



**Third Semiannual Report on the
Progress of Remedy Selection**

**TVA Johnsonville Fossil Plant,
New Johnsonville, Humphreys
County, Tennessee**

January 15, 2021

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.

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1.0 Introduction

In accordance with 40 CFR § 257.97(a), the Tennessee Valley Authority (TVA) has prepared this third semiannual report to document progress toward remedy selection and design at the Active Ash Pond 2 (CCR Unit) at the Johnsonville Fossil Plant (JOF) in New Johnsonville, Humphreys County, Tennessee.

1.1 Regulatory Background

On April 17, 2015, the United States Environmental Protection Agency (U.S. EPA) published a rule that sets forth national criteria for the management of coal combustion residuals (CCR) produced by electric utilities. The requirements can be found in Title 40, Code of Federal Regulations (CFR) Part 257, Subpart D. The rule includes requirements for monitoring groundwater and assessing corrective measures if constituents listed in Appendix IV to Part 257 of the rule are detected in groundwater samples collected from downgradient monitoring wells at statistically significant levels (SSLs) greater than established groundwater protection standards (GWPS).

In January 2019, TVA determined if there were SSLs over established GWPS as defined in 40 CFR § 257.95(h) for one or more Appendix IV constituents in accordance with 40 CFR § 257.95(g). At the CCR Unit, assessment monitoring in 2018 detected SSLs greater than the GWPS for cobalt at monitoring wells 10-AP3 and JOF-103. Since this time, TVA has updated the statistical analysis.

- In mid and late 2019, TVA updated the statistical analysis after incorporating additional groundwater monitoring data from the assessment monitoring events in 2019.
- In mid and late 2020, TVA updated the statistical analysis after incorporating results from the semiannual assessment monitoring events in 2020.

The same SSLs were observed at the same monitoring wells as previously identified. As of the date of this report, TVA has not demonstrated that a source other than the CCR Unit associated with wells 10-AP3 and JOF-103 caused the SSLs, as allowed under 40 CFR § 257.95(g)(3)(ii).

In accordance with 40 CFR § 257.96(a), TVA prepared the 2019 Assessment of Corrective Measures (ACM) Report for the CCR Unit at JOF, placed it in the facility operating record on July 15, 2019, and uploaded it to the TVA CCR Rule Compliance Data and Information website on August 14, 2019. The ACM Report provided an assessment of the effectiveness of potential corrective measures in achieving the criteria provided in 40 CFR § 257.96(c). Three primary strategies were evaluated to address groundwater exhibiting concentrations of cobalt above the GWPS:

- Monitored Natural Attenuation (MNA)
- Hydraulic Containment and Treatment
 - Physical Barriers
 - Pumping Systems
- Enhanced In-Situ Treatment (EIST)
 - Infiltration Galleries
 - Direct Injection

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- Permeable Reactive Barriers.

Following preparation of the ACM Report, TVA began the remedy selection process. Semiannual reports are required pursuant to 40 CFR § 257.97(a) to document progress toward remedy selection and design. The CCR Rule contemplates that more investigation and consideration may be needed to evaluate and design the remedy before making the final selection. TVA placed the first and second Semiannual Reports on the Progress of Remedy Selection into the facility operating record on January 15, and July 15, 2020, respectively, pursuant to 40 CFR § 257.97(a) and § 257.105(h)(12). TVA provided notification of the availability of the semiannual reports describing the progress in selecting and designing the remedy and placed them on the TVA CCR Rule Compliance Data and Information website on February 14, and August 14, 2020, respectively, in accordance with 40 CFR § 257.106(h)(9) and § 257.107(h)(9). TVA will continue to review new data as it becomes available and implement changes to the groundwater monitoring and corrective action program as necessary to maintain compliance with 40 CFR § 257.90 through § 257.98.

At least 30 days prior to final groundwater remedy selection pursuant to the CCR Rule, a public meeting will be held with interested and affected parties to discuss the results of the corrective measures assessment in accordance with 40 CFR § 257.96(e). The selected remedy must meet the requirements of 40 CFR § 257.97(b) and must consider the evaluation factors set forth in 40 CFR § 257.97(c). Once a final remedy is chosen, a final report describing the remedy and how it meets the standards set forth in 40 CFR § 257.97(b) will be prepared. The owner/operator must provide a schedule for implementing the selected remedy that considers the factors set forth in 40 CFR § 257.97(d).

1.2 Summary of State Required Investigation and Remedy Selection Process

With oversight from the Tennessee Department of Environment and Conservation (TDEC), TVA is currently conducting environmental investigations of the CCR disposal areas at JOF, including the Active Ash Pond 2 CCR Unit, in accordance with TDEC Commissioner's Order, OGC 15-0177 (TDEC Order). The TDEC Order sets forth the process by which TVA is investigating the site, will provide an assessment of the data to TDEC, and will present proposed corrective measures and remedies, including for groundwater, to TDEC for approval. More specifically, once TDEC determines that the environmental investigations are complete, TVA will submit an environmental assessment report (EAR) that provides an analysis of the extent of CCR impacts, including groundwater impacts, at JOF to TDEC for approval. Then, as part of the TDEC Order process, TVA will submit a Corrective Action/Risk Assessment (CARA) Plan that specifies all actions that TVA plans to take at the site, including corrective measures for groundwater remediation, to TDEC for approval. TDEC must approve the CARA Plan, including the CCR Unit closure methodology, selected final remedy(s) and corrective measures for groundwater remediation. The TDEC Order process includes a public comment period for the public to provide comments on the CARA Plan.

1.3 Report Contents

This third semiannual progress report provides a summary of JOF site characteristics, the groundwater assessment monitoring program, the findings of the ACM process, and the current progress of selecting and designing a final remedy for statistically significant GWPS exceedances.

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2.0 Site Background and Characteristics

JOF is located in New Johnsonville, Humphreys County, Tennessee. The facility lies on the eastern bank of the Tennessee River (Kentucky Lake). **Figure 1** shows an overview map of JOF including the CCR Unit. Construction of JOF began in 1949, and operations commenced in 1951. Coal-fired power generation ceased in December of 2017. The coal combustion process at JOF resulted in the production of fly ash and bottom ash. The plant most recently managed these materials in the Active Ash Pond 2 CCR Unit.

Active Ash Pond 2 encompasses approximately 90 acres and is surrounded by perimeter dikes with a height that ranges from approximately 25 to 35 feet. During plant operations, the CCR Unit received sluiced fly and bottom ash, plant effluent, and stormwater runoff pumped from the Coal Yard Drainage Basin. The last JOF coal-fired generating units were shut down in December 2017 and CCR discharges to the CCR Unit ceased. The CCR Unit will continue to receive non-CCR waste streams until new systems for handling these flows are completed. Thus, the CCR Unit is not closed.

2.1 Conceptual Site Model Summary

The hydrogeologic conceptual site model (CSM) is one of the primary tools that can be used to support decisions on corrective measures. This section of the report provides a summary of the hydrogeologic CSM. The geology and hydrogeology of the JOF site have been characterized during implementation of multiple investigations. These investigations provide a detailed understanding of site geology and the water-bearing zones.

The CCR Unit has two clay dikes, a hydraulic fill layer, and two foundation layers. The two clay dikes are the upper clay dike and the lower clay dike. The dikes and foundation layers are separated by a hydraulic fill layer. The upper clay dike has textural descriptions of lean clay, lean clay with sand and lean clay with gravel. Underlying the upper clay dike is the lower clay dike with textural descriptions ranging from lean clay to silt with sand and gravel in places. The hydraulic fill material underlies the lower clay dike and consists of clay, silt, sand and gravel. The uppermost foundation layer is encountered below the hydraulic fill material and is comprised of alluvial lean clay, lean clay with sand and gravel, silt, and silt with gravel. Beneath the alluvial clay and silt layer is the lower foundation layer consisting of alluvial sand and gravel. A typical cross-section view of the subsurface geology is shown on **Figure 2**. The groundwater flow direction is primarily west towards the Tennessee River. **Figure 3** presents a generalized groundwater flow direction map for JOF.

2.2 Potential Receptor Review

There are two public drinking water providers that use the Tennessee River as the source of drinking water in the vicinity of JOF. The town of New Johnsonville has a surface water intake on the east bank of the Tennessee River approximately 1.8 miles upstream of the JOF facility. The town of Camden also sources its drinking water from the Tennessee River, and based on the location of the Camden Water Plant, the intake is on the west bank of the Tennessee River upstream from JOF (approximately 0.45 miles). Upstream drinking water providers are not expected to be affected by the facility because of the direction of flow in the river. No downstream water providers using the Tennessee River as a source of drinking water were identified from immediately north of JOF to the border with Kentucky, approximately 37 miles downstream.

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Two identified private well locations are located south of JOF within a 1/2-mile radius from the center of the facility property on the south side of Highway 70. Based on their locations and the understanding of groundwater flow directions in this area, which is primarily west towards the river, these wells are either upgradient or cross-gradient of the facility or are located far enough from the facility that groundwater migration from the facility to the wells would be negligible.

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3.0 Groundwater Assessment Monitoring Program

Groundwater assessment monitoring for the CCR Unit is conducted at JOF in accordance with 40 CFR § 257.95.

3.1 Groundwater Monitoring Well System

In compliance with 40 CFR § 257.91, two background wells (B-9 and JOF-101) were installed upgradient and four monitoring wells (10-AP1, 10-AP3, JOF-103, and JOF-104) were installed downgradient of the CCR Unit. The locations of these monitoring wells are presented on **Figure 1**.

3.2 Groundwater Characterization

Groundwater assessment monitoring was conducted during 2018, 2019, and 2020, and at the time of this report, the second semiannual assessment monitoring event and retest event in 2020 had been conducted. The following Appendix IV constituent was detected at SSLs above a GWPS in 2018, 2019 and 2020:

- SSLs for cobalt were identified at monitoring wells 10-AP3 and JOF-103; and,
- The GWPS for cobalt is 6 µg/L.

Data from existing wells have been used to characterize the nature and extent of SSLs as required by 40 CFR § 257.95(g)(1). The targeted area for corrective measures to address the estimated extent of cobalt above GWPS along the unit perimeter is illustrated on **Figure 4**. The work being performed under the TDEC Order process will further refine this characterization and inform the evaluation and selection of the remedy(s) under 40 CFR § 257.97 of the CCR Rule.

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4.0 Assessment of Corrective Measures

TVA prepared the 2019 ACM Report for the CCR Unit and placed it in the operating record on July 15, 2019. The report was posted to the TVA CCR Rule Compliance Data and Information website on August 14, 2019. The ACM Report provided an assessment of the effectiveness of potential corrective measures in achieving the criteria provided in 40 CFR § 257.96(c).

4.1 Planned Source Control Measures

The objectives of corrective measures under 40 CFR § 257.96(a) are to “prevent further releases [from the CCR units], to remediate any releases, and to restore affected areas to original conditions.” Ultimately, in accordance with 40 CFR § 257.97(b)(3), the selected corrective measure must at a minimum “Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents of appendix IV to this part into the environment.”

The Preamble (80 Fed. Reg. 21302, 21406) to the CCR Rule discusses that source control measures may include modifying operational procedures. To comply with regulatory requirements and timeframes under the CCR Rule, TVA will close the CCR Unit. The method of final closure for the CCR Unit will be determined following the outcome of the TDEC Order process and will be in accordance with 40 CFR § 257.102.

Routing of the flows from the coal yard runoff pond, which includes process flows from the Johnsonville Combustion Turbine (CT) site, and the retired fossil plant station sumps to the CCR Unit continues. To comply with CCR Rule requirements and deadlines, an interim flow management (IFM) system has been constructed to handle flows from the coal yard runoff pond and the station sumps once the new Process Water Basin is fully operational to receive the process flows from the Johnsonville CT site. When the IFM system is fully operational, both process flows and station sump flows will be discontinued to the CCR Unit and the CCR Unit will be removed from service. Then the water level in the CCR Unit will be lowered. The coal yard and Active Ash Pond 2 will be closed upon completion of the TDEC Order process.

The initial process changes described above will reduce the potential for releases and migration of CCR constituents. Groundwater assessment monitoring as required by 40 CFR § 257.96(b) will continue until a remedy is selected. The monitoring will be conducted to track changes in groundwater conditions resulting from these closures and operational changes. Long term groundwater assessment monitoring is a component of the corrective measures implementation. These data will also be considered in the selection and design of a remedy in accordance with 40 CFR § 257.97.

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4.2 Potential Remedial Technologies

Subject to necessary environmental reviews, the CCR Unit will be closed in accordance with the TDEC Order and the criteria set forth in 40 CFR § 257.102.

In addition to source control measures, three primary strategies were evaluated to address groundwater exhibiting concentrations of cobalt above the GWPS including:

- MNA
- Hydraulic Containment and Treatment
 - Physical Barriers
 - Pumping Systems
- EIST
 - Infiltration Galleries
 - Direct Injection
 - PRB

The ACM Report provides a more detailed description of these corrective measures. The effectiveness of each potential corrective measure was assessed in accordance with 40 CFR § 257.96(c) and all measures are currently considered feasible for remediating the groundwater at the CCR Unit.

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5.0 Selection of Remedy: Current Progress

A remedy to address SSLs in groundwater will be selected in accordance with 40 CFR § 257.97. Upon selection of a remedy, the owner or operator must prepare a final report (i.e., Remedy Selection Report) describing the selected remedy and how it meets the standards specified below pursuant to 40 CFR § 257.97(b)(1)-(5). Remedies must:

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

In support of the remedy selection process, additional investigation is needed and is described below.

5.1 Data Requirements for Design of Groundwater Corrective Action

The characterization of the horizontal extent of cobalt impacts downgradient of the CCR Unit is being further refined by the environmental investigation required under the ongoing TDEC Order process. Additional data may be required to further refine the targeted area for corrective measures, develop remedial cost estimates, and finalize the alternative for the CCR Unit. It is noted that additional data collection requirements will include ongoing TDEC Order work that is reported separately.

Activities completed to further evaluate site conditions include:

- Completed installation of three additional monitoring wells on the west side of the coal yard. These monitoring wells will provide groundwater quality data hydraulically upgradient of the CCR Unit.
- Completed installation of three additional monitoring wells around former Ash Disposal Area 1, which is closed and not regulated as a CCR unit under the CCR Rule. These monitoring wells will provide groundwater quality data hydraulically upgradient of Active Ash Pond 2.
- Completed a dye trace study of the CCR Unit.
- Performed slug testing at 32 monitoring wells located on the dike surrounding the CCR Unit.
- Completed installation of five temporary monitoring wells at Active Ash Pond 2 and collected CCR material, pore water, and analyzed water levels within the CCR Unit.

Potential future activities to further evaluate MNA include:

- A geochemical investigation will be conducted to evaluate groundwater and aquifer solids east of the CCR Unit.

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- TVA will initiate geochemical modeling at the CCR Unit to determine the influence of native soils on groundwater chemistry. Furthermore, the geochemical modeling will aid in evaluating corrective measures. Geochemical processes operating in groundwater influence migration of Appendix IV constituents through adsorption, ion exchange, and potential mineral formation. The time frame of effectiveness and capacity of the native soil system to attenuate Appendix IV constituents will be evaluated using geochemical modeling.
- Numerical groundwater flow modeling may be conducted incorporating the additional groundwater elevation data gained from the ongoing environmental investigation and additional hydrogeologic characterization efforts under the TDEC Order process. This groundwater flow modeling effort would be used to further refine the understanding of groundwater flow direction and velocity.

If necessary, groundwater fate and transport modeling may be conducted to further evaluate the natural attenuation and constituent migration. The refined groundwater flow model would be used in conjunction with the fate and transport model.

Potential future activities to further evaluate hydraulic containment and treatment include:

- Groundwater Flow Modeling – The numerical groundwater flow model may be used to evaluate hydraulic containment, as appropriate. A calibrated groundwater model may be used to evaluate a variety of approaches (e.g., vertical wells, horizontal wells, physical barriers) and to estimate the groundwater extraction rates necessary to contain an identified target zone.
- Groundwater Treatability Study - For ex-situ treatment of extracted groundwater, treatability studies would be needed to evaluate technologies for the treatment of extracted groundwater.
- Supplemental Hydraulic Properties Evaluation – This evaluation could be necessary if the existing understanding of the hydraulic characteristics of the subsurface are not sufficient to evaluate hydraulic capture geometry and potential groundwater recovery rates. If needed, installation of new wells and performance of pumping tests to evaluate hydraulic capture geometry and potential groundwater recovery rates would be incorporated into the groundwater flow modeling simulations for groundwater extraction. These data would inform the feasibility, design, and implementation of any groundwater recovery systems.

Potential future activities to evaluate Enhanced In-situ Treatment include:

- Groundwater Treatability Study – For in-situ treatment of groundwater, bench-scale treatability studies may be conducted on representative groundwater samples prior to selecting a groundwater corrective measure.

5.2 Semiannual Reporting, Public Meeting, Remedy Selection and Final Report

Progress toward the selection and design of the remedy will be documented in semiannual reports in accordance with 40 CFR § 257.97(a). Semiannual reports will be placed into the facility operating record pursuant to 40 CFR § 257.105(h)(12). TVA will provide notifications of the availability of the semiannual reports describing the progress in selecting and designing the remedy and will place the reports on the TVA CCR Rule Compliance Data and Information website in accordance with 40 CFR § 257.106(h)(9) and § 257.107(h)(9) respectively 30 days after placement in the facility operating record. At least 30 days prior to selecting a remedy, a public meeting to discuss the results of the corrective measures assessment will be conducted as required by 40 CFR § 257.96(e).

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A final report will be prepared upon selection of the remedy. This final report will describe the remedy and how it meets the standards specified in 40 CFR § 257.97(b) and 257.97(c). Recordkeeping requirements specified in 40 CFR § 257.105(h), notification requirements specified in 40 CFR § 257.106(h), and internet requirements specified in 40 CFR § 257.107(h) will be complied with as required by 40 CFR § 257.96(f).

Attachments:

Figures

Figure 1 – CCR Unit with Background and Downgradient Wells

Figure 2 – Geological Cross-Section

Figure 3 – Groundwater Elevation Contour Map – September 8, 2020

Figure 4 – Monitoring Wells and Limits of Appendix IV Constituents Impacts

FIGURES



- Investigation Well (TDEC Order)
- Background Well (CCR Rule)
- Downgradient Well (CCR Rule)
- Geologic Cross Section Location
- ▭ CCR Unit Subject to CCR Rule
- ▭ TVA Property Boundary



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Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

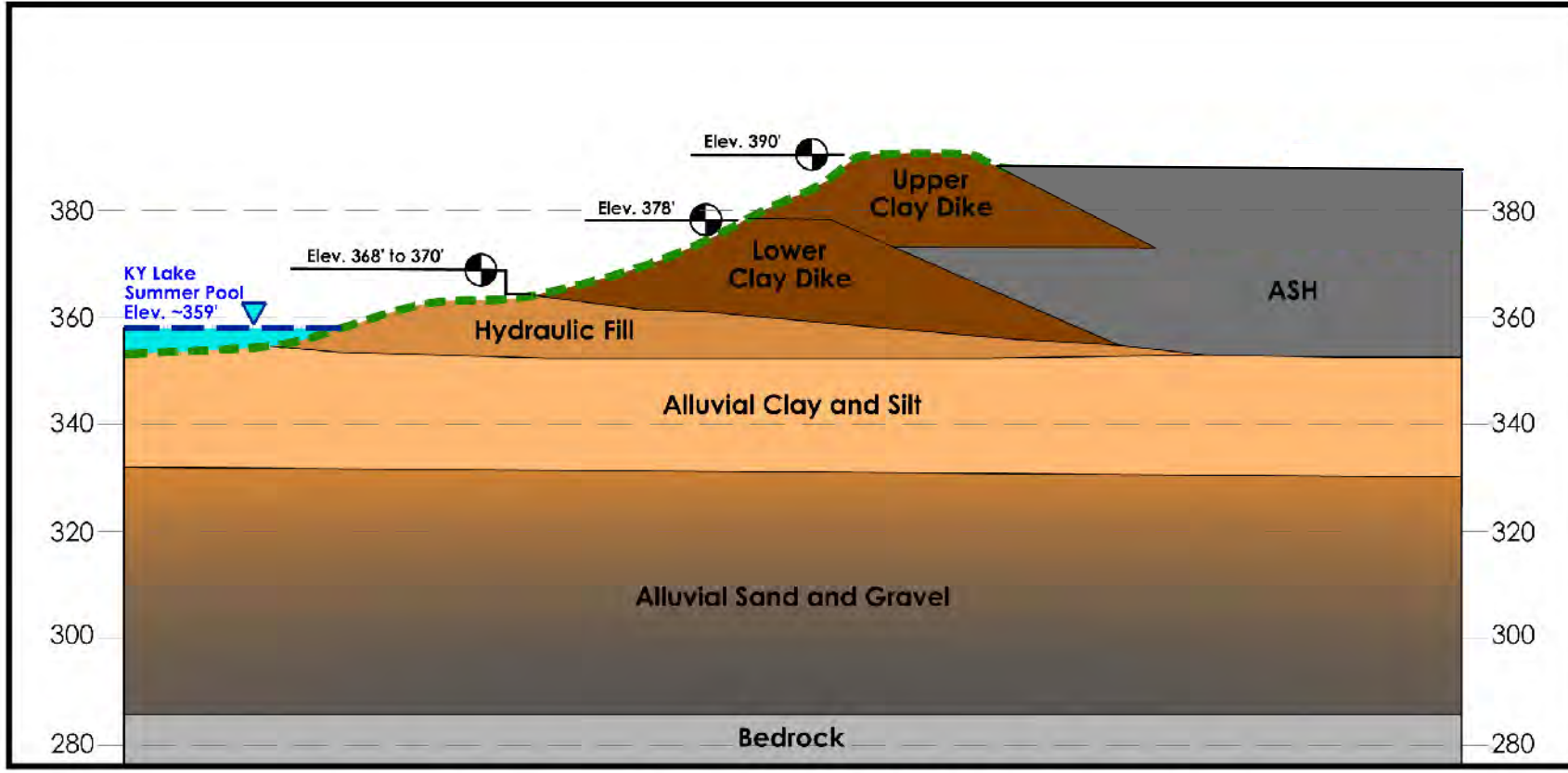
Project Location Prepared by DMB on 2021-01-04
 New Johnsonville Technical Review by MD on 2021-01-04
 Humphreys County, TN Independent Review by MD on 2021-01-04
Client/Project Tennessee Valley Authority
 Johnsonville Fossil Plant
 CCR Rule 182603597

Figure No.
Figure 1

Title
CCR Unit with Background and Downgradient Wells



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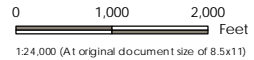
Project Location Prepared by DMB on 2020-11-24
 New Johnsonville Technical Review by MD on 2020-11-24
 Humphreys County, TN Independent Review by MD on 2020-11-24
Client/Project 182603597
 Tennessee Valley Authority
 Johnsonville Fossil Plant
 CCR Rule

Figure No. _____
Figure 2
 Title
Geologic Cross-Section





- CCR Network Well
- CCR Unit Subject to CCR Rule
- Groundwater Contour (5 foot interval)
- TVA Property Boundary
- Surface Water Flow Direction
- 2017 Imagery Boundary
- 2018 Imagery Boundary



- Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
 2. Base map: TVA (2017 and 2018-09-18) and Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
 3. The surface water elevation of the Tennessee River was 355.60 ft amsl on September 8, 2020.



CCR: Coal combustion residuals

Project Location 182603597
 New Johnsonville Prepared by WSW on 2021-01-11
 Humphreys County, Technical Review by MD on 2021-01-11
 Tennessee Independent Review by JK on 2021-01-11

Client/Project
 Tennessee Valley Authority
 Johnsonville Fossil Plant
 CCR Rule

Figure No.
 Figure 3

Title
 Groundwater Elevation Contour Map
 September 8, 2020



- Investigation Well (TDEC Order)
- ▲ Staff Gauge
- Background Well (CCR Rule)
- Downgradient Well (CCR Rule)
- CCR Unit Subject to CCR Rule
- TVA Property Boundary
- ▨ Potential Cobalt Treatment Zone



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Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Project Location
 New Johnsonville
 Humphreys County, TN

Prepared by DMB on 2021-01-04
 Technical Review by MD on 2021-01-04
 Independent Review by MD on 2021-01-04

Client/Project
 Tennessee Valley Authority
 Johnsonville Fossil Plant
 CCR Rule

182603597

Figure No.

Figure 4

Title
**Monitoring Wells and
 Limits of COI Impacts**

