STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF REMEDIATION

RECORD OF DECISION (ROD)
TENNESSEE VALLEY AUTHORITY (TVA) - ALLEN FOSSIL PLANT (ALF)
SHELBY COUNTY, TENNESSEE
SITE ID #79-735

INTRODUCTION

In 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Commissioner's Order), to the Tennessee Valley Authority (TVA), setting forth a process to investigate, assess, and address environmental conditions at TVA's coal-fired power plants in Tennessee. Specifically, the focus of the TDEC Commissioner's Order was to assess and remediate unacceptable environmental risks associated with the management and disposal of coal combustion residuals (CCR) at seven of TVA's facilities, including the Allen Fossil Plant (ALF) in Memphis, Tennessee. In 2017, during TVA's routine groundwater monitoring near the East Ash Disposal Area (EADA) at ALF, elevated pH values and primary constituents of concern at concentrations above U.S. Environmental Protection Agency (EPA) maximum contaminant levels (MCLs) were detected. Based on the high concentrations of constituents detected near the EADA, TVA's proposed use of groundwater production wells near the site, and the potential risk to the underlying aquifer, TDEC determined an expedited groundwater investigation was necessary and requested TDEC's Division of Remediation (DoR) provide oversight pursuant to Part 2 of the Hazardous Waste Management Act of 1983 (Tenn. Code Ann. §§ 68- 212-201 to -227).

This Record of Decision (ROD), issued by TDEC DoR, documents the decision following the groundwater investigation to remove CCR from ALF that is currently stored within the EADA as well as the West Ash Disposal Area (WADA). In addition, TVA is also installing a groundwater extraction and treatment system as an interim response action (IRA) for EADA impacted groundwater. This system may be expanded or enhanced during or after CCR removal.

This ROD does not supplant the authority of the TDEC Commissioner's Order at ALF. The TDEC DoR-lead expedited groundwater investigation was an extension of the TDEC Commissioner's Order's authority, which was necessary due to the specific environmental risks presented at ALF. Although the activities described in this ROD satisfy components of the order, TVA remains obligated to comply with all conditions of the TDEC Commissioner's Order at ALF and TDEC's corrective action decisions.

SITE DESCRIPTION

ALF is a non-operational TVA coal-fired power plant in Shelby County, in the southwest corner of Memphis, Tennessee (Figure 1). TVA ceased operations at the power plant in March 2018 and is

currently decommissioning the facility. ALF is located on the south shore of McKellar Lake, on the eastern bank of the Mississippi River, and adjacent to a United States Army Corps of Engineers (USACE) flood-control levee. TVA's Allen Combined Cycle (ACC) natural gas plant is located south of ALF. The local topography is relatively level except for the USACE levee and CCR disposal area dikes, which rise approximately 20 to 25 feet above the surrounding land. Unlike other TVA power plants, much of the land occupied by ALF is not owned by TVA, but by third parties, including the City of Memphis, Shelby County, and Memphis Light Gas and Water Division (MLGW). The land on which ALF is located is part of the Frank C. Pidgeon Industrial Park which is zoned for heavy-industrial use. Redevelopment of the land is of particular interest because it holds economic potential for the non-TVA owners due to its location within the Industrial Park and its access to the Port of Memphis via McKellar Lake.

Site-specific and regional geologic mapping indicate that ALF is directly underlain by fill material and Quaternary age (Holocene-Pleistocene) alluvium of the Mississippi River Valley Alluvial aquifer (referred to as the Alluvial aquifer). The thickness of the alluvium, which is predominantly sands and gravels, ranges from 111-128 feet underlying most of the EADA, to a maximum thickness of approximately 245 feet observed near the southeastern boundary of the EADA. The alluvium deposits are underlain by the fine-grained silts and clays of the Cook Mountain Formation (hydrogeologically referred to as the upper Claiborne confining unit in this location). When present, the upper Claiborne confining unit near the EADA Area ranges in thickness from approximately 27-69 feet. The Cook Mountain Formation conformably overlies the Memphis Sand and serves as an upper confining layer. The Memphis Sand is referred to hydrogeologically as the Memphis aquifer and is characterized by predominantly very fine- to very coarse-grained sand with lenses of fine-grained material. Groundwater flow within the Alluvial aquifer beneath ALF is primarily horizontal. The direction of groundwater flow is either to or from McKellar Lake, depending on the lake level.

SITE OPERATIONAL HISTORY

ALF was constructed in 1959 by MLGW and consisted of three coal-fired electric generating units. TVA began leasing the plant in 1965. From 1968 through 1978, several improvements were completed at ALF, including raising the dikes and redeveloping the original WADA and EADA. The USACE levees were constructed east and west of the ALF Plant, creating the south dike of the West Ash Pond (also referred to herein as the WADA) and the north dike of the East Ash Pond (also referred to herein as the EADA). Plant discharges into the WADA ceased in 1978 when they were rerouted back to the EADA. When the EADA was taken off-line in 1991 during excavation work, plant discharges were routed to the WADA. When the EADA went back into operation in 1992, plant discharges to the WADA ceased permanently (TVA, 1993). In 2015, stormwater flows were rerouted away from the WADA and the unit was retrofitted to not impound stormwater. The EADA ceased receiving CCR in 2018. Both the EADA and WADA are subject to the TDEC Commissioner's Order.

While in operation, ALF consumed approximately 7,200 tons of coal per day and produced approximately 5,160 million kilowatt-hours of electricity per year. CCR produced by the three coal-fired units included approximately 85,000 dry-tons of slag and fly ash annually. Site features are shown in Figure 1.

DOCUMENTS REVIEWED

- Updated TVA Allen Fossil Plant – East Ash Disposal Area – Remedial Investigation Report. Stantec. May 31, 2019.
- TVA Allen Fossil Plant Groundwater Flow & Solute Transport Modeling Report. Stantec. July 13, 2020.
- Feasibility Study: East Ash Disposal Area, Tennessee Valley Authority Allen Fossil Plant. Stantec. September 2, 2020.
- 2019 Remedial Investigation & Interim Response Action Groundwater Monitoring Annual Report – Revision 1. Stantec. September 2, 2020.
- East Ash Pond Closure-by-Removal Drawings and Technical Specifications, July 10, 2020.
- West Ash Pond Closure-by-Removal Drawings and Technical Specifications, July 10, 2020.
- Interim Response Action Design, Allen Fossil Plant. Stantec. July 31, 2020.

DISCUSSION OF PREVIOUS INVESTIGATIONS AND RESPONSE ACTIONS

On August 6, 2015, TDEC issued the TDEC Commissioner's Order, to TVA, setting forth a transparent, comprehensive process to investigate, assess, and remediate unacceptable risks resulting from the management and disposal of CCR at seven of TVA's coal-fired power plants in Tennessee. This multi-site order included the EADA and WADA at ALF. In 2017, during TVA's routine groundwater monitoring near the EADA, arsenic, lead, and fluoride (the primary constituents of concern, or COCs), and other CCR-related constituents were detected in groundwater at elevated concentrations above EPA MCLs. Corresponding elevated pH values in groundwater were also observed. In May 2017, TVA voluntarily initiated an investigation to evaluate groundwater conditions on the north and south sides of the EADA where COCs had been detected. In July 2017, TVA received a letter from TDEC Division of Remediation requesting a Remedial Investigation (RI) for the area near the EADA. Based on this request, the RI for the EADA proceeded under TDEC DoR oversight. All other activities, including activities related to the WADA, remained under the TDEC Commissioner's Order. TVA then completed the RI and a supplemental RI (as described below).

Remedial Investigation (2017-2018) and Supplemental Remedial Investigation (2018-2019)

In response to TDEC's July 2017 letter, TVA prepared an RI Work Plan that was approved by TDEC on September 19, 2017. The primary purpose of the RI was to collect and analyze samples of groundwater, soil, ash, and ash pore water to evaluate concentrations of CCR constituents as listed in Appendices III and IV of the USEPA CCR Rule. The specific COCs were identified as arsenic, lead, and fluoride because these constituents had been detected in groundwater near the EADA at concentrations above their respective MCLs. In addition, the RI was to define the hydrogeologic setting and include the construction of a site-specific groundwater flow and solute transport model, which would incorporate the results of an aquifer pumping test performed by the United States Geological Survey (USGS) in 2017.

Detailed descriptions of field activities and the findings are described in the above referenced RI reports. A summary of the RI and supplemental RI activities performed by TVA is provided below.

- To delineate the horizontal and vertical extent of CCR constituents in the Alluvial aquifer north and south of the EADA, TVA installed 22 direct-push technology (DPT) borings and collected 60 groundwater samples from these borings at various depths. The total depths

of these borings were generally 50 feet below ground surface (bgs) with some borings extending to 90 feet bgs.

- To identify and delineate potential source areas of CCR, TVA collected 19 ash samples and 59 ash pore water samples from 21 DPT borings within the EADA. DPT borings extended to a depth of approximately 28 feet.
- To evaluate concentrations of CCR parameters in soil, TVA collected 27 soil samples from nine borings outside the perimeter of the EADA.
- To monitor the delineated groundwater areas north and south of the EADA, and to further characterize the Alluvial aquifer, TVA installed 27 new groundwater monitoring wells within the shallow, intermediate, and deep portions of the Alluvial aquifer. Between May 2017 and December 2018, TVA collected groundwater samples from the onsite monitoring wells during five rounds of monitoring.
- Samples of soil, ash, ash pore water, and groundwater were analyzed for CCR constituents.

In addition, deep soil borings drilled during the RI were used to identify a stratigraphic offset in the upper Claiborne confining unit (a clay layer separating the upper Alluvial aquifer from the underlying Memphis aquifer). As part of the RI, TVA requested that USGS perform pumping tests of TVA's production wells. These production wells are located on the ACC property, and are screened at depths ranging from 425 to 650 feet bgs in the Memphis aquifer. The production wells are not in use. Results of the USGS pumping test indicated that pumping the production wells produced discernible drawdown in the Alluvial aquifer. This indicates that a hydraulic connection exists locally between the Memphis and the Alluvial aquifers. The RI was completed in 2017, and TVA published a draft RI report in March 2018.

Thereafter, TVA prepared a Supplemental RI Work Plan to address data gaps, which was finalized on December 18, 2018, following TDEC approval. The Supplemental RI provided additional information on the horizontal and vertical extent of arsenic in groundwater, and further definition of the upper Claiborne confining unit. The investigation was completed in December 2018. The results of both phases of investigation were presented in the *Updated TVA Allen Fossil Plant – East Ash Disposal Area – Remedial Investigation Report,* published on May 31, 2019, following TDEC approval.

Post-RI Groundwater Monitoring

Since completion of the RI, TVA has continued to monitor groundwater at ALF. Currently, a groundwater monitoring network of 70 wells located within the EADA and the WADA are sampled every three months. Groundwater samples are analyzed for CCR-related constituents. The *2019 Remedial Investigation & Interim Response Action Groundwater Monitoring Annual Report – Revision 1,* September 2, 2020, documents groundwater quality through 2019, and a subsequent report for 2020 is forthcoming. The areas of groundwater impact have remained essentially unchanged in magnitude and extent since 2017.

Groundwater Modeling (2018-2020)

In 2018, TVA initiated development of a three-dimensional groundwater flow and solute transport model, which will continue to be refined as additional hydrogeologic data become available. The overall modeling objective is to create a quantitative tool that can be used to predict groundwater flow and potential CCR constituent transport under varying conditions. The model was developed with a sufficient level of detail to evaluate groundwater management scenarios, constituent fate and transport, and remedial strategies within the context of the Feasibility Study. The *TVA Allen*

Fossil Plant Groundwater Flow & Solute Transport Modeling Report was published on July 13, 2020, following TDEC approval. The groundwater model will be updated as new information is obtained.

Feasibility Study 2020

Following completion of the RI, TVA conducted a Feasibility Study (FS) to develop, screen, and evaluate remedial alternatives for the EADA and the nearby groundwater. The FS was prepared in accordance with TDEC DoR, Chapter 0400-15-01 Hazardous Substance Remedial Action, section 0400-15-01-.09(3) Feasibility Study. The report, titled *Feasibility Study: East Ash Disposal Area, Tennessee Valley Authority Allen Fossil Plant*, was published on September 2, 2020, following TDEC approval. The FS was completed to evaluate various options to address CCR storage within the EADA and the two adjacent areas of shallow groundwater with elevated concentrations of arsenic. The FS concluded by recommending offsite disposal of CCR from the EADA and extraction and treatment of impacted groundwater. Portions of the FS were incorporated into this ROD. Although the FS focused on the EADA, it was determined the selected remedy for CCR (i.e., offsite disposal) would also apply to the WADA. Details of the decision to include the WADA are provided in later sections of this ROD.

CURRENT SITE CONDITIONS

In the FS, two separate but related Operable Units (OUs)[1] were identified onsite. The first OU is the EADA (OU 1), and the second OU is groundwater proximal to the EADA (OU 2). These units are described below:

> **OU 1 – East Ash Disposal Area:** The EADA is located east of the former coal yard and non-operational power plant, and the USACE levee forms its north dike. OU 1 is a total of approximately 80 acres and contains approximately 2,300,000 cubic yards of CCR material. The EADA was an active impoundment and is subject to the CCR Rule. The area formerly received plant process flows but ceased receiving CCR following plant shutdown. All flows of process water from the plant to the EADA ceased in April 2019. Coal burned at the ALF plant generated ash, which was mixed with water and piped to the EADA. Over time, the ash settled to the bottom of the pond, and the water that conveyed it clarified. Water from the pond was discharged via a permitted outfall.
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> **OU 2 – Groundwater:** Based on the results of the RI, impacted groundwater was generally limited to the shallow portion of the Alluvial aquifer near monitoring wells ALF-203 and ALF-204 (the "north groundwater area" of OU 2) and ALF-202 and ALF-212 (the "south groundwater area" of OU 2). These areas are characterized by the presence of primary COCs (i.e., arsenic, lead, and fluoride) with concentrations above MCLs. TVA plans to further evaluate groundwater quality beneath the EADA when safe to do so (i.e., to protect workers) and without disrupting CCR removal operations (i.e., to avoid schedule delays).

In addition to these two OUs, TVA has also subsequently elected to use this ROD to address CCR storage within the WADA. The WADA is located west of the powerhouse, and the USACE levee forms its south dike. It was historically used for intermittent CCR disposal during maintenance. It has not received CCR materials since 1992 and is not subject to EPA's CCR Rule. Approximately

[1] The term "Operable Unit" means a discrete action that comprises an incremental step toward comprehensively addressing site problems by managing migration, or eliminating or mitigating a release, threat of release, or pathway exposure.

300,000 cubic yards of CCR is stored within the WADA.

SITE RISK THAT THIS RECORD OF DECISION ADDRESSES

The FS included an evaluation of potential health risks to humans relative to CCR at ALF. The scenarios described below summarize hypothetical risks to human health for individuals onsite and offsite of the ALF property. As described in the FS, "Potentially Complete" pathways are those where an exposure will likely occur, and it may contribute meaningfully to risk. "Potentially Complete but Insignificant" pathways are those where an exposure may occur, but it is not expected to contribute significantly to risk.

1. *Hypothetical Future Industrial Worker – Potentially Complete*: A hypothetical future industrial worker may be exposed to residual CCR-related constituents in surface soil through inhalation of wind-blown dust, incidental ingestion, and dermal contact.

2. *Hypothetical Future Construction/Utility Worker – Potentially Complete:* A hypothetical future construction/utility worker may be exposed to residual CCR-related constituents in surface soil through inhalation of wind-blown dust, incidental ingestion, and dermal contact. Additionally, this receptor may be exposed to residual CCR-related constituents in subsurface soil in construction or utility excavations through the same pathways.

3. *Site Visitor – Potentially Complete but Insignificant*: A site visitor may be exposed to residual CCR-related constituents in surface soil through inhalation of wind-blown dust, incidental ingestion, and dermal contact. However, these pathways are considered insignificant due to the expected short duration and/or infrequent nature of site visits.

4. *Off-Site Resident – Potentially Complete*: Although unlikely, an off-site resident may be exposed to CCR constituents in groundwater, if impacted groundwater from the shallow Alluvial aquifer migrated into the Memphis aquifer. Current data do not support this scenario but was included as a potentially complete pathway as a precautionary measure. Potable use exposure pathways include possible inhalation of volatile CCR constituents in water vapor while showering, ingestion of potable water, and dermal contact. An offsite resident is not expected to be exposed to CCR-related constituents in surface soil, as no residences are directly adjacent to the ALF and wind transport is unlikely to transport significant quantities of surface soil to off-site areas.

5. *Off-Site Industrial Worker – Potentially Complete*: Although unlikely, an off-site Industrial worker may be exposed to CCR constituents in groundwater, if impacted groundwater from the shallow Alluvial aquifer migrated into the Memphis aquifer. Current data do not support this scenario but was included as a potentially complete pathway as a precautionary measure. Potable use exposure pathways include inhalation of volatile CCR constituents in water vapor while showering, ingestion of potable water, and dermal contact.

6. *Recreational User – Potentially Complete*: Possible exposure of recreational users to CCR-related constituents in McKellar Lake surface water, sediment, and biota are assumed to be potentially complete.

Risk-based screening levels (RBSLs) were developed for the scenarios that were identified as *Potentially Complete* for soil, groundwater, and/or surface water at ALF. The RBSLs are summarized in Table 1 (soil) and were used to develop the target cleanup goals in Table 2 (groundwater).

REMEDIATION GOALS

For OU 1, the following remediation goal has been identified:

1. Soil: The selected remedial approach for OU 1 is based on a performance-based goal of safely removing visible CCR from the EADA followed by an additional 1-foot of underlying soil. After CCR removal, remaining subsurface soil impacts will be addressed through groundwater cleanup, using target clean-up goals for groundwater. Because soil remaining after the CCR excavation may serve as a source of exposure for future site workers, RBSLs were developed for hypothetical future industrial workers and hypothetical future construction/utility workers, respectively. Post-excavation soil sample results can be compared first to background levels and then to these soil screening levels. These RBSLs are presented in Table 1. RBSLs are not target cleanup goals but are meant to be used to evaluate soils and groundwater remaining post-excavation and to support post-removal decision making (e.g., post-removal soil data may help direct future groundwater investigations).

For OU 2, the following risk-based remediation goals have been identified:

2. Alluvial Aquifer Protective of Memphis Aquifer: The selected remedy should use engineering actions to limit the potential migration of COCs from CCR materials into the Alluvial aquifer to concentrations that are protective of the Memphis Aquifer. Protectiveness will be achieved by meeting target cleanup goals for Alluvial groundwater that are based on applicable regulatory standards or risk-based concentrations. The target cleanup goals for the Alluvial aquifer are presented in Table 2. In the future, it is possible that environmental regulations change such that meeting drinking water standards in the Alluvial aquifer is not required (because the Alluvial aquifer is not used for drinking water purposes). Instead, it may be possible to meet alternative target cleanup goals in the Alluvial aquifer that are still protective of the Memphis aquifer.

3. Alluvial Aquifer Protective of McKellar Lake: The selected remedy should use engineering actions to limit the potential migration of COCs from CCR materials into McKellar Lake to concentrations that are protective of beneficial uses of McKellar Lake. Beneficial uses of McKellar Lake include human recreational uses (e.g., fishing) and aquatic habitat. Protectiveness will be achieved by meeting target cleanup goals for Alluvial groundwater that are based on applicable regulatory standards (e.g., surface water quality criteria) or risk-based concentrations for these beneficial uses after dilution and attenuation between Alluvial aquifer groundwater and surface water within McKellar Lake have been considered. The target cleanup goals for the Alluvial aquifer are presented in Table 2.

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Potentially Applicable or Relevant and Appropriate Requirements (ARARs) are listed in Table 3. These ARARs were considered during the FS and helped support remedy selection.

PROPOSED ALTERNATIVES

TVA considered the following three alternatives for OU 1 during the FS.

Alternative 1 – No Action Alternative. Under the no action alternative, TVA would not close the EADA. No closure activities (i.e., no excavation) would occur. This alternative is inconsistent with TVA's plans to convert all of its wet CCR systems to dry systems and is inconsistent with the EPA's CCR Rule. In addition, under the no action alternative, the EADA land would not be made available to its owners for future economic development projects in the greater Memphis area. Consequently, this alternative would not satisfy the project purpose and need and is not considered viable or reasonable. It does, however, provide a benchmark for comparing the environmental impacts of implementation of Alternatives 2 and 3.

Alternative 2 – Closure-by-Removal; Disposal of CCR in an Off-site Landfill. Under Alternative 2, TVA would close the EADA via closure-by-removal. Closure-by-removal involves excavating and relocating CCR from the surface impoundments in accordance with federal and state requirements. The final extent of CCR removal will be determined in accordance with a CCR Removal Verification plan prepared by TVA and approved by TDEC. The EADA contains approximately 2,300,000 cubic yards of CCR. CCR materials would be removed by excavation and transported to off-site landfill(s) for disposal. The location of the offsite landfill(s) has not been determined at this time. Potential locations of the off-site landfill and potential methods of transport were studied and evaluated in TVA's Environmental Impact Statement (EIS, March 13, 2020). The remaining soil within the EADA would be graded to drain (with borrow fill as needed) and the disturbed areas would be vegetated with native plant species or otherwise stabilized. Alternative 2 would include relocating existing sanitary sewer force mains and proper abandonment of inactive sewer pipes within the OU 1 footprint. Removal of the CCR material at OU 1 would precede and support the remediation of impacted groundwater at OU 2.

Alternative 3 – Closure-by-Removal; Disposal of CCR Materials in a Beneficial Re-use Process & Off-site Landfill. Under Alternative 3, TVA would close the EADA via closure-by-removal in the same manner as Alternative 2. However, instead of transporting all excavated CCR material to an off-site landfill, most CCR material (ranging from approximately 75 to 95 percent) would be transported to a beneficial re-use facility to be processed for use in concrete and other building materials. Only the remaining percentage of CCR material not suitable for beneficial re-use would be transported to the off-site landfill. A potential beneficial re-use processing facility and off-site landfill has not been identified. The closest currently identified beneficial re-use processing facility is located approximately 600 miles from the ALF. The anticipated processing capacity of this facility is approximately 200,000 cubic yards or 240,000 tons per year. The remaining soil within the EADA would be graded to drain (with borrow fill as needed) and the disturbed areas would be vegetated with native plant species or otherwise stabilized. Alternative 3 would include relocating existing sanitary sewer force mains and proper abandonment of all sewer pipes within the OU 1 footprint. Removal of the CCR material at OU 1 would precede and support the ongoing IRA remediation of related impacted groundwater at OU 2.

TVA considered the following alternatives for OU 2 during the FS: 1) No Action, 2) Extraction, Treatment, and Discharge, 3) Extraction, Treatment, and Discharge; with Engineered Barrier Wall, 4) Permeable Reactive Barrier Wall, 5) In Situ Treatment: Chemical Oxidation, 6) In Situ Treatment: Carbon Dioxide Sparge, and 7) Monitored Natural Attenuation. Alternatives 1 and 2 were retained for further evaluation and are described below.

Alternative 1 – No Action. This alternative assumes that no action is taken to remediate the areas of groundwater impact. The no action alternative is inconsistent with the EPA's CCR Rule. Another disadvantage of no action is the potential migration of groundwater COCs to sensitive receptors, such as McKellar Lake and the Memphis aquifer. The no action alternative is not considered viable or reasonable, but it does provide a benchmark for comparing the environmental impacts of implementation of other alternatives.

Alternative 2 – Extraction, Treatment, and Discharge. Under Alternative 2, groundwater would be collected using extraction wells that would capture groundwater and convey the water through a pipe network connected to an above-ground treatment system located onsite. The treatment system would likely consist of storage tanks, process pumps, sediment filtration, pH adjustment, and the addition of a coagulation / coprecipitation reagent. The treated groundwater would then be discharged to the T.E. Maxson Wastewater Treatment Plant or to surface water under an NPDES permit. Alternative 2 is effectively a continuation of the TVA's Interim Response Action (IRA) for groundwater extraction and treatment.

Alternatives 3 through 7 were eliminated during the FS for the reasons outlined below. However, it is possible that some of the remedies eliminated may be advantageous for further addressing groundwater beneath the EADA after CCR removal.

Alternative 3 – Extraction, Treatment, and Discharge; with Engineered Barrier Wall. Because an engineered barrier wall would need to extend to approximately 50 to 90 ft below ground surface (bgs), installing such a wall to that depth increases the design complexity, would be more difficult to implement, and creates additional construction-related safety hazards for personnel.

Alternative 4 – Passive Reactive Barrier Wall. A PRB wall was eliminated from further consideration as a remedy because of several disadvantages. Installing a PRB wall to the required depth (50 to 90 ft bgs) requires a high degree of design complexity, has a low degree of implementability, and creates additional construction-related safety hazards for personnel.

Alternative 5 – In Situ Treatment: Chemical Oxidation. This alternative assumes that chemical oxidation can be achieved using potassium permanganate ($KMnO_4$), sodium hypochlorite ($NaOCl$), or other suitable oxidants. The oxidant would be introduced to the targeted groundwater area through a series of temporary injection points. Groundwater remediation would occur as a result of oxidation and adsorption of arsenic within the treatment area. Because, in-situ treatment, by itself, lacks hydraulic control to limit potential groundwater migration, it was not further considered. In the future, however, chemical oxidation may be useful to speed the process toward achieving target cleanup goals and could be an additional component of groundwater treatment.

Alternative 6 – In Situ Treatment: Carbon Dioxide Sparge. This alternative assumes that carbon dioxide (CO2) would be introduced into the targeted groundwater areas through a series of installed, small diameter injection points. System design includes site-specific calculations regarding the radius of influence of each injection well, CO2 dosage rate, and pH of the treatment area. Groundwater remediation occurs as a result of acidification by CO2 within the targeted treatment area that causes formation of precipitates that adsorb or coprecipitate arsenic. Because in-situ treatment, by itself, lacks any means of hydraulic control to limit potential groundwater migration, this alternative was not further considered. In the future, however, carbon dioxide sparging may be useful to speed the process toward achieving target cleanup goals and could be an additional component of groundwater treatment.

Alternative 7 – Monitoring Natural Attenuation (MNA). MNA does not actively address the source of Appendix IV constituents above target cleanup goals, and it does not include measures to control potential migration of impacted groundwater toward sensitive receptors. Considering the concentrations of constituents in groundwater, MNA may take decades to reduce elevated arsenic concentrations to levels below the MCL. In the future, MNA may be viable for groundwater after the EADA has been remediated and the source mitigated.

CRITERIA FOR EVALUATION OF ALTERNATIVES

Tennessee Code Annotated § 68-212-206(d) specifies the criteria that the TDEC Commissioner shall consider when determining containment and cleanup actions, including monitoring and maintenance for sites addressed pursuant to Part 2, Hazardous Waste Management Act of 1983. These criteria include:

a) The technological feasibility of each alternative
b) The cost-effectiveness of each alternative
c) The nature of the danger to the public health, safety, and the environment posed by the hazardous substance at the site
d) The extent to which each alternative would achieve the goal of clean up and containment of the site through the elimination of the threat to the public health, safety, and the environment posed by the hazardous substance

EVALUATION OF THE PROPOSED ALTERNATIVES

For OU 1, Alternative 1 – No Action would not implement any direct remediation or mitigation; therefore, it would not meet the remediation goal. Alternatives 2 and 3 would eliminate ash material in OU 1 and would eliminate the source material for COCs affecting groundwater in OU 2. For both Alternatives 2 and 3, the closure-by-removal action would be performed to comply with ARARs. Successful completion of the removal is anticipated to achieve the remediation goal for OU 1 and support meeting the remediation goals for OU 2. Therefore, both Alternatives 2 and 3 (i.e., closure-by-removal) are viable alternatives for OU 1. However, for Alternative 3, the processing rate and distance from ALF would significantly increase the estimated duration and cost for closure. The extended duration increases potential risk to human health and the

environment, reduces short-term effectiveness and may increase community concerns due to longer time frame of transportation of CCR. Therefore, Alternative 2 is the preferred alternative for OU 1.

For OU 2, Alternative 1 would not actively address impacted groundwater. Therefore, Alternative 2 is the preferred alternative for OU 2. Alternative 2 meets the remediation goal and ARARs. Alternative 2 would implement an extraction and treatment system to remediate groundwater. Extraction and treatment systems are a proven technology that have been used effectively at many environmental sites. These types of systems can be designed and optimized to account for site-specific conditions. They are protective of human health and the environment and have little offsite risk resulting from implementation. The extraction of groundwater would provide hydraulic control to help minimize the potential for impacted groundwater to migrate toward sensitive receptors such as McKellar Lake and the Memphis aquifer.

PUBLIC PARTICIPATION

TVA prepared a Proposed Plan to address the environmental conditions associated with OU 1 and OU 2 for the EADA and removal actions for the WADA. The Proposed Plan and related documents were posted on the TVA website for review by the public. A public information session was held on November 17, 2020. Public comments on the scope of the Proposed Plan were collected from November 17 through December 17, 2020, and during the public information session. TVA received several comment submissions from members of the pubic, local groups, and government agencies. TVA's responses to these comments are provided as Attachment 1 of this ROD. These comments were considered during the preparation of this ROD.

SELECTED ALTERNATIVE AND RATIONALE FOR SELECTION

For OU 1, the EADA, the selected remedy is Alternative 2, Closure-by-Removal: Disposal of CCR Materials in an Off-Site Landfill. The potential landfills include South Shelby Landfill (Memphis, TN) and Tunica Landfill (Tunica, MS). This alternative would remove CCR from the EADA and eliminate the source material for COCs affecting groundwater in OU 2. This remedy will be designed and implemented to comply with ARARs, meet the remedial goals, and provide the best short-term and long-term protection of onsite human health and the environment at ALF. TVA will prepare a Traffic Management Plan with possible actions to mitigate impacts along haul routes.

For OU 2, Groundwater, the selected remedy is Alternative 2 – Extraction, Treatment, and Discharge. This remedy involves groundwater extraction, treatment, and discharge under a permit. The ex situ treatment system would remove COCs from extracted groundwater. Groundwater extraction would provide hydraulic control to help minimize the potential for impacted groundwater to migrate toward sensitive receptors. Site-specific conditions at ALF, including the size, shape, and depth of the two groundwater plume areas at OU 2, are amenable to an extraction and treatment system. The system would comply with ARARs. System performance would be routinely monitored and operation may be modified to optimize system performance. After CCR removal, groundwater quality will be re-evaluated, and the extraction system will be modified as necessary to adequately address groundwater impacts that may be identified after removal of the CCR. Modifications may include additional extraction wells or in-situ treatment (e.g., pH adjustment) to speed the remediation process. If this remedial approach results in asymptotic conditions that do not meet the target cleanup goals, alternative remedial technologies will be further evaluated and

used as necessary to accelerate the process. These processes may include engineered barrier wall(s), permeable reactive barrier wall(s), in situ chemical oxidation / reduction, in situ carbon dioxide sparging, and/or monitored natural attenuation. Attainment of target cleanup goals for OU 2 will be based on statistical analyses of the data obtained from routine groundwater monitoring. TVA will continue to monitor groundwater quality during and after system operation until the target cleanup goals are met.

As previously mentioned, in addition to addressing OU 1 and OU 2 TVA has elected to implement the selected remedy for OU 1 to also address the WADA. TVA has opted to close the WADA by removing the CCR material from this unit, simultaneously with the EADA. As stated in the Introduction, both the EADA and WADA are subject to the TDEC Commissioner's Order for the investigation and remediation of CCR-related impacts to environmental media and this ROD does not alleviate TVA's obligations under the order. However, to meet TVA's long-standing commitment to environmental stewardship and to facilitate future site re-use, TVA will remove the CCR from the WADA concurrently while addressing OU 1. Residual environmental impacts associated with the EADA and/or WADA following CCR removal (e.g., groundwater conditions) will be addressed as provided under the TDEC Commissioner's Order.

DECLARATION

Consistent with Part 2 of the Hazardous Waste Management Act as amended, it has been determined that the selected remedy will be cost effective and provide adequate protection of public health and the environment.

James S Sanders Digitally signed by James S Sanders Date: 2021.08.16 13:05:48 -05'00' 08/16/2021

Steve Sanders Date
Director
Division of Remediation
Tennessee Department of Environment & Conservation

Figures

Legend

Plant Boundary (approximate); The ALF Plant includes portions of Parcels #050101 00001 (City of Memphis), #050101 00002 (City of Memphis), and #050101 00074C (Economic Development Growth).

Parcel Boundary (approximate; not a legal survey)

CCR Unit (approximate)

ALF-202 Monitoring Well (approximate) associated with OU 2 provided as reference.

Figure No.
1

Title
Site Features

Client/Project
TVA ALLEN FOSSIL PLANT
SHELBY COUNTY, TENNESSEE
SITE ID #79-735

Stantec

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Tables

Table 1
Risk-Based Screening Levels - Soil
TVA - Allen Fossil Plant
Site ID #79-735
Shelby County, Tennessee

Analyte	CAS	Units	Risk-Based Screening Level	Note
Antimony	7440-36-0	mg/kg	470	c
Arsenic	7440-38-2	mg/kg	300	b
Barium	7440-39-3	mg/kg	220,000	b
Beryllium	7440-41-7	mg/kg	2,300	b
Boron	7440-42-8	mg/kg	230,000	b
Cadmium	7440-43-9	mg/kg	980	b
Chromium (total)	7440-47-3	mg/kg	1,800,000	d
Cobalt	7440-48-4	mg/kg	350	b
Copper	7440-50-8	mg/kg	47,000	b
Fluoride	16984-48-8	mg/kg	47,000	b
Lead	7439-92-1	mg/kg	800	b
Lithium	7439-93-2	mg/kg	2,300	b
Mercury (inorganic)	7439-97-6	mg/kg	350	e
Molybdenum	7439-98-7	mg/kg	5,800	b
Nickel	7440-02-0	mg/kg	22,000	f
Radium-226	13982-63-3	pCi/g	2.5	a
Radium-226+228	-	pCi/g	4.1	a, g
Radium-228	15262-20-1	pCi/g	1.9	a
Selenium	7782-49-2	mg/kg	5,800	b
Silver	7440-22-4	mg/kg	5,800	b
Sulfate	14808-79-8	mg/kg	183	a
Thallium	7440-28-0	mg/kg	12	h
Vanadium	7440-62-2	mg/kg	5,800	b
Zinc	7440-66-6	mg/kg	350,000	b

Notes:

"-" - not available
CAS - Chemical Abstracts Service registry number
mg/kg - milligrams per kilogram
pCi/g - picocuries per gram
PRG - preliminary remediation goal
RSL - regional screening level
USEPA - United States Environmental Protection Agency

[a] Background threshold value

[b] November 2019 USEPA RSLs for industrial soil based on a target carcinogenic risk and noncancer hazard quotient (HQ) of $1x10^{-4}$ and 1, respectively. PRGs for radionuclides developed using the PRG calculator for a default composite worker scenario and a target carcinogenic risk of $1x10^{-4}$. RSLs are subject to review based on updated values.

[c] RSL for antimony (metallic) presented.

[d] RSL for chromium (III) used as a surrogate.

[e] RSL for mercuric chloride used as a surrogate.

[f] RSL for nickel soluble salts presented.

[g] PRG for radium-228 used as a surrogate.

[h] RSL for thallium soluble salts presented.

Table 2
Target Cleanup Goals - Groundwater
TVA - Allen Fossil Plant
Site ID #79-735
Shelby County, Tennessee

Analyte	CAS	Units	Target Cleanup Level	Note
Antimony	7440-36-0	ug/L	6	a, b
Arsenic	7440-38-2	ug/L	10	a, b
Barium	7440-39-3	ug/L	2,000	a, b
Beryllium	7440-41-7	ug/L	4	a, b
Boron	7440-42-8	ug/L	4,000	c
Cadmium	7440-43-9	ug/L	5	a, b
Chromium (total)	7440-47-3	ug/L	100	a, b
Cobalt	7440-48-4	ug/L	7	g
Copper	7440-50-8	ug/L	1,300	b, e
Fluoride	16984-48-8	ug/L	4,000	b
Lead	7439-92-1	ug/L	15	e
Lithium	7439-93-2	ug/L	40	c
Mercury (inorganic)	7439-97-6	ug/L	2	a, b, f
Molybdenum	7439-98-7	ug/L	100	c
Nickel	7440-02-0	ug/L	100	a
Radium-226+228	-	pCi/L	5.0	b
Selenium	7782-49-2	ug/L	50	a, b
Silver	7440-22-4	ug/L	94	c
Sulfate	14808-79-8	ug/L	250,000	d
Thallium	7440-28-0	ug/L	2	a, b
Vanadium	7440-62-2	ug/L	86	c
Zinc	7440-66-6	ug/L	6,000	c

Notes:

"-" - not available

CAS - Chemical Abstracts Service registry number
MCL - maximum contaminant level
ug/L - micrograms per liter
pCi/L - picocuries per liter
PRG - preliminary remediation goal
RSL - regional screening level
TDEC - Tennessee Department of Environment and Conservation
USEPA - United States Environmental Protection Agency

[a] Rules of the TDEC Chapter 0400-40-03 General Water Quality Criteria. Criteria for the use of domestic water supply. September, 2019 (Revised).

[b] USEPA National Primary Drinking Water Regulation MCLs. Accessed September, 2019.

[c] November 2019 USEPA tapwater RSLs based on a target carcinogenic risk and noncancer hazard quotient (HQ) of $1x10^{-6}$ and 1, respectively. PRGs for radionuclides developed using the PRG calculator for a default residential tap water scenario and a target carcinogenic risk of $1x10^{-6}$. RSLs are subject to review based on updated values.

[d] USEPA National Secondary Drinking Water Regulation secondary MCLs. Accessed September 2019.

[e] Copper and lead action levels

[f] MCL for inorganic mercury

[g] BTV - Background threshold value

ATTACHMENT 1 – Response to Public Comments

Public Comments and Responses-to-Comments
Allen Fossil Plant (ALF) Proposed Plan

TVA released the Proposed Plan for public review on November 17, 2020. The Proposed Plan outlined TVA's planned activities to close the coal combustion residual (CCR) storage units at the ALF property and to address groundwater conditions near the East Ash Disposal Area (EADA). The Proposed Plan was prepared in coordination with the Tennessee Department of Environment & Conservation (TDEC) Division of Remediation. The 30-day public comment period on the Proposed Plan concluded on December 17, 2020.

The availability of the Proposed Plan was announced in local newspapers. A news release was issued to the media and posted to TVA's website and shared on TVA's social media platforms. TVA's agency involvement included sending letters to local, state, and federal agencies and federally recognized tribes to notify them of the availability of the Proposed Plan.

On November 17, 2020 (5:00 to 7:00 p.m. CST), TVA hosted a live virtual open house (www.tvavirtual.com/allen) to solicit public input. TVA chose the virtual format due to concerns with the COVID-19 pandemic. Members of the public were provided the opportunity to view informational exhibits, ask questions of TVA subject matter experts, and submit comments. Ninety-two (92) unique visitors attended the live portion of the virtual open house, during which time questions related to the Proposed Plan were asked and answered in a live format. The questions and answers are provided in **Attachment 1**. In total, TVA's website for the Proposed Plan, which is still accessible, was visited by 680 unique visitors during the 30-day public comment period.

The public comment period ended on December 17, 2020. Comments were submitted through phone, mail, email, and TVA's website. Comments were reviewed and aggregated as appropriate (in the case of duplicative or similar comments) and TVA's responses are included in **Attachment 2**. Original comment submissions are retained as part of the project's Administrative Record.

By the end of the comment period, TVA received 31 comment submissions on the Proposed Plan. These 31 submissions included one phone call, 13 online submittals, and 17 letters. One of the 17 letters was submitted by the Sierra Club which included 109 signatories to a generalized statement and 32 additional discrete comments. Other letters included 13 copies of a letter with different signatories (**Attachment 2A**) from southern Memphis (zip code 38109). Other letters were submitted by individuals or representatives for larger groups and are included as **Attachment 2B** through **Attachment 2D**.

Attachments

Attachment 1 – Response to Comments: Virtual Open House, November 17, 2020
Attachment 2 – Response to Comments: Public Comment Period
- Attachment 2A – Letter from Zip Code 38109 Residents
- Attachment 2B – Letter from Carol Mann
- Attachment 2C – Letter from Joe Laubenstein, WCI
- Attachment 2D – Letter from Amanda Garcia, SELC

Attachment 1
Response to Comments: Virtual Open House, November 17, 2020

No.	Name	Comment	TVA Response
1	Scott Banbury	How will the communities along the haul routes to the South Shelby Landfill or Tunica Landfill be engaged?	During the course of this project, TVA will continue to engage the local communities through public meetings, newsletters, local media outlets, and social media. The public is encouraged to use TVA's website (below) to access project documents and sign up for TVA's newsletter. In addition, we will be working with neighborhood associations to encourage additional feedback from residents. (https://www.tva.com/allen)
2	Matt Boner	When will demolition start and will there be any thing built to replace such as gas turbines or nuclear power?? Thank you.	TVA plans to start deconstruction of the former Allen Fossil Plant in 2022 and complete the process in 2026. The property will then be available for future economic development. TVA's Allen Combined Cycle gas plant, which is located nearby and began operating in 2018, replaces the former Allen Fossil Plant.
	Chris Connolly	When do you plan on having the site deconstructed and ready to hand over to the next user?	
3	Matt Boner	Will it be replaced with gas turbines or nuclear power and how many craft people will be involved in demo?	TVA has already replaced the former Allen Fossil Plant with the Allen Combined Cycle gas plant. This state-of-the-art natural gas plant is located nearby and has been serving the Memphis area since 2018. The number of craft people involved with the deconstruction will be determined as the project continues. As of now, TVA estimates that 40 to 150 workers will be employed during facility decommissioning.
4	Chris Connolly	Does the remediation timeline change if the ash is removed via rail or via truck? What would the traffic impact be if via truck?	TVA's *Allen Fossil Plant Ash Impoundment Closure Environmental Impact Statement* (EIS) evaluated the use of both rail and trucks for transport of the CCR (see Section 3.17.2.2). The assessment concluded that the use of railcars to transport the CCR offsite would require more time than using trucks. This assessment was performed as part of the Final EIS. However, TVA may consider using railcars in the future. If TVA elects to transport CCR offsite by rail, further study on loading rates and rail facilities at ALF will be conducted.
5	Nicole Lacey	Please indicate again where exactly the ash is going to be moved to. Is it another place in Shelby County? How is that location determined? How safe is it for the coal ash to be moving through the county?	The potential landfills identified in the Proposed Plan include the South Shelby Landfill and the Tunica Landfill. These landfills were deemed suitable for long-term storage and management of CCR through a systematic screening process. All of the candidate landfill sites are existing permitted landfills that meet applicable state and federal criteria for the operation of municipal waste and industrial waste landfills, including design criteria, location restrictions, financial assurance, corrective action (cleanup), and closure requirements.
	Joe Laubenstien	What are the names of the two landfills you'll be sending your ash to?	
6	Joe Laubenstein	I appreciate the safety record of TVA and how important it is to TVA. With that being the case would not be safer to use rail for moving the ash to a landfill rather than trucks?	Safety is a core value at TVA and was a primary consideration when evaluating transportation options. As discussed in Section 3.17 of the *Allen Fossil Plant Ash Impoundment Closure Environmental Impact Statement* (EIS), both of these transportation options can be performed safely. While TVA's initial CCR removal activities will be via truck transport, rail removal could be considered at a future time.
7	Scott Banbury	What safety measures will you put in place to make sure that workers are not exposed to health harming impacts from handling coal ash?	TVA is committed to ensuring the safety of our employees and subcontractors. TVA is a zero-injury culture company and expects the same of our contractors and their subcontractors. At all times, including during the implementation of this proposed remedial

No.	Name	Comment	TVA Response
	Anonymous	TVA must provide specifics about how the utility will protect removal workers from exposure to the toxic coal ash.	action, TVA will require that activities be performed in accordance with applicable local, state, and federal health and safety laws and regulations, and TVA's procedures. These procedures include but are not limited to: • TVA employees and contractors will be trained on the specific potential hazards of the project and appropriate practices to be used to mitigate these hazards. • Proper personal protective equipment will be provided to onsite workers and its use will be enforced. • Worker and equipment decontamination stations will be constructed onsite and the use these facilities will be enforced. • Side-dump truck trailers will be used to transport CCR from ALF to the landfill. These trucks are designed to be tightly covered with tarps, and the truck beds are impermeable. These measures will help ensure safe transport of the CCR to the landfill. • TVA will use a third-party health and safety consultant to perform checks on a regular basis to confirm conformance and implement corrective measures if needed. • Air quality monitoring will be performed during CCR removal at the property boundary, in working areas, and on employees to confirm adequate worker protection is in place relative to dust.
8	John Jackye Norman	What happens to the coal ash when it's moved to the landfills?	After the CCR is transported to the landfill, it will be managed by the landfill owner, which operates in accordance with applicable state and federal regulations. Each of the potential landfills are existing permitted landfills that meet applicable state and federal criteria for the operation of municipal waste and industrial waste landfills, including design criteria, location restrictions, financial assurance, corrective action (cleanup), and closure requirements. These requirements are intended to protect public health and the environment.
9	John Jackye Norman	Is it possible for the CCR to leach into the ground water near the landfill?	The potential landfills have been constructed in accordance with applicable state and federal regulations. These regulations included liners, leachate management systems, protective covers, and groundwater monitoring systems. These measures are designed to prevent CCR constituents from leaching to groundwater and will be confirmed through groundwater monitoring.
10	Miguel Ordaz	Will union labor be used for the demolition process?	TVA will use union labor during plant deconstruction.
11	Clayton Ward	It was my understanding that dewatering will be the first thing starting out. When will that start?	Dewatering has been underway since 2019. Over 20 million gallons of water have been removed from the East Ash Disposal Area, treated onsite, and discharged under a permit issued by TDEC.
12	Anonymous	TVA must provide specifics about how the utility will protect communities located near the landfill sites from exposure to the toxic coal ash.	Each of the potential landfills are existing permitted landfills that meet applicable state and federal criteria for the operation of municipal waste and industrial waste landfills, including design criteria, location restrictions, financial assurance, corrective action (cleanup), and closure requirements. These requirements are intended to protect public health and the environment.

Attachment 1
Response to Comments: Virtual Open House, November 17, 2020

No.	Name	Comment	TVA Response
13	Gregory Webster	Does the ash removal include both top ash and bottom ash?	TVA plans to remove all the CCR from onsite storage units. At ALF, this includes both the fly ash and boiler slag (sometimes called bottom ash).
14	Scott Banbury	What efforts will be taken to make sure that arsenic already released from the TVA site will not contaminate the Memphis Sand Aquifer?	The Proposed Plan includes an Interim Response Action (IRA) for groundwater which focuses on the extraction and treatment of groundwater from two areas north and south of the EADA. The groundwater IRA will operate during the closure-by-removal process to control impacted groundwater and begin treatment. Removal of arsenic from these areas will help protect groundwater in the Memphis aquifer. It is important to note that the Memphis aquifer has not been impacted by activities at the Allen Fossil Plant.

Attachment 2
Response to Comments: Public Comment Period

No.	Name	Comment	TVA Response
1	Rachel Stevens	Please confirm that the only two landfills being considered are South Shelby and North Mississippi (Waste Management).	Closure-by-removal of the East and West Ash Disposal Areas to an offsite existing landfill was evaluated in the *Allen Fossil Plant Ash Impoundment Closure Environmental Impact Statement* (EIS). Several landfills, which met TVA's screening criteria for disposal of coal combustion residuals (CCR), were evaluated in this document. The Final EIS was published on March 6, 2020. The Record of Decision (ROD) selecting Alternative B Closure of the Metal Cleaning Pond, Closure-by-Removal of the East Ash Pond Complex and the West Ash Pond; Disposal of CCR in an Offsite Landfill Location was published in the Federal Register on April 13, 2020. Both the Final EIS and ROD are available on TVA's environmental reviews website at: http://tva.com/nepa. TVA could remove the CCR from the Allen Fossil Plant to any of the landfills evaluated in the EIS. At present, TVA plans to utilize Republic Services (South Shelby Landfill in Memphis, TN) and/or Waste Management (Tunica Landfill in Tunica, MS) for the disposal.
2	Anonymous	While TVA's proposed disposal plan for the coal ash conforms to EPA guidelines, those guidelines are not strict enough with respect to coal ash and its toxic constituents. TVA must ensure the coal ash toxins are remediated and do not pollute communities.	TVA is committed to protecting human health and the environment. We plan to safely implement the Proposed Plan to address environmental concerns at the ALF Plant. TVA will continue to work closely with the TDEC Division of Remediation to ensure the remedial objectives are met.
3	Anonymous	The communities and residents living near the proposed landfill sites should be given resources ($), information, and governance power over nearby coal ash disposal. How are communities in South Shelby and Tunica being consulted?	During the course of this project, TVA will continue to engage the local communities through public meetings, newsletters, local media outlets, and social media. The public is encouraged to use TVA's website (below) to access project documents and sign up for TVA's newsletter. In addition, we will be working with neighborhood associations to encourage additional feedback from residents. (https://www.tva.com/allen)
4	Anonymous	Our understanding is that the groundwater cannot be discharged to the Memphis Publicly Owned Treatment Works (POTW) containing the arsenic (As), lead (Pb), and chlorine (Cl) so how are these to be removed in the planned onsite pretreatment facility? Chemical precip then sand filters, ion exchange, other? Will hydroxide or sulfide precip be employed? Has barium sulfide precip been evaluated versus lime, Na2S, NaSH, or iron (Fe) based approaches?	The groundwater treatment system has been designed to remove arsenic below the City of Memphis's POTW discharge criteria. Lead and chloride concentrations in the groundwater already meet the POTW discharge requirements. Ferric chloride will be used to create an insoluble, non-hazardous, precipitate-solid, which can be separated in gravity vessels and by a mechanical filter press. After arsenic removal, treated water will be sent through additional filtering prior to discharge to the Memphis POTW.
5	Carol Mann	I read with interest that TVA plans to remove 3.5 million cubic yards of coal ash. I understand that a landfill in Tunica Co., MS- 30 mi. from the site - is being considered. Why is the Tunica Co. landfill being considered? I cannot find any information to justify this site being considered. Please provide or show me where to look for what assessments you have made on this site. The public comment period deadline is Dec. 17, as you know.	Closure-by-removal of the East and West Ash Disposal Areas to an offsite existing landfill was evaluated in the *Allen Fossil Plan Ash Impoundment Closure Environmental Impact Statement* (EIS). The Tunica Landfill was one of several which met TVA's screening criteria and was evaluated in this document. The Final EIS was published on March 6, 2020. The Record of Decision (ROD) selecting Alternative B Closure of the Metal Cleaning Pond, Closure-by-Removal of the East Ash Pond Complex and the West Ash Pond; Disposal of CCR in an Offsite Landfill Location was published in the Federal Register on April 13, 2020. Both the Final EIS and ROD are available on TVA's environmental reviews website at: http://tva.com/nepa.

Attachment 2
Response to Comments: Public Comment Period

No.	Name	Comment	TVA Response
6	Brenda Magill	Our area isn't in the TVA service area so please don't bring the ash to our area.	The *Allen Fossil Plant Ash Impoundment Closure Environmental Impact Statement* (EIS) identified and evaluated the landfills suitable for disposal of CCR through a systematic screening process. The screening process identified and evaluated 1,158 landfills, of which 784 were located within 600 miles of ALF. The landfill sites in the Proposed Plan (including the Tunica Landfill) are existing permitted landfills that meet applicable state and federal criteria for the operation of municipal waste and industrial waste landfills, including design criteria, location restrictions, financial assurance, corrective action (cleanup), and closure requirements. These criteria and regulations included liners, leachate management systems, protective covers, and groundwater monitoring systems. These requirements are intended to protect public health and the environment. As such, and as described in the EIS, disposal of CCR within the existing limits of these landfills would be consistent with the permitted landfill use. The potential for adverse impacts affecting public health or the environment of the surrounding area would be low. The transportation related impacts to the surrounding communities would be moderate and would be mitigated through implementation of a comprehensive traffic management plan and best management practices to minimize fugitive dust emissions.
	Debra Currie	I live in Eudora, MS. On the bluff just east of the landfill in Tunica County. My drinking water comes for a well near the landfill. Please don't bring these waste products to Mississippi to contaminate our water supply. Please find another use for it or keep it in Tennessee. Residents of the Delta do not need this contamination!	
	Dr. Yvonne D. Nelson	Thank you for the opportunity to speak regarding the seemingly endless fight against environmental injustice in this predominantly black community. We understand the need to remove this toxic coal ash by-product from the now defunct Allen Fossil Plant; however, the community is largely opposed to your 8 to ten-year project to accomplish this goal. Furthermore, the community is overwhelmingly opposed to any such project, including, but not limited to the Byhalia Pipeline project. Please stop being in such a hurry to and work with the community to develop a plan that all can agree on.	
	Leslie Davis	This toxic ash was created in Tennessee, for the benefit of residents and low TVA electric rates. Mississippi should not be the dumping ground for a waste product that was not created here and gave no benefit to our citizens.	
	M White	Tunica & Desoto counties don't benefit from TVA… we shouldn't have their TOXIC WASTE dumped in our county, possibly endangering our water supply and the soil on the surrounding thousands of acres of farm land that supply our food & products.	
	Patricia Brassfield	Hello, I'm concerned about your plans to remove toxic ash from the Allen station in Memphis. I understand that one of your options is a location in Tunica MS. I am opposed to you removing the ash from Shelby county and trucking it to dump in Tunica. Our state is not serviced by TVA - we have not received any benefits of being a TVA customer and I don't see any reason that our area should be impacted by your toxic waste. It seems to me you are choosing a county with a high rate of poor people because they don't matter. Or wont notice. Keep your toxic ash in the county and state that created it.	
	Sheila Deese	Please keep your hazardous waste in your TVA service area. We do not with to store your coal ash due to future contamination.	
	Timothy Cottam	Neither Tunica County, MS nor Desoto County, MS have ever benefited from the low-priced electric service provided by TVA's Allen Fossil plant in Memphis, TN, yet you are considering removing thousands of pounds of toxic-ladened CCR from storage in Memphis to a site in Tunica County, MS. We are not in the TVA service area and do not want to take possession of your environmental wastes. Please understand we will be organizing all the residents of Tunica and Desoto counties to protest this potential outcome. Keep your environmental waste within the confines of your service area. IT is only fair. Shame on you for trying to take advantage of the citizens of northwest Mississippi.	

Attachment 2
Response to Comments: Public Comment Period

No.	Name	Comment	TVA Response
	Zachary Underwood	As a private citizen and resident of Mississippi it is my desire that you cease and desist with your consideration of the Tunica site for the removal of coal ash from the Allen Plan. The people of Mississippi do not want your toxic waste deposited on our soil and getting in our underground aquifers poisoning our drinking water.	
7	Phillip Walker	I support the efforts of Protect Our Aquifer calling for the safest method to relocate the coal ash. Protecting the Memphis Sands Aquifer from contamination must be the first priority.	TVA has been a part of this community for more than 60 years. We care about our neighbors and about protecting the air, land, and water resources. The Memphis aquifer has not been impacted by activities at the Allen Fossil Plant. We plan to safely implement the Proposed Plan to address environmental concerns at the ALF Plant, which in turn will further help protect the Memphis aquifer.
	Sara Oaks	Our aquifer must remain uncontaminated throughout this process.	
8	Jonathan Levenshus, Sierra Club	The attached document contains 109 signatures, 32 of which are accompanied by additional personal messages. These signatures indicate broad and diverse support for robust worker and community protections regarding the removal and storage of the coal ash currently at the Allen Fossil Plant. The following spreadsheet contains names and contact information of people who signed the letter below: I support the safe removal of coal ash from the impoundments at the Allen coal plant because of groundwater contamination. Closing the leaking, unlined impoundments and disposing of the ash in dry, lined landfills out of the groundwater and away from McKellar Lake is the right decision for our community. It is essential that TVA prioritize worker and community safety before the coal ash is removed from the impoundments and the waste is transported and stored in a new location. Specifically, I ask that TVA develop a plan to ensure the adoption and implementation of stringent safety measures that will apply to all workers and contractors involved with this project. TVA must also ensure the final disposal location for its coal ash complies with laws that are designed to protect people from air and water pollution. Finally, I urge TVA to hold public meetings and conduct outreach in the communities that will be impacted during the transport and storage of its waste. Ensuring transparent communication with frontline communities is the best way to avoid environmental justice concerns and risks. Thank you for your consideration of these comments.	TVA appreciates Sierra Club's interest in this project and the individual comments included with this submittal. TVA shares the principals outlined in the Sierra Club's letter, including protecting workers, residents, and the environment during the safe relocation of the CCR from the site to a permitted landfill. Safety is a core value at TVA. Safety drives every decision we make and is woven into every action we take. TVA is committed to protecting workers and the community during this project. At all times, TVA requires that activities be performed in accordance with applicable local, state, and federal health and safety laws and regulations. Please also see the response to Comment No. 7 in Attachment 1. The potential landfill sites are existing permitted landfills which meet applicable state and federal criteria for the operation of municipal waste and industrial waste landfills, including design criteria, location restrictions, financial assurance, corrective action (cleanup), and closure requirements. These requirements are intended to protect public health and the environment. During this project, TVA will continue to work with local communities and their representatives to provide information and address potential concerns. Additional informational sessions and publications will be provided periodically during the course of this project. Please also see the response to Comment No. 1 in Attachment 1.
9	Multiple	See Attachment 2A Letter from Zip Code 38109 Residents	TVA appreciates the feedback provided in this letter and is committed to working with local residents to address potential concerns. Responses to specific items discussed in this letter are provided below:

Attachment 2
Response to Comments: Public Comment Period

No.	Name	Comment	TVA Response
9.1	-	Alternative C and D should be selected based on your initial presentation to TDEC. There needs to be beneficial reuse for the CCR and/ or another option: D: TVA should purchase land nearby (like at Frank Pidgeon Industrial Park), and start your own landfill: lined, leachate collection, monitored and managed properly.	The selection process for addressing the CCR was described in the report *Final Allen Fossil Plan Ash Impoundment Closure Environmental Impact Statement* (EIS) March 6, 2020. The Record of Decision (ROD) selecting Alternative B Closure of the Metal Cleaning Pond, Closure-by-Removal of the East Ash Pond Complex and the West Ash Pond; Disposal of CCR in an Offsite Landfill Location was published in the Federal Register on April 13, 2020. The EIS and ROD are available on TVA's environmental reviews website at: http://tva.com/nepa. Alternative B (i.e., Offsite Disposal) is the preferred alternative as it would achieve the purpose and need of the project to support the implementation of TVA's goal to eliminate all wet CCR storage at its coal plants; close CCR surface impoundments across the TVA system; and comply with the EPA's CCR Rule and other applicable federal and state statutes and regulations. Alternative C (i.e., Beneficial Reuse and Offsite Disposal) was not selected because the construction of a new facility to process CCR from ALF would extend the duration of closure. This in turn would delay the future economic development of the site and result in greater direct and cumulative impacts associated with air emissions, noise emissions, impacts to transportation system, impacts to environmental justice communities, safety risks and disruptions to the public associated with the extended time frame for closure. Construction of a new landfill within the nearby area would result in similar if not greater impacts to the local area than Alternative C.
9.2	-	We do not want to have trucks driving up and down our roads for 10 years with these dangerous chemicals that can spill if there's an accident as well. The community isn't going to be reimbursed for the millions it will take to repave the roads either-or time lost as these trucks travel through the community creating the burden of more congestion.	To ensure safe and efficient transport of the material to the landfills, TVA is conducting a detailed traffic study of the proposed haul routes. A traffic mitigation plan will be prepared following this study. To minimize damage to road surfaces, local traffic laws and load limits will be enforced throughout the project. Additionally, side-dump truck trailers will be used to transport CCR from ALF to the landfill. These trucks are designed to be tightly covered with tarps, and the truck beds are impermeable. These measures will help ensure safe transport of the CCR to the landfill.
10	Carol Mann	See Attachment 2B	TVA appreciates the feedback provided in this letter and is committed to working with interested parties to address potential concerns. Responses to specific items discussed in this letter are provided below:

Attachment 2
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No.	Name	Comment	TVA Response
10.1	Carol Mann	TVA reasons that because toxic coal ash is leaching high levels of arsenic, lead and fluoride into the shallow aquifers near the Memphis Sand Aquifer, threatening the city's public water supply, all that is necessary is to shuffle the waste to a poorer, more defenseless area down the road, such as in Tunica, Miss., where it will be dumped into an already-permitted municipal landfill over the large Wilcox Aquifer, which poses a direct threat to the drinking water for Tunica Co.	The Memphis aquifer has not been impacted by activities at the former Allen Fossil Plant. TVA has collected multiple samples from Memphis aquifer near ALF and continues to do so on a regular basis. The sample results for arsenic, lead, and fluoride (and all other constituents) meet state and federal drinking water standards. Each of the potential landfills that was identified by TVA are existing permitted landfills that meet applicable state and federal criteria for the operation of municipal waste and industrial waste landfills, including design criteria, location restrictions, financial assurance, corrective action (cleanup), and closure requirements. These requirements are intended to protect public health and the environment. The permit for the Tunica Landfill (issued the Mississippi Department of Environmental Quality) requires the installation of composite liner system consisting of a flexible membrane liner atop of a compacted clay liner. The system is inspected prior to placement of material. In addition, the permit requires routine groundwater monitoring along with a final cover system (to prevent infiltration) and 30 years of post-closure monitoring.

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No.	Name	Comment	TVA Response
10.2	Carol Mann	And though the enormity of transporting 3.5 million cubic yards of toxic coal ash will slog on for eight to ten years, the decision as to where it goes will be accomplished quickly, without even a public hearing, much less an environmental study.	TVA disagrees with this comment. TVA has been evaluating closure options for the CCR storage units at ALF since 2018. The *Allen Fossil Plan Ash Impoundment Closure Environmental Impact Statement* (EIS) evaluated the closure options for the CCR storage units at ALF. The Notice of Intent (NOI) to prepare an EIS was published in the Federal Register on November 30, 2018. The NOI was also published in local area newspapers. The 30-day public comment period ended on January 31, 2019. During that comment period, a public information session was held on January 17, 2019 at the Mitchell Community Center in Memphis, TN. The Scoping Report which summarized the comments received was published on March 27, 2019. TVA published the Draft EIS on October 4, 2019, the notice of availability of the Draft EIS was published in the Federal Register on October 11, 2019. The notice of availability was also published in local area newspapers (e.g., *the Tunica Times, the Commercial Appeal; Memphis Flyer; the Tri- Stare Defender; the Marion times-Standard; The Taylor County News;* and *Lee County Observer*). Additionally, the Commercial Appeal, WANT-TV and WKNO-FM (NPR) attended the open house with a subsequent news story about the event published on the same evening by the Commercial Appeal (October 9, 2019) and coverage broadcast the following day by WANT-TV (October 10, 2019). The 45-day public comment period ended on November 25, 2019. Two public information sessions were held during the comment period, on October 8, 2019 at the Mitchell Community Center in Memphis, TN and on October 30, 2019 at the Benjamin L. Hooks Public Library in Memphis, TN. Comments that were received on the Draft EIS were reviewed and incorporated into the Final EIS which was published on March 6, 2020. The Record of Decision (ROD) selecting Alternative B Closure of the Metal Cleaning Pond, Closure-by-Removal of the East Ash Pond Complex and the West Ash Pond; Disposal of CCR in an Offsite Landfill Location was published in the Federal Register on April 13, 2020. Both the Final EIS and ROD are available on TVA's environmental reviews website at: http://tva.com/nepa. Additional information related to public involvement is provided in the EIS.
10.3	Carol Mann	The EPA has also admitted: "No liner… can keep all liquids out of the ground for all time. Eventually liners will either degrade, tear, or crack and will allow liquid to migrate out of the unit."	Please note that this statement was made by EPA in 1982 (Federal Register/Vol. 47, No. 143/July 26, 1982) and advancements have been made in liner designs, technologies, and installations over the past 38 years. Further reading of this document reveals that the EPA's intention for their statement is that liners are not intended to be a stand-alone mitigation strategy for landfill designs and should be paired with leachate collection, groundwater monitoring, capping, and post-closure care. Each of these elements are included in the permit requirements for the landfills evaluated by TVA.
10.4	Carol Mann	We already have evidence-based science and technology solutions for dealing with coal ash.	Beneficial reuse was considered during the EIS analysis. However, beneficial reuse was not selected because the construction of a new facility to process CCR from ALF would extend the duration of closure, delay the future economic development of the site, and result in greater direct and cumulative impacts to the public. Please note that TVA continues to beneficially reuse CCR at several other TVA facilities where appropriate. Currently, TVA recycles 40 percent of the CCR we generate.

Attachment 2
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No.	Name	Comment	TVA Response
11	Joe Laubenstein, WCI	See Attachment 2C	TVA appreciates the feedback provided in this letter and is committed to working with interested parties to address potential concerns. Responses to specific items discussed in this letter are provided below:
11.1	Joe Laubenstein, WCI	1) A comment was made during the public meeting and was verified in the Environmental Impact Statement (EIS) that transporting the CCR by truck was both safer and less of an impact to Green House Gas (GHG) emissions. I find it hard to believe that it would be safer moving 3.2 million tons of CCR by truck rather than by rail. How can the equivalent of putting 647 trucks on the road be safer than moving 11,000 tons by one unit train?	Safety is a core value at TVA and was a primary consideration when evaluating transportation options. As discussed in Section 3.17 of the *Allen Fossil Plant Ash Impoundment Closure Environmental Impact Statement* (EIS), both of these transportation options can be performed safely. While TVA's initial CCR removal activities will be via truck transport, rail removal could be considered at a future time.
11.2	Joe Laubenstein, WCI	I am not sure why WC was excluded when the author of the EIS did the evaluation of landfills in close proximity to the ALF site and also had the capabilities for handling the volume of CCR that needed to be removed from the ALF impoundment. We do have sites in close proximity and do have landfill capacity for this volume.	During the EIS, Subtitle D RCRA landfills were considered for this analysis as these landfills would meet applicable state and federal criteria for the operation of municipal waste and industrial waste landfills, including design criteria, location restrictions, financial assurances, corrective measures, and closure requirements. TVA identified 1,158 landfills, of which 784 were located within 600 miles of ALF. Waste Connections was included during the initial screening of large commercial carriers that resulted in a total of 226 potential landfills. During further evaluation based on unloading infrastructure and landfill attributes, seven potential landfills were identified. Waste Connections facilities were not retained during this evaluation because none met the specified criteria of either being within a 30-mile trucking radius or having existing rail or barge unloading capabilities.
12	Amanda Garcia, SELC	See Attachment 2D	TVA appreciates Citizen Groups' interest in this project. Responses to specific items discussed in this letter are provided below:
12.1	Amanda Garcia, SELC	Citizen Groups care about protecting the City of Memphis and Shelby County's clean drinking water source, the Memphis Sand Aquifer, for the benefit of the resource, our community, and future generations. We support TVA's decision to remove toxic coal ash from its leaking, unlined pits at the Allen Fossil Plant ("Allen Coal Plant" or "Coal Plant"). Removing the coal ash at the Allen Coal Plant is an essential component of remediating the extremely high levels of coal ash contamination that are currently threatening the Memphis Sand Aquifer and McKellar Lake. We urge TVA to clean up its coal ash pollution as quickly as is safely possible.	TVA shares many of the principals outlined in the letter provided by Citizen Groups, including protecting workers, residents, and the environment during the safe relocation of the CCR from the site to a permitted landfill. Please note that TVA is working diligently to address the environmental conditions at the site quickly and safely. This process includes complying with procedures outlined in applicable state and federal regulations, in addition to soliciting and responding to public feedback. Consequently, the timeline for implementation of the remedy is predicated on this collaborative process.

Attachment 2
Response to Comments: Public Comment Period

No.	Name	Comment	TVA Response
12.2	Amanda Garcia, SELC	…we respectfully insist that TVA: Accurately characterize the site's geology, groundwater flow, and contaminant plume before proposing, selecting and implementing a final groundwater remedy for the site;	TVA has been diligently investigating and characterizing the geology, hydrology, and groundwater impacts beneath the site. Activities have included the installation over 70 monitoring wells, the collection of over 1,300 groundwater samples, multiple aquifer tests, and development of a groundwater model. This information has been provided in the following documents: • *Updated TVA Allen Fossil Plant – East Ash Disposal Area – Remedial Investigation Report*. Stantec. May 31, 2019. • *TVA Allen Fossil Plant Groundwater Flow & Solute Transport Modeling Report*. Stantec. July 13, 2020. • *Feasibility Study: East Ash Disposal Area, Tennessee Valley Authority Allen Fossil Plant*. Stantec. September 2, 2020. • *2019 Remedial Investigation & Interim Response Action Groundwater Monitoring Annual Report – Revision 1*. Stantec. September 2, 2020. These efforts have resulted in the Proposed Plan for groundwater that is based an accurate characterization of the site conditions that will be protective of human health and the environment. See additional information provided in responses to Comments No. 12.11 to 12.24.
12.3	Amanda Garcia, SELC	…we respectfully insist that TVA: Disclose and analyze the impacts that will affect the communities along the haul routes and near the South Shelby and Tunica landfills, and consider other alternatives that will not disproportionately burden environmental justice communities;	Responses to specific items discussed in this subsection are provided below:
12.4	Amanda Garcia, SELC	TVA has not disclosed and analyzed the full range of environmental impacts—including environmental justice impacts—associated with the South Shelby or Tunica Landfills and the proposed haul routes in its Environmental Impact Statement (EIS) for the coal ash closure project at Allen. Instead, in the EIS, TVA employed a "bounding analysis" that analyzed the impacts associated with a generic suite of site features. This approach obscures the differences in impacts among alternative disposal and beneficial re-use sites, making it impossible for the public and decision-makers to adequately evaluate the choices.	TVA disagrees with this comment. The bounding analysis in the EIS provided a conservative estimate of impacts uniquely associated with transport of CCR to each evaluated landfill. To complete the bounding analysis, TVA identified and examined the proposed transport routes to suitable landfills, and the environmental attributes of conditions along each route, to determine the most impactful or bounding characteristics of CCR transport via each potential mode of transportation. As such, the bounding analysis does not obscure impacts. Rather it allows for the assessment of an impact condition that is effectively greater in magnitude than any of the independent options considered in the bounding analysis.

No.	Name	Comment	TVA Response
12.5	Amanda Garcia, SELC	TVA has narrowed its options down to two landfills, in two different communities, with two very different settings and two very different haul routes to reach them. Although it is TVA's job, not ours, to disclose and analyze the impacts of its potential choices so that communities have a meaningful opportunity to provide input into TVA's choice, we provide some basic information that illuminates different considerations with respect to South Shelby and Tunica • The South Shelby landfill is largely surrounded by industrial uses, with some limited residential areas. The South Shelby landfill is surrounded by census blocks with populations of greater than 80% people of color. The haul route to South Shelby landfill would be primarily on interstates and highways with few residential areas until the last portion of the route. • The Tunica landfill is in an agricultural area. Although the uses around the Tunica landfill are primarily agricultural, there are several residential developments nearby that appear to be mobile homes. The Tunica landfill is surrounded by census blocks with populations of greater than 80% people of color. Tunica County residents are experiencing extreme poverty, with an estimated 28% of households below the federal poverty line. For comparison, the US poverty rate is 12.3% and the Mississippi statewide poverty rate is 19.5%. These data are based on the 2019 US Census Bureau American Community Survey. The haul route traveling through South Memphis to the Tunica landfill is also very different. The route to Tunica would run through dense urban neighborhoods in South Memphis, including Westwood, again with populations of greater than 80% people of color. Route 61 is a main commercial thoroughfare for the entire South Memphis area (on both sides of the road). This route includes major commercial anchor areas and a host of small businesses. It is heavily used by local communities.	TVA has considered the characteristics and setting of both landfills and their associated haul routes, as each was thoroughly evaluated in the development of the bounding analysis. US Census Bureau block groups with significant minority and/or low-income populations were identified along each haul route, with the most impactful route providing the bounding values. Minority and/or low-income populations located in residential areas along either of the landfill haul routes would experience similar transportation-related impacts, which were detailed in the environmental justice section of the EIS. Similarly, sensitive air and noise receptors in the vicinity of each haul route were individually identified. Potential transportation-related impacts to these receptors were detailed in the air quality and noise sections of the EIS, with the haul route with the most receptors providing the bounding condition. TVA believes the bounding analysis presents the scenario with the largest extent of potential impacts. However, the transport of CCR to a chosen disposal site may result in less severe impacts. Additionally, because the candidate landfills are existing landfills with the capacity to accept the CCR within existing permitted limits, the operations associated with disposal of CCR within the landfill boundaries would be consistent with current, permitted use. TVA limited its consideration to landfills owned and operated by commercial carriers that offer established management systems, reliability, and as such, are assumed to comply with environmental practices consistent with TVA standards. These large commercial landfill operators are expected to have robust environmental control plans, effective project designs, and a history of compliance that ensures that offsite impacts to surrounding environmental justice populations are low.
12.6	Amanda Garcia, SELC	The Tunica Landfill appears to be within the 100-year floodplain and therefore not an appropriate site for the disposal of coal ash. As a mitigation measure in the EIS, TVA committed to "obtain documentation from permitted landfill(s) receiving ash that the ash would be disposed in an area outside the 100-year floodplain." TVA must explain how its selection of the Tunica Landfill would be consistent with that commitment.	Waste Management (the operator of the Tunica Landfill) provided a floodplain analysis report submitted in 2017 to the Tunica County, Mississippi, Office of Planning and Development (floodplain administrator), stating, among other things, that the landfill is hydraulically separated from the floodplain, specifically that "stormwater runoff from the landfill is pumped across the earthen berm into Lost Lake Bayou." Therefore, although the northeast corner of the Tunica Landfill is shown on the flood insurance rate map as being within the 100-year floodplain, that area is actually hydraulically separated from Lost Lake Bayou and not in the Lost Lake Bayou 100-year floodplain, and selection of the Tunica Landfill for disposal of coal ash would be consistent with the commitment in the EIS.

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No.	Name	Comment	TVA Response
12.7	Amanda Garcia, SELC	The transport of borrow also bodes harm, disruption, and danger to residents of the area. Where the hauling of the coal ash keeps to somewhat larger highways and expressways, the re-filling process will take place entirely within the community (according to the big dots and inset road map). Some of this material will be transported along local two-lane roads—not intended for large dump truck traffic.	The impacts of borrow transport, including those related to air quality, noise, transportation, health and safety, and environmental justice, were evaluated in the respective sections of the EIS. TVA has committed to minimizing potential effects through the development of a comprehensive traffic management plan and implementation of best-management-practices (BMPs) designed to minimize fugitive dust emissions (such as covered loads). Furthermore, TVA will review the contractor's borrow plan to ensure it conforms to the terms and conditions outlined in the traffic management plan to avoid concentrated use of borrow sites that utilize low volume roadways to minimize effects to local communities.
12.8	Amanda Garcia, SELC	TVA must carefully consider the environmental justice, worker safety, traffic, noise, air quality, and other environmental impacts associated with these specific sites. In addition, in light of these potential impacts in already-burdened communities, TVA should revisit a range of other alternatives that will not disproportionately burden environmental justice communities, or will minimize any such impacts, such as: • Beneficial reuse of the coal ash. • Construction of a single waste stream industrial landfill in an appropriate location; • Transport of coal ash by rail or barge. While we recognize that TVA considered some of these alternatives in its environmental impact statement, it did so without the benefit of understanding specific impacts to the South Memphis and Tunica communities.	TVA disagrees with this comment. The EIS evaluated impacts to the South Memphis and Tunica communities through the bounding analysis. As previously noted, the EIS identified and examined the proposed transport routes to each suitable landfill, and the environmental attributes of conditions along each route, to determine the most impactful or bounding characteristics of CCR transport. Based on the analyses in the EIS, which assessed a range of feasible alternatives including beneficial reuse of CCR and transport of CCR by rail or barge, TVA's selected Alternative B - Closure of the Metal Cleaning Pond, Closure-by-Removal of the East Ash Pond Complex and the West Ash Pond; Disposal of CCR in an Offsite Landfill Location via either truck or rail. While TVA's initial CCR removal activities will be via truck transport, rail removal could be considered at a future time.
12.9	Amanda Garcia, SELC	To ensure that the potentially affected communities have an adequate opportunity to make informed comments, TVA must commit to developing a supplemental EIS and circulating it for public comment before selecting a specific disposal and/or beneficial re-use site.	TVA disagrees with this comment. TVA's EIS process for the closure began in 2018 and has included multiple public comment periods at various points in the process. Please see response to Comment 10.2. TVA has determined the analysis in the EIS adequately addresses the potential impacts associated with the closure and disposal activities.

No.	Name	Comment	TVA Response
12.10	Amanda Garcia, SELC	…we respectfully insist that TVA: Commit to ensuring the safety of workers who engage in the removal, hauling, and disposal of toxic coal ash in the implementation of TVA's clean-up plan.	TVA is committed to ensuring the safety of our employees and subcontractors. TVA is a zero-injury culture company and expects the same of our contractors and their subcontractors. At all times, including during the implementation of this proposed remedial action, TVA will require that activities be performed in accordance with applicable local, state, and federal health and safety laws and regulations, and TVA's procedures. These procedures include but are not limited to: • TVA employees and contractors will be trained on the specific potential hazards of the project and appropriate practices to be used to mitigate these hazards. • Proper personal protective equipment will be provided to onsite workers and its use will be enforced. • Worker and equipment decontamination stations will be constructed onsite and the use these facilities will be enforced. • Side-dump truck trailers will be used to transport CCR from ALF to the landfill. These trucks are designed to be tightly covered with tarps, and the truck beds are impermeable. These measures will help ensure safe transport of the CCR to the landfill. • TVA will use a third-party health and safety consultant to perform checks on a regular basis to confirm conformance and implement corrective measures if needed. • Air quality monitoring will be performed during CCR removal at the property boundary, in working areas, and on employees to confirm adequate worker protection is in place relative to dust.
12.11	Amanda Garcia, SELC	…the Proposed Plan continues to assert that TVA's coal ash pollution is limited to the shallow portion of the alluvial aquifer and is further limited to two "localized areas" along the southeast and northwest corners of the East Ash Pond… Further, TVA has not installed wells in the alluvial aquifer underneath the East or West Ash Ponds, or in the Memphis Sand Aquifer, so its conclusion that the pollution is limited to "localized areas" is not supported by any data.	Over 70 groundwater monitoring wells are located onsite and screened within multiple depths of the Alluvial aquifer. These wells are sampled on a quarterly basis for CCR constituents. Based on the information collected to date, shallow groundwater impacts have been identified at two areas near the EADA: the north area and the south area. These two areas exhibit the highest concentrations of arsenic and other constituents and are therefore the focus of the groundwater extraction and treatment system being installed by TVA. During CCR removal, access to the CCR units will be limited due to significant construction activities (e.g., dewatering, excavation, staging, and backfilling). As TVA has previously stated, investigation of the groundwater beneath the CCR storage units will be performed after the conditions are made safe to do so and without interrupting closure-by-removal operations. Following unit closure, groundwater conditions near the WADA will be further investigated and addressed as part of the existing TDEC Commissioner's Order OGC15-0177. Please note, the Memphis aquifer has not been impacted by activities at the former Allen Fossil Plant. TVA has collected multiple samples from Memphis aquifer near ALF and continues to do so on a regular basis. The sample results meet state and federal drinking water standards.

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No.	Name	Comment	TVA Response
12.12	Amanda Garcia, SELC	The effects of TVA's failure to investigate the groundwater conditions under the East Ash Pond are exacerbated by several assumptions included in its groundwater model ("Model") that directly conflict with site-specific data in the record. Of particular concern is the assumption in the Model that the so-called "blue clay zone" creates a site-wide impermeable barrier between the shallow and deep layers of the Alluvial aquifer. The available evidence contradicts this assumption; in fact, TVA's own remedial investigation report acknowledges that blue clay zone "does not entirely prevent downward movement like a confining unit." In comments on the Feasibility Study for this site, TDEC similarly stated that the blue clay zone "is not a barrier to downward migration of contaminants," and admonished TVA that "[t]o state that arsenic and other COCs at the site is contained is false…." Finally, as Figures 5 and 6 in the 2020 Cosler Comments show, the blue clay layer cuts through the middle of the arsenic plume as well as the boron and sulfate plumes at the site. Nowhere does TVA or its consultant explain how, if there were actually an impermeable barrier created by the blue clay layer, the coal ash contaminants would have migrated beneath it, deeper into the Alluvial aquifer. Yet the data show that these contaminants have migrated deeper into the Alluvial aquifer. Given the actual data described in TVA's own documents, and the acknowledgment by TVA and TDEC that the blue clay layer is not a confining unit, there is no basis for the assumption in the Model that it acts as one. The Model must be corrected to eliminate this unfounded assumption and calibrated to ensure that it can explain the actual conditions at the site.	As previously reported, TVA's understanding of hydrogeology is based on several years of observed data (e.g., boring logs, aquifer testing, groundwater monitoring, etc.) that have been incorporated into the model. As TVA has previously stated, investigation of the groundwater beneath the CCR storage units will be performed after the conditions are made safe to do so and without interrupting closure-by-removal operations. TVA has stated in reports that the blue clay layer is "less permeable" and "limits downward movement of the water." As further explained in the Updated Remedial Investigation Report (May 2019), "the vertical flux of groundwater and COCs from the blue clay zone are expected to be low given the presence of fine-grained confining clay and silt separating the blue clay zone and the underlying sandy zone shallow Alluvial aquifer. This is consistent with the presence of the highest COCs concentrations within the blue clay zone and lesser concentrations at depth." Additionally, the Feasibility Study (FS) accurately states "the blue clay zone aids in the containment" of constituents. This statement is based on nature of the blue clay (i.e., low hydraulic conductivity and capacity to adsorb arsenic and other metals) and the observed limited vertical migration of constituents. TVA does not contend that the blue clay layer is an "impermeable barrier." Accordingly, the model represents this understanding and does not assume the blue clay zone creates a site-wide "impermeable barrier." The basis for the model assumptions is described in the model report (July 2020). The assumptions support TVA's understanding of the upper Alluvial aquifer acting to inhibit (not prevent) downward vertical migration of dissolved-phase constituents in groundwater. This is reflected in the model parameters used for the upper Alluvial aquifer (which includes the blue clay zone). The groundwater model accurately simulates the current groundwater flow and constituent fate and transport. To date, it has been calibrated with 3,400 field-measured data points. As additional data become available, the model will be further refined to simulate subsurface conditions.
12.13	Amanda Garcia, SELC	Even more astoundingly, the Model assumes that there is no breach in the clay layer at the bottom of the Alluvial aquifer. As explained in the 2020 Cosler Comments, this assumption is directly contradicted by all of the available evidence at the site, including multiple reports authored by groundwater experts at University of Memphis CAESER.	It is inaccurate to state that the model "assumes there is no breach in the clay layer at the bottom of the Alluvial aquifer," which is identified as the upper Claiborne confining unit (UCCU). Rather the model domain is limited to the UCCU and overlying sediments because this is the area of interest (i.e., the Alluvial aquifer). These assumptions are clearly described in the model report (July 2020). Please note that further evaluation of the connectivity between the Alluvial aquifer and the Memphis aquifer is being assessed through the addition of the Memphis aquifer to the groundwater flow model. The Memphis aquifer has been included as an additional layer below the Upper Claiborne Confining Unit. Using the updated groundwater flow model, the fate and transport model will also be updated to support the understanding of constituent migration and the potential effects of the planned remedial activities.

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No.	Name	Comment	TVA Response
12.14	Amanda Garcia, SELC	TVA's contractor acknowledges this obvious flaw in the Model, and deems the assumption of a total no-flow boundary condition at the bottom of the Model "reasonable" because of "the focus of the model on the upper portion of the Alluvial aquifer, the relatively small observed vertical gradients in the deeper portion of the Alluvial aquifer, and the location of the upper Claiborne confining unit encountered in borings at ALF." But these hydraulic gradient findings are themselves created using flawed assumptions. The Model uses flawed assumptions regarding hydraulic conductivity and fails to accurately characterize the long-term average groundwater velocities, errors that further artificially restrict downward flow and contaminant transport.	TVA disagrees with this opinion. The groundwater model for ALF is technically sound, has been calibrated based on 3,400 data points, and continues to be refined as further data becomes available. Vertical hydraulic gradients at ALF have been measured in nested monitoring well locations and the model has been shown through calibration to simulate the observed hydraulic conditions. Hydraulic conductivity assigned within the model is based on calibration and constrained by the conceptual site model.
12.15	Amanda Garcia, SELC	Finally, the Model employs grid cell sizes that are too coarse to simulate accurate contaminant reductions and uses inaccurate dispersivity values.	Grid cell size is very fine with respect to the distribution of available data at the site. A finer discretization would not be anticipated to provide additional accuracy in the fate and transport simulations at a site-wide scale. However, as groundwater remediation progresses, smaller grid-cell sizes may be developed near the extraction wells to ensure that capture zones and constituent transport are accurately represented in these focused areas of interest. The dispersivity value used in the model was within the general range of acceptable values published in literature (Gelhar et al, 1992). Dispersivity is typically estimated based upon studied relationships and calibration to constituent distribution data. Therefore, TVA will continue to evaluate this parameter during future updates of the groundwater model.
12.16	Amanda Garcia, SELC	The result of all of these unfounded and inaccurate assumptions in the Model is that it is essentially useless for the task it is supposed to perform. As designed, the Model does not and cannot accurately predict the contaminant fate and transport at the Allen site, particularly with regard to vertical distribution of contaminants. It is therefore "unsuitable for the design and performance evaluation of remedial measures at the site." At a practical level, this means that the groundwater remedy outlined in the Proposed Plan is likely grossly inadequate. Any thorough groundwater remediation is likely, at a minimum, to require more extraction wells and other methods, and take much longer than the nine years currently projected in the Proposed Plan.	The groundwater model is capable of meeting the project objectives, and as more data becomes available, it will be incorporated into the model to provide further calibration and refinement. The Proposed Plan includes an Interim Response Action (IRA) for groundwater which focuses on the extraction and treatment of groundwater from two areas north and south of the EADA. The groundwater IRA will operate during the closure-by-removal process to control groundwater and begin treatment. TVA recognizes that further evaluation and groundwater remediation may be necessary, and the Proposed Plan includes the following statement relative to additional remedial activities for groundwater: "After CCR removal, additional extraction wells may be added within the current EADA footprint if impacts are found. In addition, in-situ treatment methods may be added (e.g., pH adjustment) if TVA and TDEC determine they will safely speed the groundwater remediation process." Finally, the Proposed Plan does not state that groundwater remediation will take nine years. The Proposed Plan states operation of the groundwater extraction and treatment system will "continue throughout the CCR removal process and until concentrations of CCR constituents in groundwater meet target remediation goals." TVA anticipates that groundwater extraction and treatment will begin in 2022.

Attachment 2 – Public Comment Period

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Date: 11/25/20 **How Submitted:** TVA Public Site **Representing:**
Organization: Resident of Desoto county MS
Comments: Hello, I'm concerned about your plans to remove toxic ash from the Allen station in Memphis. I understand that one of your options is a location in Tu...

Cottam	Timothy	11395 HICKORY DR	HERNANDO	MS	38632	US	tim@statesouthaven.com

Date: 11/23/20 **How Submitted:** TVA Public Site **Representing:**
Organization: Woodland Lake Improvement Association
Comments: Neither Tunica County, MS nor Desoto County, MS have ever benefited from the low-priced electric service provided by TVA's Allen Fossil plant in Memph...

Currie	Debra	3640 Glen Artney	Hernando	MS	38632	USA	djmcurrie0128@gmail.com

Date: 12/01/20 **How Submitted:** TVA Public Site **Representing:**
Organization: None
Comments: I live in Eudora, MS. On the bluff just east of the landfill in Tunica County. My drinking water comes from a well near that landfill. Please dont ...

Davis	Leslie	1325 Fieldstone	Hernando	MS	38632	United States	Davisfamille96@gmail.com

Date: 11/25/20 **How Submitted:** TVA Public Site **Representing:**
Organization: None
Comments: This toxic ash was created in Tennessee, for the benefit of residents and low TVA electric rates. Mississippi should not be the dumping ground for a ...

Deese	Sheila	11355 1st Cypress Cove	Hernando	MS	38632	Usa	Sdeese2@gmail.com

Date: 11/23/20 **How Submitted:** TVA Public Site **Representing:**
Organization: None
Comments: Please keep your hazardous waste in your TVA service area. We do not wish to store your coal ash due To future contamination....

Harrison	Ashley	1575 Dexter Lake Dr	Cordova	TN	38016	United States	Ashley.harrison106@gmail

Date: 12/17/20 **How Submitted:** TVA Public Site **Representing:**
Organization: None
Comments: Dear Jeff Lyash and TVA, I hope this comment finds you well. I'm extremely concerned about the persisting attack on the people who live in the 3810...

Holdford	Madeleine	719 Maury Street	Memphis	TN	38107	United States	holdfordm@gmail.com

Date: 12/17/20 **How Submitted:** TVA Public Site **Representing:**
Organization: None
Comments: I'm extremely concerned about the persisting attack on the people who live in the 38109 area of Memphis by pollutants and by environmental racism. The...

Jones	Kizzy	1729 Turtle Hill Dr Cordova	Cordova	TN	38016	United States	kdunjones1@gmail.com

Date: 12/17/20 **How Submitted:** TVA Public Site **Representing:**
Organization: None
Comments: Dear Jeff Lyash and TVA, I hope this comment finds you well. I'm extremely concerned about the persisting attack on the people who live in the 3810...

Levenshus	Jonathan	50 F Street, NW	Washington	DC	20001	United States	jonathan.levenshus@sierra

Date: 12/17/20 **How Submitted:** TVA Public Site **Representing:**
Organization: Sierra Club **Attachment:** View
Comments: The attached document contains 109 signatures, 32 of which are accompanied by additional personal messages. These signatures indicate broad and divers.

Magill	Brenda	3325 Woodland Lake Dr	Hernando	MS	38632	USA	bwmagill@gmail.com

Date: 11/23/20 **How Submitted:** TVA Public Site **Representing:**
Organization: None
Comments: Our area isn't in the TVA service area so please don't bring the ash to our area!

Mann	Carol	316 Sonoma Cove	Madison	MS	39110	USA	cmann@mannageny.com

Date: 12/16/20 **How Submitted:** TVA Public Site **Representing:**
Organization: None **Attachment:** View
Comments: Mann comments attached.

Nelson	Dr. Yvonne D.	Post Office Box 9146	Memphis	TN	38190-0146	US	myzip463@gmail.com

Date: 12/17/20 **How Submitted:** TVA Public Site **Representing:**
Organization: My ZIP
Comments: Thank you for the opportunity to speak regarding the seemingly endless fight against environmental injustice in this predominantly black community. We...

Oaks	Sara	73 Viking Cv	Cordova	TN	38018	United States	Sacoaks@att.net

Date: 12/04/20 **How Submitted:** TVA Public Site **Representing:**
Organization: Protect Our Aquifer
Comments: Our aquifer must remain uncontaminated throughout this process.

Pearson	Justin	3583 Norriswood Ave.	Memphis	TN	38111	United States	Justinjpearson1@gmail.co

Date: 12/17/20 **How Submitted:** TVA Public Site **Representing:**
Organization: Memphis Community Against the Pipeline
Comments: Dear Jeff Lyash and TVA, I hope this comment finds you well. I'm extremely concerned about the persisting attack on the people who live in the 3810...

Siebert	Uele	525 HIGH POINT TER	MEMPHIS	TN	38122-3759	United States	ueleriver@gmail.com

Date: 12/17/20 **How Submitted:** TVA Public Site **Representing:**
Organization: Memphis Community Against the Pipeline
Comments: Dear Jeff Lyash and TVA, I hope this comment finds you well. I'm extremely concerned about the persisting attack on the people who live in the 38109 ...

Underwood	Zachary	409 E Harding Ave	Greenwood	MS	38930	USA	zlunderwood57@gmail.con

Date: 11/17/20 **How Submitted:** TVA Public Site **Representing:**
Organization: Private citizen of Mississippi
Comments: As a private citizen and resident of the state of Mississippi it is my desire that you cease and desist with your consideration of the Tunica site for...

Walker	Phillip	3113 Mt. Paloma Cive	Bartlett	TN	38134		Phillp_walker@bellsouth.n

Date: 12/05/20 **How Submitted:** TVA Public Site **Representing:**
Organization: None
Comments: I support the efforts of Protect Our Aquifer calling for the safest method to relocate the coal ash. Protecting the Memphis Sands Acquifer from contam...

White	M		Hernando	MS	38632	USA

Date: 11/23/20 **How Submitted:** TVA Public Site **Representing:**
Organization: None
Comments: Tunica & Desoto counties don't benefit from TVA ... we shouldn't have their TOXIC WASTE dumped in our county, possibly endangering our water supply an.

add new commenter

TVA Public Comments Form

Thank you for your submission.

Project: Allen Proposed Plan to Address Environmental Conditions
First Name: Jonathan
Last Name: Levenshus
Organization: Sierra Club - Official Representative
Address: 50 F Street, NW
City: Washington
State: DC
Zip Code: 20001
Country: United States
E-mail: jonathan.levenshus@sierraclub.org
Phone: 2025900893
Fax:

What would be the best way to contact you? E-mail

You uploaded a comments file. View the uploaded file.

You entered the following comments:

The attached document contains 109 signatures, 32 of which are accompanied by additional personal messages. These signatures indicate broad and diverse support for robust worker and community protections regarding the removal and storage of the coal ash currently at the Allen Fossil Plant.

The following spreadsheet contains names and contact information of people who signed the letter below:

I support the safe removal of coal ash from the impoundments at the Allen coal plant because of groundwater contamination. Closing the leaking, unlined impoundments and disposing of the ash in dry, lined landfills out of the groundwater and away from McKellar Lake is the right decision for our community.

It is essential that TVA prioritize worker and community safety before the coal ash is removed from the impoundments and the waste is transported and stored in a new location.

Specifically, I ask that TVA develop a plan to ensure the adoption and implementation of stringent safety measures that will apply to all workers and contractors involved with this project. TVA must also ensure the final disposal location for its coal ash complies with laws that are designed to protect people from air and water pollution.

Finally, I urge TVA to hold public meetings and conduct outreach in the communities that will be impacted during the transport and storage of its waste. Ensuring transparent communication with frontline communities is the best way to avoid environmental justice concerns and risks.

Thank you for your consideration of these comments. If you have any questions, please contact Jonathan Levenshus at jonathan.levenshus@sierraclub.org.

Jonathan Levenshus
Sierra Club Beyond Coal Campaign

delivery mission. TVA will use the responses to plan and inform its efforts to improve or maintain the quality of service and programs offered to the public. Furnishing this information is voluntary; any comments received, including names and addresses, will become part of the project administrative record and will be available for public inspection.

	A	B	C	D	E	F	G
1	**Name**	**Email**	**Mailing Street**	**Mailing City**	**State**	**ZIP**	**Personal Message**
2	Missy Lutterloh	artteacher24@gmail.com	3293 Sycamore View Rd	Bartlett	TN	38134	It is imperative that the TVA prioritize worker and community safety before the coal ash is removed from the Allen station to the designated new location. We don't need to be the new Flint Michigan news item and let the nation know we don't care about the welfare of our citizens and workers.
3	Chet Kibble	chetnsherry@bellsouth.net	3229 Lakeview Rd	Memphis	TN	38116	Memphis poor communities have experienced many environmental exposures that have effected their health and children, satistics show many communities have a SHORTER LIFE SPAN and we rank second in region four of lead poisoned children, asthma is a very serious problem. It is time peoples health take a priority and safety becomes some thing that is done prior to a tragedy.
4	Sue Williams	sueawilliams.saw@gmail.com	4292 Clifford Rives Rd	Union City	TN	38261	Tennesseans deserve environmental justice.
5	Karen Parker	captkarenfedex@aol.com	90 Karen Cv	Eads	TN	38028	It's your job to protect our citizens, our air and our groundwater - do your job!
6	Charles Belenky	cbelenky@gmail.com	5019 Welchshire Ave	Memphis	TN	38117	It is very important the ash be transported safely on non-residential streets. There are a lot of bad drivers and if it could move by rail, that might be better.
7	Felecia Brooks	tranquilight@aol.com	11230 Highway 64	Arlington	TN	38002	Please do the right thing for the people and the environment, that the creator left under our care. This planet is our only home. Treat it like it is our actual home. Because it is.
8	Cody Lock	codylock73@gmail.com	9018 Osborntown Rd	Arlington	TN	38002	Coal Ash storage in unprepared places puts civilian lives at risk. These people expect decision makers to think of public interest and put their lives before dollar bills. One must consider the human impact of their decisions, and I urge you to do so.
9	Thomas Davis	bornmemphis@gmail.com	4467 Coltwood Dr	Lakeland	TN	38002	Our water is one of the precious resources that we have here in Memphis. We are a poor city and can't make a mistake here. Please protect us and our water any and every way possible.
10	Stephanie Norwood	info@studionorwood.com	970 N Barksdale St	Memphis	TN	38107	Just do the right thing. Don't cut corners when it comes to protectecting people and our environment! Please and Thank you.
11	Barbara Presley	barbara.presley@gmail.com	8164 Scruggs Dr	Germantown	TN	38138	Please do the right thing. Think about your own families and their health. Would you put this in your own neighborhood? Thank you for your consideration.
12	Justin J. Pearson	justinjpearson1@gmail.com	3583 Norriswood Ave	Memphis	TN	38111	This coal ash pond has continued to create damage and do harm to our community. The communities do not deserve more damage or environmental devastation in their neighborhoods. Please SAFELY remove the toxic waste.
13	Shahin Samiei	ssamiei_mem@yahoo.com	4125 Hilldale Ave	Memphis	TN	38117	I am a native Memphian and have been very concerned about the ash from the Allen coal plant. We must preserve, protect, and defend the irreplacable natural resources of the Mid-South -- most saliently, our remarkable aquifer. Following what took place at the other end of our great state (Kingston, TN) in 2008, know that our community is watching closely. Please, do the right thing by our region and its remarkable residents and ensure that community and worker protections are of paramount priority.
14	George Williams	dachshunddoc@sbcglobal.net	160 Shady Oaks Dr	Eads	TN	38028	The workers and our communities must be top priority! No exceptions!
15	Linda Raiteri	lraiteri@gmail.com	3817 Allandale Ln	Memphis	TN	38111	2020 has demonstrated the cost of lives and livelihoods of poor leadership, lack of communication, and lack of concern. TVA has the opportunity to show good leadership through protecting the workers, the environment, and the communities involved in this project.
16	Don Talley	dhtalley49@gmail.com	4097 Southlawn Ave	Memphis	TN	38111	I don't want people to die because the TVA considers it too costly to clean up it's messes . My tax money pay your salaries . You don't deserve it .
17	Lisa Moore	lisa@dancingwaterusa.com	88 Marne St	Memphis	TN	38111	Please include community voice and input in the establishment of protocols and plans for removal and disposal of Allen plan ash. I worked with residents in Frayser to mobilize information about a proposed landfill in their area. The more they know the better informed they are and the best outcomes for the community are achieved!
18	Janice Vanderhaar	gvanderh@earthlink.net	5067 Waters Edge Cv N	Memphis	TN	38141	Please act quickly to remove coal ash from the allen coal plant. Too many people and the environment at risk. I am deeply concerned. No more delays. Thank you!
19	Karl Erickson	kheone@gmail.com	424 Angelus St	Memphis	TN	38112	Please keep our communities and workers safe. Do not deposit the coal ash in areas of high population density.
20	Emily Oppenheimer	emoppenheimer@gmail.com	1319 Goodbar Ave	Memphis	TN	38104	Health, safety, and water purity are of the utmost importance! Do the right thing for Memphis, TVA!
21	Charlee Graham	findyourvoice2@gmail.com	1588 Galloway Ave	Memphis	TN	38112	Please do the right thing to protect the health and well being of workers citizens, and the environment that we all share. Please consider what is right over the bottom line. Your choices can preserve lives. You have the power to make this world better.... or so much worse.
22	Zack McMillin	zackmcm@yahoo.com	1437 Eastridge Dr	Memphis	TN	38120	It's important you listen to citizens of Memphis on this issue.
23	Diane Mattson	sdianemattson@gmail.com	6135 Kentwood Dr	Horn Lake	MS	38637	Environment = only thing that matters.
24	joan laney	jonilaney@gmail.com	2547 McAdoo Ave	Memphis	TN	38112	Please, please, please be aware of the health costs to your removing coal ash and only protecting your profits. Keep coal ash workers safe, protect the water and air from spills and give communities an opportunity to respond to your proposals before construction begins.
25	Edward Jones	edshouse35@me.com	5071 Anchor Cv	Memphis	TN	38117	Protect workers and neighborhoods while moving coal ash. Prevent spillage.
26	Barbara Blum	newday_456@yahoo.com	423 Angelus St	Memphis	TN	38112	Please do the right thing. Safeguard employees but remove the ash to ensure clean water.

	A	B	C	D	E	F	G
1	**Name**	**Email**	**Mailing Street**	**Mailing City**	**State**	**ZIP**	**Personal Message**
27	Leslie Fuller	lesliefuller55@yahoo.com	2101 Cowden Ave	Memphis	TN	38104	Back in the early 70s, I went water skying with friends at McKellar Lake. Shortly thereafter I had a horrific urinary tract infection which resulted in being hospitalized at Methodist Hospital and treatment for 9 months on an outpatient basis. I was fortunate that I had aggressive follow up by a urologist. My life was dramatically changed because I nearly died from exposure to chemicals dumped on McKellar lake. The coal ash safety issue is even more imperative than ever.
28	Becky and James Mercer	jamercer@bellsouth.net	1381 Vinton Ave	Memphis	TN	38104	I am glad that TVA will finally be removing the coal ash from its current dangerous location at the Allen plant, but I beg you to make specific and detailed plans to move the ash safely in order to protect the workers and the local community. We as members of that community need to be told in public meetings all about those removal plans and about the plans for the next storage location. Protection from this toxic mess is essential!
29	Janice Vanderhaar	gvanderh@earthlink.net	5067 Waters Edge Cv N	Memphis	TN	38141	Please remove coal ash from the Allen coal plant and protect our precious water from contamination. No time to waste. Do it promptly.
30	Leslie Jacobs	mythic.omens@gmail.com	69 N Ashlawn Rd	Memphis	TN	38112	Keep our city safe.
31	Sara Oaks	sacoaks@att.net	73 Viking Cv	Cordova	TN	38018	We want to ensure that workers or the community aren't endangered in the process.
32	Sarah Houston	sgwhouston@gmail.com	673 E. Parkway S. 3	Memphis	TN	38104	Thank you for taking this necessary step to remove the leaking, toxic coal ash from southwest Memphis. The removal process is a large undertaking and we want assurance that every type of safety measure can be used to protect the air quality during removal, the water quality and that the roadways are repaired after years of heavy usage by TVA contracted truckers.
33	charles belenky	lalaradio@hotmail.com	5019 Welchshire Ave	Memphis	TN	38117	Don't go through Boxtown on 3rd street. Use I-55 to I-69.
34	Donathan Beasley	justplaindon@comcast.net	4598 Plato Ave	Memphis	TN	38128	
35	Karen Terre	oliver1229@aol.com	6603 Massey Ln	Memphis	TN	38120	
36	Alleia Bakker	alleiakragtbakker@gmail.com	1752 Vinton Ave	Memphis	TN	38104	
37	Stephanie Poole	stephanie@airfieldetc.com	2922 Tulane Rd	Nesbit	MS	38651	
38	Jo Cohen	jacohen97@gmail.com	3144 Woodland Crest Dr	Lakeland	TN	38002	
39	Carol Kloville	navaho8@gmail.com	3881 Faxon Ave	Memphis	TN	38122	
40	Diana Gill	dkcgill@gmail.com	265 W Poplar Ave	Collierville	TN	38017	
41	William Brisolara	wjb618@comcast.net	561 S Reese St	Memphis	TN	38111	
42	Scott Banbury	scott.banbury@sierraclub.org	1051 Stonewall St	Memphis	TN	38107	
43	Anne Hagler	anneh6616@gmail.com	1833 Tutwiler Ave Apt 2	Memphis	TN	38107	
44	Darrel Easter	deaster@netzero.com	3165 Woodsman Ln	Bartlett	TN	38135	
45	Hunter Oppenheimer	hunteropp@gmail.com	2038 Carr Ave	Memphis	TN	38104	
46	Linda Kaplan	lindackaplan@msn.com	2922 Hamilton Sq	Decatur	TN	38138	
47	Diana Saunders	diana@seainvestments.net	320 Fountain Crest Dr	Memphis	TN	38120	
48	Julia Kathryn Dennis	emeralddove444@gmail.com	4735 Lynn Rd	Memphis	TN	38122	
49	Frank Chalona	frankchalona@gmail.com	1897 Autumn Ave	Memphis	TN	38112	
50	Noel Emswiler	noelnick@me.com	5016 Rivercrest Ln	Bartlett	TN	38135	
51	Nigel Bowen	ngb1@yahoo.com	9680 White Spruce Cv	Lakeland	TN	38002	
52	Alice Hudson	amhudson@bellsouth.net	3816 Piper Bay Cv	Lakeland	TN	38002	
53	Nabil Bayakly	bayakly@aol.com	8835 Doveland Dr	Cordova	TN	38018	
54	J Stephen Adams	stadams@aol.com	45 S Rembert St	Memphis	TN	38104	
55	Elaine Vowell	evowell@hotmail.com	524 Summitt St	Memphis	TN	38104	
56	Milan Vigil	milanvigil@yahoo.com	PO Box 11532	Memphis	TN	38111	
57	Debbie Mcgr	debmc369@gmail.com	8164 S Park Cir	Southaven	MS	38671	
58	Sandra Chapman	skpchapman@msn.com	6312 Dawn Haven Dr	Millington	TN	38053	
59	Richard Sorak	528hemi@gmail.com	3147 Egypt Central Rd	Memphis	TN	38128	
60	Pat Papachriston	ppapachr@cbu.edu	389 Holmes Cir	Memphis	TN	38111	
61	Amanda Hawkins	ajredwolf@yahoo.com	3548 Brandon Ln	Bartlett	TN	38134	
62	Linda Kaplan	lindackaplan@msn.com	2922 Hamilton Sq	Decatur	TN	30033	
63	Jesse Mccabe	jessemccabe777@gmail.com	9660 Trotter Dr	Lakeland	TN	38002	
64	Augustus Gottlieb	gusjtgottlieb@gmail.com	250 Buena Vista Pl	Memphis	TN	38112	
65	Linda Ross	linross7@comcast.net	2303 Ridgeland St	Memphis	TN	38119	
66	Sarah Reeves	sarah.r.e.reeves@gmail.com	682 Springhurst Dr	Lexington	KY	40503	
67	Kathleen Panarisi	kathleenpanarisi@gmail.com	900 Chesterton Dr	Memphis	TN	38127	
68	Lawrence Jasud	ljasud@bellsouth.net	244 S Greer St	Memphis	TN	38111	

	A	B	C	D	E	F	G
1	**Name**	**Email**	**Mailing Street**	**Mailing City**	**State**	**ZIP**	**Personal Message**
69	Steve Cunningham	cunninghamsteve@hotmail.com	641 N Trezevant St	Memphis	TN	38112	
70	Eric Robinson	black-rose@mindspring.com	108 N Belvedere Blvd Apt 17	Memphis	TN	38104	
71	Johanna Ankkuri-Fagan	johannayo0426@aol.com	8720 Thomas Ln	Olive Branch	MS	38654	
72	Priscilla Awsumb	pawsumb42@me.com	3725 Waynoka Ave	Memphis	TN	38111	
73	Rebecca Russell	neubernrussell@comcast.net	25 Stagg Rd	Oakland	TN	38060	
74	Gina Turner	gmgturn@yahoo.com	4036 Forrest Dr	Memphis	TN	38122	
75	Rachel Levine	rblforu@yahoo.com	1806 Kimbrough Rd	Germantown	TN	38138	
76	Leslie Fuller	lesliefuller55@yahoo.com	2101 Cowden Ave	Memphis	TN	38104	
77	Linda Purser	lspurser@bellsouth.net	3473 Hendricks Ave	Memphis	TN	38111	
78	Cheryl Dare	mary.go_around@yahoo.com	108 N Auburndale St Apt 721	Memphis	TN	38104	
79	Philip Williams	exster989@gmail.com	1696 Oaken Bucket Dr	Cordova	TN	38016	
80	C. Thrasher	rthras2@yahoo.com	2047 Higbee Ave	Memphis	TN	38104	
81	Zoë Elliotte	zoemelliotte@gmail.com	710 S Cox St	Memphis	TN	38104	
82	Albert Kirk	albert.kirk@vv.cdom.org	10599 Bishop Dozier Dr	Cordova	TN	38016	
83	Hattie Lattner	hattie.lattner@memphistr.org	761 Homer St	Memphis	TN	38122	
84	Anna Hogan	annamhogan@hotmail.com	279 Stonewall St	Memphis	TN	38112	
85	don hill	dhill140@centurylink.net	150 academy st.	Franklinville	NC	27248	
86	PAUL MANGOLD	paul_mangold@msn.com	2101 Clover Bend Dr	Monroe	NC	28110	
87	Elaine Becker	elainebecker@yahoo.com	2514 Sharmar Rd	Roanoke	VA	24018	
88	Margaret Franklin	harbormarg@msn.com	145 E Pecan Valley St	Collierville	TN	38017	
89	Pearl Walker	pearlevawalker@gmail.com	5378 Loch Lomond Rd	Memphis	TN	38116	
90	Jerry Lee	jerryglee1102@gmail.com	2211 Legacy Park Loop	Tuscaloosa	AL	35404	
91	Lesha Thornton	lthornto@earthlink.net	3218 Monmouth St	Knoxville	TN	37917	
92	Rosemary Ward	arosemary1@yahoo.com	1216 Greenway St	Greenville	MS	38701	
93	Katherine Ragsdale	leeragsdale0@gmail.com	6453 Fleetwood Dr	Nashville	TN	37209	
94	Jackie Edmonson	ann.ericson@yahoo.com	800 Swadley Rd	Johnson City	TN	37601	
95	Caitlin Lloyd	caitlinlloyd42@gmail.com	301 Lippencott St	Knoxville	TN	38112	
96	Patricia Dishman	dishmanx2@aol.com	914 Briarwood Crst	Nashville	TN	37221	
97	Colleen Radbill	cradbill@yahoo.com	4986 Sawgrass Pl NW	Acworth	GA	30102	
98	Connie Arduini	cmarduini@gmail.com	2053 Nelson Ave	Memphis	TN	38104	
99	Allison Stillman	allee33@sbcglobal.net	204 Longwood Ct	Nashville	TN	37215	
100	Barbara Hipps	barbara.hipps@gmail.com	1796 S Goodlett St	Memphis	TN	38111	
101	Elizabeth Clark	elizabethclark54@gmail.com	916 Tatum Rd	Memphis	TN	38122	
102	Gus Gottlieb	gusjtgottlieb@gmail.com	250 Buena Vista Pl	Memphis	TN	38112	
103	Jeffrey Land	jeffrey.land@colorado.edu	2262 Lovitt Dr	Memphis	TN	38119	
104	Rebecca Beaton	becky.beaton@comcast.net	80 Talbot Ave Apt 204	Memphis	TN	38103	
105	Leslie Fuller	lesliefuller55@yahoo.com	2101 Cowden Ave	Memphis	TN	38104	
106	Caroline Mudbone	bcmudbone@yahoo.com	1650 Walter St	Memphis	TN	38108	
107	Jamie Warden				TN	38018	
108	Tara Fredenburg				TN	38117	
109	Erika Guyton	erikaguyton@gmail.com	2777 Mahue Dr	Memphis	TN	38127	
110	Duffy-Marie Arnoult				TN	38112	

Attachment 2A – Letter from Zip Code 38109 Residents

Name: joseph dougherty

Comments: Good evening,

I OPPOSE the Byhalia Pipeline construction and am EXTREMELY CONCERNED about the TVA's coal ash clean-up planning. I request that TVA spend 9 years doing 240 truck trips of poisonous coal ash through the neighborhood to a landfill across 38109. "We chose the path of least resistance." Do you know who said that regarding the neighborhoods most directly impacted by the deleterious effects of the Allen Fossil Plant ash and the potential Byhalia oil pipeline? The spokesperson from Plains All American Pipeline--the very person tasked with educating the community about why they chose the route they did for the pipeline and who is supposed to ensure the safety of the people affected by a project such as theirs. The route is set to cut through an already vulnerable community. I ask that you question whose interests they had in mind when the Plains All American spokesperson so grossly provided that as what he thought was an acceptable answer. We do not accept that explanation. It is negligent and will cost people their lives.

"When under-resourced or minority or at-risk communities gain access to knowledge that they need to pursue their claims in court or against the state or against industry or whatever, does that new knowledge actually affect the outcome?" says Frickel [Sociologist, Brown University]. "I'm not sure what the answer to that is. Sometimes it might. My suspicion is that more often than not, powerful interests with more resources can overcome hard-won environmental knowledge or data that communities work to get." You have an opportunity to do the right thing. I implore you, I beg you to please listen to your humanity, to your heart, and think about whether you would be ok with the pipeline or the current plan for ash removal if it were going through the backyards and into the lungs of your grandchildren.

I am asking you look at the data, look at the science and let that guide your decision-making. According to a 2013 study, the cumulative cancer risk from toxic air in southwest Memphis, which includes Boxtown, is four times higher than the national average, and driven by industrial and transportation-related pollutants like benzene and formaldehyde. As is the case with many communities experiencing environmental injustice, no public health studies focus specifically on health risks facing Boxtown residents. But we know that Boxtown is already surrounded by 32 industrial facilities and a Valero oil refinery within a 5 mile radius. This community cannot handle another pipeline. It cannot handle another shoddy clean-up job. Please help these people.

Although nearly half of residents in Boxtown's census tract have an annual household income below $25,000 a year, 61% are homeowners — well above the most recent average national Black homeownership rate of 47%, which lags behind that of white homeowners, at 76%, due to a history of discriminatory housing policies. Many Boxtown residents own and live in houses that have been in the family since they were built, some as far back as five generations when their relatives were freed from slavery. A 2015 study from the University of California, Berkeley and the California Environmental Protection Agency published in the American Journal of Public Health found that risk exposure to environmental hazards (in proximity to where they live) for Hispanics was 6.2 times higher than whites, and 5.8 times higher for African Americans. Asians and Native American face double the environmental health hazard risks compared to whites. So for generations, residents in the 38109 and 38106 zip codes, residents of the historically black neighborhood to Boxtown, have been been exposed to environmental hazards that we know definitively impact their health and life outcomes.

Additionally, for most parts of the 38109 zip code, no more than 30% of its residents have access to broadband internet. Community outreach and engagement on the Byhalia pipeline project moved to virtual zoom meetings and other virtual platforms this summer due to COVID. As a result, 70% of the people in this community were effectively shut out of the conversation regarding the Byhalia pipeline. This is not sufficient community engagement, input, or education for the residents and stands to be criminal if it is not recognized and if this plan pushes through without postponement. We need to halt any decision making until everyone in the community most affected can be brought fully into the conversation.

Please do the right thing.

Sincerely,
Joe Dougherty

Name: Patricia Dougherty

Comments: I OPPOSE the Byhalia Pipeline construction and am EXTREMELY CONCERNED about the TVA's coal ash clean-up planning. I request that TVA spend 9 years doing 240 truck trips of poisonous coal ash through the neighborhood to a landfill across 38109. "We chose the path of least resistance." Do you know who said that regarding the neighborhoods most directly impacted by the deleterious effects of the Allen Fossil Plant ash and the potential Byhalia oil pipeline? The spokesperson from Plains All American Pipeline--the very person tasked with educating the community about why they chose the route they did for the pipeline and who is supposed to ensure the safety of the people affected by a project such as theirs. The route is set to cut through an already vulnerable community. I ask that you question whose interests they had in mind when the Plains All American spokesperson so grossly provided that as what he thought was an acceptable answer. We do not accept that explanation. It is negligent and will cost people their lives.

"When under-resourced or minority or at-risk communities gain access to knowledge that they need to pursue their claims in court or against the state or against industry or whatever, does that new knowledge actually affect the outcome?" says Frickel [Sociologist, Brown University]. "I'm not sure what the answer to that is. Sometimes it might. My suspicion is that more often than not, powerful interests with more resources can overcome hard-won environmental knowledge or data that communities work to get." You have an opportunity to do the right thing. I implore you, I beg you to please listen to your humanity, to your heart, and think about whether you would be ok with the pipeline or the current plan for ash removal if it were going through the backyards and into the lungs of your grandchildren.

I am asking you look at the data, look at the science and let that guide your decision-making. According to a 2013 study, the cumulative cancer risk from toxic air in southwest Memphis, which includes Boxtown, is four times higher than the national average, and driven by industrial and transportation-related pollutants like benzene and formaldehyde. As is the case with many communities experiencing environmental injustice, no public health studies focus specifically on health risks facing Boxtown residents. Although nearly half of residents in Boxtown's census tract have an annual household income below $25,000 a year, 61% are homeowners — well above the most recent average national Black homeownership rate of 47%, which lags behind that of white homeowners, at 76%, due to a history of discriminatory housing policies. Many Boxtown residents own and live in houses that have been in the family since they were built , some as far back as five generations when their relatives were freed from slavery. A 2015 study out of California published in the American Journal of Public Health found that risk exposure for Hispanics was 6.2 times higher than whites, and 5.8 times higher for African Americans. Asians and Native American face double the environmental health hazard risks compared to whites. Boxtown is already surrounded by 32 other industrial facilities and a Valero oil refinery. This community cannot handle another pipeline. It cannot handle another shoddy clean-up job. Please help these people.

Additionally, for most parts of the 38109 zip code, no more than 20% of its residents have access to broadband internet. Community outreach and engagement on the Byhalia pipeline project moved to virtual zoom meetings and other virtual platforms this summer due to COVID. This is not sufficient community engagement, input, or education for the residents and stands to be criminal if it is not recognized.

Please do the right thing.

With love,
Patty Dougherty

Name: Theresa Dougherty

Comments: Dear Jeff Lyash and TVA,

I hope this comment finds you well. I'm extremely concerned about the ongoing negligence of the TVA in its handling of the removal of the coal ash. The TVA has a duty to the people, ALL people, that it operate in the most safe and protective manner possible--regardless of the cost. If people get sick and God forbid, die, you cannot bring them back. Money can substitute for a lot of things but that's not one of them. The public has entrusted to you the responsibility of holding tantamount the human life that is affected by fossil fuel manufacturing and its environmental impact, in particular, those residents living in the 38109 and 38106 communities which are most directly impacted by the environmental pollutants and toxins produced by the Allen Plant and by other industry around those communities.

The zip code 38109 is 99% black. It is one of the poorest area codes in the nation with a median income of $31K compared to $41K in Memphis and a staggering $51K in Shelby County. A study based on census data from 2000 found that 68% percent of Black people lived within 30 miles of a coal-fired power plant, while only 56% of white people lived within 30 miles of a coal-fired power plant. Coal-fired power plants produce air, land and water pollution (including radioactive materials...big yikes) and are linked to higher rates of cancer. According to the NAACP's 2012 'Coal-Blooded' study, 53% of people who live within three miles of the most heavily-polluting coal-fired power plants are Black. This shows that not only do Black people live closer to coal-fired power plants, they also tend to live closer to the most dangerous coal-fired power plants. A number of holding tanks have collapsed over the years -- most notably in Tennessee -- spilling coal ash into area waterways. Dry coal ash can potentially escape into the air. Researchers from Duke University in North Carolina in 2015, studying coal ash, found that high concentrations of radioactive contaminants have been found in coal ash produced in North America's regions with the presence of coal manufacturing and its waste.
'Because of the tiny size of the fly ash particles, they are much more likely to be suspended in air if they are disposed in a dry form,' Lauer said. 'People breathing this air may face increased risks, particularly since tiny particles tend to be more enriched in radioactivity.'
The Allen plant's existence in this area is a monument to environmental racism and environmental degradation of an already vulnerable and low-income Black community. The poisonous toxins that are now being planned to be removed (which is good news) is not being planned by thoughtfully considering the effect on this overly burdened community (which is bad news).
The coal ash must be removed. It is toxic in an unlined pit alongside McKellar Lake where a known gap exists in the clay layer that protects the aquifer. It is known to be leaking three nasty chemicals (arsenic, lead, and fluoride). TVA burned the coal and TVA should clean it up. Shelby County and Memphis paid for the electricity for 50 years and now we are being told that we will continue to be burdened to pay to clean up the decades of residue from the coal. This community will have to have semi-trucks on our roads carrying coal ash for 9 years. Then, the toxic ash will take up space in our landfills which may not be able to properly handle all of the toxins from TVA's Allen plant clean up from seeping into our soil.
Alternative C and D should be selected based on your initial presentation to TDEC. There needs to be beneficial reuse for the CCR and/or another option: D: TVA should purchase land nearby (like at Frank Pidgeon Industrial Park), and start your own landfill: lined, leachate collection, monitored and managed properly.
It is impossible to believe if this were a higher Socio-economic status community that you would propose "240 truck trips per day" to remove your toxic waste. You've admitted in your own findings that these coal ash ponds have "arsenic, fluoride, and lead in groundwater." So much "arsenic that it is above the USEPA drinking water standard was found north and south of the East Ash Disposal Area in the shallow Alluvial aquifer" with "the highest concentrations were found within the upper 40 feet." Why should anyone be expected to accept this as okay to be driven down the roads where we drive and take children to school especially when a safer and more fair alternative exists (see above).
"Because of the long operating history of the TVA Fossil Plants, there have been potential opportunities for CCR materials to move into surface water and for dissolved CCR constituents to migrate via groundwater flow into surface water...." Our aquifer and land continue to be in danger by not carefully considering an alternative where TVA takes ownership of making sure this community is safe. We do not want to have trucks driving up and down our roads for 10 years with these dangerous chemicals that can spill if there's an accident as well. The community isn't going to be reimbursed for the millions it will take to repave the roads either-or time lost as these trucks travel through the community creating the burden of more congestion.
One of TVA's stated commitments is "protecting human health and the environment and doing the right thing for the people of Memphis." By refusing to hear the voice of the community and its advocates due to racism and classism does the opposite of what you've committed to doing. This community doesn't deserve nearly a decade of damage to our roads and our land after dealing for half a century with the harmful effects of coal being burned in our air and our lungs. This community should not be responsible for bearing this burden, TVA should.
Kind regards and talk soon,
Tess Dougherty

Name: Eleanor Forrester

Comments: Dear Jeff Lyash and TVA,

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Kind regards,
Eleanor Forrester

Name: Tara Fredenburg

Comments: To Jeff Lyash and TVA,

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Thank you,
Tara Fredenburg

Name: Ashley Harrison

Comments: Dear Jeff Lyash and TVA,

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Kind regards and talk soon,

Ashley Harrison

Name: Madeleine Holdford

Comments: I'm extremely concerned about the persisting attack on the people who live in the 38109 area of Memphis by pollutants and by environmental racism. The Allen plant's existence in this area is a monument to environmental racism and environmental degradation of an already vulnerable and low-income Black community. The poisonous toxins that are now being planned to be removed (which is good news) is not being planned by thoughtfully considering the effect on this overly burdened community (which is bad news).

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Name: Kizzy Jones

Comments: Dear Jeff Lyash and TVA,

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Name: Tray Munn

Comments: Dear Jeff Lyash and TVA,

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Name: Kimberly Owens-Pearson

Comments: Dear Jeff Lyash and TVA,

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Kimberly Owens-Pearson

Name: Justin Pearson

Comments: Dear Jeff Lyash and TVA,

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One of TVA's stated commitments is "protecting human health and the environment and doing the right thing for the people of Memphis." By refusing to hear the voice of the community and its advocates due to racism and classism does the opposite of what you've committed to doing. This community doesn't deserve nearly a decade of damage to our roads and our land after dealing for half a century with the harmful effects of coal being burned in our air and our lungs. This community should not be responsible for bearing this burden, TVA should.

Kind regards and talk soon,
Justin J. Pearson

Name: Kathy Robinson

Comments: I hope this comment finds you well. I'm extremely concerned about the persisting attack on the people who live in the 38109 area of Memphis by pollutants and by environmental racism. The Allen plant's existence in this area is a monument to environmental racism and environmental degradation of an already vulnerable and low-income Black community. The poisonous toxins that are now being planned to be removed (which is good news) is not being planned by thoughtfully considering the effect on this overly burdened community (which is bad news).

The coal ash must be removed. It is toxic in an unlined pit alongside McKellar Lake where a known gap exists in the clay layer that protects the aquifer. It is known to be leaking three nasty chemicals (arsenic, lead, and fluoride). TVA burned the coal and TVA should clean it up. Shelby County and Memphis paid for the electricity for 50 years and now we are being told that we will continue to be burdened to pay to clean up the decades of residue from the coal. This community will have to have semi-trucks on our roads carrying coal ash for 9 years. Then, the toxic ash will take up space in our landfills which may not be able to properly handle all of the toxins from TVA's Allen plant clean up from seeping into our soil.

Alternative C and D should be selected based on your initial presentation to TDEC. There needs to be beneficial reuse for the CCR and/or another option: D: TVA should purchase land nearby (like at Frank Pidgeon Industrial Park), and start your own landfill: lined, leachate collection, monitored and managed properly.

It is impossible to believe if this were a higher Socio-economic status community that you would propose "240 truck trips per day" to remove your toxic waste. You've admitted in your own findings that these coal ash ponds have "arsenic, fluoride, and lead in groundwater." So much "arsenic that it is above the USEPA drinking water standard was found north and south of the East Ash Disposal Area in the shallow Alluvial aquifer" with "the highest concentrations were found within the upper 40 feet." Why should anyone be expected to accept this as okay to be driven down the roads where we drive and take children to school especially when a safer and more fair alternative exists (see above).

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Kind regards and talk soon,

Name: Uele Siebert

Comments: Dear Jeff Lyash and TVA,

I hope this comment finds you well. I'm extremely concerned about the persisting attack on the people who live in the 38109 area of Memphis by pollutants and by environmental racism. The Allen plant's existence in this area is a monument to environmental racism and environmental degradation of an already vulnerable and low-income Black community. The poisonous toxins that are now being planned to be removed (which is good news) is not being planned by thoughtfully considering the effect on this overly burdened community (which is bad news).

The coal ash must be removed. It is toxic in an unlined pit alongside McKellar Lake where a known gap exists in the clay layer that protects the aquifer. It is known to be leaking three nasty chemicals (arsenic, lead, and fluoride). TVA burned the coal and TVA should clean it up. Shelby County and Memphis paid for the electricity for 50 years and now we are being told that we will continue to be burdened to pay to clean up the decades of residue from the coal. This community will have to have semi-trucks on our roads carrying coal ash for 9 years. Then, the toxic ash will take up space in our landfills which may not be able to properly handle all of the toxins from TVA's Allen plant clean up from seeping into our soil.

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"Because of the long operating history of the TVA Fossil Plants, there have been potential opportunities for CCR materials to move into surface water and for dissolved CCR constituents to migrate via groundwater flow into surface water…." Our aquifer and land continue to be in danger by not carefully considering an alternative where TVA takes ownership of making sure this community is safe. We do not want to have trucks driving up and down our roads for 10 years with these dangerous chemicals that can spill if there's an accident as well. The community isn't going to be reimbursed for the millions it will take to repave the roads either-or time lost as these trucks travel through the community creating the burden of more congestion.

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Kind regards and talk soon,

Uele Siebert

Attachment 2B – Letter from Carol Mann

MEMORANDUM

TO: TVA: Response to Project: Allen Proposed Plan to Address Environmental Conditions
FROM: CAROL MANN
DATE: Dec. 16, 2020
CONTACT INFO: (601) 594-3715, cmann@mannagency.com

Dear Sirs,

I am a mother. And like any good mother, I watch out for my children.

The EPA and TVA are not good mothers. Their track record for keeping U.S. citizens safe from the effects of toxic coal ash exposure has been compromised numerous times for the benefit of the coal industry. Thanks to their turning a blind eye for generations, citizens have suffered and died from liver, heart, kidney and lung disease and a host of cancers due to poisoning from coal ash.

In defiance of scientific evidence, the Environmental "Protection" Agency has classified coal ash as non-hazardous solid waste, as if it were no more toxic than banana peels, or coffee grounds.

And with that false label, without scientific site studies or sufficient warning, TVA has cavalierly decided to revise an old playbook, pitting one community against another: either a local municipal landfill in Tunica, Miss. or a landfill at the state border in Shelby Co., Tenn. will be the recipient of a massive amount of toxic coal ash waste due to the mistakes made at the Allen Fossil Plant.

Sadly, it's left up to the housewives to dig through the data and the written records of false assurances of safety to discover the neglect and lack of oversight on the part of TVA and the states' Departments of Environmental Quality regarding the pollution and health risks this dump will eventually cause.

TVA reasons that because toxic coal ash is leaching high levels of arsenic, lead and fluoride into the shallow aquifers near the Memphis Sand Aquifer, threatening the city's public water supply, all that is necessary is to shuffle the waste to a poorer, more defenseless area down the road, such as in Tunica, Miss., where it will be dumped into an already-permitted municipal landfill over the large Wilcox Aquifer, which poses a direct threat to the drinking water for Tunica Co.

And though the enormity of transporting 3.5 million cubic yards of toxic coal ash will slog on for eight to ten years, the decision as to where it goes will be accomplished quickly, without even a public hearing, much less an environmental study.

If coal ash is so "non-hazardous," then why is TVA even moving it at a cost of tens of millions of rate-payer dollars? You know, the same rate-payer dollars that pay TVA salaries?

The threat of millions of tons of toxic coal ash being dumped in a municipal landfill is real. Transporting and dumping this material into a plastic-lined pit on the edge of the city limits of Tunica over the span of a decade is a serious threat to its citizens' health, safety, livelihoods and future economic development.

As per the safety of landfill pits, the Conservation Law Foundation said: *"There's simply no such thing as a safe landfill. No matter how many barriers, liners, and pipes we install to try to mitigate the risk, landfills will always leak toxic chemicals into the soil and water."*

The EPA has also admitted: *"No liner… can keep all liquids out of the ground for all time. Eventually liners will either degrade, tear, or crack and will allow liquid to migrate out of the unit."*

This time will it be different? A state-of-the-art facility? Isn't that what every generation says, and what TVA said when it stored coal ash at site after site throughout Tennessee, only to have them leach toxins into lands and rivers with disastrous consequences?

We already have evidence-based science and technology solutions for dealing with coal ash. Why are these not being discussed? Let's solve our coal ash waste problem once and for all by putting the top R&D minds of this nation on the tail end of the fuel cycle. Our sister state Georgia and others are doing just that. On March 21, 2020, Georgia Power announced approximately two million tons of stored coal ash will be removed from the existing ash ponds for reuse in Portland Cement, concrete and other products. Some countries are way ahead of us: ALL of the coal ash in Denmark is recycled.

A new federal administration is coming. We fully intend to work with them to explore safer alternatives to growing problems that TVA has created and left to fester for years for the sake of the coal industry. Clean energy is coming. The days of TVA presiding over dump hearings, pitting one Not-In-My-Back-Yard community against another, are hopefully ending. Stop shuffling these poisons from one unsuspecting, poor area of our country to the next. Get with the program. Stop this madness. Just Stop.

Many thanks for your cooperation.

Carol Mann

Sources:

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Attachment 2C – Letter from Joe Laubenstein, WCI

WASTE CONNECTIONS, INC.
Connect with the Future®

Public Comments Addressing the TVA Allen Fossil Plant Ash Impoundment Closure

Introduction:

My name is Joe Laubenstein and I serve as the Director of Coal Combustion Residuals (CCR) Management for Waste Connections, Inc. Waste Connections (WC) is the third largest solid waste company in the United States with annual revenues of $5.3 billion, operating in 42 states and six provinces in Canada, serving more than seven million residential, commercial and industrial customers with its' 18,500 employees. More importantly to Tennessee Valley Authority (TVA), WC has major operations in Tennessee and the number one service provider of solid waste in the Memphis, Tennessee area. And, just like TVA, safety is our number one value, safety to our employees, customers and the environment. You can learn more on our safety program and commitment to being an ESG leader in the solid waste industry by reading the attached Waste Connection's 2020 Sustainability Report.

I have worked in the solid waste industry for the past 38 years. More specifically, I've developed integrated programs for handling large quantities of industrial wastes for disposal and beneficial use applications. My educational background in Agronomy (Soil Chemistry) has given me the knowledge and intuition to look at industrial wastes based on their intrinsic properties for proper handling in transporting, developing beneficial use markets where appropriate and advanced disposal methods for maximizing landfill airspace for disposal. Since being the Director of CCR Management, since the CCR rule was promulgated in 2015, I've developed programs for other operating coal burning power plants and for those that have switched over to burning natural gas as their fuel source. We have an Alliance Agreement with Boral Resources who together with WC can offer safe removal, transportation and placement of CCR materials into Subtitle "D" landfills that can later be harvested for use into encapsulated beneficial use markets. This way we preserve the value of the CCR product by placing the material into a monofill cell then processing the CCR into a useable Class "C" or "F" fly ash product. By employing closure by removal, which is the closure method chosen by TVA for the Allen Fossil Plant (ALF) impoundments, the parameters of concern will stop leaching into ground and surface water being that the CCR material will be moved to an offsite fully contained lined landfill cell with a leachate collection system. I've attached our CCR brochure which will provide you additional information on our services to meet the needs for proper CCR management.

3 Waterway Square Place, Ste 100, The Woodlands, TX 77380
Tel (832) 442-2200 • Fax (832) 442-2290 • www.wasteconnections.com

WASTE CONNECTIONS, INC.
Connect with the Future®

Comments Pertaining to the TVA Virtual Public Meeting of November 17, 2020 and Allen Fossil Plant ash Impoundment Closure Environmental Impact Statement of March 2020:

1) A comment was made during the public meeting and was verified in the Environmental Impact Statement (EIS) that transporting the CCR by truck was both safer and less of an impact to Green House Gas (GHG) emissions.

I find it hard to believe that it would be safer moving 3.2 million tons of CCR by truck rather than by rail. How can the equivalent of putting 647 trucks on the road be safer than moving 11,000 tons by one unit train?

I can't understand how the author of the EIS can make the statement that it would take approximately 8.2 years to remove the 3.5 million yards of CCR in the ALF impoundment compared to approximately 15 years if the CCR was transported offsite by rail. The EIS states the truck capacities to be used for this project would be 17 cubic yards. We at WC use 25 cubic yard aluminum trailers for hauling CCR materials. By using the proper size trailers not only would you reduce the time to complete the project but also reduce the transportation costs dramatically.

If we were to move the CCR from ALF by rail we would move the material in unit train loads which would equate to 11,000 tons of CCR per train load. We could load and move a unit train carrying 11,000 tons every week. We would deploy two unit trains so as one was being loaded at ALF the other would be unloading at the final disposition landfill. Also, we have the capabilities to backhaul the 3 million cubic yards of burrow material necessary to bring the site back to its' original elevation for future utilization as an industrial site.

I am not sure why WC was excluded when the author of the EIS did the evaluation of landfills in close proximity to the ALF site and also had the capabilities for handling the volume of CCR that needed to be removed from the ALF impoundment. We do have sites in close proximity and do have landfill capacity for this volume. We certainly would like an opportunity to meet with the TVA Team and show them how we can offer a disposal solution exceeding their expectations.

I truly believe we can move all 3.2 million tons of CCR and backhaul 3.0 million cubic yards of burrow material in a 5 year period. If this project was on a 5 year timeline the City of Memphis would be able to repurpose the site to be used for an industrial tenant that would bring in new

taxes to the county and city while providing high paying employment to the local population quicker than the ten year projection in the EIS.

Lastly, WC believes in 2022 or no later than 2023 we would have the capabilities to use electric vehicles (EV) to transport the CCR by truck to our landfill. We currently are in beta testing with an EV supplier and working with three of the major manufactures of EV long-haul tractor trailers. We would construct an electric charging facility at the ALF site. EV trucks would greatly reduce the GHG generation.

I look forward to having future conversations to go into more details on what I'm proposing in this write up.

In closing, let me say I admire TVA for all they do for the communities they operate in and their commitment to renewable energy. It would be our privilege to work on this project developing systems and new technologies to show Memphis, the state of Tennessee, and the country how a partnership between two great companies can protect the environment, work with the highest safety standards and leave a clean site to be repurposed for future industrial use.

Thank you,

Joe Laubenstein
Director of CCR Management
Waste Connections

Attachment 2D – Letter from Amanda Garcia, SELC

SOUTHERN ENVIRONMENTAL LAW CENTER

Telephone 615-921-9470 | 1033 DEMONBREUN STREET, SUITE 205 NASHVILLE, TN 37203 | Facsimile 615-921-8011

December 17, 2020

Ms. Latrivia Welch
TVA Allen Fossil Plant
2574 Plant Rd.
Memphis, TN 38109
Via email to lswelch0@tva.gov

Re: TVA's Proposed Plan to Address Environmental Conditions at the Allen Fossil Plant

Dear Ms. Welch:

On behalf of Protect Our Aquifer, the Tennessee Chapter Sierra Club ("Sierra Club"), Jobs with Justice of East Tennessee, and Interfaith Worker Justice of East Tennessee (collectively, "Citizen Groups"), we offer the following comments on TVA's Proposed Plan to Address Environmental Conditions at the Allen Fossil Plant in Memphis, Tennessee.[1] We submit these comments together with the comments of Adaptive Groundwater Solutions LLC, which are included as Attachment 1 and incorporated by reference.[2]

Citizen Groups care about protecting the City of Memphis and Shelby County's clean drinking water source, the Memphis Sand Aquifer, for the benefit of the resource, our community, and future generations. We support TVA's decision to remove toxic coal ash from its leaking, unlined pits at the Allen Fossil Plant ("Allen Coal Plant" or "Coal Plant"). Removing the coal ash at the Allen Coal Plant is an essential component of remediating the extremely high levels of coal ash contamination that are currently threatening the Memphis Sand Aquifer and McKellar Lake. We urge TVA to clean up its coal ash pollution as quickly as is safely possible.

Despite our general support for TVA's proposal to remove the coal ash from the leaking, unlined pits at the Allen Coal Plant, we write to reiterate many of the same fundamental concerns Protect Our Aquifer and Tennessee Chapter Sierra Club have raised previously in several sets of comments on the Environmental Impact Statement and the Environmental Investigation Plan for the Allen site, and to explain how TVA has so far failed to ensure a thorough, safe, and equitable remedial plan for the Allen site. Specifically, we respectfully insist that TVA:

[1] Tennessee Valley Authority, Proposed Plan to Address Environmental Conditions at the Allen Fossil Plant (October 2020), https://tva-azr-eastus-cdn-ep-tvawcm-prd.azureedge.net/cdn-tvawcma/docs/default-source/environment/coal-combustion-residuals/allen/alf_proposed_plan_for_public_review333182772.pdf?sfvrsn=f5700ce_2.

[2] Att. 1, Douglas J. Cosler, Adaptive Groundwater Solutions LLC, Comments re: Proposed Plan to Address Environmental Conditions at the Allen Fossil Plant (December 16, 2020), submitted via letter to Amanda Garcia, Southern Environmental Law Center [2020 Cosler Comments].

- Accurately characterize the site's geology, groundwater flow, and contaminant plume *before* proposing, selecting and implementing a final groundwater remedy for the site;
- Disclose and analyze the impacts that will affect the communities along the haul routes and near the South Shelby and Tunica landfills, and consider other alternatives that will not disproportionately burden environmental justice communities; and
- Commit to ensuring the safety of workers who engage in the removal, hauling, and disposal of toxic coal ash in the implementation of TVA's clean up plan.

I. Factual Background

A. The Ash Ponds are the subject of several ongoing investigations and remedial actions.

At the Allen Coal Plant, extremely high levels of coal ash contamination, including arsenic, emanating from the Ash Ponds are the subject of at least two ongoing state investigations and remedial processes: (1) a remedial investigation overseen by the Tennessee Department of Environment and Conservation ("TDEC") Bureau of Remediation,[3] and (2) an environmental investigation being conducted pursuant to the TDEC Commissioner's Order.[4] Although TVA does not make it clear, we understand that the Proposed Plan is related to the remedial investigation being overseen by the Bureau of Remediation.

A report commissioned by TVA to comply with the state remedial investigation, and subsequently published by the United States Geological Survey ("USGS") and the University of Memphis Center for Applied Earth Science and Engineering Research ("CAESER") in 2018, concluded that the contaminated shallow groundwater at the Allen Coal Plant is connected to the Memphis Sand Aquifer, Shelby County's primary drinking water source ("USGS/CAESER report").[5]

In addition to these state investigations, TVA is also conducting an investigation into groundwater contamination at the East Ash Pond pursuant to the federal Coal Ash Rule.[6] TVA

[3] Letter from Steve Goins, TDEC to TVA (July 18, 2017) (outlining requirements for remedial investigation) [TDEC Letter re: RI Requirements].

[4] Tennessee Department of Environment and Conservation, In the Matter of Tennessee Valley Authority, Order No. OGC15-0177, Sec. VII.A.d (Aug. 6, 2015) [Commissioner's Order].

[5] Carmichael, J.K., Kingsbury, J.A, Larsen, Daniel, and Schoefernacker, Scott, 2018 Preliminary evaluation of the hydrogeology and groundwater quality of the Mississippi River Valley alluvial aquifer and Memphis aquifer at the Tennessee Valley Authority Allen Power Plants, Memphis, Shelby County, Tennessee: U.S. Geological Survey Open-File Report 2018-1097, 66 p., https://doi.org/10.3133/ofr20181097 [USGS/CAESER Report].

[6] TVA, Notice of Establishment of Assessment Monitoring Program, https://ccr.tva.gov/Plants/ALF/Surface%20Impoundment%20-%20East%20Ash%20Disposal%20Area/Groundwater%20Monitoring/Assessment%20Monitoring/TVA%20NOTICE%20OF%20ESTABLISHMENT%20OF%20AN%20ASSESSMENT%20MONITORING%20PROGRAM%20ALF%20EAST%20ASH%20POND.pdf.

reported high levels of multiple coal ash contaminants in groundwater under the East Ash Pond in its annual Coal Ash Rule groundwater monitoring report for 2017.[7] After determining that the contaminants did not come from a source other than its own coal ash, TVA placed the East Ash Pond in assessment monitoring under the federal Coal Ash Rule.[8] In February 2019, after the scoping period for this EIS had concluded, TVA determined that there have been detections of statistically significant increases of four Appendix IV constituents, arsenic, fluoride, lead, and molybdenum, above the groundwater protection standards in the downgradient wells.[9] TVA has since performed an assessment of corrective measures and updated its closure plan for the East Ash Pond.[10]

Information obtained through all three of these ongoing investigations at the Allen Coal Plant is relevant to the environmental setting in which TVA's Proposed Plan will be implemented.

B. The East Ash Pond is contaminating groundwater that is locally connected to the Memphis Sand Aquifer.

As Protect Our Aquifer and Sierra Club explained in comments submitted in November 2018 on the environmental investigation plan required by the Commissioner's Order, data from the state remedial investigation and the USGS/CAESER report demonstrate that there is a current and ongoing risk of coal ash contamination entering the Memphis Sand Aquifer and McKellar Lake.[11] TVA has continually refused to acknowledge these contamination risks, and

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[7] TVA, 2017 Annual Groundwater Monitoring and Corrective Action Report, Program (Allen Fossil Plant; East Ash Disposal Area), https://ccr.tva.gov/Plants/ALF/Surface%20Impoundment%20-%20East%20Ash%20Disposal%20Area/Groundwater%20Monitoring/Annual%20Groundwater%20Report/257-90(e)_Annual%20Groundwater%20Monitoring%20Report_ALF_East%20Ash%20Disposal%20Area.pdf.

[8] TVA, Notice of Establishment of an Assessment Monitoring Program (Allen Fossil Plant; East Ash Disposal Area), https://ccr.tva.gov/Plants/ALF/Surface%20Impoundment%20-%20East%20Ash%20Disposal%20Area/Groundwater%20Monitoring/Assessment%20Monitoring/TVA%20NOTICE%20OF%20ESTABLISHMENT%20OF%20AN%20ASSESSMENT%20MONITORING%20PROGRAM%20ALF%20EAST%20ASH%20POND.pdf.

[9] Notification Identifying Appendix IV Constituents Exceeding Groundwater Protection Standards at the Allen Fossil Plant East Ash Disposal Area CCR Unit Pursuant to 40 C.F.R. § 257.95(g) (February 13, 2019), https://ccr.tva.gov/Plants/ALF/Surface%20Impoundment%20-%20East%20Ash%20Disposal%20Area/Groundwater%20Monitoring/Assessment%20Monitoring/257-95(g)_notification_appiv_gwps_exceed_alf_east_ash_disposal_area.pdf.

[10] TVA, Assessment of Corrective Measures TVA Allen Fossil Plant, Memphis, Tennessee (July 15, 2019), https://ccr.tva.gov/Plants/ALF/Surface%20Impoundment%20-%20East%20Ash%20Disposal%20Area/Groundwater%20Monitoring/Corrective%20Measures/257-96(d)_Corrective%20Measures%20Assessment_ALF_East%20Ash%20Disposal%20Area.pdf**;** TVA, Closure Plan, East Ash Disposal Area, EPA Final CCR Rule (40 C.F.R. §257.102), TVA Allen Fossil Plant, Memphis, Tennessee (April 23, 2019), https://ccr.tva.gov/Plants/ALF/Surface%20Impoundment%20-%20East%20Ash%20Disposal%20Area/Closure%20-%20Post-Closure%20Plan/Closure%20Plan/257-102(b)_Written%20Closure%20Plan_ALF_East%20Ash%20Disposal%20Area_Rev1.pdf.

[11] Att. 2, Letter from Amanda Garcia, Southern Environmental Law Center, on behalf of Protect Our Aquifer and Sierra Club to TDECorder@tva.gov, re: Tennessee Department of Environment and Conservation Commissioner's

the Proposed Plan perpetuates and exacerbates the same flaws that have pervaded TVA's analysis in the various remedial investigations it has undertaken at the Allen Coal Plant. In particular, the Proposed Plan continues to assert that TVA's coal ash pollution is limited to the shallow portion of the alluvial aquifer and is further limited to two "localized areas" along the southeast and northwest corners of the East Ash Pond.[12]

The November 2018 comments showed that TVA's own data refute these assertions. Arsenic is present above the Maximum Contaminant Level midway into the shallow aquifer, and boron and sulfate—coal ash indicator pollutants—are present at extremely high levels deep in the shallow aquifer.[13] Further, TVA has not installed wells in the alluvial aquifer underneath the East or West Ash Ponds, or in the Memphis Sand Aquifer,[14] so its conclusion that the pollution is limited to "localized areas" is not supported by any data. Nor is TVA's conclusion supported by common sense, which would dictate that pollution levels are likely to be higher underneath the source of the pollution—3 million tons of coal ash—than along the perimeter of the pit.

C. TVA's past off-site coal ash disposal practices have raised serious environmental justice concerns.

TVA's history of mismanagement of its coal ash raises concerns regarding the selection of an appropriate disposal and beneficial re-use site with adequate consideration given to disproportionately impacting an environmental justice community. In the aftermath of the Kingston coal ash failure, TVA transported ash to the Arrowhead Landfill in Perry County, Alabama, a landfill in an environmental justice community that had already been subjected to repeated violations of pollution laws.[15] In September 2016, the United States Commission on Civil Rights issued a report finding that the decision to move coal ash to the Arrowhead Landfill was primarily based on technical considerations, including cost, and did not properly take into account environmental justice concerns.[16] This must not happen again. TVA must ensure that any disposal location for its coal ash, including any "beneficial re-use facility," complies with

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Order: Environmental Investigation Plan, Revision 2, Allen Fossil Plant (November 28, 2018) [POA/SC Comments on EIP], submitted together with Douglas J. Cosler, Adaptive Groundwater Management LLC, Risk of Contamination of the Memphis Sand Aquifer, Allen Fossil and Combined-Cycle Combustion Turbine Plants: Review and Analysis of the Environmental Investigation Plan, Remedial Investigation, and Interim Remedial Action (November 26, 2018) [2018 Cosler Report].

[12] Proposed Plan, 4.

[13] 2018 Cosler Report, 15 Fig. 12 and 16 Fig. 13.

[14] *Id.*18, 21-23.

[15] Kristen Lombardi, *Welcome to Uniontown: Arrowhead Landfill Battle a Modern Civil Rights Struggle*, NBC News (Aug. 5, 2015), http://www.nbcnews.com/news/nbcblk/epa-environmental-injustice-uniontown-n402836.

[16] U.S. Commission on Civil Rights, Environmental Justice: Examining the Environmental Protection Agency's Compliance and Enforcement of Title VI and Executive Order 12,898, 65-69 (September 2016), http://www.usccr.gov/pubs/Statutory_Enforcement_Report2016.pdf.

laws designed to protect people from pollution, and takes into account disproportionate impacts on communities that are already burdened. Remarkably, despite the findings of the United States Commission on Civil Rights, TVA has obscured the potential impacts of its landfill selection on real communities by employing a so-called "bounding" analysis in its environmental study that improperly concludes that impacts to one environmental justice community are the same as any other, as long as certain parameters are met.[17]

D. TVA's past coal ash remediation projects have raised grave worker safety concerns.

In addition, TVA's history with the Kingston coal ash remediation raises concerns about the safety of clean-up workers.[18] In November 2018, a jury found that TVA's contractor for the Kingston clean-up failed to adequately protect workers from exposure to coal ash contamination.[19] More than 50 Kingston disaster workers have died from illnesses they assert in the lawsuit were caused by coal ash exposure, and more than 400 are sick, according to an ongoing tally from court records by Knox News.[20] This, too, must never happen again.

The Proposed Plan fails to address community concerns about worker exposure to coal ash pollution, instead making vague claims about TVA's "zero-injury culture."[21] These self-congratulatory statements fail to convince. In any Proposed Plan for the Allen site, TVA must commit to following all laws, regulations, and best practices for worker safety and require its contractors to do the same. TVA must explicitly and specifically address concerns about worker exposure to coal ash pollution to gain the confidence of the Memphis community with respect to any of the available alternatives. Such measures should include a commitment by TVA not to use the same contractor it used in the Kingston coal ash remediation, specific coal ash exposure

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[17] TVA, Final Allen Ash Impoundment Closure EIS [Final EIS], 28-30 and Table 2-4 (March 2020), https://tva-azr-eastus-cdn-ep-tvawcm-prd.azureedge.net/cdn-tvawcma/docs/default-source/default-document-library/site-content/environment/environmental-stewardship/environmental-reviews/allen-fossil-plant-ash-impoundment-closures/alf-ash-impoundment-closure-final-eis.pdf?sfvrsn=1463e97f_5.

[18] *See, e.g.*, Austyn Gaffney, *A Legacy of Contamination: What happens when the fallout from the nation's largest industrial disaster goes nuclear?*, Grist Magazine (December 15, 2020), https://grist.org/justice/tva-kingston-coal-ash-spill-nuclear/; Austyn Gaffney, *'They Deserve to Be Heard': Sick and Dying Coal Ash Cleanup Workers Fight for Their Lives*, The Guardian (Aug. 17, 2020), https://www.theguardian.com/us-news/2020/aug/17/coal-spill-workers-sick-dying-tva; Jamie Satterfield, *Kingston coal ash spill: Roane County leaders push for testing of children's sports complex*, Knox News (December 14, 2018), https://www.tennessean.com/story/news/crime/2018/12/14/kingston-coal-ash-spill-roane-county-workers-memorial-tva/2242929002/.

[19] Jamie Satterfield, *Jury: Jacobs Engineering endangered Kingston disaster clean-up workers*, Knox News (November 7, 2018), https://www.knoxnews.com/story/news/crime/2018/11/07/verdict-reached-favor-sickened-workers-coal-ash-cleanup-lawsuit/1917514002/.

[20] Jamie Satterfield, *Another Widow Mourns as Death Toll Hits 50 Among Kingston Coal Ash Workers*, Knox News (Sep. 3, 2020), https://www.knoxnews.com/story/news/crime/2020/09/03/death-toll-among-kingston-coal-ash-cleanup-workers-rises-again/3385462001/.

[21] Proposed Plan, 2.

safety criteria that TVA will apply to its selection of a new contractor, and on-site contractor supervision and whistleblower protections for workers as outlined in more detail in Section IV.

II. TVA must accurately characterize the Allen site's geology, groundwater flow, and contaminant plume *before* proposing and selecting a final groundwater remediation strategy for the East Ash Disposal Area.

The key finding of the USGS/CAESER report published *more than two years ago* is that the contaminated alluvial aquifer and the Memphis Sand Aquifer are hydraulically connected.[22] Despite this established fact, TVA's public-facing position consistently has been that its coal ash pollution is not migrating to the Memphis Sand Aquifer.[23] Yet TVA has so far failed to accurately characterize the extent of the existing coal ash contaminant plume. TVA has selectively included only data for arsenic, fluoride, and lead,[24] and failed to take into account additional indicators of downward groundwater flow at the site.[25] The groundwater remediation approach outlined in the Proposed Plan, and the Groundwater Modeling Report upon which it is based, perpetuate and exacerbate the flaws and inaccuracies we have previously identified.[26]

Our previous independent review of the data from the investigations and the USGS/CAESER report support the following key findings:

- There is a hydraulic connection between the Mississippi River Valley Alluvial ("MRVA") Aquifer and the Memphis Sand Aquifer;

- The areal extent of the breach in the confining layer that is causing the hydraulic connection may be much larger than the USGS-CAESER report initially indicated;

- The degree of hydraulic connection, based on pumping-induced water-level reductions in the MRVA Aquifer, may be much stronger than the USGS-CAESER report initially indicated;

- There are significantly elevated concentrations of boron and sulfate, CCR indicator constituents, deep in the MRVA Aquifer at the Allen Plant;

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[22] USGS/CAESER Report, 44 ("The aquifer-test results indicate that the MRVA and Memphis aquifers are hydraulically connected in the TVA plants area.").

[23] Stantec, Draft TVA Allen Fossil Plant-East Ash Disposal Area-Remedial Investigation Report, ES-i (March 6, 2018) [RI Report] ("The north and south areas of affected groundwater are not impacting the Memphis aquifer or the public drinking water supply."); Final EIS 77 ("[G]roundwater sampling results do not indicate adverse impacts to the Memphis Aquifer or the public drinking water supply.").

[24] *Compare* RI Report, ES-i ("Sampling confirmed the highest concentrations of arsenic, fluoride and lead were limited to the north and south areas, primarily within the upper 40 feet of the shallow Alluvial aquifer. The aquifer is over 100 feet thick. Groundwater flow in the aquifer is essentially horizontal and is not moving downward.") *with* 2018 Cosler Report, 15 Fig. 12 and 16 Fig. 13.

[25] *Id.*; *see also* 2018 Cosler Report, 17-19.

[26] *See generally* 2020 Cosler Comments.

- These boron and sulfate tracer concentration distributions indicate that long-term downward groundwater flow has been occurring in the MRVA Aquifer in the Allen Plant area;

- Shallow and deep vertical hydraulic gradients within the MRVA Aquifer, as well as significantly higher hydraulic heads in the MRVA Aquifer compared to the Memphis Sand, also indicate downward groundwater flow; and

- Age dating of groundwater and elevated sulfate concentrations in Memphis-Sand Production Well 5 indicate that mixing of MRVA Aquifer groundwater with Memphis Sand Aquifer water is occurring in the vicinity of the Allen Plant and that potential ongoing transport of CCR constituents from the MRVA into the Memphis Sand Aquifer is occurring.[27]

These site-specific findings are based on TVA's own data and the analysis provided by independent experts in the USGS-CAESER report.

The groundwater remediation approach outlined in the Proposed Plan, and the Groundwater Modeling Report upon which it is based, fail to account for these well-supported findings.[28] Instead, TVA and its consultant, against all evidence and over the repeated objections of Protect Our Aquifer, the Sierra Club, and TDEC, continue to claim that the coal ash contamination is limited to the "upper portion of the Alluvial aquifer," and "[t]he Memphis Sand aquifer has not been affected."[29] As a result, TVA's proposed remedial approach only scratches the surface of the likely groundwater contamination problem at the Allen site.[30]

The Proposed Plan purports to describe the "final" groundwater remedy for the East Ash Pond.[31] This is alarming, because TVA has not even fully or accurately characterized the contaminant plume at the site or the fate and transport of those contaminants. Any final groundwater remedy for the East Ash Pond must be based on an accurate characterization of the environmental conditions on the site. But as TVA tacitly acknowledges in the Proposed Plan, it has yet to "investigate groundwater conditions *beneath*" the East Ash Pond.[32] Thus, its assumption that the coal ash contamination is limited to the small areas along the north and south

[27] 2018 Cosler Report, 1-33.

[28] *See generally* 2020 Cosler Comments.

[29] Proposed Plan, 1.

[30] *See* Proposed Plan, 1 (plan addresses "shallow impacted groundwater near the EADA"); *see id.* at 4 (proposing to remediate only two small areas along the border of the East Ash Pond).

[31] Proposed Plan, 3.

[32] Proposed Plan, 1 (emphasis added).

borders of the East Ash Pond is unfounded, and, based on what we know about the site, likely profoundly incorrect.[33]

The effects of TVA's failure to investigate the groundwater conditions under the East Ash Pond are exacerbated by several assumptions included in its groundwater model ("Model") that directly conflict with site-specific data in the record.[34] Of particular concern is the assumption in the Model that the so-called "blue clay zone" creates a site-wide impermeable barrier between the shallow and deep layers of the Alluvial aquifer.[35] The available evidence contradicts this assumption; in fact, TVA's own remedial investigation report acknowledges that blue clay zone "does not entirely prevent downward movement like a confining unit."[36] In comments on the Feasibility Study for this site, TDEC similarly stated that the blue clay zone "is not a barrier to downward migration of contaminants," and admonished TVA that "[t]o state that arsenic and other COCs at the site is contained is false…."[37] Finally, as Figures 5 and 6 in the 2020 Cosler Comments show, the blue clay layer cuts *through the middle of the arsenic plume* as well as the boron and sulfate plumes at the site.[38] Nowhere does TVA or its consultant explain how, if there were actually an impermeable barrier created by the blue clay layer, the coal ash contaminants would have migrated beneath it, deeper into the Alluvial aquifer. Yet the data show that these contaminants *have* migrated deeper into the Alluvial aquifer. Given the actual data described in TVA's own documents, and the acknowledgment by TVA and TDEC that the blue clay layer is not a confining unit, there is no basis for the assumption in the Model that it acts as one. The Model must be corrected to eliminate this unfounded assumption and calibrated to ensure that it can explain the actual conditions at the site.

Even more astoundingly, the Model assumes that *there is no breach* in the clay layer at the bottom of the Alluvial aquifer.[39] As explained in the 2020 Cosler Comments, this assumption is directly contradicted by all of the available evidence at the site, including multiple reports authored by groundwater experts at University of Memphis CAESER.[40]

TVA's contractor acknowledges this obvious flaw in the Model, and deems the assumption of a total no-flow boundary condition at the bottom of the Model "reasonable" because of "the focus of the model on the upper portion of the Alluvial aquifer, the relatively small observed vertical gradients in the deeper portion of the Alluvial aquifer, and the location of

[33] 2020 Cosler Comments, 8.

[34] 2020 Cosler Comments, 1-7.

[35] *Id.* at 1-4.

[36] *Id.* at 2-3 (quoting TVA Remedial Investigation Report).

[37] 2020 Cosler Comments, 3 (quoting TDEC comments on Feasibility Study).

[38] *Id.* at 4-5, Figure 5 and 6.

[39] 2020 Cosler Comments, 7.

[40] *Id.* at 5-7.

the upper Claiborne confining unit encountered in borings at ALF."[41] But these hydraulic gradient findings are themselves created using flawed assumptions. The Model uses flawed assumptions regarding hydraulic conductivity and fails to accurately characterize the long-term average groundwater velocities, errors that further artificially restrict downward flow and contaminant transport.[42] Finally, the Model employs grid cell sizes that are too coarse to simulate accurate contaminant reductions, and uses inaccurate dispersivity values.[43] Once again, the Model must be corrected to eliminate these unfounded assumptions and calibrated to ensure that it can explain the actual conditions at the site.

The result of all of these unfounded and inaccurate assumptions in the Model is that it is essentially useless for the task it is supposed to perform. As designed, the Model does not and cannot accurately predict the contaminant fate and transport at the Allen site, particularly with regard to vertical distribution of contaminants. It is therefore "unsuitable for the design and performance evaluation of remedial measures at the site."[44] At a practical level, this means that the groundwater remedy outlined in the Proposed Plan is likely grossly inadequate. Any thorough groundwater remediation is likely, at a minimum, to require more extraction wells and other methods, and take much longer than the nine years currently projected in the Proposed Plan.[45]

III. TVA must disclose and analyze the impacts that will affect communities along the haul routes and near the South Shelby and Tunica landfills, and consider other alternatives that will not disproportionately burden environmental justice communities.

The Proposed Plan states that TVA is considering moving 3.5 million cubic yards of coal ash through South Memphis to either the South Shelby Landfill in Memphis or the Tunica Landfill in Tunica, MS.[46] TVA also plans to use local borrow sites "to provide backfill" for the coal ash excavations.[47] TVA predicts that it will take nine years to remove all of the coal ash from the leaking pits at the Allen site.[48] Despite the enormity of this project and its potential impacts on South Memphis and Tunica communities for nearly a decade into the future, TVA

[41] Section 11 of 2020 TVA Allen Groundwater Model Report, https://tva-azr-eastus-cdn-ep-tvawcm-prd.azureedge.net/cdn-tvawcma/docs/default-source/environment/environmental-stewardship/tdec/allen/tva-allen-fossil-plant-groundwater-flow-solute-transport-modeling-report.pdf?sfvrsn=f9979cf3_2.

[42] 2020 Cosler Comments, 7.

[43] 2020 Cosler Comments, 8-11.

[44] 2020 Cosler Comments, 7.

[45] Proposed Plan, 4.

[46] Proposed Plan, 2.

[47] Proposed Plan, 2-3.

[48] Proposed Plan, 4.

devotes only a single paragraph and one map to community impacts. The only potential impacts identified are traffic impacts; even for traffic impacts TVA states only that "a traffic management plan will be developed," without providing any detail that would help the potentially affected communities understand what is at stake.[49]

Nor has TVA disclosed and analyzed the full range of environmental impacts—including environmental justice impacts—associated with the South Shelby or Tunica Landfills and the proposed haul routes in its Environmental Impact Statement (EIS) for the coal ash closure project at Allen. Instead, in the EIS, TVA employed a "bounding analysis" that analyzed the impacts associated with a generic suite of site features.[50] This approach obscures the differences in impacts among alternative disposal and beneficial re-use sites, making it impossible for the public and decision-makers to adequately evaluate the choices.[51]

TVA's approach in the EIS is particularly concerning because *all* of the disposal sites it includes in its "bounding" analysis are located in environmental justice communities.[52] Each community bears a unique burden of existing polluting transportation and land uses. TVA nevertheless arbitrarily concluded that as long as any landfill site and haul route stayed within the "bounds" dictated by TVA, it was all the same, and that no additional site-specific analysis would be needed. In short, TVA took the approach that burdening one environmental justice community was the same as burdening any other environmental justice community. Accordingly, the utility determined that it would *not* at a later moment have to disclose and analyze impacts on the particular communities that might be affected by its specific landfill choice.

Now that moment has come. TVA has narrowed its options down to two landfills, in two different communities, with two very different settings and two very different haul routes to reach them. It is unclear whether TVA intends to select only one of these landfills or potentially use them both. Although it is TVA's job, not ours, to disclose and analyze the impacts of its potential choices so that communities have a meaningful opportunity to provide input into TVA's choice, we provide some basic information that illuminates different considerations with respect to South Shelby and Tunica.

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[49] Proposed Plan, 2. In addition to the lack of detail in the Proposed Plan, gaining access to the Proposed Plan itself also proved to be elusive. It was difficult even for an advocate with years of experience working on TVA issues to find the document about which TVA was requesting comment on TVA's website.

[50] Final EIS, 30 and Table 2-4 (bounding attributes for hypothetical disposal site); *id.* at 40-43 (bounding attributes for hypothetical beneficial re-use facility).

[51] *See Oak Ridge Environmental Peace Alliance v. Perry*, Case No. 3:18-cv-150 Reeves/Poplin, 2019 WL 4655904, *50 (Eastern Dist. Tenn. September 24, 2019) ("The concern presented by using a bounding analysis is that by using it, the agency may obscure differences in impacts among alternatives"); *see id.* ("That is exactly what happened here.").

[52] Final EIS, 29 ("[A]ll landfills are located in areas that contain communities that meet the requirements for environmental justice considerations.").

A. South Shelby Landfill

As the maps included below show, the South Shelby landfill is largely surrounded by industrial uses, with some limited residential areas. The South Shelby landfill is surrounded by census blocks with populations of greater than 80% people of color. The haul route to South Shelby landfill would be primarily on interstates and highways with few residential areas until the last portion of the route.

B. Tunica Landfill

The Tunica landfill is in an agricultural area. Although the uses around the Tunica landfill are primarily agricultural, there are several residential developments nearby that appear to be mobile homes. The Tunica landfill is surrounded by census blocks with populations of greater than 80% people of color. Tunica County residents are experiencing extreme poverty, with an estimated 28% of households below the federal poverty line. For comparison, the US poverty rate is 12.3% and the Mississippi statewide poverty rate is 19.5%. These data are based on the 2019 US Census Bureau American Community Survey.

The haul route traveling through South Memphis to the Tunica landfill is also very different. The route to Tunica would run through dense urban neighborhoods in South Memphis, including Westwood, again with populations of greater than 80% people of color. Route 61 is a main commercial thoroughfare for the entire South Memphis area (on both sides of the road). This route includes major commercial anchor areas and a host of small businesses. It is heavily used by local communities.

Sending trucks full of toxic coal ash through dense neighborhoods would seem to clearly carry a greater risk of exposing people living and working nearby to pollutants, both through the air and in case of accidents, compared to using highways and interstates.

Finally, we note that the Tunica Landfill appears to be within the 100-year floodplain and therefore not an appropriate site for the disposal of coal ash.[53] As a mitigation measure in the EIS, TVA committed to "obtain documentation from permitted landfill(s) receiving ash that the ash would be disposed in an area outside the 100-year floodplain."[54] TVA must explain how its selection of the Tunica Landfill would be consistent with that commitment.

An excerpt of the FEMA flood hazard map is shown below.

[53] Att. 3, FEMA Floodplain Map, Tunica County.

[54] Final EIS, 55.

C. Borrow Sites

The borrow sites are also primarily located in communities in South Memphis. In the information provided by TVA, a poorly drawn map is shown indicating "borrow pits" that we assume will be used to bring the land in the coal ash area back to height. A similar intrusion of truck traffic, noise, wear and tear will be a part of this restoration activity.

This portion of the project work also bodes harm, disruption, and danger to residents of the area. Where the hauling of the coal ash keeps to somewhat larger highways and expressways, the re-filling process will take place entirely within the community (according to the big dots and inset road map). Some of this material will be transported along local two lane roads—not intended for large dump truck traffic. A drive through the area revealed the following:

- Riverport Road. Four lane.
- Rivergate Road. Wide two lane.
- New Horn Lake Road. Four lanes with a fifth turn lane.
- Mitchell Road. Turns into a narrow, two lane (going west) right at the intersection with N. Horn Lake, lined with houses and small businesses (and Mitchell High School). Then turns into forest
- Weaver Road. Four lanes with turn lane, lined with homes, small businesses and trees.
- Raines Road. Four lanes going west, turns into two lanes after Ridge Road, lined with houses and trees, fairly rural.
- Sewanee Road. Two lane road lined with occasional houses and trees, fairly rural until you get up into Boxtown where there are more homes (small and close to the road).

These roads pass by properties, homes, and parks right next to the roads in question. These include roads like Mitchell and Sewanee—two-lane blacktops with minimum shoulder and houses less than 50' away from the road. The effect of hauling dirt back to the coal ash site will disrupt local traffic, hurt local roads, and possibly even damage old and fragile homes that sit too close to the road for these types of continuing activities. Safety and health concerns for residents are also an issue.


Tunica Landfill
Tunica Landfill
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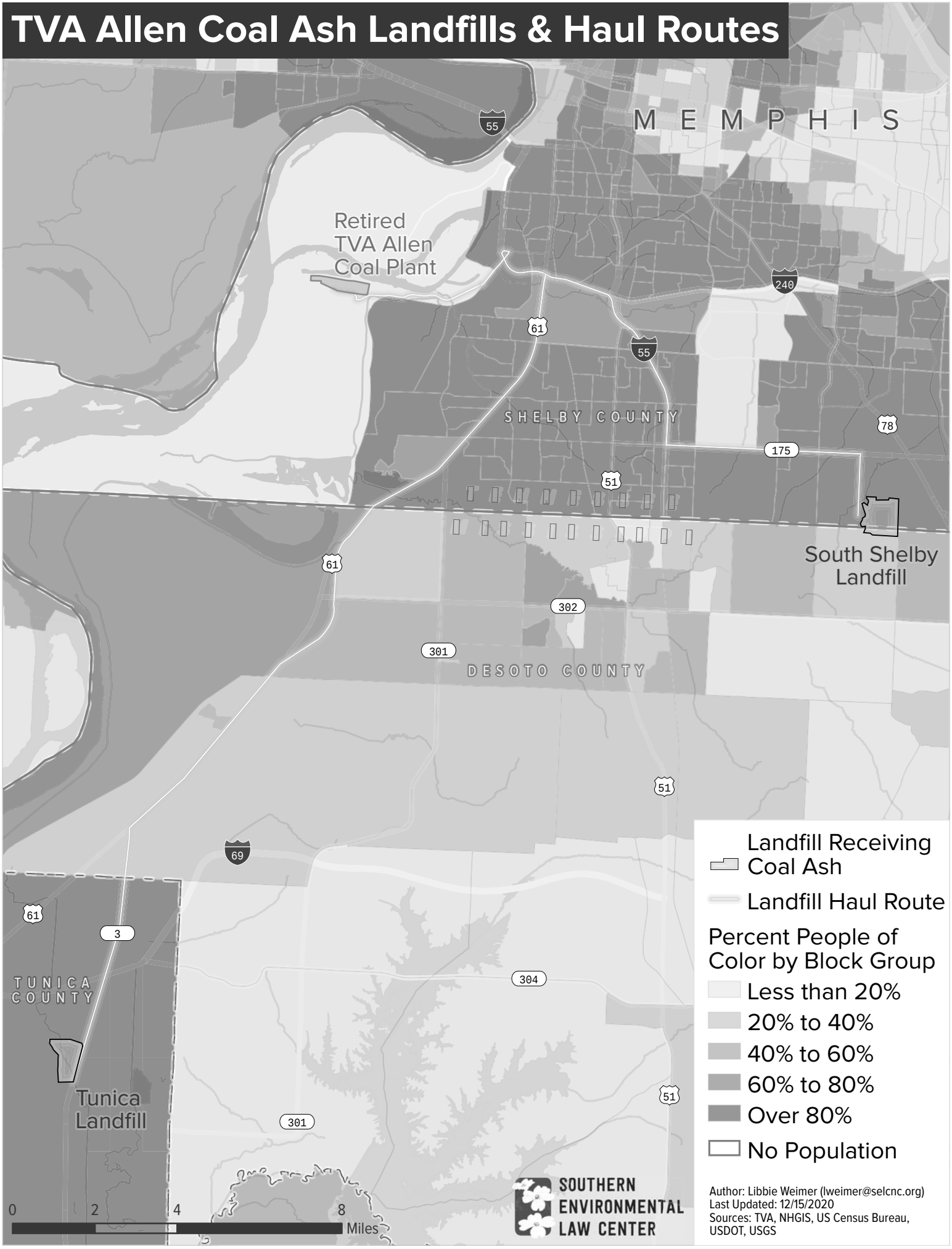
Miles


South Shelby Landfill
South Shelby Landfill
SOUTHERN ENVIRONMENTAL LAW CENTER
Author: Libbie Weimer (lweimer@selcnc.org)
Last Updated: 12/15/2020
Sources: TVA, Esri, USDA

TVA Allen Coal Ash Landfills & Haul Routes



SOUTHERN ENVIRONMENTAL LAW CENTER

Author: Libbie Weimer (lweimer@selcnc.org)
Last Updated: 12/15/2020
Sources: TVA, NHGIS, US Census Bureau, USDOT, USGS

Potentially affected communities in Memphis and Tunica deserve to know about the specific impacts that may occur and affect them where they live and work as a result of TVA's proposed actions. TVA must carefully consider the environmental justice, worker safety, traffic, noise, air quality, and other environmental impacts associated with these *specific sites*. In addition, in light of these potential impacts in already-burdened communities, TVA should revisit a range of other alternatives that will not disproportionately burden environmental justice communities, or will minimize any such impacts, such as:

- Beneficial reuse of the coal ash;
- Construction of a single waste stream industrial landfill in an appropriate location;
- Transport of coal ash by rail or barge.

While we recognize that TVA considered some of these alternatives in its environmental impact statement, it did so without the benefit of understanding specific impacts to the South Memphis and Tunica communities.

To ensure that the potentially affected communities have an adequate opportunity to make informed comments, TVA must commit to developing a supplemental EIS and circulating it for public comment before selecting a specific disposal and/or beneficial re-use site.

IV. TVA must commit to ensuring the safety of workers who engage in the removal, hauling, and disposal of toxic coal ash in the implementation of TVA's remedial plan.

Coal ash is dangerous. After the nation's largest spill at TVA's Kingston Fossil Plant in 2008, roughly 900 workers spent the next five years cleaning up coal ash.[55] Today, fifty of those workers are dead and over 400 are sick because TVA and its contractor failed to protect them from the hazards of radioactive and toxic coal ash.[56] Following the tragedy at Kingston, TVA must make clear and enforceable commitments to protect workers during the nine-year coal ash removal process at the Allen site.

Cleaning up coal ash is dangerous work, yet TVA's general approach to the current round of coal ash clean ups, including the one at the Allen site, would leave essentially all the planning and implementation up to its contractors. Following the tragedy of the Kingston coal ash cleanup, TVA cannot blithely trust its contractors to protect workers. In November 2018, a jury found that TVA's contractor for the Kingston cleanup failed to adequately protect workers from

[55] Austyn Gaffney, *'They Deserve to Be Heard': Sick and Dying Coal Ash Cleanup Workers Fight for Their Lives*, The Guardian (Aug. 17, 2020), https://www.theguardian.com/us-news/2020/aug/17/coal-spill-workers-sick-dying-tva.

[56] Jamie Satterfield, *Another Widow Mourns as Death Toll Hits 50 Among Kingston Coal Ash Workers*, Knox News (Sep. 3, 2020), https://www.knoxnews.com/story/news/crime/2020/09/03/death-toll-among-kingston-coal-ash-cleanup-workers-rises-again/3385462001/.

exposure to coal ash contamination.[57] The workers, their relatives, and their survivors sued Jacobs Engineering, TVA's contractor. At trial, plaintiffs presented evidence of the contractor's egregious behavior. Employees of Jacobs:

> - Manipulated monitoring results by watering down stationary monitors and taking readings only when wet or raining;
> - Tampered with personal dust monitors by "tapping out" the contents;
> - Failed to provide decontamination stations for workers;
> - Did not allow workers to wear dust masks, threatening to fire those who did, taking dust masks away from employees who wore them, and destroying dust masks that were available on the site;
> - Did not warn workers about the dangers of exposure to fly ash;
> - Told workers that fly ash was safe to consume.
>
> Also presented was testimony and evidence about the large amount of fly ash—even airborne clouds of it—present at the site. And plaintiffs' expert witness, epidemiologist Dr. Paul Terry, testified that fly ash exposure is capable of causing the diseases from which plaintiffs claim to suffer.

Adkisson v. Jacobs Eng'g Grp., Inc., 370 F. Supp. 3d 826, 834 (E.D. Tenn. 2019) (internal citations omitted). The court upheld the jury's finding that Jacobs had failed to exercise reasonable care in carrying out the duties it owed the worker plaintiffs, a breach capable of causing each of ten medical conditions. *Id.* at 835.

More than fifty Kingston disaster workers have died from illnesses they assert in the lawsuit were caused by coal ash exposure, and more than 400 are sick, according to an ongoing tally from court records by Knox News.[58] TVA must not repeat the mistakes that endangered workers at Kingston. Instead, TVA must impose, monitor, and enforce project-specific worker protections with which any contractor must comply.

A. TVA must protect workers from the risks of fugitive dust and other sources of toxic coal ash exposure.

In the Proposed Plan, TVA proposes to remove 3 million cubic yards of coal ash from its leaking, unlined pits, haul it to off-site landfills and replace the coal ash with fill from borrow sites.

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[57] Jamie Satterfield, *Jury: Jacobs Engineering endangered Kingston disaster clean-up workers*, Knox News (November 7, 2018), https://www.knoxnews.com/story/news/crime/2018/11/07/verdict-reached-favor-sickened-workers-coal-ash-cleanup-lawsuit/1917514002/.

[58] Jamie Satterfield, *Another Widow Mourns as Death Toll Hits 50 Among Kingston Coal Ash Workers*, Knox News (Sep. 3, 2020), https://www.knoxnews.com/story/news/crime/2020/09/03/death-toll-among-kingston-coal-ash-cleanup-workers-rises-again/3385462001/.

The project will take more than nine years and an untold number of hours of work by real people on the ground, including the friends, relatives and neighbors of people living in the South Memphis community. Coal ash contains many toxic metals.

Despite the enormity of this task, the Proposed Plan reveals almost no discussions regarding how TVA will conduct this project while protecting the TVA staff, contract workers, the community at large, or the public who may use the adjoining river. Quite simply, TVA takes the position that some or all of this will be handled in a future Health and Safety Plan to be developed by the selected contractor.[59] Yet, TVA provides no discussions of its own expectations from such a contractor or how important health and safety metrics will be considered during the contractor selection process itself.

Given the quantity of coal ash to be moved and the apparent area of its future home, the size of this landfill is likely to be very significant at completion. Ensuring worker and public protection during such a long project time period, during which many workers and even many contractors will likely be involved makes it imperative that TVA assume responsibility for the overall management of health and safety instead of point to one or more contractors.

TVA's deferral of health and safety to its contractors is particularly alarming given its own (and its selected contractors') history of ash mismanagement at the Kingston plant as described above. An appropriate starting point for all health and safety issues (i.e., affecting staff, workers, and the public) that might arise for this project should begin with a thorough assessment of the lessons learned from the health and safety failures during the Kingston cleanup effort. A root-cause analysis of what happened during the cleanup effort at Kingston and how to prevent anything remotely similar should be completed, ending with actionable recommendations which should be implemented for this project.

TVA should include, minimum health and safety requirements in its contractor bid specifications and assign proper weight to the health and safety performance history of contractors during the selection process. Below are some specific suggestions regarding fugitive dust and worker safety that TDEC should require.

1. Conduct a root-cause analysis of the failure of health and safety protections during the Kingston cleanup.

TVA should conduct (or, preferably hire a reputable third-party to conduct) a root-cause analysis of the health and safety failures during the Kingston cleanup process. Findings from that analysis should guide the design of prevention measures for the future, including this project. Results of this analysis should be made available to workers involved in coal-ash handling in the future, to their unions, and to the community at large. If a root-cause analysis has already been conducted but has not yet been made public, TVA should explain how this can still be the case over a decade after the Kingston disaster.

[59] Proposed Plan, 2 ("TVA requires all contractors and subcontractors to provide written site-specific health and safety plans.").

2. Screen potential contractors for health and safety.

TVA should develop a process which screens/scores potential coal-ash contractors for their competence, capacity and commitment to handle toxic coal ash in a safe and healthy manner under normal and abnormal potential situations expected during this project. It is our understanding that TVA uses a company called ISNetworld[60] as part of its safety compliance. However, this process does not appear to be geared to coal ash and its specific toxic properties and should therefore be modified or customized for use on this project.

3. Have emergency contractors selected and in place in case of disaster.

In addition to hiring its project contractor(s), TVA should also have in place contractors that can quickly mobilize in case of emergencies. The current documentation only mentions such a contractor in case karst conditions are encountered. But emergencies are broader than just encountering karst geology. Specifically, drawing on lessons from Kingston, TVA should have contractors that can handle large, unexpected coal-ash spill, in a safe manner.

4. Require contractors to have a site-specific safety and health plan which meets minimum TVA specifications.

As noted earlier, TVA cannot just leave it to contractors or sub-contractors to develop health and safety plans. TVA must define minimum requirements for such plans in its bid specification documents. It must evaluate potential contractors' OSHA compliance history and experience with safely handling hazardous waste remediation. Suggestions for this process include:

- Require that the health and safety plan be approved and certified by a certified industrial hygienist (ABIH certification) and then e-evaluated and re-approved by a certified industrial hygienist every year;
- Include workers in the development of this plan. Specifically, provide work-stoppage authority for safety (or potential safety) reasons to every worker on the ground;
- Include specific whistleblower encouragement and protections in the plan;
- Require submittal of the plan for TVA, agency, and public review.

5. Require contractor supervision.

TVA should have proper contractor supervision in place, including oversight of contractor safety training programs. Periodic and random unannounced safety audits should be integral components of such supervision at all work activities associated with the project. Contractor contracts should include both incentives to encourage full compliance with health and safety plans and disincentives if safety goals are not met.

[60] See https://www.isnetworld.com/en/.

6. Require ongoing safety training.

Training should be an integral and ongoing aspect of the project. Training should be specific to coal ash handling practices and should be developed consistent with best practices. The program should be developed in consultation with the affected trades that contractors and sub-contractors are required to use with workers at any TVA coal-ash site. It should adequately communicate the risks involved, the safety procedures required, the right to refuse dangerous work, and the legal protections that workers can call upon if they need to lodge a complaint or seek assistance as needed. The training should be hands-on and not just web or video based. It should not be a one-time event, but should include follow-up, including an assessment of how well each trainee understood and absorbed the material, a period of active supervision by someone with more experience and preparation, as well as refresher events, etc. Training materials are available from a number of sources including the Center for Construction Research & Training, CPWR.[61]

7. Put in place specific protections for coal ash.

- *Personal protective equipment (PPE)*: Adopt a TVA standard requiring use of respirators and other appropriate PPE during activities that will require exposure to coal ash. Abide by existing standards for PPE requiring medical assessment, proper fit testing, and safe procedures for timely replacement and/or cleaning.
- *Trucks and heavy equipment*: Properly equip and consistently maintain trucks and heavy equipment used to excavate or transport coal ash so that ash is kept out of the cabs. Trucks should be dedicated and remain on-site. Any trucks leaving the work site should be properly decontaminated at truck wash stations.
- *Cleaning*: Adequate and convenient shower and laundry facilities should be provided on site so that workers do not carry coal ash into their automobiles or homes. Work clothes should be provided so that personal clothes do not carry coal ash to worker homes.

8. Protect workers and the public from exposure to fugitive dust.

This Plan's entire dust management begins and ends with the use of watering trucks to manage moisture in such a fashion as to not create dust. Further, the plan contains no verification requirements to ensure that even this meager management effort will be effectively done. TVA's air permit similarly does not address the fugitive dust activities associated with the ash removal process, and the existing provisions in the air permit are inadequate to ensure that excessive levels of dust do not migrate beyond the boundary of the facility, let alone protect worker health and safety.

[61] See, for instance, https://www.cpwr.com/about-cpwr/ and https://www.cpwr.com/training/training-programs/disaster-response/.

Minimizing fugitive dust emissions for this project should focus on mitigation measures appropriate for each activity: excavation of ash from its current location (including from dewatered piles); loading onto haul trucks; truck travel along haul roads; unloading at the destination; and placement/compaction at the receiving location.

Verification that mitigation measures are adequate and working is a must. This includes installation of a few local meteorological towers, fixed ambient air monitors for PM and PM2.5, mobile monitors at the source and destination areas (which can be moved to upwind and downwind locations depending on the working day/hours' predominant wind direction), and fixed low-cost ambient monitors such as PurpleAir II (or similar). Data from all of the monitoring should be made available on a public website.

V. Conclusion

After polluting the air and water of South Memphis for decades, TVA owes it to this community to ensure a thorough, safe, and equitable remediation process and clean up of the Allen site. While we support TVA's decision to remove the coal ash from the leaking, unlined pits at Allen, we cannot support the groundwater remediation proposal outlined in the Proposed Plan. Nor has TVA adequately addressed environmental justice and worker safety concerns raised by the Proposed Plan.

Thank you for your consideration of these comments.

Sincerely,

Amanda Garcia

Attachment 1 is attached to this letter. Attachments 2 and 3 are available at the following ShareFile link:

https://southernenvironment.sharefile.com/d-s45b443dcfb1c45eca003652f400f6bc3

Attachment 1

Adaptive Groundwater Solutions LLC
10240 Stonemede Lane
Matthews, NC 28105

December 16, 2020

Via email to agarcia@selctn.org

Amanda Garcia
Tennessee Office Director
Southern Environmental Law Center
1033 Demonbreun St., Ste. 205
Nashville, TN 37203

Re: **Proposed Plan to Address Environmental Conditions, Tennessee Valley Authority (TVA), Allen Fossil Plant, Memphis, Shelby County, Tennessee (October 2020)**

Dear Ms. Garcia,

Per your request, I reviewed several documents related to the Proposed Plan to Address Environmental Conditions at the TVA Allen Fossil Plant in Memphis, Tennessee, including the following:

- TVA, 2020. Proposed Plan to Address Environmental Conditions, Tennessee Valley Authority (TVA), Allen Fossil Plant, Memphis, Shelby County, Tennessee, October 2020.
- Stantec, 2019. Assessment of Corrective Measures, TVA Allen Fossil Plant, Memphis, Tennessee, July 15, 2019.
- Stantec, 2019. Updated TVA Allen Fossil Plant – East Ash Disposal Area – Remedial Investigation Report, Tennessee Valley Authority, Allen Fossil Plant, Memphis, Tennessee. Prepared for: Tennessee Valley Authority, Chattanooga, Tennessee by Stantec Consulting Services, May 31, 2019.
- Stantec, 2020. TVA Allen Fossil Plant Groundwater Flow & Solute Transport Modeling Report, Allen Fossil Plant, Memphis, Tennessee. Prepared for: Tennessee Valley Authority, Chattanooga, Tennessee by Stantec Consulting Services, July 13, 2020.
- Assorted comments by the Tennessee Department of Environment and Conservation regarding the above-referenced documents.

Based on my review of these documents, I am providing the attached comments regarding the groundwater remediation approach outlined in the proposed plan and the groundwater model upon which it is based.

Sincerely,

Douglas J. Cosler, Ph.D., P.E.
Principal Chemical Hydrogeologist
Adaptive Groundwater Solutions LLC

Comments on Proposed Plan to Address Environmental Conditions
Tennessee Valley Authority, Allen Fossil Plant, October 2020

Model Representation of Blue Clay Zone

The TVA groundwater flow and solute transport model (the Model) incorrectly represents the blue-clay zone in the upper portion of the shallow Alluvial aquifer as an areally-extensive impermeable barrier that artificially blocks the downward transport by groundwater of dissolved coal combustion residual (CCR) contaminants from the East Ash Disposal Area (EADA). Due to this numerical-model design error and failure to perform transport-model calibration, the Model is incapable of simulating the observed distributions of CCR concentrations (e.g., arsenic, lead, fluoride, boron, sulfate) in the middle and deep portions of the Alluvial aquifer. As a result, the Model is unsuitable for the design and performance evaluation of remedial measures at the site (e.g., the interim groundwater response action for the EADA).

Figure 1 shows the Model layers in a regional cross-section view. Layer 5 represents the base of the upper alluvium and Layers 6 and 7 represent the lower part of the Alluvial aquifer. The blue clay zone is contained in Layer 5 (Figure 2) and is assumed to be an extensive continuous layer of low-permeability clay with a hydraulic conductivity (K_{blue}) of 2.37E-03 feet per day (ft/day; Table 1). Moreover, cross-sections A-A' and B-B' in Figure 3 illustrate how the Model also assumes incorrectly that the entire EADA is effectively encapsulated by a thick blanket of this low-permeability clay, even though no geologic data have been collected within the EADA footprint to support this assumption (Figure 4).

Figure 1
Regional Cross-Section Showing Model Layers and Soil Types (Stantec, 2020)

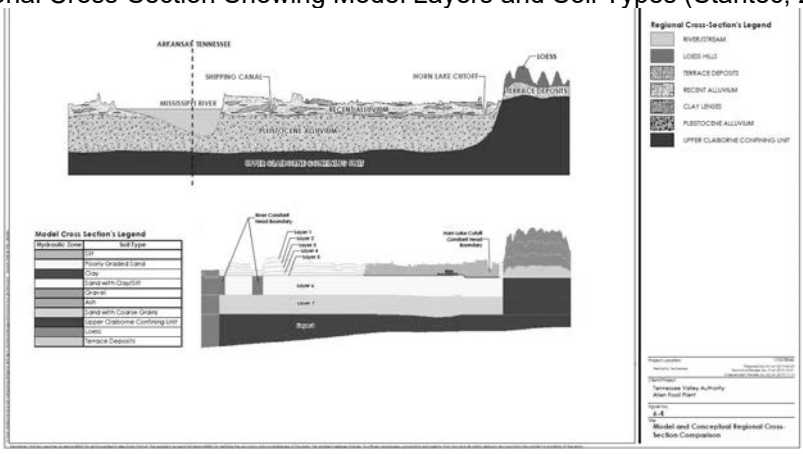


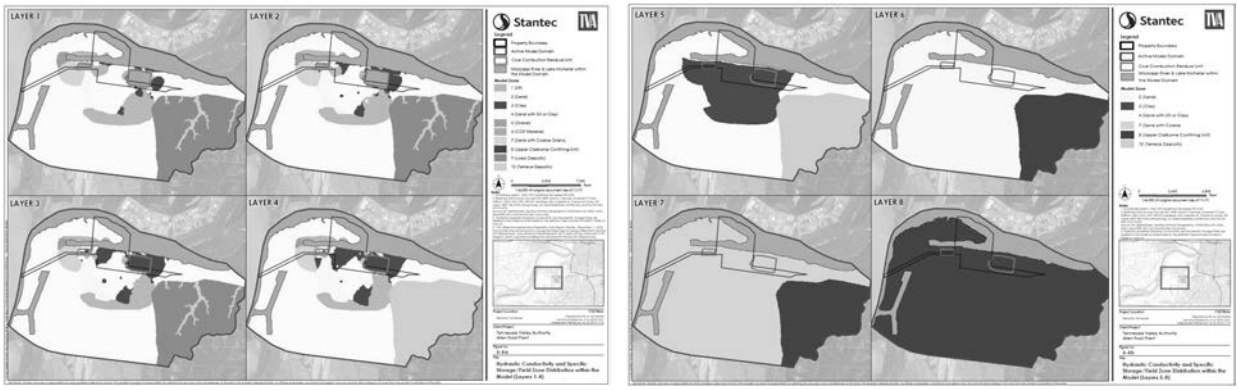
Table 1
Model Hydraulic-Conductivity Zone Values (Stantec, 2020)
(Blue Clay is Zone 3)

Table 6-1
Summary Hydraulic Conductivity Applied to the Model
TVA Allen Fossil Plant
Memphis, Tennessee

Model Zone Number	Soil Type	Hydraulic Conductivity (Feet Per Day)							
		Hydraulic Conductivity Applied to the Model		Site-Specific Kxy Ranges			Site-Specific Kz Ranges		
		Kxy	Kz	Minimum	Maximum	Average	Minimum	Maximum	Average
1	Silt	4.74E-02	4.70E-03	*	*	*	8.50E-03	2.34E-01	7.20E-02
2	Poorly Graded Sand	300	30	1.55E+01	1.73E+02	6.65E+01	*	*	*
3	Clay	2.37E-03	2.37E-03	*	*	*	1.50E-05	2.62E+00	2.39E-01
4	Sand with Clay/Silt	10	0.001	3.10E-03	1.59E+02	2.72E+01	3.83E-04	9.35E-01	1.58E-01
5	Gravel	500	50	*	*	*	*	*	*
6	Ash	8.50E-02	8.50E-02	*	*	*	8.50E-02**	8.50E-02**	8.50E-02**
7	Coarse-Grained Sand	375	3.75	6.81E+00	5.85E+02	1.56E+02	*	*	*
8	Upper Claiborne Confining Unit	3.50E-05	3.50E-06	*	*	*	1.17E-06	1.72E-03	1.49E-04
9	Loess	27.9	12.7	*	*	*	*	*	*
10	Terrace Deposits	200	20	*	*	*	*	*	*

Notes:
Kxy - Horizontal Hydraulic Conductivity in the x-direction and y-direction
Kz - Vertical Hydraulic Conductivity in the z-direction
* - No Site Specific Data available
** - Only one sample was available

Figure 2
Hydraulic Conductivity Zones for Each Model Layer (Stantec, 2020)
(Layer 5 is Assumed Blue Clay Zone)



However, the modelled blue clay zone is a highly-inaccurate misrepresentation of the actual subsurface geologic conditions. First, the geometric mean (average) measured blue clay hydraulic conductivity is 4.8 ft/day (Table 2), which is a factor of 2,000 greater than the Model value. In fact, the measured K_{blue} is only about a factor of 10 smaller than the highly-permeable sandy zone of the shallow aquifer and the coarse-grained sands of the deep Alluvial aquifer (Table 2). Second, field boring logs show that the blue clay zone is a heterogeneous mixture of sand, silt, and clay and not a uniform and continuous clay layer. Indeed, TVA acknowledges in Section 6.1.5 of the RI report (Stantec, 2019) that the blue clay zone "…*can be interbedded with more permeable fine-grained sand in certain locations (so it does not entirely prevent downward movement like a confining unit)…*". TDEC further commented on this issue in a 11-20-2019 comment (TDEC, 2019) on the Feasibility Study report: "*Though the "blue clay" zone is an area of lower hydraulic conductivity within the Alluvial Aquifer, it is not a barrier to downward migration of contaminants. To state that arsenic and other COCs at the site is contained is false...*". The U.S. Geological Survey also considers the blue clay zone to be heterogeneous and discontinuous in some areas of the site (USGS, 2018).

Figure 3
Cross-Sections A-A' and B-B' EADA Showing Assumed Blue Clay Layer (Stantec, 2020)

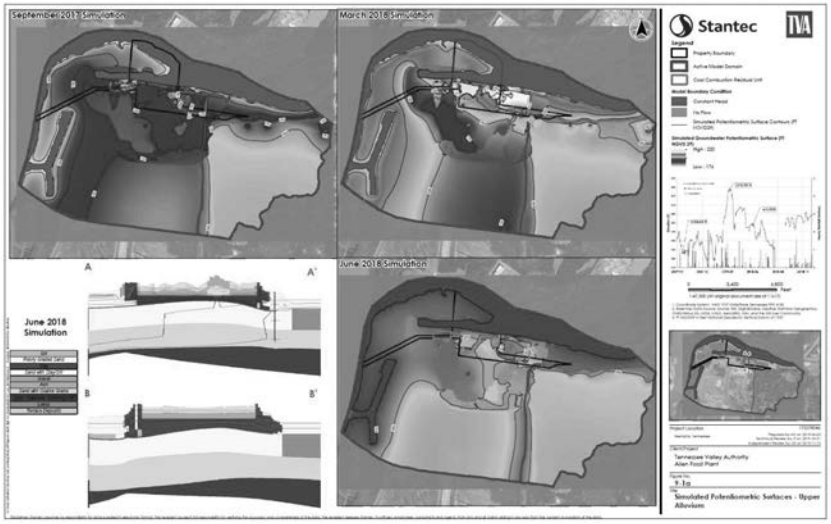


Figure 4
Geologic Cross-Section Map (Stantec, 2020)

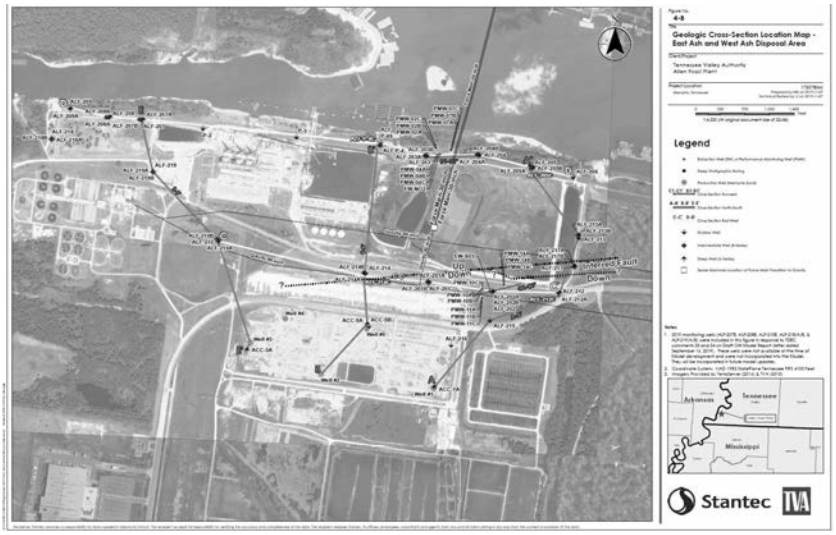


Table 2
Measured Blue-Clay Zone Hydraulic Conductivity (Stantec, 2019)

RESULTS AND EVALUATION
May 31, 2019

Alluvial Aquifer Screened Interval	Average		Geometric Mean	
	ft/day	cm/sec*	ft/day	cm/sec
Blue Clay Zone of Shallow	5.7	2.03E-03	4.8	1.70E-03
Sandy Zone of Shallow	66.5	2.35E-02	47.9	1.69E-02
Intermediate	225.0	7.94E-02	145.7	5.14E-02
Deep	109.2	3.85E-02	62.5	2.20E-02

* centimeter per second (cm/sec)

Measured CCR constituent concentrations provide the most direct evidence that the blue clay zone is not a barrier to downward migration of CCR contaminants (refer to more detailed discussions in Attachment 1). As shown in Figures 5 (South Area cross-section) and 6 (North Area cross-section), the arsenic, boron, and sulfate CCR plumes extend far below the blue clay zone. (The vertical scales are the same and aligned in each figure). In fact, zones of boron and sulfate concentrations much greater than background values extend almost to the bottom of the Alluvial aquifer. Figures 5 and 6 also demonstrate that the arsenic cleanup simulations presented in Section 9 of the Model report (Stantec, 2020) are incorrect because they only simulate the extraction of the upper portion of the arsenic plumes in the North and South areas. Further, as discussed below, these cleanup simulations likely greatly underestimate the time required to achieve arsenic concentration reductions because the three-dimensional dimensions of the arsenic plume are expected to be significantly larger once the results of the field investigation of groundwater contamination beneath the EADA footprint are completed (TDEC, 2019).

Figure 5
South Area Cross Sections
(a) Geologic Cross-Section C-C' from RI Report (Stantec, 2019) and Assumed Blue Clay Zone
(b) Measured Arsenic (black), Boron (red), and Sulfate (green)
Concentrations (ppb) in Groundwater (Attachment 1, Fig. 13)

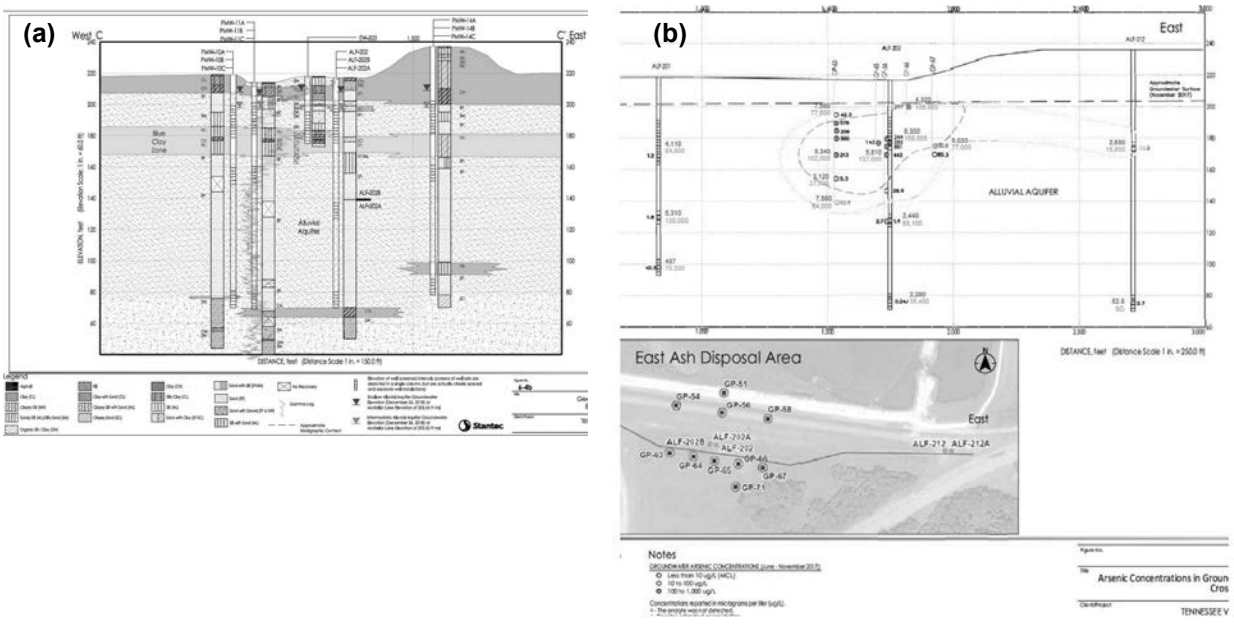
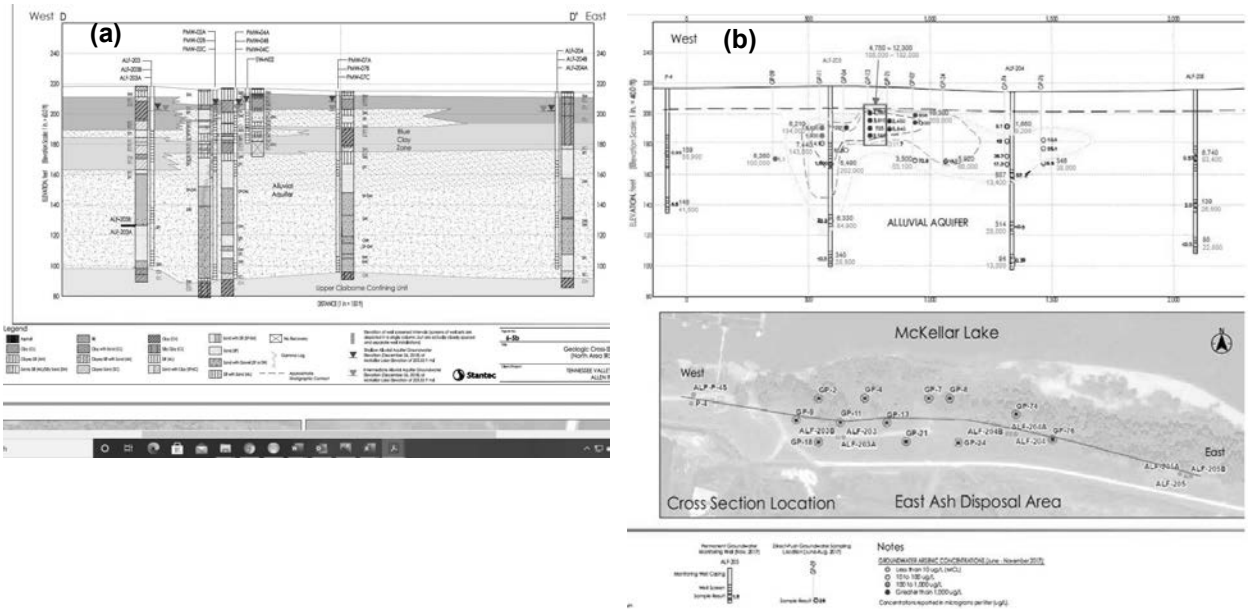


Figure 6
North Area Cross Sections
(a) Geologic Cross-Section D-D' from RI Report (Stantec, 2019) and Assumed Blue Clay Zone
(b) Measured Arsenic (black), Boron (red), and Sulfate (green)
Concentrations (ppb) in Groundwater (Attachment 1, Fig. 12)



It is very important to note that the Model cannot correctly simulate this observed contaminant transport behavior because the artificial blue clay zone in the Model forces CCR contaminants to remain in the upper portion of the Alluvial aquifer above the blue clay zone. The RI, FS, and Model reports largely ignore this direct evidence of deep CCR contamination and rely on indirect evaluations of potential groundwater "mounding" to make a case that the blue clay zone is a contaminant transport barrier, when in fact it clearly is not. As part of a transport-model calibration process, which has not been performed, the hydraulic-conductivity zonation in the Model needs to be corrected so that the observed distributions of arsenic, boron, and sulfate in Alluvial-aquifer groundwater at all depths can be reproduced.

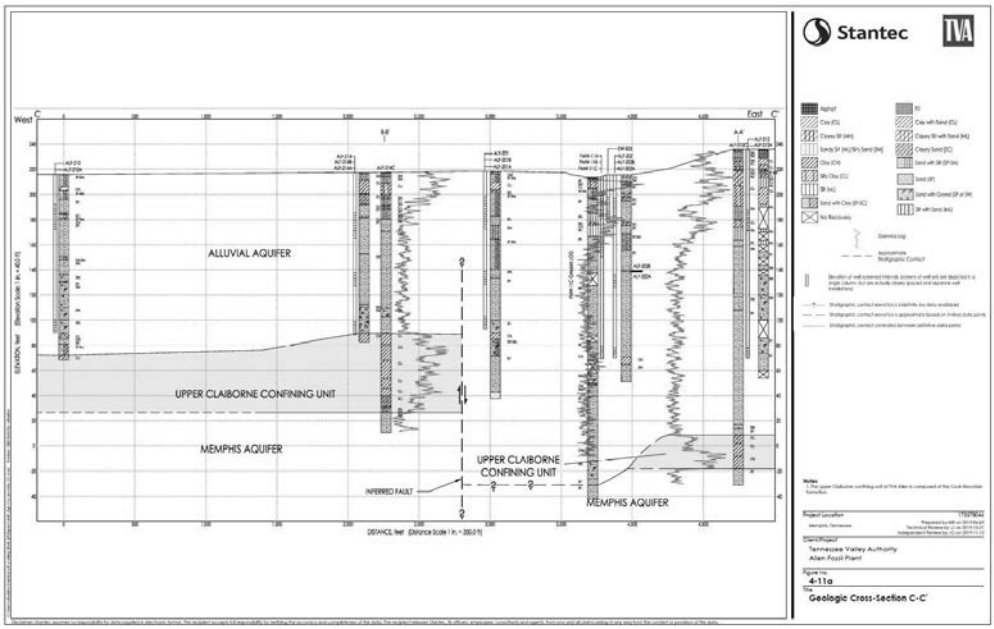
Breach in Upper Claiborne Confining Unit (UCCU)

As discussed in Attachment 1 and the report documenting a recent U.S. Geological Survey field investigation and groundwater pumping test (USGS, 2018), the Alluvial and Memphis Sand Aquifers are hydraulically interconnected in the Allen plants area due to the presence of a window or breach in the UCCU separating the two aquifers at a location adjacent to the EADA (Figure 7). Figure 8 illustrates how CCR contaminants from the EADA could migrate through this breach into the Memphis Sand aquifer due to the

fact that the natural groundwater “driving force” (i.e., vertical hydraulic head difference) in this area is strongly downward from the Alluvial aquifer to the Memphis Sand (USGS, 2018; Attachment 1).

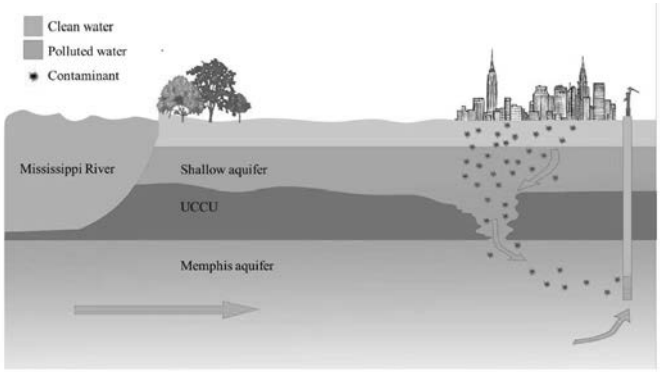
Regional groundwater-flow simulations (Clark and Hart, 2009; Jazaei et al., 2018) also confirm strong downward hydraulic gradients from the Alluvial aquifer to the Memphis Sand in this area, in addition to thinning of the UCCU near the Allen plant. As discussed above, the very high boron and sulfate CCR-constituent concentrations (up to 30 times background levels) detected near the bottom of the Alluvial aquifer beneath the EADA are consistent with this measured average downward flow component in the Alluvial aquifer. Further, water-quality data for the Memphis Sand aquifer (e.g., PW 5) are consistent with possible ongoing transport of CCR constituents from the Alluvial to Memphis Sand aquifers in the ALF Plant area (Attachment 1).

Figure 7
Geologic Cross-Section Showing Breach in UCCU (Stantec, 2020)



Therefore, it is critical that further characterization and quantification of the risk of contamination of the Memphis Sand Aquifer by CCR constituents in the Allen Plant area be conducted. The conclusions of the USGS (2018) investigation also strongly recommend these types of investigations. Specifically, the location(s) and extent(s) of leakage/window features in the confining unit need to be better defined and the fluxes of groundwater and CCR constituents from the Alluvial to Memphis Sand aquifers need to be accurately quantified under current hydrogeologic conditions and into the future under both static and pumping conditions.

Figure 8
Potential Mechanisms for Contaminant Transport from the
Shallow Alluvial Aquifer to the Memphis Sand Aquifer through a Breach in the UCCU
(from Jazaei et al., 2018)



Notwithstanding the measured large-scale breach in the UCCU and the clear evidence of downward flow and CCR migration in the Alluvial aquifer, the Model inexplicably "plugs" the hole in the UCCU (Layer 8 in Figures 1 and 2), thus creating an impermeable barrier across the entire bottom of the Model that prevents hydraulic communication with the Memphis Sand. The Model also artificially restricts downward flow and transport in the Alluvial aquifer because the ratio of vertical to horizontal hydraulic conductivity, A_v, in the Model (1E-4 for Zone 4 in Table 3) is about a factor of 58 too low compared to the mean measured value (0.0058) for the upper portion of the aquifer. In addition, the modelled A_v for the lower part of the Alluvial aquifer (A_v = 0.01 for Zone 7, Table 3) is on the order of 10 times smaller than typical values for alluvial aquifers (Weeks, 1969; Kontis et al., 2004; Warren et al., 1996; Harte, 2004). This increased resistance to vertical flow in the Model (compared to actual field conditions) may be the reason that the simulated hydraulic heads (Figure 9) are significantly higher than the measured heads (i.e., biased). The bias is illustrated by the fact that the mean residual (measured minus simulated head) in the model is -1.38 feet, but should be close to zero (ASTM, 2014; USDOI, 2010; MDOH, 2018).

As a result, in combination with the incorrect numerical (Layer 5) representation of the blue clay zone in the upper alluvial aquifer (discussed above), the Model is (i) incapable of simulating, or reproducing, the measured vertical distribution of CCR constituent concentrations in the Alluvial aquifer and (ii) unsuitable for the design and performance evaluation of remedial measures at the site.

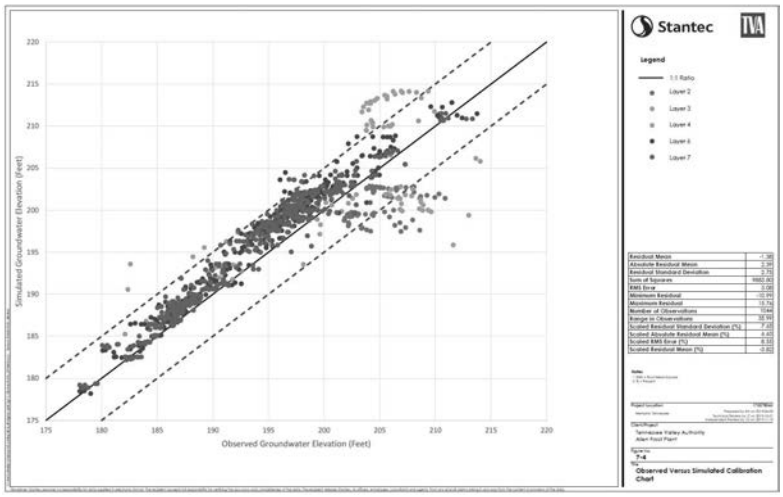
Table 3
Hydraulic Conductivity Values for Model Zones (Stantec, 2020)

Table 6-1
Summary Hydraulic Conductivity Applied to the Model
TVA Allen Fossil Plant
Memphis, Tennessee

Model Zone Number	Soil Type	Hydraulic Conductivity (Feet Per Day)							
		Hydraulic Conductivity Applied to the Model		Site-Specific Kxy Ranges			Site-Specific Kz Ranges		
		Kxy	Kz	Minimum	Maximum	Average	Minimum	Maximum	Average
1	Silt	4.74E-02	4.70E-03	*	*	*	8.50E-03	2.34E-01	7.20E-02
2	Poorly Graded Sand	300	30	1.55E+01	1.73E+02	6.65E+01	*	*	*
3	Clay	2.37E-03	2.37E-03	*	*	*	1.50E-05	2.62E+00	2.39E-01
4	Sand with Clay/Silt	10	0.001	3.10E-03	1.59E+02	2.72E+01	3.83E-04	9.35E-01	1.58E-01
5	Gravel	500	50	*	*	*	*	*	*
6	Ash	8.50E-02	8.50E-02	*	*	*	8.50E-02**	8.50E-02**	8.50E-02**
7	Coarse-Grained Sand	375	3.75	6.81E+00	5.85E+02	1.56E+02	*	*	*
8	Upper Claiborne Confining Unit	3.50E-05	3.50E-06	*	*	*	1.17E-06	1.72E-03	1.49E-04
9	Loess	27.9	12.7	*	*	*	*	*	*
10	Terrace Deposits	200	20	*	*	*	*	*	*

Notes:
Kxy - Horizontal Hydraulic Conductivity in the x-direction and y-direction
Kz - Vertical Hydraulic Conductivity in the z-direction
* - No Site Specific Data available
** - Only one sample was available

Figure 9
Measured Versus Simulated Hydraulic Heads (Stantec, 2020)



Steady-State Simulations of Arsenic Transport

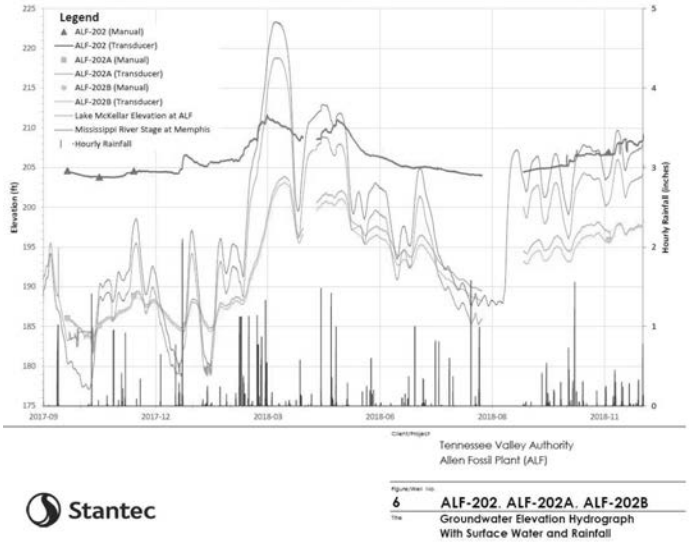
Due to the major design flaws in the Model, as discussed above, and several other factors, the arsenic transport and cleanup simulations presented in Section 9 of the modeling report (Stantec, 2020) are highly inaccurate. First, the assumed initial (time=0) three-dimensional arsenic concentration distribution likely only represents a small fraction of the arsenic-contaminated groundwater in the Alluvial aquifer: the upper portion of the aquifer in the small North and South areas where contamination was detected outside of the EADA footprint. No monitoring-well clusters have been installed beneath the large EADA source area (i.e., laterally or vertically downgradient from the arsenic source). However, per Attachment 1, historical downward groundwater pore velocities beneath the EADA have been very large compared to horizontal

velocities due to the hydraulic mounding caused by the approximate 30-foot higher water level in the EADA compared to the adjacent hydraulic heads in the aquifer.

Therefore, the Section 9 cleanup simulations likely greatly underestimate the time required to achieve arsenic concentration reductions because the size of the arsenic plume is expected to be significantly larger (horizontally and potentially vertically) once the results of the field investigation of groundwater contamination beneath the EADA footprint are completed (TDEC, 2019). In addition, as discussed above, the transport simulation results are adversely impacted by (i) the incorrect numerical (Model) representation of the blue clay zone as a continuous impermeable layer that artificially blocks upward flow of arsenic-contaminated groundwater from deeper portions of the Alluvial aquifer into the extraction wells and (ii) the fact that no transport-model calibration was performed. If standard Model calibration (e.g., history matching) was performed using, for example, measured arsenic, boron, and sulfate concentrations at all depths in the Alluvial aquifer then the Model design errors discussed above would have been detected.

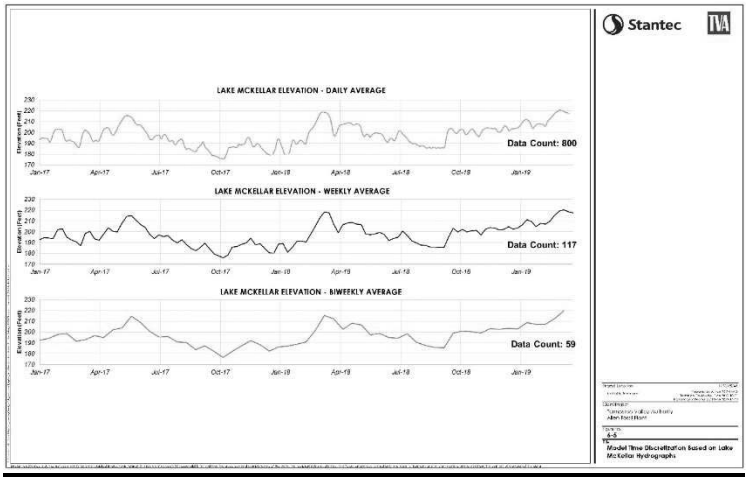
Another serious limitation of the Section 9 transport simulations is that no characterization of the steady-state (i.e., average) groundwater velocities in the Alluvial aquifer was conducted in the RI. This is because the RI failed to measure the true average horizontal and vertical hydraulic heads in the alluvial aquifer which determine long-term horizontal/vertical chemical transport fluxes (Bear, 1979). Instead, as discussed further in Attachment 1, the RI hydraulic-head maps are only random "snapshots" of the hydraulic heads and groundwater flow directions in the Alluvial aquifer which, due to Lake McKellar stage fluctuations, significantly change from one measurement date to another (e.g., Figure 10). Lake McKellar stage data

Figure 10
Model Calibration Water-Level Data for Monitoring Well Cluster ALF-202 (Stantec, 2020)



were averaged for the steady-state flow simulation (Figure 11), but no averaging of the continuous data-logger water levels for monitoring wells was conducted so that the simulated steady-state groundwater flow field could be compared to the actual measured average flow field for this approximate two-year calibration period. In other words, short-term transient flow model calibration was performed, but no steady-state flow (i.e., average flow conditions) flow calibration was completed. As a result, the accuracy of the steady-state groundwater flow model used to drive the transport simulations is unknown. To address this issue, averaging of continuous water-level data should be conducted throughout the study area and the resulting mean-measured hydraulic heads should be compared with simulated values to determine what Model modifications are needed in order to accurately simulate mean groundwater flow conditions in the Alluvial aquifer.

Figure 11
Model Averaging of Lake McKellar Stage Data (Stantec, 2020)



Transport model simulation error was also introduced by the overly-coarse grid cell sizes used in the arsenic plume areas and the excessively large dispersivity values (Table 4) that were assumed. As shown in Figure 12, the 30x30 foot horizontal cell size used in the Model is similar in size to the arsenic “hot spot” dimension (concentration greater than 1,000 ppb), which is too large to accurately simulate the large measured horizontal concentration gradients. These large cell sizes cause numerical dispersion, which is artificial mixing that leads to exaggerated concentration reductions as a function of time.

In addition, the dispersivity values used in the Model (Table 4), which control mixing of zones of higher arsenic concentration with less-polluted groundwater, are at least 10 times greater than reliable field measurements (Figure 13) for plume sizes on the order of 200 to 300 feet in the flow direction (Figure 12). To address these Model limitations, the sensitivity of the transport simulations to horizontal cell size, vertical

layer thickness, and horizontal and vertical dispersivity values should be carefully examined in future Model analyses.

Figure 12
Simulated Model-Layer 3 Arsenic Concentrations in North Area for Scenario 3 (Stantec, 2020)

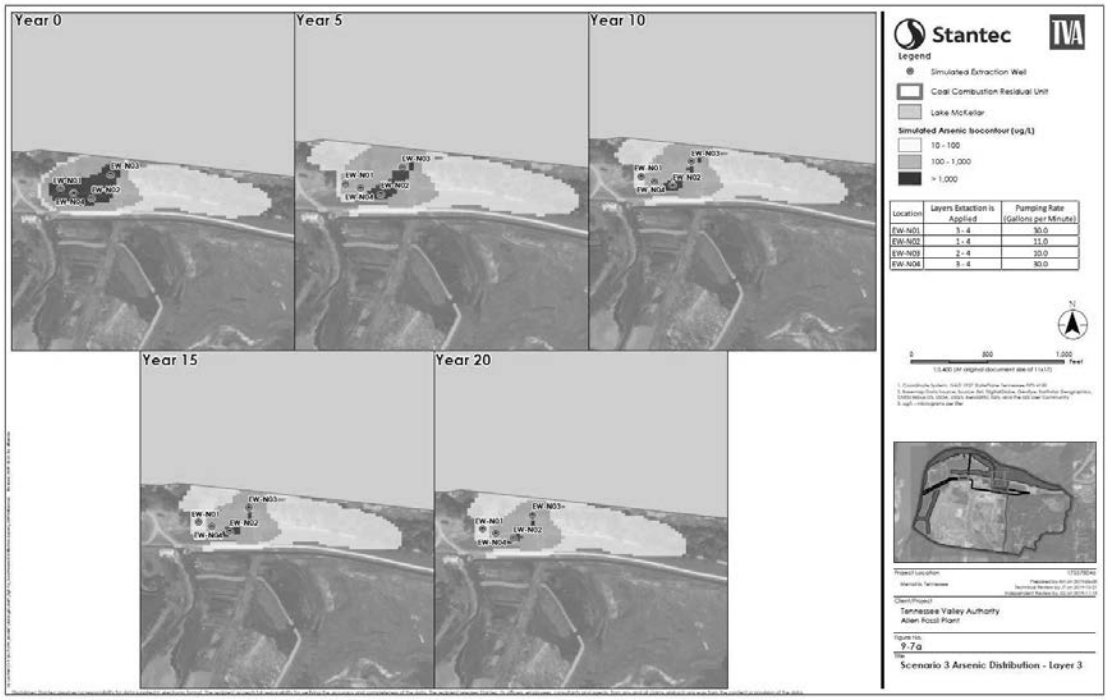


Table 4
Groundwater Transport Parameters (Stantec, 2020)

Table 9-1
Summary of Groundwater Transport Parameters
TVA Allen Fossil Plant
Memphis, Tennessee

	Coarse Sediments (Sand and Gravel)	Fine Sediments (Silt and Clay)	Reference
Effective Porosity	0.35-0.42	0.05-0.20	Jazaei, et al. (2018), Heath (1938), and Morris & Johnson (1967)
Longitudinal Dispersivity (ft)	100	100	Gelhar et al. (1992)
Transverse Dispersivity (ft)	10	10	Gelhar et al. (1992)
Vertical Dispersivity (ft)	1	1	Gelhar et al. (1992)
Arsenic Distribution Coefficient (cm^3/g)	4.7	18.7	Site-specific Data
Bulk Density (g/cm^3)	1.62	1.28	Jury (1986)
Zone 7 - Sand with Coarse Grains	0.0011	0.35	-
Zone 8 - upper Claiborne confining Unit	0.0001	0.05	-
Zone 9 - Loess	0.0001	0.2	-
Zone 10 - Terrace Deposits	0.00001	0.366	-

Notes:
ft - feet
cm^3/g - cubic centimeter per gram
g/cm^3 - grams per cubic centimeter

Figure 13

Representative Field-Scale Measurements of Dispersivity (Gelhar et al., 1992)

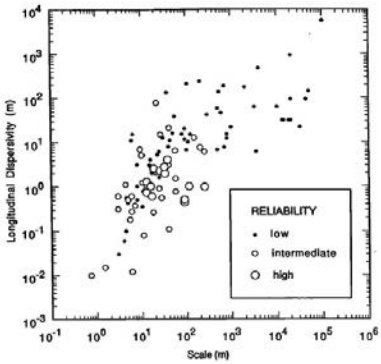


Fig. 2. Longitudinal dispersivity versus scale with data classified by reliability.

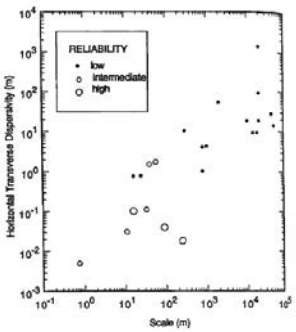


Fig. 4. Horizontal transverse dispersivity as a function of observation scale.

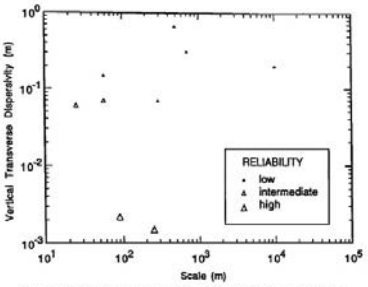


Fig. 5. Vertical transverse dispersivity as a function of observation scale.

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Attachment 1

Risk of Contamination of the Memphis Sand Aquifer Allen Fossil and Combined-Cycle Combustion Turbine Plants: Review and Analysis of the Environmental Investigation Plan, Remedial Investigation, and Interim Remedial Action

Memphis, Tennessee

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November 26, 2018

Executive Summary

The Environmental Investigation Plan, revision 2, for the Allen Fossil Plant (EIP) repeatedly refers to data collected and analyses performed pursuant to the Remedial Investigation (RI). See, for example, Sections 3.3 (Groundwater Monitoring), 3.8 (Migration of Constituents via Groundwater and Identification of Uppermost Aquifer), 4.3.3, 4.3.4, 4.3.5, 4.3.6, and 4.3.7 (Groundwater Monitoring and Mapping Requests). The RI data and analyses are not, however, included in the EIP. Instead, in the EIP, TVA states: "Based on the similarities between the RI activities and the TDEC Order EI objectives, TVA plans to provides the results of the investigations in the TDEC Order EAR." [EIP at page 18 in Section 3.3.1]. This report addresses fundamental flaws in the RI that also affect data collection and analyses referenced in the EIP.

The RI was conducted pursuant to the request of the Tennessee Department of Environment and Conservation (TDEC) after Tennessee Valley Authority (TVA) reported elevated concentrations of arsenic and other Coal Combustion Residual (CCR) constituents in the Mississippi River Valley Alluvial (MRVA) aquifer at the Allen Fossil (ALF) Plant, adjacent to the new Allen Combined Cycle (ACC) Plant in southwest Memphis, Shelby County, Tennessee (Figure 1). In particular, TDEC requested that TVA evaluate the effects of pumping the five new Memphis aquifer production wells installed at the ACC Plant to evaluate potential hydraulic interconnection of the MRVA and Memphis Sand aquifers and possible leakage of groundwater from the overlying MRVA aquifer into the Memphis Sand. As a result, TVA requested that the U.S. Geological Survey (USGS) and the University of Memphis' Center for Applied Earth Science and Engineering Research (CAESER) jointly investigate the hydrogeology and groundwater conditions in the area. TVA also retained Stantec to conduct a Remedial Investigation (RI) and prepare a RI Report (Stantec, 2018a) for the TVA ALF Plant that discusses the nature and extent of potential contamination in the MRVA aquifer.

As TVA acknowledges in the EIP, the RI and the data upon which it is based are vitally important to accomplishing the objectives outlined in the Commissioner's Order. These objectives include to (1) fully identify the extent of soil, surface water, and groundwater contamination by CCR constituents (Section VII.A.d); (2) adequately characterize the extent of CCR contamination in soil, surface water, and groundwater at [Allen] (Section VII.A.e); (3) remediate CCR-contaminated soil, surface water, and groundwater at [Allen] (Section VII.A.f.ii); and (4) protect public and private water supplies from CCR contamination (Section VII.A.f.v). In my opinion, to achieve the stated objectives of the EIP—to fully identify the extent of soil, surface water and groundwater contamination by CCR constituents at Allen—it is vitally important to disclose and understand the data provided through the RI process and its implications.

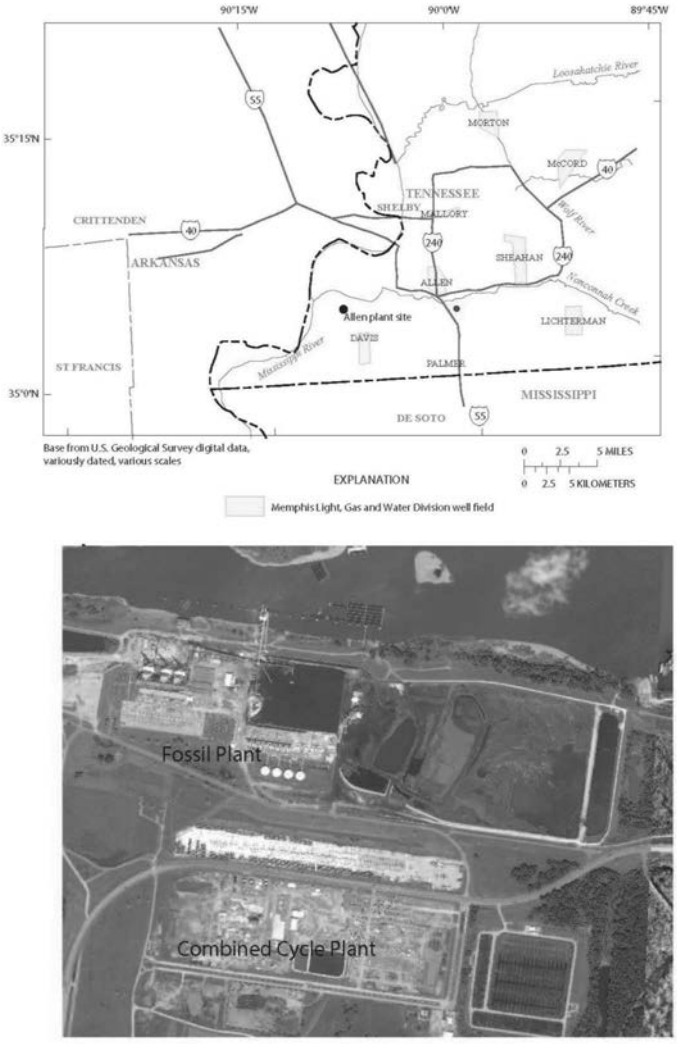

Figure 1
Locations of the ALF and ACC Plants in Southwest Memphis, Tennessee (Stantec, 2018a)

In the report that follows, I describe my independent review of the data collected and analyses performed pursuant to the RI and the related USGS-CAESER pumping test in the Memphis Sand. In particular, I evaluate the implications of the data for the risk of contamination of the Memphis Sand Aquifer by CCR constituents present in the MRVA aquifer at the Allen Plant. I also evaluate the risk of contamination of McKellar Lake via groundwater transport of CCR constituents. Data sources that I evaluated include the RI report, USGS-CAESER pumping test report (USGS, 2018), and various referenced USGS regional groundwater investigations and groundwater modeling studies.

My independent evaluation of the RI and USGS-CAESER data leads me to make the following findings:

- There is a hydraulic connection between the MRVA Aquifer and the Memphis Sand Aquifer;

- The areal extent of the breach in the confining layer that is causing the hydraulic connection may be much larger than the USGS-CAESER report initially indicated;
- The degree of hydraulic connection, based on pumping-induced water-level reductions in the MRVA Aquifer, may be much stronger than the USGS-CAESER report initially indicated;
- There are significantly elevated concentrations of boron and sulfate, CCR indicator constituents, deep in the MRVA Aquifer at the Allen Plant;
- These boron and sulfate tracer concentration distributions indicate that long-term downward groundwater flow has been occurring in the Alluvial aquifer in the Allen Plant area;
- Shallow and deep vertical hydraulic gradients within the MRVA Aquifer, as well as significantly higher hydraulic heads in the MRVA aquifer compared to the Memphis Sand, also indicate downward groundwater flow;
- Age dating of groundwater (e.g., tritium analyses by USGS, 2018) and elevated sulfate concentrations in Memphis-Sand Production Well 5 indicate that mixing of MRVA Aquifer groundwater with Memphis Sand Aquifer water is occurring in the vicinity of the Allen Plant and that potential ongoing transport of CCR constituents from the MRVA into the Memphis Sand Aquifer is occurring;
- TVA's extraction of Memphis Sand Aquifer groundwater from the Davis well field will result in long-term drawdown in the Memphis Sand under the Allen Plant and increase downward vertical hydraulic gradients from the MRVA to the Memphis Sand;

Based on these findings, I recommend the following significant changes in the RI and EIP:

- Require TVA to incorporate the conclusions of the USGS-CAESER report (USGS, 2018, page 44) into the RI and EIP;
- Require TVA to implement the recommendations of the USGS-CAESER report for future data collection and analysis (USGS, 2018, page 44), including more accurate characterization of the location(s) and extent(s) of leakage/breach features in the confining unit and more accurate quantification of the fluxes of groundwater and dissolved CCR constituents from the MRVA Aquifer to the Memphis Sand Aquifer;
- Install monitoring well clusters (shallow, intermediate, and deep) within the footprint of the East Ash Pond and within the footprint of the West Ash Pond to adequately assess the spatial distribution of CCR contamination (including all Appendix III and IV constituents), the true groundwater velocity distribution (vertical and horizontal), and chemical transport rates;
- Properly average water-level measurements for monitoring wells, McKellar Lake, and the East Ash Basin water surface to allow construction of accurate mean hydraulic head maps that can reliably be used to analyze long-term chemical transport in the subsurface;
- Engage in site-specific characterization of the soil-water partition coefficient for the various CCR constituents (including boron, sulfate, and all other Appendix III and IV constituents) so that chemical transport rates can be estimated;
- Implement three-dimensional groundwater flow and chemical transport modeling that takes into account the above data (including all Appendix III and IV constituents); and
- Redesign the interim remedial action as further discussed in this report.

Investigations of Leakage from MRVA Aquifer into Memphis Sand

The USGS has conducted multiple hydrologic investigations which evaluate the potential for vertical groundwater flow and chemical transport between the MRVA and the Memphis Sand Aquifer (i.e., inter-aquifer exchange of groundwater) in the vicinity of the Allen plants (USGS, 1986; USGS, 1990; USGS, 1992; USGS, 1995; USGS, 2016; USGS, 2018). [Note: Vertical geologic cross-sections showing the

alluvial and Memphis Sand aquifers, separated by a confining unit (absent in some areas), are presented below]. This issue is the subject of EIP Sections 3.3.5, 3.3.6, 4.3.3, 4.3.6, 4.3.7, and 4.4.2.

The 1986 USGS investigation analyzed the following types of data in the Memphis area: geologic information; groundwater-level data; carbon and hydrogen isotope concentration data; and groundwater temperature data. One of the key findings of the 1986 USGS study was that the hydraulic head (i.e., groundwater "driving force") in the uppermost water-table aquifers (including the MRVA) is greater than or equal to the hydraulic head in the Memphis Sand Aquifer in the Memphis urban area (Figure 2), including

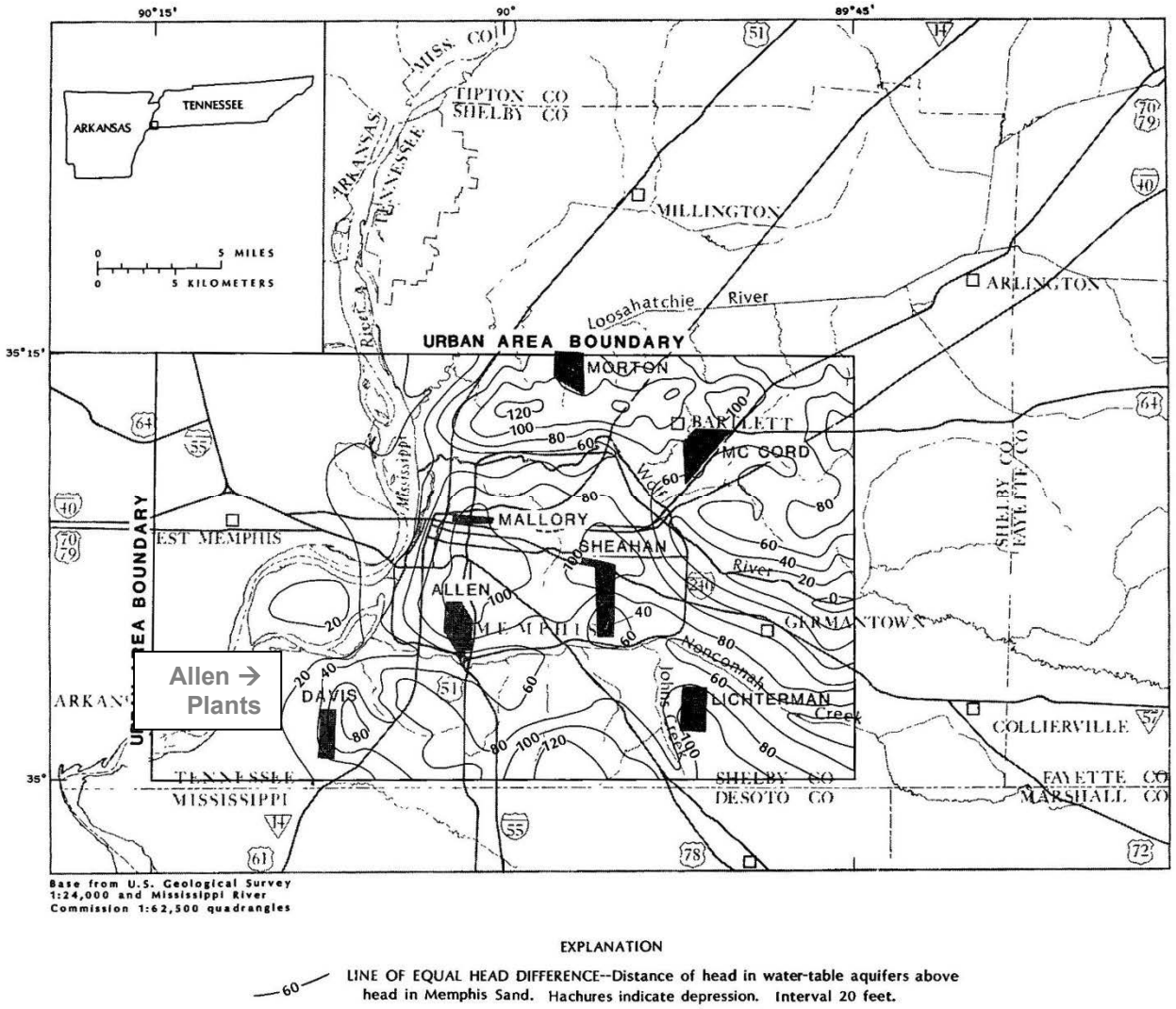

Figure 2
Hydraulic Head Differences beween the Water-Table Aquifers and the Memphis Sand in the Memphis Urban Area, Fall 1984 (from USGS, 1986; locations of Memphis Light, Gas, and Water well fields are shown as black-filled polygons)

the Allen site. Specifically, the water-table aquifer hydraulic heads range from about 20 feet (e.g., near the Allen site) to 130 feet greater than the heads in the Memphis Sand. Therefore, throughout this area the vertical hydraulic gradient is downward toward the Memphis Sand, as is the associated vertical direction of groundwater flow. The hydraulic-head differences are greater in areas where water-supply wells extract significant amounts of groundwater from the Memphis Sand and generally smallest near the Mississippi River and major streams, where the water-table elevation (e.g., MRVA aquifer near the Allen plants) is lower. The USGS (1986) has also identified localized reductions in hydraulic head in the upper alluvial aquifers due to Memphis-Sand groundwater extraction in areas where breaches in the confining layer (separating the alluvial and Memphis Sand aquifers) have been identified (further discussed below). Geothermal gradients computed from groundwater temperature data confirm that vertical leakage occurs from the water-table aquifers through the Jackson-upper Claiborne confining unit to the Memphis Sand. This groundwater leakage rate is greatest in areas where the hydraulic head in the Memphis Sand is depressed due to groundwater extraction. The vertical distribution of carbon-14 concentrations in groundwater generally confirm this vertical-leakage pattern.

The 1990 and 1995 USGS investigations identified “windows”, or discontinuities, in the upper Claiborne confining unit separating the MRVA and Memphis aquifers (Figure 3). One inferred window is located

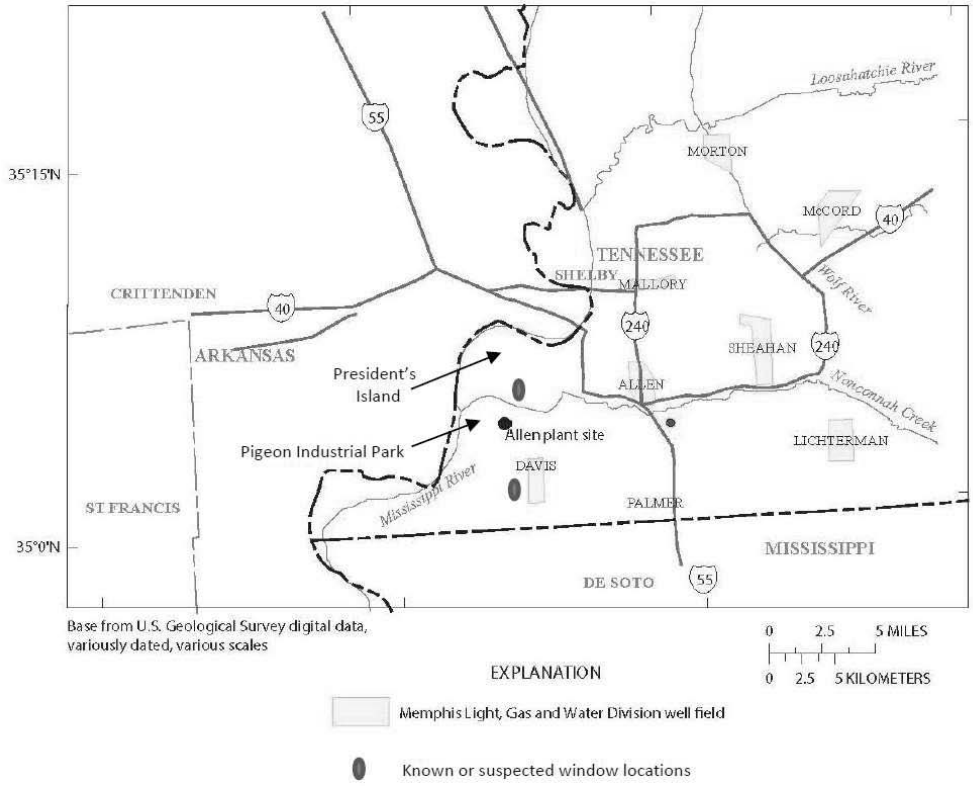

Figure 3
Known or Suspected Windows in Upper Claiborne Confining Unit
(from Appendix E of RI Report)

beneath President's Island one mile northeast of the Allen plants. A second window was identified about three miles south of the Allen plants and west of the Davis Well Field, where downward groundwater leakage from the MRVA to the Memphis aquifer was documented (USGS, 1995; Koban et al., 2011). As summarized in Appendix E of the Remedial Investigation report (Stantec, 2018a), downward leakage from the shallow water-table aquifers into the Memphis Sand Aquifer has been identified at several other locations in the Memphis area based on shallow-aquifer water-table lowering, water-quality changes in the Memphis aquifer, and/or hydrologic tracer studies (USGS, 1986; USGS, 1992; Larsen et al., 2003; Gentry et al., 2005; Gentry et al., 2006; Ivey et al., 2008; Larsen et al., 2013; Larsen et al., 2016).

The 2016 USGS report summarizes the results of a regional groundwater modeling study in which the USGS Mississippi Embayment Regional Aquifer Study (MERAS) groundwater-flow model (Clark and Hunt, 2009) was used to simulate the potential effects (i.e., hydraulic-head decreases caused by pressure reductions related to pumping) of future groundwater withdrawals from the Memphis Sand Aquifer at the proposed Allen combined-cycle plant (potential groundwater-quality changes were not analyzed). The groundwater extraction scenario for the simulation was a 30-year average withdrawal of 2,500 gallons per minute (gpm), followed by a 30-day maximum expected withdrawal rate of 5,000 gpm. The simulated hydraulic head reduction (Figure 4) in the Memphis Sand after the average 30-year period was as large

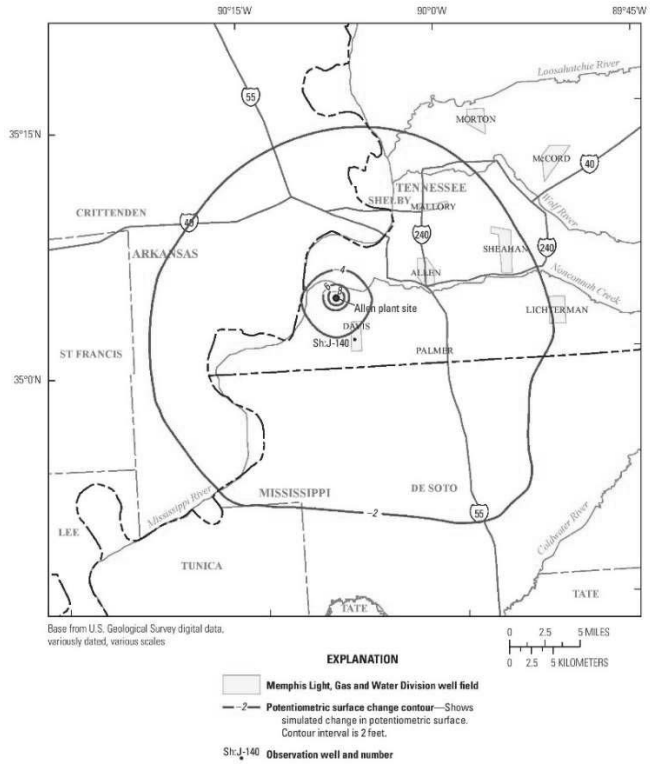

Figure 4
Simulated Hydraulic Head Change in Memphis Sand Aquifer
at End of TVA Withdrawal Scenario for ACC Plant (from USGS, 2016)

as 7 feet; the Memphis-Sand head reductions after the 30-day maximum-withdrawal period were up to 11 feet. Hydraulic head reductions in the shallow MRVA aquifer did not exceed one foot. Note that the MERAS model did not incorporate recent hydrogeologic information from the RI or the 2018 USGS-CAESER study (USGS, 2018).

USGS-CAESER Hydrogeologic Investigation and Groundwater-Pumping Test

Introduction

The objectives of the USGS-CAESER investigation were to evaluate (i) the potential for hydraulic connection between the MRVA and Memphis Sand aquifers and (ii) the potential for water-quality impacts in the Memphis Sand Aquifer due to groundwater leakage from the MRVA aquifer. In addition to the MRVA-aquifer monitoring wells installed by Stantec for the RI, four deep stratigraphic borings were also drilled into the upper Memphis aquifer to determine the thickness of the confining unit. USGS-CAESER correlated geophysical logs from TVA production wells, and other historical wells in the study area, with site boring logs to develop a conceptual hydrogeologic model of the study area. Field investigations also included groundwater sampling and a 24-hour pumping test during which as much as 5,000 gpm was extracted from the Memphis aquifer. The results of the USGS/CAESER investigation are presented in Appendix E of the RI report (Stantec, 2018a) and by USGS (2018). The following is my discussion of specific investigation results that are particularly relevant to the evaluation of the risk of groundwater contamination in the Memphis Sand Aquifer by CCR constituents present in the MRVA aquifer in the vicinity of the Allen plants.

Results

The most important finding of the USGS/CAESER investigation is that the MRVA and Memphis Sand Aquifers are hydraulically interconnected in the Allen plants area due to the presence of a window or breach in the confining (upper Claiborne) unit separating the two aquifers. Significantly, during the Memphis-aquifer pumping test hydraulic head reductions (drawdown) were observed in several overlying MRVA monitoring wells at both Allen plants. Figure 5 is a contour map of estimated maximum drawdown in MRVA wells related to the pumping test. Drawdown in the MRVA aquifer ranged from 0.1 feet near McKellar Lake to 0.5 feet in the southeastern part of the ALF Plant and along the eastern part of the ACC Plant. It is important to note, per my discussion below, that no drawdowns at any MRVA monitoring wells should have been measured if the confining unit was continuous across the site. Therefore, as USGS/CAESER conclude, these Alluvial aquifer drawdowns indicate that an area of downward leakage from the MRVA to the Memphis Sand aquifer is present in this general vicinity.

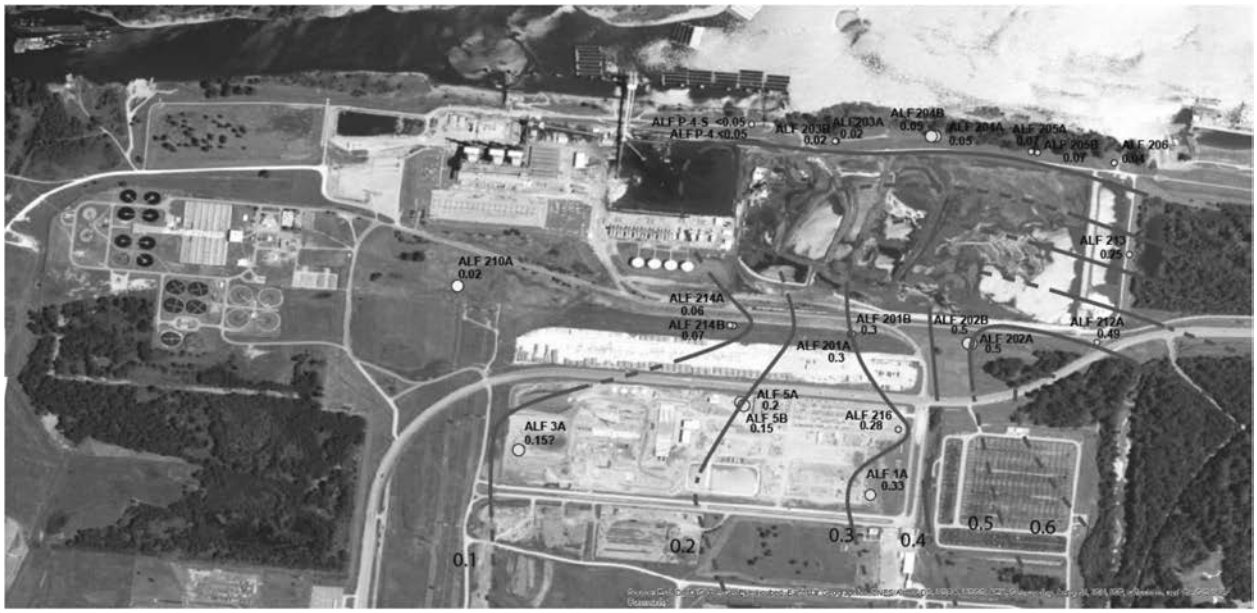

Figure 5
Estimated Drawdown in MRVA Aquifer Monitoring Wells During Memphis Aquifer Pumping Test (values in black, contours in blue; from USGS, 2018)

The hydraulically-identified window, or breach, in the confining unit is consistent with the findings of the refined site geologic conceptual model developed by USGS/CAESER. Figure 6 shows the locations of geologic cross-sections developed as part of the conceptual model for the ALF and ACC Plants area. Cross-sections A-B, C-B, and D-E are presented in Figures 7, 8, and 9 respectively. As shown, the Claiborne confining unit thins in an east-southeasterly direction across the site (e.g., questionable thickness at boring location ALF-212). As shown in Figure 6 the investigation also identified two geologic faults (a discontinuity in geologic units across which a significant vertical displacement has occurred), one which extends southwest to northeast across the site and may contribute to the hydraulic connection between the MRVA and Memphis aquifers.

Discussion

To further illustrate why the Claiborne confining unit would hydraulically isolate the MRVA and Memphis Sand aquifers if it was continuous across the site I used an analytical (exact mathematical) solution for one-dimensional groundwater flow (Crank, 1975) through a homogeneous porous medium to compute the transient, vertical hydraulic head reduction (drawdown) in a clay layer (hydraulic conductivity of 1E-7 cm/sec) in response to a 10-foot drawdown (head reduction) in the underlying aquifer (Memphis Sand).

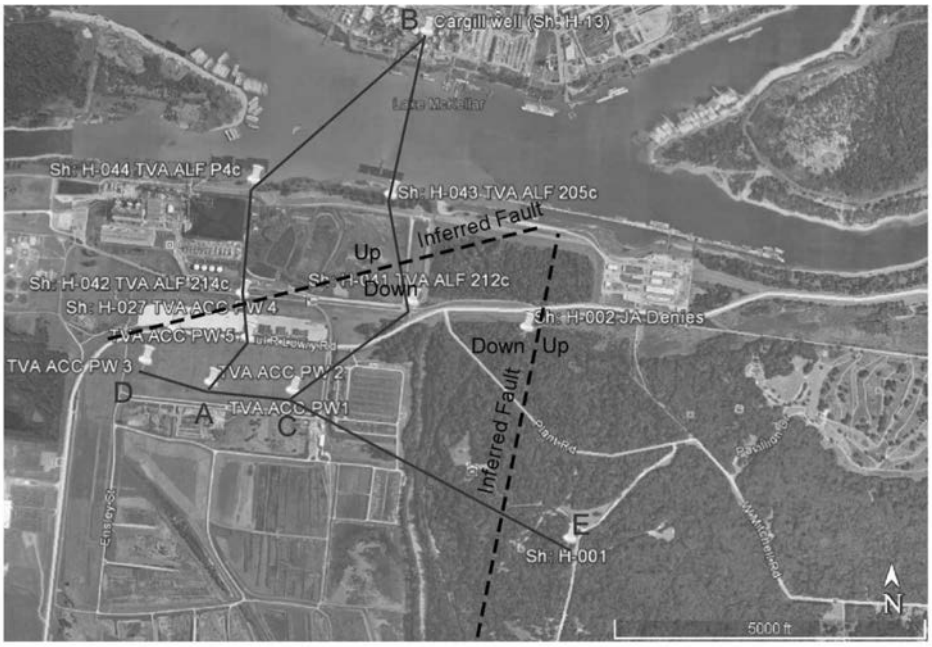

Figure 6
Geologic Cross-Section Locations and Inferred Faults in ALF and ACC Plants Area
(from USGS, 2018)

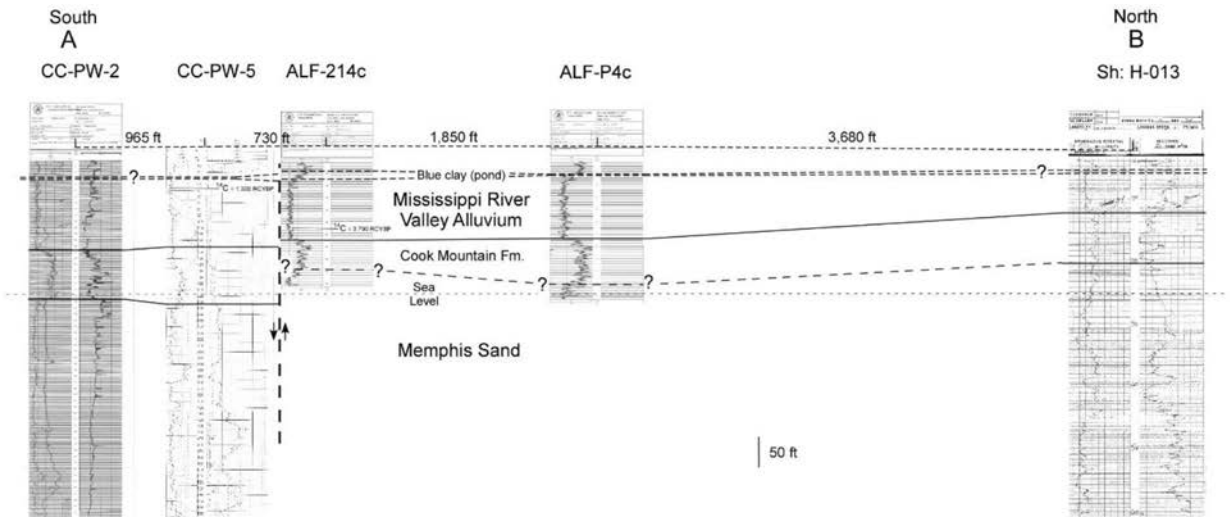

Figure 7
Geologic Cross-Section A-B in ALF and ACC Plants Area
(from USGS, 2018)

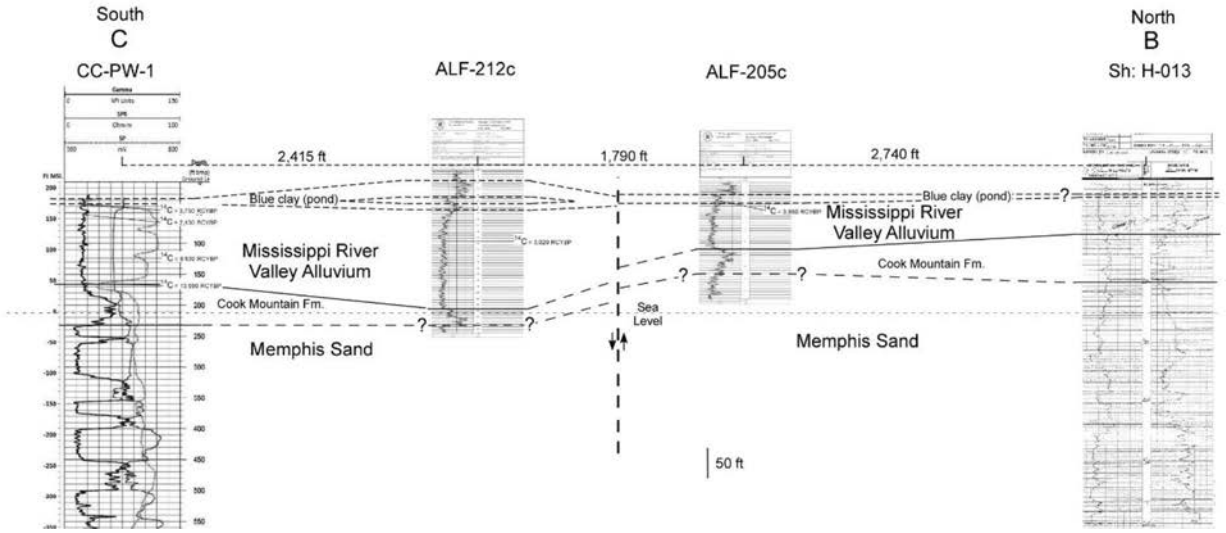

Figure 8
Geologic Cross-Section C-B in ALF and ACC Plants Area
(from USGS, 2018)

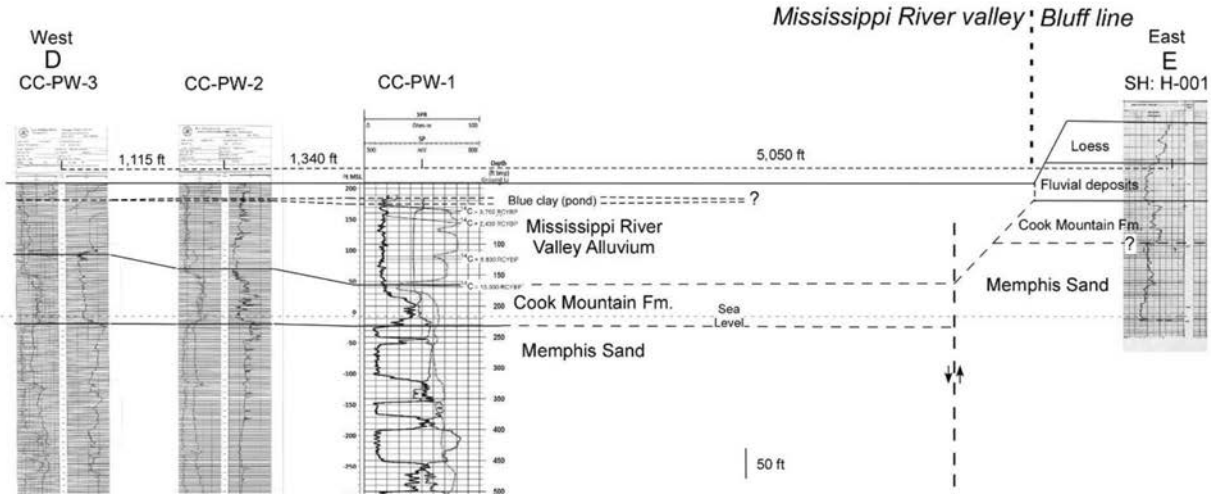

Figure 9
Geologic Cross-Section D-E in ALF and ACC Plants Area
(from USGS, 2018)

The simulated confining-unit drawdown as a function of distance above the base of the clay layer (Figure 10) shows that the drawdown after 24 hours (USGS pumping test duration) would be less than about 0.01 inch at a distance of two inches into the clay due to a constant 10-foot drawdown at the base of the clay layer. This simple example illustrates why the drawdown in the MRVA aquifer in response to groundwater withdrawal from the Memphis aquifer should have been zero.

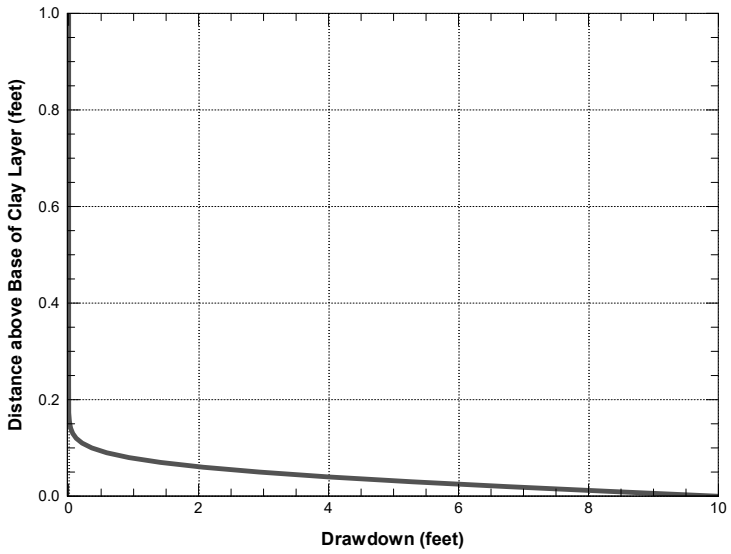

Figure 10
Drawdown in Clay Confining Layer after 24 Hours

I also further analyzed the magnitudes of the measured MRVA pumping-test drawdowns based on their locations relative to the Mississippi River, McKellar Lake, and ponded water in the East Ash Disposal Area. It is well-know that drawdown is reduced in the vicinity of a constant-head or leaky-type boundary (e.g., river, lakes, and/or impoundments) due to recharge from the waterbody in response to hydraulic head reductions in the aquifer (Bear, 1979; Freeze and Cherry, 1979). For example, as shown in Figure 5 a large portion of the area with measurable pumping-test drawdown in the MRVA aquifer is either located close to McKellar Lake or underlies impoundments in the East Ash Disposal Area. Therefore, depending on the distance of an MRVA monitoring well from one of these waterbodies, it is expected that the true hydraulic interconnection (as measured by MRVA drawdown) between the MRVA and Memphis aquifers is greater than that suggested by Figure 5.

To illustrate this point I computed drawdown versus distance and time in a hypothetical confined aquifer with similar hydraulic conductivity and thickness (i.e., transmissivity) as the Memphis aquifer due to a groundwater extraction rate of 5,000 gpm (similar to the USGS-CAESER pumping test). I used the Theis solution for drawdown due to groundwater from a fully-penetrating pumping well located in an infinite homogeneous confined aquifer (Bear, 1979). Figure 11 is a plot of the simulated drawdowns versus time and distance from the pumping well for two scenarios: with and without a constant-head boundary at a distance of 2,600 feet from the extraction well. Figure 11 also contains a graph of the ratio of drawdown without the waterbody to the drawdown with the hydraulic effects of the waterbody (constant-head in this case, which reduces the drawdown). This hypothetical scenario is designed to approximately mimic the 24-hour pumping test and the hydraulic effects of McKellar Lake (with the assumption that the lake acts as a constant-head boundary for illustration purposes). The drawdown ratio graphs show that at about

the midpoint between the pumping well and waterbody (~1,300 feet) the hydraulic impacts of pumping (as measured by drawdown) would be almost twice as large if the assumed waterbody was not present. Moreover, the hydraulic effects of the waterbody significantly increase as the distance between the waterbody and the monitoring point decreases. For example, at a distance of 300 feet from the waterbody (2,300 feet from the extraction well) the measured drawdown would be expected to be on the order of five times greater without the hydraulic impact of the waterbody. Therefore, it is very possible that (i) the areal extent of MRVA drawdown during the Memphis-aquifer pumping test is larger than that indicated in Figure 5 (i.e., the window in the confining unit may be much larger than Figure 5 suggests) and (ii) the drawdown values shown in Figure 5 may have been much larger if the waterbodies and impoundments were not present (i.e., the hydraulic interconnection between the MRVA and Memphis Sand aquifers may be stronger than the Figure 5 results indicate).

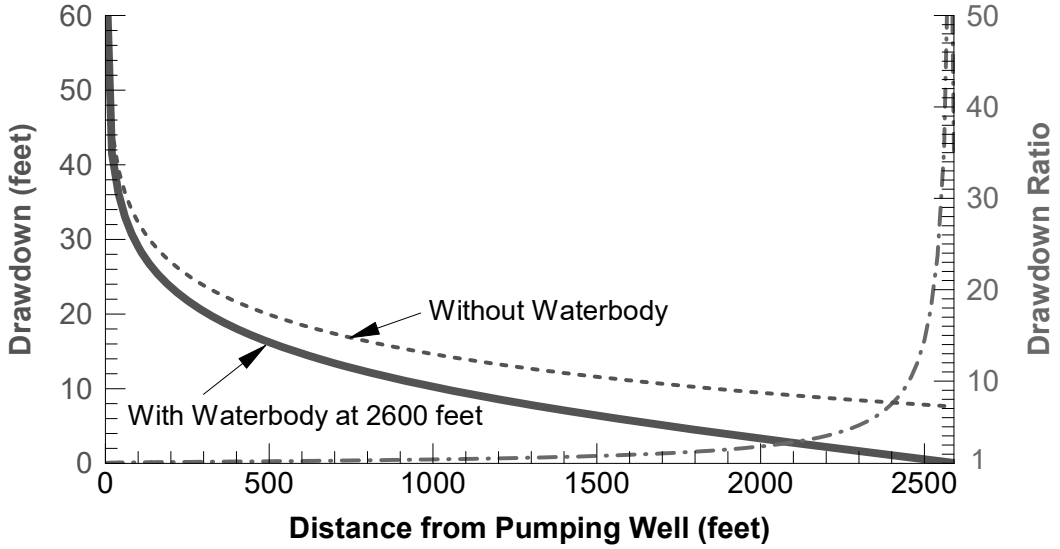

Figure 11
Drawdown vs. Distance from Pumping Well with and without Constant-Head Boundary Condition at 2,600 Feet

Boron and Sulfate Transport in the MRVA and Memphis Sand Aquifers

Introduction

Boron and sulfate are commonly used as environmental tracers to monitor the fate and transport of CCR constituents in groundwater (Ruhl et al., 2014). The reasons for this are primarily because these two constituents are present at high concentrations in CCR source areas, and they are very mobile in groundwater relative to other CCR constituents. In contrast, most metals (e.g., arsenic and lead) migrate much slower (e.g., 10-100 times, or more) than the groundwater pore velocity due to a very strong

tendency of the metals to bind, or adsorb, to immobile soil grains (Hemond and Fechner, 1994). The fact that boron and sulfate concentrations in CCR source areas are typically large leads to more reliable detection of the leading edge of a CCR plume despite dilution mechanisms (e.g., mixing and dispersion) that reduce groundwater concentrations as a function of transport distance and time. Environmental tracers such as boron and sulfate are also excellent tools for accurately determining the long-term (e.g., decades), average three-dimensional groundwater flow directions in an aquifer and the relative importance of horizontal and vertical flow because their aqueous-phase concentration distributions are the direct result of the mean groundwater velocity field. This tracer attribute is particularly useful at the ALF and ACC Plants site where (i) short-term hydraulic-head variations in the MRVA aquifer, induced by stage fluctuations in McKellar Lake and the Mississippi River, have made it difficult to determine the true mean groundwater flow directions based on the limited hydraulic data set and (ii) the potential for leakage and chemical transport from the MRVA aquifer to the Memphis Sand are relevant questions that are currently being evaluated. This issue is the subject of EIP Sections 3.3.5, 3.3.6, 4.3.3, 4.3.6, 4.3.7, and 4.4.2.

Boron and Sulfate Transport within the MRVA Aquifer in the ALF and ACC Plants Area

In Figures 12 and 13 I have plotted the measured boron and sulfate concentrations based on filtered groundwater samples from several MRVA monitoring wells (MW) and Direct-Push Technology (DPT) borings along east-west cross-sections on the northern and southern parts of the ALF-ACC Plants area, respectively. These figures also show arsenic concentration data and interpreted contours developed for the RI report. Notably, high boron and/or sulfate concentrations extend from shallow source areas down to the bottom (or near-bottom) of the MRVA aquifer (e.g., MWs ALF-203A, ALF-204A, ALF-205A, P-4, ALF-202A, ALF-201A). In the northern cross-section (Figure 12) boron and sulfate concentrations in deep groundwater are as large as 340 – 6,330 μg/L and about 23,000 – 85,000 μg/L, respectively. In the southern cross-section (Figure 13) boron and sulfate concentrations in deep groundwater are as large as 2,280 μg/L and about 35,000 – 70,000 μg/L, respectively. High sulfate concentrations were also detected at depth in the MRVA aquifer in ACC monitoring wells ACC-005-A (32,000 – 64,700 μg/L) and ACC-003-A (12,000 – 23,100 μg/L) (see RI Tables 6-13,a,b,c). These concentrations are significant relative to background levels. As reproduced in Table 1, the 2017 Annual Groundwater Monitoring Report (TVA, 2018a) for the ALF Plant indicates average (November 2016 to August 2017) boron and sulfate background concentrations of approximately 78 and 5,700 micrograms per liter (μg/L). The sulfate and boron concentrations at depth also represent a large percentage of the source concentrations. As illustrated in Figures 12 and 13, and ash porewater DPT data (RI report Fig. 3-1), source-area boron and sulfate concentrations in groundwater are generally in the ranges of 6,000 - 12,000 μg/L and 100,000 - 200,000 μg/L, respectively. Assuming one percent of the source-area concentrations as representative of the leading edge of the CCR plume (e.g., refer to analytical solutions of the one-dimensional advection-

dispersion equation presented by Bear, 1979), equivalent “transport-based” threshold values would correspond to boron and sulfate concentrations ranging from 60 - 120 μg/L and 1,000 - 2,000 μg/L, respectively. These “plume leading-edge” indicator concentrations are similar in magnitude to the respective measured background levels.

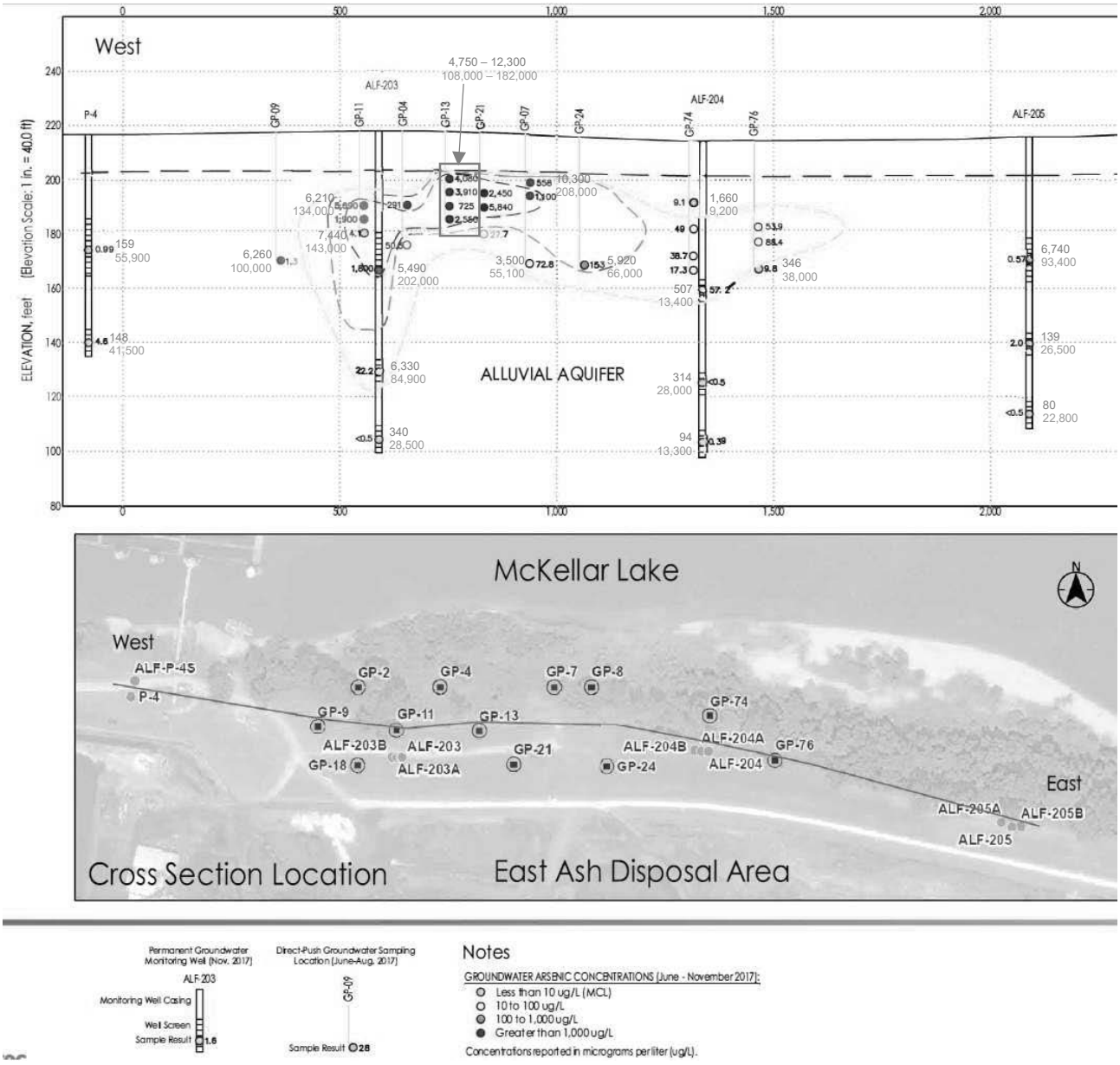

Figure 12
Arsenic (black), Boron (red), and Sulfate (green) Concentrations in Groundwater (Filtered)
East-West Cross-Section in Northern ALF and ACC Plants Area
(based on Fig. 6-20a in RI Report; Stantec, 2018a)

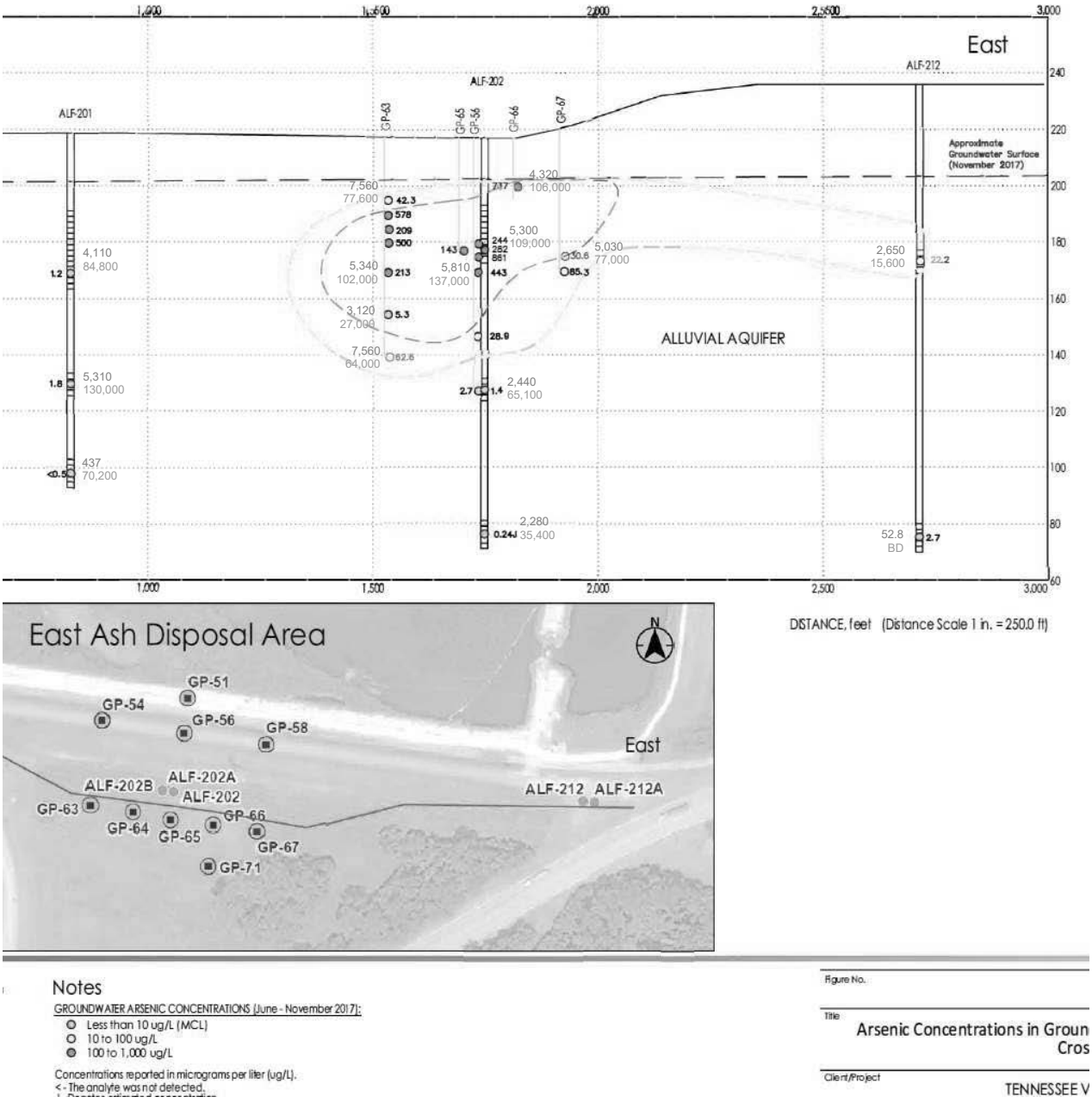

Figure 13
Arsenic (black), Boron (red), and Sulfate (green) Concentrations in Groundwater (Filtered)
East-West Cross-Section in Southern ALF and ACC Plants Area
(based on Fig. 6-20b in RI Report; Stantec, 2018a)

Therefore, using both background and source-area concentrations (i.e., transport-based threshold values) as a comparison, the site groundwater analytical data demonstrate that a long-term, downward component of groundwater transport has resulted in the migration of aqueous-phase boron and sulfate plumes to near the base of the MRVA alluvial aquifer. For example, boron levels in groundwater from the deepest alluvial-aquifer (MRVA) monitoring wells are typically a factor of 5 to 30 times greater than the

background concentration. Similarly, sulfate levels in groundwater near the base of the MRVA aquifer are typically a factor of 5 to 12 times greater than the background concentration. Relative to shallow-depth MRVA groundwater concentrations, this deep boron/sulfate contamination is generally about 10-35 percent and 25-50 percent of the boron/sulfate source-area concentrations, respectively, which is a very strong indicator that these deep boron/sulfate detections are related to CCR source areas. Moreover, if the predominant flow directions in the MRVA aquifer were horizontal or upward (e.g., near McKellar Lake) as concluded in the RI report, these high boron/sulfate concentrations would not be present at depth in the aquifer because vertical mixing due to transverse dispersion (assuming predominantly horizontal flow) is known to be very small (Gelhar et al., 1992; Zheng et al., 2010; Sudicky and Illman, 2011; Siegel, 2014) and would not cause such deep contamination. Specifically, the boron and sulfate tracer concentration distributions indicate that long-term downward groundwater flow (i.e., solute advection) has been occurring in the ALF-ACC Plants area.

Table 1
Background Groundwater Sampling Results
ALF Plant (from TVA, 2018a)

Monitoring Well		ALF-210																			
Sample Date		15-Nov-16		30-Jan-17		28-Feb-17		28-Mar-17		18-Apr-17		09-May-17		13-Jun-17		13-Jul-17		18-Jul-17		23-Aug-17	
Sample Type		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
Location/Well ID		ALF-210		ALF-210		ALF-210		ALF-210		ALF-210		ALF-210		ALF-210		ALF-210		ALF-210		ALF-210	
Sample ID		ALF-GW-014-11152016		ALF-GW-014-01302017		ALF-GW-014-02282017		ALF-GW-014-03282017		ALF-GW-014-04182017		ALF-GW-014-05092017		ALF-GW-014-06132017		ALF-GW-014-07132017		ALF-GW-014-07182017		ALF-GW-014-08232017	
Well Designation		Background		Background		Background		Background		Background		Background		Background		Background		Background		Background	
Analyte	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Total Metals																					
Antimony	mg/L	< 0.000330	U*	< 0.000998	U*	< 0.000565	U*	< 0.00142	U*	< 0.000478	U*	< 0.000443	U	< 0.000443	U	< 0.00103	U*	< 0.000669	U*	< 0.000918	U*
Arsenic	mg/L	0.00957	J	0.00346		0.0106		0.00924		0.00351		0.00293		0.00671		0.00637		0.00703		0.00474	
Barium	mg/L	0.298		0.323		0.328		0.313		0.339		0.424		0.361		0.335		0.324		0.311	
Beryllium	mg/L	< 0.000102	U	< 0.000131	U	< 0.000131	U	< 0.000131	U	< 0.000131	U	< 0.000131	U	< 0.000131	U	< 0.000131	U	< 0.000131	U	< 0.000131	U
Boron	mg/L	0.0803		0.0840		0.0794	J	0.0675	J	0.0694	J	0.0831		0.0691	J	< 0.0830	U*	0.0807		0.0805	
Cadmium	mg/L	< 0.000152	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U
Calcium	mg/L	133		137		137		123		132		158		131		136		135		132	
Chromium	mg/L	< 0.000339	U	< 0.000378	U	< 0.000378	U	< 0.000378	U	< 0.000378	U	< 0.000378	U	< 0.000378	UJ	< 0.000378	U	< 0.000378	U	< 0.000378	U
Cobalt	mg/L	0.00246		0.000212	J	0.00182		0.000726		0.000164	J	< 0.0000960	U*	0.000970		0.00105		0.00181		0.00124	
Lead	mg/L	< 0.0000675	U	< 0.000318	U	< 0.000318	U	< 0.000318	U	< 0.000318	U	< 0.000318	U	< 0.000318	U	< 0.000318	U	< 0.000318	U	< 0.000318	U
Lithium	mg/L	0.0231		0.0246		0.0233		0.0210		0.0204		0.0230		0.0206		0.0211		0.0207		0.0203	
Mercury	mg/L	< 0.0000521	U	< 0.0000521	U	< 0.0000653	U	< 0.0000653	U	< 0.0000653	U	< 0.0000653	U	< 0.0000653	U	< 0.0000653	U	< 0.0000653	U	< 0.0000653	U
Molybdenum	mg/L	0.00237	J	0.00154	J	0.00258	J	0.00141	J	0.00137	J	< 0.00108	U*	0.00122	J	0.00122	J	0.00161	J	< 0.00176	U*
Selenium	mg/L	0.000687	J	< 0.00127	U	< 0.00127	U	< 0.00127	U	< 0.00127	U	< 0.00127	U	< 0.00127	U	< 0.00127	U	< 0.00127	U	< 0.00127	U
Thallium	mg/L	< 0.0000360	U	0.000135	J	< 0.000110	U*	< 0.0000531	U	< 0.0000531	U	< 0.0000531	U	< 0.0000531	U	< 0.0000531	U	< 0.0000531	U	< 0.0000531	U
Radium 226 + radium 228	pCi/L	< 0.568	U	< 0.887	U	< 0.724	U	< 0.992	U*	0.844	J	< 0.830	U*	0.685	J	< 0.518	U	1.13	J	< 0.551	U
Anions																					
Chloride	mg/L	1.14		1.28		1.11	J	1.18		1.50		1.40		1.34		1.45		1.56		1.21	
Fluoride	mg/L	0.189		0.169		0.183		0.216		0.261		0.227		0.287		0.279		0.208		0.212	
Sulfate	mg/L	5.49		0.876	J	5.14		1.62		0.970	J	3.08		7.54		11.1		8.47		12.5	
General Chemistry																					
Total Dissolved Solids	mg/L	488		488		506		503		491		537		524		495		496		481	
Field pH																					
pH (field)	SU	6.67		6.78		6.73		6.73		6.76		6.83		6.73		6.72		6.72		6.78	

Notes:
NA - Not Available
Q - Data Qualifier
U* - Result should be considered "not-detected" because it was detected in a rinsate blank or laboratory blank at a similar level
J - Quantitation is approximate due to limitations identified during data validation
UJ - Analyte not detected, but the reporting limit may or may not be higher due to a bias identified during data validation
U - Analyte not detected
mg/L - milligrams per liter
pCi/L - picoCurie per liter
SU - Standard Unit

The shallow and deep hydraulic gradients in the MRVA aquifer also indicate downward groundwater flow. For example, in Figure 14 I have added the vertical hydraulic head differences (positive indicates downward flow) between shallow and deep MRVA monitoring wells measured before the start of the pumping test (9-20-2017) to the pumping-test drawdown contour map (Figure 5). These data show that the vertical flow direction is downward within the MRVA aquifer across most of the ALF-ACC Plants area

except for one well cluster by McKellar Lake. Further, prior to the pumping test USGS/CAESER noted that hydraulic heads in the MRVA aquifer were about 3 to 5 feet greater than heads in the Memphis Sand at Production Wells 5, 3, and 1 ("Data Analysis" section of RI Appendix E). A consistent downward flow component in the MRVA aquifer within this area is also demonstrated by the USGS regional modeling results (Figure 2) due to the very-high Memphis-Aquifer transmissivity and groundwater withdrawal, both of create a downward "driving force" for groundwater flow. In the ALF-ACC Plants area the identified window in the confining unit significantly increases downward flow and associated chemical transport rates due to the absence of the low-permeability layer.

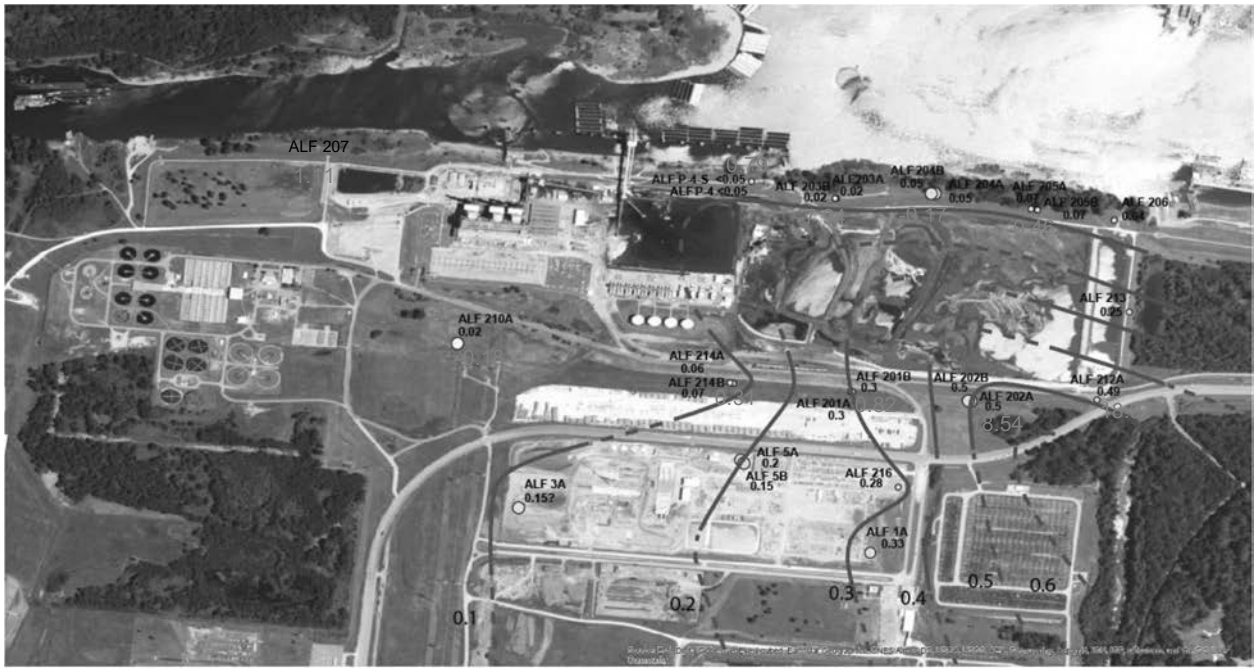

Figure 14
Estimated Drawdown in MRVA Aquifer Monitoring Wells During Memphis Aquifer Pumping Test (values in black, contours in blue). Red Numbers are 9-20-2017 (before Pumping Test) Hydraulic Head Differences between Shallow and Deep MRVA Monitoring Wells (pos. values indicate downward groundwater flow; neg. values indicate upward flow) (from USGS, 2018)

Groundwater Quality in the Memphis Sand Aquifer

The USGS/CAESER investigation also concluded that that mixing of MRVA groundwater with Memphis Sand water is occurring in in the vicinity of Production Wells (PW) 5 and PW 3 based on water quality differences. Water-quality parameters that indicate this contrast before and during the pumping test include specific conductance (Tables 3 and 5 in RI Appendix E), tritium (Tables 4 and 5 in RI Appendix E), sulfate (Table 3 in RI Appendix E and RI Tables 6-15a,b,c), total dissolved solids (RI Tables 6-15a,b,c), and other major inorganic constituents. The tritium analyses demonstrate that a component of

young groundwater (post 1950) is present in the Memphis Sand aquifer beneath the ALF-ACC Plants area. Concentrations of these parameters are much higher in samples from PW 5 compared to the other PWs, which is likely due to the shallower-depth well screen for PW 5 (i.e., less mixing of deeper, lower-concentration groundwater in the Memphis Sand aquifer).

Of particular interest are the high PW-5 sulfate concentrations (about 26,000 – 30,000 μg/L), which are almost a factor of ten greater than concentrations in samples of the other PWs and are similar in magnitude to MRVA sulfate levels in deep groundwater (discussed above). Sulfate concentrations in PW-5 water samples remained greater than 24,000 μg/L throughout the pumping test (Table 5 in RI Appendix E). These sulfate detections in PW 5 water samples are about an order of magnitude (~10x) greater than reported Memphis-Sand background sulfate levels of approximately 2,000-8,000 μg/L (Table A-1 of Stantec, 2017) and median of 3,100 μg/L (Table A-2 of Stantec, 2017). The fact that sulfate concentrations in PW-5 groundwater samples are similar in magnitude to deep-MRVA groundwater suggests possible ongoing transport of CCR constituents from the MRVA to Memphis Sand aquifers. The relatively elevated tritium and inorganic constituent concentrations in PW-5 water samples are consistent with this potential MRVA- to Memphis-aquifer chemical migration in the ALF-ACC Plants area.

Potential Hydraulic Impacts of Off-Site Groundwater Extraction at Davis Well Field

Due to environmental concerns the TVA is now planning on purchasing ACC-plant cooling water from the Memphis Light, Gas and Water (MLGW) Division's Davis Pumping Station located about three miles from the Allen plants (e.g., Charlier, 2018; Figure 1). To evaluate potential hydraulic head decreases in the Memphis Sand aquifer beneath the Allen plants due to pumping at the Davis Well Field I developed a three-dimensional, analytical (exact mathematical solution) groundwater flow model (Hantush, 1964) of the Memphis Sand aquifer. The steady-state (i.e., non-transient, average hydraulic conditions) Hantush model assumes a uniform hydraulic-conductivity distribution and groundwater leakage (proportional to drawdown) from the MRVA aquifer. I calibrated the Memphis Sand hydraulic conductivity and leakage rate to approximately match the steady-state Memphis-Sand hydraulic head decrease (drawdown) predicted by the USGS MERAS groundwater flow model for a uniform 2,500 gpm pumping rate (Figure 15).

Figure 16 shows the simulated Hantush-solution, steady-state Memphis-Sand drawdown for Davis Well Field groundwater pumping rates of 2,500 and 5,000 gpm. The rate of 2,500 gpm is the reported average cooling water requirements for the ACC plant, and 5,000 gpm corresponds to a short-term maximum required flow rate (Figure 4). The calibrated model hydraulic conductivity (*K*) is 230 ft/day and the aquifer

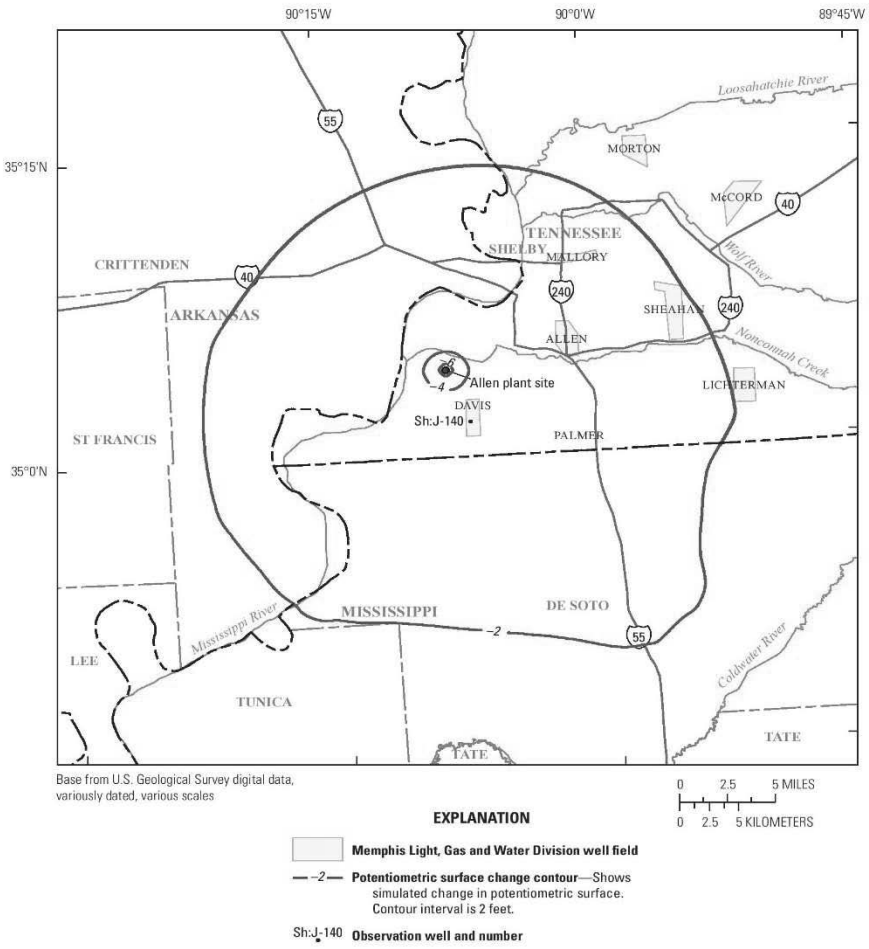

Figure 15
Simulated Hydraulic Head Change in Memphis Sand Aquifer
at End of 30-Year Average Withdrawal (2,500 gpm) Scenario for ACC Plant (from USGS, 2016)

thickness (*b*) is 350 feet. A 100-foot extraction well screen was assumed and drawdown was computed at the top of the aquifer. This calibrated transmissivity (*K* x *b*) is similar in magnitude to reported measured values in the Memphis area (Parks and Carmichael, 1990). The estimated long-term drawdown in the Memphis Sand aquifer beneath the Allen plants is about 3 to 7 feet for uniform pumping rates of 2,500 and 5,000 gpm, respectively. Note that these drawdown values could be smaller beneath the Allen plants due to local recharge from the Mississippi River and McKellar Lake. However, the near-circular nature of the drawdown distribution in Figure15 suggests that the difference would not be significant. For example, if the Mississippi River acted as a constant-head boundary (i.e., direct hydraulic connection between the river and the Memphis Sand) the drawdown near the Allen plants in Figure 15 would be near zero.

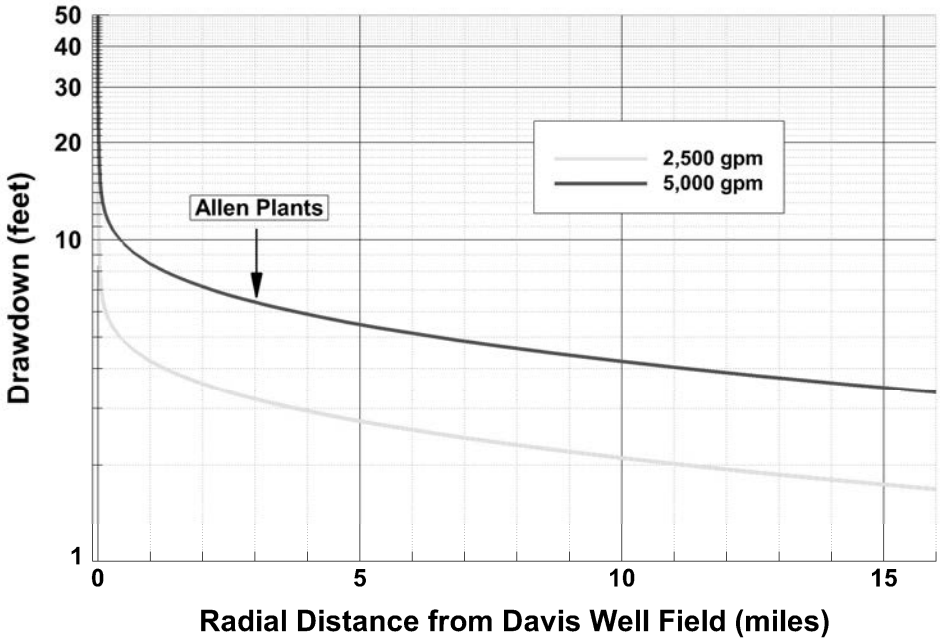

Figure 16
Simulated (Hantush Model) Steady-State Drawdown in Memphis Sand Aquifer
due to Groundwater Extraction at the Davis Well Field

As discussed in the previous section, prior to the recent Allen-site pumping test USGS/CAESER noted that hydraulic heads in the MRVA aquifer were about 3 to 5 feet greater than heads in the Memphis Sand at Production Wells 5, 3, and 1 ("Data Analysis" section of RI Appendix E). Therefore, extraction of an additional 2,500-5,000 gpm of groundwater from the Davis Well Field could double the downward flux of groundwater from the MRVA aquifer to the Memphis Sand in the vicinity of the Allen plants due to the possible doubling of the vertical hydraulic gradient between the two aquifers. Moreover, the flux of any dissolved coal-ash constituents that may be present in deep MRVA groundwater into the Memphis Sand could also be increased by up to a factor of two. Additional data collection and groundwater flow and solute transport modeling are needed to refine these estimates and better assess the potential groundwater quality impacts.

Chemical and Hydraulic Characterization of Groundwater beneath East Ash Basin

As shown below in Figure 17, no monitoring well clusters (shallow, intermediate, or deep) have been installed in the Alluvial Aquifer to enable the collection of groundwater hydraulic-head data or water-quality data directly beneath the central portion of the East Ash Basin CCR source area. This issue relates to the following sections of the EIP: 3.3.5, 4.3.3, 4.3.6, 4.3.7, and 4.5.2. These groundwater data are important for the following reasons:

- As illustrated in RI Figure 17 below, and other hydraulic-head maps presented in the RI report (Stantec, 2018a), the total horizontal hydraulic-head difference between the northern and southern limits of the East Ash Basin is generally on the order of a few feet, with the horizontal groundwater flow direction varying from northerly (toward McKellar Lake) to southerly on different dates. In addition, the RI interprets the vertical groundwater flow direction in the Alluvial Aquifer to vary from upward to downward on different dates, with a vertical groundwater velocity that is small (due to small vertical hydraulic head differences at monitoring well clusters that are typically less than a foot to a few tenths of a foot).

- Per EIP Section 3.2.4 (TDEC Memorandum of Agreement Request No. 4) the normal pool (water surface) elevation in the East Ash Disposal Area Stilling Pond is 225.39 feet. As shown above in Figure 12 this Stilling Pond water surface elevation is similar to the ground surface elevation in this area and is more than 30 feet higher than the interpolated East Ash Basin water table elevation (~ 185-190 feet in Figure 17). The water surface elevations of other ponded areas in the East Ash Disposal Area are likely to be similar in magnitude. In addition, if measured, the hydraulic head in the uppermost portion of the Alluvial Aquifer would be similar in magnitude to the Disposal Area ponded-water surface elevations because the East Basin acts as a constant-head boundary relative to groundwater flow (i.e., large source of groundwater inflow to the Alluvial Aquifer).

- Therefore, the true vertical groundwater velocity beneath most of the East Ash Basin CCR source area is definitively downward, and the corresponding downward groundwater velocity (proportional to shallow minus deep hydraulic heads) is more than a factor of 30 (30-foot vertical head difference compared to one foot, as reported in the RI) greater than the values reported in the RI. Similarly, the downward transport rates of all CCR constituents from the East Ash Basin source area are more than 30 times greater than values suggested in the RI. In other words, the potential for CCR contamination at depth in the Alluvial Aquifer is much greater than what was concluded in the RI. The RI ignored these key site-specific groundwater-flow and chemical-transport mechanisms and only installed monitoring-well clusters outside of the East Ash Basin footprint.

- Horizontal groundwater velocities and CCR transport rates are also much greater than values reported in the RI when the correct hydraulic head values beneath the East Ash Basin are used. In the immediate vicinity of the East Ash Basin the horizontal hydraulic gradients (and

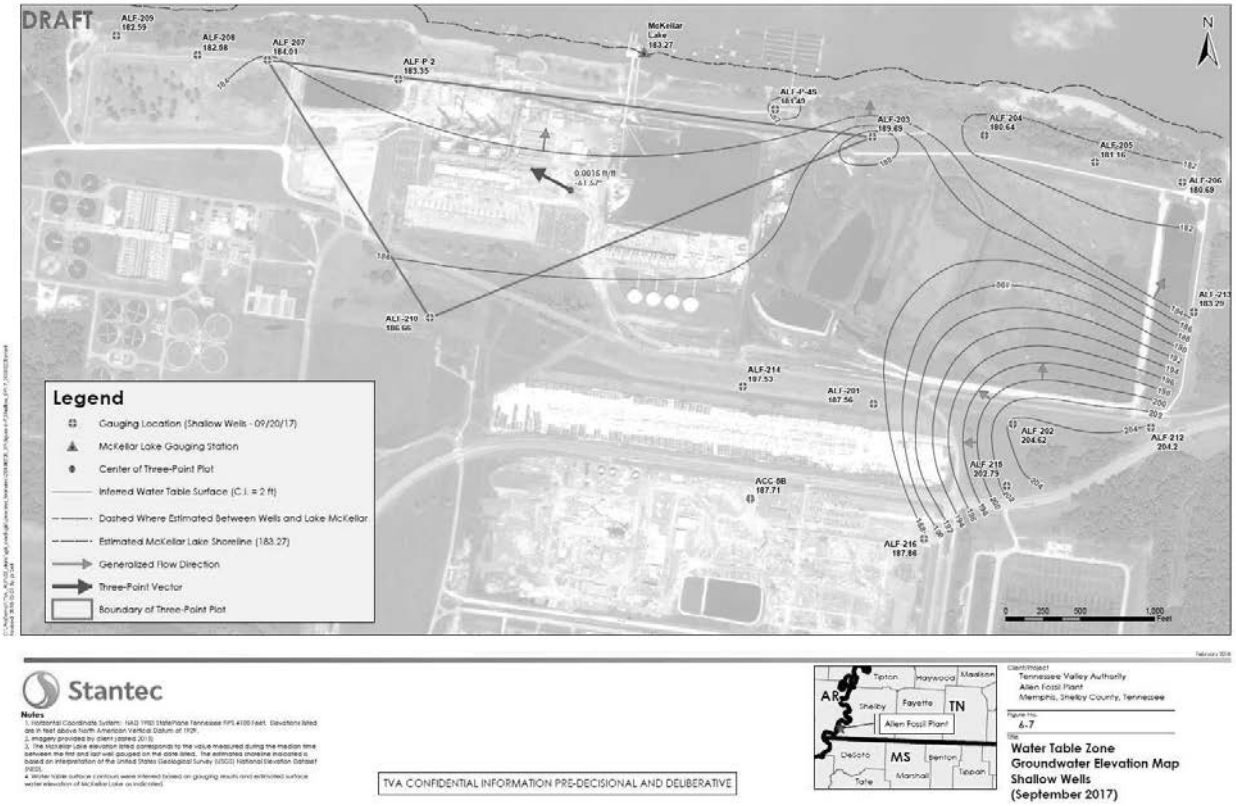

Figure 17
Locations of Shallow-Depth Monitoring Wells in Alluvial Aquifer (from Stantec, 2018a)

groundwater velocities) are expected to be as much as a factor of ten greater than reported in the RI (e.g., 30 feet actual horizontal head change compared to the few feet shown on RI hydraulic-head maps). Moreover, the correct groundwater flow direction beneath large portions of the East Ash Basin is expected to be northerly from the CCR source areas toward McKellar Lake and downward toward the Memphis Sand. The groundwater flow direction at depth in the Alluvial aquifer may also be influenced by flow into the Memphis Sand through the identified breach in the confining layer. This interpretation is significantly different that the RI conclusions of horizontal flow directions that vary from northerly to southerly.

- Moreover, the RI failed to measure the true average horizontal and vertical hydraulic heads in the alluvial aquifer which determine long-term horizontal/vertical chemical transport fluxes. Instead, the RI hydraulic-head maps are only random “snapshots” of the hydraulic heads and groundwater flow directions based on manual water-level measurements which, due to McKellar-Lake stage fluctuations, significantly change from one measurement date to another. Therefore, the RI significantly underestimates the horizontal mass transport rate of CCR constituents from groundwater into McKellar Lake and the downward flux of contaminants toward the Memphis Sand because the large influx of water from the East Ash Basin is not incorporated into the RI

groundwater flow characterization and correct mean hydraulic gradients were not used to evaluate chemical transport directions and rates. This situation is similar to a coastal aquifer and flow regime wherein tidally-induced water-level fluctuations must be filtered out of the data sets using analysis methods such as those presented by Serfes (1991). The U.S. Geological survey addressed this issue in their analysis of pumping-test data (water-level drawdown data in RI Appendix E) by using the software program SeriesSEE (Version 1.20), which is a Microsoft Excel Add-In (Halford et al., 2012), to remove the hydraulic influences of McKellar Lake and other environmental fluctuations such as barometric pressure changes and drawdown due to local water-supply wells. These types of water-level filtering techniques (i.e., averaging) need to be applied to water-level data collected by transducers over a sufficient averaging period in order to develop correct mean hydraulic head maps and groundwater-velocity distributions for the alluvial aquifer.

Characterization of CCR Constituent Sorption to Soil

Background

The fraction of chemical mass sorbed to soil can be represented by the soil-water partition coefficient, K_d (Lyman et al., 1982). K_d is an especially important parameter for most CCR constituents because the bulk of the chemical mass in the soil is associated with the solid phase (i.e., sorbed to soil grains rather than dissolved in pore water). In effect, the solid fraction of the soil matrix acts as a large "storage reservoir" for chemical mass when K_d is large [e.g., metals (e.g., CCR), many chlorinated solvents, and highly-chlorinated polycyclic aromatic hydrocarbon (PAH) compounds associated with coal tars and wood-treating fluids]. K_d is also a very important chemical transport parameter which is used to compute the chemical retardation factor, R_d, assuming linear equilibrium partitioning of mass between the soil (solid) and pore-water phases (Hemond and Fechner, 1994):

$$R_d = 1 + \rho_b K_d / n_e$$

where ρ_b is the soil matrix bulk dry density and n_e is the effective soil porosity. For example, the chemical migration rate (V) is directly proportional to hydraulic conductivity (K) and inversely proportional to R_d :

$$V = \frac{K i}{n_e R_d}$$

where i is the hydraulic gradient (change in hydraulic head divided by distance).

The total contaminant mass in an aquifer is also directly proportional to R_d, as well as aquifer cleanup times once the source is removed (e.g., Zheng et al., 1991). For most CCR constituents R_d is on the order of 10 to 1,000 (e.g., EPRI, 1984). For example, a chemical with R_d equal to 100 has 99 percent of its total mass sorbed to soil. Similarly, even constituents with R_d ~ 10 have about 90 percent of their mass sorbed onto the soil matrix with the remaining ten percent dissolved in groundwater.

Discussion

The RI has not measured or characterized the most critical chemical-specific fate and transport parameter, the soil-water partition coefficient (K_d), for any CCR constituent (refer to EIP Sections 3.3.3 and 4.1.2). As discussed above, K_d is a chemical parameter that quantifies the amount of chemical mass that is sorbed, or partitioned, onto the immobile soil grains in the aquifer compared to the dissolved-phase (porewater) mass. K_d also determines both chemical migration rate (along with hydraulic conductivity and hydraulic gradient) and the total mass of any CCR constituent in the Alluvial Aquifer. Clearly, site-specific characterization of the soil-water partition coefficient for the various CCR constituents should have been a key component of the Remedial Investigation.

Initial Remedial Design – Interim Response Action

The Initial Remedial Design (IRD) of the groundwater extraction well locations and pumping rates for the East Ash Basin (Stantec, 2018b) is incorrect because it is based on a groundwater model that was improperly calibrated and does not match existing hydraulic conditions in the alluvial aquifer. Hydrogeologic issues related to the IRD are the subject of most sections of the EIP. In addition, the vertical extent of CCR constituent contamination beneath the East Basin source area has not been determined, as discussed above. Therefore, the target depth for hydraulic containment of CCR plumes (i.e., capture zone), which largely determines extraction-well locations and pumping rates, has not been accurately characterized. The primary flaw in the model is that it inexplicably does not include a boundary condition to represent the major groundwater mounding effect of the East Ash Basin (refer to Figure 18 and above discussion), even though the model was constructed (i.e., calibrated) using hydraulic heads that were measured while the impoundment was active (full of effluent). One of the most impactful results of this erroneous approach to groundwater model development is that artificial, high-rate groundwater recharge zones (e.g., several hundred inches per year, whereas natural recharge rates are on the order of 10-20 inches per year) were defined in the model without any physical basis (refer to Figure 19). The false recharge zones are due to the fact that the water-level data sets used to calibrate the model were measured when the East Basin was full of effluent, but the model does not include the East Basin. Therefore, basically the model developers were forced to introduce an artificial source of groundwater recharge to account for the “real” influx of water from the East Ash Basin. A major problem with this, of course, is that these spurious recharge zones largely determined the extraction-well locations

and pumping rates presented in the IRD. Accordingly, the IRD extraction-well designs need to be corrected.

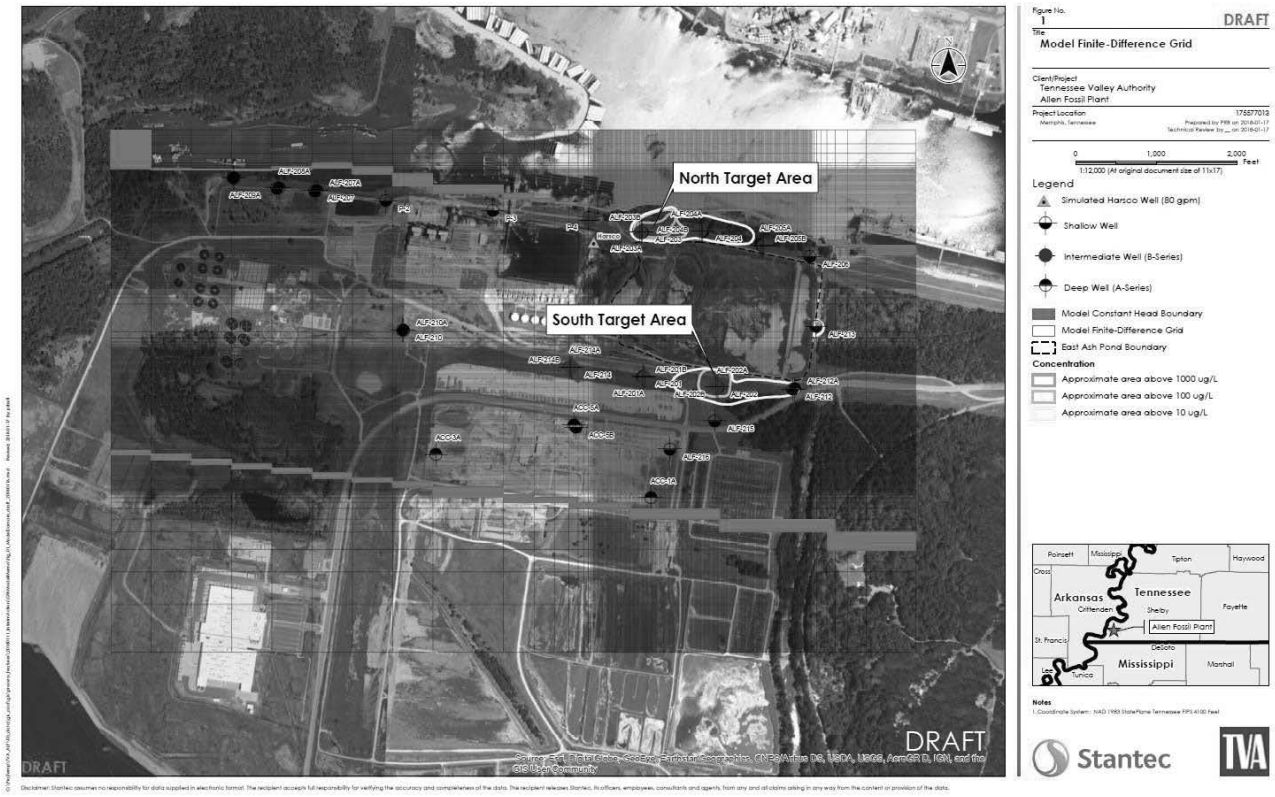

Figure 18
Groundwater Model Computational Grid for Initial Remedial Design (from Stantec, 2018b)

The IRD report (Section 2.6) also proposes monitoring of CCR concentration trends (i.e., concentration versus time) in monitoring and extraction wells as a key part of the Performance Monitoring plan:

Treatment performance will be measured through analysis of groundwater COC concentration trends, estimation of contaminant mass distribution prior to and during remedy operation, and by analyzing the COC concentration and general chemistry of the effluent.

However, as discussed above, accurate evaluation of temporal concentration trends requires that site-specific characterization of the soil-water partition coefficients (K_d) for CCR constituents has been completed. Since K_d values have not been measured it is not possible to achieve the stated IRD objectives of "*analysis of groundwater COC concentration trends*" and "*estimation of contaminant mass distribution prior to and during remedy operation*" because concentration trends (a function of chemical migration rate, V, presented above) and contaminant mass (directly proportional to R_d values) are determined by both groundwater (aqueous-phase) concentrations and soil (sorbed fraction, which is proportional to K_d) concentrations. For example, if Performance-Monitoring decisions related to hydraulic

containment of CCR plumes ignore chemical sorption and retardation then it is very possible that short-term Performance Monitoring Well (PMW) concentration reductions (e.g., due to effluent concentration reductions caused by rainwater infiltration events) would be misconstrued as meaningful levels of aquifer remediation. The present CCR distribution in the Alluvial Aquifer has occurred over a period of decades, and a very-long time period will be required for aquifer cleanup. These types of time scales are consistent with characteristic CCR R_d values on the order of 100 to 1,000.

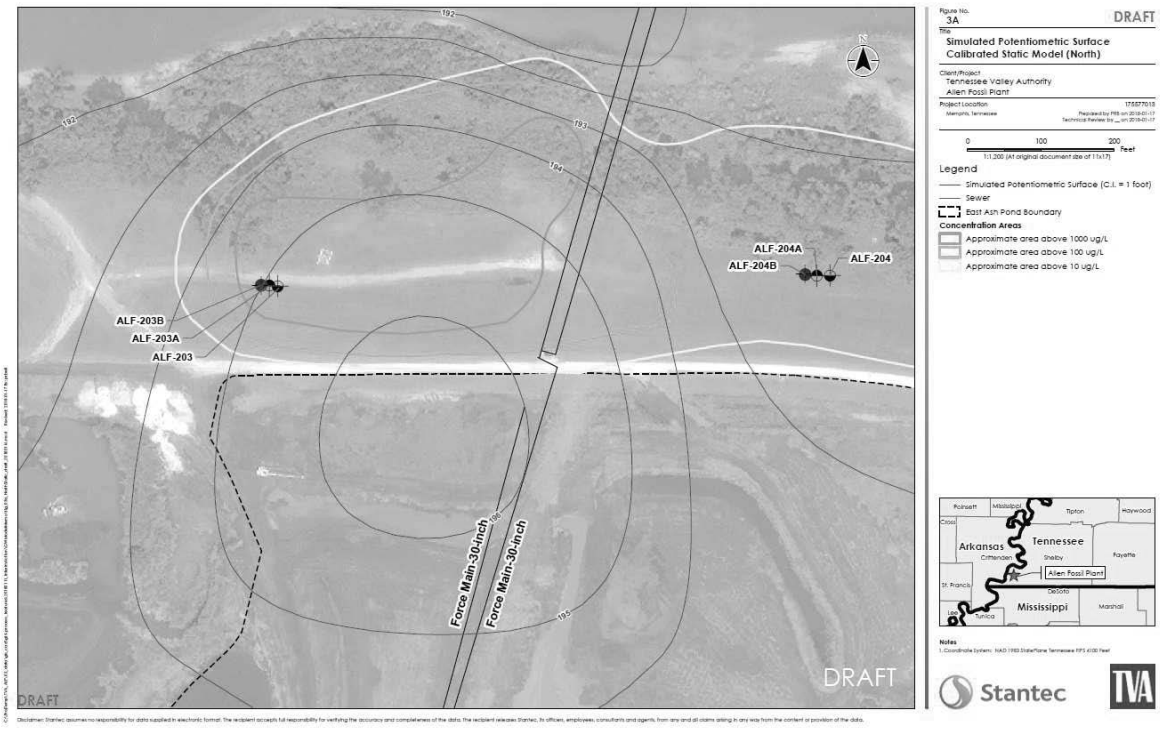

Figure 19
Simulated Shallow-Depth Hydraulic Heads Used for Initial Remedial Design (from Stantec, 2018b)

Characterization of Groundwater beneath West Ash Disposal Area

Figure 20 (TVA, 2018b; EIP Appendix M) shows the proposed monitoring well clusters (shallow, intermediate, deep) in the vicinity of the West Ash Disposal Area. This topic relates to EIP Sections 3.3.1, 3.4.1, and 4.3.6. Three of the proposed locations are downgradient well clusters (northern area), one is side-gradient (ALF-218), and two other clusters are upgradient (ALF-217 and ALF-210). Note that no monitoring wells are proposed in the middle of the coal-ash source area, which is also a major limitation with the East Ash Basin monitoring network. This data gap is very important because the West Ash Disposal Area used to be an active wastewater treatment facility during its operational phase, which means that the deepest vertical extent of CCR contamination is likely the interior portions of the disposal

area due to the large downward hydraulic gradients that existed while the West Disposal Area was active (refer to similar discussions above regarding the East Ash Basin).

Figure 20
Proposed West Ash Disposal Area Monitoring Wells (from TVA, 2018b)

Summary and Conclusions

Hydrogeologic and groundwater-quality data from the recent 24-hours USGS/CAESER pumping test in the Memphis Sand Aquifer clearly identify a window, or breach, in the upper Claiborne confining unit that separates the MRVA and Memphis Sand aquifers in the ALF-ACC Plants area. In addition, pre-pumping-test vertical hydraulic gradient data (shallow-deep MRVA monitoring wells, and MRVA-Memphis aquifer gradients) indicated that the vertical groundwater flow direction in the MRVA aquifer was downward across most of the ALF-ACC Plants area. Regional groundwater-flow simulations using the USGS MERAS model also confirm strong downward hydraulic gradients from the MRVA to Memphis aquifer in the Memphis area and beyond on an average basis. Consistent with the measured downward flow component in the MRVA aquifer, very high boron and sulfate CCR-constituent concentrations (up to 30 times background levels) were detected near the bottom of the MRVA aquifer during the Remedial Investigation in both the northern and southern parts of the ALF-ACC Plants area. Further, water-quality

data for the Memphis Sand aquifer (e.g., PW 5) are consistent with possible ongoing transport of CCR constituents from the MRVA to Memphis Sand aquifers in the ALF-ACC Plants area. Based on the high concentrations of boron and sulfate in the deepest parts of the MRVA aquifer the potential exists for increased fluxes of CCR constituents through the confining unit window(s) in the future.

Therefore, it is very important to further characterize and quantify the risk of contamination by CCR constituents of the Memphis Sand Aquifer in the Allen Plants area. The conclusions of the USGS/CAESER investigation also strongly recommend these types of analyses. Specifically, the location(s) and extent(s) of leakage/window features in the confining unit need to be better defined and the fluxes of groundwater and CCR constituents from the MRVA to Memphis Sand aquifers need to be accurately quantified under current conditions and into the future under both static and pumping conditions. Depending on the results of these computations, three-dimensional groundwater flow and chemical transport (advection-dispersion) modeling of the Memphis Sand Aquifer should be conducted to evaluate potential impacts on downgradient environmental receptors.

In summary, my conclusions are:

- There is a hydraulic connection between the MRVA Aquifer and the Memphis Sand Aquifer;
- The areal extent of the breach in the confining layer that is causing the hydraulic connection may be much larger than the USGS-CAESER report initially indicated;
- The degree of hydraulic connection, based on pumping-induced water-level reductions in the MRVA Aquifer, may be much stronger than the USGS-CAESER report initially indicated;
- There are significantly elevated concentrations of boron and sulfate, CCR indicator constituents, deep in the MRVA Aquifer at the Allen Plant;
- These boron and sulfate tracer concentration distributions indicate that long-term downward groundwater flow has been occurring in the Alluvial aquifer in the Allen Plant area;
- Shallow and deep vertical hydraulic gradients within the MRVA Aquifer, as well as significantly higher hydraulic heads in the MRVA aquifer compared to the Memphis Sand, also indicate downward groundwater flow;
- Age dating of groundwater (e.g., tritium analyses by USGS, 2018) and elevated sulfate concentrations in Memphis-Sand Production Well 5 indicate that mixing of MRVA Aquifer groundwater with Memphis Sand Aquifer water is occurring in the vicinity of the Allen Plant and that potential ongoing transport of CCR constituents from the MRVA into the Memphis Sand Aquifer is occurring;
- TVA's extraction of Memphis Sand Aquifer groundwater from the Davis well field will result in long-term drawdown in the Memphis Sand under the Allen Plant and increase downward vertical hydraulic gradients from the MRVA to the Memphis Sand;

Based on these findings, I recommend the following significant changes in the RI and EIP:

- Require TVA to incorporate the conclusions of the USGS-CAESER report (USGS, 2018, page 44) into the RI and EIP;
- Require TVA to implement the recommendations of the USGS-CAESER report for future data collection and analysis (USGS, 2018, page 44), including more accurate characterization of the location(s) and extent(s) of leakage/breach features in the confining unit and more accurate quantification of the fluxes of groundwater and dissolved CCR constituents from the MRVA Aquifer to the Memphis Sand Aquifer;

- Install monitoring well clusters (shallow, intermediate, and deep) within the footprint of the East Ash Pond and within the footprint of the West Ash Pond to adequately assess the spatial distribution of CCR contamination (including all Appendix III and IV constituents), the true groundwater velocity distribution (vertical and horizontal), and chemical transport rates;
- Properly average water-level measurements for monitoring wells, McKellar Lake, and the East Ash Basin water surface to allow construction of accurate mean hydraulic head maps that can reliably be used to analyze long-term chemical transport in the subsurface;
- Engage in site-specific characterization of the soil-water partition coefficient for the various CCR constituents (including boron, sulfate, and all other Appendix III and IV constituents) so that chemical transport rates can be estimated;
- Implement three-dimensional groundwater flow and chemical transport modeling that takes into account the above data (including all Appendix III and IV constituents); and
- Redesign the interim remedial action as further discussed in this report.

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