0.000153	0.00111	0.0000448	0.00305	-
AW-5	2/20/2019	147	-	<20	0	-	0.0962	<0.0000627	12.767	-	0.00192	<0.0011	<0.0000946	0.00633	<0.00046	0.00276	<0.000428
AW-5	9/26/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AW-5	10/29/2019	99	-	-	-	-	0.0421	0.000292	5.8227	0.000224	0.000711	0.0011	0.000153	0.000777	0.000046	0.0011	-
AW-5	12/19/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AW-5	3/23/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AW-5	6/15/2020	128	-	-	-	-	0.0395	0.000332	10.104	-	0.00134	0.0011	0.000153	0.00073	0.000052	0.00256	0.000244
AW-5	8/18/2020	119	-	20	0	-	0.0343	0.000292	8.3354	-	0.00113	0.0011	0.000153	0.000676	0.0000448	0.00207	0.000183
AW-5	12/17/2020	158	-	-	-	-	0.0423	0.000377	13.281	-	0.00176	0.0011	0.000153	0.000619	0.000116	0.00303	0.000219
AW-6	2/20/2019	46.5	-	<20	0	-	0.0526	<0.0000627	3.2519	-	0.000917	<0.0011	<0.0000946	0.00479	<0.00046	<0.00135	<0.000428
AW-6	6/17/2019	42	-	-	-	-	0.0466	<0.000292	4.4041	<0.000224	<0.000711	<0.0011	0.000387	0.00132	0.000057	0.00224	-
AW-6	9/26/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AW-6	10/29/2019	46.3	-	-	-	-	0.0437	0.000292	4.2894	0.000224	0.000711	0.0011	0.000153	0.00131	0.0000448	0.000473	-
AW-6	12/19/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AW-6	3/23/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AW-6	6/15/2020	50.1	-	-	-	-	0.0391	0.000314	4.2545	-	0.00077	0.0011	0.000153	0.00114	0.000052	0.00134	0.000372
AW-6	8/18/2020	58.6	-	20	0	-	0.0382	0.000292	4.3564	-	0.000711	0.0011	0.000153	0.00125	0.0000448	0.00137	0.000183
AW-6	12/17/2020	62.9	-	-	-	-	0.0431	0.000485	5.1105	-	0.000711	0.0011	0.000153	0.00177	0.000102	0.00153	0.000197
AW-7	2/20/2019	46.7	-	65.6	0	-	0.0362	<0.0000627	3.9244	-	0.000343	<0.0011	0.0003	0.00898	<0.00046	0.00148	<0.000428
AW-7	8/18/2020	74.6	-	75.9	0	-	0.0633	0.000292	9.5997	-	0.000711	0.0011	0.000293	0.0196	0.0000448	0.00183	0.000183
AW-7	12/17/2020	42.7	-	-	-	-	0.048	0.000292	6.5919	-	0.000711	0.0011	0.00103	0.0117	0.000101	0.00165	0.000183
AW-8	10/29/2019	51.9	-	-	-	-	0.0371	0.000429	8.5572	0.000224	0.00167	0.0011	0.000153	0.00107	0.000072	0.000733	-
AW-8	12/19/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AW-8	3/23/2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AW-8	6/15/2020	62.5	-	-	-	-	0.0296	0.000683	9.7831	-	0.00246	0.0011	0.000153	0.00107	0.000072	0.0016	0.000294
AW-8	8/18/2020	57.1	-	20	0	-	0.0272	0.000584	8.8874	-	0.00215	0.0011	0.000153	0.000784	0.0000448	0.00192	0.000183
AW-8	12/17/2020	60.4	-	-	-	-	0.0295	0.000702	8.8818	-	0.0024	0.0011	0.000153	0.000832	0.000132	0.00176	0.000183
AW-9	6/15/2020	53.2	-	-	-	-	0.0715	0.000292	0.0704	-	0.00239	0.0011	0.000157	0.00252	0.000193	0.000867	0.000259
AW-9	8/18/2020	63.2	-	20	0	-	0.0931	0.000292	0.081	-	0.0012	0.0011	0.000153	0.000481	0.0000448	0.000867	0.000183
AW-9	12/17/2020	55.2	-	-	-	-	0.10776	0.000507	0.0812	-	0.00158	0.0011	0.000153	0.000708	0.000108	0.000867	0.000183
CCR-1	11/30/2015	31.6	-	-	-	-	0.0663	<0.0000777	0.0183	<0.000144	<0.000539	<0.0005	<0.000813	0.002	<0.000813	0.00129	0.00015
CCR-1	1/21/2016	29.2	-	-	-	-	0.0636	0.00119	0.0267	<0.000144	0.00131	<0.0005	<0.000813	<0.00139	<0.000813	0.00441	<0.000113
CCR-1	2/23/2016	29.5	-	-	-	-	0.0588	0.000352	0.0206	<0.000144	<0.000539	<0.0005	<0.000813	<0.00139	<0.000813	<0.000846	0.000343
CCR-1	3/23/2016	29.6	-	-	-	-	0.0524	0.0000841	0.0183	<0.000144	0.000733	<0.0005	<0.000813	<0.00139	<0.000813	<0.000846	0.000187
CCR-1	5/25/2016	25.4	-	-	-	-	0.0575	0.000844	0.10852	<0.000144	<0.000539	<0.0005	<0.000813	<0.00139	<0.000813	0.00517	<0.000113

Appendix A: Groundwater Sample Data

Well ID	Sample Date	Chloride	Total Dissolved Solids	Alkalinity (Bicarbonate)	Alkalinity (Carbonate)	T Hardness (as $CaCO_3$)	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Antimony	Arsenic	Lead	Selenium	Thallium
		mg/L	mg/L	mg as $CaCO_3$/L	mg as $CaCO_3$/L	mg as $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
CCR-1	7/27/2016	25.7	-	-	-	-	0.0518	<0.0005	0.0438	<0.0005	<0.0025	<0.005	<0.000175	<0.000615	<0.000491	0.000747	0.000291
CCR-1	9/20/2016	22.6	-	-	-	-	0.0858	<0.0005	0.124	<0.0005	<0.0025	<0.005	<0.0005	0.00087	0.0115	0.0016	<0.0005
CCR-1	11/8/2016	24.6	-	-	-	-	0.0447	0.000118	0.0352	<0.000069	<0.000298	<0.00273	<0.000175	<0.000615	<0.000491	<0.000678	<0.000261
CCR-1	2/22/2017	22.6	-	-	-	-	0.044	0.000112	0.0483	<0.000069	0.000645	<0.00273	<0.000175	<0.000615	<0.000491	0.00134	<0.000261
CCR-1	4/18/2017	22.4	-	-	-	-	0.0467	<0.000028	0.057	<0.000069	<0.000298	<0.00273	0.000221	0.000635	<0.000491	<0.000678	<0.000261
CCR-1	6/22/2017	-	-	-	-	-	0.24146	0.00072	0.66775	<0.000069	0.00033	<0.00273	<0.00123	0.00214	<0.000412	<0.00272	<0.000942
CCR-1	10/11/2017	22	-	-	-	-	0.0548	0.000107	0.0899	<0.000069	0.000358	<0.00273	<0.00123	<0.00138	<0.000412	<0.00272	<0.000942
CCR-1	3/26/2018	-	-	-	-	-	0.23685	0.000337	0.41757	<0.000224	<0.000342	<0.0011	<0.00012	0.00037	0.000096	0.00019	<0.000028
CCR-1	6/27/2018	18	-	-	-	-	0.163	<0.0005	0.209	-	<0.0025	<0.005	<0.0005	<0.0005	<0.0005	0.0014	<0.0005
CCR-1	12/19/2018	16.8	-	-	-	-	0.19523	0.000837	1.118	-	<0.000342	<0.0011	<0.0000946	0.000514	<0.00046	<0.00135	<0.000428
CCR-1	3/25/2019	-	-	-	-	-	0.15374	0.000375	-	0.000849	<0.000342	<0.0011	<0.0000946	0.00032	<0.00046	<0.00135	<0.000428
CCR-1	6/17/2019	23.5	-	-	-	-	0.13751	0.000432	0.60777	<0.000224	<0.000711	<0.0011	<0.000191	0.000275	<0.000056	<0.00054	-
CCR-1	12/19/2019	15	-	-	-	-	0.0676	0.00105	1.2525	0.000224	0.000711	0.0011	0.000233	0.000623	0.0000448	0.000755	-
CCR-1	3/23/2020	-	-	-	-	-	0.0619	0.000988	-	0.000224	0.000711	0.0011	0.000153	0.00034	0.0000448	0.00103	0.000183
CCR-1	6/15/2020	15.9	-	-	-	-	0.0514	0.00103	1.2718	-	0.000711	0.0011	0.000153	0.000389	0.0000448	0.000867	0.000207
CCR-1	12/17/2020	19.1	-	-	-	-	0.0623	0.000837	1.1157	-	0.000711	0.0011	0.000153	0.000554	0.00016	0.000867	0.000183
CCR-2	11/30/2015	22	-	-	-	-	0.12097	<0.0000777	0.0835	<0.000144	0.00739	0.00112	<0.000813	0.00412	0.00358	0.00146	0.000135
CCR-2	1/21/2016	20.2	-	-	-	-	0.09	0.000641	0.0885	<0.000144	0.00103	<0.0005	<0.000813	<0.00139	<0.000813	0.00524	<0.000113
CCR-2	2/23/2016	21.3	-	-	-	-	0.0934	0.000173	0.0869	<0.000144	<0.000539	<0.0005	<0.000813	<0.00139	<0.000813	0.00136	<0.000113
CCR-2	3/23/2016	21.4	-	-	-	-	0.0911	<0.0000777	0.0897	<0.000144	<0.000539	<0.0005	<0.000813	<0.00139	<0.000813	<0.000846	<0.000113
CCR-2	5/25/2016	21	-	-	-	-	0.11018	0.000748	0.12122	<0.000144	0.00126	<0.0005	<0.000813	<0.00139	<0.000813	0.00652	<0.000113
CCR-2	7/27/2016	19.7	-	-	-	-	0.0973	<0.0005	0.151	<0.0005	<0.0025	<0.005	<0.000175	<0.000615	<0.000491	0.000941	0.000379
CCR-2	9/20/2016	19	-	-	-	-	0.118	<0.0005	0.183	<0.0005	0.003	<0.005	<0.0005	0.00089	0.0074	0.00069	<0.0005
CCR-2	11/8/2016	19.2	-	-	-	-	0.12569	0.000317	0.19398	<0.000069	0.00247	<0.00273	<0.000175	0.0011	0.000948	<0.000678	<0.000261
CCR-2	2/22/2017	17.5	-	-	-	-	0.17272	0.000327	0.26015	<0.000069	0.00177	<0.00273	<0.000175	<0.000615	<0.000491	<0.000678	<0.000261
CCR-2	4/18/2017	16.7	-	-	-	-	0.1807	0.00023	0.2745	<0.000069	0.000651	<0.00273	0.000199	<0.000615	<0.000491	0.000827	<0.000261
CCR-2	6/22/2017	18.3	-	-	-	-	0.16252	0.00033	0.25873	<0.000069	0.00176	<0.00273	<0.00123	0.00178	<0.000412	<0.00272	<0.000942
CCR-2	10/11/2017	17.5	-	-	-	-	0.19391	0.000411	0.39966	<0.000069	0.00113	<0.00273	<0.00123	<0.00138	<0.000412	<0.00272	<0.000942
CCR-2	3/26/2018	-	-	-	-	-	0.15338	0.000685	0.5429	<0.000224	0.0027	<0.0011	<0.00012	0.00099	0.0011	0.00033	0.000042
CCR-2	6/27/2018	18	-	-	-	-	0.0924	<0.0016	0.559	-	<0.0017	<0.0023	<0.0005	<0.0005	<0.0005	0.0011	<0.0005
CCR-2	12/19/2018	18.4	-	-	-	-	0.0561	0.00113	0.74692	-	0.00139	<0.0011	<0.0000946	0.000391	<0.00046	<0.00135	<0.000428
CCR-2	3/25/2019	-	-	-	-	-	0.0478	0.000995	-	0.000647	0.00219	<0.0011	<0.0000946	0.000493	<0.00046	<0.00135	<0.000428
CCR-2	6/17/2019	17.8	-	-	-	-	0.0537	0.00115	0.83807	<0.000224	0.00286	0.00168	<0.000191	0.000737	0.000577	<0.00054	-
CCR-2	12/19/2019	16.4	-	-	-	-	0.0475	0.0011	0.72647	0.000224	0.00318	0.00115	0.000288	0.000911	0.000583	0.000432	-
CCR-2	3/23/2020	-	-	-	-	-	0.0482	0.000728	-	0.000224	0.00215	0.0011	0.000153	0.00052	0.000297	0.000432	0.000278
CCR-2	6/15/2020	14.9	-	-	-	-	0.0599	0.000612	0.47084	-	0.00325	0.0011	0.000153	0.000776	0.000833	0.000867	0.000213
CCR-2	12/17/2020	12.5	-	-	-	-	0.0663	0.000703	0.60369	-	0.00339	0.0011	0.000153	0.000712	0.000502	0.000867	0.000183
CCR-3	11/30/2015	11.7	-	-	-	-	0.0732	<0.0000777	0.0853	<0.000144	0.0021	<0.0005	<0.000813	0.00525	0.00137	0.00116	<0.000113
CCR-3	1/21/2016	10.6	-	-	-	-	0.0562	0.000646	0.0783	<0.000144	0.000686	<0.0005	<0.000813	<0.00139	<0.000813	0.0045	<0.000113
CCR-3	2/23/2016	11.8	-	-	-	-	0.054	0.000128	0.0839	<0.000144	<0.000539	<0.0005	<0.000813	<0.00139	<0.000813	0.00478	<0.000113
CCR-3	3/23/2016	13.7	-	-	-	-	0.0665	<0.0000777	0.10508	<0.000144	<0.000539	<0.0005	<0.000813	<0.00139	<0.000813	<0.000846	<0.000113
CCR-3	5/25/2016	12.3	-	-	-	-	0.0721	0.000491	0.0999	<0.000144	<0.000539	<0.0005	<0.000813	<0.00139	<0.000813	0.00512	<0.000113
CCR-3	7/27/2016	13.4	-	-	-	-	0.0985	<0.0005	0.146	<0.0005	<0.0025	<0.005	<0.000175	<0.000615	<0.000491	<0.000678	<0.000261
CCR-3	9/20/2016	11.2	-	-	-	-	0.075	<0.0005	0.0896	<0.0005	<0.0025	<0.005	<0.0005	0.0014	<0.005	<0.0005	<0.0005
CCR-3	11/8/2016	11.6	-	-	-	-	0.075	0.00013	0.12238	<0.000069	<0.000298	<0.00273	<0.000175	0.000711	<0.000491	<0.000678	<0.000261
CCR-3	2/22/2017	11.1	-	-	-	-	0.0726	0.000133	0.13115	<0.000069	0.00054	<0.00273	<0.000175	<0.000615	<0.000491	<0.000678	<0.000261

Appendix A: Groundwater Sample Data

Well ID	Sample Date	Chloride	Total Dissolved Solids	Alkalinity (Bicarbonate)	Alkalinity (Carbonate)	T Hardness (as $CaCO_3$)	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Antimony	Arsenic	Lead	Selenium	Thallium
		mg/L	mg/L	mg as $CaCO_3$/L	mg as $CaCO_3$/L	mg as $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
CCR-3	4/18/2017	10.1	-	-	-	-	0.0572	<0.000028	0.0926	<0.000069	<0.000298	<0.00273	0.000234	0.000703	<0.000491	<0.000678	<0.000261
CCR-3	6/22/2017	10	-	-	-	-	0.0496	0.0001	0.0608	<0.000069	0.00041	<0.00273	<0.00123	0.0031	<0.000412	<0.00272	<0.000942
CCR-3	10/11/2017	8.1	-	-	-	-	0.0636	0.000077	0.086	<0.000069	0.000346	<0.00273	<0.00123	<0.00138	<0.000412	<0.00272	<0.000942
CCR-3	3/26/2018	-	-	-	-	-	0.10807	0.000124	0.1585	<0.000224	<0.000342	<0.0011	<0.00012	0.00022	0.0001	<0.00017	<0.000028
CCR-3	6/27/2018	9.8	-	-	-	-	0.044	<0.0016	0.0414	-	<0.0017	<0.0023	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
CCR-3	12/19/2018	31.9	-	-	-	-	0.11682	0.000656	7.038	-	0.000846	<0.0011	<0.0000946	0.000913	<0.00046	<0.00135	<0.000428
CCR-3	3/25/2019	-	-	-	-	-	0.0951	0.000442	-	0.000241	0.000877	<0.0011	<0.0000946	0.000848	<0.00046	<0.00135	<0.000428
CCR-3	6/17/2019	25.6	-	-	-	-	0.0696	<0.000292	3.822	<0.000224	<0.000711	<0.0011	<0.000191	0.000473	<0.000056	<0.00054	-
CCR-3	12/19/2019	42.7	-	-	-	-	0.0612	0.000541	8.5077	0.000224	0.00108	0.0011	0.000224	0.00102	0.000109	0.000696	-
CCR-3	3/23/2020	-	-	-	-	-	0.0563	0.00041	-	0.000224	0.000711	0.0011	0.000153	0.000606	0.000049	0.000747	0.00024
CCR-3	6/15/2020	33.9	-	-	-	-	0.0499	0.000454	6.0851	-	0.000832	0.0011	0.000153	0.000676	0.000053	0.000867	0.0002
CCR-3	12/17/2020	45.3	-	-	-	-	0.024	0.000309	3.4173	-	0.000759	0.0011	0.000153	0.000634	0.000098	0.000867	0.000183
CCR-4	11/30/2015	50.5	-	-	-	-	0.0562	<0.0000777	21.526	0.000153	0.00295	0.0015	<0.000813	0.0119	0.00102	0.00705	<0.000113
CCR-4	1/21/2016	70.9	-	-	-	-	0.0652	0.000916	24.585	<0.000144	0.00211	0.000864	<0.000813	0.00637	<0.000813	0.0105	<0.000113
CCR-4	2/25/2016	74.4	-	-	-	-	0.0713	0.000314	26.2	<0.000144	<0.000539	<0.0005	<0.000813	0.0111	<0.000813	0.009	<0.000113
CCR-4	3/23/2016	75.1	-	-	-	-	0.0722	0.000176	24.805	<0.000144	<0.000539	<0.0005	<0.000813	0.0103	<0.000813	<0.000846	<0.000113
CCR-4	5/25/2016	64.4	-	-	-	-	0.0777	0.00227	24.209	<0.000144	<0.000539	0.000509	0.00197	0.00856	<0.000813	0.0161	<0.000113
CCR-4	7/27/2016	52.8	-	-	-	-	0.0791	0.0052	20	<0.0005	0.0046	<0.005	0.00406	0.0173	<0.000491	0.00581	<0.000261
CCR-4	9/20/2016	52.1	-	-	-	-	0.0922	0.0033	19.3	0.00051	0.0036	<0.005	0.0019	0.0075	<0.005	0.0029	<0.0005
CCR-4	11/8/2016	40.1	-	-	-	-	0.0661	0.012	17.04	<0.000069	0.019	0.00315	0.0083	0.0191	0.0117	0.26423	0.000316
CCR-4	2/21/2017	52.1	-	-	-	-	0.089	0.00324	18.093	<0.000069	0.00356	<0.00273	0.0032	0.00749	0.000852	0.00948	<0.000261
CCR-4	4/18/2017	53.7	-	-	-	-	0.0796	0.00545	17.826	<0.000069	0.00431	<0.00273	0.00191	0.00466	0.00108	0.00125	0.000365
CCR-4	6/22/2017	45.1	-	-	-	-	0.0738	0.00064	15.734	<0.000069	0.00246	<0.00273	<0.00123	0.00387	<0.000412	0.0216	<0.000942
CCR-4	10/11/2017	77.4	-	-	-	-	0.0998	0.00161	22.143	<0.000069	0.00275	<0.00273	0.0015	0.00672	<0.000412	0.0145	<0.000942
CCR-4	12/13/2017	65.8	-	-	-	-	-	-	21.452	-	-	-	-	-	-	-	-
CCR-4	3/26/2018	-	-	-	-	-	0.11778	0.0014	25.751	<0.000224	0.00177	<0.0011	0.0021	0.0071	0.0005	0.0011	<0.000028
CCR-4	6/27/2018	68	-	-	-	-	0.0982	0.0033	20.4	-	0.0027	<0.005	0.0019	0.0087	0.0009	0.0044	<0.0005
CCR-4	12/19/2018	80.8	-	-	-	-	0.10116	0.00185	28.878	-	0.00318	<0.0011	0.00395	0.0143	0.00126	0.00617	<0.000428
CCR-4	3/25/2019	-	-	-	-	-	0.10921	0.00098	-	<0.000224	0.00314	<0.0011	0.0021	0.00589	0.000658	0.00499	<0.000428
CCR-4	6/17/2019	60.8	-	-	-	-	0.11705	0.000606	31.283	<0.000224	0.00177	0.00172	0.004	0.0116	0.000887	0.00538	-
CCR-4	12/19/2019	54.1	-	-	-	-	0.10678	0.000799	31.669	0.000224	0.00381	0.00179	0.00266	0.0117	0.00152	0.00441	-
CCR-4	3/23/2020	-	-	-	-	-	0.10772	0.000292	-	0.000224	0.000972	0.0011	0.00222	0.00726	0.000698	0.00355	0.00021
CCR-4	6/15/2020	28.8	-	-	-	-	0.0674	0.000357	16.835	-	0.00295	0.0011	0.000711	0.00266	0.00105	0.0128	0.000183
CCR-4	12/17/2020	75.6	-	-	-	-	0.10413	0.000345	46.021	-	0.00178	0.0011	0.00077	0.0047	0.000775	0.00437	0.000183
CCR-5	11/30/2015	169	-	-	-	-	0.0629	<0.0000777	12.702	0.000815	0.00301	<0.0005	<0.000813	0.00411	0.00212	0.0219	<0.000113
CCR-5	1/21/2016	137	-	-	-	-	0.0611	<0.0000777	6.8595	<0.000144	0.000991	<0.0005	<0.00065	<0.00111	<0.00065	0.0158	<0.00009
CCR-5	2/23/2016	145	-	-	-	-	0.0972	0.00263	6.35	0.00104	<0.000539	<0.0005	<0.000813	<0.00139	<0.000813	0.0194	<0.000113
CCR-5	3/23/2016	145	-	-	-	-	0.11307	0.000216	5.0792	<0.000144	0.00196	<0.0005	<0.000813	<0.00139	<0.000813	0.00354	<0.000113
CCR-5	5/25/2016	126	-	-	-	-	0.20382	0.00847	3.3852	<0.000144	<0.000539	<0.0005	<0.000813	<0.00139	<0.000813	0.0311	<0.000113
CCR-5	7/27/2016	141	-	-	-	-	0.204	0.00099	2.72	<0.0005	<0.0025	<0.005	<0.000175	<0.000615	<0.000491	0.0138	<0.000261
CCR-5	9/20/2016	158	-	-	-	-	0.254	0.001	2	<0.0005	<0.0025	<0.005	<0.0005	0.0011	0.0131	0.0009	<0.0005
CCR-5	11/8/2016	150	-	-	-	-	0.22359	0.000974	1.7199	<0.000069	0.00301	<0.00273	<0.000175	0.00167	0.0015	0.0112	<0.000261
CCR-5	2/22/2017	160	-	-	-	-	0.23039	0.000869	2.185	<0.000069	0.00177	<0.00273	<0.000175	0.00346	<0.000491	0.0125	<0.000261
CCR-5	4/18/2017	183	-	-	-	-	0.25287	0.000805	1.795	<0.000069	0.00142	<0.00273	0.000262	0.00265	<0.000491	0.0065	<0.000261
CCR-5	6/22/2017	191	-	-	-	-	0.27848	0.00092	1.8136	<0.000069	0.00127	<0.00273	<0.00123	0.00526	<0.000412	0.0108	<0.000942
CCR-5	10/11/2017	189	-	-	-	-	0.311216	0.000977	2.3166	<0.000069	0.00132	<0.00273	<0.00123	0.00497	<0.000412	0.0258	<0.000942

Appendix A: Groundwater Sample Data

Well ID	Sample Date	Chloride	Total Dissolved Solids	Alkalinity (Bicarbonate)	Alkalinity (Carbonate)	T Hardness (as $CaCO_3$)	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Antimony	Arsenic	Lead	Selenium	Thallium
		mg/L	mg/L	mg as $CaCO_3$/L	mg as $CaCO_3$/L	mg as $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
CCR-5	12/13/2017	178	-	-	-	-	-	-	2.0757	-	-	-	-	-	-	-	-
CCR-5	3/26/2018	-	-	-	-	-	0.26641	0.000691	2.3299	<0.000224	0.00102	<0.0011	<0.00012	0.00065	0.00012	0.00018	<0.000028
CCR-5	6/27/2018	195	-	-	-	-	0.331	0.00096	2.43	-	<0.0025	<0.005	<0.0005	0.0009	<0.0005	0.00092	<0.0005
CCR-5	12/19/2018	286	-	-	-	-	0.433	0.00114	4.8909	-	0.00148	<0.0011	<0.0000946	0.00077	<0.00046	0.0265	<0.000428
CCR-5	3/25/2019	-	-	-	-	-	0.26621	0.000841	-	0.000869	0.0015	<0.0011	<0.0000946	0.000727	<0.00046	0.00541	<0.000428
CCR-5	6/17/2019	318	-	-	-	-	0.33534	0.00113	6.6876	<0.000224	0.00179	<0.0011	<0.000191	0.000701	0.000073	0.00711	-
CCR-5	12/19/2019	291	-	-	-	-	0.3348	0.00133	8.8078	0.000224	0.00279	0.0011	0.000185	0.00113	0.000466	0.0072	-
CCR-5	3/23/2020	-	-	-	-	-	0.20449	0.00121	-	0.000224	0.00191	0.0011	0.000153	0.00113	0.000079	0.0048	0.000183
CCR-5	6/15/2020	266	-	-	-	-	0.25398	0.0014	10.641	-	0.00295	0.0011	0.000153	0.00137	0.000492	0.0051	0.000183
CCR-5	12/17/2020	271	-	-	-	-	0.1511	0.00141	13.44	-	0.00286	0.0011	0.000153	0.00107	0.000293	0.00461	0.000183
CCR-6	11/30/2015	70.5	-	-	-	-	0.047	<0.0000777	62.248	<0.000144	<0.000539	<0.0005	<0.000813	0.00251	<0.000813	0.00994	<0.000113
CCR-6	1/21/2016	154	-	-	-	-	0.0395	<0.0000777	42.886	<0.000144	<0.000539	<0.0005	<0.000813	0.00221	<0.000813	0.00791	<0.000113
CCR-6	2/23/2016	159	-	-	-	-	0.0414	0.000364	37.5	<0.000144	<0.000539	<0.0005	<0.000813	<0.00139	<0.000813	0.00971	<0.000113
CCR-6	3/23/2016	184	-	-	-	-	0.036	0.0000901	34.628	<0.000144	<0.000539	<0.0005	<0.000813	<0.00139	<0.000813	0.00275	<0.000113
CCR-6	5/25/2016	191	-	-	-	-	0.0472	0.00186	23.783	<0.000144	<0.000539	<0.0005	<0.000813	<0.00139	<0.000813	0.0349	<0.000113
CCR-6	7/27/2016	185	-	-	-	-	0.0474	0.00062	26.4	<0.0005	<0.0025	<0.005	<0.000175	<0.000615	<0.000491	0.0147	<0.000261
CCR-6	9/20/2016	189	-	-	-	-	0.0562	<0.0005	19.4	<0.0005	<0.0025	<0.005	<0.0005	0.0008	0.0059	0.0019	<0.0005
CCR-6	11/8/2016	160	-	-	-	-	0.0529	<0.000028	19.772	<0.000069	0.000501	<0.00273	<0.000175	0.000651	<0.000491	0.00657	<0.000261
CCR-6	2/21/2017	137	-	-	-	-	0.0424	<0.000028	23.813	<0.000069	0.000785	<0.00273	<0.000175	0.00181	<0.000491	0.012	<0.000261
CCR-6	4/18/2017	136	-	-	-	-	0.0483	<0.000028	29.389	<0.000069	0.000528	<0.00273	0.000214	0.00217	<0.000491	0.00505	<0.000261
CCR-6	6/22/2017	153	-	-	-	-	0.0403	<0.000028	20.178	<0.000069	0.00082	<0.00273	<0.00123	0.00448	<0.000412	0.00876	<0.000942
CCR-6	10/11/2017	122	-	-	-	-	0.0376	<0.000028	25.155	<0.000069	0.000766	<0.00273	<0.00123	0.00235	<0.000412	0.0183	<0.000942
CCR-6	12/14/2017	111	-	-	-	-	-	-	24.132	-	-	-	-	-	-	-	-
CCR-6	3/26/2018	-	-	-	-	-	0.0371	<0.0000627	20.423	<0.000224	0.00059	<0.0011	<0.00012	0.00069	0.000064	0.0016	<0.000028
CCR-6	6/27/2018	95.5	-	-	-	-	0.0372	<0.0005	22.5	-	<0.0025	<0.005	<0.0005	0.0012	<0.0005	0.0017	<0.0005
CCR-6	12/4/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CCR-6	12/19/2018	103	-	-	-	-	0.0377	<0.0000627	24.974	-	0.000502	<0.0011	<0.0000946	0.000595	<0.00046	0.0112	<0.000428
CCR-6	2/20/2019	88.3	-	196	0	-	0.0377	<0.0000627	30.652	-	0.000516	<0.0011	<0.0000946	0.000683	<0.00046	0.00195	<0.000428
CCR-6	3/25/2019	-	-	-	-	-	0.0607	<0.0000627	-	0.000384	0.00372	0.00214	<0.0000946	0.00105	<0.00046	0.00506	<0.000428
CCR-6	6/17/2019	123	-	-	-	-	0.0374	<0.000292	31.248	<0.000224	<0.000711	<0.0011	0.000248	0.00079	0.000201	0.00477	-
CCR-6	9/26/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CCR-6	10/29/2019	101	-	-	-	-	0.0391	0.000292	38.988	0.000224	0.000711	0.0011	0.000214	0.000734	0.000168	0.00198	-
CCR-6	12/19/2019	97.8	-	-	-	-	0.0376	0.000292	37.87	0.000224	0.000711	0.0011	0.000351	0.000739	0.000299	0.00265	-
CCR-6	3/23/2020	-	-	-	-	-	0.0377	0.000292	-	0.000224	0.000711	0.0011	0.000153	0.000373	0.000148	0.00167	0.000183
CCR-6	6/15/2020	74	-	-	-	-	0.0358	0.000292	32.643	-	0.000711	0.0011	0.000153	0.000466	0.000057	0.00236	0.000183
CCR-6	8/18/2020	65.6	-	433	0	-	0.0296	0.000292	28.999	-	0.000711	0.0011	0.000153	0.000467	0.000061	0.00203	0.000183
CCR-6	12/17/2020	26.7	-	-	-	-	0.0251	0.000292	25.985	-	0.000711	0.0011	0.000153	0.000355	0.000115	0.00178	0.000274
CCR-7	11/30/2015	80.2	-	-	-	-	0.0371	<0.0000777	7.469	<0.000144	0.00188	0.000975	<0.000813	0.00191	<0.000813	0.0121	<0.000113
CCR-7	1/21/2016	85.4	-	-	-	-	0.0293	<0.0000777	7.4714	<0.000144	0.00106	0.000684	<0.000813	0.00295	<0.000813	0.00818	<0.000113
CCR-7	2/23/2016	92	-	-	-	-	0.0304	0.000138	7.27	<0.000144	0.00122	0.000761	<0.000813	0.0014	<0.000813	0.00796	<0.000113
CCR-7	3/23/2016	93.9	-	-	-	-	0.0294	0.0000848	10.05	<0.000144	0.00235	0.000938	<0.000813	<0.00139	<0.000813	0.00777	<0.000113
CCR-7	5/25/2016	79.5	-	-	-	-	0.0255	0.00137	6.1935	<0.000144	0.00139	0.00126	<0.000813	<0.00139	<0.000813	0.0219	<0.000113
CCR-7	7/27/2016	87.3	-	-	-	-	0.0299	<0.0005	6.83	<0.0005	0.0029	<0.005	<0.000175	<0.000615	<0.000491	0.0101	<0.000261
CCR-7	9/20/2016	89.4	-	-	-	-	0.0367	<0.0005	7.78	<0.0005	0.0046	<0.005	<0.0005	<0.0005	<0.005	<0.0005	<0.0005
CCR-7	11/8/2016	96.9	-	-	-	-	0.0466	<0.000028	12.837	<0.000069	0.00281	<0.00273	<0.000175	0.000793	<0.000491	0.00943	<0.000261
CCR-7	2/22/2017	77.1	-	-	-	-	0.0256	<0.000028	5.6559	<0.000069	0.00242	<0.00273	<0.000175	<0.000615	<0.000491	0.00207	<0.000261

Appendix A: Groundwater Sample Data

Well ID	Sample Date	Chloride	Total Dissolved Solids	Alkalinity (Bicarbonate)	Alkalinity (Carbonate)	T Hardness (as $CaCO_3$)	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Antimony	Arsenic	Lead	Selenium	Thallium
		mg/L	mg/L	mg as $CaCO_3$/L	mg as $CaCO_3$/L	mg as $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
CCR-7	4/18/2017	119	-	-	-	-	0.046	<0.000028	13.077	<0.000069	0.00255	<0.00273	0.000206	0.00193	<0.000491	0.00627	<0.000261
CCR-7	6/22/2017	139	-	-	-	-	0.0515	<0.000028	16.721	<0.000069	0.00363	<0.00273	<0.00123	0.00544	<0.000412	0.0118	<0.000942
CCR-7	10/11/2017	145	-	-	-	-	0.053	<0.000028	17.099	<0.000069	0.0039	<0.00273	<0.00123	0.00499	<0.000412	0.0268	<0.000942
CCR-7	12/14/2017	135	-	-	-	-	-	-	19.904	-	-	-	-	-	-	-	-
CCR-7	3/26/2018	-	-	-	-	-	0.0316	<0.0000627	11.634	<0.000224	0.00261	0.00126	<0.00012	0.0007	0.000039	0.00061	<0.000028
CCR-7	6/27/2018	122	-	-	-	-	0.0402	<0.0005	14.3	-	0.003	<0.005	<0.0005	0.0012	<0.0005	0.0012	<0.0005
CCR-7	12/19/2018	95.6	-	-	-	-	0.0599	<0.0000627	25.338	-	0.00391	0.00213	<0.0000946	0.00112	<0.00046	0.0239	<0.000428
CCR-7	2/20/2019	254	-	<20	0	-	0.0611	<0.0000627	30.806	-	0.00363	0.00172	<0.0000946	0.00111	<0.00046	0.00484	<0.000428
CCR-7	3/25/2019	-	-	-	-	-	0.035	<0.0000627	-	<0.000224	0.000556	<0.0011	<0.0000946	0.000655	<0.00046	0.00278	<0.000428
CCR-7	6/17/2019	446	-	-	-	-	0.0712	<0.000292	25.015	<0.000224	0.00397	0.00333	0.000259	0.00147	0.000097	0.0084	-
CCR-7	9/26/2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CCR-7	10/29/2019	415	-	-	-	-	0.0677	0.000292	27.445	0.000224	0.00369	0.00345	0.000153	0.00202	0.000089	0.0051	-
CCR-7	12/19/2019	416	-	-	-	-	0.0665	0.000292	30.496	0.000224	0.00435	0.00365	0.000201	0.00181	0.000162	0.00708	-
CCR-7	3/23/2020	-	-	-	-	-	0.0594	0.000292	-	0.000224	0.00367	0.00259	0.000153	0.00134	0.000058	0.00553	0.000183
CCR-7	6/15/2020	289	-	-	-	-	0.0578	0.000292	33.523	-	0.00441	0.00238	0.000153	0.00149	0.000185	0.00448	0.000183
CCR-7	8/18/2020	328	-	20	0	-	0.0545	0.000292	35.357	-	0.0042	0.00209	0.000153	0.00123	0.000141	0.00528	0.000183
CCR-7	12/17/2020	382	-	-	-	-	0.0521	0.000292	34.036	-	0.00451	0.00203	0.000153	0.00172	0.000343	0.00585	0.000227
MW-8	12/4/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-8	8/18/2020	37.4	-	28.2	0	-	0.0189	0.000292	0.0242	-	0.000711	0.0011	0.000153	0.000149	0.000118	0.000867	0.000183
MW-9	12/4/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-9	8/18/2020	21.5	-	31.7	0	-	0.0344	0.000318	0.0262	-	0.00225	0.0011	0.000153	0.000899	0.000524	0.000867	0.000183
SW	2/20/2019	52.9	-	59.1	0	-	0.0501	<0.0000627	6.2467	-	<0.000342	<0.0011	0.00112	0.00759	<0.00046	0.0028	<0.000428

Appendix A: Groundwater Sample Data

Well ID	Sample Date	Mercury	Fluoride	Lithium	Molybdenum	Aluminum	Iron	Nitrate/Nitrite	Nitrate	Total Phosphorous	Radium-226	Radium-228	Gross Alpha
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	pCi/L	pCi/L
AW-1	12/3/2018	-	-	-	-	-	-	-	-	-	3.8	4.3	15.1
AW-1	2/20/2019	-	0.26	0.00056	<0.00127	19.711	38.126	<0.05	-	0.04	1.8	3.29	-
AW-1	8/18/2020	-	0.24	0.0011	0.00127	19.83	23.666	-	0.05	0.03	2.45	12.5	-
AW-2	12/3/2018	-	-	-	-	-	-	-	-	-	2.64	4.24	11.8
AW-2	2/20/2019	-	<0.17	0.00029	0.0262	8.2671	9.3791	<0.05	-	0.03	1.82	2.63	-
AW-2	8/18/2020	-	0.16	0.0011	0.0199	8.5705	11.609	-	0.05	0.03	2.26	2.08	-
AW-3	12/3/2018	-	-	-	-	-	-	-	-	-	7.43	8.06	31.5
AW-3	2/20/2019	-	<0.17	<0.00019	<0.00127	4.5274	10.261	<0.05	-	0.04	7.54	10.8	-
AW-3	8/18/2020	-	0.073	0.0011	0.00127	5.5685	6.4901	-	0.05	0.02	5.07	4.6	-
AW-4	2/20/2019	-	<0.17	0.0003	0.00282	3.492	10.246	<0.05	-	0.04	4.44	6.64	-
AW-4	10/29/2019	0.00000575	0.17	0.0044	0.00161	5.764	9.24	0.05	-	0.02	4.85	6.21	-
AW-5	2/20/2019	-	<0.17	0.00052	0.00133	2.1467	13.941	<0.05	-	0.04	2.82	2.6	-
AW-5	9/26/2019	-	-	-	-	-	-	-	-	-	0.871	1.95	-
AW-5	10/29/2019	0.00000575	0.068	0.0022	0.00127	5.0036	6.35	0.05	-	0.02	1.22	1.78	-
AW-5	12/19/2019	-	-	-	-	-	-	-	-	-	<0.65	<0.957	-
AW-5	3/23/2020	-	-	-	-	-	-	-	-	-	0.759	2.4	-
AW-5	6/15/2020	-	0.073	0.00023	0.00127	-	-	-	-	-	<0.795	0.983	-
AW-5	8/18/2020	-	0.12	0.0011	0.00127	6.5162	8.231	-	0.05	0.03	1.52	1.4	-
AW-5	12/17/2020	-	<0.073	0.00044	0.00127	-	-	-	-	-	1.36	<1.2	-
AW-6	2/20/2019	-	<0.068	0.0003	<0.00127	0.88911	5.5569	<0.05	-	<0.02	1.21	1.39	-
AW-6	6/17/2019	<0.00000575	<0.17	0.00022	<0.00127	-	-	-	-	-	1.29	1.17	-
AW-6	9/26/2019	-	-	-	-	-	-	-	-	-	1.15	<0.918	-
AW-6	10/29/2019	0.00000575	0.068	0.0022	0.00127	2.4495	1.23	0.05	-	0.02	1.28	1.14	-
AW-6	12/19/2019	-	-	-	-	-	-	-	-	-	<1.18	1.36	-
AW-6	3/23/2020	-	-	-	-	-	-	-	-	-	1.11	1.11	-
AW-6	6/15/2020	-	0.068	<0.00022	0.00127	-	-	-	-	-	1.35	<0.886	-
AW-6	8/18/2020	-	0.073	0.0011	0.00127	2.4895	0.74807	-	0.05	0.02	1.35	1.57	-
AW-6	12/17/2020	-	0.073	0.00032	0.00127	-	-	-	-	-	1.15	1.04	-
AW-7	2/20/2019	-	<0.17	<0.00019	0.00682	0.12064	2.9179	<0.05	-	0.05	1.78	1.36	-
AW-7	8/18/2020	-	0.073	0.0011	0.00927	0.0637	0.0402	-	0.05	0.02	5.74	3.06	-
AW-7	12/17/2020	-	0.073	0.00065	0.0105	-	-	-	-	-	2.84	1.59	-
AW-8	10/29/2019	0.00000575	0.16	0.0022	0.00127	8.9852	7.65	0.05	-	0.02	4.14	2.96	-
AW-8	12/19/2019	-	-	-	-	-	-	-	-	-	1.88	2.64	-
AW-8	3/23/2020	-	-	-	-	-	-	-	-	-	2.52	3.18	-
AW-8	6/15/2020	-	0.18	<0.00022	0.00127	-	-	-	-	-	1.97	2.82	-
AW-8	8/18/2020	-	0.21	0.0011	0.00127	15.195	5.3424	-	0.05	0.02	1.93	3.52	-
AW-8	12/17/2020	-	0.18	<0.00022	0.00127	-	-	-	-	-	2.4	3.23	-
AW-9	6/15/2020	-	0.046	0.003	0.00127	-	-	-	-	-	<0.818	0.894	-
AW-9	8/18/2020	-	0.056	0.0011	0.00127	0.51829	1.7541	-	0.05	0.02	2.13	2.32	-
AW-9	12/17/2020	-	0.055	<0.00022	0.00127	-	-	-	-	-	2.41	1.21	-
CCR-1	11/30/2015	<0.000005	0.056	0.0033	<0.000944	-	-	-	-	-	1.01	1.3	-
CCR-1	1/21/2016	<0.000005	0.076	<0.0125	<0.000944	-	-	-	-	-	<0.84	0.69	-
CCR-1	2/23/2016	<0.000005	0.057	<0.0125	<0.000944	-	-	-	-	-	0.95	<0.69	-
CCR-1	3/23/2016	<0.000005	0.054	<0.0125	<0.000944	-	-	-	-	-	<0.69	1.14	-
CCR-1	5/25/2016	<0.000005	0.054	<0.0125	<0.000944	-	-	-	-	-	0.68	<0.65	-

Appendix A: Groundwater Sample Data

Well ID	Sample Date	Mercury	Fluoride	Lithium	Molybdenum	Aluminum	Iron	Nitrate/Nitrite	Nitrate	Total Phosphorous	Radium-226	Radium-228	Gross Alpha
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	pCi/L	pCi/L
CCR-1	7/27/2016	<0.000005	0.053	<0.0125	<0.005	-	-	-	-	-	<0.98	<0.81	-
CCR-1	9/20/2016	0.0000199	0.067	<0.0125	<0.005	-	-	-	-	-	<1.25	<0.73	-
CCR-1	11/8/2016	<0.000005	0.069	<0.0125	<0.000475	-	-	-	-	-	<0.54	<0.86	-
CCR-1	2/22/2017	<0.000005	0.065	<0.0125	<0.000475	-	-	-	-	-	<0.83	<0.85	-
CCR-1	4/18/2017	<0.000005	0.067	<0.0125	<0.000475	-	-	-	-	-	<0.71	1.03	-
CCR-1	6/22/2017	<0.000005	-	-	<0.000475	-	-	-	-	-	-	-	-
CCR-1	10/11/2017	0.0000171	0.063	-	<0.000475	-	-	-	-	-	-	-	-
CCR-1	3/26/2018	<0.000017	0.085	0.0013	<0.00127	-	-	-	-	-	3.65	<0.95	-
CCR-1	6/27/2018	-	0.062	0.0011	<0.005	-	-	-	-	-	1.34	1.02	-
CCR-1	12/19/2018	-	0.1	0.0018	<0.00127	-	-	-	-	-	3.42	1.48	-
CCR-1	3/25/2019	<0.00000575	0.083	0.0015	<0.00127	-	-	-	-	-	1.52	1.88	-
CCR-1	6/17/2019	<0.00000575	0.082	0.0018	<0.00127	-	-	-	-	-	2.77	0.98	-
CCR-1	12/19/2019	0.00000575	0.13	0.0011	0.00127	-	-	-	-	-	1.78	<0.803	-
CCR-1	3/23/2020	0.00000575	0.15	0.00089	0.00127	-	-	-	-	-	2.4	1.21	-
CCR-1	6/15/2020	-	0.11	0.00079	0.00127	-	-	-	-	-	1.98	<1.25	-
CCR-1	12/17/2020	-	0.092	0.0018	0.00127	-	-	-	-	-	1.98	0.781	-
CCR-2	11/30/2015	0.0000127	0.052	0.0057	<0.000944	-	-	-	-	-	1.71	<0.67	-
CCR-2	1/21/2016	<0.000005	0.058	<0.0125	<0.000944	-	-	-	-	-	0.71	<0.62	-
CCR-2	2/23/2016	<0.000005	0.051	<0.0125	<0.000944	-	-	-	-	-	<0.98	<0.69	-
CCR-2	3/23/2016	<0.000005	0.045	<0.0125	<0.000944	-	-	-	-	-	0.78	<0.89	-
CCR-2	5/25/2016	<0.000005	0.05	<0.0125	<0.000944	-	-	-	-	-	1.11	<0.61	-
CCR-2	7/27/2016	<0.000005	0.051	<0.0125	<0.005	-	-	-	-	-	0.92	<1.82	-
CCR-2	9/20/2016	0.0000276	0.066	<0.0125	<0.005	-	-	-	-	-	<1.39	<1.01	-
CCR-2	11/8/2016	0.0000059	0.069	<0.0125	<0.000475	-	-	-	-	-	1.85	1.42	-
CCR-2	2/22/2017	<0.000005	0.065	<0.0125	<0.000475	-	-	-	-	-	<0.78	<0.76	-
CCR-2	4/18/2017	<0.000005	0.071	<0.0125	<0.000475	-	-	-	-	-	<0.97	0.82	-
CCR-2	6/22/2017	<0.000005	0.14	<0.0125	<0.000475	-	-	-	-	-	<3.26	<0.94	-
CCR-2	10/11/2017	0.0000181	0.089	-	<0.000475	-	-	-	-	-	-	-	-
CCR-2	3/26/2018	<0.000017	0.1	0.0029	<0.00127	-	-	-	-	-	<0.8	<0.87	-
CCR-2	6/27/2018	-	0.12	0.0029	<0.004	-	-	-	-	-	<0.9	0.95	-
CCR-2	12/19/2018	-	0.14	0.0031	<0.00127	-	-	-	-	-	<0.77	<0.72	-
CCR-2	3/25/2019	<0.00000575	0.16	0.0028	<0.00127	-	-	-	-	-	<0.88	<1.48	-
CCR-2	6/17/2019	<0.00000575	0.18	0.0031	<0.00127	-	-	-	-	-	1.36	1.14	-
CCR-2	12/19/2019	0.0000064	0.14	0.0038	0.00127	-	-	-	-	-	<0.875	<0.971	-
CCR-2	3/23/2020	0.00000575	0.099	0.0024	0.00127	-	-	-	-	-	1.31	1.05	-
CCR-2	6/15/2020	-	0.091	0.0026	0.00127	-	-	-	-	-	0.702	<1.43	-
CCR-2	12/17/2020	-	0.092	0.0029	0.00127	-	-	-	-	-	<0.671	<1.05	-
CCR-3	11/30/2015	<0.000005	0.053	0.0017	<0.000944	-	-	-	-	-	1.38	1.28	-
CCR-3	1/21/2016	<0.000005	0.056	<0.0125	<0.000944	-	-	-	-	-	<0.75	0.9	-
CCR-3	2/23/2016	<0.000005	0.053	<0.0125	<0.000944	-	-	-	-	-	<0.95	<0.67	-
CCR-3	3/23/2016	<0.000005	0.062	<0.0125	<0.000944	-	-	-	-	-	1.78	1.52	-
CCR-3	5/25/2016	<0.000005	0.059	<0.0125	<0.000944	-	-	-	-	-	1.06	<0.74	-
CCR-3	7/27/2016	<0.000005	0.074	<0.0125	<0.005	-	-	-	-	-	1.58	1.08	-
CCR-3	9/20/2016	0.0000195	0.067	<0.0125	<0.005	-	-	-	-	-	1.67	1.26	-
CCR-3	11/8/2016	<0.000005	0.072	<0.0125	<0.000475	-	-	-	-	-	1.35	1	-
CCR-3	2/22/2017	<0.000005	0.06	<0.0125	<0.000475	-	-	-	-	-	1.05	1.38	-

Appendix A: Groundwater Sample Data

Well ID	Sample Date	Mercury	Fluoride	Lithium	Molybdenum	Aluminum	Iron	Nitrate/Nitrite	Nitrate	Total Phosphorous	Radium-226	Radium-228	Gross Alpha
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	pCi/L	pCi/L
CCR-3	4/18/2017	<0.000005	0.051	<0.0125	<0.000475	-	-	-	-	-	<0.93	<0.69	-
CCR-3	6/22/2017	<0.000005	0.041	<0.0125	<0.000475	-	-	-	-	-	<0.96	<1.95	-
CCR-3	10/11/2017	<0.000017	0.053	-	0.000545	-	-	-	-	-	-	-	-
CCR-3	3/26/2018	<0.000017	0.064	0.00017	<0.00127	-	-	-	-	-	2.13	1.55	-
CCR-3	6/27/2018	-	0.043	<0.00014	<0.004	-	-	-	-	-	1.17	1.41	-
CCR-3	12/19/2018	-	0.17	0.00024	<0.00127	-	-	-	-	-	4.04	3.79	-
CCR-3	3/25/2019	<0.00000575	0.14	<0.00019	<0.00127	-	-	-	-	-	2.79	3.88	-
CCR-3	6/17/2019	<0.00000575	0.13	<0.00019	<0.00127	-	-	-	-	-	2.04	1.06	-
CCR-3	12/19/2019	0.00000575	0.17	<0.00022	0.00127	-	-	-	-	-	3.88	2.83	-
CCR-3	3/23/2020	0.00000575	0.088	<0.00022	0.00127	-	-	-	-	-	0.22	3.06	-
CCR-3	6/15/2020	-	<0.073	<0.00022	0.00127	-	-	-	-	-	2.61	2.64	-
CCR-3	12/17/2020	-	<0.073	<0.00022	0.0317	-	-	-	-	-	2	1.56	-
CCR-4	11/30/2015	<0.000005	0.57	0.0067	0.00167	-	-	-	-	-	1.52	1.7	-
CCR-4	1/21/2016	<0.000005	0.56	<0.0125	0.00194	-	-	-	-	-	<0.96	1.07	-
CCR-4	2/25/2016	<0.000005	0.2	<0.0125	0.00209	-	-	-	-	-	<0.83	<0.84	-
CCR-4	3/23/2016	<0.000005	0.21	<0.0125	0.00213	-	-	-	-	-	<0.99	1.57	-
CCR-4	5/25/2016	<0.000005	0.36	<0.0125	0.00579	-	-	-	-	-	1.4	1.66	-
CCR-4	7/27/2016	0.0000138	0.5	<0.0125	0.0169	-	-	-	-	-	1	1.56	-
CCR-4	9/20/2016	0.0000355	0.8	<0.0125	0.0114	-	-	-	-	-	<0.25	1.96	-
CCR-4	11/8/2016	0.0000576	0.52	<0.0125	0.0212	-	-	-	-	-	0.62	1.76	-
CCR-4	2/21/2017	0.0000071	0.52	<0.0125	0.0146	-	-	-	-	-	1.12	1.83	-
CCR-4	4/18/2017	0.0000062	0.35	<0.0125	0.0113	-	-	-	-	-	<0.94	1.4	-
CCR-4	6/22/2017	<0.000005	0.5	<0.0125	0.00356	-	-	-	-	-	<1.24	<1.91	-
CCR-4	10/11/2017	0.0000237	0.51	-	0.0103	-	-	-	-	-	-	-	-
CCR-4	12/13/2017	-	0.4	-	-	-	-	-	-	-	-	-	-
CCR-4	3/26/2018	<0.000017	0.12	0.00024	0.00814	-	-	-	-	-	2.98	0.82	-
CCR-4	6/27/2018	-	0.09	0.00032	0.0089	-	-	-	-	-	1.9	1.97	-
CCR-4	12/19/2018	-	0.045	<0.00019	0.014	-	-	-	-	-	1.74	1.17	-
CCR-4	3/25/2019	0.000012	<0.17	0.00038	0.0236	-	-	-	-	-	1.23	1.38	-
CCR-4	6/17/2019	0.000018	<0.17	<0.00019	0.0202	-	-	-	-	-	2.74	1.81	-
CCR-4	12/19/2019	0.000155	0.17	0.0004	0.0179	-	-	-	-	-	1.47	1.43	-
CCR-4	3/23/2020	0.00000575	0.029	<0.00022	0.0106	-	-	-	-	-	3.1	1.61	-
CCR-4	6/15/2020	-	0.073	<0.00022	0.00349	-	-	-	-	-	1.34	2.64	-
CCR-4	12/17/2020	-	0.12	<0.00022	0.00733	-	-	-	-	-	1.86	1.66	-
CCR-5	11/30/2015	0.0000146	0.38	0.0061	<0.000944	-	-	-	-	-	1.1	1.95	-
CCR-5	1/21/2016	<0.000005	0.32	<0.0125	<0.000944	-	-	-	-	-	2.68	<0.65	-
CCR-5	2/23/2016	<0.000005	0.25	<0.0125	<0.000944	-	-	-	-	-	<0.95	0.81	-
CCR-5	3/23/2016	<0.000005	0.23	<0.0125	<0.000944	-	-	-	-	-	<0.78	0.94	-
CCR-5	5/25/2016	<0.000005	0.2	<0.0125	<0.000944	-	-	-	-	-	1.03	<0.73	-
CCR-5	7/27/2016	0.0000052	0.16	<0.0125	<0.005	-	-	-	-	-	1.59	<0.93	-
CCR-5	9/20/2016	0.0000242	0.19	<0.0125	<0.005	-	-	-	-	-	1.44	1.15	-
CCR-5	11/8/2016	0.000106	0.15	<0.0125	<0.000475	-	-	-	-	-	<1.04	0.9	-
CCR-5	2/22/2017	<0.000005	0.11	<0.0125	<0.000475	-	-	-	-	-	<0.78	<0.96	-
CCR-5	4/18/2017	<0.000005	0.12	<0.0125	<0.000475	-	-	-	-	-	<1.24	1.31	-
CCR-5	6/22/2017	<0.000005	0.12	<0.0125	<0.000475	-	-	-	-	-	<1.45	<0.8	-
CCR-5	10/11/2017	0.0000179	0.11	-	<0.000475	-	-	-	-	-	-	-	-

Appendix A: Groundwater Sample Data

Well ID	Sample Date	Mercury	Fluoride	Lithium	Molybdenum	Aluminum	Iron	Nitrate/Nitrite	Nitrate	Total Phosphorous	Radium-226	Radium-228	Gross Alpha
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	pCi/L	pCi/L
CCR-5	12/13/2017	-	0.12	-	-	-	-	-	-	-	-	-	-
CCR-5	3/26/2018	<0.000017	0.11	0.0013	<0.00127	-	-	-	-	-	0.82	<0.72	-
CCR-5	6/27/2018	-	0.11	0.0015	<0.005	-	-	-	-	-	1.86	1.35	-
CCR-5	12/19/2018	-	<0.068	0.0014	<0.00127	-	-	-	-	-	2.01	2.44	-
CCR-5	3/25/2019	<0.00000575	0.14	0.0015	<0.00127	-	-	-	-	-	<1.06	<1.16	-
CCR-5	6/17/2019	<0.00000575	0.16	0.0018	<0.00127	-	-	-	-	-	1.68	1.78	-
CCR-5	12/19/2019	0.0000154	0.15	0.0025	0.00127	-	-	-	-	-	0.841	0.967	-
CCR-5	3/23/2020	0.00000575	0.2	0.0015	0.00127	-	-	-	-	-	0.73	1.72	-
CCR-5	6/15/2020	-	0.15	0.0019	0.00127	-	-	-	-	-	0.785	1.59	-
CCR-5	12/17/2020	-	0.029	0.002	0.00127	-	-	-	-	-	1.32	2.29	-
CCR-6	11/30/2015	<0.000005	<0.17	0.0048	0.069	-	-	-	-	-	4.1	5.06	-
CCR-6	1/21/2016	<0.000005	<0.68	<0.0125	0.0724	-	-	-	-	-	5.38	6.36	-
CCR-6	2/23/2016	<0.000005	<0.068	<0.0125	0.0656	-	-	-	-	-	3.9	4.68	-
CCR-6	3/23/2016	<0.000005	<0.068	<0.0125	0.0642	-	-	-	-	-	4.69	5.09	-
CCR-6	5/25/2016	<0.000005	<0.068	<0.0125	0.0468	-	-	-	-	-	3.02	8.52	-
CCR-6	7/27/2016	<0.000005	<0.17	<0.0125	0.0778	-	-	-	-	-	3.1	8.26	-
CCR-6	9/20/2016	0.0000233	<0.17	<0.0125	0.0239	-	-	-	-	-	4.39	8.43	-
CCR-6	11/8/2016	0.0000096	<0.17	<0.0125	0.0362	-	-	-	-	-	4.62	9.11	-
CCR-6	2/21/2017	<0.000005	<0.17	<0.0125	0.0397	-	-	-	-	-	2.35	7.37	-
CCR-6	4/18/2017	<0.000005	0.05	<0.0125	0.0381	-	-	-	-	-	3.53	7.3	-
CCR-6	6/22/2017	<0.000005	<0.17	<0.0125	0.035	-	-	-	-	-	<4.02	<4.56	-
CCR-6	10/11/2017	<0.000017	<0.17	-	0.0416	-	-	-	-	-	-	-	-
CCR-6	12/14/2017	-	-	-	-	-	-	-	-	-	-	-	-
CCR-6	3/26/2018	<0.000017	<0.17	<0.00014	0.0313	-	-	-	-	-	2.09	3.39	-
CCR-6	6/27/2018	-	<0.068	<0.00014	0.0368	-	-	-	-	-	2.78	4.72	-
CCR-6	12/4/2018	-	-	-	-	-	-	-	-	-	1.1	3.07	12.5
CCR-6	12/19/2018	-	<0.034	<0.00019	0.0252	-	-	-	-	-	2.77	5.57	-
CCR-6	2/20/2019	-	<0.17	<0.00019	0.0255	0.25396	1.5004	<0.05	-	0.03	3.08	3.35	-
CCR-6	3/25/2019	<0.00000575	<0.68	0.00054	<0.00127	-	-	-	-	-	2.19	3.37	-
CCR-6	6/17/2019	<0.00000575	<0.17	<0.00019	0.17434	-	-	-	-	-	3.31	2.76	-
CCR-6	9/26/2019	-	-	-	-	-	-	-	-	-	2.11	2.91	-
CCR-6	10/29/2019	0.00000575	0.17	0.0044	0.14994	0.96056	0.809	0.05	-	0.02	2.71	2.19	-
CCR-6	12/19/2019	0.00000575	0.17	<0.00022	0.15622	-	-	-	-	-	2.58	2.35	-
CCR-6	3/23/2020	0.00000575	0.16	<0.00022	0.17221	-	-	-	-	-	1.59	3.24	-
CCR-6	6/15/2020	-	0.073	0.00034	0.24489	-	-	-	-	-	1.86	2.33	-
CCR-6	8/18/2020	-	0.15	0.0011	0.26155	0.41904	0.75634	-	0.07	0.02	1.39	3.1	-
CCR-6	12/17/2020	-	0.073	<0.00022	0.10295	-	-	-	-	-	1.86	1.78	-
CCR-7	11/30/2015	<0.000005	0.1	0.003	<0.000944	-	-	-	-	-	1.54	1.78	-
CCR-7	1/21/2016	<0.000005	0.092	<0.0125	<0.000944	-	-	-	-	-	1.23	2.37	-
CCR-7	2/23/2016	<0.000005	0.079	<0.0125	<0.000944	-	-	-	-	-	1.99	1.08	-
CCR-7	3/23/2016	<0.000005	0.093	<0.0125	<0.000944	-	-	-	-	-	2.25	3.11	-
CCR-7	5/25/2016	<0.000005	0.07	<0.0125	<0.000944	-	-	-	-	-	0.74	1.96	-
CCR-7	7/27/2016	<0.000005	0.073	<0.0125	<0.005	-	-	-	-	-	1.36	3.18	-
CCR-7	9/20/2016	0.0000197	0.076	<0.0125	<0.005	-	-	-	-	-	1.93	3.19	-
CCR-7	11/8/2016	<0.000005	0.11	<0.0125	<0.000475	-	-	-	-	-	2.66	3.92	-
CCR-7	2/22/2017	<0.000005	0.088	<0.0125	<0.000475	-	-	-	-	-	<0.97	1.78	-

Appendix A: Groundwater Sample Data

Well ID	Sample Date	Mercury	Fluoride	Lithium	Molybdenum	Aluminum	Iron	Nitrate/Nitrite	Nitrate	Total Phosphorous	Radium-226	Radium-228	Gross Alpha
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	pCi/L	pCi/L
CCR-7	4/18/2017	<0.000005	0.11	<0.0125	<0.000475	-	-	-	-	-	4.94	4.03	-
CCR-7	6/22/2017	<0.000005	<0.17	<0.0125	<0.000475	-	-	-	-	-	<3.61	<3.07	-
CCR-7	10/11/2017	0.0000225	0.1	-	<0.000475	-	-	-	-	-	-	-	-
CCR-7	12/14/2017	-	<0.17	-	-	-	-	-	-	-	-	-	-
CCR-7	3/26/2018	<0.000017	<0.068	0.00048	<0.00127	-	-	-	-	-	2.31	1.28	-
CCR-7	6/27/2018	-	0.063	0.00061	<0.005	-	-	-	-	-	2.68	3.24	-
CCR-7	12/19/2018	-	0.045	0.00059	<0.00127	-	-	-	-	-	3.97	5.99	-
CCR-7	2/20/2019	-	<0.17	0.00068	<0.00127	6.0444	9.2617	<0.05	-	0.03	1.93	4.51	-
CCR-7	3/25/2019	<0.00000575	<0.17	<0.00019	0.0256	-	-	-	-	-	1.99	2.86	-
CCR-7	6/17/2019	<0.00000575	<0.17	0.00083	<0.00127	-	-	-	-	-	5.24	4.16	-
CCR-7	9/26/2019	-	-	-	-	-	-	-	-	-	3.1	4.74	-
CCR-7	10/29/2019	0.00000575	0.17	0.0044	0.00127	6.7963	11.3	0.05	-	0.02	4.68	3.21	-
CCR-7	12/19/2019	0.00000575	0.17	0.0008	0.00127	-	-	-	-	-	3.16	3.86	-
CCR-7	3/23/2020	0.00000575	0.1	0.00054	0.00127	-	-	-	-	-	2.88	5.19	-
CCR-7	6/15/2020	-	0.073	0.00072	0.00127	-	-	-	-	-	4.28	4.73	-
CCR-7	8/18/2020	-	0.15	0.0011	0.00127	6.5666	4.5587	-	0.05	0.02	3.79	4.34	-
CCR-7	12/17/2020	-	0.17	0.00059	0.00127	-	-	-	-	-	2.64	<0.889	-
MW-8	12/4/2018	-	-	-	-	-	-	-	-	-	<0.67	1.24	<2.21
MW-8	8/18/2020	-	0.18	0.0011	0.00127	0.2289	0.98806	-	0.05	0.19	0.324	1.14	-
MW-9	12/4/2018	-	-	-	-	-	-	-	-	-	1.07	<0.75	2.91
MW-9	8/18/2020	-	0.16	0.0021	0.00127	0.85892	1.3382	-	0.05	0.76	0.438	1.28	-
SW	2/20/2019	-	1	0.0035	0.0343	0.0583	0.25794	<0.05	-	0.09	0.74	<0.95	-

APPENDIX B

Groundwater Flow Model Technical Memorandum

TECHNICAL MEMORANDUM

DATE September 28, 2021 **Project No.** 19-124481

TO Jaclyn Vu
JEA

CC

FROM Howard Huang **EMAIL Howard_Huang@golder.com**

JEA – ST. JOHNS RIVER POWER PARK BYPRODUCT STORAGE AREA B GROUNDWATER MODEL

INTRODUCTION

The Byproduct Storage Area B (Site) is an ash landfill located at JEA's St. Johns River Power Park (SJRPP) facility in Jacksonville, Florida. The Site spans approximately 42 acres and is located between Clapboard Creek and Brown Island. The Site has been actively receiving coal ash since January 2009. Landfill closure construction is scheduled to be initiated in December 2020.

MODEL OBJECTIVE

Groundwater modeling was used to assist the evaluation of potential natural attenuation of the constituents of concerns released from the ash landfill into the surficial aquifer. The groundwater model was completed using MODFLOW-2005 for flow direction and magnitude and using MT3D-USGS for the solute dilution from advection and mechanical dispersion. The models use finite-difference approaches to approximate the partial-differential flow and solute transport equations and are based on flow through a three-dimensional array of cells. The graphic pre- and post-processor program, Groundwater Vistas Version 7 (Environmental Simulations, Inc.), was used to facilitate model input and output.

The groundwater flow model was developed to simulate the hydrogeological interactions among rainfall, adjacent water bodies, and various porous materials within the Site footprint. Following the model setup, the input parameters were calibrated to improve accuracy using the observed groundwater elevations. The solute transport model, simulating the diluting process in the aquifer over time, was constructed using the calibrated flow model and characteristics of the constituent of concerns. The model results were then used in a geochemical model to evaluate potential natural attenuation of the constituents of concerns.

GROUNDWATER FLOW MODEL SETUP (EXISTING CONDITIONS)

A steady-state flow model was constructed as a base model for calibration. The grid developed for the simulation consisted of three layers with 200 rows and 250 columns in each layer. The cell dimensions are 20 feet by 20 feet across the model domain. The total model domain covers approximately 20 million square feet (4,000 feet by 5,000 feet) and the active model cells covers approximately 15.2 million square feet (0.55-square mile).

A three-layer model was set up to match the general lithology of the site. The top elevations of the model were determined using as-built survey data to match existing topography. The bottom elevation of the model was set at -85 feet NAVD88, the estimated top elevation of the Hawthorn formation. Intermediate layer top/bottom elevations were generated in ArcGIS using geological boring data collected during the site investigation and imported into the model. The horizontal and vertical extents of the coal ash were delineated based on multiple surveys conducted at the Site.

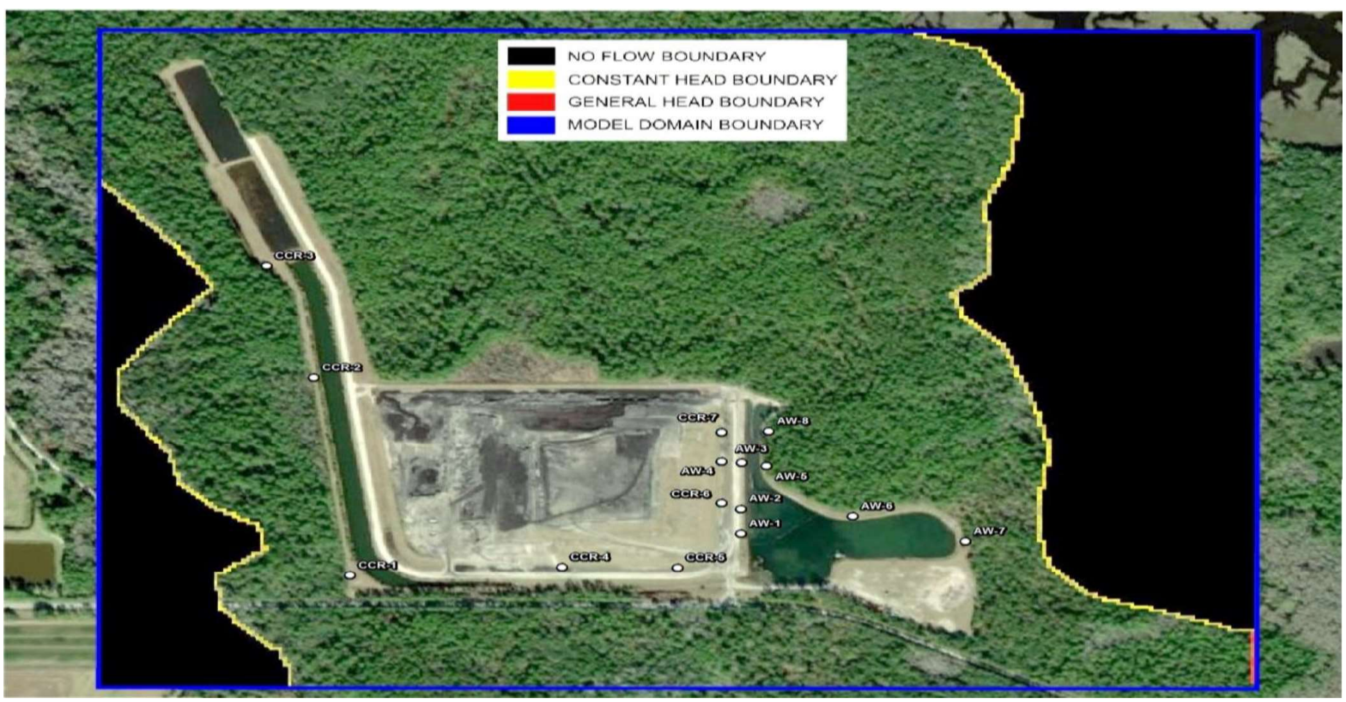
The porous materials in each layer are summarized in Table 1 below.

Table 1: Groundwater Model Layer Information

Layer ID	Porous Material
1	Coal ash or Fine Sand
2	Medium to Fine Sand
3	Coarse to Fine Sand with Silty Clay and Clayey Silt

Groundwater generally flows from west to east across the Site. Head boundaries, including general head boundaries (GHBs) and constant head boundaries (CHBs), were used along adjacent wetland boundaries to establish hydrogeological connectivity between surface water bodies and the Site. Head values between 2.0 feet NAVD88 and 2.5 feet NAVD88 were assigned to the eastern wetland boundaries to represent water levels near Clapboard Creek. Head values between 11.5 feet NAVD88 and 12.0 feet NAVD88 were assigned to the western wetland boundaries to represent water levels upgradient from the Site. Hydraulic conductivities and distances from the model boundary to the adjacent water bodies were used by GHBs to simulate the potentiometric surface gradients along the southeast corner of the Site. The model implicitly places no-flow boundaries at the bottom of the lowest layer. No-flow boundaries were also assigned to areas outside the GHBs and CHBs in each layer. The boundary conditions shown on Figure 1.

Figure 1: Boundary Conditions

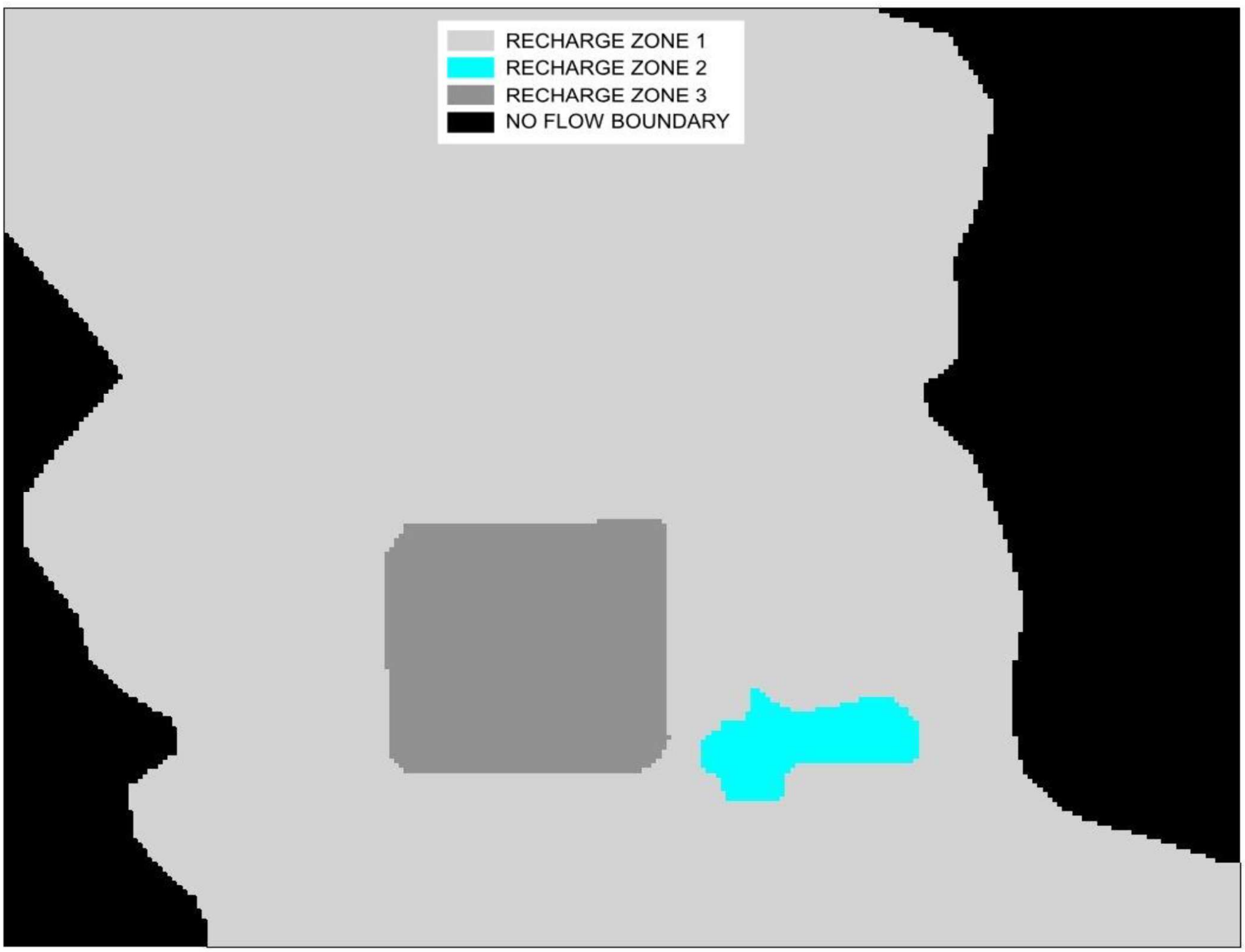


Model Input Parameters

Lateral hydraulic conductivities (Kx and Ky) and vertical hydraulic conductivity (Kz) were used to represent the hydraulic characteristics of the porous materials. The hydraulic conductivity input data used are based on the calculated values from the slug test analysis. A high conductivity value of 9999 feet per day was also assigned to the pond areas with standing water in layer 1.

The recharge package of MODFLOW was used to introduce the net gain of water into the porous materials resulting from precipitation infiltration and evapotranspiration. Three recharge zones were delineated based on the existing Site topography and are shown on Figure 2. Each recharge zone was assigned an estimated net recharge rate (the difference between recharge and evapotranspiration). Recharge in the landfill area was assumed to be low due to the Site grading and the low permeability of coal ash. The pond area east of the landfill was assumed to have a higher recharge rate considering that it receives stormwater runoff from the landfill. The input parameters were entered into the model using consistent units of feet and days.

Figure 2: Recharge Zones Existing



MODFLOW was run in steady-state mode to generate simulated groundwater potentiometric surfaces for all layers across the site.

Model Calibration

Groundwater elevations collected from monitoring event December 19, 2020 were used as head targets for model calibration. Calibration head target information is summarized in Table 2 and head target locations are shown in Figure 1.

Table 2: Head Target Values

Target ID	Head Value (feet NAVD88)	Layer	Northing	Easting
CCR-1	11.00	2	2221016.3	485450.1
CCR-2	10.97	2	2222219.7	485293
CCR-3	12.16	2	2222897.8	485087.8
CCR-4	10.01	2	2221065.3	486365.4
CCR-5	8.04	2	2221064.3	486865.4
CCR-6	7.05	2	2221456.0	487055.8
CCR-7	7.08	2	2221887.4	487053.8
AW-1	6.64	2	2221270.4	487137.1
AW-2	6.62	2	2221421.0	487138.7
AW-3	6.65	2	2221703.8	487140.9
AW-4	7.04	2	2221708.3	487053.4
AW-5	6.55	2	2221682.1	487249.3
AW-6	6.43	2	2221376.2	487621.7
AW-7	5.97	2	2221221.4	488106.8
AW-8	6.67	2	2221893.7	487258.4

Model error, scaled root mean square (RMS), was calculated by MODFLOW to indicate the deviation between the simulated head values and target head values. PEST, a built-in calibration tool in Groundwater Vistas Version 7, was used to adjust the hydraulic conductivity and recharge values and rerun the model until the scaled RMS was minimized. Slug testing data were used to keep the parameters within an acceptable range for the Site area. The calibrated input parameters are shown in the tables below.

Table 3: Calibrated Recharge Values

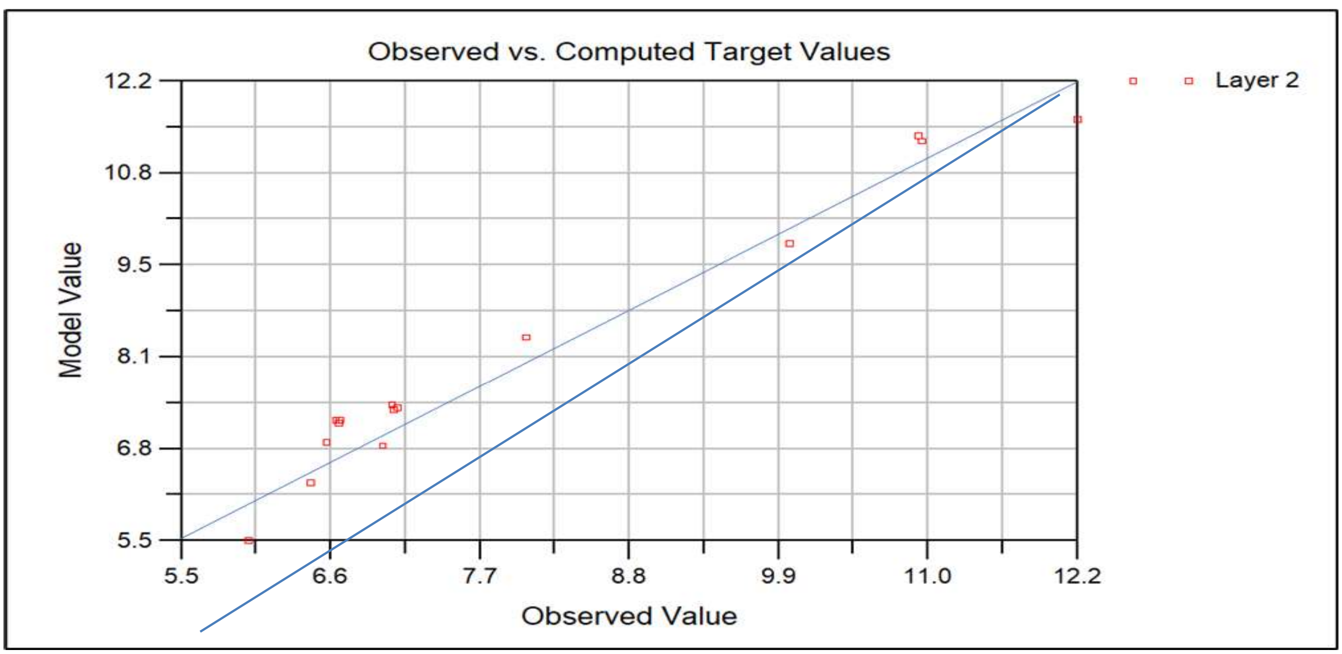
Recharge Zone	Recharge (feet per day)	Recharge (inches per year)
1	0.00187	8.19
2	0.00854	37.4
3	0.00108	4.73

Table 4: Calibrated Hydraulic Conductivity Values

Porous Material	Kx and Ky (feet per day)	Kz (feet per day)
Coal Ash	0.0399	0.0266
Fine Sand	21.3	14.2
Medium to Fine Sand	25.1	16.7
Coarse to Fine Sand with Silty Clay and Clayey Silt	1.40	0.693

The existing condition groundwater flow model was updated and reran using the prementioned calibrated input parameters. The scaled RMS error of the calibrated model is 0.066. Cell-by-cell flow function of MODFLOW was used to determine the flow quantities and directions within the Site area. The simulated head values and target head values are plotted in Figure 3 below.

Figure 3: Simulated Head Values vs. Target Head Values



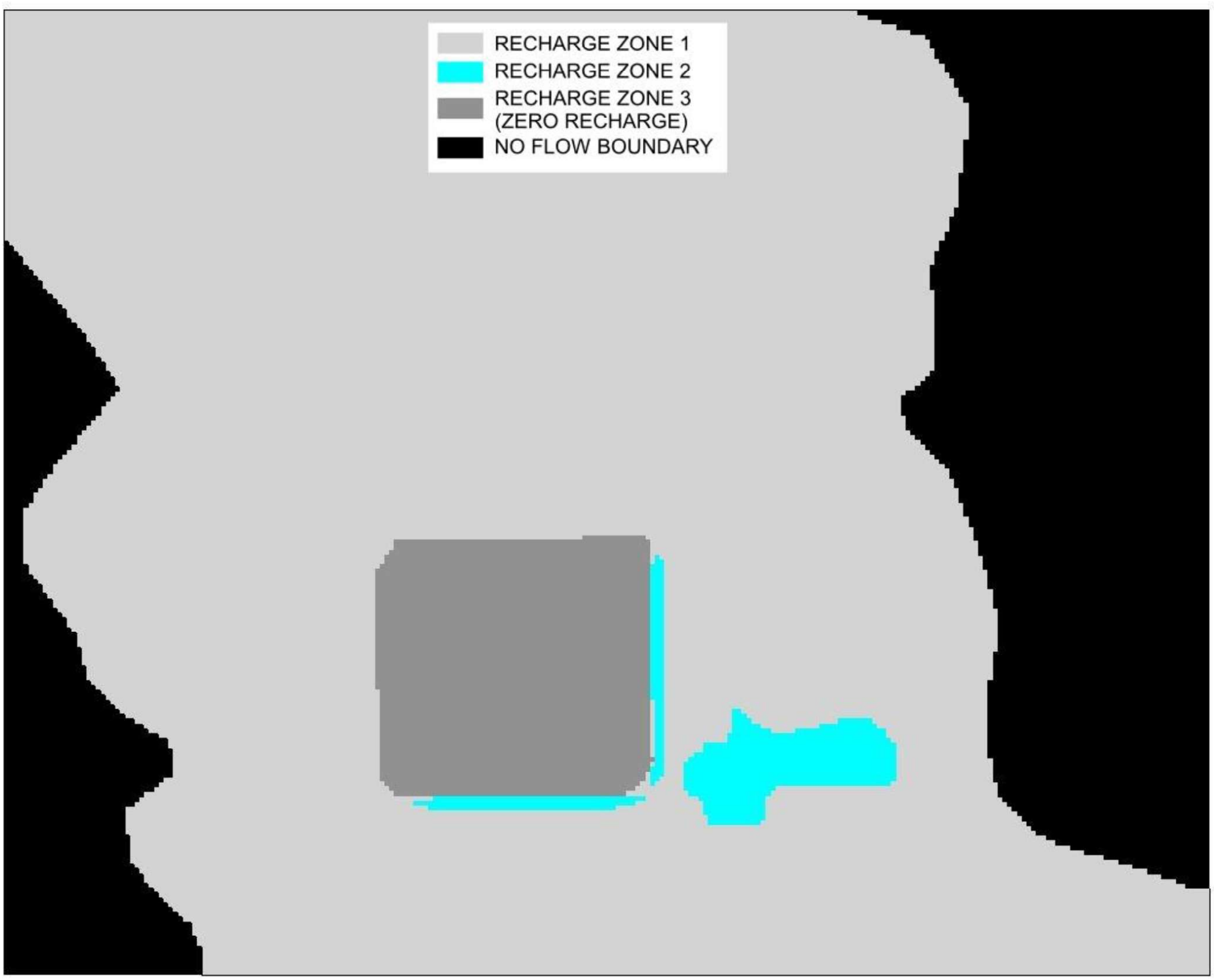
POST-CLOSURE GROUNDWATER FLOW MODEL

The ash landfill closure will be completed by installation of a final cover system, consisting of a 50 mil LLDPE liner with full stormwater and cover seepage controls, and a dedicated stormwater runoff routing and attenuation system. In order to simulate the groundwater potentiometric surfaces after completion of the landfill closure, the following modifications were made to the calibrated existing condition flow model:

- Top elevations of the landfill area were updated using the final cover system design grading.
- Recharge rates within the closed landfill area were adjusted to zero to represent the liner cover to be installed.
- Recharge rates within southern and eastern swales were increased to the calibrated recharge value for the eastern pond, considering the increased runoff contributed to the stormwater system.

The post-closure flow model was run in steady-state mode to determine flow direction and magnitude. The post-closure recharge zones are shown on Figure 4.

Figure 4: Recharge Zones Post-closure



SOLUTE TRANSPORT MODEL

The constituents of concern in groundwater will be diluted due to the following factors:

- Final cover system installed will stop the release of any constituents from the coal ash into the groundwater.
- Upgradient and adjacent clean groundwater will reduce the constituent concentrations through mixing by advection and mechanical dispersion.
- Infiltration of clean runoff from the stormwater system will add to the diluting process.

The MT3D solute transport model was constructed based on the post-closure flow model to simulate this dilution process. The geochemical factors (including adsorption, reaction, and molecular diffusion) were not considered in this model. Chloride was selected for the simulation due to its inert geochemical characteristic in groundwater. The latest available chloride concentrations were contoured in the ArcGIS system to generate the 2-D plume and the plume was introduced into the model as initial concentrations within layer 2 to be dissipated in the transient model simulation. The chloride concentrations are shown in Table 5 below.

Table 5: Chloride Concentration Values

Sample Location	Sample Date	Chloride Concentration (mg/L)
CCR-3	06/15/2020	33.9
CCR-4	06/15/2020	28.8
CCR-5	06/15/2020	266
CCR-6	06/15/2020	74.0
CCR-7	06/15/2020	289
AW-1	02/20/2019	312
AW-2	02/20/2019	197
AW-3	02/20/2019	270
AW-4	10/29/2019	291
AW-5	06/15/2020	128
AW-6	06/15/2020	50.1
AW-7	02/20/2019	46.7
AW-8	06/15/2020	62.5
AW-9	06/15/2020	53.2

MT3D was run in transient mode for 20 years to simulate the changes of chloride concentrations over time within the model domain. The time-series solute transport model results are used in a geochemical model to evaluate potential natural attenuation of the constituents of concern.

Chloride concentrations in layer 2 on day 2, day 1760 (4.8 years), day 5187 (14.2 years), and day 7300 (20 years) of the simulation are shown in the color flood figures below.

Figure 5: Chloride Concentrations Layer 2 Day 2

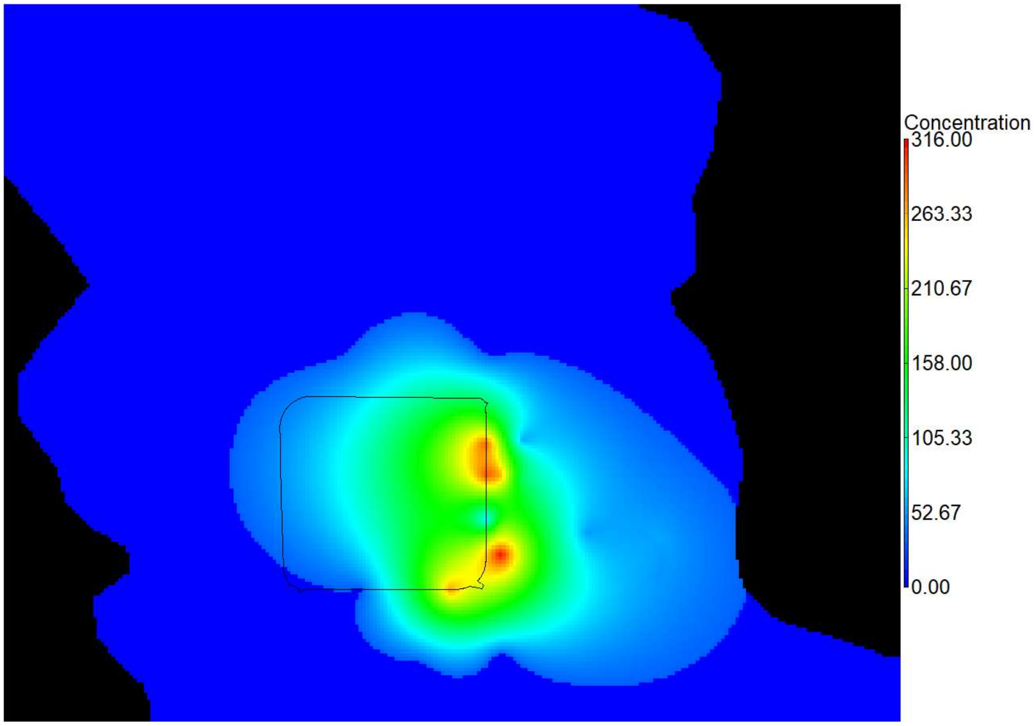


Figure 6: Chloride Concentrations Layer 2 Day 1760

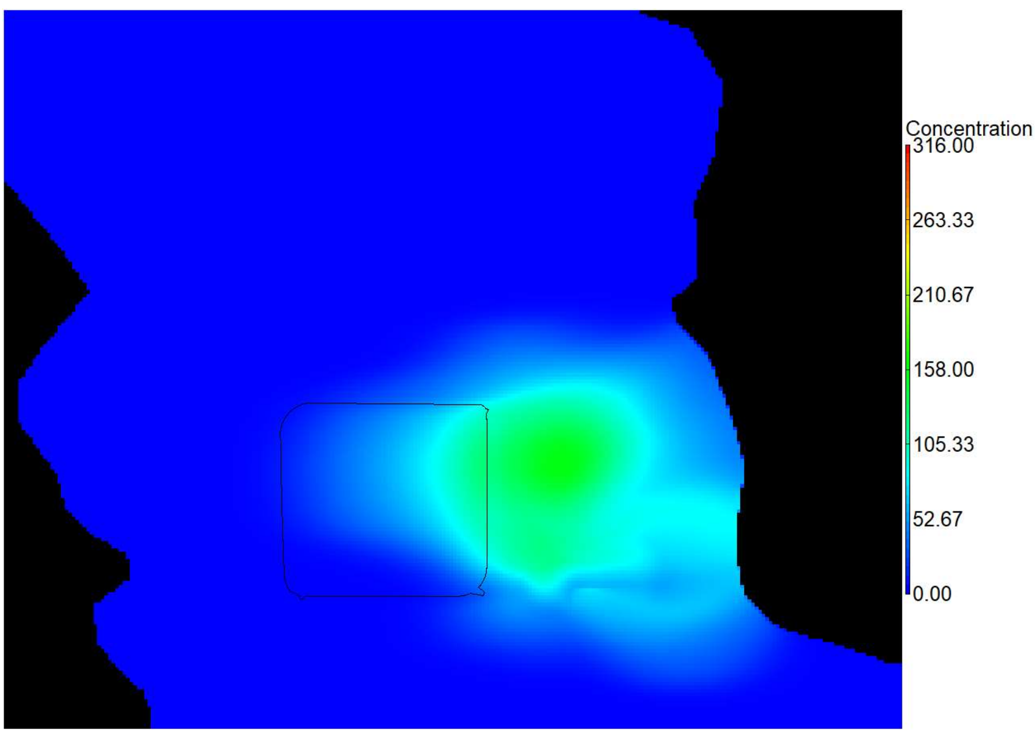


Figure 7: Chloride Concentrations Layer 2 Day 5187

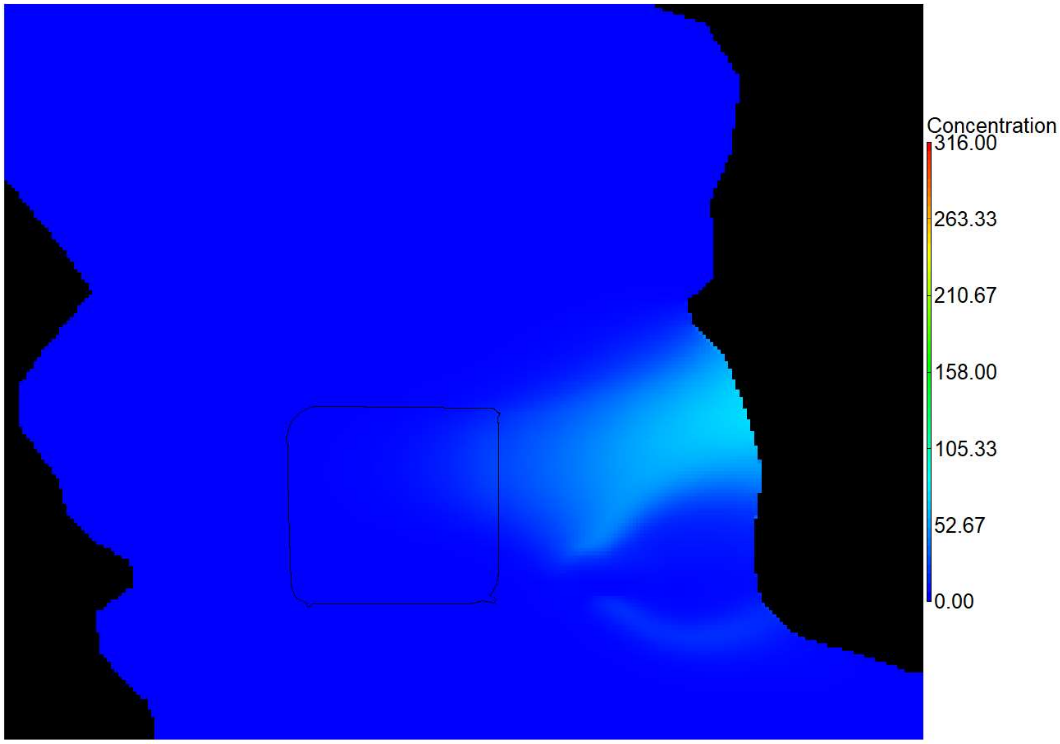
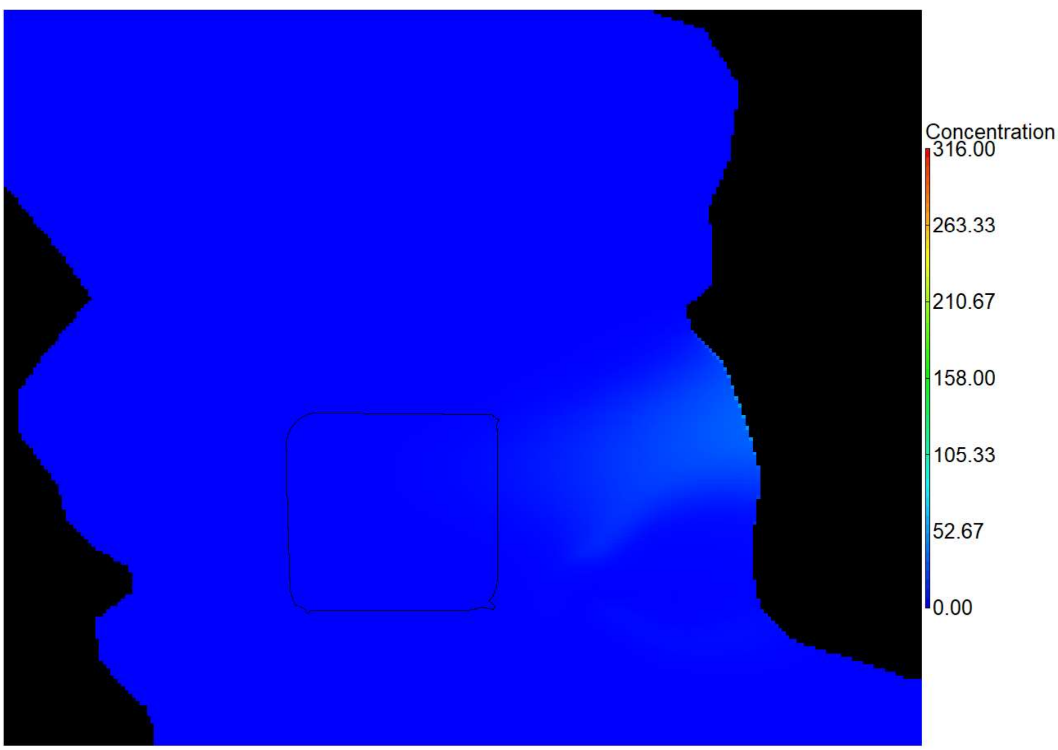


Figure 8: Chloride Concentrations Layer 2 Day 7300



https://golderassociates.sharepoint.com/sites/110243/Project Files/6 Deliverables/GW Model TM/SJRPP GW Model TM_FINAL.docx