

**2022 Annual Groundwater  
Monitoring and Corrective  
Action Report**



Tennessee Valley Authority  
Kingston Fossil Plant Stilling Pond  
CCR Unit

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# 2022 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT

TVA Kingston Fossil Plant Stilling Pond CCR Unit

January 31, 2023

In accordance with 40 § CFR 257.90(e) of the Disposal of Coal Combustion Residuals from Electric Utilities final rule (CCR Rule), this 2022 Annual Groundwater Monitoring and Corrective Action Report (2022 Annual Report) documents 2022 groundwater monitoring activities at the Tennessee Valley Authority (TVA) Kingston Fossil Plant (KIF) Stilling Pond CCR Unit. This CCR Unit is an inactive CCR surface impoundment (i.e., vacatur unit) under the CCR Rule and is subject to the deadlines set forth in 40 CFR § 257.100.

## OVERVIEW

An overview of the status of the groundwater monitoring and corrective action program for the Stilling Pond CCR Unit is provided below in accordance with 40 CFR § 257.90(e)(6).

- At the start and end of the current 2022 annual reporting period, the Stilling Pond CCR Unit was operating under an assessment monitoring program in accordance with 40 CFR § 257.95. The assessment monitoring program for the Stilling Pond CCR Unit was initiated on January 14, 2020.
- Constituents listed in Appendix III with statistically significant increases (SSIs) over background and the names of the monitoring wells are summarized in Table 1.
- During the 2020 assessment monitoring events, statistically significant levels (SSLs) above the groundwater protection standard (GWPS) for cobalt were observed at monitoring wells 6AR, KIF-103, and KIF-104. As a result, an assessment of corrective measures was initiated for the Stilling Pond CCR Unit on October 12, 2020 and was completed on January 8, 2021.
- During the 2021 assessment monitoring events, SSLs above the GWPS for cobalt were observed at monitoring wells 6AR, KIF-103 and KIF-104.
- During the 2022 assessment monitoring events, no new SSLs were identified, and the SSLs for cobalt were at the same monitoring wells identified during the 2020 and 2021 assessment monitoring events.
- As a final remedy has not been selected for the Stilling Pond CCR Unit pursuant to 40 CFR § 257.97, Semiannual Reports on the Progress of Remedy Selection were prepared and placed in the operating record on January 7, 2022 and July 8, 2022, in accordance with 40 CFR § 257.97(a) and § 257.105(h)(12) to document the progress made toward selection and design of the remedy.
- Since a remedy has not been selected pursuant to 40 CFR § 257.97, remedial activities have not been initiated for the Stilling Pond pursuant to 40 CFR § 257.98 during the current 2022 annual reporting period discussed herein.

## 2022 AND PROJECTED 2023 GROUNDWATER MONITORING ACTIVITIES

TVA has established a groundwater monitoring system and program at the KIF Stilling Pond CCR Unit in accordance with 40 CFR § 257.91. The groundwater monitoring system was certified by a qualified Professional Engineer as required by 40 CFR § 257.91(f). During 2022, TVA performed the following groundwater monitoring activities:

## 2022 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT

TVA Kingston Fossil Plant Stilling Pond CCR Unit

January 31, 2023

- Completed the statistical evaluation of the 2021 second semiannual assessment monitoring data for Appendix IV constituents in accordance with 40 CFR § 257.95(g) in January 2022 and determined that there were statistically significant levels over the GWPS for cobalt at monitoring wells 6AR, KIF-103, and KIF-104.
- Prepared and placed in the operating record Semiannual Reports on the Progress of Remedy Selection on January 7, 2022 and July 8, 2022 in accordance with 40 CFR § 257.97(a) to document the progress made toward selection and design of the remedy.
- Sampled wells in the certified groundwater monitoring system and analyzed samples for CCR constituents (Appendix III and Appendix IV constituents) for the 2022 semiannual assessment monitoring events in accordance with 40 CFR § 257.95(d)(1).
- Placed the sampling results in the operating record as required by 40 CFR § 257.95(d)(1) and 257.105(h)(6). Additionally, these results are included in Table 2 of this 2022 Annual Report in accordance with 40 CFR § 257.95(d)(3).
- Evaluated whether one or more Appendix IV constituents are detected at SSLs above the established GWPS in accordance with 40 CFR § 257.95(g).
- Placed notification of the statistical exceedances of established GWPS in the facility operating record in accordance with 40 CFR § 257.95(g) and 257.105(h)(8); provided notification to the State of Tennessee in accordance with 40 CFR § 257.106(h)(6); and placed notification on the CCR Compliance Data and Information website (<https://www.tva.com/environment/environmental-stewardship/coal-combustion-residuals/kingston>) in accordance with 40 CFR § 257.107(h)(6).
- Performed field and desktop site characterization investigations to improve the KIF Conceptual Site Model (CSM).
- Continued TVA's third-party Quality Assurance Program to evaluate groundwater analytical data using best practices concerning field methods and validation techniques, and application of appropriate statistical methods.
- Reviewed new data as it became available to maintain compliance with 40 CFR § 257.90 through 257.98.
- Complied with recordkeeping requirements as 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).

No problems were encountered during the 2022 Groundwater Quality Monitoring Program; therefore, no additional action has been recommended, except for the planned key activities for 2023 that are outlined below.

# 2022 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT

TVA Kingston Fossil Plant Stilling Pond CCR Unit

January 31, 2023

The projected key activities for 2023 reporting period are:

- Continue semiannual assessment monitoring at the certified groundwater monitoring system consistent with 40 CFR § 257.95 and place the sampling results in the operating record as required by 40 CFR § 257.95(d)(1) and 257.105(h)(6).
- Evaluate whether one or more Appendix IV constituents are detected at SSLs above the established GWPS in accordance with 40 CFR § 257.95(g).
- Place notification of statistical exceedances of GWPS in the facility operating record in accordance with 40 CFR § 257.95(g) and 257.105(h)(8); provide notification to the State of Tennessee in accordance with 40 CFR § 257.106(h)(6); and place notification on the CCR Rule Compliance Data and Information website (<https://www.tva.com/environment/environmental-stewardship/coal-combustion-residuals/kingston>) in accordance with 40 CFR § 257.107(h)(6).
- Perform further field and desktop site characterization investigations to improve the KIF CSM.
- Continue to work toward selection and design of the groundwater remedy. Until a remedy is selected, Semiannual Reports on the Progress of Remedy Selection will be prepared and placed in the operating record in accordance with 40 CFR § 257.97(a) to document the progress made toward selection and design of the remedy.
- Continue TVA's third-party Quality Assurance Program to evaluate groundwater analytical data using best practices concerning field methods and validation techniques, and application of appropriate statistical methods.
- Review new data as it becomes available and implement changes to the groundwater monitoring program as necessary to maintain compliance with 40 CFR § 257.90 through 257.98.
- Comply with recordkeeping requirements as 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).

## GROUNDWATER MONITORING SYSTEM

The certified groundwater monitoring system for the KIF Stilling Pond CCR Unit consists of one background well (AD-1) and three downgradient wells (6AR, KIF-103, and KIF-104). Figure 1 is an aerial photograph that shows the groundwater monitoring well locations. The groundwater monitoring system was designed for a single CCR Unit (Stilling Pond).

No monitoring wells in the certified groundwater monitoring system were installed or decommissioned during the 2022 reporting period. The certification of the groundwater monitoring system required under 40 CFR § 257.91(f) is included in the facility operating record and on the TVA CCR Rule Compliance Data and Information website: (<https://www.tva.com/environment/environmental-stewardship/coal-combustion-residuals/kingston>).

# 2022 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT

TVA Kingston Fossil Plant Stilling Pond CCR Unit

January 31, 2023

## GROUNDWATER SAMPLING AND LABORATORY ANALYTICAL TESTING

A groundwater sampling and analysis program was developed and includes procedures and techniques for sample collection, sample preservation and shipment, analytical procedures, chain-of-custody control, and quality assurance and quality control (QA/QC) required by 40 CFR § 257.93(a). The groundwater monitoring program includes sampling and analysis procedures designed to provide monitoring results that are an accurate representation of groundwater quality at background and downgradient wells.

The 2022 assessment monitoring groundwater sampling was conducted between February and September 2022, and the results are summarized in Table 2. Two semiannual assessment monitoring groundwater sampling events were each followed by retesting groundwater sampling events. A summary of groundwater sample locations, well designations, analytes sampled, sampling dates and monitoring program status is provided in Table 3.

Groundwater elevations were measured in each monitoring well immediately prior to purging as required by 40 CFR § 257.93(c). Groundwater elevations for monitoring wells in the certified monitoring system and Emory River surface water elevations are summarized in Table 4.<sup>1</sup> Groundwater flow directions were estimated for each sampling event, and a depiction of groundwater flow direction for the September 19, 2022 event<sup>2</sup> is illustrated on Figure 2. In general, groundwater flow at the KIF Stilling Pond CCR Unit is influenced by the Emory River to the east and intake channel to the south of the CCR Unit. The primary groundwater flow direction from the CCR unit is to the southeast towards the Emory River and the intake channel.

Testing for hydraulic conductivity in the uppermost aquifer at the background and downgradient monitoring wells, as summarized in Table 5, was estimated during a recent hydrogeological evaluation (TVA, 2019). Testing data indicated that the uppermost saturated zone has a geometric mean hydraulic conductivity of  $7.0 \times 10^{-5}$  centimeters per second (cm/sec). Linear groundwater flow velocity was calculated for the uppermost aquifer using:

- The geometric mean hydraulic conductivity calculated from hydraulic testing
- Horizontal hydraulic gradients calculated during the implementation of the groundwater sampling and analysis program, ranging from 0.0198 to 0.0249 feet per foot, and
- An effective porosity of 27% (TVA, 2005).

The average linear flow velocity in the uppermost aquifer ranges from approximately 5.3 to 6.7 feet per year. The rate and direction of groundwater flow for each groundwater sampling event is summarized in Table 6 in accordance with 40 CFR § 257.93(c).

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<sup>1</sup> Groundwater elevations were collected at additional monitoring wells during each sampling event and are summarized in Table A-1 in Appendix A.

<sup>2</sup> Groundwater flow direction maps for the February, March, August, and September 2022 sampling events are included in Appendix B.

# 2022 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT

TVA Kingston Fossil Plant Stilling Pond CCR Unit

January 31, 2023

## STATISTICAL ANALYSIS OF GROUNDWATER DATA

The groundwater monitoring data for the 2022 assessment monitoring and retest events were evaluated using statistical procedures as required by 40 CFR § 257.93(f) through 257.93(h). The statistical method certification is included in the facility operating record and the TVA CCR Rule Compliance Data and Information website. GWPS were established in accordance with 40 CFR § 257.95(h), as the larger of published regulatory limits or screening criteria (e.g., maximum contaminant levels (MCLs) and upper tolerance limits (UTLs) derived from background). Maximum contaminant levels may or may not be considered the appropriate GWPS depending on background well concentrations for each Appendix IV<sup>3</sup> constituent.<sup>4</sup> The 2022 Statistical Analysis Report is included in Appendix C.

The sampling results used to identify potential GWPS statistical exceedances were obtained during four monitoring events that were performed between February and September of 2022.<sup>5</sup> Comparisons were made against a fixed GWPS via a confidence interval band. Retesting was conducted after each semiannual sampling event and none of the individual compliance point measurements were directly compared against the GWPS. The Appendix IV monitoring data collected in 2019 through 2022 were used to construct the confidence interval bands. Cross-sections of each confidence interval band were then compared to the GWPS for the most recent assessment monitoring event in each case for the purpose of identifying any SSLs. A well-constituent pair is considered out of compliance only if its average constituent levels, as estimated via the confidence interval cross-section, currently exceed the GWPS.

## NARRATIVE DISCUSSION OF ANY TRANSITION BETWEEN MONITORING PROGRAMS

An Assessment Monitoring Program was established on January 14, 2020 and implemented as specified in 40 CFR § 257.95. The notification of the establishment of the assessment monitoring program was placed in the operating record on February 13, 2020 in accordance with 40 CFR § 257.105(h)(5). Notification of the assessment monitoring program was provided to the State of Tennessee on March 16, 2020 and placed on the CCR Rule Compliance Data and Information website (<https://www.tva.com/environment/environmental-stewardship/coal-combustion-residuals/kingston>) in accordance with 40 CFR § 257.106(h)(4) and 40 CFR § 257.107(h)(4), respectively.

In accordance with assessment monitoring program requirements, subsequent sampling and analysis of

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<sup>3</sup> Appendix IV CCR Constituents: antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, fluoride, lead, lithium, mercury, molybdenum, selenium, thallium, and radium 226 and radium 228 combined

<sup>4</sup> USEPA has published MCLs or alternate regulatory limits for each of the Appendix IV constituents. Consequently, in most cases the groundwater protection standard is equal to the MCL. However, there may be cases where background levels of a constituent exceed the MCL. In these instances, an alternate groundwater protection standard must be derived from on-site background levels. On July 30, 2018, EPA provided alternate regulatory limits (i.e., potential GWPS) for four of the Appendix IV chemical Constituents of Interest (COIs) for which the agency has not assigned MCLs to date. In the absence of MCLs or site-specific GWPS, those may be used in place of background levels under 40 CFR § 257.95(h)(2). Specifically, those alternate COIs include threshold values at the following health-based levels: 1.) Cobalt - 6 µg/L; 2.) Lithium - 40 µg/L; 3.) Molybdenum – 100 µg/L; and 4.) Lead - 15 µg/L.

<sup>5</sup> The CCR rule requires a minimum of two semiannual sampling events per well once the required background data has been obtained. In 2022, two assessment monitoring events were each followed by retesting groundwater sampling events.

## **2022 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT**

TVA Kingston Fossil Plant Stilling Pond CCR Unit

January 31, 2023

wells in the certified monitoring system for Appendix III and IV constituents occurred in accordance with 40 CFR § 257.95(d)(1). Appendix III and IV constituent concentrations from 2022 assessment monitoring are summarized in Table 2. GWPS were established in accordance with 40 CFR § 257.95(d)(2) and are summarized along with Appendix IV SSLs in Table 7. Evaluations of whether there were SSLs over established GWPS for one or more Appendix IV constituents were completed in accordance with 40 CFR § 257.95(g). During the 2022 semiannual assessment monitoring, three cobalt-related SSLs were recorded at monitoring wells 6AR, KIF-103 and KIF-104. These are the same SSLs at the same wells as were previously identified during 2020 and 2021 assessment monitoring. TVA will continue to review new data as it becomes available and implement changes to the groundwater monitoring program as necessary to maintain compliance with 40 CFR § 257.90 through 257.98.

# 2022 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT

TVA Kingston Fossil Plant Stilling Pond CCR Unit

January 31, 2023

## LIMITATIONS

This document entitled 2022 Annual Groundwater Monitoring and Corrective Action Report was prepared by Stantec Consulting Services Inc. ("Stantec") for the Tennessee Valley Authority (the "Client"). The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec relied upon data and information supplied to it by the client.



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# 2022 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT

TVA Kingston Fossil Plant Stilling Pond CCR Unit

January 31, 2023

## References:

TVA, Kingston Fossil Plant, 2005. Peninsular Site, Hydrogeological Evaluation of Coal-Combustion Byproduct Disposal Facility WR2005-1-36-133. October 2005.

TVA, Kingston Fossil Plant, 2019. Annual Groundwater Monitoring and Corrective Action Report. August 2019.

## Attachments:

Figure 1 - CCR Unit Background and Downgradient Wells

Figure 2 - Potentiometric Map September 19, 2022

Table 1 - Summary of Appendix III Constituent Statistically Significant Increases

Table 2 - Assessment Monitoring Groundwater Sampling Results

Table 3 - Groundwater Sampling Summary

Table 4 - Groundwater and Surface Water Elevation Summary

Table 5 - Hydraulic Conductivity Data Summary

Table 6 - Rate and Direction of Groundwater Flow Summary

Table 7 – Appendix IV Constituent Statistically Significant Levels Above GWPS

Appendix A - Groundwater and Surface Water Elevation Summary - Additional Monitoring Wells

Appendix B - Groundwater Potentiometric Maps

Appendix C - 2022 Statistical Analysis Report

## **FIGURES**

## **TABLES**

**APPENDIX A  
GROUNDWATER AND SURFACE WATER  
ELEVATION SUMMARY – ADDITIONAL  
MONITORING WELLS**

**APPENDIX B**  
**GROUNDWATER POTENTIOMETRIC MAPS**

**APPENDIX C**  
**2022 STATISTICAL ANALYSIS REPORT**