



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

**TVA Cumberland Fossil Plant,  
Stilling Pond (Including Retention  
Pond) CCR Unit, Cumberland  
City, Stewart County, Tennessee**

January 15, 2020

Prepared for:

Tennessee Valley Authority  
Chattanooga, Tennessee

Prepared by:

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## **1.0 Introduction**

In accordance with 40 CFR § 257.97(a), the Tennessee Valley Authority (TVA) has prepared this semiannual report to document progress toward remedy selection and design at the Stilling Pond (including Retention Pond) (also referred to herein as CCR Unit) at the Cumberland Fossil Plant (CUF) in Cumberland City, Stewart 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 of the rule are detected in groundwater samples collected from downgradient monitoring wells at statistically significant levels (SSL) greater than established groundwater protection standards (GWPS).

In January 2019, TVA completed an evaluation of whether 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 CUF CCR unit, assessment monitoring in 2018 detected SSLs greater than the GWPS for arsenic at monitoring well CUF-206. TVA recalculated the statistical analysis in mid-2019 after incorporating additional groundwater monitoring data from the first assessment monitoring event and retest event. In late-2019, TVA updated the statistical analysis after incorporating results from the second semiannual assessment monitoring event. The same SSL was observed at the same monitoring well as previously identified. As of the date of this report, TVA has not completed a demonstration that a source other than the CCR Unit associated with well CUF-206 caused the SSL, 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 CUF, placed it in the facility operating record on July 15, 2019 and uploaded it to the public 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 arsenic above the GWPS:

- Monitored Natural Attenuation (MNA);
- Hydraulic Containment and Treatment; and,
- Enhanced In-Situ Treatment (EIST).

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 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.

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At least 30 days prior to when the final remedy is selected, 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**

TVA is currently conducting environmental investigations of the CCR disposal areas at CUF, including the Stilling Pond (including Retention Pond), under the oversight of the Tennessee Department of Environment and Conservation (TDEC) through the TDEC Commissioner's Order, OGC 15-0177 (TDEC Order), issued on August 6, 2015. Once the environmental investigation (EI) is complete, TVA will submit environmental assessment reports (EARs) that provide an analysis of the extent of CCR contamination, including groundwater contamination, at CUF to TDEC for approval. Then, as part of the TDEC Order process, TVA will submit Corrective Action/Risk Assessment (CARA) Plans that specify actions that TVA plans to take at a site, including corrective measures for groundwater remediation, to TDEC for approval. TDEC must approve the CARA Plans, including the CCR unit closure methodologies, selected final remedy(s) and corrective measures for groundwater remediation.

**1.3 Report Contents**

This first semiannual progress report provides a summary of CUF 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 GWPS exceedances.

## 2.0 Site Background and Characteristics

CUF is located in Cumberland City, Stewart County, Tennessee. The facility lies on the south bank of Cumberland River and adjacent to Wells Creek. **Figure 1** shows an overview map of CUF including the Stilling Pond (including Retention Pond). Construction of CUF began in 1968 and operations commenced in 1972. CUF currently continues to operate as a coal-fired power generation facility. The coal combustion process at CUF has resulted in the production of fly ash, bottom ash, and gypsum.

### 2.1 Conceptual Site Model Summary

CUF is located within the Wells Creek Basin, which is a meteor impact structure. The subsurface geology at CUF is characterized by two hydro-stratigraphic units which includes the alluvium and bedrock. The alluvium can be further differentiated into alluvial silts and clays and alluvial sands and gravels. The CUF site overlies eight, bedrock formations that primarily consist of limestone, dolomite or shale. The alluvial sand and gravel is considered the upper-most aquifer and groundwater from this hydro-stratigraphic unit is monitored in accordance with 40 CFR § 257.91. A typical cross-section view of the subsurface geology is shown on **Figure 2**.

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 CUF site have been characterized during implementation of multiple investigations. These investigations provide an understanding of site geology and the presence of water-bearing zones in which groundwater and potential contaminants would be present and potentially migrating. Groundwater flow direction at the CCR Unit is generally to the west toward Wells Creek. **Figure 3** presents a groundwater flow direction map for CUF.

### 2.2 Potential Receptor Review

The two largest public water suppliers in Stewart County are the Dover Water Department and the North Stewart Utility District (CDC, 2019). The Dover Water Department withdraws its drinking water from the Cumberland River. The Dover water treatment plant is located approximately 14.4 miles downstream of CUF. The North Stewart Utility District withdraws its water from the Brandon Spring, which is within the Cumberland River, is located approximately 20 miles downstream of CUF. The City of Erin Water Department provides potable water to Cumberland City and the survey area. The City of Erin water supply is sourced from the Cumberland River at its confluence with Yellow Creek (approximately 3.7 miles northeast (upstream) of CUF Plant).

## 3.0 Groundwater Assessment Monitoring Program

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

### 3.1 Groundwater Monitoring Well Network

In compliance with 40 CFR § 257.91, two background wells (CUF-201 and CUF-202) were established and four monitoring wells (CUF-205, CUF-206, CUF-207 and CUF-208) were installed downgradient and within the containment dikes 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 and 2019. Arsenic, an Appendix IV constituent, was detected at SSLs above a GWPS. The following summarizes the 2018 and 2019 Appendix IV SSLs at the CUF CCR Unit.

- Arsenic
  - SSLs for arsenic were identified at monitoring well CUF-206 in 2018 and 2019;
  - The GWPS for arsenic is 10 µg/L.

Data from existing CCR network wells has been utilized to characterize the nature and extent of releases from the CCR Unit as required by 40 CFR 257.95(g)(1). The potential treatment zone to address the extent of arsenic above GWPS along the unit perimeter is illustrated on **Figure 4**. Under the CCR Rule, work is being performed and additional wells are being installed that will further inform the evaluation and selection of the remedy(s) under 40 CFR 257.97 of the CCR Rule (reference **Figure 5**).

## **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 “[c]ontrol 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 achieve TVA’s commitment to convert from wet to dry handling of CCR and to comply with regulatory requirements and timeframes under the CCR Rule, TVA will close the CCR Unit. The final closure method for the CCR Unit at CUF will be determined based on the outcome the TDEC Order EI and will be in accordance with 40 CFR § 257.102. Closing of the CCR Unit will limit water infiltration through the CCR and reduce further releases.

Closure of the Stilling Pond (Including Retention Pond) cannot be completed until a temporary, lined process water basin (PWB) is installed. A temporary lined PWB is being constructed within a portion of the CCR Unit so that flows can be rerouted to the temporary PWB and a portion of the unit will be closed by removal. The temporary PWB will be removed and the remaining portion of the Retention Pond (over which the temporary PWB was constructed) will be closed by removal or closed in place depending upon the outcome of the TDEC Order process.

Section 4.2 of the ACM Report describes the plan for closing CCR units at CUF. The initial closure methods described above will reduce the potential for releases and migration of CCR constituents. Subsequent groundwater assessment monitoring will be conducted to track changes in groundwater conditions as a result of these closures and operational changes. These data will also be considered in the selection and design of a remedy in accordance with 40 CFR § 257.97.

Groundwater assessment monitoring as required by 40 CFR § 257.96(b) will continue until a final remedy is selected.

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**4.2 Potential Remedial Technologies**

Subject to all necessary environmental reviews, the CCR Unit will be closed in accordance with the requirements set forth in 40 CFR § 257.102.

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

- Monitored Natural Attenuation (MNA);
- Hydraulic Containment and Treatment; and,
- Enhanced In-situ Treatment (EIST).

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 are currently considered feasible for remediating the groundwater at the CCR Unit.

## 5.0 Selection of Remedy: Current Progress

A remedy to address the arsenic SSL in groundwater will be selected in accordance with 40 CFR § 257.97 and the CARA Plan required by the TDEC Order.

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

To further refine the targeted area for corrective measures, develop remedial cost estimates and finalize the alternative for the Stilling Pond (including Retention Pond), the currently available site-specific data may require additional refinement to address potential data gaps. The characterization of the horizontal extent of arsenic downgradient of the CCR Unit further refined by the investigation required under the ongoing TDEC Order work.

Current and future activities to further evaluate site conditions:

- One temporary monitoring well is tentatively scheduled to be installed on the dike separating the Stilling Pond from the Retention Pond. Both CCR material and pore water have been collected for analysis and the temporary well is being used to analyze water level response within the CCR Unit.
- Two additional monitoring wells will be installed north and west of well CUF-206 to delineate dissolve arsenic concentrations in groundwater and characterize conditions closer to the facility boundary (reference **Figure 5**).
- Slug testing will be performed at the new well locations surrounding the Stilling Pond (including Retention Pond) to further characterize hydraulic conductivity.

Potential future activities to further evaluate MNA:

- A geochemical investigation will be conducted to evaluate groundwater, pore water and aquifer solids proximal to the Stilling Pond (including Retention Pond).
- Supplemental Groundwater Flow Modeling Simulations – The existing groundwater flow model developed for the EI is currently being refined based on expanded groundwater elevation data gained from the ongoing EI and additional hydrogeologic characterization efforts.
- Supplemental Groundwater Fate and Transport Modeling Simulations – The refined groundwater flow model will first be calibrated to more recent existing conditions before groundwater fate and transport modeling can be performed. Fate and transport modeling is expected to start in the second quarter of 2020 following completion of the above groundwater flow simulations. The fate and transport model will be used to further evaluate the estimated time for natural attenuation mechanisms to reduce the arsenic concentrations to below GWPS.

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Potential future activities to further evaluate hydraulic containment and treatment:

- Supplemental Groundwater Flow Modeling Simulations – The existing groundwater flow model developed for the EI is currently being refined based on expanded groundwater elevation data gained from the ongoing EI and additional hydrogeologic characterization efforts. These flow model refinements will incorporate several groundwater extraction scenarios to optimize hydraulic containment of arsenic-impacted groundwater while balancing extracted groundwater treatment requirements.
- Wastewater Treatment Capacity Study – Evaluation of either the existing on-site wastewater treatment system's capacity or a to-be-built wastewater treatment system's capacity are needed to understand options for extracted groundwater treatment should the hydraulic containment and treatment option be considered.
- Groundwater Treatability Study - For ex-situ treatment of extracted groundwater, treatability studies will be needed to evaluate technologies for the treatment of arsenic.
- Supplemental Hydraulic Properties Evaluation – This evaluation could be necessary if the existing understanding of the hydraulic characteristics of the subsurface is 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 feed back into the groundwater flow modeling simulations for groundwater extraction. This data would inform the feasibility, design, and implementation of any groundwater recovery systems.

Potential future activities to evaluate Enhanced In-situ Treatment:

- 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 for implementation to address arsenic concentrations.

## **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). 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). A final report will be prepared after the remedy is selected. 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).

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**Attachments:**

**Figures**

Figure 1 – Map with CCR Unit Background and Downgradient Wells

Figure 2 – Conceptual Cross-Section of Stilling Pond (including Retention Pond)

Figure 3 – Generalized Groundwater Flow Direction Map

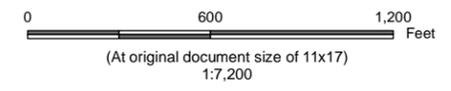
Figure 4 – Monitoring Wells and Limits of Constituents of Interest (COI) Impacts

Figure 5 – Location of Existing Monitoring Well CUF-206 and Proposed Soil Boring/Monitoring Well Locations



- Legend**
- Background Well
  - Downgradient Well
  - TVA Property Boundary
  - CCR Unit Area (Approximate)

**Notes**  
 1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet  
 2. Background: TVA Imagery flown by Tuck Mapping (c. 2017)



**Project Location**  
 Stewart County, Tennessee

Prepared by MB on 2020-01-13  
 Technical Review by MD on 2020-01-13

**Client/Project**  
 Tennessee Valley Authority  
 Cumberland Fossil Plant

182603538

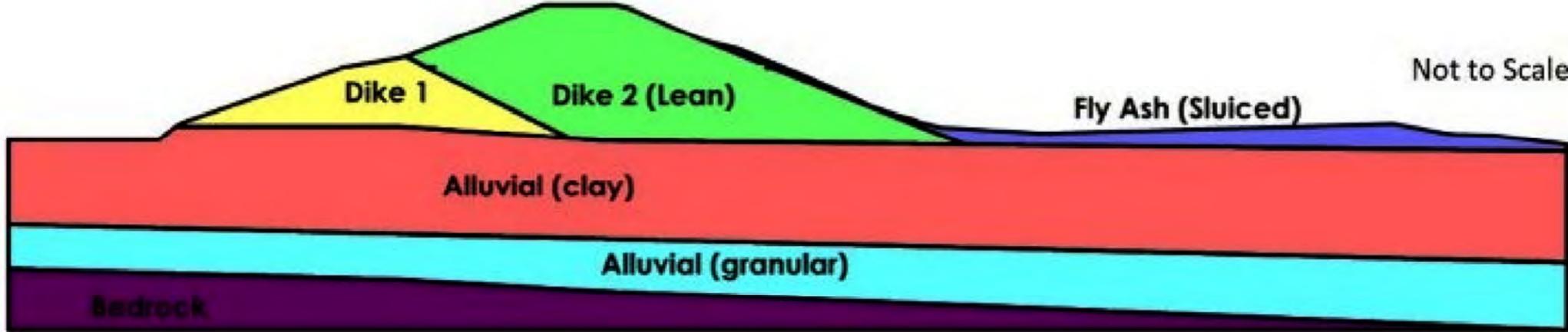
**Figure No.**  
 1

**Title**  
 Map with CCR Unit Background and  
 Downgradient Monitoring Wells

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# Characterization of subsurface at Stilling Pond:

Material Type	Unit Weight	Cohesion	Friction Angle
Dike 1 (Lean Clay)	123 pcf	200 psf	22 °
Dike 2 (Lean Clay)	123 pcf	200 psf	32 °
Fly Ash (Sluiced)	100 pcf	0 psf	22 °
Alluvial Clay	124 pcf	200 psf	33 °
Alluvial Granular	130 pcf	0 psf	32 °
Bedrock			



Typical section through NW dike  
 Source: Report of Geotechnical Exploration and Slope Stability Evaluation – Ash Pond,  
 Stantec 2010

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Legend

(At original document size of 11x17)  
 Image Not To Scale

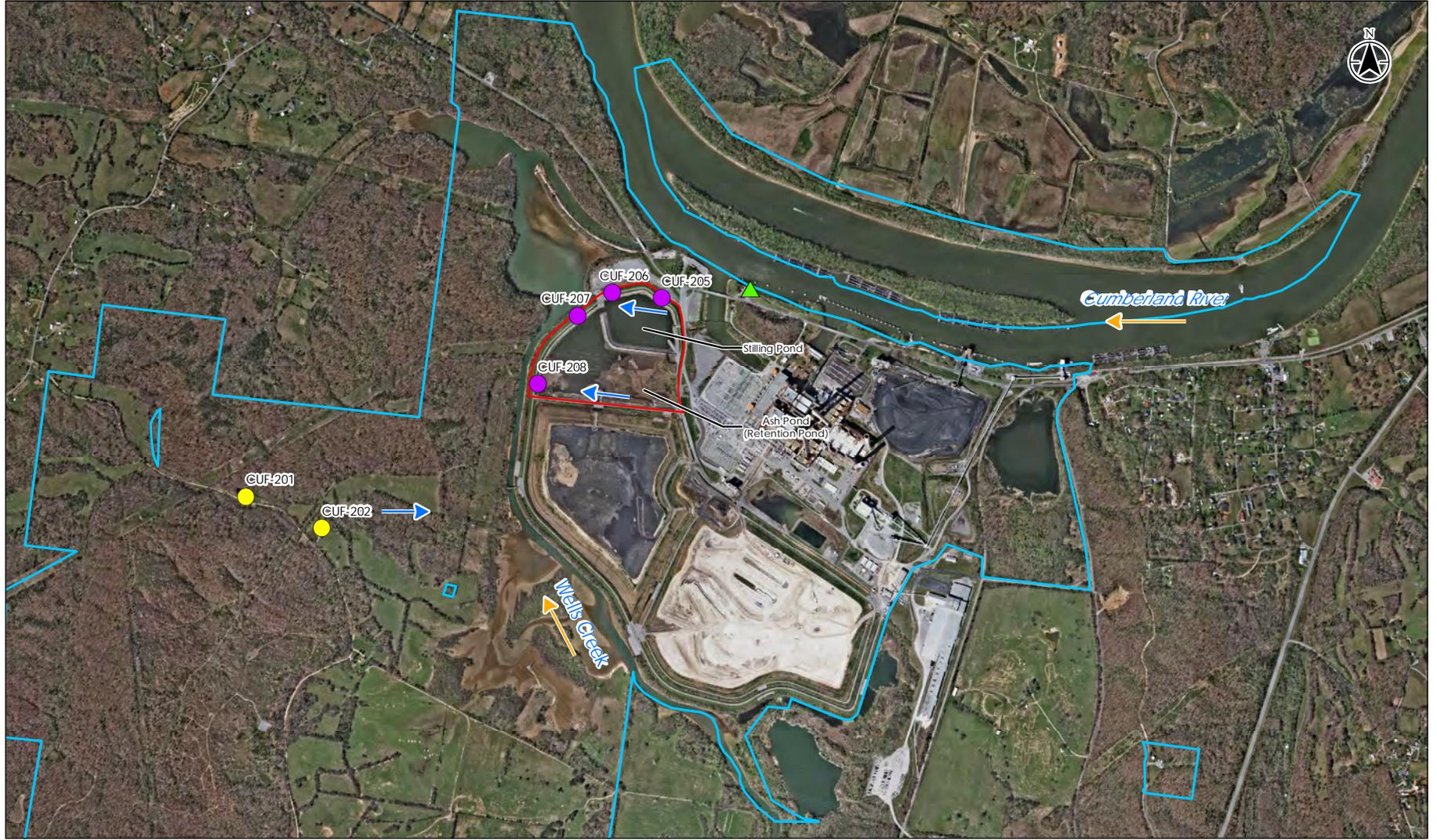


**Project Location**  
 Stewart County, Tennessee

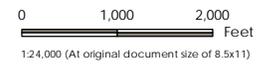
**Client/Project**  
 Tennessee Valley Authority  
 Cumberland Fossil Plant

**Figure No.**  
 2

**Title**  
 Conceptual Cross-Section of Stilling Pond  
 (including Retention Pond)



- ▲ Staff Gauge
- Background Well
- Downgradient Well
- Groundwater Flow Direction
- CCR Unit Subject to CCR Rule
- TVA Property Boundary



Notes  
 1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet  
 2. Imagery Source: Tucker Mapping Solutions, INC (Flown April 8, 2017)

Project Location  
 Cumberland City  
 Stewart County,  
 Tennessee  
 Prepared by CMB on 2020-01-13  
 Technical Review by WSW on 2020-01-13  
 Independent Review by MD on 2020-01-13

Client/Project  
 Tennessee Valley Authority  
 Cumberland Fossil Plant  
 CCR Rule

Figure No.  
**3**



Title  
 Generalized Groundwater  
 Flow Direction Map

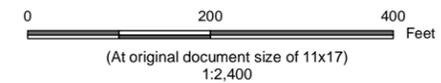
Groundwater flow directions are based on groundwater elevations from CCR and Non-CCR monitoring wells.

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.



- Legend**
- Downgradient Well
  - TVA Property Boundary
  - CCR Unit Area (Approximate)
  - Potential Arsenic Treatment Zone

**Notes**  
 1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet  
 2. Background: TVA Imagery flown by Tuck Mapping (c. 2017)



*Project Location*  
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Prepared by MB on 2020-01-13  
 Technical Review by MD on 2020-01-13

*Client/Project*  
 Tennessee Valley Authority  
 Cumberland Fossil Plant

182603538

*Figure No.*  
**4**

*Title*  
**Monitoring Wells and Limits of  
 Constituents of Interest (COI) Impacts**

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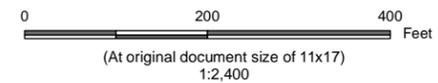


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- Legend**
- Downgradient Well
  - Proposed Soil Boring/Monitoring Well
  - TVA Property Boundary
  - CCR Unit Area (Approximate)

**Notes**  
 1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet  
 2. Background: TVA Imagery flown by Tuck Mapping (c. 2017)



*Project Location*  
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Prepared by MB on 2020-01-13  
 Technical Review by MD on 2020-01-13

*Client/Project*  
 Tennessee Valley Authority  
 Cumberland Fossil Plant

182603538

*Figure No.*  
**5**

*Title*  
**Location of Existing Monitoring Well  
 CUF-206 and Proposed Soil Boring/  
 Monitoring Well Location**