



**Fifth Semiannual Report on the  
Progress of Remedy Selection  
Stilling Pond (Including Retention  
Pond) CCR Unit  
TVA Cumberland Fossil Plant  
Cumberland City, Stewart  
County, Tennessee**

January 14, 2022

Prepared for:

Tennessee Valley Authority  
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.

# **Fifth Semiannual Report on the Progress of Remedy Selection TVA Cumberland Fossil Plant, Cumberland City, Stewart County, Tennessee**

**January 14, 2022**

## **1.0 Introduction**

In accordance with Title 40 Code of Federal Regulations (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) (CCR Unit) at the Cumberland Fossil Plant (CUF) in Cumberland City, Stewart County, Tennessee. This CCR Unit is also known as the Main Ash Pond.

### **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, 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 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 arsenic at monitoring well CUF-206. 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 2019 assessment monitoring events.
- In mid and late 2020, TVA updated the statistical analysis after incorporating results from the 2020 assessment monitoring events.
- In mid and late 2021, TVA updated the statistical analysis after incorporating results from the 2021 assessment monitoring events.

The same SSL was observed at the same monitoring well as previously identified. As of the date of this report, TVA has not demonstrated 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 TVA CCR Rule Compliance Data and Information website on August 14, 2019. The ACM Report provided an assessment of the effectiveness of corrective measures in accordance with 40 CFR § 257.96(c).

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Three primary strategies were evaluated to address groundwater exhibiting concentrations of arsenic above the GWPS:

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

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 prior Semiannual Reports on the Progress of Remedy Selection into the facility operating record 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 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 Unit at CUF in accordance with TDEC Commissioner's Order, OGC, 15-0177 (TDEC Order). The TDEC Order sets forth the process by which TVA will investigate 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

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(EAR) that provides an analysis of the extent of CCR impacts, including groundwater impacts, at CUF to TDEC for approval. Then, as part of the TDEC Order process, TVA will submit a Corrective Action/Risk Assessment (CARA) Plan to TDEC for approval. The CARA Plan will specify actions that TVA plans to take at the site, including corrective measures for groundwater remediation. TDEC must approve the CARA Plan, including the closure methodology for the CCR Unit and corrective measures for groundwater remediation. The TDEC Order process includes a public comment period for the CARA Plan.

### **1.3 Report Contents**

This 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 statistically significant GWPS exceedances.

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## 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 CCR Unit. Construction of CUF began in 1968 and operations commenced in 1972 and continues to operate as a coal-fired power generation facility to the present. The coal combustion process at CUF has resulted in the production of fly ash, bottom ash, and gypsum.

The CCR Unit encompassed approximately 56 acres and impounded approximately 819,000 cubic yards (CY) of water with 1,077,000 CY of storage remaining (Stantec, 2016a; Stantec 2018a). The Stilling Pond was previously used for: (1) detention for stormwater runoff from the Gypsum Storage Area and Dry Ash Stack, process water from the Bottom Ash Pond, and effluent from various other plant operations and sumps, and (2) discharge of flow to the Cumberland River via the Condensing Cooling Water Discharge Channel. A temporary lined basin (TLB) has been constructed to facilitate draw down and closure of the CCR Unit. The CCR Unit stopped receiving flows on April 11, 2021 and has since been drawn down.

### 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 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.

CUF is located within the Wells Creek Basin, which is a meteor impact structure. The subsurface geology is characterized by two hydro-stratigraphic units that includes both the alluvium and the bedrock. The alluvium can be further differentiated into alluvial silts and clays and alluvial sands and gravels. The CUF CCR Unit overlies eight bedrock formations that primarily consist of limestone, dolomite and shale. The alluvial sand and gravel are 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**. Groundwater flow direction at the CCR Units is generally toward Wells Creek. **Figure 3** presents a groundwater flow direction map for CUF using groundwater data collected on August 16, 2021.

### 2.2 Potential Receptor Review

The largest public water suppliers in Stewart County are the Dover Water Department and the North Stewart Utility District, and the City of Erin Water Department provides water to Cumberland City. The Dover Water Department withdraws its water from the Cumberland River. The Dover water treatment plant intake 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 and is located approximately 20 miles downstream of CUF. The City of Erin Water Department water supply is sourced from the Cumberland River at its confluence with Yellow Creek approximately 3.7 miles northeast (upstream) of CUF Plant.

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### **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 System**

In compliance with 40 CFR § 257.91, two background (CUF-201 and CUF-202) and four downgradient monitoring wells (CUF-205, CUF-206, CUF-207 and CUF-208) were installed and comprise the certified groundwater monitoring system for 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, 2020, and 2021. The following Appendix IV constituent was detected at SSLs above the GWPS in 2018, 2019, 2020, and 2021:

- Arsenic
  - An SSL for arsenic was identified at monitoring well CUF-206
  - The GWPS for arsenic is 0.01 mg/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 monitoring well with arsenic above the GWPS is illustrated on **Figure 4**. Under the CCR Rule, an additional well, CUF-218, has been installed that will further inform the evaluation and selection of the remedy(s) under 40 CFR § 257.97 and is discussed further in Section 5.1.

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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 corrective measures in accordance with 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. The management of wet CCRs has ceased in order 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. Additionally, TVA has initiated closure of the CCR Unit under the requirements of 40 CFR § 257.101(a)(1). The final closure method for the Stilling Pond at CUF will be determined based on the outcome of the TDEC Order process and will be in accordance with 40 CFR § 257.102.

Flows to the CCR Unit have been redirected to a TLB and flows to the CCR Unit have ceased in accordance with the requirements of 40 CFR § 257.101(a)(1). Construction of the Main Ash Pond Repurposing Project, including dewatering of the Main Ash Pond, began in November 2020 and is ongoing with the TLB helping to facilitate dewatering of the Main Ash Pond. CCR material has also been removed from a portion of the CCR Unit as part of the repurposing project. Upon completion of the repurposing project and construction of the process water basin, the remaining portion of the CCR Unit will be closed by removal or closed in place depending upon the outcome of the TDEC Order process.

These measures will reduce the potential for migration of CCR constituents to groundwater. Subsequent groundwater assessment monitoring will be conducted to track changes in groundwater conditions resulting from 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. Long-term groundwater assessment monitoring is a component of the corrective measures implementation.

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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 arsenic 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 the SSL in groundwater will be selected in accordance with 40 CFR § 257.97 and subject to TDEC's approval of the CARA Plan in accordance with the TDEC Order. 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:

- Be protective of human health and the environment
- Attain the groundwater protection standard as specified pursuant to §257.95(h)
- Control the source(s) of releases to reduce or eliminate, to the maximum extent feasible, further releases of constituents in Appendix IV to this part into the environment
- 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
- Comply with standards for management of wastes as specified in §257.98(d).

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

### **5.1 Data Requirements for Design of Groundwater Corrective Action**

Additional data is required to address data gaps to further refine the targeted area for corrective measures and to evaluate the selected remedy(s) for the CCR Unit. It is noted that additional data collection requirements will include ongoing TDEC Order work that is reported separately. Pursuant to the TDEC Order, the groundwater remedy for this CCR Unit must be approved by TDEC upon completion of the TDEC Order process, which is currently ongoing.

The following activities have been completed to date:

- One additional monitoring well was installed northwest of well CUF-206 as a facility boundary well (CUF-218) to delineate dissolved arsenic concentrations in groundwater and characterize conditions closer to the facility boundary (reference **Figure 4**).
- Slug testing was performed at the new monitoring well to further characterize hydraulic conductivity.

Future activities planned to further evaluate site conditions:

- Additional groundwater sampling will be conducted on the newly installed facility boundary well in 2022 and 2023 to obtain baseline groundwater analytical results for statistical analysis.

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Ongoing and potential future activities to further evaluate MNA:

- A geochemical investigation is being conducted to evaluate groundwater and soil in areas downgradient of the CCR Unit. TVA has developed geochemical models at the CCR Unit to evaluate the influence of native soils on groundwater chemistry. Furthermore, the geochemical modeling will aid in evaluating corrective measures identified. Geochemical processes operating in groundwater influence migration of Appendix IV constituents through adsorption, ion exchange, and potential mineral precipitation/dissolution. The time frame of effectiveness and capacity of the native soil system to attenuate Appendix IV constituents is being evaluated as part of these models as well as enhancement alternatives. Additional modeling will continue, and models will be further refined as the ACM process progresses.
- A numerical groundwater flow model has been constructed incorporating the hydrogeologic CSM, groundwater elevation data, and additional hydrogeologic characterization efforts under the TDEC Order. The groundwater flow model is being used to support geochemical modeling and understanding of groundwater flow direction and velocity. In addition, as new data becomes available the model is being updated, as appropriate.

Ongoing and potential future activities to further evaluate hydraulic containment and treatment:

- Groundwater Flow Modeling – The numerical groundwater flow model may be used to evaluate targeted hydraulic containment. A calibrated groundwater flow model may be used to evaluate a variety of hydraulic containment approaches (e.g., vertical wells, horizontal wells, physical barriers) and to estimate the groundwater extraction rates necessary to contain an identified target zone. The objective of hydraulic containment modeling would be to incorporate groundwater extraction scenarios to optimize hydraulic containment of arsenic-impacted groundwater while balancing extracted groundwater treatment requirements.
- Groundwater Treatability Study - For treatment of extracted groundwater, treatability studies are needed to evaluate technologies for the ex-situ treatment of arsenic and are currently being planned.
- Supplemental Hydraulic Properties Evaluation – This evaluation could be necessary if the existing understanding of the hydraulic characteristics of the subsurface is insufficient 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 used in the groundwater flow modeling simulations for groundwater extraction evaluation. These data would inform the feasibility, design, and implementation of groundwater recovery systems.

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Potential future activities to evaluate EIST:

- A geochemical investigation is being conducted to evaluate groundwater and soils associated with the CCR Unit.
- 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. Results of geochemical modeling will be used to guide treatability testing. The groundwater chemistry is site-specific and area-specific; therefore, bench-scale treatability testing can be used to evaluate the best method to immobilize or treat arsenic. Bench-scale treatability studies may be conducted on representative groundwater samples prior to selecting a groundwater corrective measure for implementation.

**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).

A final report will be prepared upon selection of the remedy. This final report will describe the remedy and how it meets 40 CFR § 257.97. 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 § 257.97(e).

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**References:**

Stantec. (2016a). Initial Structural Stability Assessment. Cumberland Fossil Plant – Stilling Pond (including Retention Pond) Stewart County, Tennessee. October 12.

Stantec. (2018a). Wetland Demonstration. Stilling Pond (Including Retention Pond). Cumberland Fossil Plant Cumberland City, Stewart County, Tennessee. October 12.

**Attachments:**

**Figures**

Figure 1 – Map with CCR Unit Background and Downgradient Monitoring Wells

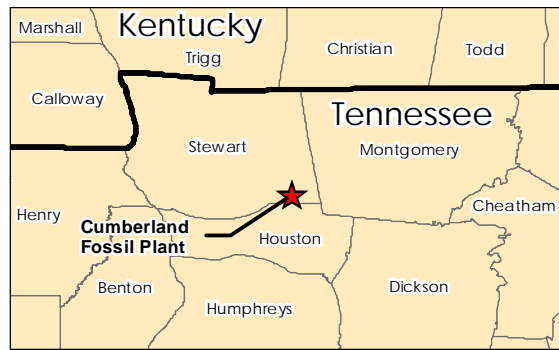
Figure 2 – Conceptual Cross-Section of Stilling Pond (including Retention Pond)

Figure 3 – Groundwater Potentiometric Map - August 16, 2021

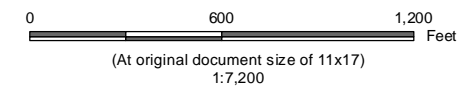
Figure 4 – Monitoring Wells and Appendix IV Constituents Above GWPS

# FIGURES

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- Legend**
- Background Well
  - Downgradient Well
  - ↔ Conceptual Cross-Section Location
  - Surface Water Flow Direction
  - 2019 Imagery Boundary
  - 2020 Imagery Boundary
  - TVA Property Boundary
  - CCR Unit Area (Approximate)



*Project Location*  
Stewart County, Tennessee

*Prepared by MB on 2022-01-05*  
*Technical Review by MD on 2022-01-05*

*Client/Project*  
Tennessee Valley Authority  
Cumberland Fossil Plant

*182603655*

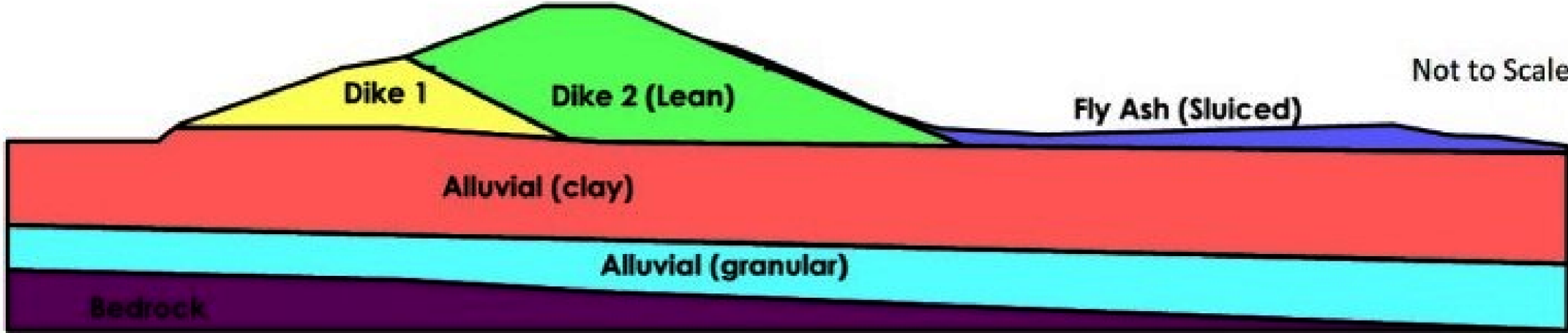
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**1**

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

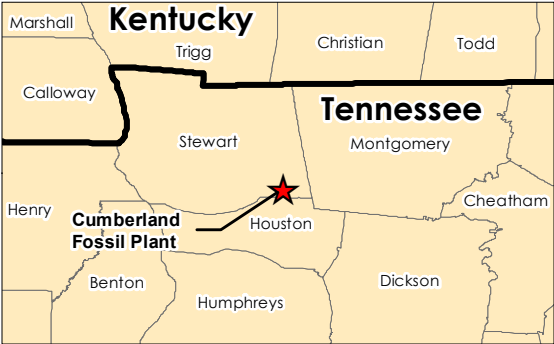
**Notes**  
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet  
2. Background: TVA Imagery flown by Tuck Mapping (c. 2017); 2019 and 2020 imagery provided by TVA and is dated 12/11/2019 and 11/09/2020

# 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



Legend

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



Project Location: Stewart County, Tennessee  
 Prepared by MB on 2021-11-29  
 Technical Review by MD on 2021-11-29

Client/Project: Tennessee Valley Authority  
 Cumberland Fossil Plant  
 182603655

Figure No.: 2  
 Title: Conceptual Cross-Section of Stilling Pond (including Retention Pond)

**Figure 3**

**GROUNDWATER  
POTENTIOMETRIC MAP  
AUGUST 16, 2021**





REVISION NUMBER: REV. 6	DRAWN BY: ALLISON.YOUNG	REVIEWED BY: BENJAMIN.SADLER
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**ENVIRONMENTAL COMPLIANCE  
& OPERATIONS**

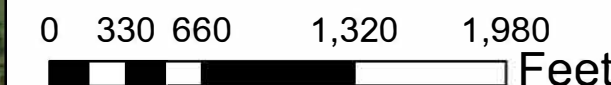
**CUMBERLAND FOSSIL PLANT  
TENNESSEE VALLEY AUTHORITY**

DATE APPROVED: 1/12/2022	APPROVED BY: DENNIS.CONNAIR
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**Legend**

-  Groundwater Monitoring Well
-  Groundwater Flow Direction (inferred)
-  Potentiometric Contours (ft-amsl)(dashed where inferred)
-  TVA Property Boundary

338.15\*=values not used in contouring  
NM=Not Measured



Cumberland River elevation was 357.57 ft-amsl on August 16, 2021



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

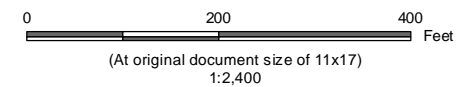


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- Legend**
- Downgradient Well
  - Facility Boundary Monitoring Well
  - GWPS Exceedance Well
  - Surface Water Flow Direction
  - 2019 Imagery Boundary
  - TVA Property Boundary
  - CCR Unit Area (Approximate)

**Notes**  
 1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet  
 2. Background: TVA Imagery flown by Tuck Mapping (c. 2017); 2019 imagery provided by TVA and is dated 12/11/2019



**Project Location**  
Stewart County, Tennessee

Prepared by MB on 2022-01-06  
Technical Review by MD on 2022-01-06

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

182603655

**Figure No.**  
**4**

**Title**  
**Monitoring Wells and Appendix IV  
Constituents Above GWPS**