APPENDIX H –
HYDROGEOLOGIC INVESTIGATIONS

APPENDIX H.1

TECHNICAL EVALUATION OF HYDROGEOLOGY

Appendix H.1 – Technical Evaluation of Hydrogeology

TDEC Commissioner's Order:
Environmental Assessment Report
Watts Barr Fossil Plant
Spring City, Tennessee

March 31, 2024

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APPENDIX H.1 – TECHNICAL EVALUATION OF HYDROGEOLOGY

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Sign-off Sheet

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Abbreviations

amsl	Above Mean Sea Level
CARA	Corrective Action/Risk Assessment
CCR	Coal Combustion Residuals
CCR Parameters	Constituents listed in Appendices III and IV of 40 CFR 257 and five inorganic constituents included in Appendix I of Tennessee Rule 0400-11-01-.04
CCR Rule	Title 40, Code of Federal Regulations, Part 257
CFR	Code of Federal Regulations
cm/sec	Centimeters Per Second
EAR	Environmental Assessment Report
EI	Environmental Investigation
EIP	Environmental Investigation Plan
GSL	Groundwater Screening Level
NPDES	National Pollutant Discharge Elimination System
%	Percent
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
Redox	Oxidation/reduction potential
SAP	Sampling and Analysis Plan
SAR	Sampling and Analysis Report
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	TDEC Commissioner’s Order OGC15-0177
TI	Technical Instruction
TVA	Tennessee Valley Authority
WBF Plant	Watts Barr Fossil Plant

1.0 INTRODUCTION

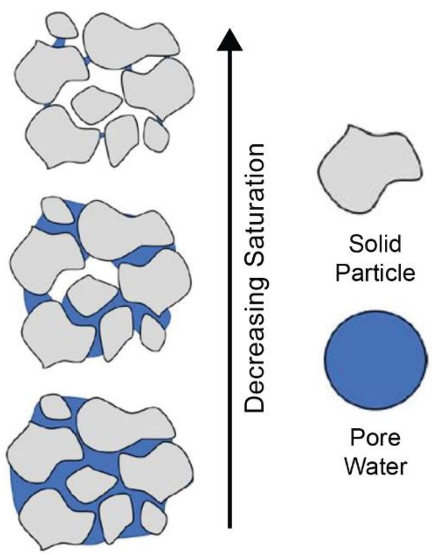
Stantec Consulting Services Inc (Stantec), on behalf of the Tennessee Valley Authority (TVA), has prepared this technical evaluation appendix to summarize historical and recent evaluations of hydrogeological and analytical results for groundwater and geochemical data at TVA's Watts Bar Fossil Plant (WBF Plant) in Spring City, Tennessee. This technical appendix also provides a characterization of the extent of contamination and preliminary explanation for the observed occurrences of coal combustion residuals (CCR) constituents in groundwater to support information provided in the Environmental Assessment Report (EAR) and to fulfill the requirements for the Tennessee Department of Environment and Conservation (TDEC)-issued Commissioner's Order No. OGC15-0177 (TDEC Order) Program (TDEC 2015). Further evaluation of the need for corrective actions and the associated extent of groundwater contamination will be provided in the Corrective Action/Risk Assessment (CARA) Plan. For purposes of this document, the following hydrogeological terms as they are defined below are used throughout this document.

- Pore water - subsurface water that occurs in pore spaces in CCR material
- Groundwater - subsurface water that occurs in pore spaces in unconsolidated or geologic materials (e.g., soil, bedrock)
- Aquifer - a geologic formation capable of yielding usable quantities of groundwater
- Confined aquifer - an aquifer present between two aquitards when the water level in a well is observed to be above the top of the aquifer due to the confining pressure (see graphic below)
- Aquitard - a geologic formation comprised of less permeable geologic materials that transmit groundwater more slowly than an aquifer
- Saturated – Unconsolidated or geologic materials (e.g., soil, bedrock) or CCR material where all of the pore space is filled with water. The use of the term "saturated" in reference to the moisture content of CCR material does not imply that the pore water is readily separable from the CCR material
- Moisture content - the measure of the amount of water contained within unconsolidated or geologic materials (e.g., soil, bedrock) or CCR material. Moisture content of saturated material can be variable because the characteristics of the material determine the amount of pore space available for water to fill
- Phreatic surface - the surface of pore water at which pressure is atmospheric and below which CCR material may be saturated with pore water. Pore water levels are measured at locations where temporary wells or piezometers were installed within CCR material. The measured pore water levels are used to infer pore water levels between the wells and piezometers to develop the phreatic surface

- Piezometric surface – the groundwater surface defined by the level to which groundwater will rise in a well completed in a confined aquifer
- Uppermost aquifer – the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within a facility's property boundary.

In a confined aquifer, measured groundwater levels rise above the top of the aquifer. The difference between the measured groundwater levels within the aquifer and the top of the aquifer is called the pressure head. A figure showing pressure head for a confined aquifer and associated bounding aquitards is provided below. For confined aquifers, groundwater is not encountered in the interval shown as pressure head above the top of the aquifer because it is bounded by an upper aquitard, which also physically separates the groundwater from the geologic unit located above the upper aquitard.

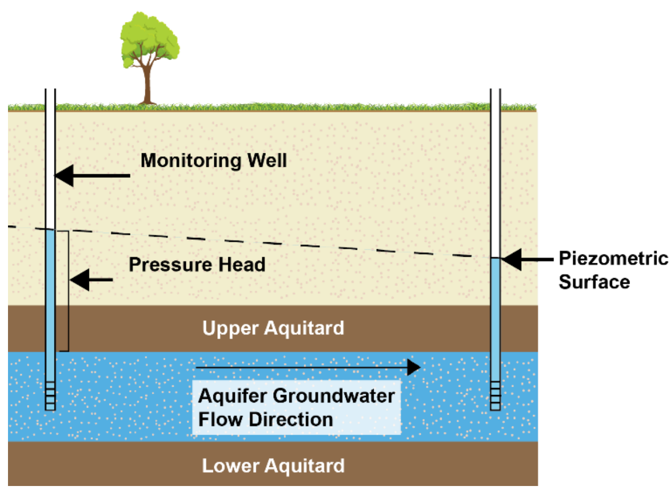
Pore Water



Benson, C., *Water Flow in Coal Combustion Products and Drainage of Free Water*, Report No. 3002021963, Electric Power Research Institute, Palo Alto, CA.

This figure depicts how subsurface water occurs in the pore spaces in CCR material (referred to as "pore water" in this EAR), and how saturation varies within the CCR material. The phreatic surface is the surface of pore water at which pressure is atmospheric and below which CCR material may be saturated with pore water.

Confined Aquifer



Groundwater is subsurface water that occurs in pore spaces in soil or bedrock. Groundwater level measurements are used to estimate directions of groundwater movement. Groundwater generally flows much more slowly than water in a surface stream or river.

2.0 GROUNDWATER AND HYDROGEOLOGICAL INVESTIGATION

The purpose of the groundwater and hydrogeological investigations was to further characterize and evaluate subsurface conditions in proximity to two CCR management units at the WBF Plant, including the Ash Pond and the Slag Disposal Area. For these investigations, TVA reviewed information from previous studies and assessments, completed field sampling programs, and conducted evaluations related to geology, hydrogeology, groundwater quality and CCR material characteristics as part of the TDEC Order Environmental Investigation (EI).

The following sections summarize the previous studies and present overall hydrogeological investigation and evaluation findings related to the WBF Plant CCR management units based on data obtained during previous studies and the EI.

2.1 PREVIOUS STUDIES AND ASSESSMENTS

This section provides a summary of prior studies that have been conducted at the WBF Plant and provide usable information related to geology, hydrogeology, groundwater quality and CCR material characteristics. No previous studies of the geochemical interaction of geological materials, groundwater or pore water are known to have been conducted. In addition to the studies summarized below, information from other hydrogeological and geotechnical studies that met the data quality objectives of the *Environmental Investigation Plan* (*EIP*) (TVA 2018) is incorporated into the evaluation presented in this appendix. Previously closed CCR management units were closed in accordance with applicable regulations in effect at the time of closure.

Exploratory drilling at the WBF Plant began in 1940 to evaluate the suitability for the foundation for a proposed power plant. The bedrock was described as shale across the plant, and overburden was thin in most cases, except near the Tennessee River (Fox 1942).

Beginning in the late 1980s, TVA began performing targeted hydrogeological studies to evaluate the existing and future proposed ash management practices. In 1988, soil borings and monitoring wells were installed to evaluate subsurface conditions and groundwater quality (TVA 1988). Field activities included drilling three soil borings, geotechnical testing and soil classification, and installing three monitoring wells.

From 1996 to 2005, US Minerals reclaimed slag from the Slag Disposal Area for use in manufacturing products. In 2009, the Slag Disposal Area and Closed Metal Cleaning Pond were closed under TDEC Permit No. TNR190741 in accordance with the *Closure and Post Closure Plan* (TVA 2007). It is unknown whether the Closed Metal Cleaning Pond was ever used. During inspections following the closure, poor surface drainage was observed in the area west of the Slag Disposal Area. A separate stormwater drainage and maintenance project was later implemented to improve drainage and remove ponded water from around the Slag Disposal Area.

TVA demolished the main powerhouse at the WBF Plant in 2012 and closed the Ash Pond in 2015 under TDEC Permit No. TN0005461 in accordance with the *Ash Pond Closure Plan* (TVA 2013). As part of the closure, CCR materials were excavated from the southern portion of the Ash Pond and consolidated/capped in the northern portion of the Ash Pond using a geosynthetic and soil cap (CDM Smith 2015). The southern portion of the former Ash Pond was converted into a National Pollutant Discharge Elimination System (NPDES) -permitted stormwater pond (Permit No. TNR058427) for the plant. A clay divider dike was constructed between the capped portion of the Ash Pond and the stormwater pond (CDM Smith 2015).

In 2011 and 2012, five borings were drilled and completed as temporary groundwater observation wells as part of the Ash Pond closure construction activities (CDM Smith 2012). Groundwater levels measured in the wells were used in geotechnical evaluations associated with the closure of the Ash Pond. No samples were collected for laboratory analysis from these wells. The observation wells were then during construction activities.

In 2014, three monitoring wells were installed in accordance with the *Ash Pond Closure Groundwater Monitoring Plan* included in the *Ash Pond Closure Plan* (TVA 2013). In 2016, an additional monitoring well was installed in an upgradient location to be monitored as a potential background well (Stantec 2017). Compliance groundwater monitoring began in October 2014 and is ongoing.

2.2 CURRENT AND ONGOING GROUNDWATER MONITORING

As of October 19, 2015, the effective date of Title 40 of the Code of Federal Regulations (40 CFR) Part 257 (CCR Rule), the Ash Pond and the Slag Disposal Area were not receiving CCR material, were not impounding water, and had been previously closed. As a result, these units are not subject to the CCR Rule.

Current and ongoing compliance groundwater monitoring at the WBF Plant CCR management units consists of one program:

- **NPDES Permit**: From 2014 to the present, TVA has conducted quarterly or semiannual groundwater monitoring at the Ash Pond under NPDES Permit No. TN0005461 in association with the *Ash Pond Closure Plan*. The Ash Pond is listed as a Non-Registered Site by TDEC. Sample collection and laboratory analysis are performed in accordance with TDEC Rule 0400-11-01-.04 and the facility *Groundwater Monitoring Plan* included within the *Ash Pond Closure Plan* (TVA 2013) approved by TDEC. Groundwater analytical data reports have been and continue to be provided to TDEC as part of this program.

Exhibit H.1-1 shows the current groundwater monitoring well and piezometer networks for the WBF Plant. Appendix E.3 provides a list of the wells and their associated monitoring program.

2.3 HYDROGEOLOGY

The objectives of the TDEC Order hydrogeological and groundwater investigations were to characterize the hydrogeology and groundwater quality and evaluate groundwater flow conditions in the vicinity of the WBF Plant CCR management units.

TVA performed well installation and groundwater sample collection activities in accordance with the *EIP*, *Groundwater Investigation and Hydrogeological Investigation Sampling and Analysis Plans* (SAPs) (Stantec 2018a and 2018b), *Quality and Assurance Project Plan* (*QAPP)* and TVA's Environmental Technical Instructions (TIs). Well installation and sample location selection, sample collection methodology, sample analyses, and quality assurance/quality control completed for the investigations are provided in the *Hydrogeological Investigation Sampling and Analysis Report (SAR)* (Appendix H.2) and the *Groundwater Investigation SARs* for the six sampling events (Appendices H.3 through H.8).

As reported in the *Groundwater and Hydrogeological Investigation SARs*, the data collected during these investigations were deemed usable for reporting and evaluation in this EAR because they met the objectives of the *EIP*. An analysis of results and discussion of the dataset from these investigations along with data collected under other *TDEC Order SAPs* and data collected under the Ash Pond closure compliance program is presented in the sections below.

2.3.1 Scope of Work

The scope of work for the EI hydrogeological and groundwater investigations included drilling soil borings and installing permanent wells at six planned locations, collecting soil samples from the screened interval of two proposed background wells, obtaining saturated zone hydraulic conductivity data, and conducting six groundwater sampling events.

The groundwater sampling events included gauging groundwater and pore water levels in permanent and temporary monitoring wells and piezometers installed as part of the EI and other existing monitoring wells and piezometers near the CCR management units. The groundwater and soil samples were analyzed for the CCR-related constituents listed in Appendices III and IV of the CCR Rule, except soil samples were not analyzed for total dissolved solids. In addition, five inorganic constituents listed in Appendix I of Tennessee Rule 0400-11-01-.04 and not included in the CCR Rule Appendices III and IV were analyzed to maintain continuity with the TDEC compliance programs. These additional TDEC Appendix I constituents included copper, nickel, silver, vanadium, and zinc. The combined federal CCR Appendices III and IV constituents and TDEC Appendix I inorganic constituents are hereafter referred to as CCR Parameters. For geochemical evaluation, groundwater samples were analyzed for major cations/anions not included in the CCR Parameters. The additional geochemical parameters included bicarbonate, carbonate, magnesium, potassium, and sodium. Table H.1-1 provides a summary of the boring and well locations associated with the hydrogeological investigation and the rationale for each well location. The locations of the EI wells and other program well locations are shown on Exhibit H.1-1.

2.3.2 Well Installation

The hydrogeological investigation well installation activities were conducted between May 29, 2019 and October 11, 2019, and consisted of hollow stem auger drilling, well installation, well development, slug testing, pump installation, and well surveys. Stantec performed field activities based on guidance and specifications listed in TVA's TIs, the *SAPs*, and the *QAPP*.

Two proposed background permanent wells (WBF-102 and WBF-103) were installed in unconsolidated materials to provide groundwater samples that have not been affected by the CCR management units and to be representative of background conditions. Soil samples were collected from the screened intervals of each of the background well borings for analysis of CCR Parameters. The soil sample results are provided in the *Background Soil Investigation SAR* (Appendix F.1).

One permanent monitoring well (WBF-101) was installed in unconsolidated materials at a location downgradient of the Ash Pond, and three permanent monitoring wells (WBF-104, WBF-105, and WBF-106) were installed in unconsolidated materials at locations downgradient of the Slag Disposal Area to provide locations to evaluate groundwater flow and quality in these areas.

2.3.3 Well Construction

Permanent monitoring wells were installed by qualified drill crews working under the direction of a Stantec Professional Geologist and a licensed Tennessee driller. Wells were constructed of four-inch diameter Schedule 40 polyvinyl chloride (PVC) pre-packed well screens (0.010-inch slots) and riser. The screen and riser consisted of flush-joint, threaded PVC pipe. The screen length was selected based on the results of the boring log and the target stratum and was either five or 10 feet in length. Well construction details are included in the *Hydrogeological Investigation SAR.* Table H.1-2 shows the well construction summary for wells WBF-101 through WBF-106 and other previously existing wells shown on Exhibit H.1-1.

2.3.4 Well Development

Each new permanent well was developed using a combination of bailing, surging, and pumping after a minimum of 24 hours following well installation. A summary of initial and final water quality measurements collected during well development is presented in Table B.2 in Appendix B of the *Hydrogeological Investigation SAR* (Appendix H.2).

2.3.5 Aquifer Testing

2.3.5.1 Slug Testing

After development of the wells installed as part of the hydrogeological investigation, Stantec performed slug testing in five of the six permanent wells (WBF-101, WBF-103, WBF-104, WBF-105, and WBF-106) to estimate the hydraulic conductivity of the unconsolidated materials within the screened interval of each well. A pressure transducer with a data recorder was used to collect water level information from the wells. Monitoring well WBF-102 could not be tested because it was repeatedly dry or had insufficient water column to conduct the tests.

The field data were analyzed using AQTESOLV™ Version 4.50 Professional software to estimate the hydraulic conductivity of the saturated unconsolidated materials in the screened interval of each tested monitoring well. Calculated hydraulic conductivities are summarized in Table B.3 in Appendix B of the *Hydrogeological Investigation SAR* (Appendix H.2), and the software output package is provided in Appendix E of the *Hydrogeological Investigation SAR*. The hydraulic conductivity in the five tested EI permanent wells WBF-101 and WBF-103 through WBF-106 ranged from 1.91 x 10^{-4} centimeters per second (cm/sec) to 7.26 x 10^{-3} cm/sec.

A summary of the EI slug test results is provided in Table H.1-3. The geometric mean of the hydraulic conductivities measured in wells listed in Table H.1-3 is 5.28 x 10^{-4} cm/sec.

2.3.6 Groundwater Sampling

Groundwater samples were collected during six events on the following dates:

- Event 1 – August 27-28, 2019
- Event 2 – October 29-31, 2019
- Event 3 – January 7-9, 2020
- Event 4 – March 3-4, 2020
- Event 5 – April 27-29, 2020
- Event 6 – July 7-8, 2020.

TVA performed investigation sample and data collection activities in accordance with the *Groundwater Investigation SAP,* TVA's TIs, and the *QAPP*. Permanent wells were purged using dedicated bladder pumps equipped with dedicated tubing and low-flow purging and sampling techniques. Details of each sampling event are provided in the *Groundwater Investigation SARs*, Events #1 through #6 (Appendices H.3 through H.8).

2.3.7 Hydrogeologic Assessment Results

Several soil boring and well installation projects at and in the vicinity of the WBF Plant CCR management units yielded information about the geology, hydrogeological properties of the geologic formations, groundwater elevations, groundwater flow direction, and groundwater quality. This section provides an evaluation of the hydrogeological setting of the WBF Plant CCR management units.

2.3.7.1 Geology and Lithology

Chapter 2.4 of the EAR provides a discussion of the regional geologic setting for the WBF Plant. This section provides a discussion of the site-specific geology and lithology of the WBF Plant. Use of the terminology "fill material" in the following discussions excludes CCR material. A discussion of CCR material is provided in Appendix G.1. Exhibit H.1-2 shows a three-dimensional representation of the extent of CCR material at the WBF Plant.

The WBF Plant is located in the Tennessee River valley in the western portion of the Appalachian Valley Physiographic Province, also known as the Valley and Ridge Province (Fox 1942). The natural unconsolidated materials consist primarily of alluvium overlying bedrock. Alluvium refers to native materials (i.e., clay, silt, sand, or gravel) that are deposited by moving water. Unconsolidated material thicknesses ranged from approximately 0 to 32 feet based on the information collected during the EI (see Appendix C of Appendix H.2 for boring logs). The unconsolidated materials are thickest near the river and thinner at greater distances from the river. The alluvium can be differentiated into silts, clays, sands, and gravels, which exhibit a coarsening downward sequence. The upper fine-grained alluvium layer varies in thickness from approximately 0 to 27 feet and is primarily comprised of clay and silty clays. Clay soils of variable thickness are present under the CCR management units. The lower alluvial layer, ranging in thickness from 0 to 20 feet, is primarily silty sand, sand, and gravel. Exhibits H.1-3 and H.1-4 show three-dimensional representations of the extent of the unconsolidated materials consisting primarily of silts and clays, and sands and silty sands, respectively.

Geologic mapping indicates that the unconsolidated materials are underlain by bedrock comprised of the Conasauga Group, specifically the Conasauga Group Middle and the Nolichucky Shale. Exhibit H.1-5 is a geologic map of the WBF Plant.

The upper bedrock consists of dark gray-green shale, weathered in the upper few feet, with varying amounts of gray limestone based on boring logs from the *Exploratory Drilling SAR* (Appendix G.2). The bedrock surface slopes east toward the Tennessee River, with elevations ranging from 696 feet above mean sea level (amsl) west of the Slag Disposal Area to 664 feet amsl along the Tennessee River. The average dip of the strata is 35 degrees southeast, and the average strike is 35 degrees to the northeast (Fox 1942). The Kingston Fault has been identified west of the plant. Exhibit H.1-6 shows the regional geology and the location of the nearby mapped faults. Exhibit H.1-7 shows a three-dimensional representation of the bedrock surface.

2.3.7.2 Hydrostratigraphic Units and the Uppermost Aquifer

Hydrostratigraphic units are geological formations that are defined to characterize the hydrogeology of the WBF Plant to understand where and how groundwater is flowing. Groundwater flows from higher groundwater elevations to lower elevations. In saturated geological formations that have higher permeability than adjacent formations, groundwater flows in a mostly horizontal direction. In saturated geological formations that have lower permeability than adjacent formations, groundwater flows in a more vertical direction. The more permeable geological formations capable of yielding useable quantities of groundwater are called aquifers. Aquifers are targeted for development as water sources by property owners. The less permeable geological formations are called aquitards.

Hydraulic characteristics of hydrostratigraphic units are used to classify aquifers. An aquifer located between two aquitards is called a confined aquifer. Groundwater can flow through aquitards into underlying aquifers, but the rate of flow is commonly much slower than the rate of flow within the aquifer. Aquifers can be considered confined even if they are not completely covered by an aquitard. For example, the Memphis aquifer in western Tennessee is a confined aquifer, yet it is known that the aquitard above the Memphis aquifer is thin or absent in some areas (United States Geological Survey 1990).

As shown in the graphical representation in Section 1.0, in a confined aquifer, measured groundwater levels rise above the top of the aquifer. The difference between the measured groundwater levels within the aquifer and the top of the aquifer is called the pressure head. For confined aquifers, groundwater is not encountered in the interval shown as pressure head above the top of the aquifer because it is bounded by an upper aquitard, which also physically separates the groundwater from the geologic unit located above the upper aquitard.

In state and federal regulations, the term uppermost aquifer is used. This is the aquifer nearest the natural ground surface, as well as lower aquifers that are hydraulically interconnected with this aquifer within a facility's property boundary that are capable of yielding usable quantities of groundwater. Regulations are designed to protect the groundwater in the uppermost aquifer because it could be used by property owners as a source of water. The term uppermost aquifer is used in this report.

Based on the geology and hydraulic conductivities measured in the vicinity of the CCR management units, the alluvial sands and gravels above bedrock shown on Exhibit D-2 in Appendix D of the EAR, are considered to be the uppermost aquifer. The uppermost aquifer is overlain by less permeable clays that are defined as an aquitard; therefore, the uppermost aquifer is a confined aquifer. Groundwater in the confined aquifer is not in contact with the CCR material inside the CCR management units because the aquitard physically separates them.

Exhibit H.1-8 shows the distribution and thickness of the clays that comprise the aquitard above the uppermost aquifer. Based on visual field descriptions of unconsolidated materials on borings logs, two locations might not have clay above the uppermost aquifer. These locations are shown on Exhibit H.1-9, and both locations are in the Drainage Improvements Area. The following bullets present information about the visual field descriptions provided on boring logs for these locations. Also, an evaluation of the changes in water levels, above and below the aquitard, to fluctuations in surface stream water levels are provided in Section 2.3.7.4.

- WBF-B11 in the Drainage Improvements Area: The base of the CCR material in this boring was at a depth of approximately 20 feet, and the material beneath it consisted of approximately one foot of clayey sand. The bedrock interface is below the sand interval
- WBF-B15 in the Drainage Improvements Area: The base of the CCR material in this boring was at a depth of approximately 21 to 23 feet and consisted of CCR / clayey gravel mixture over the bedrock interface.

2.3.7.3 Groundwater Flow

This section provides a discussion of how groundwater flows at the WBF Plant. Groundwater flow occurs because gravity moves groundwater from areas of higher groundwater elevations to areas of lower elevations along flow paths that are generally perpendicular to groundwater elevation contours. Physiographic and hydrogeological features affect how groundwater flows. Hydrogeological barriers (i.e., rivers and surface streams) and divides (i.e., ridges that form watershed boundaries) bound the extent of groundwater flow. Groundwater flows toward, but not across, hydrogeological barriers and away from hydrogeological divides.

Exhibit H.1-9 shows the physiographic setting of the WBF Plant within the floodplain of the Tennessee River. The key characteristics of the setting are that the plant is situated in a low-lying area along the Tennessee River with higher elevation ridges to the northwest of the plant. Physiographic features that affect groundwater flow in the vicinity of the WBF Plant include the Tennessee River to the east and ridges, which serve as a topographic divide to groundwater flow (Exhibit H.1-10).

Groundwater levels in the uppermost aquifer were measured in 10 wells and used for groundwater elevation contour map development. Groundwater level measurements were also obtained from 9 piezometers installed for other programs. Surface water elevation measurements for the Tennessee River were continuously recorded at the tailwater levels of Watts Bar Dam as part of TVA's plant operations. The automated reading recorded closest to noon on the gauging date was used for comparison to manually gauged groundwater levels. The groundwater level measurements were converted to elevations. Table H.1-4 provides groundwater and Tennessee River level and elevation data for Event #6 in July 2020. Table H.1-5 provides elevation data from the Groundwater Investigation. Exhibit H.1-10 provides a representative groundwater elevation contour map for Event #6 in July 2020. Groundwater elevation contour maps for other sampling events can be found in Appendices H.3 through H.7.

At the WBF Plant, groundwater levels were measured within the alluvial sands and gravels. Generally, the horizontal groundwater flow direction is from the west-northwest to the east-southeast towards the Tennessee River. Groundwater flow in the sands and gravels is bounded to the east by the Tennessee River. Exhibit H-1.10 from groundwater sampling Event #6 in July 2020 is a representative groundwater elevation contour map for the sands and gravels.

Horizontal groundwater flow rates were calculated using groundwater elevation data acquired during the six EI groundwater sampling events and a mean hydraulic conductivity derived from the results of slug testing data (Table H.1-3) for the Slag Disposal Area and Ash Pond. Horizontal groundwater flow direction and hydraulic gradient were estimated using the triangulation method and groundwater elevations for each event. The flow rate was calculated using typical effective porosity percentages based on soil type, constant hydraulic conductivity values based on geometric mean calculations from slug testing, and the groundwater elevation inputs specific to each gauging event. Table H.1-6 provides a summary of the information used to estimate the average horizontal flow rate and the results of the calculations for each groundwater sampling event.

<u>Slag Disposal Area</u>

For unconsolidated materials at the Slag Disposal Area, the values used to calculate groundwater flow rates follow:

- Geometric mean of hydraulic conductivity of 5.28 x 10^{-4} cm/sec
- Average horizontal hydraulic gradient ranged from 0.0159 feet/foot (Event #5) to 0.0183 feet/foot (Event #2)
- Effective porosity of 25%. The reference for the effective porosity of the unconsolidated material (fine-medium sand) uses specific yield as a proxy for effective porosity of unconsolidated material (Johnson, A.I. Revised 1966, page D18).

The average groundwater flow rate for the unconsolidated materials at the Slag Disposal Area ranged from 35 feet/year (Event #5) to 40 feet/year (Event #2). These calculated groundwater flow rates, and those presented below, are generally much slower than water flow in surface streams or rivers. Flow rates in surface streams or rivers generally are measured in feet per second (United States Geological Survey 1999).

<u>Ash Pond</u>

For unconsolidated materials at the Ash Pond, the values used to calculate groundwater flow rates follow:

- Geometric mean of hydraulic conductivity of 5.28 x 10^{-4} cm/sec
- Average horizontal hydraulic gradient ranged from 0.0209 feet/foot (Event #1) to 0.0228 feet/foot (Event #3)
- Effective porosity of 25%. (Johnson, A.I. Revised 1966, page D18).

The average groundwater flow rate for the unconsolidated materials at the Ash Pond ranged from 46 feet/year (Event #1) to 50 feet/year (Event #3).

2.3.7.4 Groundwater/Surface Stream/Pore Water Relationships

This section provides a discussion of groundwater, surface stream, and pore water elevation relationships. The discussion consists of two parts. The first part of the discussion is focused on a general comparison of differences in pore water and inferred groundwater elevations in the vicinity of each of the CCR management units. The second part of the discussion is focused on correlations between fluctuations in groundwater, surface stream, and pore water levels and includes an evaluation of the effect of precipitation events. Exhibit H.1-1 shows the locations of wells and piezometers used to manually gauge groundwater and pore water elevations. Exhibit H.1-11 shows locations of wells and piezometers that are automated to record pore water and groundwater elevations. Exhibit H.1-12 provides hydrographs of the Tennessee River (as measured at the Watts Bar Tailwater) and groundwater elevations (for automated piezometers). Exhibit H.1-13 provides hydrographs of the Tennessee River and groundwater elevations (for manually gauged or read wells and piezometers). Exhibit H.1-14 provides hydrographs of the Tennessee River and pore water elevations (for automated piezometers). Exhibit H.1-15 provides hydrographs of the Tennessee River and pore water elevations (for manually gauged or read wells and piezometers). Table H.1-5 provides a comparison of the groundwater elevations at wells and piezometers and the Tennessee River for the six sampling events. A complete set of hydrographs for available instrumentation is provided in Attachment H.1-A.

<u>General Comparison of Pore Water and Groundwater Elevations</u>

Within the Slag Disposal Area, the pore water phreatic surface was at an elevation approximately three to five feet higher than groundwater levels in the uppermost aquifer during the EI. An observed relationship between water levels in piezometers WBF-B15A/B and WBF-B16B and precipitation events in suggests that an adjacent pond to the west may be losing water into the subsurface, which may be affecting pore water levels. A cross section of the Slag Disposal Area included in Appendix D-2 of the EAR shows pore water levels at higher elevations near the western portion of the CCR management unit compared to pore water and surface stream elevations in the eastern portion of the CCR management unit and in the Tennessee River, respectively.

Within the Ash Pond, there is no phreatic surface because the CCR material is unsaturated based on observations made during temporary well installation activities and subsequent pore water gauging events. During well installation, the CCR material at proposed location WBF-TW01 was unsaturated. Temporary well WBF-TW02 was reported to be dry during two of the six groundwater gauging events, and the pore water level was less than 0.1 foot above the base of the screen during the other four events. Because the temporary well was screened at the base of the CCR material, this implies that the CCR material was unsaturated or effectively unsaturated during the monitoring period. This suggests that the cap is performing as expected and has effectively eliminated infiltration of precipitation into the CCR material.

Correlations Between Fluctuations in Groundwater, Surface Stream, and Pore Water Levels

The following are observations regarding correlation of fluctuations in water levels between the Tennessee River, groundwater, pore water, and precipitation.

- **Tennessee River**: Exhibit H.1-12 shows a hydrograph for the Tennessee River and a timeline of precipitation events, including the amount of precipitation, recorded at the Spring City NOAA weather station. The river stage fluctuations appear to correlate with winter and summer pool changes that are part of the management of water levels in Watts Bar Reservoir. The seasonal influence of the operating reservoir levels is apparent, with the lowest stages generally occurring during the late fall through early spring months and the highest stages generally occurring during the late spring through early fall months. Larger precipitation events sometimes correlate with higher elevations of the Tennessee River stage.

- **Slag Disposal Area.** Exhibit H.1-12 shows a comparison of river stage and groundwater level fluctuations at monitored locations near the Slag Disposal Area. The groundwater hydrographs for automated locations WBF-B13B and WBF-B14B, which are near the Tennessee River, show fluctuation patterns similar to the river stage. These hydrographs also show correlation with precipitation events. For some of the precipitation events, the fluctuation is greater for the piezometer groundwater levels than for the river stage. This suggests that the groundwater elevations in the vicinity of these piezometers are affected by precipitation events. The hydrographs for piezometers located farther from the river show subdued levels of fluctuation but are correlated with river stage and precipitation events.

  Exhibit H.1-14 shows a comparison of river stage and pore water level fluctuations at monitored locations within the Slag Disposal Area. The pore water hydrographs for the automated instruments show generally stable groundwater elevations with fluctuations of less than five feet that correlate with the seasonal precipitation. The higher pore water elevations occur in late winter to early spring. The lower elevations occur in late summer and fall. Short-term increases in pore water level elevations correlate with precipitation events. There is not strong correlation with river stage fluctuations. The pore water fluctuations appear to have more correlation with seasonal precipitation than with management of water levels in Watts Bar Reservoir. The groundwater hydrographs for the manually gauged or read instruments show generally stable groundwater elevations with fluctuations of less than five feet that correlate with seasonal precipitation (Exhibit H.1.13). These hydrographs do not have the resolution to make comparisons to short-term river level fluctuations or precipitation events.

The pore water hydrographs for the manually gauged or read instruments show generally stable pore water elevations with fluctuations of less than approximately six feet that correlate with seasonal precipitation (Exhibit H.1-15). These hydrographs do not have the resolution to make comparisons to seasonal or short-term precipitation events. The manual pore water gauging data from TW02 indicated that the pore water was at or below the base of the screen, which is located at approximately the base of the CCR management unit.

In summary, the fluctuations in groundwater levels in the uppermost aquifer are correlated with fluctuations in the Tennessee River stage, seasonal precipitation, and short-term precipitation events. The fluctuations in pore water levels generally show a closer correlation with precipitation than to the Tennessee River stage.

2.4 GROUNDWATER QUALITY

This section provides a discussion of the analytical results for groundwater samples collected from monitoring wells installed as part of the EI and previously installed wells monitored as part of the Ash Pond closure groundwater monitoring program. The groundwater quality evaluation is based on a statistical evaluation of constituents listed in Appendix I of TDEC Rule 0400-11-01-.04 (TDEC Appendix I) and Appendices III and IV of the CCR Rule. The analytical results were compared to GSLs approved by TDEC (see Appendix A.2). The results of the statistical evaluation are shown in a color-coded format where green indicates no statistically significant concentration greater than or equal to the GSL for constituents other than pH and no statistically significant difference outside the GSL range for pH, and red indicates a statistically significant concentration greater than or equal to the GSL for constituents other than pH or a statistically significant difference outside the GSL range for pH. The statistical methods applied to determine the green and red categories are discussed in the statistical evaluation of groundwater analytical data provided in Appendix E.3 and the results are summarized below. Table H.1-7 provides the analytical results of groundwater samples used in the statistical evaluation. Table H.1-8 provides a summary of groundwater quality parameters used for the statistical analyses. Table H.1-9 lists the approved GSLs. Table H.1-10 shows the results of the statistical evaluation with the color-coded format described above.

The dataset compiled for statistical analysis included available analytical data for groundwater samples collected between October 2014 and October 2022, although the specific start date and frequency of sampling may vary between wells based on date of well installation and the applicable monitoring program. Wells MW-1, MW-2, and MW-3 were sampled between October 2014 and October 2022. Well WBF-100 was sampled between January 2017 and October 2022. Wells WBF-101 and WBF-103 through WBF-106 were sampled during 10 events, and WBF-102 was sampled during nine events between October 2014 and October 2022 to complete the scope in the approved *Groundwater Investigation SAP* and additional sampling conducted in conjunction with sampling events for the Ash Pond closure groundwater monitoring program.

The statistical evaluation included screening for outliers, which are abnormally high or low values that may represent anomalous data or data errors. There were no outliers removed from further statistical analysis based on this evaluation. Appendix E.3 provides additional information regarding the outlier evaluation and methods used to compare results to the GSLs.

The statistical evaluation identified 14 CCR Rule Appendix III well-constituent pairs with statistically significantly concentrations above a GSL or outside the GSL range for pH. These included pH, sulfate, and total dissolved solids. Four well-constituent pairs for the CCR Rule Appendix IV constituents (which are also TDEC Appendix I constituents) had a statistically significant concentration above a GSL. Cadmium (WBF-104) and cobalt (MW-1, WBF-104, and WBF-106) were the only Appendix I or Appendix IV constituents with a statistically significant concentration above an approved level. Table H.1-10 provides a summary of the statistical evaluation. Exhibit H.1-11 provides the results of the statistical evaluations for CCR Rule Appendix IV and TDEC Appendix I constituents with at least one detection above the GSL for the Ash Pond and Slag Disposal Area. A detailed explanation of the interpretation of the graphs inset on these exhibits is provided in Appendix E.3.

For the well-constituent pairs identified with statistically significantly concentrations greater than or equal to a GSL or outside the GSL range for pH, linear regression analysis identified two statistically significant decreasing trends and three statistically significant increasing trends. Table H.1-11 provides a summary of the trend evaluation.

2.4.1 Piper Diagrams

Another approach to characterize the groundwater analytical results included the use of Piper diagrams, which are graphical representations of the major ion chemistry of groundwater. Available groundwater data were used to develop the diagrams, which were used to visually evaluate similarities and differences in the general chemistry characteristics of the groundwater samples and assess whether the results potentially indicated influences from the various sources of groundwater. A Piper diagram from the July 2020 groundwater sampling event is depicted in Exhibit H.1-17, which is considered to be representative of the major ion distribution of the groundwater near the WBF Plant CCR management units over the sampling time period. Piper diagrams for the remaining four events conducted between October 2019 and April 2020 are provided in Attachment H.1-B.

The groundwater-type of the upgradient well (WBF- 103) was observed to be a calcium-sulfate type. Groundwater near the Ash Pond was a calcium-sulfate type near locations WBF-101 and WBF-102. Groundwater near the Slag Disposal Area was a calcium-sulfate type near locations WBF-104, WBF-105, and WBF-106. Additional information regarding groundwater geochemistry is provided in Section 2.4.2.

2.4.2 Geochemistry of Soils-Groundwater Interaction

Groundwater quality is affected by numerous geochemical processes during groundwater flow through geological materials. The distinct difference between the chemical characteristics of pore water within the CCR material, presented in Appendix G.1, and the characteristics of groundwater quality downgradient of the CCR management units at the WBF Plant is difficult to explain without the aid of geochemistry. It is well documented in the literature that certain CCR constituents that are detected in pore water (typically at higher concentrations than in groundwater) can be affected by geochemical processes that occur between constituents dissolved in groundwater and geological materials through which it flows. The effects of these geochemical processes, which often result in the attenuation of CCR constituents (i.e., reduced concentrations) can explain observed differences between the characteristics of pore water and groundwater. The extent of the interactions between dissolved constituents in groundwater and geological materials ranges from limited interaction for constituents such as boron, chloride and sulfate, to strong interactions for constituents such as arsenic and cobalt.

Descriptions of the geochemical interactions between geological materials and constituents dissolved in groundwater are provided in many textbooks (e.g., Appelo and Postma 1996). Geochemical reactions or processes that can affect CCR constituents include:

- Adsorption/desorption on the surfaces of metal hydroxides – an interaction whereby constituents adsorb to metal hydroxide soil minerals; the process is reversible and controlled by the pH and oxidation/reduction potential (redox) of groundwater

- Cation exchange with clay minerals – a process where positively charged constituents (cations) absorb to negatively charged clay minerals, subject to competition and concentrations relative to other constituents. The strength of the electrostatic bond formed varies with the constituents involved, but in general cation exchange reactions are reversible

- Mineral precipitation or dissolution – a process where dissolved constituents in groundwater combine to form a soil mineral; minerals are also subject to dissolution (i.e., reaction is reversible) under certain conditions of groundwater pH and redox.

Observations of groundwater and pore water chemistry can indicate the extent to which geochemical processes chemically change groundwater and influence groundwater quality at the WBF Plant. Boron, chloride, and sulfate commonly occur in high concentrations in pore water and are minimally attenuated by geochemical processes. Thus, they can be used to infer locations in the groundwater monitoring program where there is an influence from pore water. This is because boron and chloride are considered non-reactive because neither constituent is subject to geochemical reactions that would materially change concentrations in groundwater during flow through geological materials. Sulfate is considered a low-reactive constituent because there are geochemical conditions in some CCR influenced groundwater where the concentration of sulfate can be reduced by mineral precipitation.

In contrast, those CCR constituents most likely to be influenced by interactions between geological materials and groundwater (e.g., arsenic, lithium, and molybdenum) typically show concentrations in groundwater monitoring wells that are much different than those observed in pore water, indicating that groundwater is being chemically changed relative to pore water by some physical or geochemical process (or a combination of both) occurring as it flows through geological materials. Groundwater quality measured at a given groundwater monitoring location is a result not only of the interactions between its constituents and the geological materials through which it flows, but also of flow from upgradient sources (including background). Thus, the area upgradient of a groundwater monitoring well can be thought of as an interacting geochemical and hydrogeologic system, including:

- Materials that contribute chemical mass to groundwater

- The physical properties of the geological materials that govern direction and rate of groundwater flow
- Minerals in the geologic materials that can interact with constituents being transported by groundwater
- The pH and redox conditions of groundwater.

This geochemical and hydrogeological system, which includes natural and anthropogenic sources and interactions with natural geologic materials, is referred to as the upgradient system.

Understanding the geochemistry of geological materials is important in interpreting the processes influencing current conditions of groundwater chemistry at the WBF Plant and evaluating effects of activities, such as capping or groundwater remediation, on the evolution of groundwater quality. Further evaluation of the geochemical processes acting in the upgradient system at the WBF Plant to influence groundwater quality will be included in the CARA Plan during assessments of remedies, where needed.

2.4.3 Summary

Downgradient of the CCR management units, two CCR Rule Appendix IV CCR constituents (which are also TDEC Appendix I constituents) had statistically significant concentrations in onsite groundwater above a GSL in three wells, including cadmium (WBF-104) and cobalt (MW-1, WBF-104, and WBF-106). The groundwater impacts described above are limited to onsite areas downgradient along the perimeter of the CCR management units. These constituents and onsite groundwater in the vicinity of these wells will be further evaluated in the CARA Plan to determine the need for corrective actions.

3.0 SUMMARY

The objectives of the TDEC Order hydrogeological and groundwater investigations were to characterize the hydrogeology and groundwater quality and evaluate groundwater flow conditions in the vicinity of the WBF Plant CCR management units. The key findings of the WBF Plant hydrogeological and groundwater investigations are summarized below:

- TVA evaluated analytical results for groundwater in support of the EAR based on data collected under two groundwater monitoring programs, including the EI and the Ash Pond closure groundwater monitoring programs. Monitoring well locations and CCR constituents that will require further evaluation in the CARA Plan are provided below.

Summary of Findings Requiring Further Evaluation in the CARA Plan	
CCR Management Unit	**Groundwater**
Ash Pond	Cobalt (Well MW-1)
Slag Disposal Area	Cadmium (Well WBF-104) Cobalt (Wells WBF-104 and WBF-106)

- Drainage modifications or potential corrective actions are expected to reduce concentrations of CCR constituents to below GSLs in groundwater at downgradient monitoring locations.

- Pore water within the CCR material has specific chemical characteristics that are different from the characteristics of groundwater downgradient of the CCR management units. Certain CCR constituents that have been detected in pore water are affected by geochemical processes during groundwater flow through geological materials. The effect of these geochemical processes, which can result in the attenuation of CCR constituents and reduced dissolved groundwater concentrations, can explain the observed differences between the characteristics of pore water and groundwater quality.

- Within the Slag Disposal Area, the pore water phreatic surface may be affecting infiltration of storm water upgradient of the CCR management unit. The pore water levels within Slag Disposal Area would be expected to decrease in elevation if stormwater drainage or cap modifications were to be implemented. Within the Ash Pond, there is no phreatic surface because the CCR material is unsaturated. The use of the term “saturated” or references to the moisture content of CCR material does not imply that the pore water is readily separable from the CCR material.

- The coarse-grained unconsolidated alluvial deposits above bedrock are considered to be the uppermost aquifer and are under confined conditions. The uppermost aquifer is typically overlain by clays that act as an aquitard. Available water level data, including the effect of the Tennessee River stage, indicate that the aquitard provides hydraulic separation between the uppermost aquifer and the CCR material.

- The horizontal groundwater flow direction within the uppermost aquifer is generally from the west-northwest to the east-southeast toward the Tennessee River. Groundwater flow in the vicinity of the CCR management units is bounded to the east by the Tennessee River.

TVA will continue to monitor the trends of cadmium and cobalt and conduct further evaluation in the CARA Plan to determine if corrective actions are needed. The influence of geochemical processes on groundwater quality will be further evaluated in the CARA Plan as part of the assessment of remedies, where needed.

4.0 REFERENCES

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TABLES

Table H.1-1 - Summary of Environmental Investigation Monitoring Well Locations
Watts Bar Fossil Plant

Boring ID	Well ID	Location	Rationale
WBF-101	WBF-101	Northeast corner of the closed Ash Pond	To assess local groundwater flow and quality downgradient of the CCR management units
WBF-102Alt2 (Sonic)	WBF-102	West of the closed Ash Pond	To assess groundwater flow and quality at a background location
WBF-103	WBF-103	West of the closed Slag Disposal Area, south of former coal yard storage area	To assess groundwater flow and quality at a background location
WBF-104	WBF-104	Southeast of the closed Slag Disposal Area	To assess local groundwater flow and quality downgradient of the CCR management units
WBF-105/ WBF-105 (Sonic)	WBF-105	East of the closed Slag Disposal Area	To assess local groundwater flow and quality downgradient of the CCR management units
WBF-106	WBF-106	Northeast of the closed Slag Disposal Area	To assess local groundwater flow and quality downgradient of the CCR management units

Notes:

CCR	Coal Combustion Residual
ID	Identification
WBF	Watts Bar Fossil Plant

Table H.1-2 - Summary of Monitoring Well Construction Specifications
Watts Bar Fossil Plant

	Top of Casing		Bottom of Well			Screened Interval					
Well ID	Stickup	Elevation	Depth	Depth	Elevation	Depth Top	Depth Bottom	Depth Top	Depth Bottom	Elevation Top	Elevation Bottom
	ft ags	ft NGVD29	ft bgs	ft btoc	ft NGVD29	ft bgs	ft bgs	ft btoc	ft btoc	ft NGVD29	ft NGVD29
MW-1	2.5	711.92	31.0	33.5	678.4	20.8	30.8	23.3	33.3	688.6	678.6
MW-2	3.0	696.22	29.5	32.5	663.7	19.7	29.4	22.7	32.4	673.5	663.8
MW-3	3.0	704.29	28.6	31.6	672.7	18.6	28.6	21.6	31.6	682.7	672.7
WBF-100	4.1	741.49	54.2	58.3	683.2	43.6	53.7	47.7	57.8	693.8	683.7
WBF-101	4.4	703.15	33.1	37.5	665.6	22.9	32.7	27.3	37.1	675.8	666.0
WBF-102	4.8	723.98	19.8	24.6	699.4	14.6	19.4	19.4	24.2	704.6	699.8
WBF-103	4.0	725.09	18.2	22.2	702.9	13.0	17.8	17.0	21.8	708.1	703.3
WBF-104	3.4	697.45	28.3	31.7	665.8	18.1	27.9	21.5	31.3	676.0	666.2
WBF-105	4.7	704.5	32.7	37.4	667.1	27.5	32.3	32.2	37.0	672.3	667.5
WBF-106	4.7	706.34	33.3	38.0	668.4	23.1	32.9	27.8	37.6	678.5	668.7

Notes:

ags	above ground surface
bgs	below ground surface
btoc	below top of casing
ft	feet
ID	identification
NGVD29	National Geodetic Vertical Datum of 1929

1. Well information based on data provided by TVA and Stantec (e.g., well logs, well inspection report); however, there may be discrepancies between sources for certain information.
2. Wells were professionally surveyed on August 26, 2019.
3. Stick-up height based on difference between surveyed values for Top of Casing Elevation and Ground Surface Elevation.

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Table H.1-3 - Summary of Hydraulic Conductivity Results from Slug Test Data
Watts Bar Fossil Plant
May-October 2019

Monitoring Well ID	Saturated Thickness	Number of Tests		Average Hydraulic Conductivity	Average Hydraulic Conductivity
		Falling Head	Rising Head		
	ft			ft/day	cm/sec
WBF-101	14.67	3	3	0.5411	1.91E-04
WBF-103	5.59	3	3	20.59	7.26E-03
WBF-104	15.32	3	3	0.6400	2.26E-04
WBF-105	22.34	3	3	1.373	4.85E-04
WBF-106	22.16	3	3	0.7648	2.70E-04
Geometric Mean of Hydrualic Conductivity Unconsolidated Materials(cm/sec)					**5.28E-04**

Notes:

cm/sec	centimeters per second
ft	feet
ID	identification

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Table H.1-4 – Groundwater Level Measurements, Groundwater Sampling Event #6 (July 6, 2020)
Watts Bar Fossil Plant

UNID	Well / Piezometer ID	Date Measured	Depth to Groundwater	Top of Casing Elevation	Groundwater Elevation	Piezometer Ground Surface Elevation	Piezometer Sensor Elevation	Piezometer Sensor Depth	Screened Interval	Screened / Piezometer Sensor Formation
			ft btoc	ft msl	ft msl	ft msl	ft msl	ft bgs	ft btoc	
Monitoring Wells										
WBF-00-GW-43-001	MW-1	6-Jul-20	7.95	711.92	703.97	n/a	n/a	n/a	23.3 - 33.3	Alluvial silts and clays
WBF-00-GW-43-002	MW-2	6-Jul-20	20.20	704.29	684.09	n/a	n/a	n/a	22.7 - 32.4	Alluvial sand
WBF-00-GW-43-003	MW-3	6-Jul-20	12.72	696.22	683.50	n/a	n/a	n/a	21.6 - 31.6	Alluvial sand
WBF-00-GW-43-004	WBF-100	6-Jul-20	42.25	741.49	699.24	n/a	n/a	n/a	47.7 - 57.8	Alluvial sand / alluvial silts and clays
WBF-00-GW-43-005	WBF-101	6-Jul-20	15.30	703.15	687.85	n/a	n/a	n/a	27.3 - 37.1	Alluvial clay and silts / alluvial sand
WBF-00-GW-43-006	WBF-102	6-Jul-20	21.55	723.98	702.43	n/a	n/a	n/a	19.4 - 24.2	Alluvial sand with clay
WBF-00-GW-43-007	WBF-103	6-Jul-20	15.25	725.09	709.84	n/a	n/a	n/a	17.0 - 21.8	Alluvial sand with clay / alluvial sand
WBF-00-GW-43-008	WBF-104	6-Jul-20	13.91	697.45	683.54	n/a	n/a	n/a	21.5 - 31.3	Alluvial clay and silts / alluvial sand
WBF-00-GW-43-009	WBF-105	6-Jul-20	12.70	704.50	691.80	n/a	n/a	n/a	32.2 - 37.0	Alluvial silty sand
WBF-00-GW-43-010	WBF-106	6-Jul-20	13.79	706.34	692.55	n/a	n/a	n/a	27.8 - 37.6	Alluvial clay / alluvial silty sand and alluvial sand
Piezometers										
n/a	WBF-B02C	6-Jul-20	11.3	n/a	707.8	719.1	680.5	38.6	n/a	Alluvial sandy silt
n/a	WBF-B03B	6-Jul-20	3.1	n/a	696.8	699.9	665.9	34.0	n/a	Alluvial sand with silt and gravel
n/a	WBF-B04C	6-Jul-20	12.8	n/a	700.6	713.4	668.4	45.0	n/a	Alluvial silty sand / alluvial sandy gravel
n/a	WBF-B05C	6-Jul-20	11.7	n/a	705.5	717.2	668.2	49.0	n/a	Alluvial silty sand
n/a	WBF-B12B	6-Jul-20	4.9	n/a	694.5	699.4	674.4	25.0	n/a	Alluvial sandy silt
n/a	WBF-B13B	6-Jul-20	9.2	n/a	690.4	699.6	674.6	25.0	n/a	Alluvial sandy silt
n/a	WBF-B14B	6-Jul-20	12.7	n/a	688.2	700.9	676.1	24.8	n/a	Alluvial silty sand
n/a	WBF-B15B	6-Jul-20	3.8	n/a	710.9	714.7	692.7	22.0	n/a	Alluvial clayey gravel
n/a	WBF-B16B	6-Jul-20	3.1	n/a	710.5	713.6	692.6	21.0	n/a	Shale
Surface Water Gauge										
Tennessee River	n/a	6-Jul-20	n/a	n/a	683.13	n/a	n/a	n/a	n/a	n/a

Notes:

bgs	below ground surface
btoc	below top of casing
ft	feet
ID	identification
msl	mean sea level
n/a	not applicable
UNID	Unique Numerical Identification

1. Top of casing elevations, screened intervals, and screened formations were obtained from the TVA Well Inventory Log provided by TVA.
2. Tennessee River data point is the reading closest to noon recorded by the automated staff gauge provided by TVA.
3. Ground surface elevations, groundwater elevations, and piezometer data were obtained from geotechnical instrumentation database. Piezometer sensor formations were obtained from boring logs. Data from vibrating wire piezometers were averaged for the measurement date.
4. Depth to groundwater in piezometers and groundwater elevations at all locations are calculated values. Accuracy of piezometer data is to 0.1 ft.

Table H.1-5 - Tennessee River and Groundwater Elevation Comparison (August 2019-July 2020)
Watts Bar Fossil Plant

	Groundwater Elevation by Date (ft amsl)					
Well ID	**8/26/2019**	**10/28/2019**	**1/7/2020**	**3/2/2020**	**4/27/2020**	**7/6/2020**
MW-1	703.34	702.89	705.61	706.36	706.10	703.97
MW-2	684.25	NM	683.55	686.38	686.14	684.09
MW-3	683.27	681.54	683.33	685.49	685.41	683.50
WBF-100	698.74	697.96	699.61	700.60	700.53	699.24
WBF-101	687.45	685.80	688.15	690.01	689.67	687.85
WBF-102	701.61	700.73	702.96	704.23	704.21	702.43
WBF-103	710.13	710.26	711.35	710.90	710.59	709.84
WBF-104	683.34	681.80	683.70	685.57	685.56	683.54
WBF-105	690.94	689.37	691.56	693.02	692.99	691.80
WBF-106	692.10	691.33	693.26	693.67	693.70	692.55
WBF-B02C	707.2	705.8	708.5	709.8	709.4	707.8
WBF-B03B	NM	695.2	697.2	698.3	697.9	696.8
WBF-B04C	700.0	698.7	700.9	702.1	701.9	700.6
WBF-B05C	704.8	703.5	706.1	707.4	707.1	705.5
Tennessee River	683.79	681.88	685.15	684.44	683.98	683.13

Notes:

ft amsl	feet above mean sea level
ID	identification
NM	not measured

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Table H.1-6 - Rate and Direction of Groundwater Flow Summary
Watts Bar Fossil Plant

Slag Disposal Area

Sampling Event	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
Groundwater Elevation Measurement Date	26-Aug-19	28-Oct-19	6-7 -Jan-20	2-Mar-20	27-28/Apr-20	6-Jul-20
Horizontal Gradient (ft/ft)	0.0171	0.0183	0.0177	0.0161	0.0159	0.0166
Hydraulic Conductivity (cm/sec)	5.28E-04	5.28E-04	5.28E-04	5.28E-04	5.28E-04	5.28E-04
Effective Porosity	25%	25%	25%	25%	25%	25%
Flow Direction	E-SE	E-SE	E-SE	E-SE	E-SE	E-SE
Flow Rate (ft/yr)	37	40	39	35	35	36

Ash Pond

Sampling Event	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
Groundwater Elevation Measurement Date	26-Aug-19	28-Oct-19	6-7 -Jan-20	2-Mar-20	27-28- Apr-20	6-Jul-20
Horizontal Gradient (ft/ft)	0.0209	*	0.0228	0.0213	0.0217	0.0219
Hydraulic Conductivity (cm/sec)	5.28E-04	5.28E-04	5.28E-04	5.28E-04	5.28E-04	5.28E-04
Effective Porosity	25%	25%	25%	25%	25%	25%
Flow Direction	E-SE	E-SE	E-SE	E-SE	E-SE	E-SE
Flow Rate (ft/yr)	46	--	50	47	47	48

Notes:

cm/sec - centimeter per second
ft/ft - feet per foot
ft/yr - feet per year
% - percent
E-SE - East-Southeast
* Well MW-2 was not gauged in Event 2.

Table H.1-7 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		MW-1										
Sample Date		20-Oct-14	13-Jan-15	13-Jan-15	21-Apr-15	22-Jul-15	6-Oct-15	6-Oct-15	25-Jan-16	13-Apr-16	6-Jul-16	6-Jul-16
Sample ID		WBF-MW-1-1014	WBF-MW-1-0115	WBF-MW-1-0115-DUP	WBF-MW-1-0415	WBF-WM-1-0715	WBF-WM-1-1015	WBF-MW-1-1015-DUP	WBF-MW-1-0116	WBF-MW-1-0416	WBF-MW-1-0716	WBF-MW-1-0716-DUP
Parent Sample ID				WBF-MW-1-0115				WBF-MW-1-1015				WBF-MW-1-0716
Sample Depth		28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample
Program	Units	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance
Total Metals												
Aluminum	ug/L	-	-	-	-	-	-	-	-	-	-	-
Antimony	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Arsenic	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Barium	ug/L	47.7	47.4	46.3	44.7	44	42.6	41.8	48.8	53	43.1	43.4
Beryllium	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Boron	ug/L	-	-	-	-	-	-	-	-	-	-	-
Cadmium	ug/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Calcium	ug/L	-	-	-	-	-	-	-	-	-	-	-
Chromium	ug/L	<5	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Cobalt	ug/L	10.7	14.1	13.4	15.5	9.8	10.5	10.4	10	11.2	8.52	8.34
Copper	ug/L	<10	<2	<2	<2	<2	69.1	<2	<2	<2	<2	<2
Iron	ug/L	-	-	-	-	-	-	-	-	-	-	-
Lead	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Lithium	ug/L	-	-	-	-	-	-	-	-	-	-	-
Magnesium	ug/L	-	-	-	-	-	-	-	-	-	-	-
Manganese	ug/L	-	-	-	-	-	-	-	-	-	-	-
Mercury	ug/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Molybdenum	ug/L	-	-	-	-	-	-	-	-	-	-	-
Nickel	ug/L	<10	10.5	10	11.6	6.57	7.57	8.56	8.53	7.38	5.45	5.36
Potassium	ug/L	-	-	-	-	-	-	-	-	-	-	-
Selenium	ug/L	<10	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Silicon	ug/L	-	-	-	-	-	-	-	-	-	-	-
Silver	ug/L	<5	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Sodium	ug/L	-	-	-	-	-	-	-	-	-	-	-
Thallium	ug/L	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Vanadium	ug/L	<2	<2	<2	2.17	3.62	2.93	2.97	5.71	<4	<2	2.08
Zinc	ug/L	<50	<25	<25	<25	<25	75.8	<25	<25	<25	<25	<25
Radiological Parameters												
Radium-226	pCi/L	-	-	-	-	-	-	-	-	-	-	-
Radium-228	pCi/L	-	-	-	-	-	-	-	-	-	-	-
Radium-226+228	pCi/L	-	-	-	-	-	-	-	-	-	-	-
Anions												
Chloride	mg/L	-	-	-	-	-	-	-	-	-	-	-
Fluoride	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
Sulfate	mg/L	-	-	-	-	-	-	-	-	-	-	-
General Chemistry												
Alkalinity, Bicarbonate	mg/L	-	-	-	-	-	-	-	-	-	-	-
Alkalinity, Carbonate	mg/L	-	-	-	-	-	-	-	-	-	-	-
pH (lab)	SU	-	-	-	-	-	-	-	-	-	6.27	6.25
Total Dissolved Solids	mg/L	-	-	-	-	-	-	-	-	-	-	-

See notes on last page.

Table H.1-7 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		MW-1									
Sample Date		4-Oct-16	4-Oct-16	18-Jan-17	4-Apr-17	18-Jul-17	18-Jul-17	16-Oct-17	9-Jan-18	17-Apr-18	17-Apr-18
Sample ID		WBF-MW-1-1016	WBF-MW-1-1016-DUP	WBF-MW-1	WBF-MW-1-040417	WBF-MW-1	WBF-Mw-1	WBF-MW-1	WBF-MW-1-010918	WBF-MW-1	WBF-MW-1
Parent Sample ID			WBF-MW-1-1016				WBF-MW-1-0717				WBF-MW-1-0418
Sample Depth		28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft
Sample Type		Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample
Program	Units	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance
Total Metals											
Aluminum	ug/L	-	-	-	-	-	-	-	-	-	-
Antimony	ug/L	<2	<2	-	<2	-	-	<2	-	<2	<2
Arsenic	ug/L	<2	<2	-	<1	-	-	<1	-	<1	<1
Barium	ug/L	46.7	43.9	-	37.7	-	-	37.8	-	38.9	38.6
Beryllium	ug/L	<2	<2	-	<1	-	-	<1	-	<1	<1
Boron	ug/L	949	940	989	1,320	818	817	923	842	901	895
Cadmium	ug/L	<1	<1	-	<1	-	-	<1	-	<1	<1
Calcium	ug/L	72,300	73,800	69,800	61,700	70,400	72,200	68,500	79,400	57,900	57,900
Chromium	ug/L	<2	<2	-	<2	-	-	<2	-	2.12	<2
Cobalt	ug/L	7.44	7.77	-	12.3	-	-	9.39	-	11.6	11.6
Copper	ug/L	<2	<2	-	<2	-	-	<2	-	<2	<2
Iron	ug/L	-	-	-	-	-	-	-	-	-	-
Lead	ug/L	<2	<2	-	<1	-	-	<1	-	<1	<1
Lithium	ug/L	11.2 J	10.6 J	12.1	7.32	9.33	9.22	10	12.7	7.26	7.17
Magnesium	ug/L	-	-	-	-	-	-	-	-	-	-
Manganese	ug/L	-	-	-	-	-	-	-	-	-	-
Mercury	ug/L	<0.2	<0.2	-	<0.2	-	-	<0.2	-	<0.2	<0.2
Molybdenum	ug/L	<2	<2	<5	<5	<5	<5	<5	<5	<5	<5
Nickel	ug/L	6.02	5.5	-	7.73	-	-	5.78	-	8.7	8.22
Potassium	ug/L	-	-	-	-	-	-	-	-	-	-
Selenium	ug/L	<2	<2	-	<5	-	-	<5	-	<5	<5
Silicon	ug/L	-	-	-	-	-	-	-	-	-	-
Silver	ug/L	<2	<2	-	<1	-	-	<1	-	<1	<1
Sodium	ug/L	-	-	-	-	-	-	-	-	-	-
Thallium	ug/L	<2	<2	-	<1	-	-	<1	-	<1	<1
Vanadium	ug/L	<2	<2	-	<1	-	-	<1	-	2.1	2.09
Zinc	ug/L	<25	<25	-	10.8	-	-	<5	-	<5	<5
Radiological Parameters											
Radium-226	pCi/L	0.0270 +/-(0.0730)U*	0.0711 +/-(0.0755)U*	0.110 +/-(0.219)U	0.00902 +/-(0.0541)U	0.0204 +/-(0.0543)U	0.0403 +/-(0.0411)U	0.0158 +/-(0.0455)U	0.114 +/-(0.0657)	0.0800 +/-(0.0579)	0.0408 +/-(0.0511)U
Radium-228	pCi/L	0.194 +/-(0.300)U	0.445 +/-(0.347)U	-0.173 +/-(0.340)U	0.315 +/-(0.252)U	0.372 +/-(0.274)U	0.246 +/-(0.225)U	0.386 +/-(0.283)U	0.535 +/-(0.241)	0.314 +/-(0.208)U	0.172 +/-(0.174)U
Radium-226+228	pCi/L	-	-	-	-	-	-	-	-	-	-
Anions											
Chloride	mg/L	6.79	6.80	8.52	7.62	7.66	9.14	7.35	7.19	7.62	7.51
Fluoride	mg/L	<0.100	<0.100	-	<0.100	-	-	<0.100	-	<0.100	<0.100
Sulfate	mg/L	95.3	72.5	91.8	85.0	84.7	82.4	80.3	102	93.4	91.2
General Chemistry											
Alkalinity, Bicarbonate	mg/L	-	-	-	-	-	-	-	-	-	-
Alkalinity, Carbonate	mg/L	-	-	-	-	-	-	-	-	-	-
pH (lab)	SU	6.3	6.3	-	6.5	-	-	6.2	-	7.2	6.1
Total Dissolved Solids	mg/L	317	304	300	234	294	308	288	318	272	275

See notes on last page.

Table H.1-7 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		MW-1								
Sample Date		17-Jul-18	16-Oct-18	2-Apr-19	2-Apr-19	23-Oct-19	29-Apr-20	29-Apr-20	5-Oct-20	26-Apr-21
Sample ID		WBF-MW-1-GW-071718	WBF-MW-1-GW-101618	WBF-MW-1-GW-040219	WBF-MW-1-DUP-040219	WBF-GW-MW1-102319	WBF-GW-MW1-042920	WBF-AW-MW1-042920	WBF-GW-MW1-100520	WBF-GW-MW1-04262021
Parent Sample ID					WBF-MW-1-GW-040219			WBF-GW-MW1-042920		
Sample Depth		28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance
Total Metals										
Aluminum	ug/L	-	-	-	-	-	-	-	-	-
Antimony	ug/L	-	<2	<0.33	0.346 J	<0.378	<0.378	<0.378	<0.077	<0.077
Arsenic	ug/L	-	<1	0.487 J	0.449 J	<0.323	<0.313	0.691 J	0.19 J	0.20 J
Barium	ug/L	-	40.2	43.7	44.7	45.6	38.6	36.8	42.6 J	42.9
Beryllium	ug/L	-	<1	<0.33	<0.33	<0.182	<0.182	0.343 J	0.066 U*	0.076 J
Boron	ug/L	739	777	812	833	864	834	860	803	781
Cadmium	ug/L	-	<1	<0.33	<0.33	<0.125	<0.217	0.290 J	0.065 J	0.061 J
Calcium	ug/L	74,300	65,100	72,100	74,100	75,900	56,500	54,600	67,600	79,100
Chromium	ug/L	-	<2	1.78 U*	1.49 U*	<1.53	<1.53	<1.53	0.29 J	0.26 U*
Cobalt	ug/L	-	8.83	9.08	9.32	6.27	13.0	13.1	8.4	8.9
Copper	ug/L	-	<2	<0.33	0.4 J	0.843 U*	<0.627	<0.627	<0.43	<0.43
Iron	ug/L	-	-	-	-	-	-	-	-	-
Lead	ug/L	-	<1	<0.33	<0.33	<0.128	<0.128	0.590 U*	0.060 U*	<0.043
Lithium	ug/L	11.3	12.5	11.2	11.1	12.1	6.85	7.86	10	10.1
Magnesium	ug/L	-	-	-	-	-	-	-	-	-
Manganese	ug/L	-	-	-	-	-	-	-	-	-
Mercury	ug/L	-	<0.2	<0.101	<0.101	<0.101	<0.130	<0.130	<0.080	<0.070
Molybdenum	ug/L	<0.33	<5	<0.33	<0.33	<0.610	<0.610	<0.610	<0.081	<0.081
Nickel	ug/L	-	6.78	6.5	6.79	5.40	7.98	8.59	6.2	6.4
Potassium	ug/L	-	-	-	-	-	-	-	-	-
Selenium	ug/L	-	<5	<0.33	<0.33	<1.51	<1.51	<1.51	<0.14	<0.14
Silicon	ug/L	-	-	-	-	-	-	-	-	-
Silver	ug/L	-	<1	<0.33	<0.33	<0.177	<0.177	<0.177	<0.077	<0.077
Sodium	ug/L	-	-	-	-	-	-	-	-	-
Thallium	ug/L	-	<1	<0.5	<0.5	<0.148	<0.148	0.673 U*	<0.047	<0.047
Vanadium	ug/L	-	1.1 U*	1.44 U*	1.3 U*	<0.991	<0.991	<0.991	<0.27	<0.27
Zinc	ug/L	-	6.54 U*	<8.3	<8.3	<3.22	8.58	5.00	7.0	3.8 J
Radiological Parameters										
Radium-226	pCi/L	0.305 +/-(0.0968)U*	0.281 +/-(0.0966)U*	0.0616 +/-(0.0615)U	0.0468 +/-(0.0551)U	0.166 +/-(0.426)U	0.748 +/-(0.616)U	-0.00613 +/-(0.292)U	-0.00749 +/-(0.322)U	0.375 +/-(0.567)U
Radium-228	pCi/L	0.184 +/-(0.198)U	0.165 +/-(0.205)U	0.141 +/-(0.222)U	0.232 +/-(0.232)U	0.260 +/-(0.332)U	-0.0707 +/-(0.223)U	0.303 +/-(0.347)U	0.0202 +/-(0.244)U	0.508 +/-(0.516)U
Radium-226+228	pCi/L	-	-	-	-	0.427 +/-(0.540)U	0.748 +/-(0.656)U	0.303 +/-(0.454)U	0.0202 +/-(0.404)U	0.883 +/-(0.767)U
Anions										
Chloride	mg/L	6.74	6.87	7.00	6.68	6.60	7.36	6.87	6.6	7.8
Fluoride	mg/L	-	<0.100	0.0422 J	<0.0263	0.0336 J	0.0373 J	0.0441 J	0.025 U*	0.023 J
Sulfate	mg/L	82.4	81.7	89.2	83.5	79.9	76.9	72.4	78.9	84.9
General Chemistry										
Alkalinity, Bicarbonate	mg/L	-	-	-	-	-	-	-	-	-
Alkalinity, Carbonate	mg/L	-	-	-	-	-	-	-	-	-
pH (lab)	SU	-	6.4 J	6.3 J	6.3 J	6.7 J	6.6 J	6.7 J	6.0 J	6.4 J
Total Dissolved Solids	mg/L	306	432	285 J	280 J	287	241	232	280	293

See notes on last page.

Table H.1-7 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		MW-1				MW-2					
Sample Date		6-Oct-21	6-Oct-21	19-Apr-22	18-Oct-22	20-Oct-14	13-Jan-15	21-Apr-15	21-Apr-15	22-Jul-15	6-Oct-15
Sample ID		WBF-GW-MW1-10062021	WBF-GW-FD-10062021	WBF-GW-MW-1-04192022	WBF-GW-MW-1-10182022	WBF-MW-2-1014	WBF-MW-2-0115	WBF-MW-2-0415	WBF-MW-2-0415-DUP	WBF-MW-2-0715	WBF-MW-2-1015
Parent Sample ID			WBF-GW-MW1-10062021						WBF-MW-2-0415		
Sample Depth		28.5 ft	28.5 ft	28.5 ft	28.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft
Sample Type		Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	State Compliance	State Compliance	State Compliance		State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance
Total Metals											
Aluminum	ug/L	-	-	-	-	-	-	-	-	-	-
Antimony	ug/L	<0.071	<0.071	<0.071	<0.087	<2	<2	<2	<2	<2	<2
Arsenic	ug/L	0.10 J	0.12 J	0.24 J	0.23 J	<2	<2	<2	<2	<2	<2
Barium	ug/L	44.2	49.6	38.2	41.2	78.2	74.4	75.3	76	54.1	56.3
Beryllium	ug/L	0.054 J	0.034 J	0.11 U*	0.16 U*	<2	<2	<2	<2	<2	<2
Boron	ug/L	883	861	765	679	-	-	-	-	-	-
Cadmium	ug/L	0.071 J	0.082	0.084 U*	0.13 U*	<1	<1	<1	<1	<1	<1
Calcium	ug/L	74,000	83,000	67,200	69,100	-	-	-	-	-	-
Chromium	ug/L	0.30 U*	0.39 U*	0.34 U*	0.69 U*	<5	<2	<2	<2	<2	2.97
Cobalt	ug/L	9.8	11.0	10.4	8.5	<2	<2	<2	<2	<2	<2
Copper	ug/L	<0.50	<0.50	<0.50	<0.42	<10	<2	<2	<2	<2	<2
Iron	ug/L	-	-	-	-	-	-	-	-	-	-
Lead	ug/L	0.045 J	0.038 J	0.037 U*	0.10 U*	<2	<2	<2	<2	<2	<2
Lithium	ug/L	9.6	11.7	8.4	10.7	-	-	-	-	-	-
Magnesium	ug/L	-	-	-	-	-	-	-	-	-	-
Manganese	ug/L	-	-	-	-	-	-	-	-	-	-
Mercury	ug/L	<0.070	<0.070	<0.070	<0.095	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Molybdenum	ug/L	<0.094	<0.094	<0.094	<0.075	-	-	-	-	-	-
Nickel	ug/L	6.9	7.7	7.1	6.4	<10	<2	<2	<2	<2	2.15
Potassium	ug/L	-	-	-	-	-	-	-	-	-	-
Selenium	ug/L	<0.067	<0.067	<0.067	<0.074	<10	<2	<2	<2	<2	<2
Silicon	ug/L	-	-	-	-	-	-	-	-	-	-
Silver	ug/L	<0.16	<0.16	<0.16	<0.13	<5	<2	<2	<2	<2	<2
Sodium	ug/L	-	-	-	-	-	-	-	-	-	-
Thallium	ug/L	<0.041	<0.041	<0.041	0.082 U*	<2	<2	<2	<2	<2	<2
Vanadium	ug/L	<0.16	<0.16	<0.16	<0.20	2.04	<2	2.24	2.47	3.44	5.66
Zinc	ug/L	5.0	4.9 J	4.2 J	4.2 J	<50	<25	<25	<25	<25	<25
Radiological Parameters											
Radium-226	pCi/L	-0.0572 +/-(0.188)U	0.0669 +/-(0.294)U	0.456 +/-(0.543)U	0.199 +/-(0.282)U	-	-	-	-	-	-
Radium-228	pCi/L	0.539 +/-(0.414)U	0.549 +/-(0.381)	1.42 +/-(0.671)	0.273 +/-(0.409)U	-	-	-	-	-	-
Radium-226+228	pCi/L	0.539 +/-(0.454)U	0.616 +/-(0.481)J	1.88 +/-(0.863)J	0.472 +/-(0.497)U	-	-	-	-	-	-
Anions											
Chloride	mg/L	7.3	7.4	8.1	8.0	-	-	-	-	-	-
Fluoride	mg/L	0.039 J	0.034 J	0.036 J	0.026 J	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
Sulfate	mg/L	79.1	79.3	87.6	78.9	-	-	-	-	-	-
General Chemistry											
Alkalinity, Bicarbonate	mg/L	-	-	-	-	-	-	-	-	-	-
Alkalinity, Carbonate	mg/L	-	-	-	-	-	-	-	-	-	-
pH (lab)	SU	6.6 J	6.4 J	6.5 J	6.6 J	-	-	-	-	-	-
Total Dissolved Solids	mg/L	282	284	274	277	-	-	-	-	-	-

See notes on last page.

Stantec

Table H.1-7 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		MW-2									
Sample Date		25-Jan-16	25-Jan-16	13-Apr-16	6-Jul-16	4-Oct-16	18-Jan-17	4-Apr-17	17-Jul-17	16-Oct-17	16-Oct-17
Sample ID		WBF-MW-2-0116	WBF-MW-2-0116-DUP	WBF-MW-2-0416	WBF-MW-2-0716	WBF-MW-2-1016	WBF-MW-2	WBF-MW-2-040417	WBF-MW-2	WBF-MW-2	WBF-MW-2
Parent Sample ID			WBF-MW-2-0116								WBF-MW-2-1017
Sample Depth		27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft
Sample Type		Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample
Program	Units	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance
Total Metals											
Aluminum	ug/L	-	-	-	-	-	-	-	-	-	-
Antimony	ug/L	<2	<2	<2	<2	<2	-	<2	-	<2	<2
Arsenic	ug/L	<2	<2	<2	<2	<2	-	<1	-	<1	<1
Barium	ug/L	51.8	51.8	48.1	48.4	43.6	-	58.4	-	83.1	85.1
Beryllium	ug/L	<2	<2	<2	<2	<2	-	<1	-	<1	<1
Boron	ug/L	-	-	-	-	230	1,610	1,740	174	824	849
Cadmium	ug/L	<1	<1	<1	<1	<1	-	<1	-	<1	<1
Calcium	ug/L	-	-	-	-	33,500	69,700	70,400	35,100	51,400	52,000
Chromium	ug/L	<2	10.7	<2	<2	<2	-	<2	-	<2	<2
Cobalt	ug/L	<2	<2	<2	<2	<2	-	0.65	-	<0.5	<0.5
Copper	ug/L	<2	<2	<2	<2	<2	-	<2	-	<2	<2
Iron	ug/L	-	-	-	-	-	-	-	-	-	-
Lead	ug/L	<2	<2	<2	<2	<2	-	<1	-	<1	<1
Lithium	ug/L	-	-	-	-	<50	<5	<5	<5	<5	<5
Magnesium	ug/L	-	-	-	-	-	-	-	-	-	-
Manganese	ug/L	-	-	-	-	-	-	-	-	-	-
Mercury	ug/L	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.2	-	<0.2	<0.2
Molybdenum	ug/L	-	-	-	-	<2	<5	<5	<5	<5	<5
Nickel	ug/L	<2	<2	<2	<2	<2	-	<1	-	<1	<1
Potassium	ug/L	-	-	-	-	-	-	-	-	-	-
Selenium	ug/L	<2	<2	<2	<2	<2	-	<5	-	<5	<5
Silicon	ug/L	-	-	-	-	-	-	-	-	-	-
Silver	ug/L	<2	<2	<2	<2	<2	-	<1	-	<1	<1
Sodium	ug/L	-	-	-	-	-	-	-	-	-	-
Thallium	ug/L	<2	<2	<2	<2	<2	-	<1	-	<1	<1
Vanadium	ug/L	5.61	5.55	<4	2.23	<2	-	<1	-	<1	1.08
Zinc	ug/L	<25	<25	<25	<25	<25	-	<5	-	<5	<5
Radiological Parameters											
Radium-226	pCi/L	-	-	-	-	0.111 +/-(0.0809)U*	0.111 +/-(0.187)U	0.0170 +/-(0.0585)U	0.0204 +/-(0.0453)U	0.0438 +/-(0.0451)U	0.0365 +/-(0.0483)U
Radium-228	pCi/L	-	-	-	-	0.170 +/-(0.320)U	0.369 +/-(0.318)U	0.588 +/-(0.253)	0.451 +/-(0.268)	-0.253 +/-(0.220)U	0.246 +/-(0.256)U
Radium-226+228	pCi/L	-	-	-	-	-	-	-	-	-	-
Anions											
Chloride	mg/L	-	-	-	-	2.52	5.56	6.22	2.00	7.25	6.81
Fluoride	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100	-	<0.100	-	<0.100	<0.100
Sulfate	mg/L	-	-	-	-	39.6	73.0	54.2	37.8	37.6	36.2
General Chemistry											
Alkalinity, Bicarbonate	mg/L	-	-	-	-	-	-	-	-	-	-
Alkalinity, Carbonate	mg/L	-	-	-	-	-	-	-	-	-	-
pH (lab)	SU	-	-	-	6.55	6.4	-	6.8	-	6.5	6.5
Total Dissolved Solids	mg/L	-	-	-	-	148	297	221	148	191	199

See notes on last page.

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Table H.1-7 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		MW-2										
Sample Date		9-Jan-18	18-Apr-18	17-Jul-18	17-Jul-18	16-Oct-18	3-Apr-19	22-Oct-19	22-Oct-19	29-Apr-20	5-Oct-20	28-Apr-21
Sample ID		WBF-MW-2-010918	WBF-MW-2	WBF-MW-2-GW-071718	WBF-MW-2-GW-DUP-071718	WBF-MW-2-GW-101618	WBF-MW-2-GW-040319	WBF-GW-MW2-102219	WBF-AW-MW2-102219	WBF-GW-MW2-042920	WBF-GW-MW2-100520	WBF-GW-MW2-04282021
Parent Sample ID					WBF-MW-2-GW-071718				WBF-GW-MW2-102219			
Sample Depth		27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance
Total Metals												
Aluminum	ug/L	-	-	-	-	-	-	-	-	-	-	-
Antimony	ug/L	-	<2	-	-	<2	<0.33	<0.378	<0.378	<0.378	<0.077	<0.077
Arsenic	ug/L	-	<1	-	-	<1	0.332 J	<0.323	<0.323	<0.313	<0.14	<0.14
Barium	ug/L	-	40.8	-	-	31.3	37	35.4	35.0	37.4	36.9 J	33.8
Beryllium	ug/L	-	<1	-	-	<1	<0.33	<0.182	<0.182	<0.182	<0.054	<0.054
Boron	ug/L	171	196	124	117	110	125	122	121	131	116	100
Cadmium	ug/L	-	<1	-	-	<1	<0.33	<0.125	<0.125	<0.217	0.065 J	<0.030
Calcium	ug/L	32,700	37,000	31,300	29,300	25,800	30,900	28,400	29,300	32,900	31,000	34,600
Chromium	ug/L	-	<2	-	-	<2	1.85 U*	<1.53	<1.53	<1.53	<0.20	0.37 U*
Cobalt	ug/L	-	<0.5	-	-	<0.5	<0.33	0.0790 J	0.0820 J	<0.134	<0.085	<0.085
Copper	ug/L	-	<2	-	-	<2	<0.33	0.816 J	<0.627	<0.627	<0.43	<0.43
Iron	ug/L	-	-	-	-	-	-	-	-	-	-	-
Lead	ug/L	-	<1	-	-	<1	<0.33	<0.128	<0.128	<0.128	<0.043	<0.043
Lithium	ug/L	<5	<5	<2.56	<2.56	<5	<3.14	<3.39	<3.39	<3.39	0.52	0.56
Magnesium	ug/L	-	-	-	-	-	-	-	-	-	-	-
Manganese	ug/L	-	-	-	-	-	-	-	-	-	-	-
Mercury	ug/L	-	<0.2	-	-	<0.2	<0.101	<0.101	<0.101	<0.130	<0.080	<0.070
Molybdenum	ug/L	<5	<5	<0.33	<0.33	<5	<0.33	<0.610	<0.610	<0.610	<0.081	<0.081
Nickel	ug/L	-	<1	-	-	<1	<0.33	<0.336	<0.336	<0.336	0.31 J	<0.18
Potassium	ug/L	-	-	-	-	-	-	-	-	-	-	-
Selenium	ug/L	-	<5	-	-	<5	<0.33	<1.51	<1.51	<1.51	<0.14	<0.14
Silicon	ug/L	-	-	-	-	-	-	-	-	-	-	-
Silver	ug/L	-	<1	-	-	<1	<0.33	<0.177	<0.177	<0.177	<0.077	0.087 J
Sodium	ug/L	-	-	-	-	-	-	-	-	-	-	-
Thallium	ug/L	-	<1	-	-	<1	<0.5	<0.148	<0.148	<0.148	<0.047	<0.047
Vanadium	ug/L	-	2.6	-	-	1.42 U*	1.19 U*	<0.991	<0.991	<0.991	<0.27	<0.27
Zinc	ug/L	-	<5	-	-	8.45 U*	<8.3	<3.22	<3.22	<3.22	2.3 J	<2.3
Radiological Parameters												
Radium-226	pCi/L	0.111 +/-(0.0680)	0.0751 +/-(0.0565)U	0.245 +/-(0.0861)U*	0.140 +/-(0.0705)U*	0.239 +/-(0.0898)U*	0.0542 +/-(0.0617)U	0.318 +/-(0.486)U	0.278 +/-(0.478)U	0.515 +/-(0.601)U	-0.314 +/-(0.359)U	0.0706 +/-(0.420)U
Radium-228	pCi/L	0.219 +/-(0.269)U	0.138 +/-(0.164)U	0.184 +/-(0.237)U	0.145 +/-(0.202)U	0.0843 +/-(0.212)U	0.261 +/-(0.196)U	0.160 +/-(0.300)U	0.171 +/-(0.276)U	0.198 +/-(0.434)U	0.0150 +/-(0.228)U	0.00787 +/-(0.385)U
Radium-226+228	pCi/L	-	-	-	-	-	-	0.478 +/-(0.572)U	0.449 +/-(0.552)U	0.714 +/-(0.742)U	0.0150 +/-(0.425)U	0.0784 +/-(0.569)U
Anions												
Chloride	mg/L	1.90	2.13	1.69	1.79	9.37	1.43	1.84	1.83	1.66	1.3	2.0
Fluoride	mg/L	-	<0.100	-	-	<0.100	0.0635 J	0.0840 J	0.0821 J	0.0626 J	0.060 U*	0.059
Sulfate	mg/L	39.1	41.0	26.6	28.3	42.1	26.5	24.5	24.3	19.9	23.8	22.2
General Chemistry												
Alkalinity, Bicarbonate	mg/L	-	-	-	-	-	-	-	-	-	-	-
Alkalinity, Carbonate	mg/L	-	-	-	-	-	-	-	-	-	-	-
pH (lab)	SU	-	7.4	-	-	6.7 J	6.6 J	7.0 J	6.9 J	7.2 J	6.2 J	6.8 J
Total Dissolved Solids	mg/L	162	162	124	117	299	86.0	113	110	135	129	130

See notes on last page.

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Table H.1-7 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		MW-2				MW-3					
Sample Date		6-Oct-21	19-Apr-22	19-Apr-22	19-Oct-22	21-Oct-14	21-Oct-14	13-Jan-15	21-Apr-15	22-Jul-15	22-Jul-15
Sample ID		WBF-GW-MW2-10062021	WBF-GW-MW-2-04192022	WBF-GW-FD-04192022	WBF-GW-MW-2-10192022	WBF-MW-3-1014	WBF-MW-3-1014-DUP	WBF-MW-3-0115	WBF-MW-3-0415	WBF-MW-3-0715	WBF-MW-3-0715-DUP
Parent Sample ID				WBF-GW-MW-2-04192022			WBF-MW-3-1014				WBF-MW-3-0715
Sample Depth		27.5 ft	27.5 ft	27.5 ft	27.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample
Program	Units	State Compliance	State Compliance	State Compliance		State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance
Total Metals											
Aluminum	ug/L	-	-	-	-	-	-	-	-	-	-
Antimony	ug/L	<0.071	<0.071	<0.071	<0.087	<2	<2	<2	<2	<2	<2
Arsenic	ug/L	<0.083	<0.083	<0.083	<0.092	<2	<2	<2	<2	<2	<2
Barium	ug/L	37.4	38.3	36.9	36.8	132	133	94.3	101	118	125
Beryllium	ug/L	<0.032	<0.032	<0.032	<0.049	<2	<2	<2	<2	<2	<2
Boron	ug/L	86.6	95.7	91.3	88.6	-	-	-	-	-	-
Cadmium	ug/L	0.040 J	0.018 U*	0.023 U*	0.039 U*	<1	<1	<1	<1	<1	<1
Calcium	ug/L	35,000	37,600	36,400	35,200	-	-	-	-	-	-
Chromium	ug/L	0.44 U*	0.58 U*	0.56 U*	0.58 U*	<5	<5	<2	<2	<2	<2
Cobalt	ug/L	<0.081	<0.081	<0.081	<0.095	<2	<2	<2	<2	<2	<2
Copper	ug/L	<0.50	0.59 J	0.53 J	<0.42	<10	<10	<2	<2	<2	2.7
Iron	ug/L	-	-	-	-	-	-	-	-	-	-
Lead	ug/L	<0.028	0.11 U*	0.11 U*	<0.056	<2	<2	<2	<2	<2	<2
Lithium	ug/L	0.42 J	0.58	0.57	0.59	-	-	-	-	-	-
Magnesium	ug/L	-	-	-	-	-	-	-	-	-	-
Manganese	ug/L	-	-	-	-	-	-	-	-	-	-
Mercury	ug/L	<0.070	<0.070	<0.070	<0.095	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Molybdenum	ug/L	<0.094	<0.094	<0.094	0.23 U*	-	-	-	-	-	-
Nickel	ug/L	0.25 U*	0.21 J	0.24 J	0.27 J	<10	<10	<2	<2	<2	<2
Potassium	ug/L	-	-	-	-	-	-	-	-	-	-
Selenium	ug/L	<0.067	<0.067	<0.067	<0.074	<10	<10	<2	<2	<2	<2
Silicon	ug/L	-	-	-	-	-	-	-	-	-	-
Silver	ug/L	<0.16	<0.16	<0.16	<0.13	<5	<5	<2	<2	<2	<2
Sodium	ug/L	-	-	-	-	-	-	-	-	-	-
Thallium	ug/L	<0.041	<0.041	<0.041	<0.026	<2	<2	<2	<2	<2	<2
Vanadium	ug/L	0.24 J	0.16 J	<0.16	0.21 J	3.82	3.87	<2	2.12	4.29	2.3
Zinc	ug/L	<2.0	<2.0	<2.0	<1.9	<50	<50	<25	<25	<25	<25
Radiological Parameters											
Radium-226	pCi/L	-0.0395 +/-(0.212)U	0.318 +/-(0.565)U	0.112 +/-(0.539)U	0.165 +/-(0.344)U	-	-	-	-	-	-
Radium-228	pCi/L	0.318 +/-(0.542)U	0.351 +/-(0.312)U	0.175 +/-(0.350)U	0.270 +/-(0.353)U	-	-	-	-	-	-
Radium-226+228	pCi/L	0.318 +/-(0.582)U	0.668 +/-(0.645)U	0.287 +/-(0.643)U	0.435 +/-(0.493)U	-	-	-	-	-	-
Anions											
Chloride	mg/L	1.6	1.9	1.8	1.6	-	-	-	-	-	-
Fluoride	mg/L	0.059	0.064	0.064	0.053	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
Sulfate	mg/L	33.8	32.2	30.4	31.1	-	-	-	-	-	-
General Chemistry											
Alkalinity, Bicarbonate	mg/L	-	-	-	-	-	-	-	-	-	-
Alkalinity, Carbonate	mg/L	-	-	-	-	-	-	-	-	-	-
pH (lab)	SU	6.7 J	7.0 J	6.9 J	7.0 J	-	-	-	-	-	-
Total Dissolved Solids	mg/L	146	156	152	129	-	-	-	-	-	-

See notes on last page.

Table H.1-7 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		MW-3										
Sample Date		6-Oct-15	25-Jan-16	13-Apr-16	13-Apr-16	6-Jul-16	4-Oct-16	4-Apr-17	17-Jul-17	16-Oct-17	10-Jan-18	10-Jan-18
Sample ID		WBF-MW-3-1015	WBF-MW-3-0116	WBF-MW-3-0416	WBF-MW-3-0416-DUP	WBF-MW-3-0716	WBF-MW-3-1016	WBF-MW-3-040417	WBF-MW-3	WBF-MW-3	WBF-MW-3-011018	WBF-MW-3-DUP-011018
Parent Sample ID					WBF-MW-3-0416							WBF-MW-3-0118
Sample Depth		26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample
Program	Units	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance
Total Metals												
Aluminum	ug/L	-	-	-	-	-	-	-	-	-	-	-
Antimony	ug/L	<2	<2	<2	<2	<2	<2	<2	-	<2	-	-
Arsenic	ug/L	<2	<2	<2	<2	<2	<2	<1	-	<1	-	-
Barium	ug/L	120	108	113	104	107	118	39.6	-	34.7	-	-
Beryllium	ug/L	<2	<2	<2	<2	<2	<2	<1	-	<1	-	-
Boron	ug/L	-	-	-	-	-	1,190	299	941	147	1,310	1,260
Cadmium	ug/L	<1	<1	<1	<1	<1	<1	<1	-	<1	-	-
Calcium	ug/L	-	-	-	-	-	62,400	37,600	55,600	29,800	70,000	68,300
Chromium	ug/L	<2	<2	<2	<2	<2	<2	<2	-	<2	-	-
Cobalt	ug/L	<2	<2	<2	<2	<2	<2	<0.5	-	<0.5	-	-
Copper	ug/L	<2	<2	<2	<2	<2	<2	<2	-	<2	-	-
Iron	ug/L	-	-	-	-	-	-	-	-	-	-	-
Lead	ug/L	<2	<2	<2	<2	<2	<2	<1	-	<1	-	-
Lithium	ug/L	-	-	-	-	-	<50	<5	<5	<5	<5	<5
Magnesium	ug/L	-	-	-	-	-	-	-	-	-	-	-
Manganese	ug/L	-	-	-	-	-	-	-	-	-	-	-
Mercury	ug/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.2	-	-
Molybdenum	ug/L	-	-	-	-	-	<2	<5	<5	<5	<5	<5
Nickel	ug/L	<2	<2	<2	<2	<2	<2	<1	-	<1	-	-
Potassium	ug/L	-	-	-	-	-	-	-	-	-	-	-
Selenium	ug/L	<2	<2	<2	<2	<2	<2	<5	-	<5	-	-
Silicon	ug/L	-	-	-	-	-	-	-	-	-	-	-
Silver	ug/L	<2	<2	<2	<2	<2	<2	<1	-	<1	-	-
Sodium	ug/L	-	-	-	-	-	-	-	-	-	-	-
Thallium	ug/L	<2	<2	<2	<2	<2	<2	<1	-	<1	-	-
Vanadium	ug/L	3.57	5.7	<4	<4	2.42	<2	<1	-	<1	-	-
Zinc	ug/L	<25	<25	<25	<25	<25	<25	<5	-	<5	-	-
Radiological Parameters												
Radium-226	pCi/L	-	-	-	-	-	0.160 +/-(0.0985)	0.0834 +/-(0.0657)U	0.0116 +/-(0.0427)U	0.0286 +/-(0.0541)U	0.166 +/-(0.0752)	0.0902 +/-(0.0633)
Radium-228	pCi/L	-	-	-	-	-	-0.0170 +/-(0.347)U	-0.0527 +/-(0.198)U	0.0895 +/-(0.231)U	0.109 +/-(0.286)U	0.514 +/-(0.273)	0.639 +/-(0.300)
Radium-226+228	pCi/L	-	-	-	-	-	-	-	-	-	-	-
Anions												
Chloride	mg/L	-	-	-	-	-	5.56	2.77	7.04	1.89	4.68	4.69
Fluoride	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	-	<0.100	-	-
Sulfate	mg/L	-	-	-	-	-	43.4	35.0	46.8	32.6	70.6	70.7
General Chemistry												
Alkalinity, Bicarbonate	mg/L	-	-	-	-	-	-	-	-	-	-	-
Alkalinity, Carbonate	mg/L	-	-	-	-	-	-	-	-	-	-	-
pH (lab)	SU	-	-	-	-	6.52	1.7	6.9	-	6.7	-	-
Total Dissolved Solids	mg/L	-	-	-	-	-	231	141	228	129	271	268

See notes on last page.

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Table H.1-7 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		MW-3								
Sample Date		18-Apr-18	18-Jul-18	17-Oct-18	17-Oct-18	3-Apr-19	23-Oct-19	28-Apr-20	6-Oct-20	28-Apr-21
Sample ID		WBF-MW-3	WBF-MW-3-GW-	WBF-MW-3-GW-101718	WBF-MW-3-DUP-101718	WBF-MW-3-GW-040319	WBF-GW-MW3-102319	WBF-GW-MW3-042820	WBF-GW-MW3-100620	WBF-GW-MW3-04282021
Parent Sample ID					WBF-MW-3-GW-101718					
Sample Depth		26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance
Total Metals										
Aluminum	ug/L	-	-	-	-	-	-	-	-	-
Antimony	ug/L	<2	-	<2	<2	<0.33	<0.378	<0.378	<0.077	<0.077
Arsenic	ug/L	<1	-	<1	<1	0.38 J	<0.323	<0.313	0.14 J	<0.14
Barium	ug/L	97.8	-	81.2	81.5	79.8	86.5	82.4	103 J	71.2
Beryllium	ug/L	<1	-	<1	<1	<0.33	<0.182	<0.182	<0.054	<0.054
Boron	ug/L	2,030	508	597	558	972	1,210	459	642	364
Cadmium	ug/L	<1	-	<1	<1	<0.33	<0.125	<0.217	0.12	<0.030
Calcium	ug/L	79,200	56,900	46,900	47,800	65,800	64,700	53,200	46,300	53,900
Chromium	ug/L	<2	-	2.74	2.47	2 U*	<1.53	<1.53	0.64 U*	1.1 U*
Cobalt	ug/L	0.687	-	<0.5	<0.5	0.333 J	0.264 J	<0.134	0.87	<0.085
Copper	ug/L	<2	-	<2	<2	0.405 J	0.891 U*	<0.627	<0.43	<0.43
Iron	ug/L	-	-	-	-	-	-	-	-	-
Lead	ug/L	<1	-	<1	<1	<0.33	0.138 J	<0.128	0.090 U*	<0.043
Lithium	ug/L	<5	<2.56	<5	<5	<3.14	<3.39	<3.39	0.80	0.55
Magnesium	ug/L	-	-	-	-	-	-	-	-	-
Manganese	ug/L	-	-	-	-	-	-	-	-	-
Mercury	ug/L	<0.2	-	<0.2	<0.2	<0.101	<0.101	<0.130	<0.080	<0.070
Molybdenum	ug/L	<5	<0.33	<5	<5	<0.33	<0.610	<0.610	0.13 J	0.089 J
Nickel	ug/L	1.02	-	<1	<1	0.542 J	0.680 J	<0.336	1.3	<0.18
Potassium	ug/L	-	-	-	-	-	-	-	-	-
Selenium	ug/L	<5	-	<5	<5	<0.33	<1.51	<1.51	<0.14	0.20 J
Silicon	ug/L	-	-	-	-	-	-	-	-	-
Silver	ug/L	<1	-	<1	<1	<0.33	<0.177	<0.177	<0.077	<0.077
Sodium	ug/L	-	-	-	-	-	-	-	-	-
Thallium	ug/L	<1	-	<1	<1	<0.5	<0.148	<0.148	<0.047	<0.047
Vanadium	ug/L	2.61	-	1.57 U*	1.66 U*	1.44 U*	1.02	<0.991	0.45 J	0.45 J
Zinc	ug/L	<5	-	<5	<5	<8.3	<3.22	<3.22	3.8 J	<2.3
Radiological Parameters										
Radium-226	pCi/L	0.0995 +/-(0.0590)	0.181 +/-(0.0778)U*	0.141 +/-(0.0713)U*	0.148 +/-(0.0699)U*	0.00492 +/-(0.0485)U	0.496 +/-(0.598)U	0.104 +/-(0.444)U	-0.347 +/-(0.342)U	0.111 +/-(0.443)U
Radium-228	pCi/L	0.422 +/-(0.218)	-0.0865 +/-(0.184)U	0.312 +/-(0.285)U	0.125 +/-(0.248)U	0.451 +/-(0.283)U*	0.289 +/-(0.402)U	-0.130 +/-(0.380)U	0.155 +/-(0.227)U	0.242 +/-(0.450)U
Radium-226+228	pCi/L	-	-	-	-	-	0.786 +/-(0.721)U	0.104 +/-(0.585)U	0.155 +/-(0.411)U	0.353 +/-(0.632)U
Anions										
Chloride	mg/L	5.99	5.35	3.25 J	11.1 J	3.63	3.90	2.90	3.1	2.5
Fluoride	mg/L	<0.100	-	<0.100	<0.100	0.0809 J	0.0537 J	0.0571 J	0.052	0.054
Sulfate	mg/L	96.9	28.2	118	110	56.6	59.8	29.8	31.3	24.2
General Chemistry										
Alkalinity, Bicarbonate	mg/L	-	-	-	-	-	-	-	-	-
Alkalinity, Carbonate	mg/L	-	-	-	-	-	-	-	-	-
pH (lab)	SU	7.4	-	6.6 J	6.6 J	6.7 J	6.9 J	7.3 J	6.3 J	6.9 J
Total Dissolved Solids	mg/L	308	191	343	348	208	209	190	198	182

See notes on last page.

Table H.1-7 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		MW-3			WBF-100							
Sample Date		5-Oct-21	20-Apr-22	19-Oct-22	18-Jan-17	5-Apr-17	5-Apr-17	18-Jul-17	16-Oct-17	18-Jul-18	17-Oct-18	2-Apr-19
Sample ID		WBF-GW-MW3-10052021	WBF-GW-MW-3-04202022	WBF-GW-MW-3-10192022	WBF-100	WBF-100-040517	WBF-100-DUP-040517	WBF-100-071817	WBF-100-101617	WBF-100-GW-071818	WBF-100-GW-101718	WBF-100-GW-040219
Parent Sample ID							WBF-100-0417					
Sample Depth		26.5 ft	26.5 ft	26.5 ft	53.5 ft	53.5 ft	53.5 ft	53.5 ft	53.5 ft	53.5 ft	53.5 ft	53.5 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	State Compliance	State Compliance		State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance
Total Metals												
Aluminum	ug/L	-	-	-	-	-	-	-	-	-	-	-
Antimony	ug/L	<0.071	<0.071	<0.087	<2	<2	<2	-	<2	<2	<2	<0.33
Arsenic	ug/L	0.099 J	0.12 J	0.11 J	<1	<1	<1	-	<1	<1	<1	0.389 J
Barium	ug/L	79.4	67.5	77.6	108	96.7	97.9	-	68.5	63.4	63.6	63.6
Beryllium	ug/L	<0.032	<0.032	<0.049	<1	<1	<1	-	<1	<1	<1	<0.33
Boron	ug/L	413	309	603	1,670	2,650	2,450	1,560	1,790	1,690	1,650	1,650
Cadmium	ug/L	<0.016	<0.016	0.063 U*	<1	<1	<1	-	<1	<1	<1	<0.33
Calcium	ug/L	53,200	51,600	54,300	146,000	172,000	172,000	150,000	149,000	148,000	152,000	151,000
Chromium	ug/L	1.2 U*	1.4 J	0.86 U*	<2	<2	<2	-	<2	<2	<2	2.09 U*
Cobalt	ug/L	<0.081	<0.081	<0.095	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.33
Copper	ug/L	<0.50	1.7	<0.42	<2	<2	<2	-	<2	<2	<2	0.468 J
Iron	ug/L	-	-	-	-	-	-	-	-	-	-	-
Lead	ug/L	<0.028	<0.028	<0.056	<1	<1	<1	-	<1	<1	<1	0.541 J
Lithium	ug/L	0.55	0.56	0.74	<5	<5	<5	<5	<5	<5	<5	3.65 J
Magnesium	ug/L	-	-	-	-	-	-	-	-	-	-	-
Manganese	ug/L	-	-	-	-	-	-	-	-	-	-	-
Mercury	ug/L	<0.070	<0.070	<0.095	<0.2	<0.2	<0.2	-	<0.2	<0.2	<0.2	<0.101
Molybdenum	ug/L	<0.094	<0.094	0.080 U*	<5	<5	<5	<5	<5	<5	<5	<0.33
Nickel	ug/L	<0.17	0.90	0.44 J	1.03	<1	<1	-	<1	<1	<1	0.715 J
Potassium	ug/L	-	-	-	-	-	-	-	-	-	-	-
Selenium	ug/L	0.099 J	0.23 U*	0.075 J	<5	<5	<5	-	<5	<5	<5	<0.33
Silicon	ug/L	-	-	-	-	-	-	-	-	-	-	-
Silver	ug/L	<0.16	<0.16	<0.13	<1	<1	<1	-	<1	<1	<1	<0.33
Sodium	ug/L	-	-	-	-	-	-	-	-	-	-	-
Thallium	ug/L	<0.041	<0.041	<0.026	<1	<1	<1	-	<1	<1	<1	<0.5
Vanadium	ug/L	0.44 J	0.35 J	0.37 J	<1	<1	<1	-	<1	1.22	1.43 U*	1.5 U*
Zinc	ug/L	<2.0	2.4 J	<1.9	<5	24.1	<5	-	<5	<5	<5	<8.3
Radiological Parameters												
Radium-226	pCi/L	0.249 +/-(0.361)U	-0.0713 +/-(0.367)U	0.346 +/-(0.346)U	0.169 +/-(0.199)U	0.0501 +/-(0.0679)U	0.0349 +/-(0.0620)U	0.141 +/-(0.0913)	0.0397 +/-(0.0538)U	0.202 +/-(0.0819)U*	0.218 +/-(0.0863)U*	0.0475 +/-(0.0622)U
Radium-228	pCi/L	0.235 +/-(0.365)U	0.535 +/-(0.384)U	0.448 +/-(0.537)U	0.311 +/-(0.358)U	0.284 +/-(0.230)U	0.148 +/-(0.234)U	0.378 +/-(0.232)	0.0760 +/-(0.204)U	0.147 +/-(0.197)U	0.0986 +/-(0.214)U	0.234 +/-(0.204)U
Radium-226+228	pCi/L	0.484 +/-(0.513)U	0.535 +/-(0.531)U	0.794 +/-(0.639)U	-	-	-	-	-	-	-	-
Anions												
Chloride	mg/L	2.5	1.9	2.5	6.63	7.56	7.50	6.94	7.54	6.91	7.21	6.71
Fluoride	mg/L	0.054	0.051	0.058	<0.100	<0.100	<0.100	-	<0.100	<0.100	<0.100	0.0459 J
Sulfate	mg/L	22.8	21.8	39.3	194	213	226	210	226	230	220	181
General Chemistry												
Alkalinity, Bicarbonate	mg/L	-	-	-	-	-	-	-	-	-	-	-
Alkalinity, Carbonate	mg/L	-	-	-	-	-	-	-	-	-	-	-
pH (lab)	SU	6.5 J	6.9 J	6.9 J	7.2	6.9	6.8	-	6.8	6.8 J	6.9 J	6.9 J
Total Dissolved Solids	mg/L	163	160	216	578	551	555	556	572	564	725	488

See notes on last page.

Table H.1-7 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		WBF-100									
Sample Date		22-Oct-19	28-Apr-20	6-Oct-20	6-Oct-20	26-Apr-21	26-Apr-21	5-Oct-21	20-Apr-22	18-Oct-22	18-Oct-22
Sample ID		WBF-GW-100-102219	WBF-GW-100-042820	WBF-GW-100-100620	WBF-AW-100-100620	WBF-GW-100-04262021	WBF-AW-100-04262021	WBF-GW-100-10052021	WBF-GW-WBF-100-04202022	WBF-GW-WBF-100-10182022	WBF-GW-FD01-10182022
Parent Sample ID					WBF-GW-100-100620		WBF-GW-100-04262021				WBF-GW-WBF-100-10182022
Sample Depth		53.5 ft	53.5 ft	53.5 ft	53.5 ft	53.5 ft	53.5 ft	53.5 ft	53.5 ft	53.5 ft	53.5 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample
Program	Units	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance		
Total Metals											
Aluminum	ug/L	-	-	-	-	-	-	-	-	-	-
Antimony	ug/L	<0.378	<0.378	<0.077	<0.077	<0.077	<0.077	<0.071	<0.071	0.088 J	0.096 J
Arsenic	ug/L	<0.323	0.475 J	0.15 J	<0.14	<0.14	<0.14	<0.083	0.13 J	0.17 J	0.16 J
Barium	ug/L	65.5	55.1	50.4 J	48.9 J	48.0	50.4	49.5	40.2	42.2	41.6
Beryllium	ug/L	<0.182	<0.182	<0.054	<0.054	<0.054	<0.054	<0.032	<0.032	<0.049	<0.049
Boron	ug/L	1,680	1,670	1,680	1,700	1,630	1,870	1,900	2,030	1,930	1,720
Cadmium	ug/L	<0.125	<0.217	0.030 UJ	0.12 J	<0.030	<0.030	0.029 J	<0.016	0.039 U*	0.031 U*
Calcium	ug/L	153,000	141,000	147,000	138,000	162,000	171,000	178,000	163,000	166,000	153,000
Chromium	ug/L	<1.53	<1.53	0.50 U*	0.46 U*	0.47 U*	0.46 U*	0.84 U*	0.49 U*	0.86 U*	0.73 U*
Cobalt	ug/L	0.109 J	<0.134	<0.085	<0.085	<0.085	<0.085	<0.081	0.12 J	<0.095	<0.095
Copper	ug/L	0.677 J	<0.627	<0.43	<0.43	<0.43	<0.43	<0.50	<0.50	0.65 J	0.50 J
Iron	ug/L	-	-	-	-	-	-	-	-	-	-
Lead	ug/L	<0.128	0.714 U*	0.20 U*	0.20 U*	<0.043	0.048 U*	0.061 J	0.24 J	0.22 U*	0.17 U*
Lithium	ug/L	3.54 J	3.61 J	1.7	1.7	1.6	1.7	1.8	1.7	1.8	1.8
Magnesium	ug/L	-	-	-	-	-	-	-	-	-	-
Manganese	ug/L	-	-	-	-	-	-	-	-	-	-
Mercury	ug/L	<0.101	<0.130	<0.080	<0.080	<0.070	<0.070	<0.070	<0.070	<0.095	<0.095
Molybdenum	ug/L	<0.610	<0.610	<0.081	<0.081	<0.081	<0.081	<0.094	<0.094	0.11 U*	0.38 U*
Nickel	ug/L	0.926 J	0.543 J	0.53	0.50	0.61	0.65	0.75	0.70	1.1 U*	0.97 U*
Potassium	ug/L	-	-	-	-	-	-	-	-	-	-
Selenium	ug/L	<1.51	<1.51	<0.14	<0.14	<0.14	<0.14	0.089 J	0.15 U*	0.13 J	0.13 J
Silicon	ug/L	-	-	-	-	-	-	-	-	-	-
Silver	ug/L	<0.177	<0.177	<0.077	<0.077	<0.077	<0.077	<0.16	<0.16	<0.13	<0.13
Sodium	ug/L	-	-	-	-	-	-	-	-	-	-
Thallium	ug/L	<0.148	0.386 U*	0.059 U*	0.065 U*	<0.047	<0.047	<0.041	<0.041	<0.026	<0.026
Vanadium	ug/L	<0.991	<0.991	<0.27	<0.27	0.32 J	<0.27	<0.16	<0.16	<0.20	<0.20
Zinc	ug/L	<3.22	<3.22	4.4 J	<2.3	<2.3	<2.3	<2.0	<2.0	5.8	5.4
Radiological Parameters											
Radium-226	pCi/L	0.289 +/-(0.447)U	0.478 +/-(0.496)U	0.314 +/-(0.467)U	0.305 +/-(0.487)U	0.202 +/-(0.463)U	-0.324 +/-(0.334)U	-0.0256 +/-(0.237)U	0.312 +/-(0.487)U	-0.133 +/-(0.278)U	0.194 +/-(0.362)U
Radium-228	pCi/L	0.0272 +/-(0.494)U	0.127 +/-(0.247)U	0.365 +/-(0.396)U	-0.180 +/-(0.394)U	0.612 +/-(0.509)U	0.112 +/-(0.439)U	0.261 +/-(0.477)U	0.455 +/-(0.474)U	0.348 +/-(0.491)U	0.415 +/-(0.470)U
Radium-226+228	pCi/L	0.316 +/-(0.667)U	0.606 +/-(0.554)U	0.679 +/-(0.612)U	0.305 +/-(0.626)U	0.815 +/-(0.688)U	0.112 +/-(0.551)U	0.261 +/-(0.533)U	0.766 +/-(0.680)U	0.348 +/-(0.564)U	0.609 +/-(0.594)U
Anions											
Chloride	mg/L	6.39	7.83	8.0	8.1	9.9	9.9	9.3	9.9	9.4	9.2
Fluoride	mg/L	0.0543 J	0.0312 J	0.028 J	0.029 J	0.025 J	0.026 J	0.036 J	0.037 J	0.030 J	0.030 J
Sulfate	mg/L	230	169	190	193	218	229	240	262	266	249
General Chemistry											
Alkalinity, Bicarbonate	mg/L	-	-	-	-	-	-	-	-	-	-
Alkalinity, Carbonate	mg/L	-	-	-	-	-	-	-	-	-	-
pH (lab)	SU	7.1 J	7.5 J	6.7 J	6.8 J	7.1 J	7.2 J	6.8 J	7.3 J	6.8 J	5.9 J
Total Dissolved Solids	mg/L	546	502	565	571	589	585	624	633	610	613

See notes on last page.

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Table H.1-7 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		WBF-101								
Sample Date		27-Aug-19	31-Oct-19	9-Jan-20	3-Mar-20	29-Apr-20	7-Jul-20	23-Mar-21	18-Aug-21	18-Aug-21
Sample ID		WBF-GW-005-20190827	WBF-GW-005-20191031	WBF-GW-005-20200109	WBF-GW-005-20200303	WBF-GW-005-20200429	WBF-GW-005-20200707	WBF-GW-WBF-101-03232021	WBF-GW-WBF-101-08182021	WBF-GW-FD02-08182021
Parent Sample ID										WBF-GW-WBF-101-08182021
Sample Depth		32.2 ft	32.2 ft	32.2 ft	32.2 ft	32.2 ft	32.2 ft	32.2 ft	32.2 ft	32.2 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample
Program	Units	EIP	EIP	EIP	EIP	EIP	EIP	EIP	EIP	EIP
Total Metals										
Aluminum	ug/L	-	-	-	-	-	-	21.2 J	<12.5	<12.5
Antimony	ug/L	<0.378	<0.378	<0.378	<0.378	1.07 U*	<0.378	<0.378	<0.378	<0.378
Arsenic	ug/L	1.31	1.68	2.18 U*	1.94	1.19 U*	0.922 J	1.43	0.746 J	0.958 J
Barium	ug/L	466	416	141	34.1	238	334	29.9	198	200
Beryllium	ug/L	0.213 J	0.317 U*	<0.182	0.338 J	<0.182	<0.182	<0.182	<0.182	<0.182
Boron	ug/L	51.8 U*	<38.6	547	2,030	90.4	42.5 J	1,480	49.0 J	54.3 J
Cadmium	ug/L	<0.125	<0.125	0.695 J	3.76	0.414 U*	<0.217	2.34	<0.217	<0.217
Calcium	ug/L	105,000	105,000	157,000	302,000	126,000	114,000	251,000 J	140,000	140,000
Chromium	ug/L	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53
Cobalt	ug/L	0.782	1.20	73.3	297	6.82 J	0.462 J	248 J	1.27	1.39
Copper	ug/L	<0.627	<0.627	<0.627	<0.627	4.36 U*	<0.627	<0.627	<0.627	<0.627
Iron	ug/L	-	-	-	-	-	-	41,100	40,600	40,400
Lead	ug/L	<0.128	<0.128	<0.128	0.238 J	0.158 U*	<0.128	<0.128	<0.128	<0.128
Lithium	ug/L	<3.39	4.23 J	<3.39	3.80 J	<3.39	<3.39	<3.39	<3.39	<3.39
Magnesium	ug/L	13,600	14,200	22,700	39,900	16,400	15,200	35,500 J	18,700	18,700
Manganese	ug/L	-	-	-	-	-	-	29,100 J	4,010	4,030
Mercury	ug/L	0.160 J	<0.101	<0.101	<0.101	<0.130	<0.130	<0.130	<0.130	<0.130
Molybdenum	ug/L	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610
Nickel	ug/L	<0.336	0.532 U*	10.5	47.3	1.72 U*	<0.336	40.3	<0.336	<0.336
Potassium	ug/L	919	1,040	1,310	2,400	1,150	968	2,660	986	1,020
Selenium	ug/L	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51
Silicon	ug/L	-	-	-	-	-	-	12,900	10,600	10,600
Silver	ug/L	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177
Sodium	ug/L	10,600	11,100	13,800	23,600	11,500	10,300	18,800	10,800	10,900
Thallium	ug/L	0.190 J	0.692 U*	<0.148	<0.148	0.281 U*	<0.148	<0.148	<0.148	<0.148
Vanadium	ug/L	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991
Zinc	ug/L	3.88 U*	<3.22	23.4	145	8.02	9.61	128 J	<3.22	<3.22
Radiological Parameters										
Radium-226	pCi/L	0.624 +/-(0.579)U	0.688 +/-(0.448)	0.627 +/-(0.524)U	0.639 +/-(0.605)U	0.405 +/-(0.583)U	0.0206 +/-(0.395)U	-0.0212 +/-(0.154)U	0.0558 +/-(0.440)U	0.256 +/-(0.426)U
Radium-228	pCi/L	0.535 +/-(0.466)U	0.260 +/-(0.349)U	0.289 +/-(0.304)U	0.0791 +/-(0.323)U	0.287 +/-(0.283)U	0.269 +/-(0.298)U	-0.109 +/-(0.268)U	0.178 +/-(0.266)U	0.0508 +/-(0.409)U
Radium-226+228	pCi/L	1.16 +/-(0.743)U	0.947 +/-(0.568)J	0.916 +/-(0.606)U	0.718 +/-(0.686)U	0.691 +/-(0.648)U	0.290 +/-(0.495)U	0.000 +/-(0.309)U	0.234 +/-(0.514)U	0.307 +/-(0.590)U
Anions										
Chloride	mg/L	4.60	5.15	5.67	6.33	6.31	7.05	6.82	7.34	7.36
Fluoride	mg/L	0.0587 J	0.0602 U*	0.0396 J	0.0557 J	0.0985 U*	0.110 U*	0.0580 J	0.0830 U*	0.0995 U*
Sulfate	mg/L	193	158	355	884	238	240	797	369 J	291 J
General Chemistry										
Alkalinity, Bicarbonate	mg/L	157	147	148	81.6	126	129	59.6	140	134
Alkalinity, Carbonate	mg/L	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
pH (lab)	SU	-	-	-	-	-	-	-	-	-
Total Dissolved Solids	mg/L	425	427	695	1,340	551	509	1,290	614	596

See notes on last page.

Table H.1-7 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		WBF-101			WBF-102					
Sample Date		19-Apr-22	19-Apr-22	18-Oct-22	28-Aug-19	30-Oct-19	8-Jan-20	3-Mar-20	27-Apr-20	7-Jul-20
Sample ID		WBF-GW-WBF-101-04192022	WBF-GW-FD02-04192022	WBF-GW-WBF-101-10182022	WBF-GW-006-20190828	WBF-GW-006-20191030	WBF-GW-006-20200108	WBF-GW-006-20200303	WBF-GW-006-20200427	WBF-GW-006-20200707
Parent Sample ID			WBF-GW-WBF-101-04192022							
Sample Depth		32.2 ft	32.2 ft	32.2 ft	23 ft	23 ft	23 ft	23 ft	23 ft	23 ft
Sample Type		Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	CCR Program	CCR Program		EIP	EIP	EIP	EIP	EIP	EIP
Total Metals										
Aluminum	ug/L	<15.5	<15.5	15.9 J	-	-	-	-	-	-
Antimony	ug/L	<0.506	<0.506	<0.506	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378
Arsenic	ug/L	0.644 J	0.552 J	0.674 J	0.495 J	0.468 J	0.866 U*	0.483 J	0.464 U*	0.393 J
Barium	ug/L	49.8	47.4	135	61.5	60.6	36.7	50.5	52.2	42.9
Beryllium	ug/L	<0.274	<0.274	<0.274	<0.182	<0.182	0.486 U*	<0.182	<0.182	0.261 U*
Boron	ug/L	670	666	76.4 U*	105 U*	90.8	60.2 J	60.5 J	42.0 J	58.6 J
Cadmium	ug/L	0.668 J	0.609 J	<0.217	0.178 J	0.127 J	<0.217	<0.217	<0.217	<0.217
Calcium	ug/L	194,000	193,000	150,000	309,000	212,000	89,300	99,300	131,000	220,000
Chromium	ug/L	<1.53	<1.53	<1.53	<1.53	2.74 U*	<1.53	<1.53	<1.53	<1.53
Cobalt	ug/L	97.1	97.7	1.07	11.1	1.15	<0.134	<0.134	<0.134	<0.134
Copper	ug/L	<1.14	<1.14	<1.14	1.02 J	2.06 U*	1.71 U*	0.670 J	0.804 U*	<0.627
Iron	ug/L	38,700	37,700	44,300	-	-	-	-	-	-
Lead	ug/L	<0.167	<0.167	<0.167	<0.128	<0.128	<0.128	<0.128	<0.128	<0.128
Lithium	ug/L	2.24 J	2.35 J	<0.831	3.46 U*	<3.39	4.23 J	<3.39	5.63 U*	<3.39
Magnesium	ug/L	26,900	26,200	21,200	55,800	31,000	13,100	12,800	18,000	34,100
Manganese	ug/L	12,500	12,500	4,380	-	-	-	-	-	-
Mercury	ug/L	<0.130	<0.130	<0.130	<0.101	0.564	<0.101	<0.101	0.543	1.23
Molybdenum	ug/L	<0.610	<0.610	<0.610	<0.610	0.713 J	4.32 J	2.86 J	1.62 U*	<0.610
Nickel	ug/L	18.1	18.1	<0.517	2.21	1.31 U*	1.27 U*	<0.336	0.362 U*	0.726 U*
Potassium	ug/L	1,800	1,800	1,050	1,580	2,350	3,210	2,720	2,690	1,560
Selenium	ug/L	<0.739	<0.739	<0.739	<1.51	5.48	<1.51	<1.51	2.48 J	2.45 J
Silicon	ug/L	12,400	11,900	11,300	-	-	-	-	-	-
Silver	ug/L	<0.223	<0.223	<0.223	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177
Sodium	ug/L	13,800	13,400	11,200	11,800	58,800	7,430	9,430	12,300	14,100
Thallium	ug/L	<0.472	<0.472	<0.472	<0.148	<0.148	<0.148	0.237 J	0.148 U*	0.263 J
Vanadium	ug/L	<0.776	<0.776	<0.776	1.57	1.68	<0.991	<0.991	<0.991	<0.991
Zinc	ug/L	59.6	60.6	<2.88	6.25 U*	7.24 U*	<3.22	<3.22	<3.22	4.14 J
Radiological Parameters										
Radium-226	pCi/L	-0.0409 +/-(0.351)U	0.283 +/-(0.405)U	0.217 +/-(0.358)U	0.477 +/-(0.594)U	0.553 +/-(0.462)U	-0.225 +/-(0.407)U	0.910 +/-(0.681)U	0.310 +/-(0.517)U	0.475 +/-(0.565)U
Radium-228	pCi/L	0.794 +/-(0.557)U	0.763 +/-(0.461)U*	-0.00685 +/-(0.410)U	0.225 +/-(0.389)U	-0.0587 +/-(0.214)U	0.213 +/-(0.328)U	0.484 +/-(0.425)U	0.290 +/-(0.322)U	0.474 +/-(0.381)U
Radium-226+228	pCi/L	0.794 +/-(0.658)U	1.05 +/-(0.613)U*	0.217 +/-(0.544)U	0.702 +/-(0.710)U	0.553 +/-(0.509)U	0.213 +/-(0.522)U	1.39 +/-(0.802)U	0.600 +/-(0.609)U	0.949 +/-(0.681)U
Anions										
Chloride	mg/L	7.33	7.35	9.96	19.8	18.5	4.53	8.42	12.2	25.8
Fluoride	mg/L	0.128	0.0830 J	0.0638 J	0.0439 J	0.0415 U*	0.0989 J	0.0816 J	0.126 U*	0.0629 U*
Sulfate	mg/L	491	497	343	664	545	90.2 J	141	194	452
General Chemistry										
Alkalinity, Bicarbonate	mg/L	93.2	89.7	133	367	246	226	210	252	301
Alkalinity, Carbonate	mg/L	<5.00	<5.00	<2.60	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
pH (lab)	SU	-	-	-	-	-	-	-	-	-
Total Dissolved Solids	mg/L	891	876	667	1,280	1,140	386	464	562	1,040

See notes on last page.

Table H.1-7 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		WBF-102				WBF-103						
Sample Date		24-Mar-21	24-Mar-21	18-Aug-21	21-Apr-22	27-Aug-19	29-Oct-19	7-Jan-20	3-Mar-20	28-Apr-20	7-Jul-20	23-Mar-21
Sample ID		WBF-GW-WBF-102-03242021	WBF-GW-FD02-03242021	WBF-GW-WBF-102-08182021	WBF-GW-WBF-102-04212022	WBF-GW-007-20190827	WBF-GW-007-20191029	WBF-GW-007-20200107	WBF-GW-007-20200303	WBF-GW-007-20200428	WBF-GW-007-20200707	WBF-GW-WBF-103-03232021
Parent Sample ID			WBF-GW-WBF-102-03242021									
Sample Depth		23 ft	23 ft	23 ft	23 ft	19.5 ft	19.5 ft	19.5 ft	19.5 ft	19.5 ft	19.5 ft	19.5 ft
Sample Type		Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	EIP	EIP	EIP	CCR Program	EIP	EIP	EIP	EIP	EIP	EIP	EIP
Total Metals												
Aluminum	ug/L	<12.5	<12.5	<12.5	<15.5	-	-	-	-	-	-	107
Antimony	ug/L	<0.378	<0.378	<0.378	<0.506	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378
Arsenic	ug/L	<0.313	0.564 J	<0.313	0.369 J	<0.323	0.324 J	0.781 U*	<0.313	<0.313	<0.313	<0.313
Barium	ug/L	24.7	25.7	23.7	39.3	120	155	76.4	83.2	70.5	81.7	65.8
Beryllium	ug/L	<0.182	0.256 J	<0.182	<0.274	<0.182	<0.182	0.235 U*	<0.182	<0.182	<0.182	<0.182
Boron	ug/L	71.2 U*	90.2 U*	88.9	72.7 J	80.2 U*	52.2 J	58.8 J	<38.6	<38.6	41.8 J	82.7 U*
Cadmium	ug/L	<0.217	0.232 J	<0.217	<0.217	<0.125	<0.125	<0.217	<0.217	<0.217	<0.217	<0.217
Calcium	ug/L	98,900 J	103,000 J	119,000	151,000	21,600	36,400	40,200	17,800	20,600	17,600	22,700
Chromium	ug/L	1.95 J	2.56	2.39	1.91 J	<1.53	2.04 U*	<1.53	1.55 J	<1.53	<1.53	<1.53
Cobalt	ug/L	<0.134	0.195 J	<0.134	<0.261	1.03	2.34	4.44	1.12	0.903 U*	0.905	0.607
Copper	ug/L	<0.627	<0.627	<0.627	<1.14	<0.627	1.22 U*	<0.627	2.92	<0.627	<0.627	<0.627
Iron	ug/L	20.3 U*	<19.5	27.5 J	<27.7	-	-	-	-	-	-	202
Lead	ug/L	<0.128	0.207 J	<0.128	0.199 J	<0.128	<0.128	<0.128	6.21	<0.128	<0.128	<0.128
Lithium	ug/L	<3.39	<3.39	<3.39	<0.831	<3.39	<3.39	<3.39	<3.39	4.97 U*	<3.39	<3.39
Magnesium	ug/L	16,000	16,800	16,900	22,800	4,670	7,390	8,290	4,110	4,660	4,030	5,920
Manganese	ug/L	1.44 U*	1.19 U*	3.62 U*	2.43 U*	-	-	-	-	-	-	2,400
Mercury	ug/L	<0.130	<0.130	<0.130	<0.130	<0.101	<0.101	<0.101	<0.101	<0.130	<0.130	<0.130
Molybdenum	ug/L	0.656 J	0.787 J	<0.610	0.648 J	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610
Nickel	ug/L	<0.336	<0.336	0.397 J	<0.517	2.70	3.16	3.40 U*	1.66	1.38 U*	2.33 U*	1.29
Potassium	ug/L	1,260	1,460	1,320	2,320	4,450	6,530	7,500	4,060	4,050	3,520	5,220
Selenium	ug/L	<1.51	1.56 J	2.19 J	1.89 J	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51
Silicon	ug/L	2,340 J	2,690 J	3,860	4,090 J	-	-	-	-	-	-	2,930
Silver	ug/L	<0.177	<0.177	<0.177	<0.223	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177
Sodium	ug/L	6,830	6,500	6,150	13,100	5,830	11,600	10,200	5,370	5,540	6,220	4,150
Thallium	ug/L	0.230 J	0.651 J	<0.148	0.589 J	<0.148	<0.148	0.649 U*	<0.148	<0.148	<0.148	<0.148
Vanadium	ug/L	<0.991	<0.991	<0.991	<0.776	0.999 J	1.22 U*	<0.991	<0.991	<0.991	<0.991	<0.991
Zinc	ug/L	<3.22	<3.22	<3.22	3.07 J	6.70 U*	8.94 U*	4.66 J	9.38	<3.22	6.65	<3.22
Radiological Parameters												
Radium-226	pCi/L	0.0420 +/-(0.223)U	0.0932 +/-(0.256)U	-0.141 +/-(0.332)U	-0.0769 +/-(0.303)U	0.539 +/-(0.601)U	0.543 +/-(0.584)U	0.440 +/-(0.542)U	0.537 +/-(0.554)U	0.561 +/-(0.480)U	-0.0548 +/-(0.389)U	0.0654 +/-(0.236)U
Radium-228	pCi/L	0.657 +/-(0.448)U*	0.230 +/-(0.363)U	0.150 +/-(0.236)U	0.327 +/-(0.303)U	0.208 +/-(0.347)U	0.302 +/-(0.310)U	0.134 +/-(0.352)U	0.215 +/-(0.435)U	-0.00991 +/-(0.351)U	0.430 +/-(0.354)U	0.758 +/-(0.386)U*
Radium-226+228	pCi/L	0.699 +/-(0.501)U*	0.323 +/-(0.445)U	0.150 +/-(0.407)U	0.327 +/-(0.429)U	0.747 +/-(0.694)U	0.845 +/-(0.661)U	0.574 +/-(0.646)U	0.752 +/-(0.704)U	0.561 +/-(0.594)U	0.430 +/-(0.526)U	0.823 +/-(0.452)U*
Anions												
Chloride	mg/L	5.49	5.29	4.15	37.8	5.63	4.51	4.58	5.51	5.26	5.63	5.30
Fluoride	mg/L	0.0515 J	0.0450 J	0.0799 U*	0.0611 J	<0.0263	0.0443 U*	0.0362 J	0.0276 J	0.0450 U*	0.0669 U*	<0.0260
Sulfate	mg/L	110	104	161	179	84.7	71.3	86.6	67.4	61.6	60.8	50.3
General Chemistry												
Alkalinity, Bicarbonate	mg/L	247	226	201	280	60.4	78.2	73.5	36.7	44.4	36.7	37.0
Alkalinity, Carbonate	mg/L	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
pH (lab)	SU	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Solids	mg/L	433	459	460	573	184	196	230	162	183	152	147

See notes on last page.

Table H.1-7 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		WBF-103			WBF-104						
Sample Date		17-Aug-21	21-Apr-22	18-Oct-22	27-Aug-19	29-Oct-19	7-Jan-20	4-Mar-20	28-Apr-20	8-Jul-20	8-Jul-20
Sample ID		WBF-GW-WBF-103-08172021	WBF-GW-WBF-103-04212022	WBF-GW-WBF-103-10182022	WBF-GW-008-20190827	WBF-GW-008-20191029	WBF-GW-008-20200107	WBF-GW-008-20200304	WBF-GW-008-20200428	WBF-GW-008-20200708	WBF-GW-DUP01-20200708
Parent Sample ID											WBF-GW-008-20200708
Sample Depth		19.5 ft	19.5 ft	19.5 ft	26.4 ft	26.4 ft	26.4 ft	26.4 ft	26.4 ft	26.4 ft	26.4 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample
Program	Units	EIP	CCR Program		EIP	EIP	EIP	EIP	EIP	EIP	EIP
Total Metals											
Aluminum	ug/L	25.8 J	<15.5	17.0 J	-	-	-	-	-	-	-
Antimony	ug/L	<0.378	<0.506	<0.506	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378
Arsenic	ug/L	<0.313	0.373 J	<0.282	0.701 J	0.594 J	0.872 U*	0.318 J	0.559 U*	0.685 U*	0.658 U*
Barium	ug/L	73.0	76.1	73.0	21.1	27.3	23.2	43.4	38.3	33.8	34.7
Beryllium	ug/L	<0.182	<0.274	<0.274	0.182 J	<0.182	0.198 U*	0.229 J	0.200 U*	0.309 J	0.332 J
Boron	ug/L	61.2 J	79.5 J	<60.1	4,940	3,750	1,910	3,570	3,420	4,260 J	4,500 J
Cadmium	ug/L	<0.217	<0.217	<0.217	7.60	10.5	6.08	7.28	6.87	8.14	8.32
Calcium	ug/L	14,300	44,200	12,800	581,000	442,000	208,000	450,000	456,000	576,000	587,000
Chromium	ug/L	<1.53	<1.53	<1.53	<1.53	1.70 U*	<1.53	<1.53	<1.53	<1.53	<1.53
Cobalt	ug/L	0.434 J	0.827	0.317 J	437	379	167	256	249	365	373
Copper	ug/L	<0.627	<1.14	<1.14	1.06 J	2.10 U*	<0.627	<0.627	0.878 U*	<0.627	<0.627
Iron	ug/L	27.4 U*	38.5 J	<27.7	-	-	-	-	-	-	-
Lead	ug/L	<0.128	<0.167	<0.167	0.232 J	0.178 J	<0.128	<0.128	0.218 U*	0.214 U*	0.217 U*
Lithium	ug/L	<3.39	<0.831	<0.831	5.98 U*	4.06 J	<3.39	<3.39	7.07 U*	3.59 J	4.10 J
Magnesium	ug/L	3,190	8,640	3,240	69,700	53,900	25,500	52,800	52,800	64,500	65,700
Manganese	ug/L	605	1,720 J	606	-	-	-	-	-	-	-
Mercury	ug/L	<0.130	<0.130	<0.130	<0.101	<0.101	<0.101	<0.101	<0.130	<0.130	<0.130
Molybdenum	ug/L	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610
Nickel	ug/L	1.34	1.46	1.14	65.6	66.9	32.2	51.0	50.2	67.5	69.3
Potassium	ug/L	3,170	5,960	2,920	1,610	1,660	909	1,340	1,390	1,640	1,670
Selenium	ug/L	<1.51	<0.739	0.930 J	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51
Silicon	ug/L	3,590	3,090 J	3,840	-	-	-	-	-	-	-
Silver	ug/L	<0.177	<0.223	<0.223	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177
Sodium	ug/L	4,890	13,900	5,050	29,800	35,700	14,500	23,300	22,200	26,200	26,000
Thallium	ug/L	0.172 J	<0.472	<0.472	<0.148	<0.148	<0.148	<0.148	0.231 U*	0.209 U*	0.250 U*
Vanadium	ug/L	<0.991	<0.776	<0.776	1.02	1.18 U*	<0.991	<0.991	<0.991	<0.991	<0.991
Zinc	ug/L	<3.22	<2.88	<2.88	102	113	48.0	91.1	87.5	125	126
Radiological Parameters											
Radium-226	pCi/L	-0.0371 +/-(0.231)U	0.237 +/-(0.398)U	-0.0695 +/-(0.200)U	0.541 +/-(0.608)U	0.325 +/-(0.383)U	-0.0750 +/-(0.402)U	1.20 +/-(0.727)	0.309 +/-(0.502)U	0.500 +/-(0.523)U	0.370 +/-(0.552)U
Radium-228	pCi/L	-0.0227 +/-(0.227)U	0.321 +/-(0.387)U	0.540 +/-(0.555)U	-0.0176 +/-(0.367)U	0.150 +/-(0.271)U	0.0847 +/-(0.313)U	0.166 +/-(0.354)U	0.449 +/-(0.298)	0.502 +/-(0.415)U	0.903 +/-(0.434)
Radium-226+228	pCi/L	0.000 +/-(0.324)U	0.558 +/-(0.555)U	0.540 +/-(0.590)U	0.541 +/-(0.710)U	0.476 +/-(0.469)U	0.0847 +/-(0.510)U	1.36 +/-(0.808)J	0.758 +/-(0.584)J	1.00 +/-(0.668)U	1.27 +/-(0.702)J
Anions											
Chloride	mg/L	4.72	4.41	6.68	5.03	5.53	2.95	5.54	5.55	7.08	7.06
Fluoride	mg/L	0.0446 U*	0.0324 J	0.0562 J	<0.0658	0.0411 U*	0.0777 J	0.0368 J	0.0622 U*	0.149 U*	0.158 U*
Sulfate	mg/L	32.9	102	34.5	1,970	1,380	726	1,510	1,280	1,750	1,770
General Chemistry											
Alkalinity, Bicarbonate	mg/L	28.8	77.6	26.6	70.3	60.7	41.9	49.4	55.5	55.1	54.4
Alkalinity, Carbonate	mg/L	<5.00	<5.00	<2.60	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
pH (lab)	SU	-	-	-	-	-	-	-	-	-	-
Total Dissolved Solids	mg/L	97.0	223	109	2,720	2,130	1,050	1,720	2,000	2,810	2,720

See notes on last page.

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Table H.1-7 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		WBF-104					WBF-105					
Sample Date		24-Mar-21	19-Aug-21	20-Apr-22	19-Oct-22	19-Oct-22	28-Aug-19	30-Oct-19	8-Jan-20	4-Mar-20	28-Apr-20	7-Jul-20
Sample ID		WBF-GW-WBF-104-03242021	WBF-GW-WBF-104-08192021	WBF-GW-WBF-104-04202022	WBF-GW-WBF-104-10192022	WBF-GW-FD02-10192022	WBF-GW-009-20190828	WBF-GW-009-20191030	WBF-GW-009-20200108	WBF-GW-009-20200304	WBF-GW-009-20200428	WBF-GW-009-20200707
Parent Sample ID						WBF-GW-WBF-104-10192022						
Sample Depth		26.4 ft	26.4 ft	26.4 ft	26.4 ft	26.4 ft	35.1 ft	35.1 ft	35.1 ft	35.1 ft	35.1 ft	35.1 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	EIP	EIP	CCR Program			EIP	EIP	EIP	EIP	EIP	EIP
Total Metals												
Aluminum	ug/L	26.9 U*	45.0	32.6	58.1	58.6	-	-	-	-	-	-
Antimony	ug/L	<0.378	<0.378	<0.506	<0.506	0.510 J	0.563 U*	<0.378	<0.378	<0.378	<0.378	<0.378
Arsenic	ug/L	0.475 J	0.502 U*	0.517 J	<0.282	0.309 J	1.32	1.54	1.70 U*	1.35	1.27 U*	1.39
Barium	ug/L	22.2	22.5	19.8	19.7	19.9	112	101	110	97.4	101	96.1
Beryllium	ug/L	0.225 J	0.240 J	<0.274	<0.274	0.281 J	<0.182	<0.182	0.238 U*	<0.182	<0.182	0.347 U*
Boron	ug/L	3,930	5,150	4,700	5,320	5,150	52.3 U*	56.1 J	<38.6	49.7 J	47.8 J	47.8 J
Cadmium	ug/L	8.60	9.08	9.65	10.9	11.0	<0.125	<0.125	<0.217	<0.217	<0.217	<0.217
Calcium	ug/L	523,000 J	604,000	534,000	496,000	510,000	127,000	135,000	132,000	133,000	140,000	128,000
Chromium	ug/L	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53	2.04 U*	<1.53	<1.53	<1.53	10.9 U*
Cobalt	ug/L	460	541	598	596	608	0.151 J	0.113 J	0.262 U*	<0.134	0.212 U*	<0.134
Copper	ug/L	<0.627	<0.627	<1.14	<1.14	<1.14	0.930 J	1.02 U*	0.736 U*	<0.627	<0.627	<0.627
Iron	ug/L	177	382	268	191	197	-	-	-	-	-	-
Lead	ug/L	<0.128	<0.128	<0.167	<0.167	<0.167	<0.128	<0.128	<0.128	<0.128	<0.128	<0.128
Lithium	ug/L	<3.39	<3.39	3.54 J	3.92 J	3.83 J	5.46 U*	<3.39	<3.39	<3.39	6.41 U*	<3.39
Magnesium	ug/L	66,400	71,800	73,100	69,000	69,200	19,100	19,400	20,600	19,300	19,200	18,100
Manganese	ug/L	68,500	76,300	77,700	81,400	83,100	-	-	-	-	-	-
Mercury	ug/L	<0.130	<0.130	<0.130	<0.130	<0.130	<0.101	<0.101	<0.101	<0.101	<0.130	<0.130
Molybdenum	ug/L	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	1.40 J
Nickel	ug/L	76.3	93.5	98.9	105	106	<0.336	<0.336	0.865 U*	<0.336	<0.336	0.360 U*
Potassium	ug/L	1,620	1,790	1,740	2,010	2,050	894	915	857	832	911	891
Selenium	ug/L	<1.51	<1.51	<0.739	<0.739	<0.739	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51
Silicon	ug/L	17,000 J	19,200	21,700	21,300	21,800	-	-	-	-	-	-
Silver	ug/L	<0.177	<0.177	<0.223	<0.223	<0.223	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177
Sodium	ug/L	26,800	28,000	30,800	27,600	27,900	29,700	30,500	29,400	29,300	29,600	27,500
Thallium	ug/L	0.158 J	<0.148	<0.472	<0.472	<0.472	<0.148	<0.148	<0.148	<0.148	<0.148	0.294 J
Vanadium	ug/L	<0.991	<0.991	<0.776	<0.776	<0.776	<0.991	1.01	<0.991	<0.991	<0.991	1.40
Zinc	ug/L	145	185	174	241	245	4.51 U*	<3.22	<3.22	<3.22	<3.22	4.39 J
Radiological Parameters												
Radium-226	pCi/L	0.182 +/-(0.332)U	0.623 +/-(0.542)U	-0.0650 +/-(0.313)U	0.481 +/-(0.398)U	0.0626 +/-(0.240)U	0.847 +/-(0.698)U	0.310 +/-(0.364)U	0.301 +/-(0.538)U	1.33 +/-(0.785)	0.886 +/-(0.639)	0.522 +/-(0.527)U
Radium-228	pCi/L	0.538 +/-(0.411)U	0.0202 +/-(0.323)U	0.986 +/-(0.589)	0.321 +/-(0.321)U	0.354 +/-(0.386)U	0.0921 +/-(0.352)U	0.507 +/-(0.366)U	0.229 +/-(0.357)U	0.182 +/-(0.247)U	0.350 +/-(0.281)U	0.792 +/-(0.451)
Radium-226+228	pCi/L	0.721 +/-(0.528)U	0.643 +/-(0.631)U	0.986 +/-(0.667)J	0.802 +/-(0.511)U	0.417 +/-(0.454)U	0.939 +/-(0.782)U	0.817 +/-(0.516)U	0.530 +/-(0.645)U	1.51 +/-(0.823)J	1.24 +/-(0.698)J	1.31 +/-(0.694)J
Anions												
Chloride	mg/L	6.89	7.50	11.1	6.93	6.84	4.24	5.21	5.59	5.52	5.68	6.02
Fluoride	mg/L	<0.0650	0.0650 UJ	0.0328 U*	<0.0650	<0.0650	0.0790 J	0.0741 U*	0.0722 J	0.0530 J	0.115 U*	0.132 U*
Sulfate	mg/L	1,560	1,750	1,860	1,720	1,700	341	335	350 J	347	329	349
General Chemistry												
Alkalinity, Bicarbonate	mg/L	48.4	46.8	41.7	46.1	50.1	173	153	136	109	110	115
Alkalinity, Carbonate	mg/L	<5.00	<5.00	<5.00	<2.60	<2.60	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
pH (lab)	SU	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Solids	mg/L	1,350	2,320	2,450	2,380	2,570	654	657	710	640	668	709

See notes on last page.

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Table H.1-7 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		WBF-105				WBF-106					
Sample Date		25-Mar-21	19-Aug-21	20-Apr-22	17-Oct-22	28-Aug-19	28-Aug-19	30-Oct-19	30-Oct-19	8-Jan-20	8-Jan-20
Sample ID		WBF-GW-WBF-105-03252021	WBF-GW-WBF-105-08192021	WBF-GW-WBF-105-04202022	WBF-GW-WBF-105-10172022	WBF-GW-010-20190828	WBF-GW-DUP01-20190828	WBF-GW-010-20191030	WBF-GW-DUP01-20191030	WBF-GW-010-20200108	WBF-GW-DUP01-20200108
Parent Sample ID							WBF-GW-010-20190828		WBF-GW-010-20191030		WBF-GW-010-20200108
Sample Depth		35.1 ft	35.1 ft	35.1 ft	35.1 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Field Duplicate Sample
Program	Units	EIP	EIP	CCR Program		EIP	EIP	EIP	EIP	EIP	EIP
Total Metals											
Aluminum	ug/L	<12.5	<12.5	<15.5	<15.5	-	-	-	-	-	-
Antimony	ug/L	<0.378	<0.378	<0.506	0.584 J	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378
Arsenic	ug/L	1.24	1.32 U*	1.22	1.31	1.70	1.72	0.733 J	0.735 J	1.02 U*	0.848 U*
Barium	ug/L	97.1	99.2	95.0	92.0	51.4	51.0	34.4	33.6	30.2	30.5
Beryllium	ug/L	<0.182	<0.182	<0.274	<0.274	<0.182	<0.182	<0.182	<0.182	0.642 U*	0.566 U*
Boron	ug/L	<38.6	114 U*	<60.1	64.5 J	57.7 U*	43.1 U*	260	261	237	235
Cadmium	ug/L	<0.217	<0.217	<0.217	<0.217	<0.125	<0.125	0.958 J	1.05	0.980 J	0.938 J
Calcium	ug/L	133,000	139,000	136,000	130,000	161,000	163,000	162,000	166,000	163,000	166,000
Chromium	ug/L	<1.53	<1.53	<1.53	<1.53	<1.53	1.61 J	1.76 U*	1.96 U*	<1.53	<1.53
Cobalt	ug/L	<0.134	<0.134	<0.261	<0.261	2.19	2.13	80.7	79.2	78.4	79.5
Copper	ug/L	<0.627	<0.627	<1.14	<1.14	<0.627	0.723 J	1.71 U*	0.894 U*	<0.627	1.98 U*
Iron	ug/L	66,100	64,200	61,700	61,600	-	-	-	-	-	-
Lead	ug/L	<0.128	<0.128	<0.167	<0.167	0.251 J	0.226 J	0.137 J	0.348 J	<0.128	<0.128
Lithium	ug/L	<3.39	<3.39	1.16 J	<0.831	3.81 U*	4.42 U*	3.83 J	4.36 J	3.93 J	3.88 J
Magnesium	ug/L	19,000	19,700	20,100	19,100	34,800	35,000	24,500	24,400	25,200	25,500
Manganese	ug/L	3,800	3,970	3,520	3,720	-	-	-	-	-	-
Mercury	ug/L	<0.130	<0.130	<0.130	<0.130	<0.101	<0.101	<0.101	<0.101	<0.101	<0.101
Molybdenum	ug/L	<0.610	<0.610	<0.610	0.615 J	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610
Nickel	ug/L	<0.336	<0.336	<0.517	<0.517	0.359 J	0.469 J	15.8	16.1	16.5	16.2
Potassium	ug/L	876	880	877	868	1,010	1,020	5,300	5,290	5,440	5,490
Selenium	ug/L	<1.51	<1.51	<0.739	<0.739	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51
Silicon	ug/L	15,600	16,700	17,600	16,800	-	-	-	-	-	-
Silver	ug/L	<0.177	<0.177	<0.223	<0.223	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177
Sodium	ug/L	30,800	28,800	30,100	28,700	31,600	31,700	8,840	8,890	7,350	7,430
Thallium	ug/L	<0.148	0.409 U*	<0.472	<0.472	<0.148	<0.148	<0.148	<0.148	0.570 U*	0.205 U*
Vanadium	ug/L	<0.991	<0.991	<0.776	<0.776	<0.991	1.07	1.01	<0.991	<0.991	<0.991
Zinc	ug/L	<3.22	<3.22	<2.88	3.05 J	5.44 U*	5.06 U*	42.1	39.9	35.5	35.1
Radiological Parameters											
Radium-226	pCi/L	0.491 +/-(0.458)U	0.434 +/-(0.511)U	0.469 +/-(0.460)U	0.00229 +/-(0.272)U	0.623 +/-(0.591)U	0.342 +/-(0.539)U	0.411 +/-(0.399)U	0.322 +/-(0.433)U	0.823 +/-(0.675)U	0.768 +/-(0.632)U
Radium-228	pCi/L	0.220 +/-(0.385)U	0.262 +/-(0.308)U	0.137 +/-(0.331)U	0.436 +/-(0.577)U	0.519 +/-(0.407)U	0.260 +/-(0.446)U	0.192 +/-(0.277)U	0.214 +/-(0.273)U	0.511 +/-(0.398)U	-0.0265 +/-(0.258)U
Radium-226+228	pCi/L	0.710 +/-(0.599)U	0.696 +/-(0.597)U	0.606 +/-(0.567)U	0.438 +/-(0.638)U	1.14 +/-(0.718)U	0.602 +/-(0.700)U	0.603 +/-(0.486)U	0.535 +/-(0.512)U	1.33 +/-(0.784)U	0.768 +/-(0.682)U
Anions											
Chloride	mg/L	5.54	5.89	5.55	7.86	3.30	3.38	4.15	4.32	4.90	4.56
Fluoride	mg/L	0.0625 J	0.139 U*	0.0944 U*	0.0793 J	0.0899 J	0.0861 J	0.0783 U*	0.0789 U*	0.0584 J	0.0508 J
Sulfate	mg/L	326	341	354	344	527	527	511	515	524 J	570 J
General Chemistry											
Alkalinity, Bicarbonate	mg/L	120	148	117	146	140	138	35.4	35.2	34.0	34.7
Alkalinity, Carbonate	mg/L	<5.00	<5.00	<5.00	<2.60	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
pH (lab)	SU	-	-	-	-	-	-	-	-	-	-
Total Dissolved Solids	mg/L	670	692	687	716	878	895	793	794	891	847

See notes on last page.

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Table H.1-7 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		WBF-106								
Sample Date		4-Mar-20	4-Mar-20	29-Apr-20	29-Apr-20	8-Jul-20	25-Mar-21	19-Aug-21	21-Apr-22	17-Oct-22
Sample ID		WBF-GW-010-20200304	WBF-GW-DUP01-20200304	WBF-GW-010-20200429	WBF-GW-DUP01-20200429	WBF-GW-010-20200708	WBF-GW-WBF-106-03252021	WBF-GW-WBF-106-08192021	WBF-GW-WBF-106-04212022	WBF-GW-WBF-106-10172022
Parent Sample ID			WBF-GW-010-20200304		WBF-GW-010-20200429					
Sample Depth		32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft
Sample Type		Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	EIP	EIP	EIP	EIP	EIP	EIP	EIP	CCR Program	
Total Metals										
Aluminum	ug/L	-	-	-	-	-	18.7 J	39.7	<15.5	27.0 J
Antimony	ug/L	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.506	<0.506
Arsenic	ug/L	0.468 J	0.576 J	0.921 U*	0.921 U*	1.66 U*	0.414 J	0.731 U*	<0.282	0.382 J
Barium	ug/L	33.2	33.0	27.7	27.6	35.9	18.8	42.1	17.6	24.5
Beryllium	ug/L	<0.182	<0.182	<0.182	<0.182	<0.182	0.198 J	0.186 J	<0.274	<0.274
Boron	ug/L	212	217	66.4 J	51.5 J	65.2 U*	200	252 U*	199	234
Cadmium	ug/L	0.354 J	0.375 J	<0.217	<0.217	0.218 J	0.720 J	0.375 J	0.722 J	0.614 J
Calcium	ug/L	161,000	161,000	160,000	160,000	158,000	143,000	148,000	132,000	135,000
Chromium	ug/L	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53
Cobalt	ug/L	72.4	73.4	25.9	26.3	10.3	63.6	68.0	59.2	64.7
Copper	ug/L	<0.627	<0.627	3.89 U*	2.33 U*	<0.627	<0.627	<0.627	<1.14	<1.14
Iron	ug/L	-	-	-	-	-	23,300	30,500	20,800	23,500
Lead	ug/L	<0.128	0.208 J	0.138 U*	0.131 U*	0.223 U*	<0.128	<0.128	<0.167	<0.167
Lithium	ug/L	<3.39	<3.39	<3.39	<3.39	<3.39	<3.39	<3.39	2.10 J	2.27 J
Magnesium	ug/L	23,000	23,300	28,400	28,400	29,800	19,900	21,100	18,500	19,700
Manganese	ug/L	-	-	-	-	-	13,400	14,900	11,300 J	14,100
Mercury	ug/L	<0.101	<0.101	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130
Molybdenum	ug/L	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610
Nickel	ug/L	13.8	14.0	4.57	4.69	1.79 U*	12.7	12.8	11.5	12.8
Potassium	ug/L	4,720	4,770	2,740	2,750	1,580	4,840	5,180	4,810	5,470
Selenium	ug/L	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<0.739	<0.739
Silicon	ug/L	-	-	-	-	-	8,910	11,200	9,730 J	11,000
Silver	ug/L	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.223	<0.223
Sodium	ug/L	8,240	8,250	27,900	27,900	29,200	7,390	8,060	6,850	8,010
Thallium	ug/L	<0.148	<0.148	0.153 U*	<0.148	0.307 U*	<0.148	<0.148	<0.472	<0.472
Vanadium	ug/L	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991	<0.776	<0.776
Zinc	ug/L	34.4	36.2	10.8	11.2	6.09	30.1	34.1	26.5	30.3
Radiological Parameters										
Radium-226	pCi/L	0.433 +/-(0.540)U	0.558 +/-(0.618)U	1.21 +/-(0.751)J	0.213 +/-(0.523)UJ	0.461 +/-(0.509)U	0.0151 +/-(0.290)U	0.533 +/-(0.580)U	-0.0324 +/-(0.415)U	0.659 +/-(0.459)
Radium-228	pCi/L	0.179 +/-(0.247)U	0.326 +/-(0.460)U	0.575 +/-(0.387)	0.151 +/-(0.313)U	-0.116 +/-(0.432)U	0.461 +/-(0.501)U	0.107 +/-(0.271)U	0.0967 +/-(0.315)U	-0.219 +/-(0.435)U
Radium-226+228	pCi/L	0.612 +/-(0.594)U	0.884 +/-(0.770)U	1.78 +/-(0.845)J	0.364 +/-(0.609)UJ	0.461 +/-(0.668)U	0.477 +/-(0.579)U	0.640 +/-(0.640)U	0.0967 +/-(0.521)U	0.659 +/-(0.633)J
Anions										
Chloride	mg/L	4.88	4.86	4.50	4.84	4.96	4.02	3.75	7.11	7.79
Fluoride	mg/L	0.0267 J	0.0291 J	0.132 U*	0.140 U*	0.133 U*	0.0305 J	0.0778 U*	0.0642 J	0.0628 J
Sulfate	mg/L	550	522	453	465	481	484	464	427	434
General Chemistry										
Alkalinity, Bicarbonate	mg/L	10.9 J	20.6 J	77.1	69.2	122	<5.00	44.0	22.0	31.8
Alkalinity, Carbonate	mg/L	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<2.60
pH (lab)	SU	-	-	-	-	-	-	-	-	-
Total Dissolved Solids	mg/L	791	794	862	836	885	740	741	636	726

Notes:

Please note that units have been converted automatically in this table, and significant figures may not have been maintained.

15.2	measured concentration did not exceed the indicated standard
<0.03	analyte was not detected at a concentration greater than the Method Detection Limit
-	Parameter not analyzed / not available.
ft	feet
ID	Identification
J	quantitation is approximate due to limitations identified during data validation
U*	result should be considered “not detected” because it was detected in an associated field or laboratory blank at a similar level
UJ	This compound was not detected, but the reporting or detection limit should be considered estimated due to a bias identified during data validation.
mg/L	milligrams per Liter
pCi/L	picocuries per Liter
ug/L	micrograms per Liter
SU	Standard Units

Table H.1-8- Groundwater Quality Parameters
Watts Bar Fossil Plant

Sample Location		MW-1										
Sample Date		13-Apr-16	6-Jul-16	16-Oct-18	2-Apr-19	23-Oct-19	29-Apr-20	5-Oct-20	26-Apr-21	6-Oct-21	19-Apr-22	18-Oct-22
Sample ID		WBF-MW-1-0416	WBF-MW-1-0716	WBF-MW-1-GW-101618	WBF-MW-1-GW-040219	WBF-GW-MW1-102319	WBF-GW-MW1-042920	WBF-GW-MW1-100520	WBF-GW-MW1-04262021	WBF-GW-MW1-10062021	WBF-GW-MW-1-04192022	WBF-GW-MW-1-10182022
Parent Sample ID												
Sample Depth		28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft	28.5 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	
Field Parameters												
Dissolved Oxygen	%	-	-	-	-	-	-	-	43.5	27.3	14.2	31.2
Dissolved Oxygen	mg/L	0.1	0.1	1.17	0.87	0.73	1.10	0.44	4.21	2.40	1.38	2.95
ORP	mV	351	345	326	382	345	398	335	139	156	136	128
pH (field)	SU	5.7	5.7	6	6.34	5.93	5.54	5.83	5.83	5.91	5.87	5.91
Specific Cond. (Field)	uS/cm	462	407	473	755	488	371	446	484	467	441	449
Temperature, Water (C)	DEG C	-	-	18.8	17.2	17.7	11.87	18.76	18.2	20.18	17.88	17.87
Turbidity, field	NTU	-	-	0.52	1.72	0.99	0.4	1.25	2.35	1.10	4.16	3.32

See notes on last page.

Table H.1-8- Groundwater Quality Parameters
Watts Bar Fossil Plant

Sample Location		MW-2										
Sample Date		13-Apr-16	6-Jul-16	16-Oct-18	3-Apr-19	22-Oct-19	29-Apr-20	5-Oct-20	28-Apr-21	6-Oct-21	19-Apr-22	19-Oct-22
Sample ID		WBF-MW-2-0416	WBF-MW-2-0716	WBF-MW-2-GW-101618	WBF-MW-2-GW-040319	WBF-GW-MW2-102219	WBF-GW-MW2-042920	WBF-GW-MW2-100520	WBF-GW-MW2-04282021	WBF-GW-MW2-10062021	WBF-GW-MW-2-04192022	WBF-GW-MW-2-10192022
Parent Sample ID												
Sample Depth		27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft	27.5 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	
Field Parameters												
Dissolved Oxygen	%	-	-	-	-	-	-	-	12.9	16.9	23.2	18.3
Dissolved Oxygen	mg/L	0.1	0.1	1.21	0.97	1.07	1.43	0.30	1.23	1.47	2.26	1.70
ORP	mV	442	447	359	367	374	432	381	258	197	128	139
pH (field)	SU	6	6.1	6.33	5.89	6.3	6.19	6.28	6.25	6.33	6.30	6.29
Specific Cond. (Field)	uS/cm	260	261	186	473	194	211	209	217	228	244	217
Temperature, Water (C)	DEG C	-	-	19.51	15.5	19.5	19.44	19.80	18.25	20.00	16.99	18.72
Turbidity, field	NTU	-	-	0.61	0.79	2.1	0.43	0.53	0.33	0.57	3.03	0.96

See notes on last page.

Table H.1-8- Groundwater Quality Parameters
Watts Bar Fossil Plant

Sample Location		MW-3									
Sample Date		13-Apr-16	6-Jul-16	3-Apr-19	23-Oct-19	28-Apr-20	6-Oct-20	28-Apr-21	5-Oct-21	20-Apr-22	19-Oct-22
Sample ID		WBF-MW-3-0416	WBF-MW-3-0716	WBF-MW-3-GW-040319	WBF-GW-MW3-102319	WBF-GW-MW3-042820	WBF-GW-MW3-100620	WBF-GW-MW3-04282021	WBF-GW-MW3-10052021	WBF-GW-MW-3-04202022	WBF-GW-MW-3-10192022
Parent Sample ID											
Sample Depth		26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft	26.5 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	
Field Parameters											
Dissolved Oxygen	%	-	-	-	-	-	-	28.1	11.6	34.9	28.1
Dissolved Oxygen	mg/L	0.1	0.1	0.58	0.44	2.12	1.86	2.75	1.10	3.32	2.60
ORP	mV	213	251	421	289	388	314	281	192	88	163
pH (field)	SU	6.2	6.1	6.22	6.29	6.10	6.01	6.17	5.96	6.09	6.15
Specific Cond. (Field)	uS/cm	475	408	198	426	315	293	301	280	281	336
Temperature, Water (C)	DEG C	-	-	16.54	18.9	16.68	18.50	18.21	19.60	17.81	18.84
Turbidity, field	NTU	-	-	0.24	4.76	3.69	3.22	0.35	0.35	1.19	1.04

See notes on last page.

Table H.1-8- Groundwater Quality Parameters
Watts Bar Fossil Plant

Sample Location		WBF-100								
Sample Date		17-Oct-18	2-Apr-19	22-Oct-19	28-Apr-20	6-Oct-20	26-Apr-21	5-Oct-21	20-Apr-22	18-Oct-22
Sample ID		WBF-100-GW-101718	WBF-100-GW-040219	WBF-GW-100-102219	WBF-GW-100-042820	WBF-GW-100-100620	WBF-GW-100-04262021	WBF-GW-100-10052021	WBF-GW-WBF-100-04202022	WBF-GW-WBF-100-10182022
Parent Sample ID										
Sample Depth		53.5 ft	53.5 ft	53.5 ft	53.5 ft	53.5 ft	53.5 ft	53.5 ft	53.5 ft	53.5 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	State Compliance	
Field Parameters										
Dissolved Oxygen	%	-	-	-	-	-	8.4	34.2	4.9	29.5
Dissolved Oxygen	mg/L	1.8	1.27	1.69	0.19	0.90	0.79	3.08	0.49	2.86
ORP	mV	378	411	366	349	406	192	197	58	147
pH (field)	SU	6.36	6.28	6.38	6.39	6.30	6.36	6.27	6.39	6.01
Specific Cond. (Field)	uS/cm	827	388	821	771	803	840	891	879	889
Temperature, Water (C)	DEG C	17.04	16.74	18.55	16.2	18.62	18.07	18.50	16.2	16.72
Turbidity, field	NTU	0.57	1.91	0.79	1.28	0.80	0.44	0.31	0.81	1.12

See notes on last page.

Table H.1-8- Groundwater Quality Parameters
Watts Bar Fossil Plant

Sample Location		WBF-101								
Sample Date		27-Aug-19	31-Oct-19	9-Jan-20	3-Mar-20	29-Apr-20	7-Jul-20	23-Mar-21	19-Apr-22	18-Oct-22
Sample ID		WBF-GW-005-20190827	WBF-GW-005-20191031	WBF-GW-005-20200109	WBF-GW-005-20200303	WBF-GW-005-20200429	WBF-GW-005-20200707	WBF-GW-WBF-101-03232021	WBF-GW-WBF-101-04192022	WBF-GW-WBF-101-10182022
Parent Sample ID										
Sample Depth		32.2 ft	32.2 ft	32.2 ft	32.2 ft	32.2 ft	32.2 ft	32.2 ft	32.2 ft	32.2 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	EIP	EIP	EIP	EIP	EIP	EIP	EIP	CCR Program	
Field Parameters										
Dissolved Oxygen	%	7.2	4.3	3.8	2.8	6.2	4.3	1.8	3.6	4.1
Dissolved Oxygen	mg/L	0.64	0.41	0.38	0.27	0.66	0.38	0.18	0.33	0.40
ORP	mV	-105.8	-34.1	-44.8	28.7	-54.6	-87.6	33.2	-29.8	-113.5
pH (field)	SU	6.67	6.65	6.43	5.76	6.48	6.66	5.91	6.39	6.79
Specific Cond. (Field)	uS/cm	666	667	1,026	1,508	859	843	1,790	1,276	989
Temperature, Water (C)	DEG C	21.5	20.2	15.3	17.6	18.2	21.4	15.5	18.9	16.5
Turbidity, field	NTU	6.59	0.39	4.92	18.1	59.8	18.0	16.5	9.15	3.54

See notes on last page.

Table H.1-8- Groundwater Quality Parameters
Watts Bar Fossil Plant

Sample Location		WBF-102							
Sample Date		28-Aug-19	30-Oct-19	8-Jan-20	3-Mar-20	27-Apr-20	7-Jul-20	24-Mar-21	21-Apr-22
Sample ID		WBF-GW-006-20190828	WBF-GW-006-20191030	WBF-GW-006-20200108	WBF-GW-006-20200303	WBF-GW-006-20200427	WBF-GW-006-20200707	WBF-GW-WBF-102-03242021	WBF-GW-WBF-102-04212022
Parent Sample ID									
Sample Depth		23 ft	23 ft	23 ft	23 ft	23 ft	23 ft	23 ft	23 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	EIP	EIP	EIP	EIP	EIP	EIP	EIP	CCR Program
Field Parameters									
Dissolved Oxygen	%	40.0	24.2	59.0	36.9	27.8	7.0	32.7	48.1
Dissolved Oxygen	mg/L	3.55	2.26	5.80	3.60	2.70	0.65	3.30	4.62
ORP	mV	121.7	35.0	64.1	76.1	69.8	197.9	122.1	172.6
pH (field)	SU	6.94	6.60	6.93	6.98	6.62	6.52	6.82	6.76
Specific Cond. (Field)	uS/cm	1,588	1,253	547.3	527.7	739	1,305	640	821
Temperature, Water (C)	DEG C	20.6	19.3	16.9	16.9	17.0	18.4	14.7	17.2
Turbidity, field	NTU	1.50	2.74	0.63	0.36	0.27	0.72	0.44	0.44

See notes on last page.

Table H.1-8- Groundwater Quality Parameters
Watts Bar Fossil Plant

Sample Location		WBF-103								
Sample Date		27-Aug-19	29-Oct-19	7-Jan-20	3-Mar-20	28-Apr-20	7-Jul-20	23-Mar-21	21-Apr-22	18-Oct-22
Sample ID		WBF-GW-007-20190827	WBF-GW-007-20191029	WBF-GW-007-20200107	WBF-GW-007-20200303	WBF-GW-007-20200428	WBF-GW-007-20200707	WBF-GW-WBF-103-03232021	WBF-GW-WBF-103-04212022	WBF-GW-WBF-103-10182022
Parent Sample ID										
Sample Depth		19.5 ft	19.5 ft	19.5 ft	19.5 ft	19.5 ft	19.5 ft	19.5 ft	19.5 ft	19.5 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	EIP	EIP	EIP	EIP	EIP	EIP	EIP	CCR Program	
Field Parameters										
Dissolved Oxygen	%	11.4	2.5	13.5	21.5	17.6	12.7	15.8	22.8	18.9
Dissolved Oxygen	mg/L	1.04	0.22	1.26	2.14	1.84	1.19	1.47	2.27	1.75
ORP	mV	248.0	23.9	326.3	121.6	237.6	139.9	349.8	200.2	319.0
pH (field)	SU	5.48	5.68	5.79	5.52	5.15	5.21	5.45	5.83	5.47
Specific Cond. (Field)	uS/cm	989.7	299.5	352.4	153.9	178.0	184.0	217	359.1	123.3
Temperature, Water (C)	DEG C	19.8	21.5	17.4	15.9	15.8	20.5	18.1	15.9	19.0
Turbidity, field	NTU	1.56	4.17	4.63	0.86	0.78	2.99	4.44	0.67	0.13

See notes on last page.

Table H.1-8- Groundwater Quality Parameters
Watts Bar Fossil Plant

Sample Location		WBF-104									
Sample Date		27-Aug-19	29-Oct-19	7-Jan-20	4-Mar-20	28-Apr-20	8-Jul-20	24-Mar-21	19-Aug-21	20-Apr-22	19-Oct-22
Sample ID		WBF-GW-008-20190827	WBF-GW-008-20191029	WBF-GW-008-20200107	WBF-GW-008-20200304	WBF-GW-008-20200428	WBF-GW-008-20200708	WBF-GW-WBF-104-03242021	WBF-GW-WBF-104-08192021	WBF-GW-WBF-104-04202022	WBF-GW-WBF-104-10192022
Parent Sample ID											
Sample Depth		26.4 ft	26.4 ft	26.4 ft	26.4 ft	26.4 ft	26.4 ft	26.4 ft	26.4 ft	26.4 ft	26.4 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	EIP	EIP	EIP	EIP	EIP	EIP	EIP	EIP	CCR Program	
Field Parameters											
Dissolved Oxygen	%	21.0	7.8	7.2	4.0	8.5	6.3	6.3	9.7	4.0	4.9
Dissolved Oxygen	mg/L	1.82	0.70	0.79	0.40	0.83	0.60	0.56	0.88	0.39	0.47
ORP	mV	149.0	5.1	266.4	102.4	145.9	149.3	226.2	124.1	257.4	247.7
pH (field)	SU	5.50	5.48	5.78	5.54	5.48	5.34	5.37	5.34	5.32	5.49
Specific Cond. (Field)	uS/cm	2,645	2,147	1,313	1,904	2,150	2,741	2,740	2,590	2,664	2,680
Temperature, Water (C)	DEG C	22.4	21.7	15.5	15.0	17.4	20.9	19.2	20.6	15.8	17.9
Turbidity, field	NTU	1.81	0.13	0.35	1.45	0.76	0.41	0.42	0.34	3.90	0.16

See notes on last page.

Table H.1-8- Groundwater Quality Parameters
Watts Bar Fossil Plant

Sample Location		WBF-105									
Sample Date		28-Aug-19	30-Oct-19	8-Jan-20	4-Mar-20	28-Apr-20	7-Jul-20	25-Mar-21	19-Aug-21	20-Apr-22	17-Oct-22
Sample ID		WBF-GW-009-20190828	WBF-GW-009-20191030	WBF-GW-009-20200108	WBF-GW-009-20200304	WBF-GW-009-20200428	WBF-GW-009-20200707	WBF-GW-WBF-105-03252021	WBF-GW-WBF-105-08192021	WBF-GW-WBF-105-04202022	WBF-GW-WBF-105-10172022
Parent Sample ID											
Sample Depth		35.1 ft	35.1 ft	35.1 ft	35.1 ft	35.1 ft	35.1 ft	35.1 ft	35.1 ft	35.1 ft	35.1 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	EIP	EIP	EIP	EIP	EIP	EIP	EIP	EIP	CCR Program	
Field Parameters											
Dissolved Oxygen	%	4.0	2.8	3.3	1.9	3.0	4.2	1.8	4.6	2.4	4.4
Dissolved Oxygen	mg/L	0.35	0.26	0.34	0.18	0.27	0.36	0.18	0.42	0.22	0.38
ORP	mV	-125.0	-46.4	-102.9	-119.0	-116.1	-97.8	-115.2	-78.8	-121.8	-115.2
pH (field)	SU	6.53	6.51	6.69	6.70	6.52	6.52	6.67	6.60	6.71	6.73
Specific Cond. (Field)	uS/cm	972	964	1,034	892	1,016	1,070	1,080	990	1,029	1,048
Temperature, Water (C)	DEG C	21.6	19.2	15.3	17.1	19.5	23.5	17.2	20.5	18.2	21.4
Turbidity, field	NTU	4.32	4.81	4.58	4.45	4.50	3.78	9.79	3.07	4.51	3.90

See notes on last page.

Table H.1-8- Groundwater Quality Parameters
Watts Bar Fossil Plant

Sample Location		WBF-106									
Sample Date		28-Aug-19	30-Oct-19	8-Jan-20	4-Mar-20	29-Apr-20	8-Jul-20	25-Mar-21	19-Aug-21	21-Apr-22	17-Oct-22
Sample ID		WBF-GW-010-20190828	WBF-GW-010-20191030	WBF-GW-010-20200108	WBF-GW-010-20200304	WBF-GW-010-20200429	WBF-GW-010-20200708	WBF-GW-WBF-106-03252021	WBF-GW-WBF-106-08192021	WBF-GW-WBF-106-04212022	WBF-GW-WBF-106-10172022
Parent Sample ID											
Sample Depth		32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	EIP	EIP	EIP	EIP	EIP	EIP	EIP	EIP	CCR Program	
Field Parameters											
Dissolved Oxygen	%	2.5	5.1	5.5	2.9	4.6	3.3	2.4	4.7	11.8	3.7
Dissolved Oxygen	mg/L	0.24	0.48	0.54	0.27	0.44	0.30	0.24	0.43	1.08	0.35
ORP	mV	-66.5	48.3	121.0	64.2	3.2	-44.9	79.9	73.1	91.9	80.1
pH (field)	SU	6.32	5.59	5.46	5.61	6.07	6.13	5.50	5.62	5.52	5.56
Specific Cond. (Field)	uS/cm	1,122	984	1,071	891	1,086	1,174	980	910	860	926
Temperature, Water (C)	DEG C	20.4	19.6	16.6	17.0	18.5	21.0	15.0	20.7	19.3	21.3
Turbidity, field	NTU	8.15	2.01	4.95	3.97	58.7	6.95	3.70	4.78	3.28	4.02

Notes:

Please note that units have been converted automatically in this table, and significant figures may not have been maintained.

-	Parameter not analyzed / not available.
%	percent
Cond.	conductance
DEG C	degrees Celsius
ft	feet below top of casing
ID	identification
J	quantitation is approximate due to limitations identified during data validation
mg/L	milligrams per Liter
mV	milliVolts
NTU	Nephelometric Turbidity Unit
ORP	Oxidation Reduction Potential, measured using a silver reference electrode which has a standard potential of 200 mV
SU	Standard Units
uS/cm	microSiemens per centimeter

Table H.1-9 - Screening Levels for Groundwater
Watts Barr Fossil Plant

CCR Parameters	Groundwater Screening Levels	
	(µg/L)	Source
CCR Rule Appendix III Constituents :		
Boron	4,000	RSL
Calcium	--	--
Chloride	250,000	SMCL
Fluoride	4,000	MCL
pH	6.5-8.5 S.U.	SMCL
Sulfate	250,000	SMCL
Total Dissolved Solids	500,000	SMCL
CCR Rule Appendix IV Constituents :		
Antimony	6	MCL
Arsenic	10	MCL
Barium	2,000	MCL
Beryllium	4	MCL
Cadmium	5	MCL
Chromium (total)	100	MCL
Cobalt	6	CCR Rule GWPS
Fluoride	4,000	MCL
Lead	15	CCR Rule GWPS
Lithium	40	CCR Rule GWPS
Mercury	2	MCL
Molybdenum	100	CCR Rule GWPS
Radium-226 & 228	5 pCi/L	MCL
Selenium	50	MCL
Thallium	2	MCL
TDEC Appendix I Constituents :		
Copper	1,300	MCLG
Nickel	100	TN MCL
Silver	100	TN MCL
Vanadium	86	RSL
Zinc	5,000	SMCL

Notes:

CCR - coal combustion residuals

CCR Rule - Coal Combustion Residuals rule, USEPA Title 40, Code of Federal Regulations, Part 257

GWPS - groundwater protection standards

MCL - USEPA maximum contaminant level

MCLG - Maximum contaminant level goal

pCi/L - picocuries per liter

RSL - USEPA regional screening level

SMCL - USEPA secondary maximum contaminant level

S.U. - standard units

TN MCL - maximum contaminant level promulgated by State of Tennessee

TDEC - Tennessee Department of Environmental and Conservation

µg/L - micrograms per liter

USEPA - United States Environmental Protection Agency

Table H.1-10 - Summary of Statistically Significant Concentrations/Values
Watts Bar Fossil Plant

Parameter	Background	Upgradient			Ash Pond			Slag Disposal Area		
	WBF-103	MW-1	WBF-100	WBF-102	MW-2	MW-3	WBF-101	WBF-104	WBF-105	WBF-106
CCR Rule Appendix III Parameters										
Boron	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Chloride	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Fluoride[1]	Green	Green	Green	Green	Green	Green	Green	Green*	Green	Green
pH	Red	Red	Red	Green	Red	Red	Green	Red	Green	Red
Sulfate	Green	Green	Green	Green	Green	Green	Green	Red	Red	Red
Total Dissolved Solids	Green	Green	Red	Green	Green	Green	Green	Red	Red	Red
CCR Rule Appendix IV Parameters										
Antimony	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*
Arsenic	Green*	Green	Green	Green	Green*	Green	Green	Green	Green	Green
Barium	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Beryllium	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green	Green*	Green*
Cadmium	Green*	Green*	Green*	Green*	Green*	Green*	Green	Red	Green*	Green
Chromium	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*
Cobalt	Green	Red	Green*	Green[2]	Green*	Green	Green	Red	Green*	Red
Lead	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*
Lithium	Green*	Green	Green	Green*	Green	Green	Green*	Green	Green*	Green
Mercury	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*
Molybdenum	Green*	Green*	Green*	Green	Green*	Green*	Green*	Green*	Green*	Green*
Rad226+228	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*
Selenium	Green*	Green*	Green*	Green	Green*	Green*	Green*	Green*	Green*	Green*
Thallium	Green*	Green*	Green*	Green	Green*	Green*	Green*	Green*	Green*	Green*
TDEC Appendix I Parameters										
Copper	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*
Nickel	Green	Green	Green	Green*	Green	Green	Green	Green	Green*	Green
Silver	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*	Green*
Vanadium	Green*	Green	Green*	Green*	Green	Green	Green*	Green*	Green*	Green*
Zinc	Green*	Green	Green*	Green*	Green*	Green*	Green	Green	Green*	Green

Green	No statistically significant concentration greater than or equal to the GSL for constituents other than pH and no statistically significant difference outside the GSL range for pH
Green*	Limited dataset (sample size <5 or <4 detected values), but none of the available results are greater than or equal to the GSL or outside the GSL range for pH.
Red	Statistically significant concentration greater than or equal to the GSL for constituents other than pH or a statistically significant difference outside the GSL range for pH.

Notes:

CCR Rule - Title 40, Code of Federal Regulations, Part 257

GSL - Groundwater Screening Level

TDEC - Tennessee Department of Environment and Conservation

Bold colors are used to represent CCR Rule Appendix IV Parameter and TDEC Appendix I Parameter results while subdued colors represent CCR Rule Appendix III Parameter results.

[1]Fluoride is both a CCR Rule Appendix III and CCR Rule Appendix IV constituent. In this table, fluoride has been grouped with the Appendix III constituents to avoid duplication of results.

[2]For Cobalt at WBF-102, a detected concentration of 11.1 µg/L, which was greater than the GSL (6 µg/L), was observed for a single sampling event in August, 2019. Since that sampling event, cobalt at WBF-102 has been analyzed for an additional eight sampling events that took place between October 2019 and April 2022. The cobalt concentration at WBF-102 has been less than the GSL for cobalt for all eight subsequent sampling events and has been non-detect with a reported detection limit of ≤0.261 for the last seven sampling events. Because there were only two detected values (both from 2019), this well-constituent pair was not initially categorized for analysis by linear regression and confidence band/confidence interval. However, due to the single exceedance of the GSL, a confidence band was generated for this well-constituent pair based on a replacement of the non-detect values with the full detection limit. The results of this confidence band analysis are shown in Appendix E.3-D.

Table H.1-11 - Linear Regression Results
Groundwater Investigation - Watts Bar Fossil Plant - Spring City, Tennessee

Well	Constituent Type	Constituent	p-value	Trend summary[1]
WBF-103	CCR Rule Appendix III Parameters	pH (field)	0.7349	No trend detected
MW-1	CCR Rule Appendix III Parameters	pH (field)	0.6425	No trend detected
	CCR Rule Appendix IV Parameters	Cobalt	0.0765	No trend detected
WBF-100	CCR Rule Appendix III Parameters	pH (field)	0.1745	No trend detected
		Sulfate	0.0941	No trend detected
		Total dissolved solids	0.4268	No trend detected
WBF-102	CCR Rule Appendix III Parameters	Sulfate	0.1548	No trend detected
		Total dissolved solids	0.1784	No trend detected
	CCR Rule Appendix IV Parameters	Cobalt	0.2431	No trend detected
MW-2	CCR Rule Appendix III Parameters	pH (field)	0.0405	Increasing
MW-3	CCR Rule Appendix III Parameters	pH (field)	0.7873	No trend detected
WBF-101	CCR Rule Appendix III Parameters	pH (field)	0.8232	No trend detected
		Sulfate	0.7076	No trend detected
		Total dissolved solids	0.6272	No trend detected
	CCR Rule Appendix IV Parameters	Cobalt	0.941	No trend detected
WBF-104	CCR Rule Appendix III Parameters	Boron	0.0757	No trend detected
		pH (field)	0.1694	No trend detected
		Sulfate	0.2552	No trend detected
		Total dissolved solids	0.5816	No trend detected
	CCR Rule Appendix IV Parameters	Cadmium	0.0525	No trend detected
		Cobalt	0.0063	Increasing
	TDEC Appendix I Paramters	Nickel	0.0016	Increasing
WBF-105	CCR Rule Appendix III Parameters	Sulfate	0.5959	No trend detected
		Total dissolved solids	0.1088	No trend detected
WBF-106	CCR Rule Appendix III Parameters	pH (field)	0.1891	No trend detected
		Sulfate	0.0035	Decreasing
		Total dissolved solids	0.005	Decreasing
	CCR Rule Appendix IV Parameters	Cobalt	0.4628	No trend detected

Notes
CCR Rule - Title 40, Code of Federal Regulations, Part 257
1. Trend evaluated using linear regression. Slope considered significant when $p<0.05$.
2. Fluoride is both a CCR Rule Appendix III and CCR Rule Appendix IV constituent. In this table, fluoride has been grouped with the Appendix III constituents only to avoid duplication of results.

EXHIBITS

Exhibit No.

H.1-1

Title

Monitoring Well and Piezometer Network

Client/Project

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location 175668050

Spring City, Tennessee

Prepared by MB on 2022-07-13
Technical Review by MW on 2022-07-13

0 150 300 450 600 Feet

1:1,800 (At original document size of 22x34)

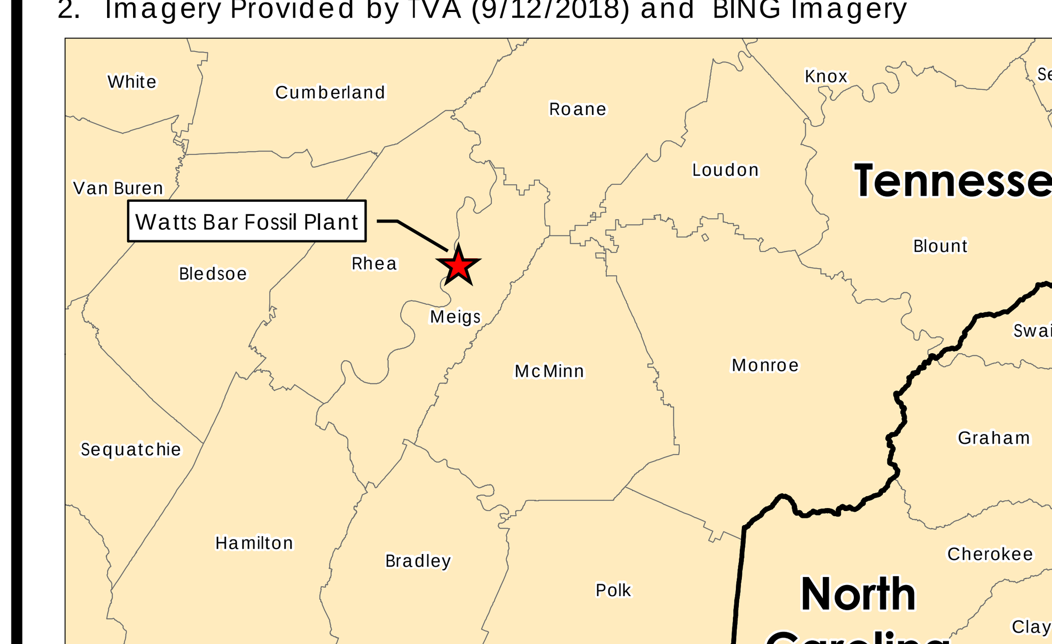
Legend

- Groundwater Investigation Monitoring Well
- Other Monitoring Well
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery



Stantec TVA

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Exhibit No.

H.1-2

Title

Lithologic Model (Oblique View Looking Northwest)

Client/Project 175668050

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

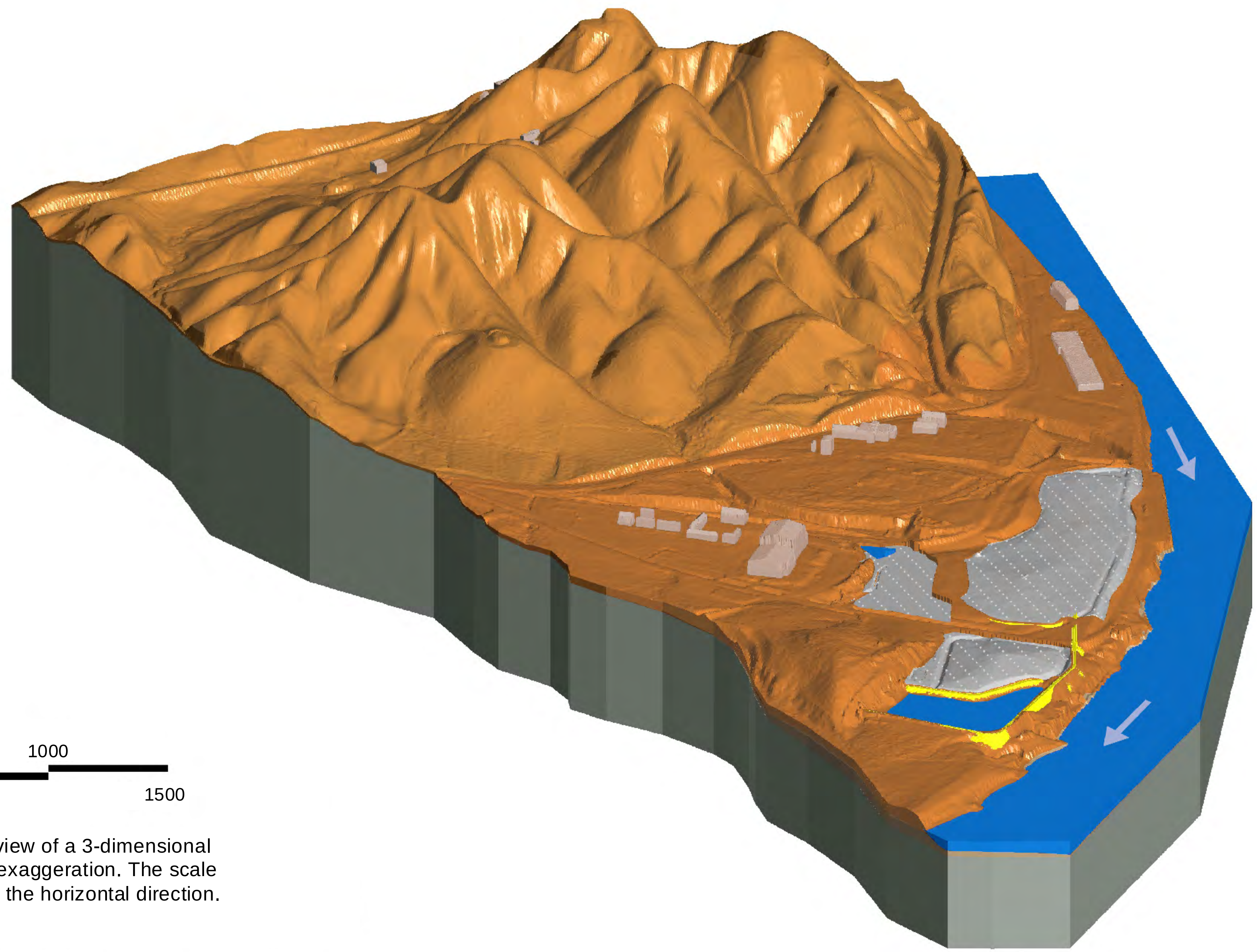
Clinton, Tennessee
Spring City, Tennessee

Prepared by DMB on 2023-09-27
TR by MD on 2023-09-27
IR Review by RB on 2023-09-27

Legend

- Building Structure
- CCR Material
- Clay Dike
- Unconsolidated Materials (Primarily Alluvial Silts and Clays)
- Waterbody
- Bedrock
- Typical Surface Stream Flow Direction

CCR: Coal combustion residuals



N

0 500 1000 1500

Image is an oblique view of a 3-dimensional model at 3X vertical exaggeration. The scale above is valid only in the horizontal direction.

Stantec

TVA

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Exhibit No.
H.1-3

Title
Lithologic Model - Primarily Alluvial Silts and Clays (Oblique View Looking Northwest)

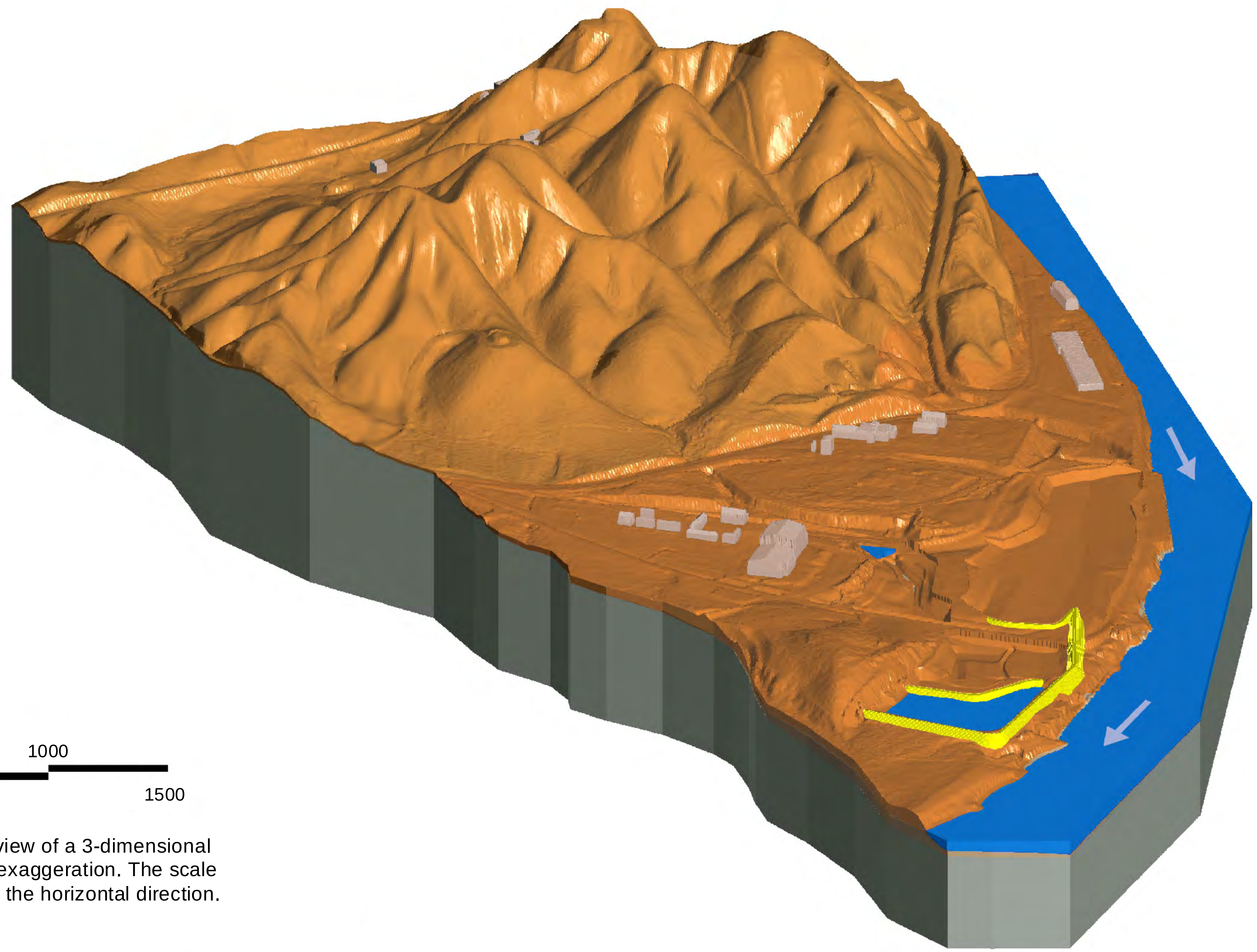
Client/Project 175668050
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Clinton, Tennessee
Spring City, Tennessee

Prepared by DMB on 2023-09-27
TR by MD on 2023-09-27
IR Review by RB on 2023-09-27

Legend

- Building Structure
- Clay Dike
- Unconsolidated Materials (Primarily Alluvial Silts and Clays)
- Waterbody
- Bedrock
- Typical Surface Stream Flow Direction



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0 500 1000 1500

Image is an oblique view of a 3-dimensional model at 3X vertical exaggeration. The scale above is valid only in the horizontal direction.

Stantec

TVA

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Exhibit No.

H.1-4

Title

Lithologic Model - Primarily Alluvial Sand (Oblique View Looking Northwest)

Client/Project 175668050

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

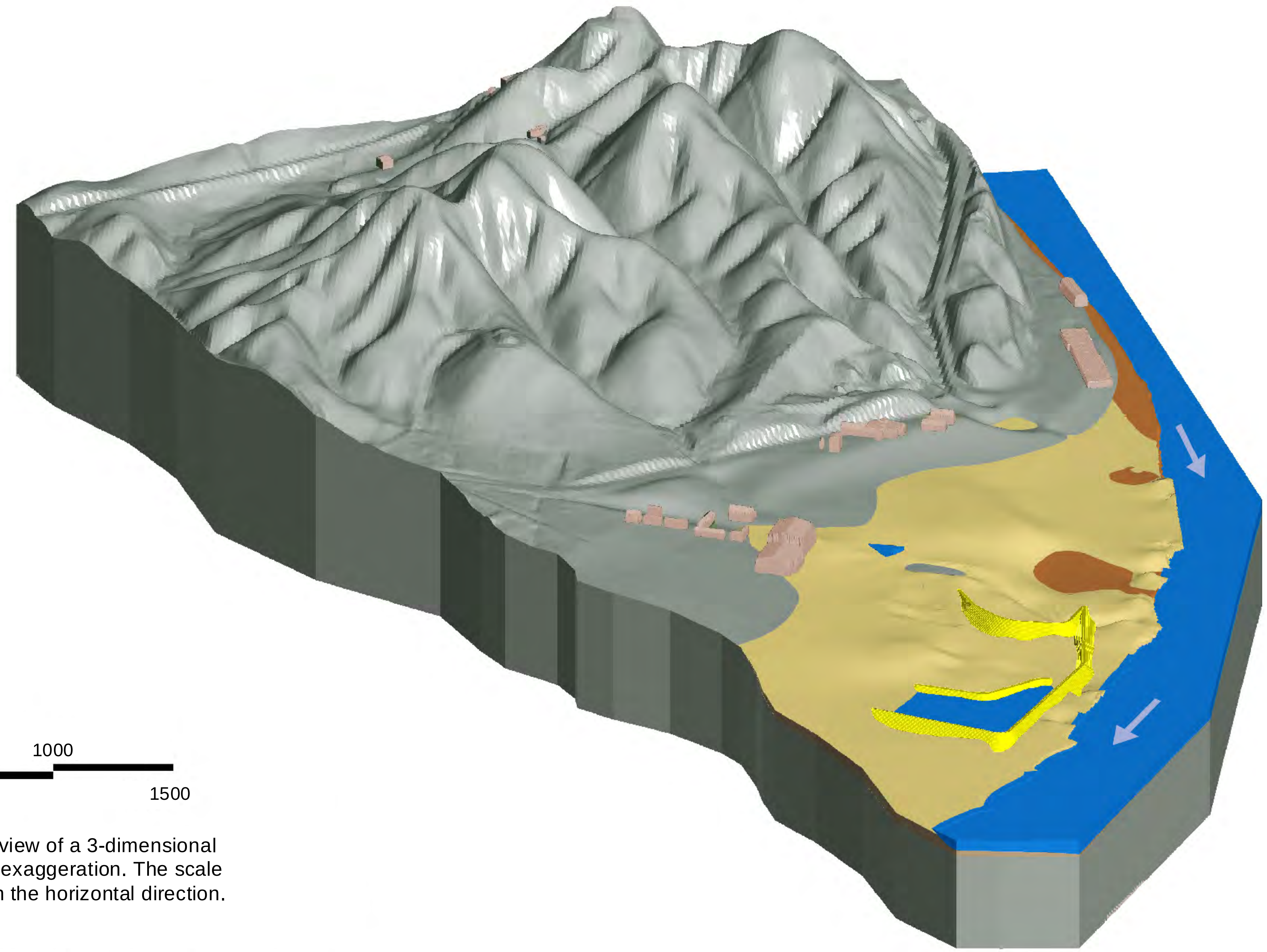
Clinton, Tennessee

Spring City, Tennessee

Prepared by DMB on 2023-09-27
TR by MD on 2023-09-27
IR Review by RB on 2023-09-27

Legend

- Building Structure
- Clay Dike
- Unconsolidated Materials (Primarily Alluvial Silts and Clays)
- Unconsolidated Materials (Primarily Alluvial Sand)
- Waterbody
- Bedrock
- Typical Surface Stream Flow Direction



N

0 1000
500 1500

Image is an oblique view of a 3-dimensional model at 3X vertical exaggeration. The scale above is valid only in the horizontal direction.

Stantec

TVA

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Exhibit No.
H.1-5

Title
Geologic Map with Top of Bedrock Contours

Client/Project
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2023-08-16
Technical Review by EM on 2023-08-16

0 150 300 450 600 Feet
1:1,800 (At original document size of 22x34)

Legend

Top of Bedrock Elevation Contour (2 ft interval)
Top of Bedrock Elevation Contour (10 ft interval)
2018 Imagery Boundary
CCR Management Unit Area (Approximate)
Closed Metal Cleaning Pond (Approximate)
Consolidated and Capped CCR Area (Approximate)
Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)

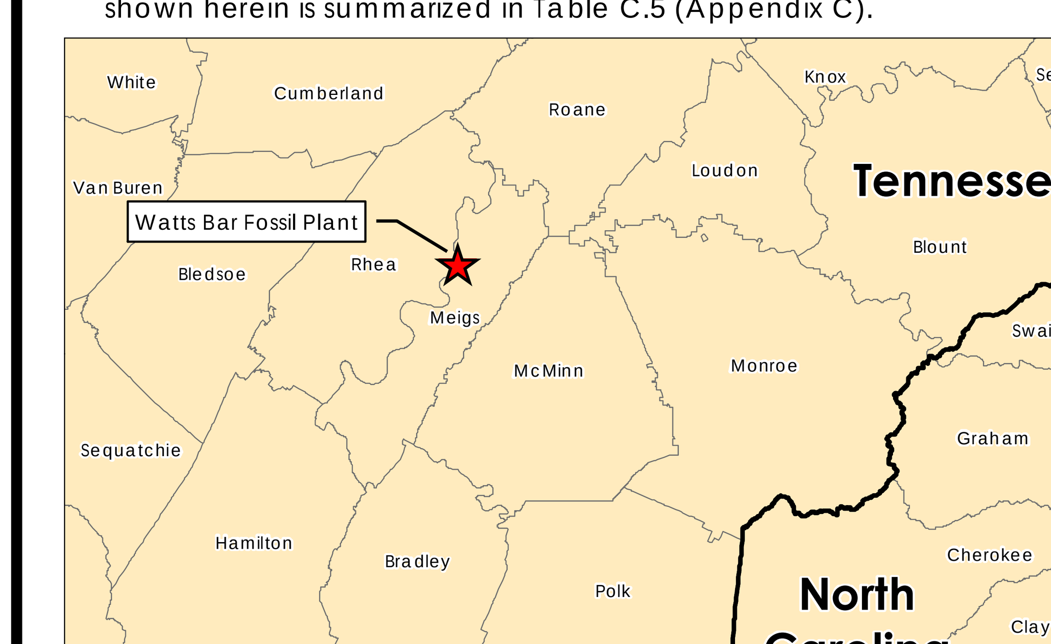
Geologic Formations

af - Artificial Fill
Qal - Quaternary Surficial Deposits
Cn / Cnr - Cambrian Nolichucky Shale
Ccm - Cambrian Conasauga Middle Group

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by TVA (9/12/2018) and TN Department of Transportation - Basemaps Imagery (https://tnmap.tn.gov/arcgis/rest/services/BASEMAPS/IMAGERY/MapServer)
3. Geologic Map: USGS TVA, Decatur Quadrangle, 1973
4. Model input data used to model the top of bedrock surface shown herein is summarized in Table C.5 (Appendix C).



Stantec TVA

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Exhibit No.

H.1-6

Title

Regional Geologic Map

Client/Project

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

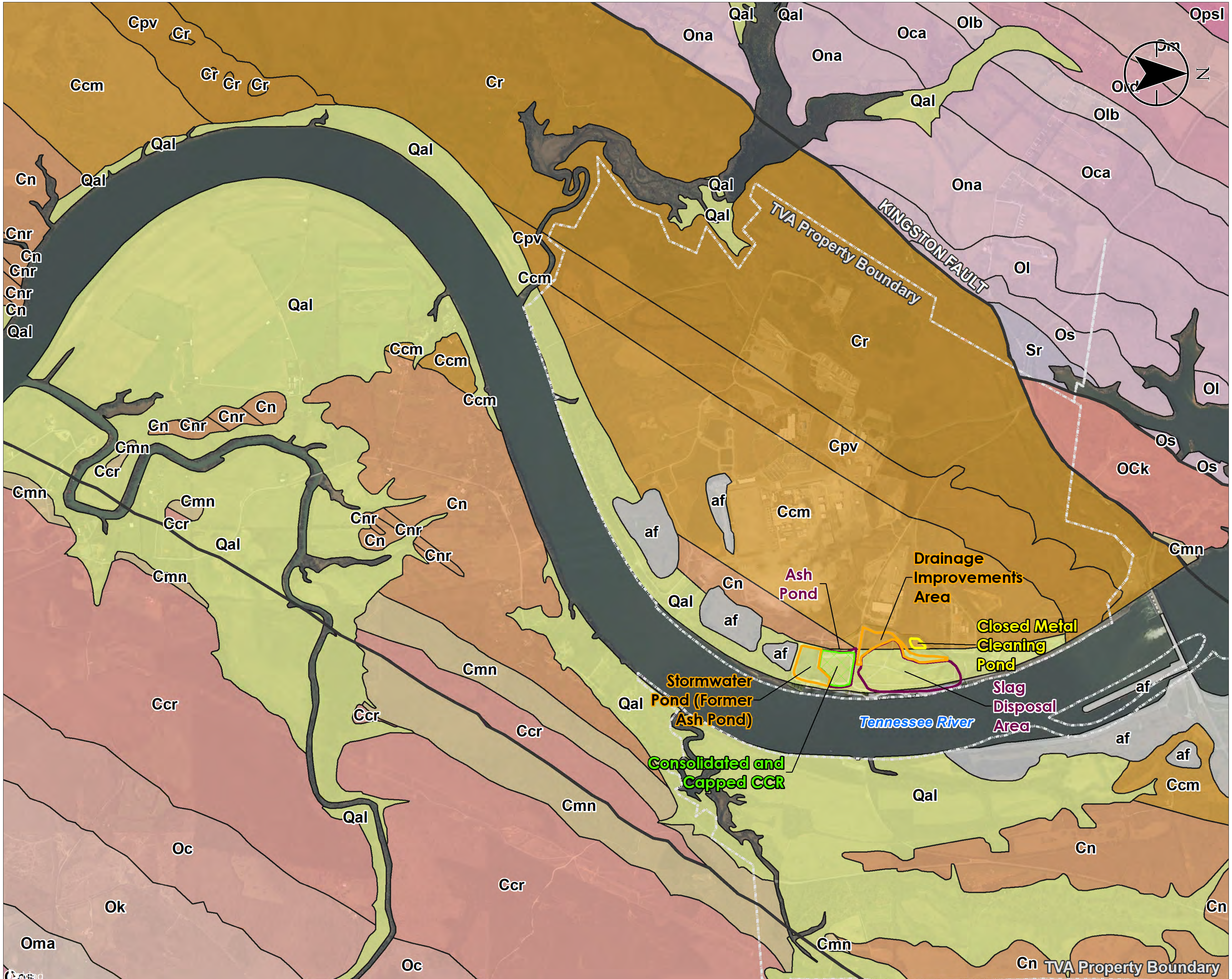
Project Location: Spring City, Tennessee

175668050

Prepared by MB on 2023-03-23
Technical Review by MD on 2023-03-23

0 | 850 | 1,700 | 2,550 | 3,400 Feet

1:10,200 (At original document size of 22x34)



Legend

- Fault
- CCR Management Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)

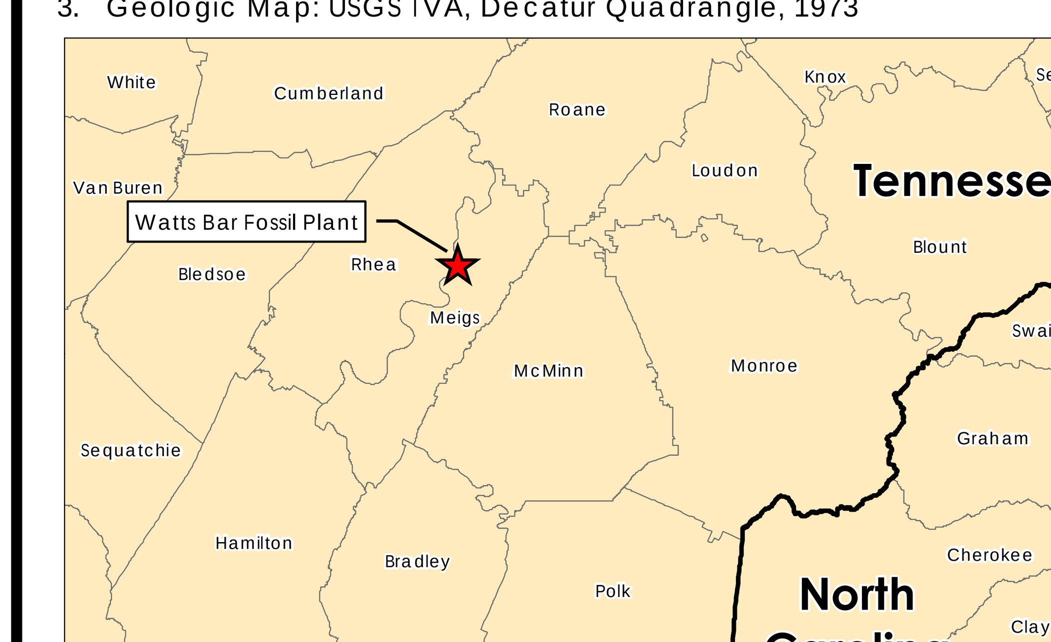
Geologic Formations

- af - Artificial Fill
- Qal - Quaternary Surficial Deposits
- Sr - Silurian Rockwood Formation
- Os - Ordovician Sequatchie Formation
- Ona - Ordovician Nashville Group Undivided
- Ol - Ordovician Leipers Limestone
- Oca - Ordovician Carters Limestone
- Olb - Ordovician Lebanon Limestone
- Ord - Ordovician Ridley Limestone
- Om - Ordovician Murfreesboro Limestone
- Ops - Ordovician Pond Springs Formation
- Opsl - Ordovician Pond Springs Dolomite
- OCk - Ordovician/Cambrian Knox Group
- Oma - Ordovician Mascot Dolomite
- Ok - Ordovician Kingsport Formation
- Oc - Ordovician Chepultepec Dolomite
- Ccr - Cambrian Copper Ridge Dolomite
- Cmn - Cambrian Maynardville Formation
- Cn / Cnr - Cambrian Nolichucky Shale
- Ccm - Cambrian Conasauga Middle Group
- Cpv - Cambrian Pumpkin Valley Shale
- Cr - Cambrian Rome Formation

Notes

CCR: Coal combustion residuals

1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by TVA (9/12/2018) and BING Imagery
3. Geologic Map: USGS TVA, Decatur Quadrangle, 1973



Stantec TVA

Exhibit No.
H.1-7

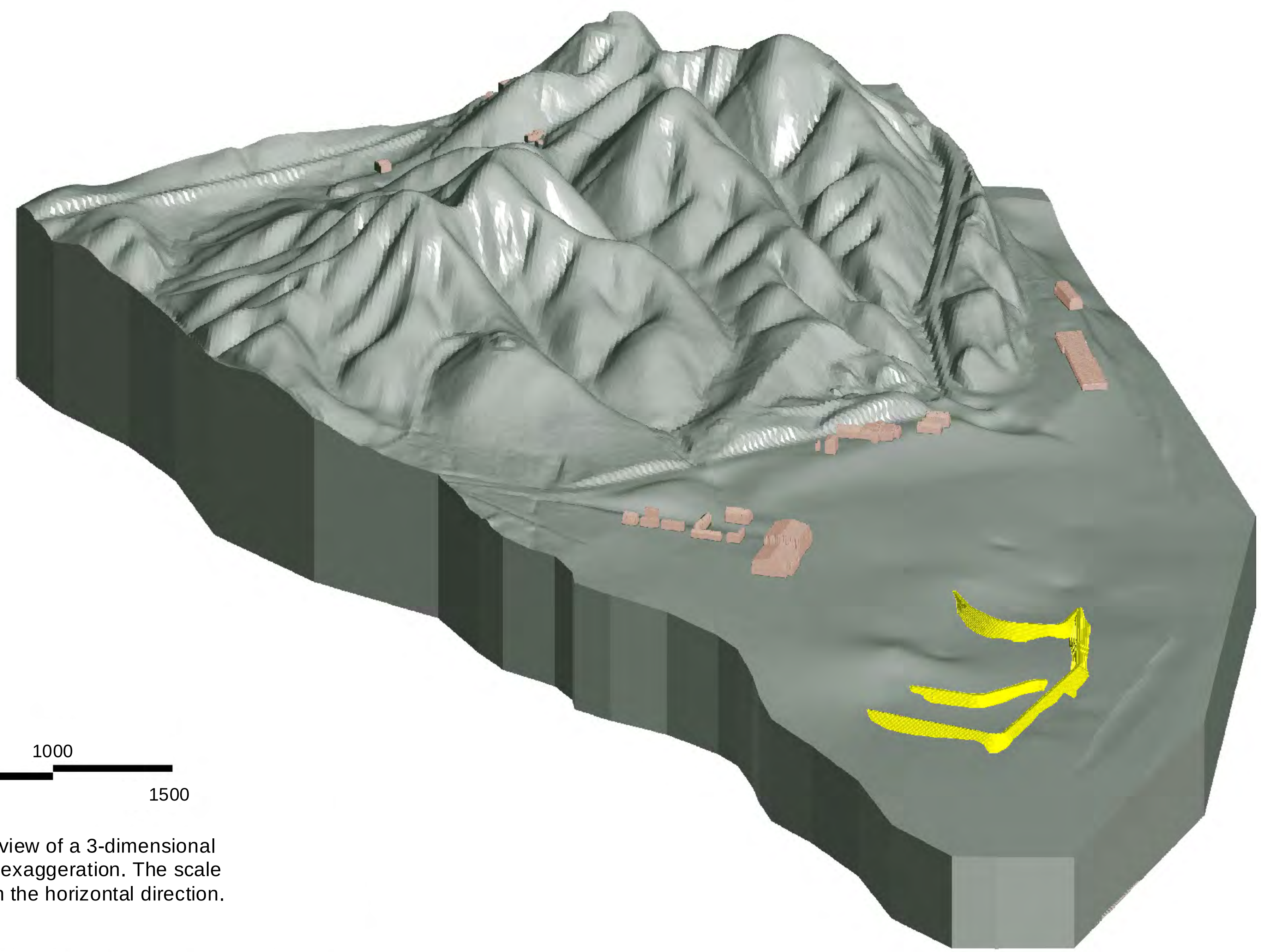
Title
Lithologic Model - Top of Bedrock (Oblique View Looking Northwest)

Client/Project 175668050
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Clinton, Tennessee
Spring City, Tennessee

Prepared by DMB on 2023-09-27
TR by MD on 2023-09-27
IR Review by RB on 2023-09-27

Legend
- Building Structure
- Clay Dike
- Bedrock
- Typical Surface Stream Flow Direction



N

0 500 1000 1500

Image is an oblique view of a 3-dimensional model at 3X vertical exaggeration. The scale above is valid only in the horizontal direction.

Stantec

TVA

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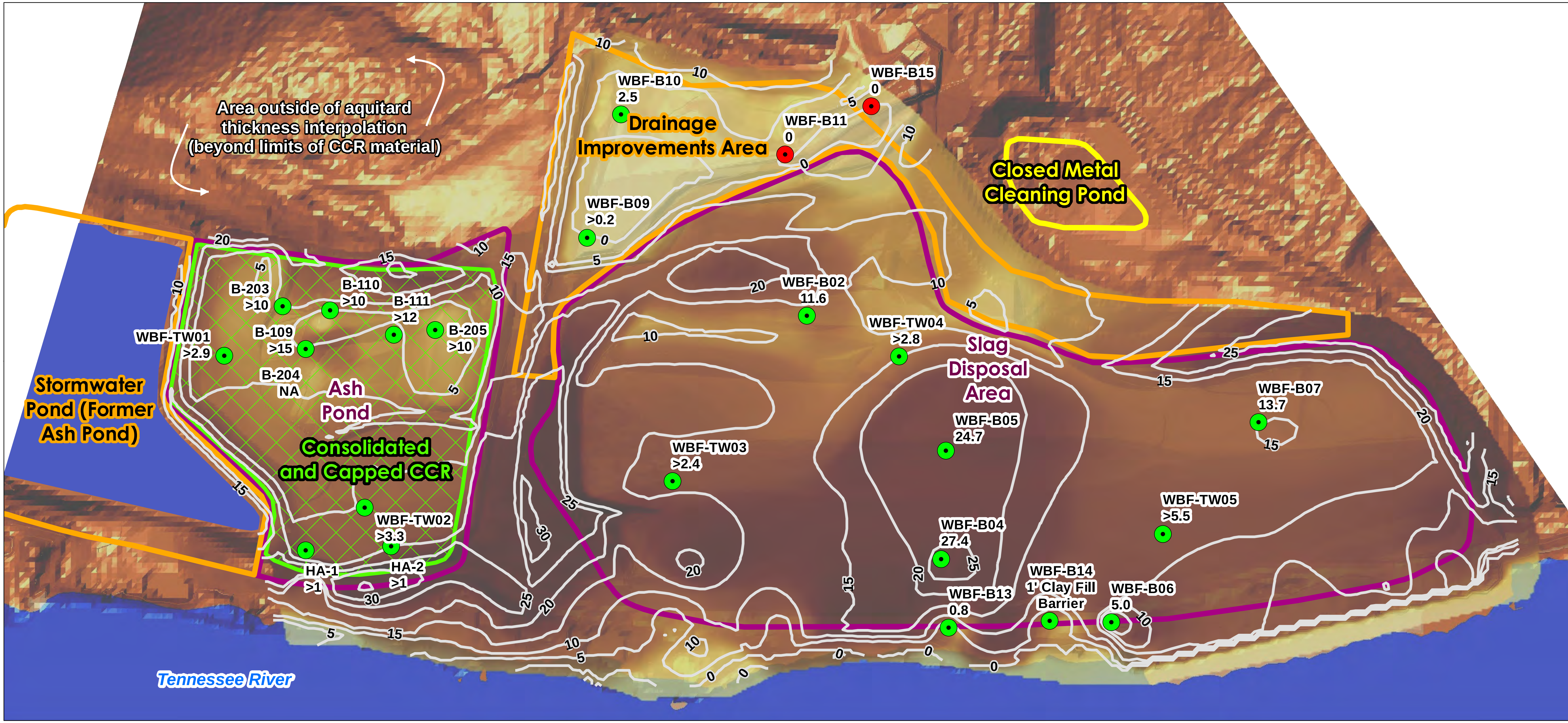

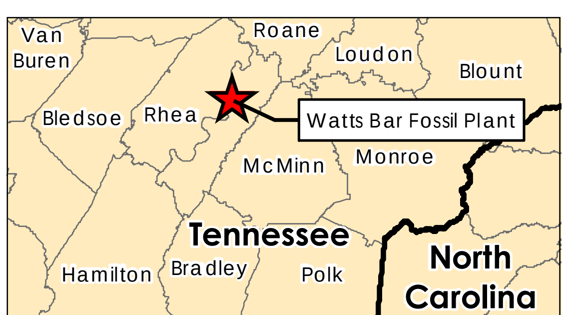

Legend

- Boring Location with Logged Clays/Silts
- Boring Location with Logged Clays/Silts Thickness of 0 feet (ft)
- Isopach Contour (5 ft interval)
- CCR Management Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)

Approximate Clay/Silt Thickness Range (feet)

- <5
- 5-10
- 10-15
- 15-20
- 20-25
- 25-30
- 30-35
- >35

0 200 400 Feet

(At original document size of 11x17)
1:2,400

N

CCR: Coal combustion residuals

Notes
1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. The isopach map was developed using the Leapfrog lithologic model and is based on the differential elevation of two surfaces: pre-construction ground surface and the top of the uppermost aquifer (either coarse alluvium or top of bedrock where coarse alluvium is absent). The boring locations with logged clay thinkness are posted as confirmatory data points.
3. Thickness values showing a ">" symbol refers to a location where the boring was stopped before penetrating the full thickness of the fine grained layer. At these locations the contouring is based solely on the differential elevation of the bottom of the CCR to the top of the alluvial aquifer model surface.

Stantec

TVA

Project Location
Spring City, Tennessee

Prepared by DMB on 2023-04-27
TR by MD on 2023-04-27
IR Review by JG on 2023-04-27

Client/Project
175668050
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Exhibit No.
H.1-8

Title
Thickness of Clays and Silts Above Uppermost Aquifer

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Exhibit No.

H.1-9

Title

Lithologic Model - Physiographic Setting (Oblique View Looking Northwest)

Client/Project 175668050

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Clinton, Tennessee
Spring City, Tennessee

Prepared by DMB on 2023-10-04
TR by MD on 2023-10-04
IR Review by RB on 2023-10-04

Legend

- Typical Surface Stream Flow Direction
- Study Area

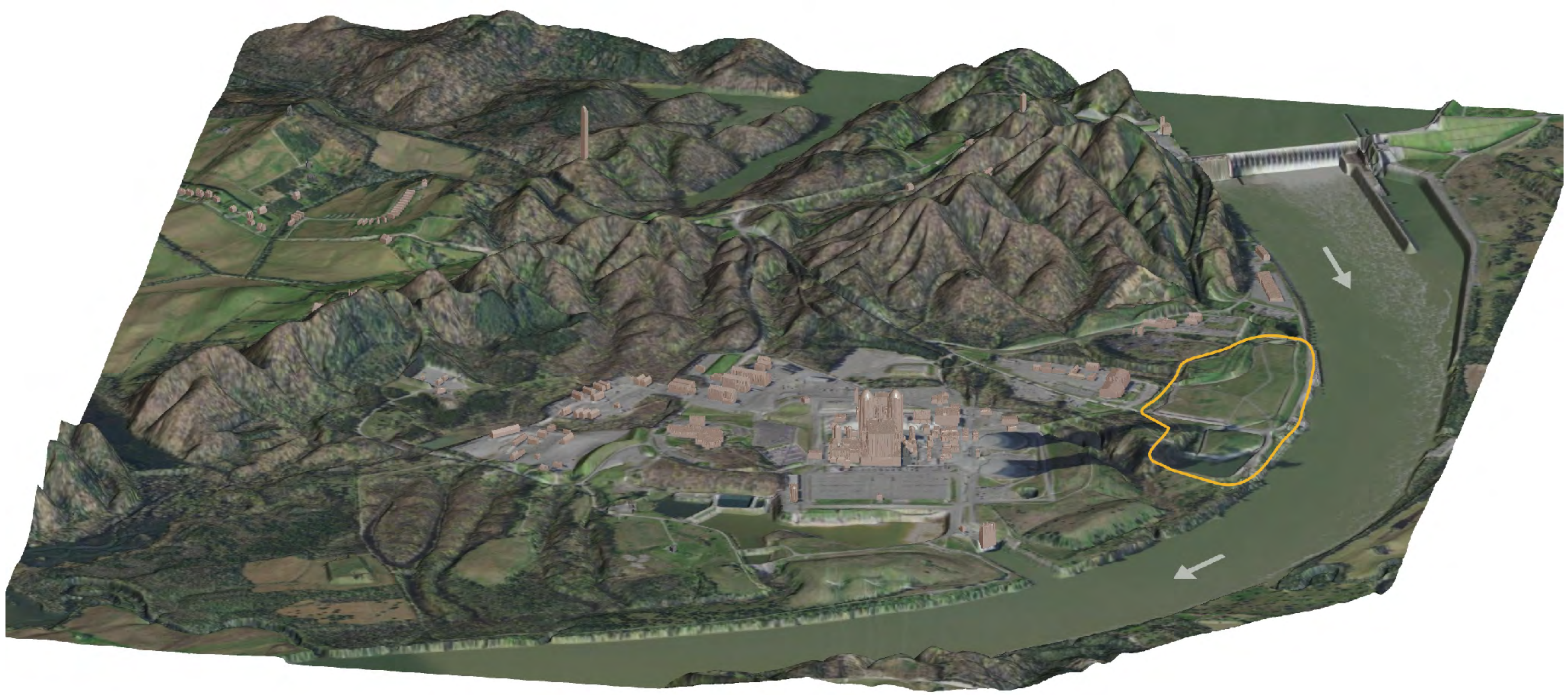

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Exhibit No.
H.1-10

Title
Groundwater Elevation Contour Map, Event #6 (July 6, 2020)

Client/Project
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location 175668050
Spring City, Tennessee
Prepared by DMB on 2022-07-21
Technical Review by MD on 2022-07-21

0 150 300 450 600 Feet
1:1,800 (At original document size of 22x34)

Legend

- Groundwater Investigation Monitoring Well groundwater elevation in feet above mean sea level (ft amsl)
- Other Monitoring Well groundwater elevation in ft amsl
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary well in CCR pore water elevation in ft amsl; value not used for contouring
- Interpolated Groundwater Contour (5 ft interval; elevations are in ft amsl)
- Groundwater Contour (5 ft interval; elevations are in ft amsl)
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

CCR: Coal combustion residuals

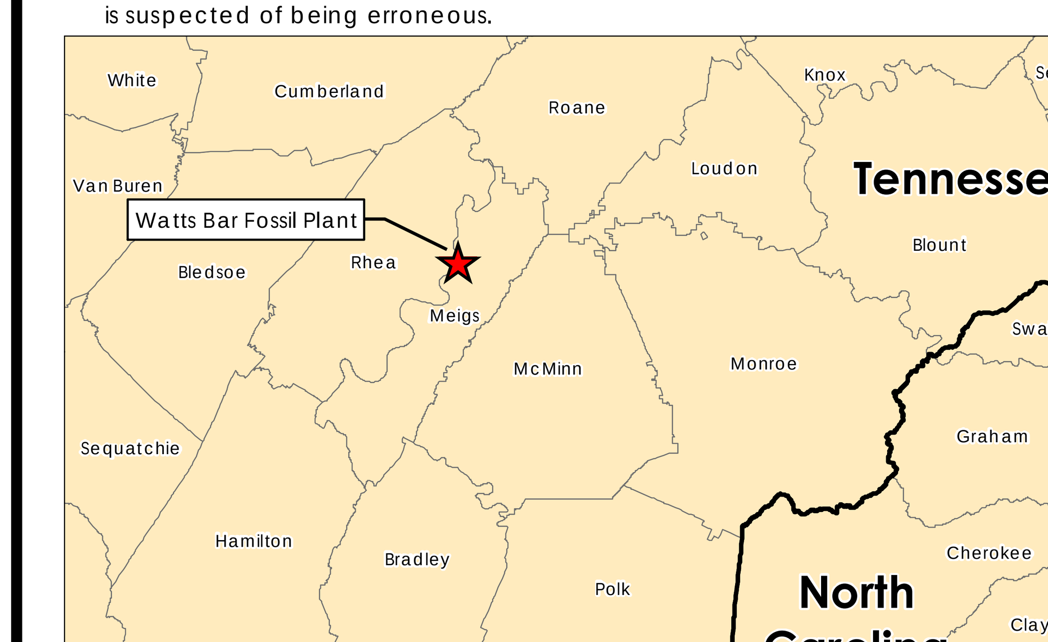
River Gauge (Not Shown - See Note 4) surface water elevation in ft amsl

*Groundwater elevation displayed but not used as input for contouring due to factors such as well construction or being screened in a different hydrogeologic unit.

*** Nested VWPZ sensors monitoring pore water and groundwater elevations in the same borehole, and the location is shown by a single symbol.

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery
3. Groundwater contours were created using Surfer Version 16.1.350 (December 13, 2018) and manual adjustment
4. Surface water elevation is measured from the tailwater reading from Watts Bar Dam located ~4,000 ft North of well WBF-106
5. For PZ's with multiple instruments in CCR material, the reading with the highest pore water elevation is displayed, unless that reading is suspected of being erroneous.



Stantec TVA

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Exhibit No.

H.1-11

Title

WBF Instrumentation Used for Surface Water / Pore Water / Groundwater Hydrograph Comparison

Client/Project

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location: Spring City, Tennessee

175668050

Prepared by MB on 2023-08-22
Technical Review by MD on 2023-08-22

0 150 300 450 600 Feet

1:1,800 (At original document size of 22x34)

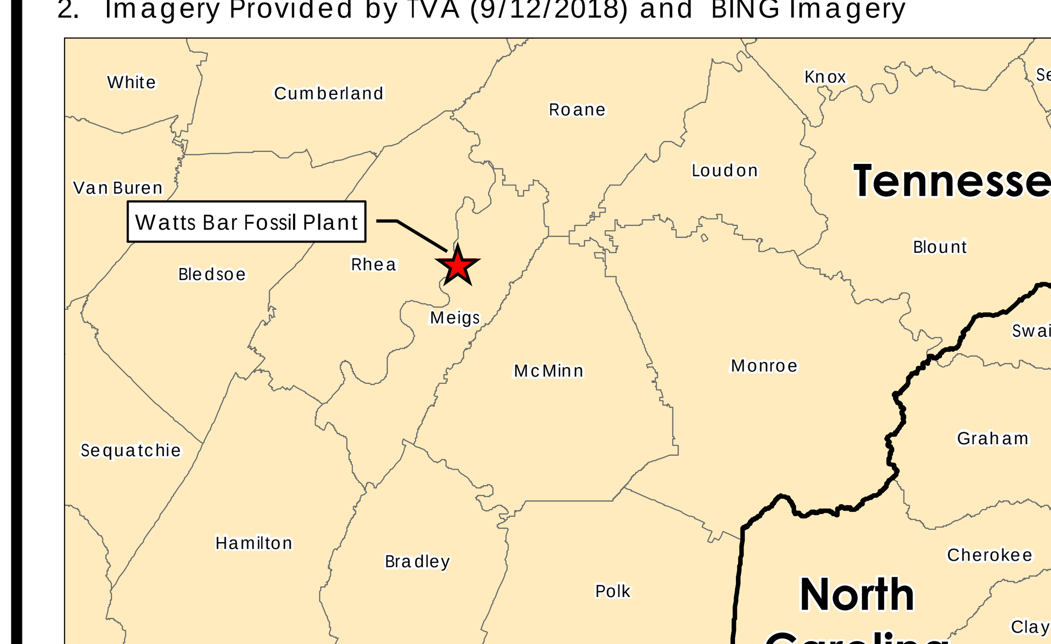
Legend

- Piezometer
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery



Stantec TVA

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Exhibit No.

H.1-12

Title

Groundwater / Surface Water Elevation Comparison

Client/Project 175668050

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

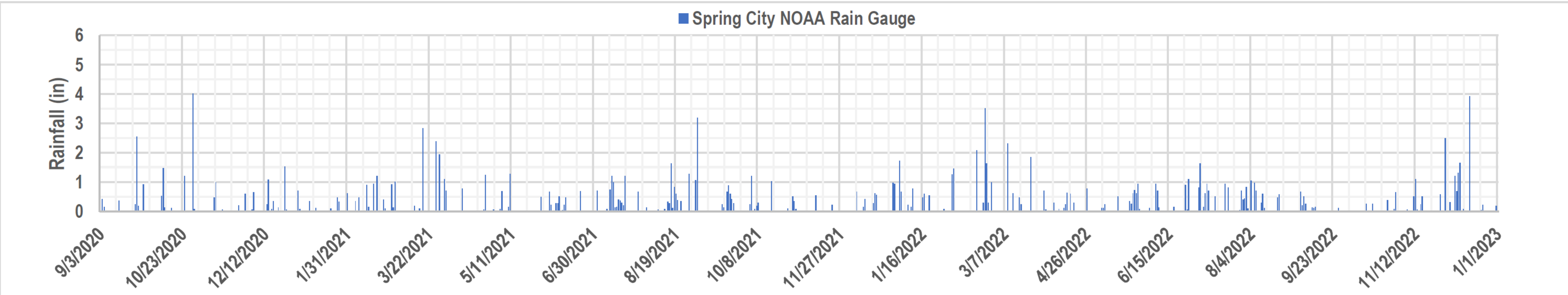
Clinton, Tennessee
Spring City, Tennessee

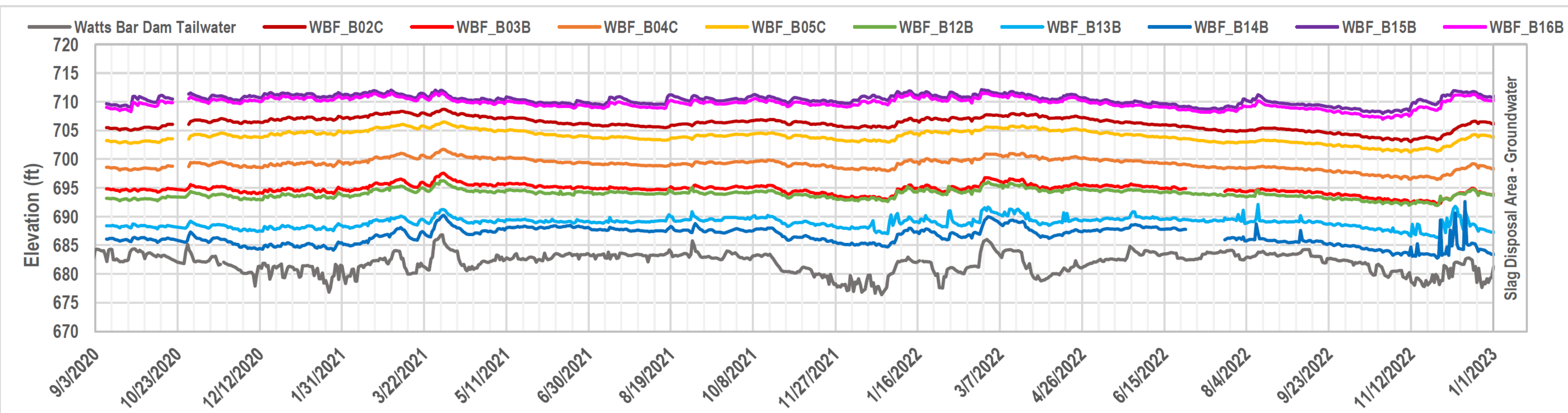
Prepared by JS on 2022-07-06
ITR by MD on 2022-07-06

Legend

ft- feet

in - inches





Stantec

TVA

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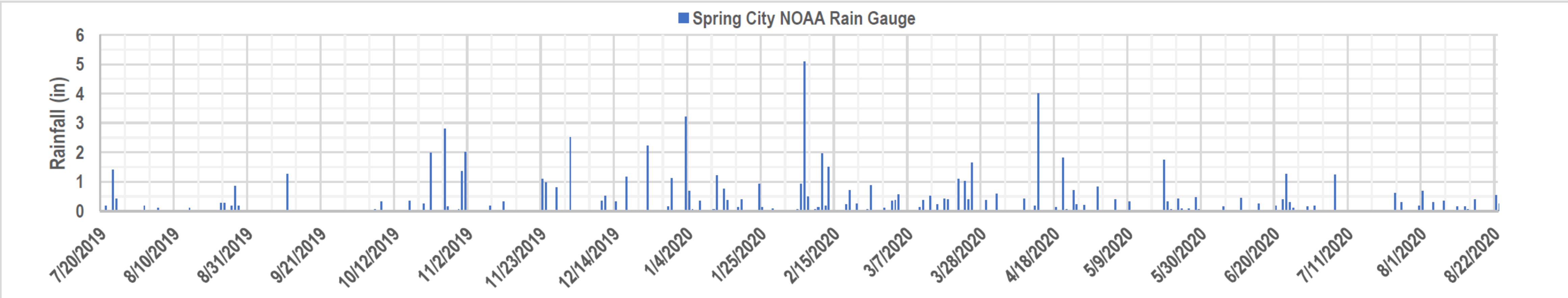
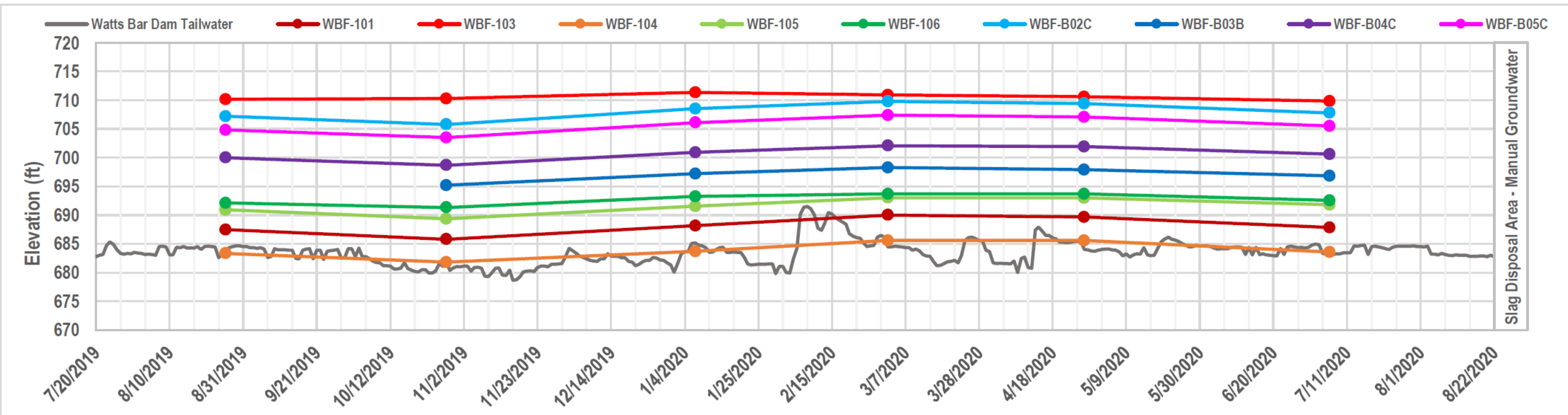




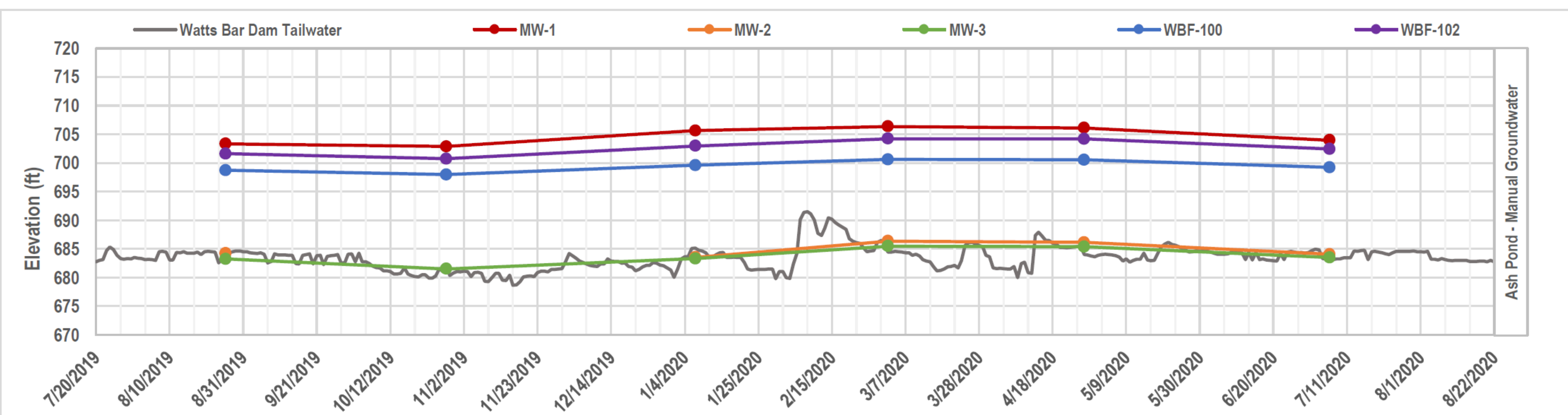


Exhibit No.

H.1-13

Title

Groundwater / Surface Water Elevation Comparison - Manual Instrumentation

Client/Project 175668050

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Clinton, Tennessee
Spring City, Tennessee

Prepared by JS on 2022-07-06
ITR by MD on 2022-07-06

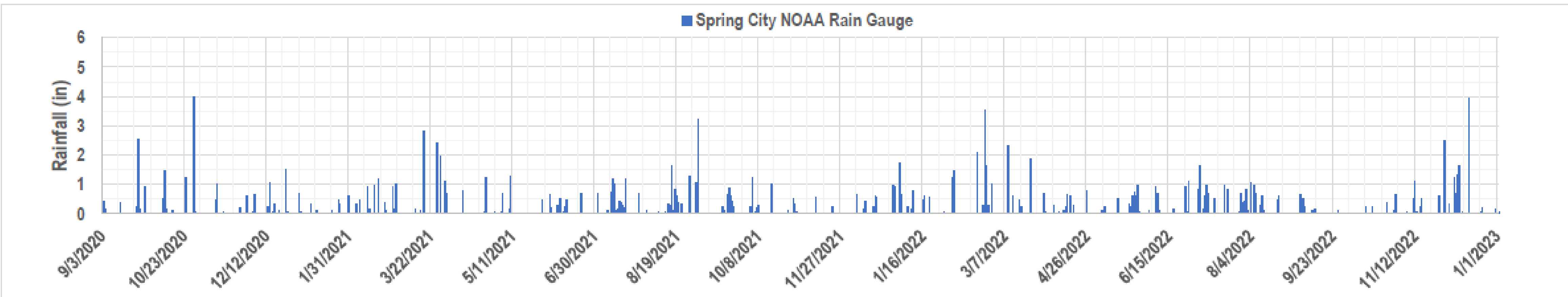
Legend

ft- feet
in - inches

Stantec

TVA

U:\TVA-EIP\175668050_WBF_WorkPlans\gis\mxd\EAR\H.1-11_ConcentrationsB_Cl_SO_CO_WBF-106.mxd Revised: 2022-06-29 By: mbough



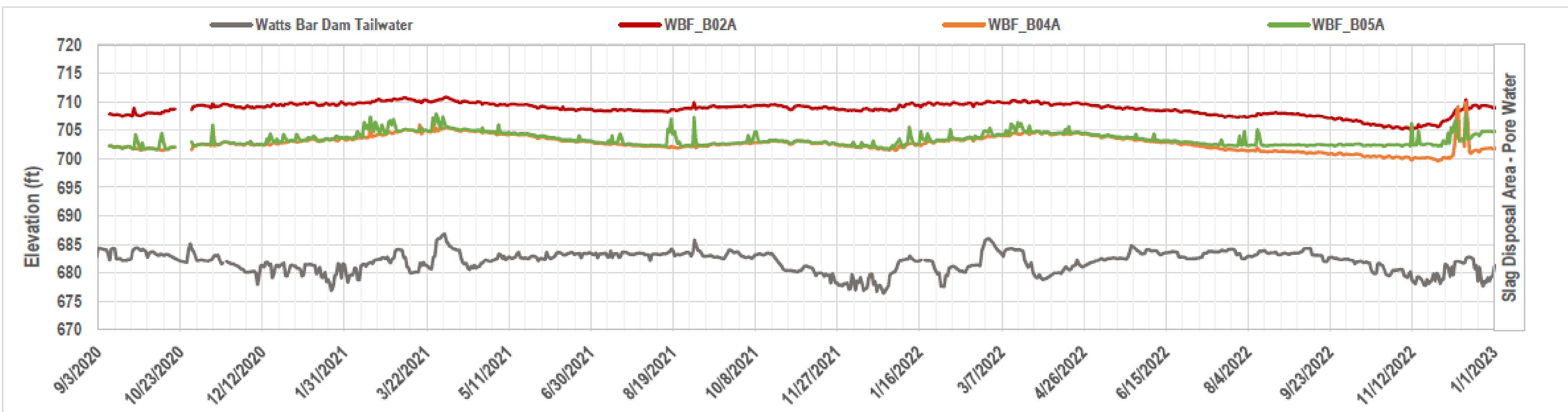


Exhibit No.

H.1-14

Title

Pore Water / Surface Water Elevation Comparison

Client/Project 175668050

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Clinton, Tennessee
Spring City, Tennessee

Prepared by JS on 2022-07-06
ITR by MD on 2022-07-06

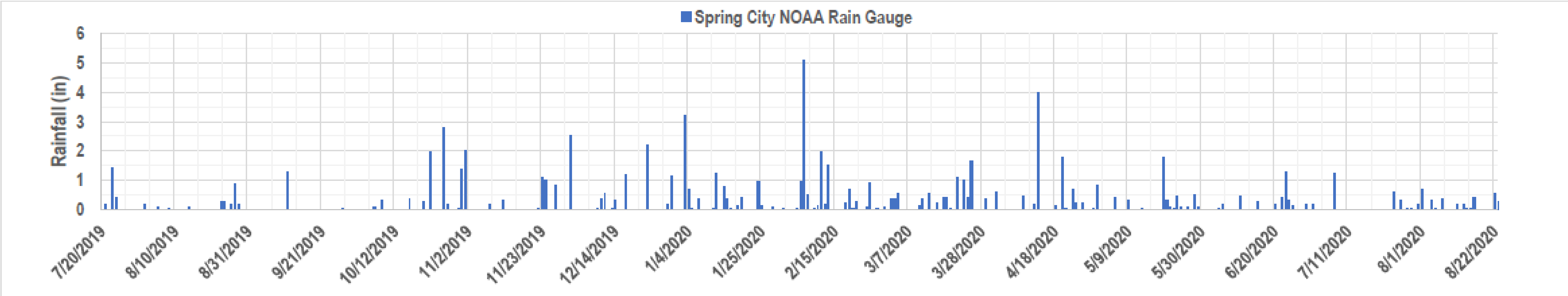
Legend

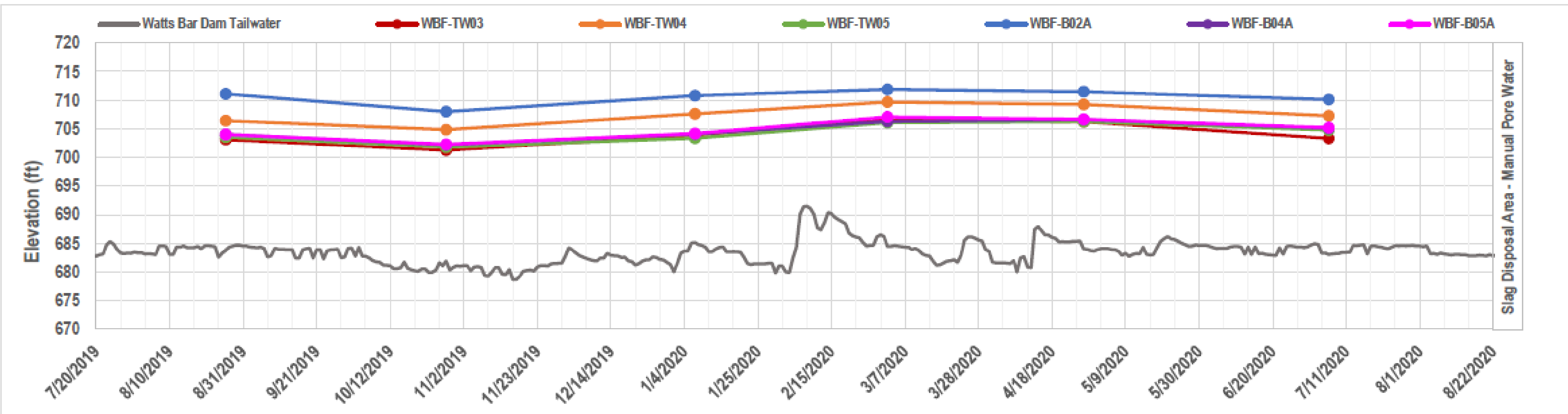
ft- feet
in - inches
NOAA - National Oceanic and Atmospheric Administration

Stantec

TVA

U:\TVA-EIP\175668050_WBF_WorkPlans\gis\mxd\EAR\H.1-11_ConcentrationsB_Cl_SO_CO_WBF-106.mxd Revised: 2022-06-29 By: mbough





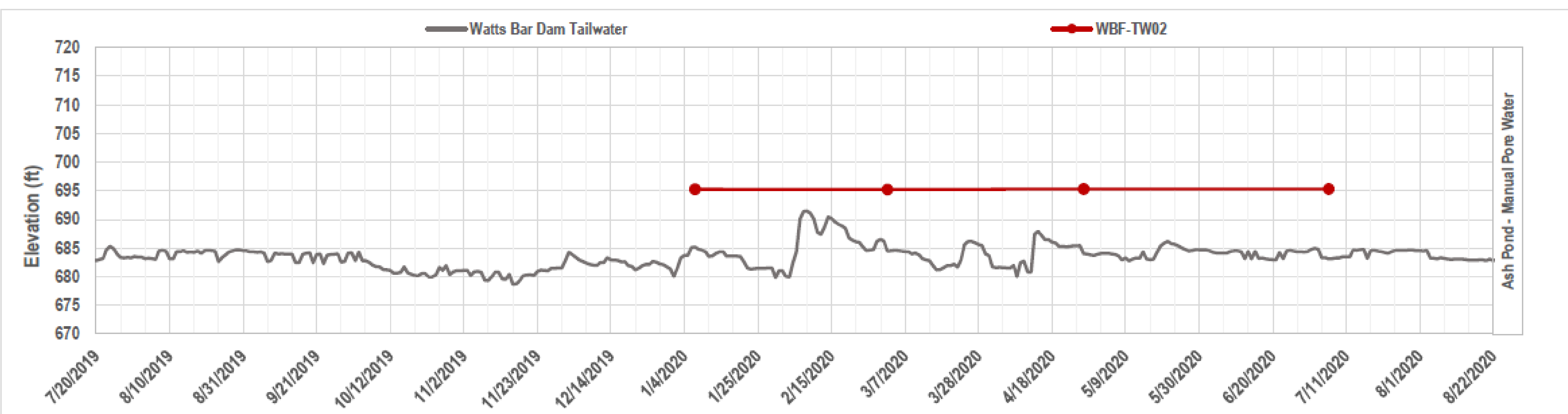


Exhibit No.

H.1-15

Title

Pore water / Surface Water Elevation Comparison - Manual Instrumentation

Client/Project 175668050

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Clinton, Tennessee
Spring City, Tennessee

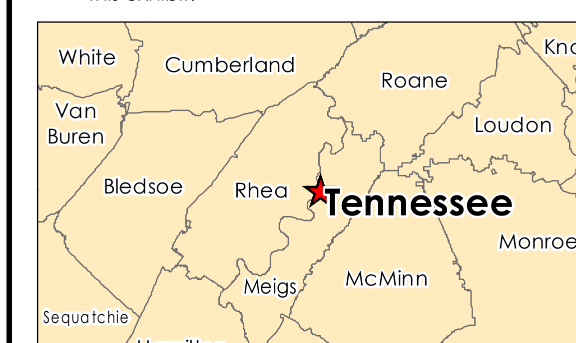
Prepared by JS on 2022-07-06
ITR by MD on 2022-07-06

Legend

ft- feet
in - inches
NOAA - National Oceanic and Atmospheric Administration

Notes:

1. The depth to water readings at WBF-TW03 and WBF-TW04 were inadvertently switched during the 4/27/2020 gauging event. This has been corrected in this exhibit.



Stantec

TVA

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Exhibit No.

H.1-16

Title

Summary of Statistical Evaluation of Groundwater Analytical Results for CCR Rule Appendix IV and TDEC Appendix I Constituents

Client/Project

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location 175668050

Spring City, Tennessee

Prepared by MB on 2023-04-06
Technical Review by LP on 2023-04-06

0 150 300 450 600 Feet

1:1,800 (At original document size of 22x34)

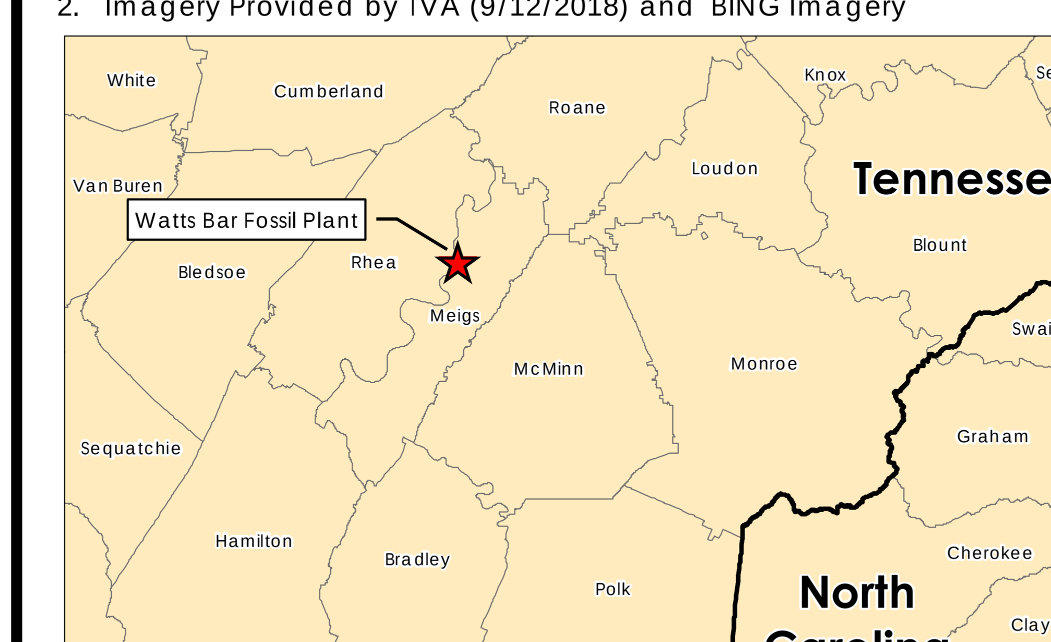
Legend

- EIP Program Well
- TDEC Non-Registered Site Wells
- Piezometer
- Temporary Well within CCR Material
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery



Stantec TVA

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WBF July 2020

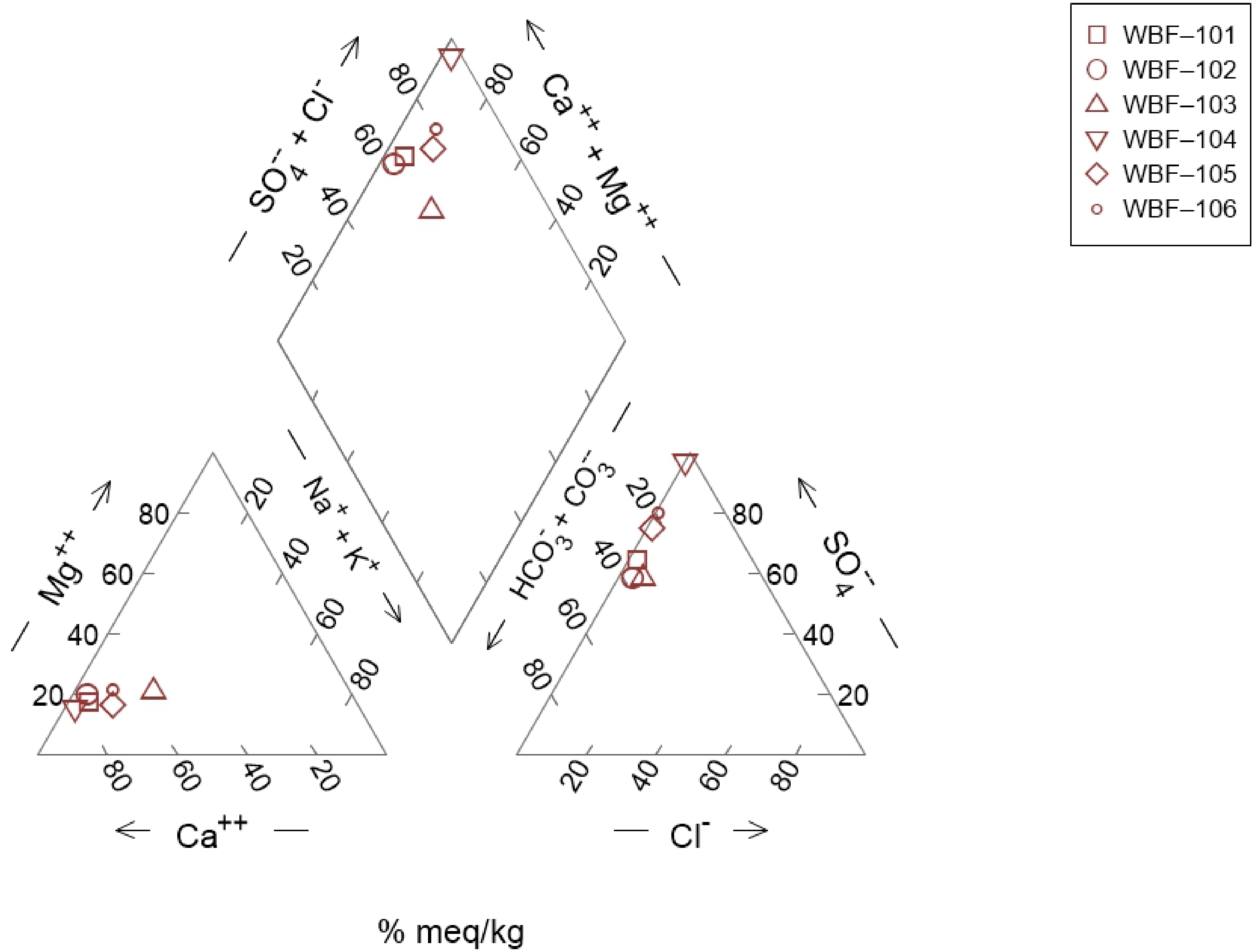


Exhibit No.

H.1-17

Title

Piper Diagram - July 2020

Client/Project 175668050

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Clinton, Tennessee
Spring City, Tennessee

Prepared by DMB on 2022-06-21
TR by BL on 2022-06-21
IR Review by RB on 2022-06-21

Legend

Notes

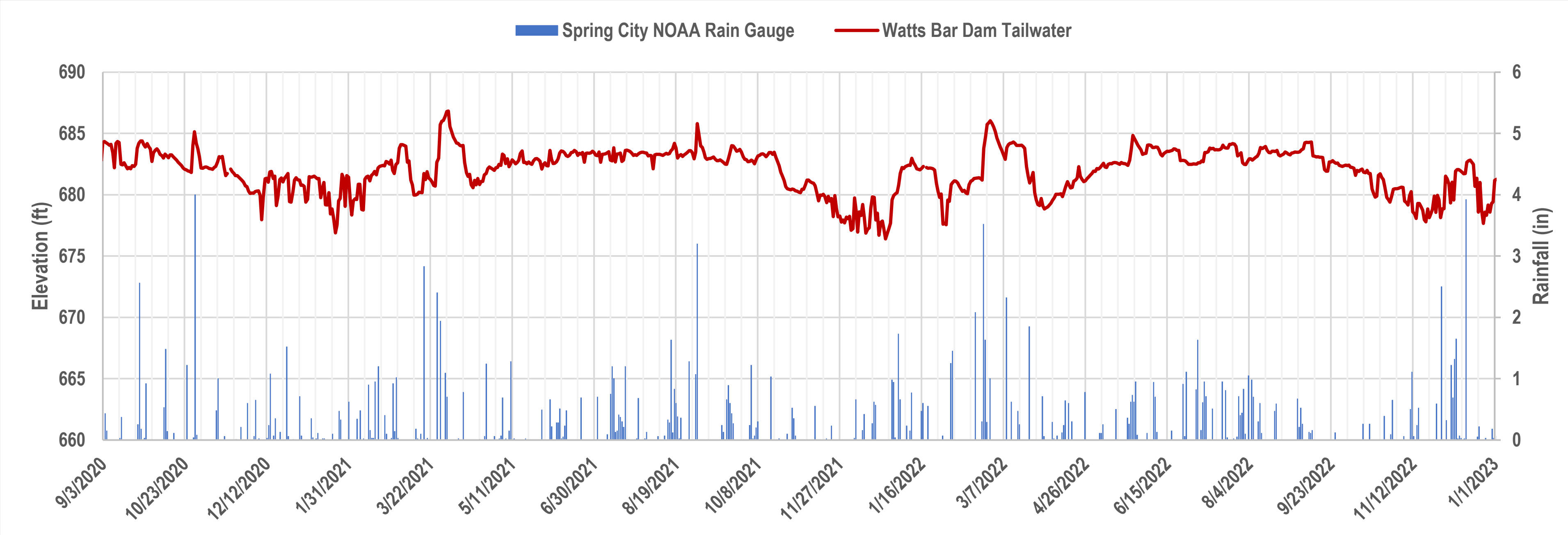
1. % meq/kg - Percent milliequivalent per kilogram
2. Ca^{++} - Calcium
3. Cl^- - Chloride
4. CO_3 - Carbonate
5. HCO_3 - Bicarbonate
6. K^+ - Potassium
7. Mg^{++} - Magnesium
8. Na^+ - Sodium
9. SO_4 - Sulfate

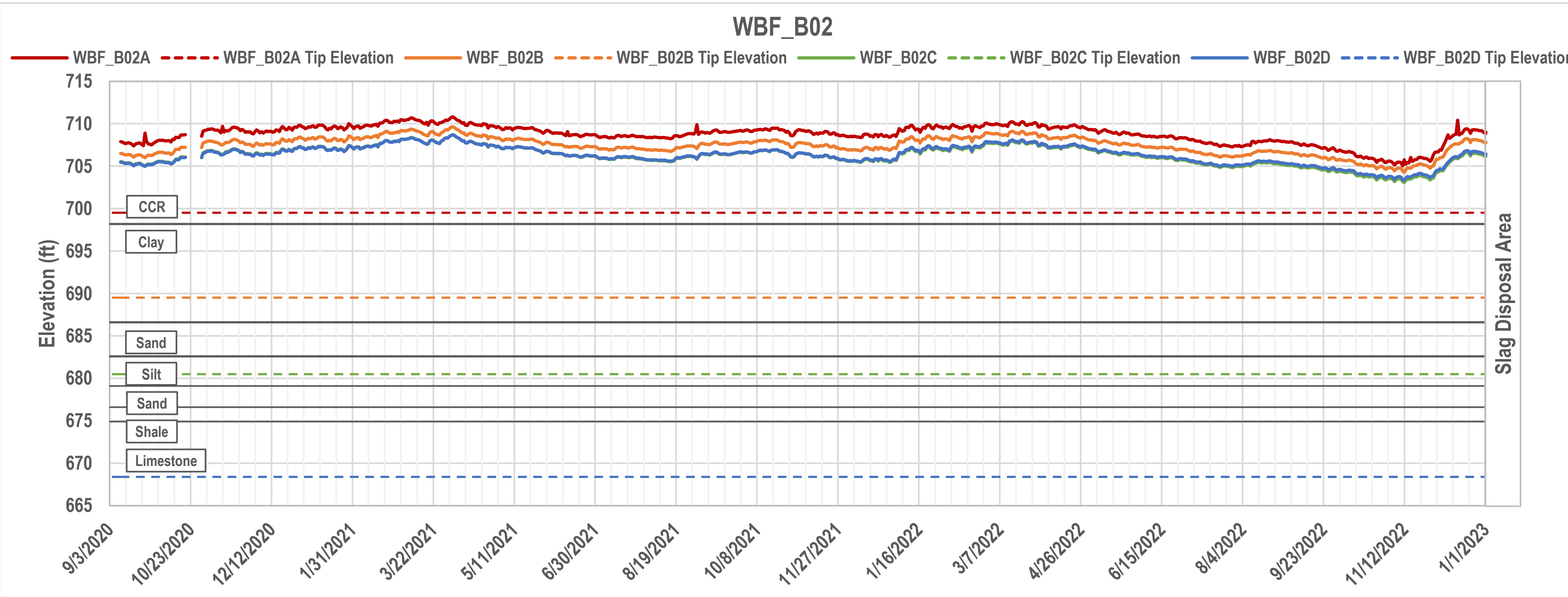
Stantec

TVA

U:\TVA-EIP\175668050_WBF_WorkPlans\gis\mxd\EAR\H.1-7_PiperPlot_July2020.mxd Revised: 2022-06-21 By: mbough

ATTACHMENT H.1-A HYDROGRAPHS


Spring City NOAA Rain Gauge
Watts Bar Dam Tailwater
Elevation (ft)
Rainfall (in)
690
685
680
675
670
665
660
6
5
4
3
2
1
0
9/3/2020
10/23/2020
12/12/2020
1/31/2021
3/22/2021
5/11/2021
6/30/2021
8/19/2021
10/8/2021
11/27/2021
1/16/2022
3/7/2022
4/26/2022
6/15/2022
8/4/2022
9/23/2022
11/12/2022
1/1/2023


WBF_B02
WBF_B02A
WBF_B02A Tip Elevation
WBF_B02B
WBF_B02B Tip Elevation
WBF_B02C
WBF_B02C Tip Elevation
WBF_B02D
WBF_B02D Tip Elevation
Elevation (ft)
715
710
705
700
695
690
685
680
675
670
665
CCR
Clay
Sand
Silt
Sand
Shale
Limestone
Slag Disposal Area
9/3/2020
10/23/2020
12/12/2020
1/31/2021
3/22/2021
5/11/2021
6/30/2021
8/19/2021
10/8/2021
11/27/2021
1/16/2022
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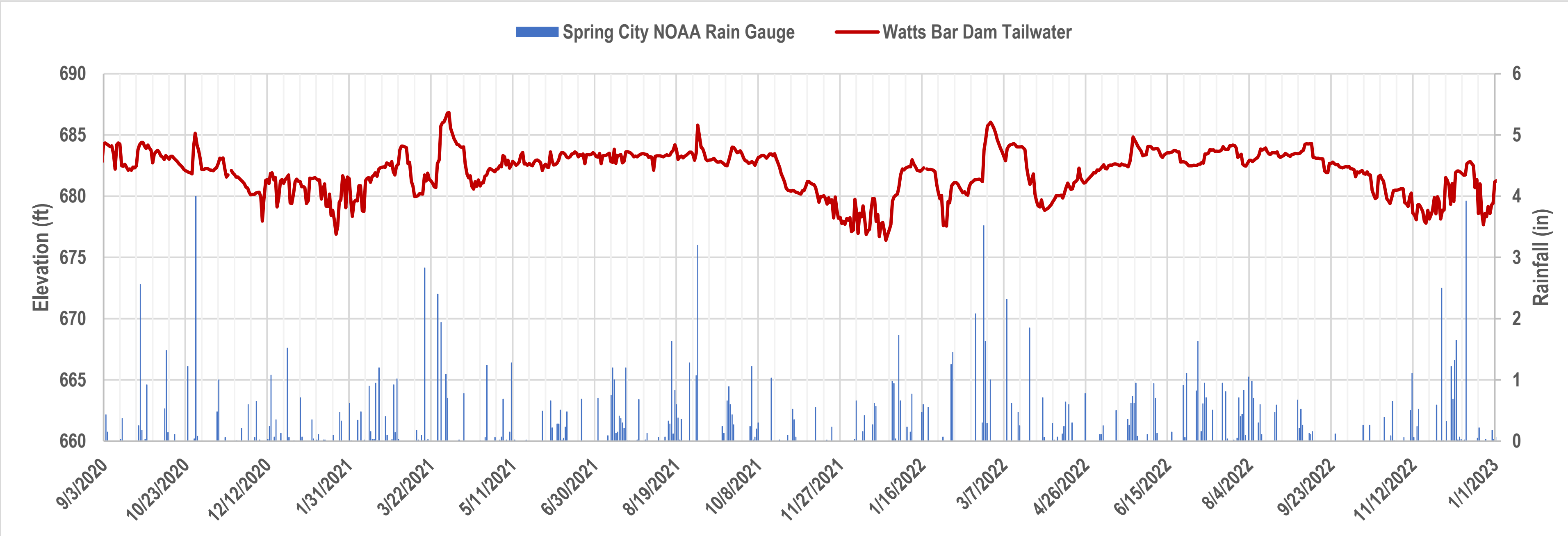
9/23/2022
11/12/2022
1/1/2023


Spring City NOAA Rain Gauge
Watts Bar Dam Tailwater
Elevation (ft)
Rainfall (in)
690
685
680
675
670
665
660
6
5
4
3
2
1
0
9/3/2020
10/23/2020
12/12/2020
1/31/2021
3/22/2021
5/11/2021
6/30/2021
8/19/2021
10/8/2021
11/27/2021
1/16/2022
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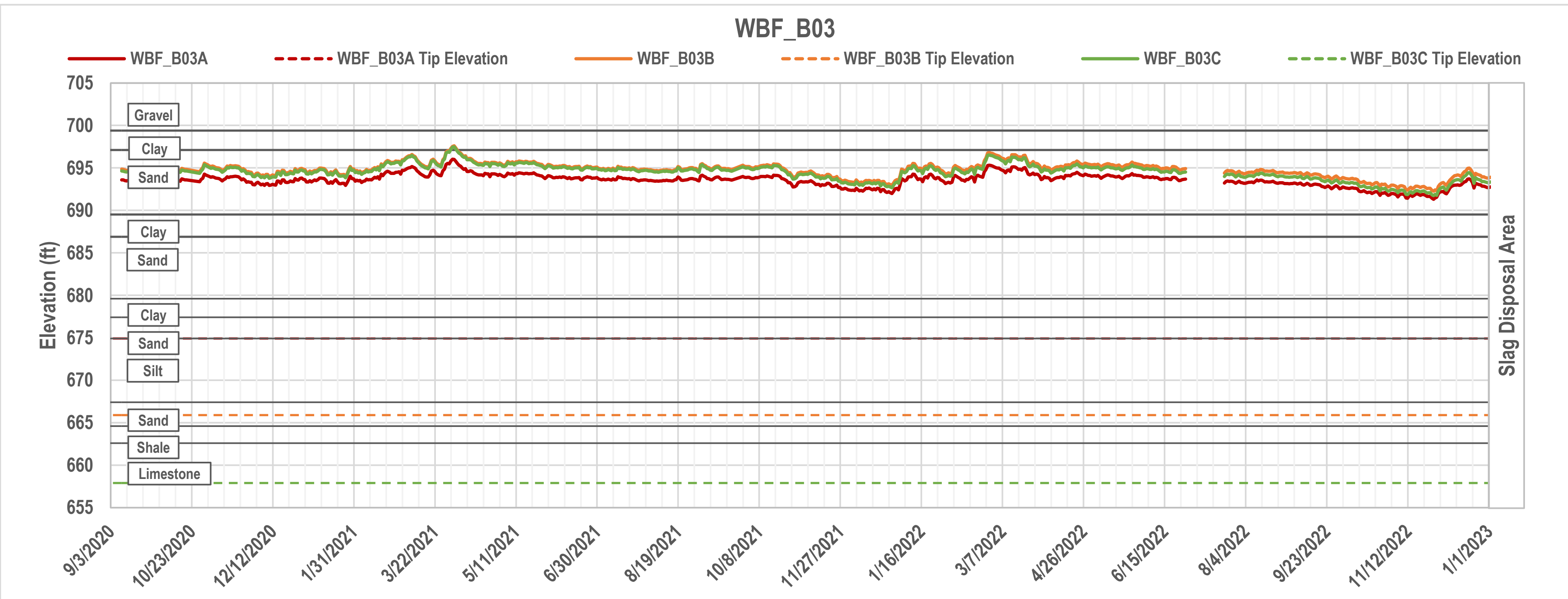
8/4/2022
9/23/2022
11/12/2022
1/1/2023


WBF_B03
WBF_B03A
WBF_B03A Tip Elevation
WBF_B03B
WBF_B03B Tip Elevation
WBF_B03C
WBF_B03C Tip Elevation
Elevation (ft)
705
700
695
690
685
680
675
670
665
660
655
Gravel
Clay
Sand
Clay
Sand
Clay
Sand
Silt
Sand
Shale
Limestone
Slag Disposal Area
9/3/2020
10/23/2020
12/12/2020
1/31/2021
3/22/2021
5/11/2021
6/30/2021
8/19/2021
10/8/2021
11/27/2021
1/16/2022
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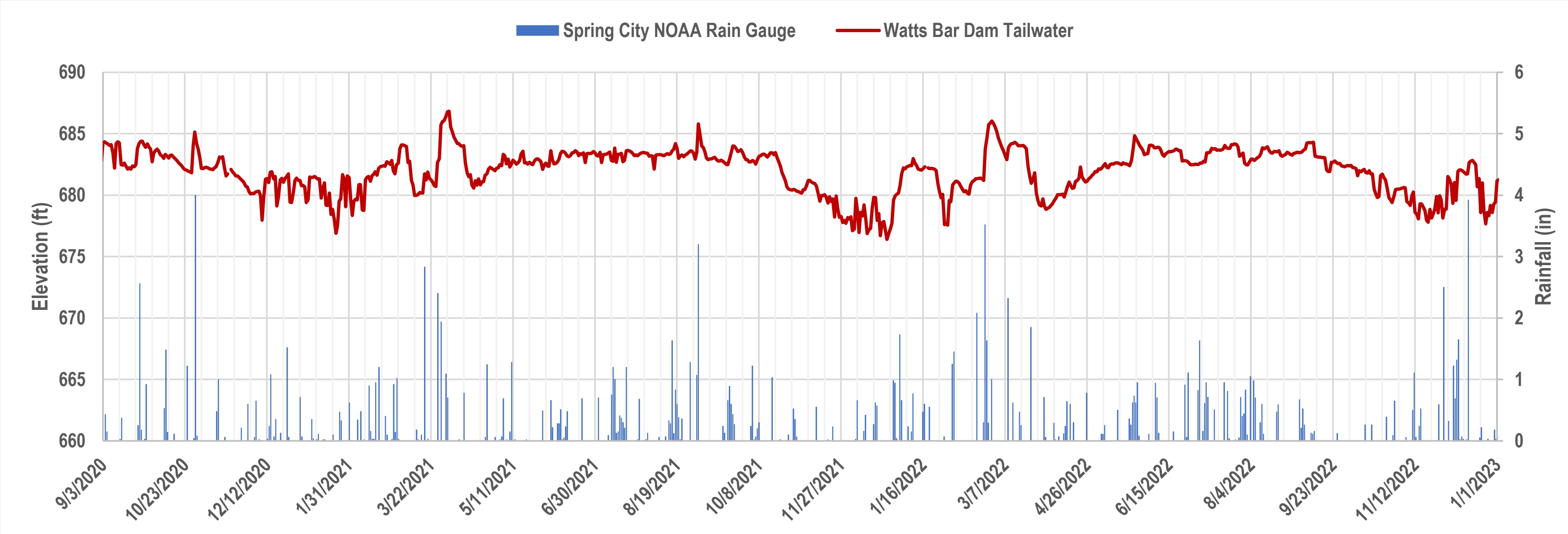
11/12/2022
1/1/2023


Spring City NOAA Rain Gauge
Watts Bar Dam Tailwater
Elevation (ft)
Rainfall (in)
690
685
680
675
670
665
660
6
5
4
3
2
1
0
9/3/2020
10/23/2020
12/12/2020
1/31/2021
3/22/2021
5/11/2021
6/30/2021
8/19/2021
10/8/2021
11/27/2021
1/16/2022
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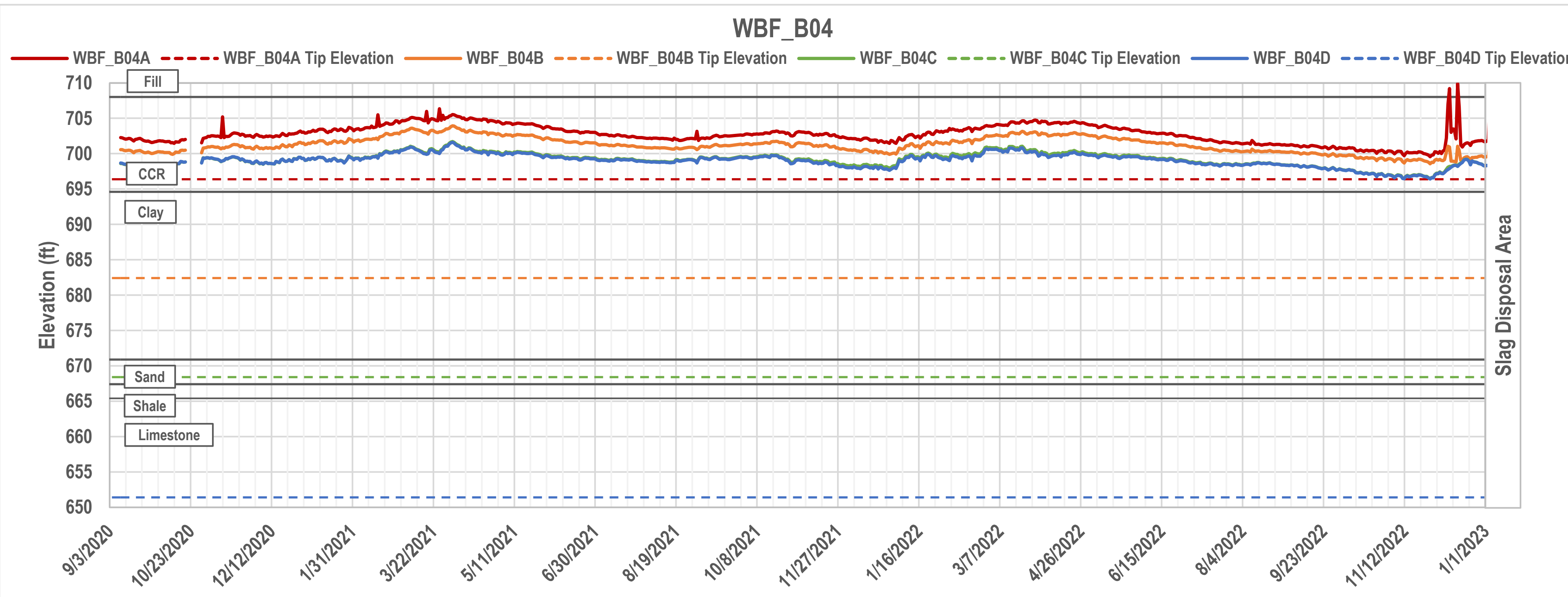
9/23/2022
11/12/2022
1/1/2023


WBF_B04
WBF_B04A
WBF_B04A Tip Elevation
WBF_B04B
WBF_B04B Tip Elevation
WBF_B04C
WBF_B04C Tip Elevation
WBF_B04D
WBF_B04D Tip Elevation
Fill
CCR
Clay
Sand
Shale
Limestone
Elevation (ft)
Slag Disposal Area
710
705
700
695
690
685
680
675
670
665
660
655
650
9/3/2020
10/23/2020
12/12/2020
1/31/2021
3/22/2021
5/11/2021
6/30/2021
8/19/2021
10/8/2021
11/27/2021
1/16/2022
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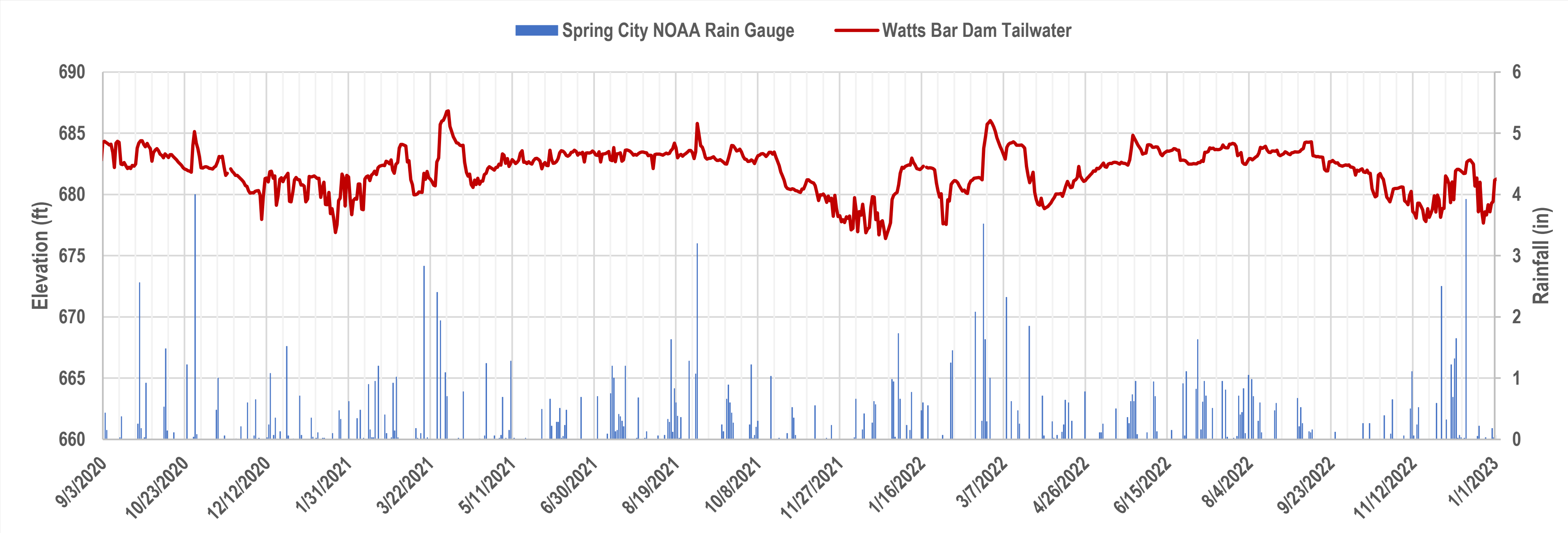
8/4/2022
9/23/2022
11/12/2022
1/1/2023



Spring City NOAA Rain Gauge
Watts Bar Dam Tailwater
Elevation (ft)
Rainfall (in)
690
685
680
675
670
665
660
6
5
4
3
2
1
0
9/3/2020
10/23/2020
12/12/2020
1/31/2021
3/22/2021
5/11/2021
6/30/2021
8/19/2021
10/8/2021
11/27/2021
1/16/2022
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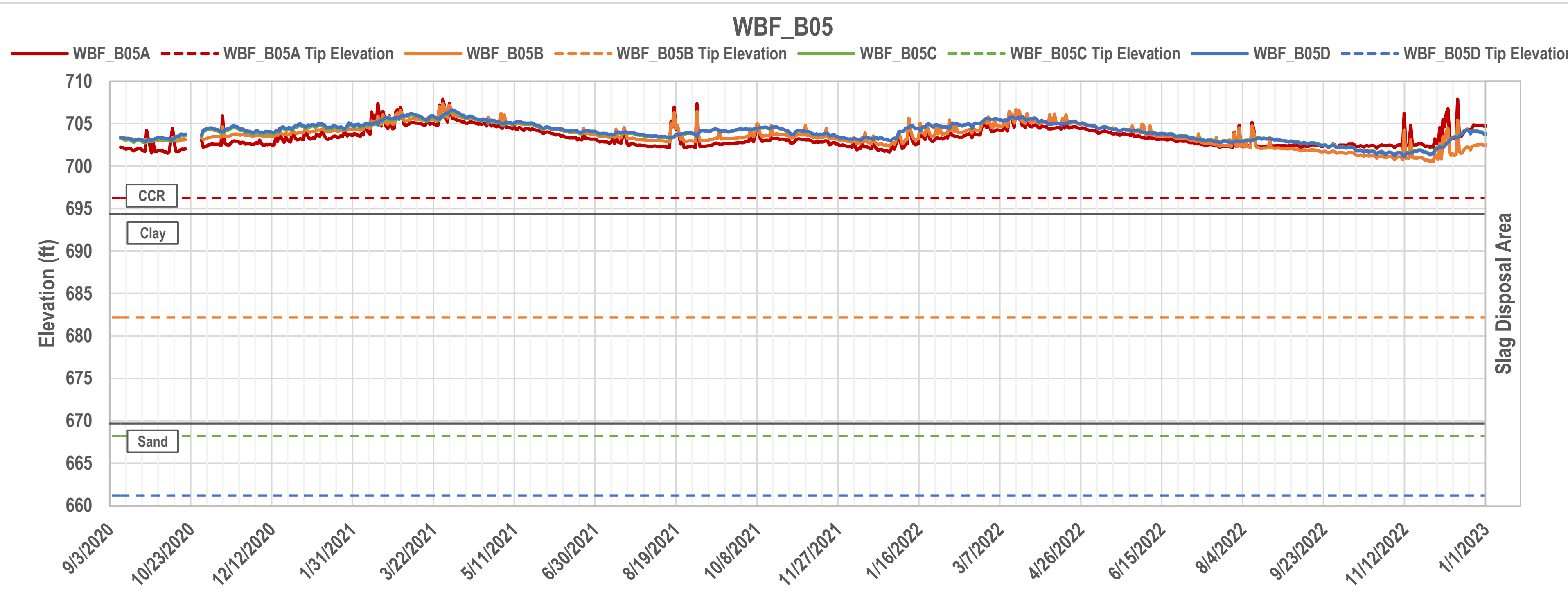
11/12/2022
1/1/2023



WBF_B05
WBF_B05A
WBF_B05A Tip Elevation
WBF_B05B
WBF_B05B Tip Elevation
WBF_B05C
WBF_B05C Tip Elevation
WBF_B05D
WBF_B05D Tip Elevation
Elevation (ft)
710
705
700
695
690
685
680
675
670
665
660
CCR
Clay
Sand
Slag Disposal Area
9/3/2020
10/23/2020
12/12/2020
1/31/2021
3/22/2021
5/11/2021
6/30/2021
8/19/2021
10/8/2021
11/27/2021
1/16/2022
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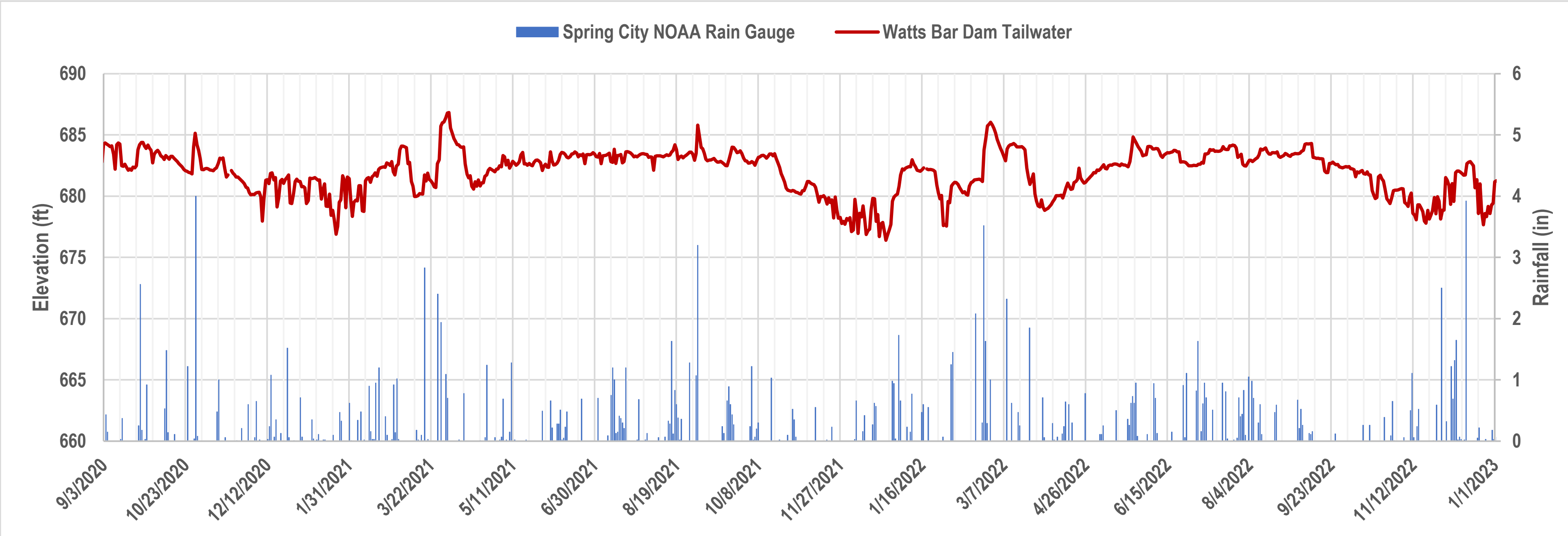
8/4/2022
9/23/2022
11/12/2022
1/1/2023



Spring City NOAA Rain Gauge
Watts Bar Dam Tailwater
Elevation (ft)
Rainfall (in)
690
685
680
675
670
665
660
6
5
4
3
2
1
0
9/3/2020
10/23/2020
12/12/2020
1/31/2021
3/22/2021
5/11/2021
6/30/2021
8/19/2021
10/8/2021
11/27/2021
1/16/2022
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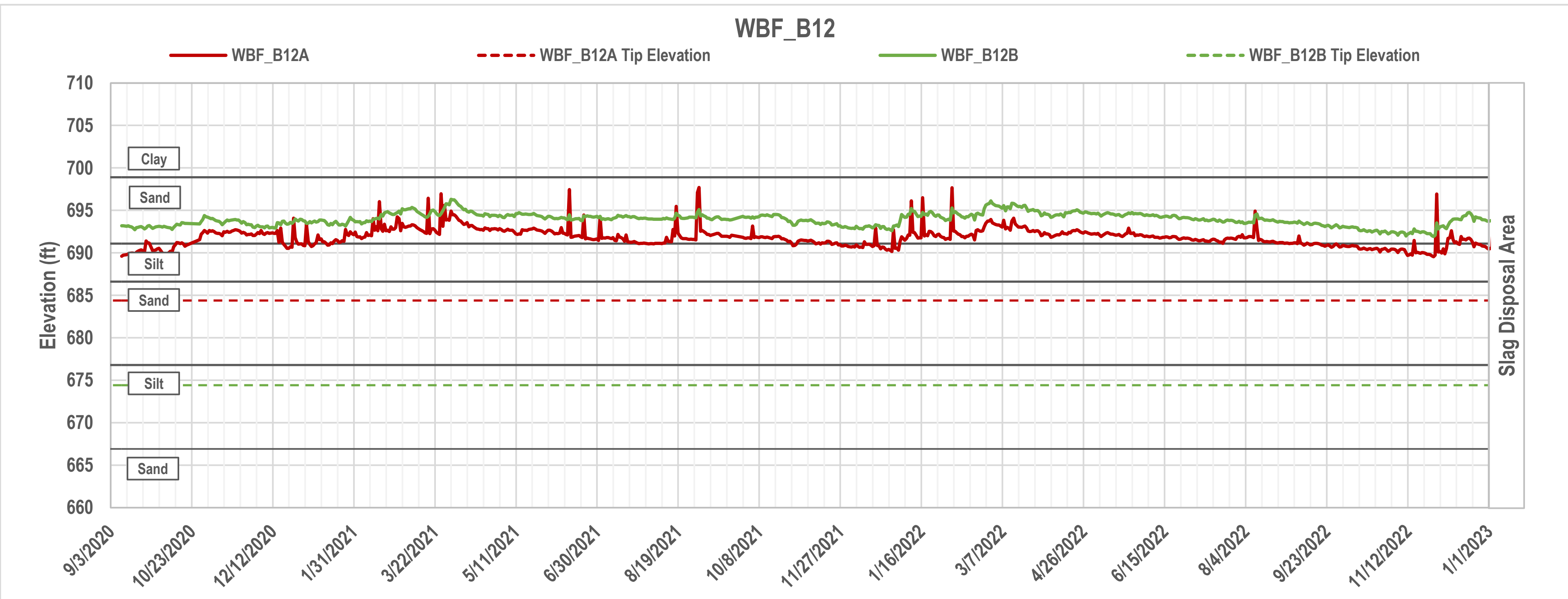
11/12/2022
1/1/2023



WBF_B12
WBF_B12A
WBF_B12A Tip Elevation
WBF_B12B
WBF_B12B Tip Elevation
Elevation (ft)
Slag Disposal Area
Clay
Sand
Silt
Sand
Silt
Sand
710
705
700
695
690
685
680
675
670
665
660
9/3/2020
10/23/2020
12/12/2020
1/31/2021
3/22/2021
5/11/2021
6/30/2021
8/19/2021
10/8/2021
11/27/2021
1/16/2022
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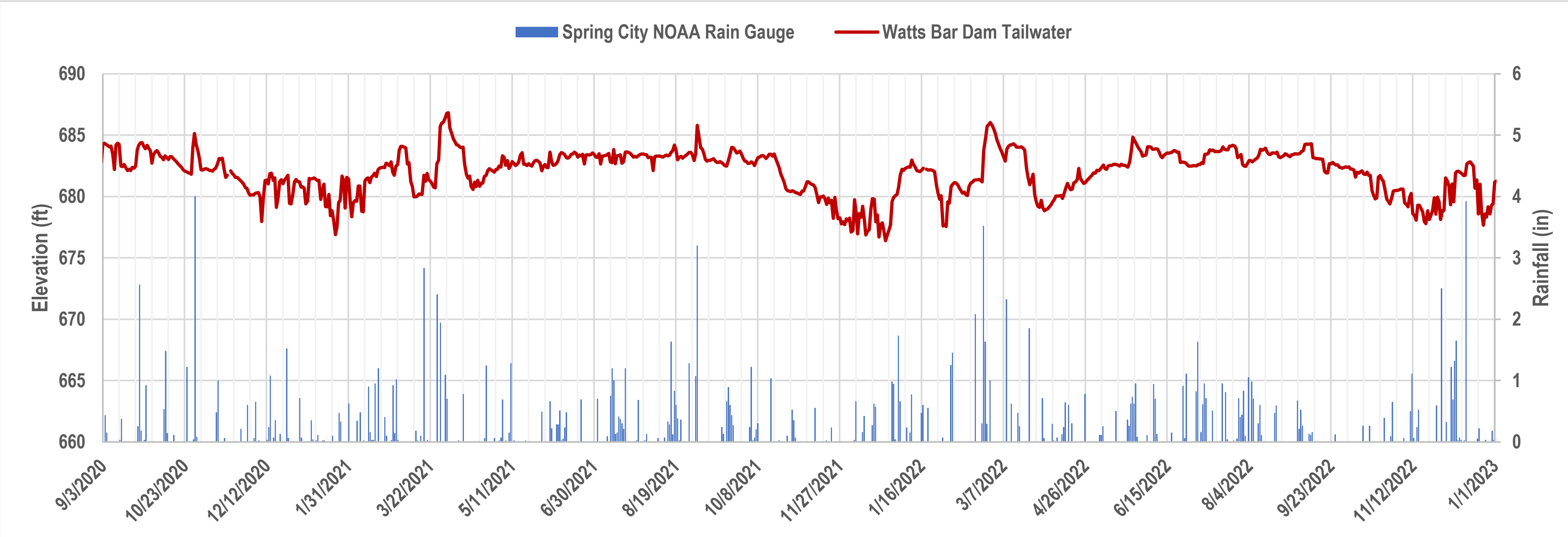
11/12/2022
1/1/2023


Spring City NOAA Rain Gauge
Watts Bar Dam Tailwater
Elevation (ft)
Rainfall (in)
690
685
680
675
670
665
660
6
5
4
3
2
1
0
9/3/2020
10/23/2020
12/12/2020
1/31/2021
3/22/2021
5/11/2021
6/30/2021
8/19/2021
10/8/2021
11/27/2021
1/16/2022
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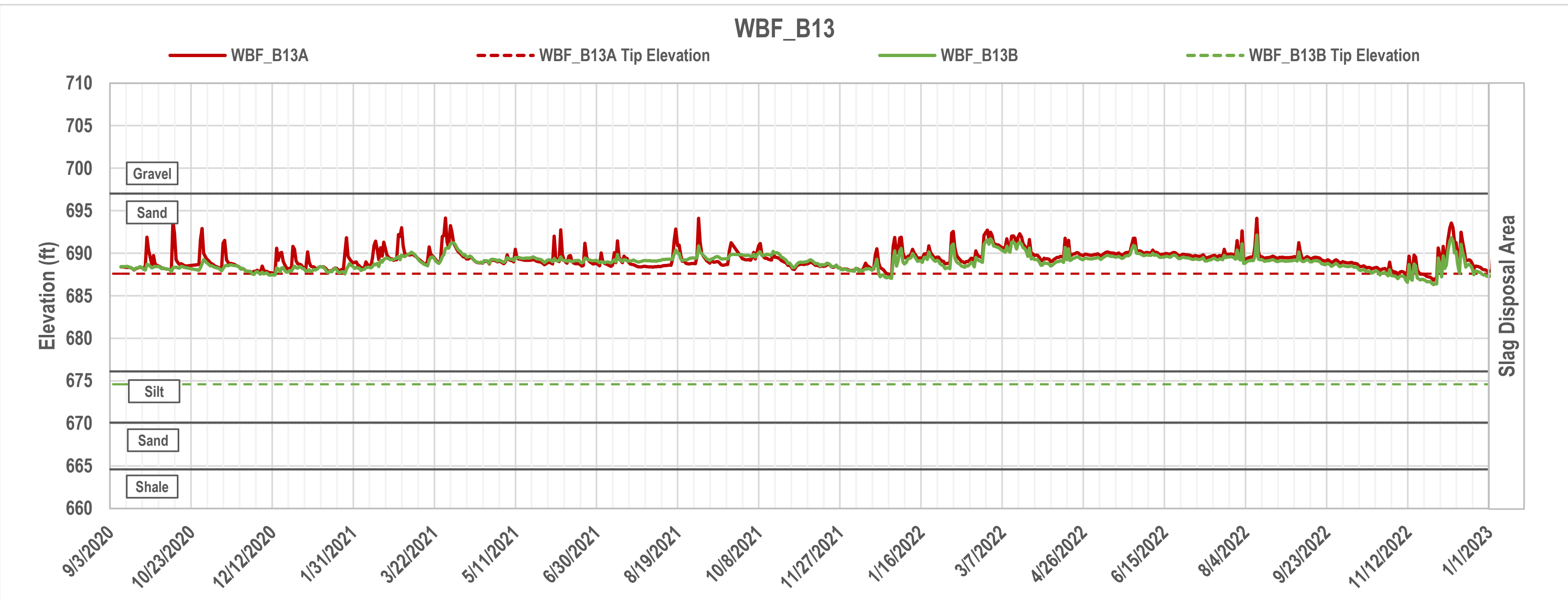
8/4/2022
9/23/2022
11/12/2022
1/1/2023


WBF_B13
WBF_B13A
WBF_B13A Tip Elevation
WBF_B13B
WBF_B13B Tip Elevation
Elevation (ft)
710
705
700
695
690
685
680
675
670
665
660
Gravel
Sand
Silt
Sand
Shale
Slag Disposal Area
9/3/2020
10/23/2020
12/12/2020
1/31/2021
3/22/2021
5/11/2021
6/30/2021
8/19/2021
10/8/2021
11/27/2021
1/16/2022
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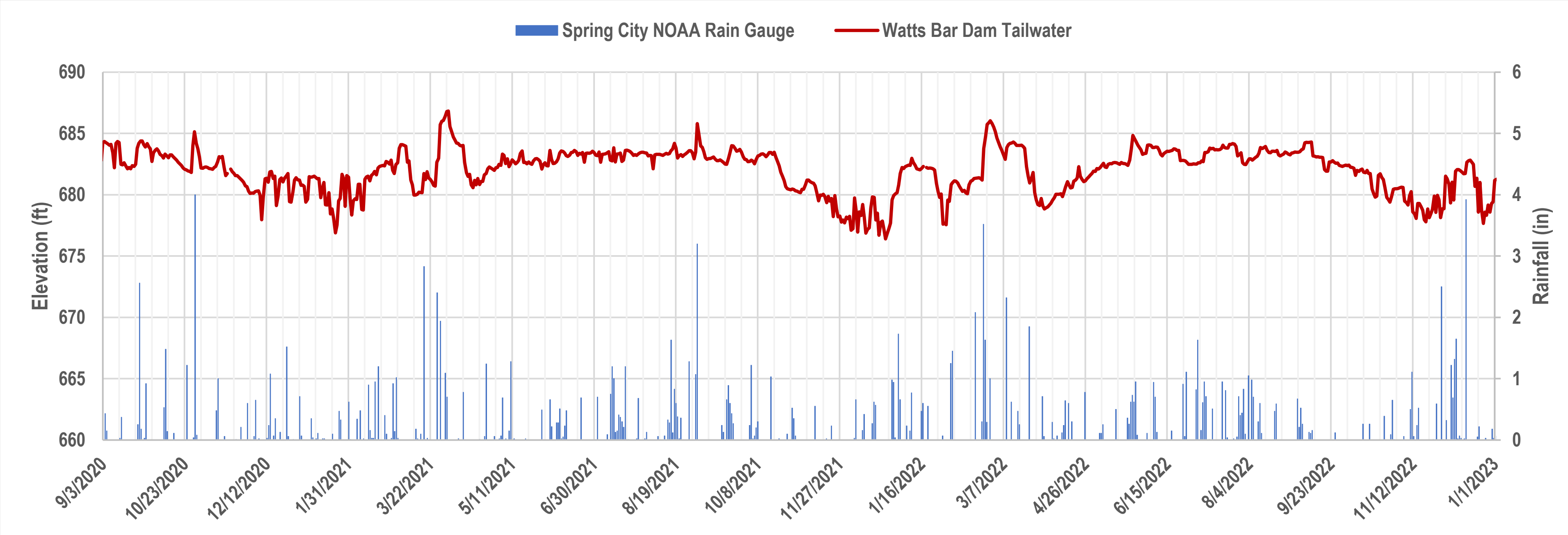
8/4/2022
9/23/2022
11/12/2022
1/1/2023


Spring City NOAA Rain Gauge
Watts Bar Dam Tailwater
Elevation (ft)
Rainfall (in)
690
685
680
675
670
665
660
6
5
4
3
2
1
0
9/3/2020
10/23/2020
12/12/2020
1/31/2021
3/22/2021
5/11/2021
6/30/2021
8/19/2021
10/8/2021
11/27/2021
1/16/2022
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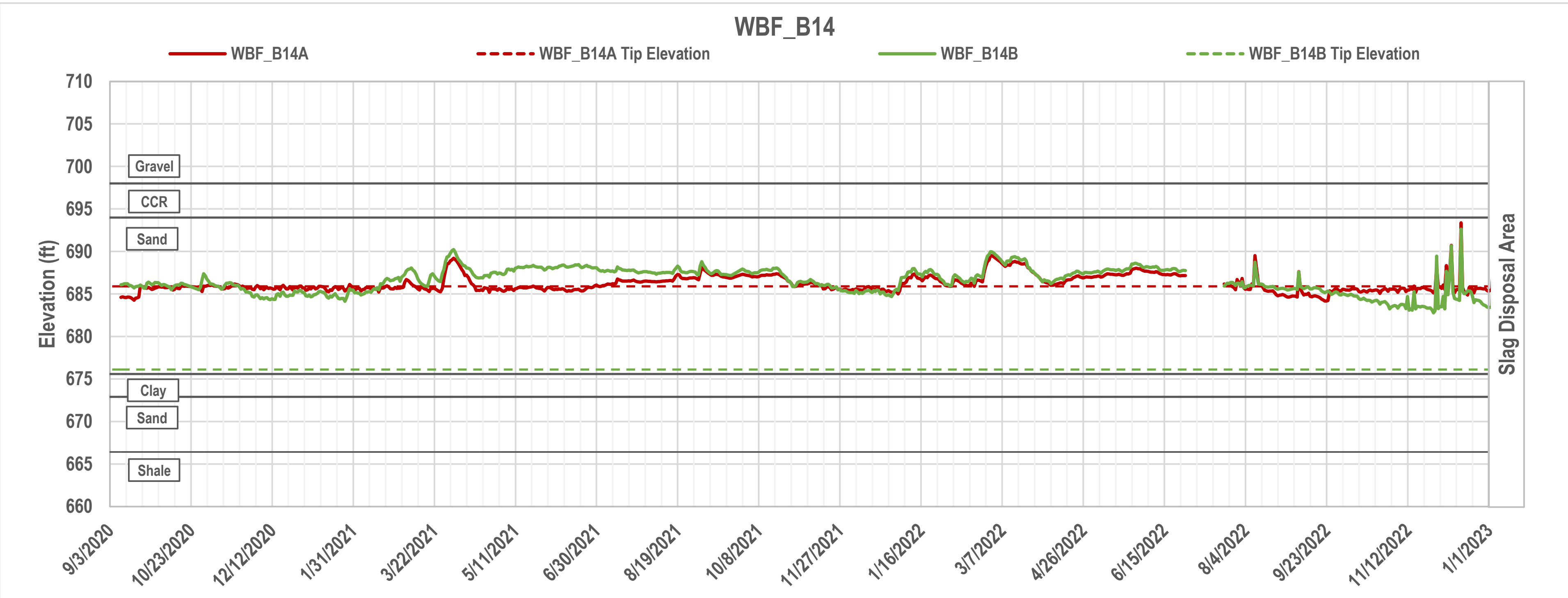
9/23/2022
11/12/2022
1/1/2023


WBF_B14
WBF_B14A
WBF_B14A Tip Elevation
WBF_B14B
WBF_B14B Tip Elevation
Elevation (ft)
Slag Disposal Area
710
705
700
695
690
685
680
675
670
665
660
Gravel
CCR
Sand
Clay
Sand
Shale
9/3/2020
10/23/2020
12/12/2020
1/31/2021
3/22/2021
5/11/2021
6/30/2021
8/19/2021
10/8/2021
11/27/2021
1/16/2022
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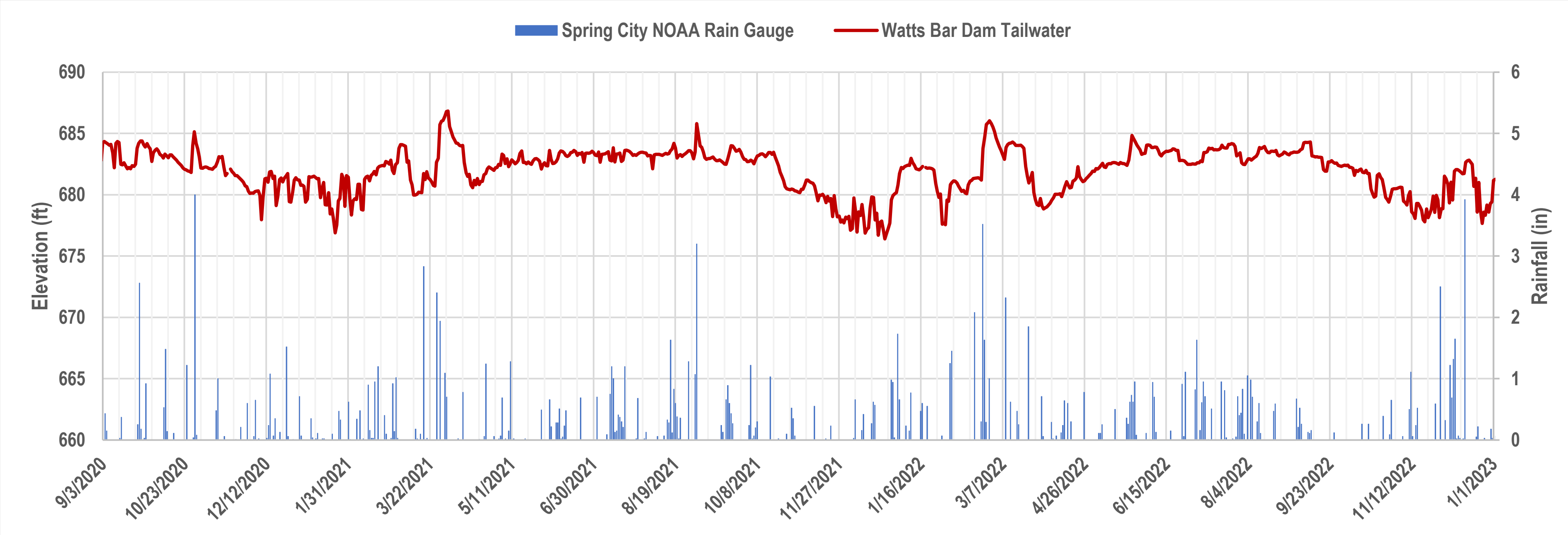
11/12/2022
1/1/2023



Spring City NOAA Rain Gauge
Watts Bar Dam Tailwater
Elevation (ft)
Rainfall (in)
690
685
680
675
670
665
660
6
5
4
3
2
1
0
9/3/2020
10/23/2020
12/12/2020
1/31/2021
3/22/2021
5/11/2021
6/30/2021
8/19/2021
10/8/2021
11/27/2021
1/16/2022
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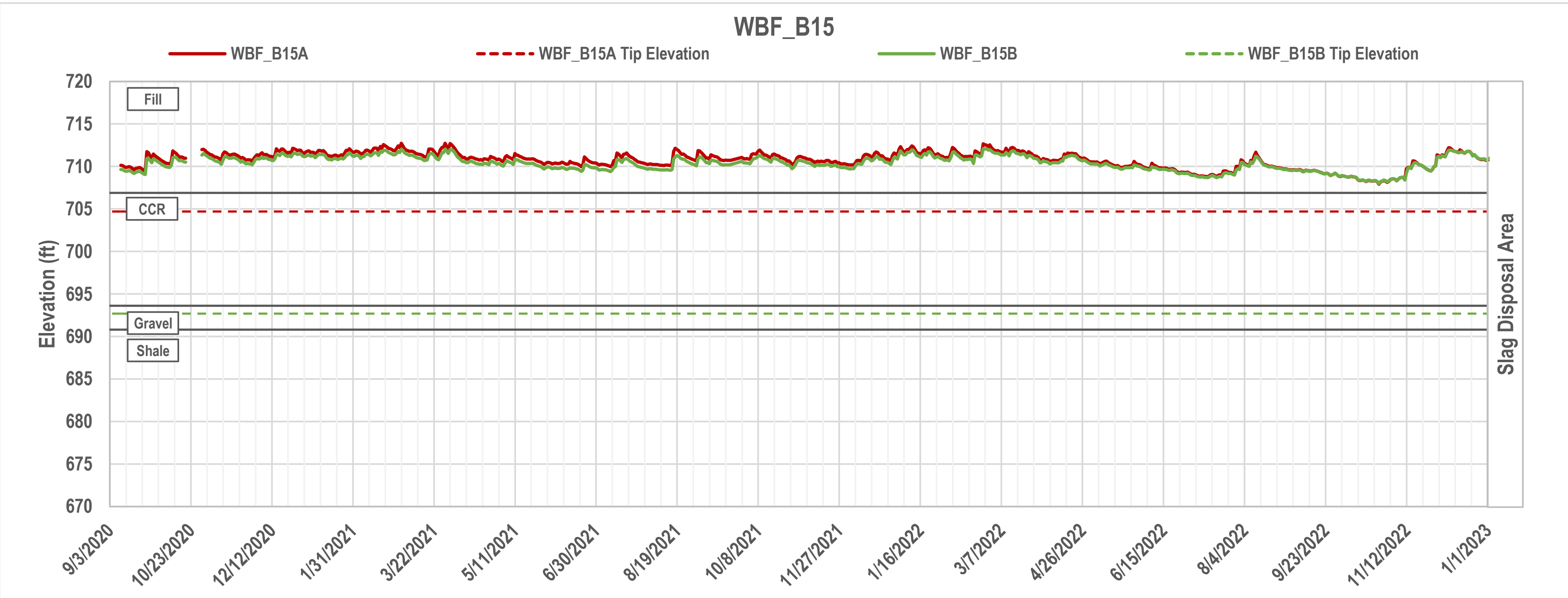
11/12/2022
1/1/2023



WBF_B15
WBF_B15A
WBF_B15A Tip Elevation
WBF_B15B
WBF_B15B Tip Elevation
Elevation (ft)
720
715
710
705
700
695
690
685
680
675
670
Fill
CCR
Gravel
Shale
Slag Disposal Area
9/3/2020
10/23/2020
12/12/2020
1/31/2021
3/22/2021
5/11/2021
6/30/2021
8/19/2021
10/8/2021
11/27/2021
1/16/2022
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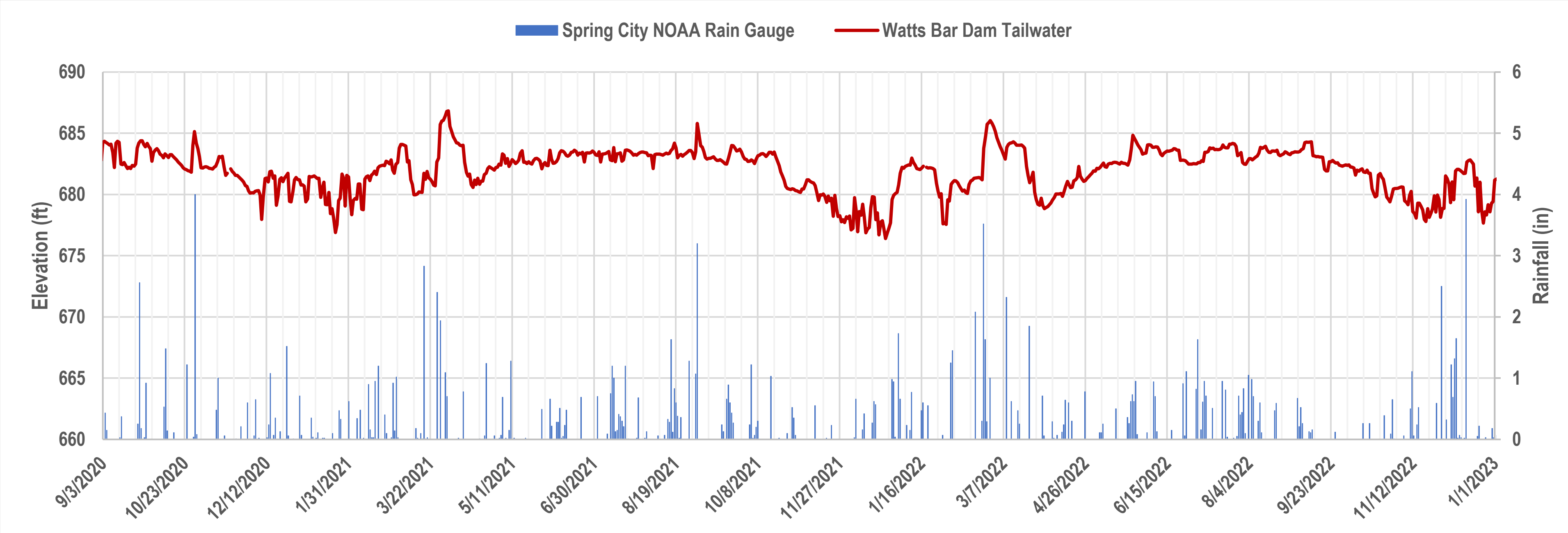
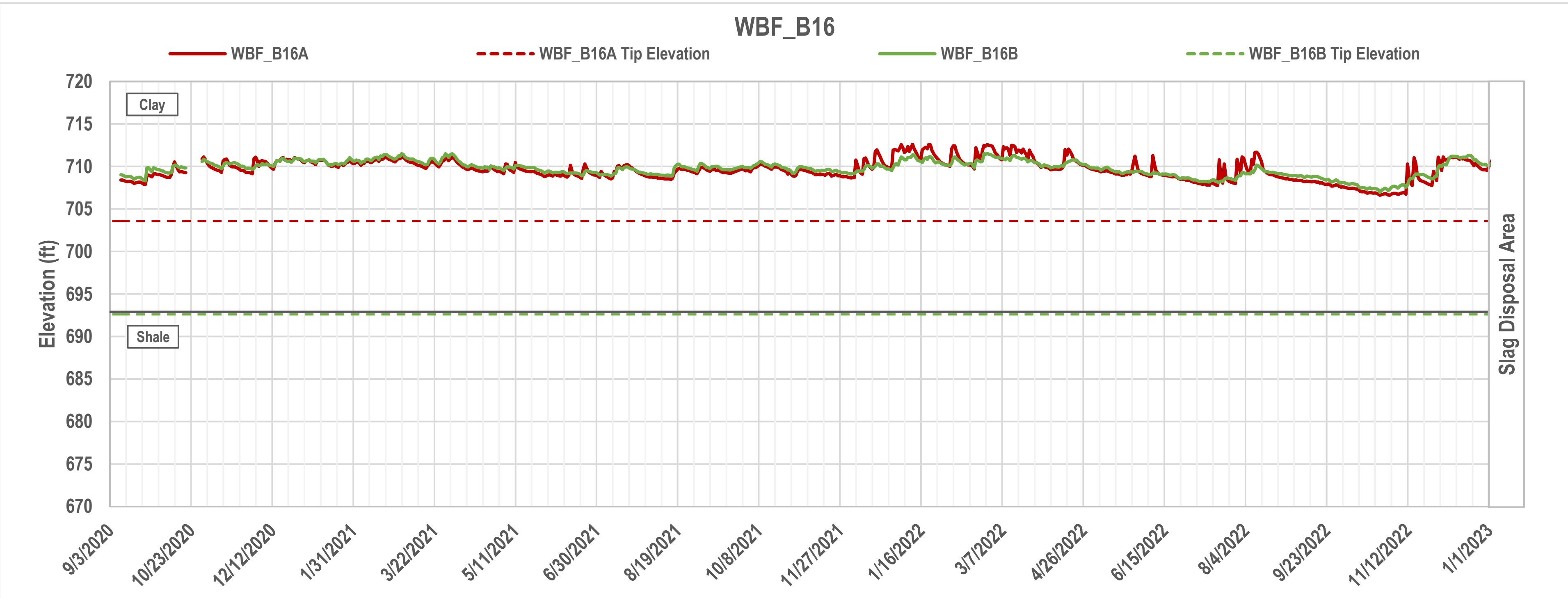
9/23/2022
11/12/2022
1/1/2023



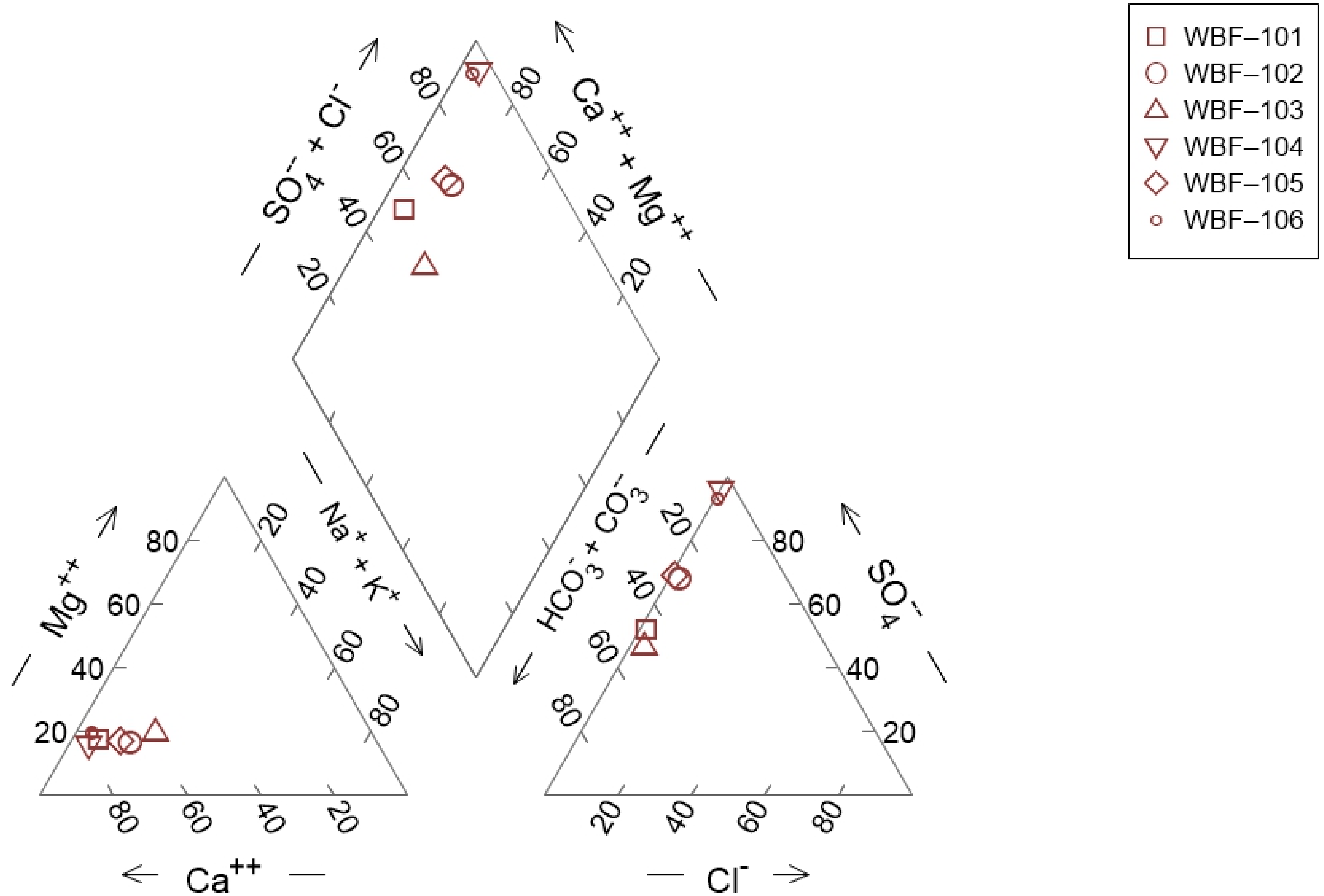
Spring City NOAA Rain Gauge
Watts Bar Dam Tailwater
Elevation (ft)
Rainfall (in)
690
685
680
675
670
665
660
6
5
4
3
2
1
0
9/3/2020
10/23/2020
12/12/2020
1/31/2021
3/22/2021
5/11/2021
6/30/2021
8/19/2021
10/8/2021
11/27/2021
1/16/2022
3/7/2022
4/26/2022
6/15/2022
8/4/2022
9/23/2022
11/12/2022
1/1/2023



WBF_B16
WBF_B16A
WBF_B16A Tip Elevation
WBF_B16B
WBF_B16B Tip Elevation
Clay
Shale
Elevation (ft)
Slag Disposal Area
720
715
710
705
700
695
690
685
680
675
670
9/3/2020
10/23/2020
12/12/2020
1/31/2021
3/22/2021
5/11/2021
6/30/2021
8/19/2021
10/8/2021
11/27/2021
1/16/2022
3/7/2022
4/26/2022
6/15/2022
8/4/2022
9/23/2022
11/12/2022
1/1/2023

ATTACHMENT H.1-B PIPER DIAGRAMS

WBF October 2019



% meq/kg

Exhibit No.
H.1-A

Title
Piper Diagram - October 2019

Client/Project 175668050
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Clinton, Tennessee
Spring City, Tennessee

Prepared by DMB on 2022-06-21
TR by BL on 2022-06-21
IR Review by RB on 2022-06-21

Legend

Notes
1. % meq/kg - Percent milliequivalent per kilogram
2. Ca^{++} - Calcium
3. Cl^- - Chloride
4. CO_3 - Carbonate
5. HCO_3 - Bicarbonate
6. K^+ - Potassium
7. Mg^{++} - Magnesium
8. Na^+ - Sodium
9. SO_4 - Sulfate

Stantec

TVA

U:\TVA-EIP\175668050_WBF_WorkPlans\gis\mxd\EAR\H.1-A_PiperPlot_Oct2019.mxd Revised: 2022-06-21 By: mbough

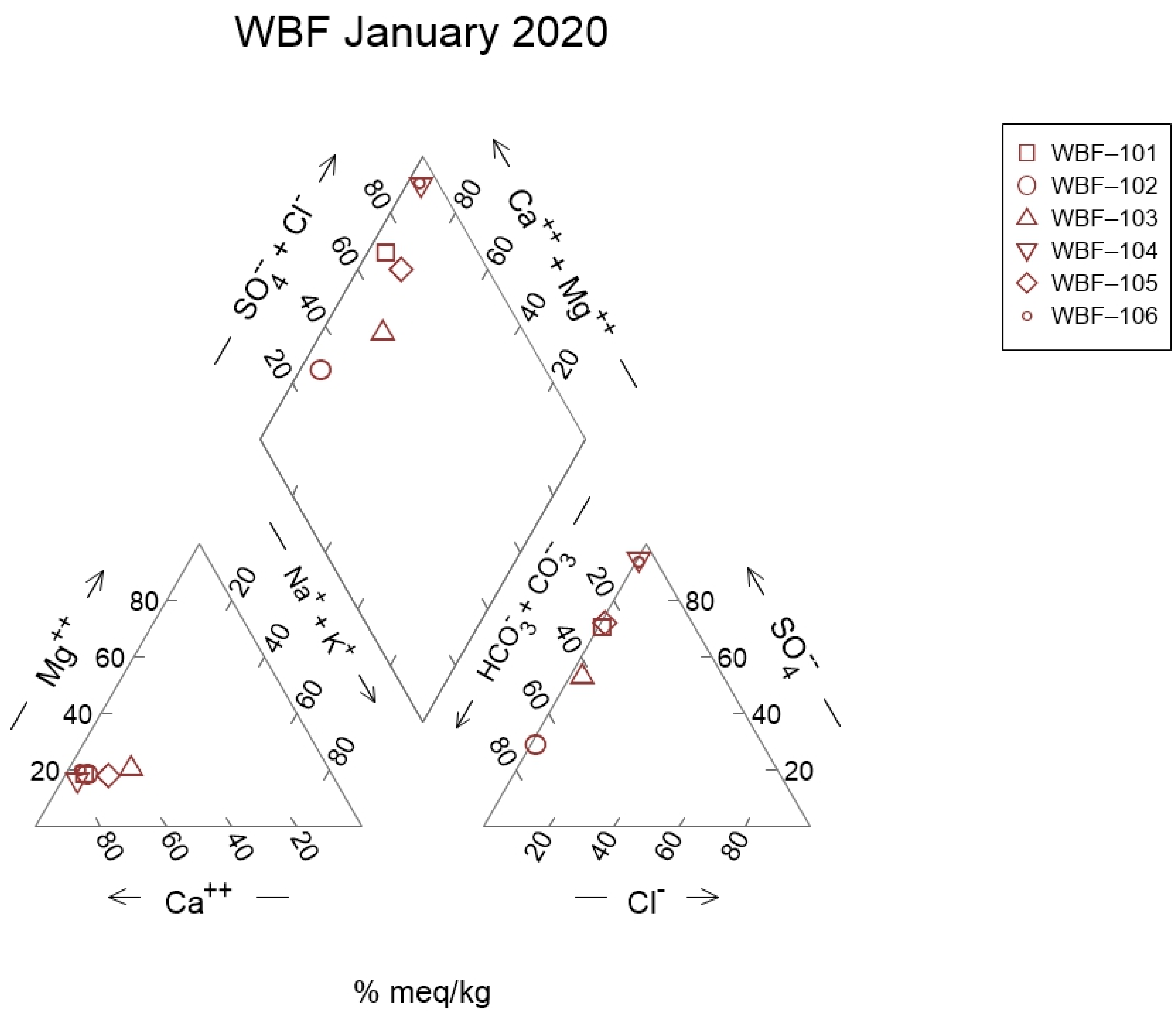


Exhibit No.
H.1-B

Title
Piper Diagram - January 2020

Client/Project 175668050
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Clinton, Tennessee
Spring City, Tennessee

Prepared by DMB on 2022-06-21
TR by BL on 2022-06-21
IR Review by RB on 2022-06-21

Legend

Notes

1. % meq/kg - Percent milliequivalent per kilogram
2. Ca^{++} - Calcium
3. Cl^- - Chloride
4. CO_3 - Carbonate
5. HCO_3 - Bicarbonate
6. K^+ - Potassium
7. Mg^{++} - Magnesium
8. Na^+ - Sodium
9. SO_4 - Sulfate

U:\TVA-EIP\175668050_WBF_WorkPlans\gis\mxd\EAR\H.1-B_PiperPlot_Jan2020.mxd Revised: 2022-06-21 By: mbough

Exhibit No.
H.1-C

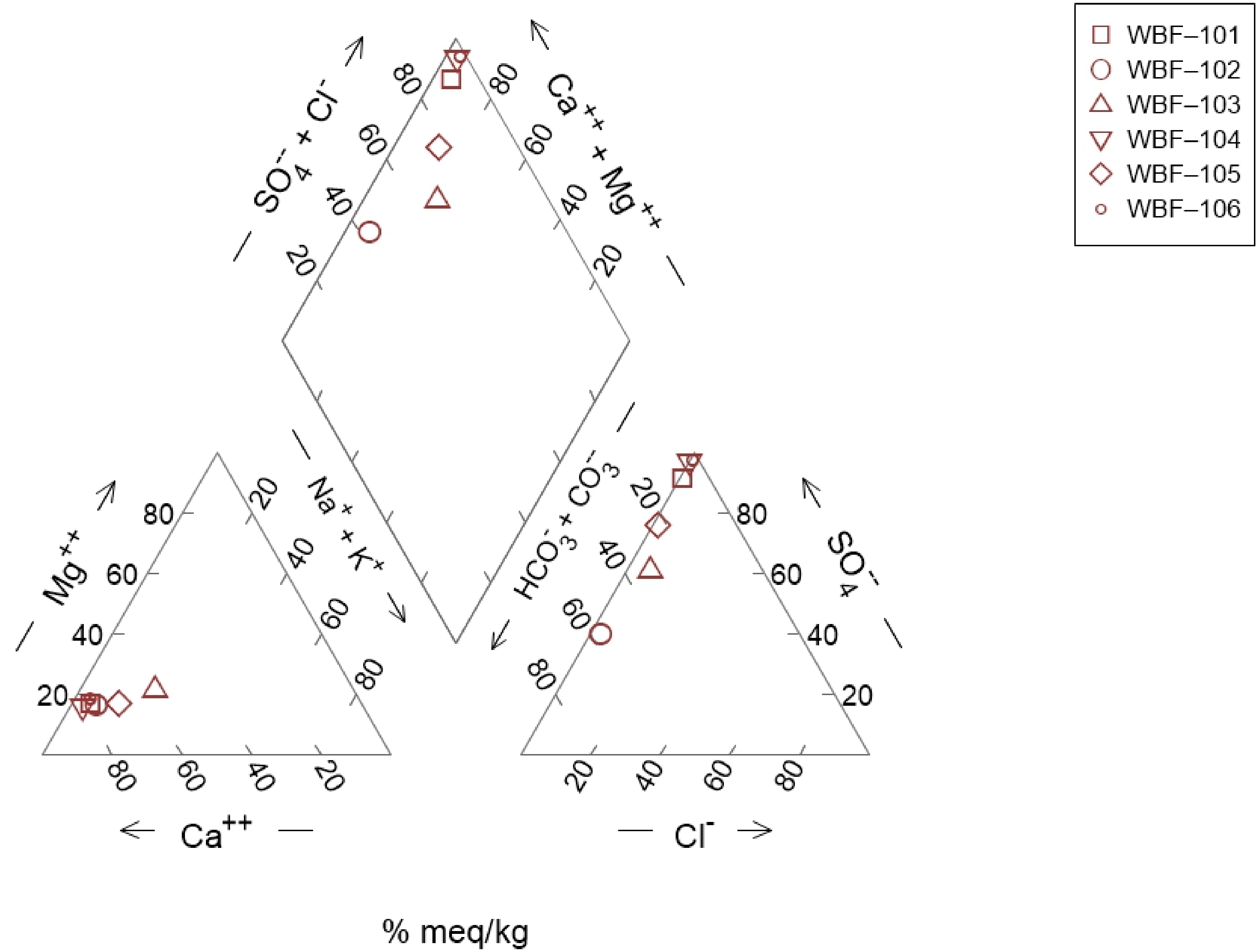
Title
Piper Diagram - March 2020

Client/Project 175668050
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Clinton, Tennessee
Spring City, Tennessee

Prepared by DMB on 2022-06-21
TR by BL on 2022-06-21
IR Review by RB on 2022-06-21

WBF March 2020



% meq/kg

Legend

Notes

1. % meq/kg - Percent milliequivalent per kilogram
2. Ca^{++} - Calcium
3. Cl^- - Chloride
4. CO_3 - Carbonate
5. HCO_3 - Bicarbonate
6. K^+ - Potassium
7. Mg^{++} - Magnesium
8. Na^+ - Sodium
9. SO_4 - Sulfate

Stantec

TVA

WBF April 2020

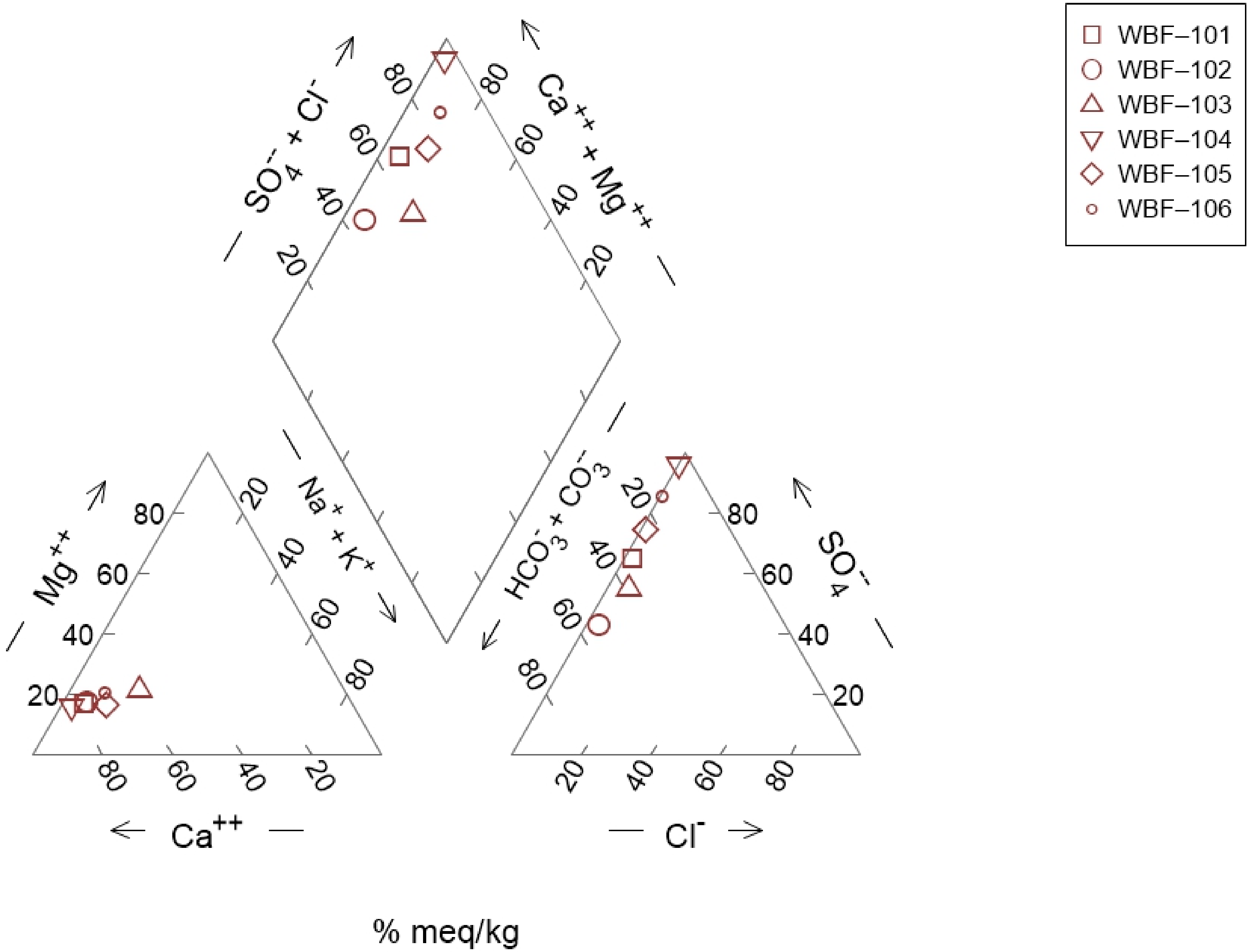


Exhibit No.

H.1-D

Title

Piper Diagram - April 2020

Client/Project 175668050

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Clinton, Tennessee

Spring City, Tennessee

Prepared by DMB on 2022-06-21
TR by BL on 2022-06-21
IR Review by RB on 2022-06-21

Legend

Notes

1. % meq/kg - Percent milliequivalent per kilogram
2. Ca^{++} - Calcium
3. Cl^- - Chloride
4. CO_3 - Carbonate
5. HCO_3 - Bicarbonate
6. K^+ - Potassium
7. Mg^{++} - Magnesium
8. Na^+ - Sodium
9. SO_4 - Sulfate

Stantec

TVA

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APPENDIX H.2

HYDROGEOLOGY INVESTIGATION SAMPLING AND ANALYSIS REPORT

Stantec

Watts Bar Fossil Plant Hydrogeological Investigation Sampling and Analysis Report

TDEC Commissioner's Order:
Environmental Investigation Plan
Watts Bar Fossil Plant
Spring City, Tennessee

November 9, 2020

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

TVA

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

Revision Record

Revision	Description	Date
0	Submittal to TDEC	September 28, 2020
1	Addresses October 26, 2020 TDEC Review Comments and Issued for TDEC	November 9, 2020

Sign-off Sheet

This document entitled Watts Bar Fossil Plant Hydrogeological Investigation Sampling and Analysis Report was prepared by Stantec Consulting Services Inc. ("Stantec") for the account of Tennessee Valley Authority (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule, and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by ______________________

Michael J. Winkler, Geologic Associate

Reviewed by ______________________

James M. Kerr, Jr., Senior Principal Geologist

Approved by ______________________

Rebekah Brooks, Principal Hydrogeologist

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LIST OF TABLES

LIST OF APPENDICES

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Abbreviations

ASTM	American Society for Testing and Materials
CCR	Coal Combustion Residuals
CCR Parameters	Constituents listed in Appendices III and IV of 40 CFR 257 and five inorganic constituents included in Appendix I of Tennessee Rule 0400-11-01-.04
CFR	Code of Federal Regulations
COC	Chain-of-Custody
DPT	Direct Push Technology
EAR	Environmental Assessment Report
EIP	Environmental Investigation Plan
ENV	Environmental
EnvStds	Environmental Standards, Inc.
FSP	Field Sampling Personnel
ft bgs	Feet Below Ground Surface
GPS	Global Positioning System
HGI	Hydrogeological Investigation
HSA	Hollow-Stem Auger
IDW	Investigation Derived Waste
PG	Professional Geologist
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SAR	Sampling and Analysis Report
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Commissioner’s Order No. OGC15-0177
TI	Technical Instruction
TVA	Tennessee Valley Authority
WBF Plant	Watts Bar Fossil Plant

1.0 INTRODUCTION

Stantec Consulting Services Inc. (Stantec) has prepared this sampling and analysis report (SAR), on behalf of the Tennessee Valley Authority (TVA), to document activities related to a hydrogeological investigation (HGI) at TVA's Watts Bar Fossil (WBF) Plant located in Spring City, Tennessee.

The purpose of the HGI was to install permanent monitoring wells to evaluate hydrogeological conditions at the WBF Plant in support of fulfilling the requirements for the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA (TDEC 2015). The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee.

The purpose of this SAR is to summarize activities completed to meet the objectives of the HGI Sampling and Analysis Plan (SAP) (Stantec 2018a). This SAR is not intended to provide conclusions or evaluations of results. The scope of the HGI represented herein was conducted pursuant to the SAP and is part of a larger environmental investigation at the WBF Plant.The evaluation of the results from this HGI will consider other aspects of the environmental investigation, as well as data collected under other State and/or coal combustion residuals (CCR) programs, and will be presented in the Environmental Assessment Report (EAR).

The HGI activities were performed in conjunction with the background soil investigation at the WBF Plant and in general accordance with the following documents developed by TVA to support fulfilling the requirements of the TDEC Order:

- *Hydrogeological Investigation SAP* (Stantec 2018a)
- *Environmental Investigation Plan (EIP)* (Stantec 2018b)
- *Background Soil SAP* (Stantec 2018c)
- *Quality Assurance Project Plan (QAPP)* (Environmental Standards, Inc. 2018).

The hydrogeological and background soil investigations were implemented in accordance with TVA- and TDEC-approved Programmatic- and Project-specific changes. Minor variations in scope and procedures from those outlined in the WBF Plant HGI SAP and Background Soil SAP occurred during field activities due to field conditions and programmatic updates and are referenced in Section 3.6.

HGI field work consisted of two primary activities – drilling and sampling, and permanent monitoring well installation. Quality Assurance oversight of field data acquisition protocols, sampling practices, and data review were performed by Environmental Standards, Inc. (EnvStds) under direct contract to TVA.

2.0 OBJECTIVE AND SCOPE

The primary objective of the HGI conducted pursuant to the HGI SAP was to install permanent monitoring wells to evaluate hydrogeological conditions at the WBF Plant in response to the TDEC Order. The activities conducted during the HGI support data collection for the groundwater and background soil investigations at the WBF Plant, including groundwater level measurements, and groundwater and background soil sample collection for analysis of CCR-related constituents.

The approach for the HGI was to:

- Identify permanent downgradient monitoring well and background well locations targeting unconsolidated materials at the WBF Plant
- Use direct push technology (DPT), hollow-stem auger (HSA), and roto-sonic drilling techniques to collect soil samples at staked monitoring locations approved by TDEC and considered suitable for the drill rigs to safely drill
- Complete monitoring well installation, well development, hydraulic conductivity (slug) testing, pump installation, and survey activities.

The scope of work of the HGI consisted of the following tasks:

- Confirming drilling locations for planned permanent downgradient monitoring well and background well locations using global positioning system (GPS) survey
- Drilling and logging soil borings for geotechnical and lithologic information
- Collecting soil samples for analysis of geotechnical parameters (if deemed warranted), and CCR-related constituents from the background monitoring well boring locations (as part of the Background Soil SAP)
- Installing permanent monitoring wells in the borings and constructing surface completions
- Developing permanent monitoring wells and conducting slug tests to estimate hydraulic conductivity for evaluation of hydrogeologic conditions for the EAR
- Surveying each permanent monitoring well.

Details on each activity are presented in the sections below. Groundwater level measurements and sampling are being conducted as part of six groundwater monitoring events being performed pursuant to the Groundwater Investigation SAP and reported in a series of Groundwater Investigation SARs for the WBF Plant. Soil sampling for CCR-related constituents was performed in accordance with the Background Soil SAP and reported in the WBF Plant Background Soil Investigation SAR.

3.0 FIELD ACTIVITIES

HGI field activities were conducted between May 29 and October 11, 2019, and consisted of DPT, HSA, and roto-sonic drilling; monitoring well installation; well development; slug tests; pump installation; and well surveys. Prior to initiating field activities, TVA conducted environmental reviews, obtained necessary permits, and performed utility clearances as necessary to complete the field work.

Stantec performed HGI field activities based on guidance and specifications listed in TVA's Environmental (ENV) Technical Instructions (TIs), the SAPs, and the QAPP prepared by EnvStds, except as noted in the Variations section of this report. As part of TVA's commitment to generate representative and reliable data, oversight of select field activities, field documentation, and centralized data management were performed by EnvStds under direct contract with TVA. EnvStds also conducted audits of field activities and provided quality reviews of field documentation.

During the HGI, Stantec conducted the following field activities:

- Confirmed drilling locations for planned monitoring well and background monitoring well locations
- Drilled 13 soil borings in the vicinity of proposed well locations to pre-screen the soil characteristics in these areas prior to advancement of well borings
- Drilled nine soil borings for installation of four permanent monitoring wells and two background monitoring wells, under the direction of a Stantec Professional Geologist (PG) licensed in the State of Tennessee
- Collected soil samples using a DPT dual tube, HSA split-spoon sampler, or roto-sonic core barrel to develop a continuous boring log/soil profile for each well boring, and for potential analysis of geotechnical parameters (if deemed warranted)
- Collected two soil samples and one field duplicate for analysis of CCR-related constituents from the screened interval depth range of two background monitoring well borings
- Installed permanent monitoring wells in six borings
- Developed each well and conducted slug tests in five wells to estimate hydraulic conductivity.

Following monitoring well installation, TVA constructed surface completions and surveyed each new permanent well.

3.1 WORK LOCATIONS

The HGI field activities were conducted at six soil boring/monitoring well locations at the WBF Plant under the HGI scope of work. As approved by TVA and TDEC, either two or three DPT pre-screen soil borings were advanced within 25 feet of each proposed well location to evaluate soil characteristics in these areas prior to well drilling and installation. This approach was used due to limited historical information in the areas of the proposed monitoring well and background well locations. A total of 13 pre-screen borings were completed as follows:

- Borings WBF-101A and WBF-101B near proposed well WBF-101
- Borings WBF-102A and WBF-102B near proposed well WBF-102
- Borings WBF-103A and WBF-103B near proposed well WBF-103
- Borings WBF-104A and WBF-104B near proposed well WBF-104
- Borings WBF-105A, WBF-105B, and WBF-105C near proposed well WBF-105
- Borings WBF-106A and WBF-106B near proposed well WBF-106.

Due to the presence of CCR material encountered in the three pre-screen borings for well WBF-105, the well was relocated to the southwest following approval by TDEC.

Based on information collected from the pre-screen borings, the borings at the proposed monitoring well and background well locations were advanced using HSA or roto-sonic methods, as described below. The HGI boring/monitoring well locations are shown on Exhibit A.1 in Appendix A and are described in Table 1 following Section 3.1.2. Tables B.1 through B.5 in Appendix B provide data and information obtained at the HGI boring/monitoring well locations as described in Section 3.4. The pre-screen boring locations are shown on Exhibit A.1 in Appendix A, and subsurface logs for these locations are provided in Attachment C.1 in Appendix C.

3.1.1 Background Locations

Soil samples were collected from within the anticipated depth range for the well screened interval at two background monitoring well location borings as described in Section 3.3.2.2 and the Background Soil SAP. Two background monitoring wells (WBF-102 and WBF-103) were installed in unconsolidated materials to provide groundwater samples that have not been affected by the CCR units and to be representative of background conditions. As shown in Table 1, one location (proposed well WBF-102) required multiple borings to complete the HGI background well installation.

3.1.2 Coal Combustion Residuals Unit Locations

Four permanent monitoring wells (WBF-101, WBF-104, WBF-105, and WBF-106) were installed in unconsolidated materials near the CCR units to provide locations to evaluate groundwater flow and quality in these areas as summarized below.

Table 1. Summary of Boring and Monitoring Well Locations

Boring ID	Well ID	Location	Rationale
WBF-101	WBF-101	Northeast corner of the closed Ash Pond	To assess local groundwater flow and quality downgradient of the CCR units
WBF-102	NC	West of the closed Ash Pond	Well not installed, boring did not encounter groundwater
WBF-102Alt	NC	West of the closed Ash Pond	Well not installed, boring encountered construction debris between 4.5 and 6 feet below ground surface
WBF-102Alt1	NC	West of the closed Ash Pond	Well not installed, boring encountered CCR material at 6 feet below ground surface
WBF-102Alt2 (Sonic)	WBF-102	West of the closed Ash Pond	To assess groundwater flow and quality at a background location
WBF-103	WBF-103	West of the closed Slag Disposal Area, south of former coal yard storage area	To assess groundwater flow and quality at a background location
WBF-104	WBF-104	Southeast of the closed Slag Disposal Area	To assess local groundwater flow and quality downgradient of the CCR units
WBF-105/ WBF-105 (Sonic)	WBF-105	East of the closed Slag Disposal Area	To assess local groundwater flow and quality downgradient of the CCR units
WBF-106	WBF-106	Northeast of the closed Slag Disposal Area	To assess local groundwater flow and quality downgradient of the CCR units

Notes:

Pre-screen soil borings are listed in Section 3.1 above.

ID Identification

NC Not completed

3.2 DOCUMENTATION

Stantec maintained HGI field documentation in general accordance with ENV-TI-05.80.03, *Field Record Keeping*, the HGI SAP, and the QAPP. Field documentation for background soil sampling activities is described in the WBF Plant Background Soil Investigation SAR. Health and safety forms were completed in accordance with TVA and Stantec health and safety requirements. Field activities and data were primarily recorded on program-specific field forms. Additional information regarding HGI field documentation is provided below.

3.2.1 Field Forms

Stantec used program-specific field forms to record field observations and data for specific activities. Field forms used during the HGI included:

- *Daily Field Activity Log*
- *Subsurface Boring Log*
- *Chain-of-Custody (COC)*
- *Monitoring Well Installation Field Log*
- *Well Development Form*
- *Slug Test Data Form*
- *QED Well Wizard Dedicated Sampling Pump Installation Checklist*
- *Well Pump Calibration Form.*

3.2.1.1 Daily Field Activity Log

Stantec field sampling personnel (FSP) recorded field activities, observations, and data on a *Daily Field Activity Log* to chronologically document the field program. Deviations from the SAP, TIs, or QAPP were also documented on the *Daily Field Activity Log*.

3.2.1.2 Subsurface Boring Log

A Stantec PG licensed in the State of Tennessee prepared a *Subsurface Log* for each boring. The log documented time, boring location, drilling personnel, tooling/equipment used, depth to water, sample number, sample recovery, blow counts (for HSA borings), soil lithology, and other relevant observations. Soil color was logged per the appropriate Munsell Soil Color Chart (Munsell Color 2009). Information from these logs was used to construct the subsurface logs provided in Attachment C.1 in Appendix C.

3.2.1.3 Chain-of-Custody

Stantec FSP completed *COC* documentation for each geotechnical soil sample collected during the HGI. As described above, documentation of soil sample collection and analysis of CCR-related constituents for the background soil samples collected during the HGI are reported in the WBF Plant Background Soil Investigation SAR.

Information on the geotechnical sample *COC* included the sample ID, sample location, sample depth, type of sample, sampling date, and sample custody record. *COCs* were completed in general accordance with *ENV-TI-05.80.02: Sample Labeling and Custody* and reviewed by the laboratory manager.

3.2.1.4 Monitoring Well Installation Field Log

A Stantec PG licensed in the State of Tennessee prepared a *Monitoring Well installation Field Log* for each monitoring well. The log documented the well location, well installation date(s), well installation materials, well depth, screened interval, depth interval for each backfill material, and surface completion details (protective casing, concrete pad, bollards, etc.). Information from these logs was used to construct the well installation details provided in Attachment C.2 in Appendix C.

3.2.1.5 Well Development Form

Stantec FSP completed a *Well Development Form* for each monitoring well. The form documented well location, well development date(s), elapsed time since development started, depth to water, purge rate, cumulative purge volume, and water quality parameter measurements throughout and at completion of the development process.

3.2.1.6 Slug Test Data Form

Stantec FSP completed a *Slug Test Data Form* for the hydraulic conductivity tests performed at the monitoring wells. The form primarily documented well location, slug test date(s), and initial and final water level measurements before and after each slug test attempt. The water level measurements during the tests were recorded by an automated pressure transducer and data recorder and subsequently downloaded.

3.2.1.7 QED Well Wizard Dedicated Sampling Pump Installation Checklist

Stantec FSP installed a dedicated bladder pump system in each monitoring well to facilitate subsequent groundwater sampling events. A *QED Well Wizard Dedicated Sampling Pump Installation Checklist* was prepared for each monitoring well to document the well information, pump information, initial testing results, and any relevant comments.

3.2.1.8 Well Pump Calibration Form

Stantec FSP performed a calibration procedure on the dedicated pump in each monitoring well and recorded the results on a *Well Pump Calibration Form*. Each form documented the well location, date, time, depth to water, flow rate, flow volume, and water quality stabilization measurements during and at completion of the calibration.

3.2.2 Photographs

In addition to documentation of field activities described above, photographs were taken to document the field investigation. A photographic log of soil cores recovered from the borings and surface completions of installed monitoring wells are provided in Attachments D.1 and D.2, respectively, in Appendix D.

3.3 DRILLING AND SAMPLING

The following sections present drilling and soil sampling procedures used in the HGI. Additional information for drilling and sampling procedures at the two background monitoring well locations is provided in the Background Soil Investigation SAR. Drilling and sampling activities were performed under the direction of a Stantec PG licensed in the State of Tennessee.

3.3.1 Drilling

The HGI borings were advanced using three drilling methods: DPT, HSA, and/or roto-sonic.

3.3.1.1 Direct Push Technology

Thirteen pre-screen soil borings were advanced in the vicinity of proposed well locations and completed using DPT. Stantec utilized the subcontractor Hawkston Drilling for these borings, who provided a driller licensed in Tennessee to operate a track-mounted DPT rig with a dual tube soil sampling system equipped with 60-inch long polyvinyl chloride (PVC) liners. Soil samples were recovered for lithologic description and photographic documentation. Completed boreholes were tremie-backfilled with a 30% solids bentonite grout.

3.3.1.2 Hollow-Stem Auger

Nine monitoring well installation borings were advanced by Stantec drillers licensed in Tennessee using HSA drilling techniques following procedures provided in American Society for Testing and Materials (ASTM) D6151: *Standard Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling*. HSA borings were generally advanced using a 4.25-inch inside diameter auger to advance the pilot boring (resulting in approximately an 8-inch borehole diameter). Standard penetration test sampling was conducted continuously in accordance with ASTM D1586 *Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils* and consisted of dropping a 140-pound hammer from a height of 30 inches, to drive a standard size 2-inch diameter split-spoon sampler to a depth of 18 inches. Blow-counts were recorded for each six inches of penetration. Soil samples were recovered for lithologic description, photographic documentation, and sample collection. Following removal, the augers and split-spoon samplers were decontaminated using a high-pressure steam cleaner and potable water after use at each boring.

Three HSA borings (WBF-102, WBF-102Alt, and WBF-102Alt1) were abandoned and backfilled after the initial pilot boring and not completed as permanent wells. The augers were withdrawn, and each borehole was tremie-backfilled using a 30% solids bentonite grout.

Four HSA borings (WBF-101, WBF-103, WBF-104, and WBF-106) were completed as planned and finished with the installation of a permanent monitoring well. After reaching the targeted depth, the augers were withdrawn, and the borehole was overdrilled using an 8.25-inch inside diameter auger (resulting in approximately a 13-inch borehole diameter). Well installation procedures for the boreholes completed as permanent wells are described in Section 3.4.

Two HSA borings (WBF-102Alt2 (Sonic) and WBF-105/WBF-105 (Sonic)) were tremie-backfilled using a 30% solids bentonite grout after the initial pilot boring and subsequently re-drilled using a roto-sonic drill rig as described in Section 3.3.1.3 below.

3.3.1.3 Roto-Sonic

Two borings (WBF-102Alt2 (Sonic) and WBF-105/WBF-105 (Sonic)), which started as HSA borings, were subsequently completed using roto-sonic techniques due to the presence of CCR material in the shallow soil layers. With TVA and TDEC approval, the drilling methodology was changed at these boring locations in order to minimize the possible migration of CCR material downward in the boreholes. Stantec utilized the subcontractor M&W Drilling for the roto-sonic portion of these borings, who provided a driller licensed in Tennessee to operate a truck-mounted roto-sonic drilling rig.

Boring WBF-102Alt2 (Sonic) was initially advanced to a depth of 10 feet below ground surface (ft bgs) as an HSA pilot boring using 8.25-inch inside diameter augers (resulting in approximately a 13-inch borehole diameter). This portion of the boring was not sampled or logged because of its close proximity to WBF-102Alt1, which was sampled and logged. The augers were withdrawn, and the borehole was tremie-backfilled with a 30% solids bentonite grout. A 10-inch diameter PVC casing sleeve was then inserted into the borehole through the grout column to a depth of 10 ft bgs to isolate the CCR material in the shallow soils from the interior of the casing. Subsequently, the roto-sonic rig was maneuvered over the borehole and advanced a 6-inch diameter steel core barrel and 8-inch diameter steel casing to 21 ft bgs nested within the grout-filled 10-inch PVC casing. The 6-inch diameter core barrel was withdrawn to facilitate subsequent installation of the monitoring well as described in Section 3.4. The 10-inch diameter PVC casing was left in place and cut off just below surface grade.

The process at boring WBF-105/WBF-105 (Sonic) was similar in most respects to boring WBF-102Alt2 (Sonic). Boring WBF-105/WBF-105 (Sonic) was initially drilled as a 4.25-inch inside diameter HSA pilot boring advanced to 19.5 ft bgs. CCR material was identified in shallow soils to a depth of approximately 9 ft bgs. The borehole was overdrilled using 8.25-inch inside diameter augers to 18 ft bgs. The augers were withdrawn, and the borehole was tremie-backfilled with a 30% solids bentonite grout. A 10-inch diameter PVC casing was installed to 18 ft bgs through the grout column. The roto-sonic 6-inch diameter core barrel and 8-inch diameter casing were advanced to 34.5 ft bgs nested within the grout-filled 10-inch PVC casing. The 6-inch diameter core barrel was withdrawn to facilitate subsequent installation of the monitoring well as described in Section 3.4. The 10-inch diameter PVC casing was left in place and cut off just below surface grade.

3.3.2 Soil Sampling

During advancement of each boring, the Stantec PG prepared field subsurface logs using a mobile data collection platform. Inputs included a description of subsurface lithology, sample recovery, color using the Munsell Soil Color Chart, and other relevant parameters as required by the SAPs and TIs. Subsurface logs for the WBF Plant HGI are presented in Attachment C.1 in Appendix C.

Soil samples recovered from each boring were examined to provide lithologic information for a continuous boring log/soil profile and for analysis, as described below.

3.3.2.1 Geotechnical Sampling

At HSA borings, following preparation of the subsurface logs, geotechnical soil samples were placed in laboratory-provided glass jars and labeled in general accordance with the SAP. FSP secured the caps on each bottle, and confirmed it was labeled legibly and externally clean before placing the sample container in a box for storage prior to transport to the laboratory. Geotechnical sample information was recorded on a *COC* as described above in Section 3.2.1.3. The samples were temporarily placed in a secure storage unit onsite under custody protocols until transport and submittal to the geotechnical laboratory.

Stantec personnel transported and submitted the geotechnical samples to the Stantec Geotechnical Laboratory in Lexington, Kentucky. No geotechnical samples were tested since they were not needed for additional lithologic and geotechnical information and they remain stored at the Stantec laboratory.

3.3.2.2 CCR Parameter Sampling

Soil samples were collected from background monitoring well boring locations for analysis of CCR-related constituents following procedures in the Background Soil SAP. Two soil samples and one field duplicate were collected from the screened interval depth range of the two background monitoring well borings and submitted for laboratory analysis:

- Boring WBF-102Alt2 (Sonic) was completed as well WBF-102 - one sample and one field duplicate sample were collected (17.5 to 19.5 ft bgs)
- Boring WBF-103 was completed as well WBF-103 - one sample was collected (12.0 to 15.0 ft bgs).

As specified in the WBF Plant Background Soil SAP, the soil samples collected from the background monitoring well boring were analyzed for CCR-related constituents listed in Appendices III and IV of Title 40 of the Code of Federal Regulations (CFR) Part 257 (40 CFR 257). In addition, five inorganic constituents listed in Appendix I of Tennessee Rule 0400-11-01-.04 and not included in the 40 CFR 257 Appendices III and IV were analyzed to maintain continuity with the TDEC environmental programs. These additional TDEC Appendix I constituents included copper, nickel, silver, vanadium, and zinc. The combined federal CCR Appendices III and IV constituents and TDEC Appendix I inorganic constituents are hereafter referred to as “CCR Parameters”.

Background soil sampling investigation activities, including sampling procedures, laboratory information, and analytical results are presented in the WBF Plant Background Soil Investigation SAR.

3.4 MONITORING WELL INSTALLATION

3.4.1 Well Installation

Monitoring wells were installed in the borings by qualified drill crews working under the direction of a Stantec PG and a licensed Tennessee driller. Well installation was carried out in general accordance with ENV-TI-05.80.25, *Monitoring Well and Piezometer Installation and Development*. Well construction details are documented on the Well Installation Details provided in Attachment C.2 in Appendix C.

The lowest portions of the borings were backfilled with sand filter pack (20/40 mesh). The monitoring well was installed above the backfilled portion. Monitoring wells consisted of a four-inch diameter Schedule 40 PVC pre-packed well screen (0.010-inch slots) and riser. The screen and riser consisted of flush-joint, threaded PVC pipe. The screen length was selected based on the results of the boring log and the target stratum and was either 4.8 feet or 9.8 feet. A four-inch diameter Schedule 40 PVC bottom well plug measuring approximately 0.4 feet in length was threaded onto the bottom of the screen. The PVC riser extended a minimum of 2.5 feet above the ground surface and was capped with a temporary plug or slip cap. The annular space was backfilled with a sand filter pack extending approximately two feet above and six inches below the screen. A bentonite pellet seal approximately two feet thick was placed on top of the sand filter pack. The sand filter pack and bentonite pellets were either placed by tremie method or poured slowly into the annular space of the drill tooling to prevent bridging.

After the bentonite pellet seal had sufficiently hydrated for a duration equal to or greater than the minimum recommended by the manufacturer (a minimum of four hours), the remaining annular space was backfilled with a 30% solids bentonite grout. The grout was placed by tremie method through one-inch diameter PVC pipe using pumps gauged to allow the installation crew to monitor pressures during the grouting process.

Subsequent monitoring well surface completions consisted of an above-grade steel locking protective cover anchored to a concrete surface pad. The protective cover extended above the concrete pad and the annular space was filled with sand or pea gravel to about six inches below the top of PVC casing. Steel protective bollards were installed near each corner of the concrete pad and filled with concrete.

A summary of monitoring well construction specifications is presented in Table B.1 in Appendix B. Full construction details are presented in the Well Installation Details provided in Attachment C.2 in Appendix C.

3.4.2 Well Development

Each new monitoring well was developed in accordance with ENV-TI-05.80.25, *Monitoring Well and Piezometer Installation and Development* by a combination of bailing, surging, and pumping after a minimum of 24 hours following well installation. First, a three-inch diameter PVC bailer was lowered and raised within the screened intervals to create a slight surging action to dislodge particles within the wells and sand filter packs. Then the bailer was used to remove turbid water from the well. Baseline readings of turbidity, pH, temperature, and specific conductance were measured using a calibrated YSI Pro Plus water quality meter and a calibrated Hach 2100Q turbidity meter. This process of alternately surging and bailing was repeated several times to decrease the water turbidity within the wells. Lastly, a submersible pump was employed to further develop the wells until stabilization criteria for turbidity (≤10 Nephelometric Turbidity Units), pH (±0.1 Standard Unit), temperature (±10%), and specific conductance (±10%) were achieved. The target turbidity value was based on well purging criteria specified in ENV-TI-05.80.42, *Groundwater Sampling* at the time of development. Well development details were recorded on the *Well Development Form.* A summary of initial and final water quality measurements is presented in Table B.2 in Appendix B.

3.4.3 Hydraulic Conductivity (Slug) Testing

After development, Stantec performed slug tests in five of the six monitoring wells to estimate hydraulic conductivity. Monitoring well WBF-102 could not be tested, because it was repeatedly dry or had insufficient water column to conduct the tests. The slug tests were performed in accordance with ASTM D4044: *Standard Test Method for (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers*. A pressure transducer with a data recorder was used to collect water level information from the wells.

Three rising-head and three falling-head slug tests were performed at each well, as shown in Table B.3 in Appendix B. Each well was tested by taking an initial measurement of the static water level followed by the insertion of the pressure transducer into the well. After the transducer had been installed, a falling-head slug test was conducted by introducing a solid slug (e.g., PVC pipe filled with sand) into the well to cause a nearly instantaneous rise in the water level. The water levels were then recorded at regular intervals until reaching near initial static levels. After the first test concluded, a rising-head slug test was conducted by removing the slug to cause a nearly instantaneous drop in the water level. Water levels were recorded until near initial static water levels were reached again. The procedure of alternating a falling-head and a rising-head slug test was conducted three times at each well. The data were recorded electronically by the transducer and downloaded into a data collector. Raw data were checked in the field for discrepancies prior to demobilizing from the WBF Plant.

The field data were analyzed using AQTESOLV™ Version 4.50 Professional software to estimate the hydraulic conductivity of the saturated soils in the screened interval. Calculated hydraulic conductivities are summarized in Table B.3 in Appendix B, and the software output package is provided in Appendix E. The following assumption and method were utilized for the calculations:

- The analysis was completed using the Bouwer-Rice method. The solution was matched to the normalized plotted recovery data between 70-80% recovery.

3.4.4 Pump Installation

A new, decontaminated, QED Environmental Systems, Inc. brand dedicated bladder pump was installed in each new monitoring well after well development was completed. The pump model installed in each well was either a P1150 if the water column height above the pump intake was less than 10 feet, or a model P1101M if it was more than 10 feet. Each pump intake was placed at approximately the mid-point of the well screened interval or the mid-point of the saturated portion of the well screened interval for future groundwater sampling. Following pump installation, the pumps were calibrated in general accordance with ENV-TI-05.80.42, *Groundwater Sampling*. Well pump placement depths, installation calculations, and calibration details were recorded on the Q*ED Well Wizard Dedicated Sampling Pump Installation Checklist* and the *Dedicated Pump Calibration Form*. Pump installation information is provided in Table B.4 in Appendix B.

3.4.5 Well Surveys

After the surface completions for each monitoring well were installed, the well was professionally surveyed using a survey-grade GPS for horizontal and vertical control. Measurements were calculated relative to the coordinate systems used by the WBF Plant. Well survey information is provided in Table B.5 in Appendix B.

3.5 INVESTIGATION DERIVED WASTE

Investigation derived waste (IDW) generated during the HGI included:

- Soil cuttings
- Well development water
- Decontamination fluids
- Personal protective equipment (PPE)
- General trash.

IDW was handled in general accordance with ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*; ENV-TI-05.80.25, *Monitoring Well and Piezometer Installation and Development*; the HGI SAP; the WBF Plant-specific waste management plan; and local, state, and federal regulations. Transportation and disposal of IDW were coordinated with the WBF Plant facility management. Soil cuttings, decontamination fluids, and well development water were managed as authorized by WBF Plant facility management and in accordance with the HGI SAP. Used disposable PPE (e.g., nitrile gloves) and general trash were placed in garbage bags and disposed of in a municipal waste dumpster onsite.

3.6 VARIATIONS

The proposed scope and procedures for the HGI were outlined in the SAP, QAPP, applicable TVA TIs, and ASTM standards as detailed in the sections above. Variations in scope or procedures discussed with TDEC and/or TVA, changes based on field conditions, or additional field sampling performed to complete the scope of work in the SAP are described in the following sections. As discussed below, these variations do not impact the overall usability and representativeness of the dataset provided in this SAR for the HGI at the WBF Plant.

3.6.1 Variations in Scope

Variations in scope are provided below.

- The location of boring WBF-102 was relocated three times due to encountering construction debris, CCR materials, or refusal before reaching groundwater. The final well location approved by TDEC was originally designated as WBF-102Alt2 (Sonic) and renamed as well WBF-102.

- The location of well WBF-105 was relocated to the southwest as approved by TDEC because three pre-screen borings encountered CCR materials.
- Monitoring well WBF-102 could not be slug tested due to insufficient water column height within the casing. Slug tests were performed at the other monitoring wells installed during the HGI.
- Geotechnical samples were not analyzed as specified in the SAP because sufficient lithologic and geotechnical information were available from other EIP drilling activities to meet the objectives of the HGI.

3.6.2 Variations in Procedures

Variations in procedures occurring in the field are provided below.

- Borings WBF-102Alt2 (Sonic) and WBF-105/WBF-105 (Sonic) encountered CCR material in the shallow soils. As described in Section 3.3.1.3, the drilling methodology was modified, as approved by TVA and TDEC, to minimize CCR material migration deeper into the boreholes. These borings were completed with the installation of monitoring wells WBF-102 and WBF-105, respectively.

4.0 SUMMARY

The data presented in this report are from the HGI at the WBF Plant. Six permanent monitoring wells were installed during the HGI to support data collection for the groundwater and background soil investigations at the WBF Plant, including groundwater level measurements, and groundwater and background soil sample collection for analysis of CCR Parameters. The scope of work for the HGI included:

- Drilled 13 pre-screen soil borings in the vicinities of proposed monitoring well locations
- Drilled nine soil borings for installation of four permanent monitoring wells and two background monitoring wells
- Collected soil samples to develop a continuous boring log/soil profile for each boring
- Collected two soil samples and one field duplicate for analysis of CCR Parameters from the screened interval depth range of two background monitoring well borings
- Installed permanent monitoring wells in six of the borings and constructed surface completions
- Developed each new monitoring well
- Conducted slug tests in five new monitoring wells to estimate hydraulic conductivity
- Surveyed each new monitoring well.

A summary of boring and monitoring well locations is presented in Table 1. Monitoring well construction specifications, well development, hydraulic testing results, pump installation details, and survey information are presented in Tables B.1 through B.5, respectively. Background soil sampling information and analytical results are reported in the Background Soil Investigation SAR, and groundwater level measurements and sampling analytical results are reported in a series of Groundwater Investigation SARs for the WBF Plant.

Stantec has completed this HGI at the WBF Plant in Spring City, Tennessee, in accordance with the HGI SAP as documented herein. The data collected during the HGI are usable for reporting and evaluation in the EAR and meet the objectives of the TDEC Order EIP. HGI drilling and well installation data will be evaluated along with data collected under other TDEC Order SAPs, including but not limited to, the background soil investigation and the six sampling events of the groundwater investigation, as well as data collected under other State and CCR programs. This evaluation will be provided in the EAR.

5.0 REFERENCES

American Society for Testing and Materials (ASTM). D6151: *Standard Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling.*

ASTM. D1586: *Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils*.

ASTM. D4044: *Standard Test Method for (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers*.

Environmental Standards, Inc. 2018. *Quality Assurance Project Plan for the Tennessee Valley Authority Watts Bar Fossil Plant Environmental Investigation*. Revision 2. Prepared for Tennessee Valley Authority. November 2018.

Munsell Color. 2009. Munsell Soil Color Book.

Stantec Consulting Services Inc. (Stantec). 2018a. *Hydrogeological Investigation Sampling and Analysis Plan, Watts Bar Fossil Plant.* Revision 3. Prepared for Tennessee Valley Authority. November 19, 2018.

Stantec. 2018b. *Environmental Investigation Plan, Watts Bar Fossil Plant.* Revision 3. Prepared for Tennessee Valley Authority. November 19, 2018.

Stantec. 2018c. *Background Soil Sampling and Analysis Plan, Watts Bar Fossil Plant*. Revision 3. Prepared for Tennessee Valley Authority. November 19, 2018.

Tennessee Department of Environment and Conservation. 2015. Commissioner's Order No. OGC15-0177.

Tennessee Valley Authority (TVA). ENV-TI-05.80.02, *Sample Labeling and Custody*.

TVA. ENV-TI-05.80.03, *Field Record Keeping.*

TVA. ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*.

TVA. ENV-TI-05.80.25, *Monitoring Well and Piezometer Installation and Development*.

TVA. ENV-TI-05.80.42, *Groundwater Sampling.*

APPENDIX A - EXHIBITS

Exhibit No.
A.1

Title
Site Map and Monitoring Well Locations

Client/Project
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2020-07-09
Technical Review by MW on 2020-07-09

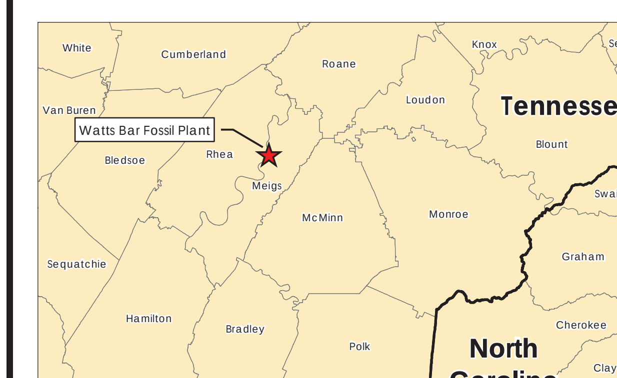
0 150 300 450 600 Feet
1:1,800 (At original document size of 22x34)

Legend

- Monitoring Well (Survey 8/26/2019) — Well Name / Boring Name
- Drilled and Abandoned Borehole — Boring Name
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Chemical Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and ESRI World Imagery
3. Boring Name* As-drilled boring location not surveyed. Horizontal coordinates based on field measurements. Vertical coordinates based on 2017 LIDAR surfaces.



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APPENDIX B - TABLES

Table B.1 - Summary of Monitoring Well Construction Specifications
Watts Bar Fossil Plant
May-October 2019

Well ID	Top of Casing Stickup	Top of Casing Elevation	Bottom of Well Depth	Bottom of Well Depth	Bottom of Well Elevation	Screened Interval Depth Top	Screened Interval Depth Bottom	Screened Interval Depth Top	Screened Interval Depth Bottom	Screened Interval Elevation Top	Screened Interval Elevation Bottom
	ft ags	ft NGVD29	ft bgs	ft btoc	ft NGVD29	ft bgs	ft bgs	ft btoc	ft btoc	ft NGVD29	ft NGVD29
WBF-101	4.4	703.15	33.1	37.5	665.6	22.9	32.7	27.3	37.1	675.8	666.0
WBF-102	4.8	723.98	19.8	24.6	699.4	14.6	19.4	19.4	24.2	704.6	699.8
WBF-103	4.0	725.09	18.2	22.2	702.9	13.0	17.8	17.0	21.8	708.1	703.3
WBF-104	3.4	697.45	28.3	31.7	665.8	18.1	27.9	21.5	31.3	676.0	666.2
WBF-105	4.7	704.50	32.7	37.4	667.1	27.5	32.3	32.2	37.0	672.3	667.5
WBF-106	4.7	706.34	33.3	38.0	668.4	23.1	32.9	27.8	37.6	678.5	668.7

Notes:

ags	above ground surface
bgs	below ground surface
btoc	below top of casing
ft	feet
ID	identification
NGVD29	National Geodetic Vertical Datum of 1929

1. Measurement data are from Well Installation Details (Appendix C.2).
2. Wells were surveyed on August 26, 2019.

Table B.2 - Summary of Well Development Data
Watts Bar Fossil Plant
May-October 2019

Well ID	pH		Turbidity		Specific Conductance		Temperature	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
			NTU	NTU	uS/cm	uS/cm	DEG C	DEG C
WBF-101	7.18	6.58	>1,000	9.68	423.9	630	18.7	21.0
WBF-102	6.68	6.41	>1,000	8.53	1,143	1,361	20.4	21.8
WBF-103	6.54	5.39	>1,000	5.72	216.9	341.8	19.3	20.0
WBF-104	6.11	6.11	>1,000	8.92	1,664	2,443	22.0	22.8
WBF-105	6.56	6.54	>1,000	2.96	759	1,021	22.8	19.7
WBF-106	6.49	6.13	>1,000	2.48	1,060	1,159	18.9	19.1

Notes:

>	result greater than
DEG C	degrees Celsius
ID	identification
NTU	Nephelometric Turbidity Unit
uS/cm	microSiemens per centimeter

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Table B.3 - Summary of Hydraulic Conductivity Testing Results
Watts Bar Fossil Plant
May-October 2019

Well ID	Saturated Thickness	Number of Tests		Average Hydraulic Conductivity	Average Hydraulic Conductivity
		Falling Head	Rising Head		
	ft			ft/day	cm/s
WBF-101	14.67	3	3	0.5411	1.91E-04
WBF-103	5.59	3	3	20.59	7.26E-03
WBF-104	15.32	3	3	0.6400	2.26E-04
WBF-105	22.34	3	3	1.373	4.85E-04
WBF-106	22.16	3	3	0.7648	2.70E-04

Notes:

cm/s	centimeters per second
ft	feet
ID	identification

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Table B.4 - Summary of Pump Installation Details
Watts Bar Fossil Plant
May-October 2019

Well ID	Top of Casing Elevation	Bottom of Well Depth	Bottom of Well Elevation	Groundwater Level Depth	Groundwater Level Elevation	Pump Intake Depth	Pump Intake Elevation	Water Column Above Intake
	ft NGVD29	ft btoc	ft NGVD29	ft btoc	ft NGVD29	ft btoc	ft NGVD29	ft
WBF-101	703.15	37.51	665.64	15.31	687.84	32.2	671.0	16.9
WBF-102	723.98	24.56	699.42	22.00	701.98	23.0	701.0	1.0
WBF-103	725.09	22.22	702.87	14.78	710.31	19.5	705.6	4.7
WBF-104	697.45	31.66	665.79	13.03	684.42	26.4	671.1	13.4
WBF-105	704.50	37.43	667.07	12.70	691.80	35.1	669.4	22.4
WBF-106	706.34	37.94	668.40	13.83	692.51	32.6	673.7	18.8

Notes:

btoc	below top of casing
ft	feet
NGVD29	National Geodetic Vertical Datum of 1929

1. Wells were surveyed on August 26, 2019.
2. Depth data are from *QED Well Wizard Dedicated Sampling Pump Installation Checklists* dated August 14-15, 2019. Depth to groundwater level was measured prior to pump insertion. Pump intake and water column above intake rounded to nearest 0.1 foot.

Table B.5 - Summary of Monitoring Well Survey Data
Watts Bar Fossil Plant
May-October 2019

Well ID	WBF Plant Local Northing	WBF Plant Local Easting	Latitude	Longitude	Ground Surface Elevation
	ft NAD27	ft NAD27	DMS NAD27	DMS NAD27	ft NGVD29
WBF-101	443,876.99	2,362,987.15	35° 36' 18.70"	-84° 46' 44.09"	698.7
WBF-102	443,745.53	2,362,237.49	35° 36' 17.49"	-84° 46' 53.19"	719.2
WBF-103	444,765.49	2,361,678.22	35° 36' 27.64"	-84° 46' 59.80"	721.1
WBF-104	444,336.57	2,363,103.76	35° 36' 23.23"	-84° 46' 42.61"	694.1
WBF-105	445,050.70	2,363,041.85	35° 36' 30.30"	-84° 46' 43.25"	699.8
WBF-106	445,872.50	2,362,862.26	35° 36' 38.45"	-84° 46' 45.30"	701.7

Notes:

DMS	Degrees, Minutes, Seconds
ft	feet
ID	identification
NAD27	North American Datum of 1927
NGVD29	National Geodetic Vertical Datum of 1929

1. Wells were surveyed on August 26, 2019. Coordinates are for the top of well casing, except ground surface elevation which is adjacent to the concrete well pad. Northing and Easting coordinates rounded to the nearest 0.01 feet. Latitude and Longitude rounded to the nearest 0.01 degree. Ground surface elevations rounded to the nearest 0.1 feet.

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APPENDIX C – SUBSURFACE LOGS AND WELL INSTALLATION DETAILS

ATTACHMENT C.1

Subsurface Logs

Subsurface Boring Legend

Lithology Graphics

Symbol	Lithology
	Fill
	Top Soil
	Gravel
	Well Graded Gravel (GW)
	Poorly Graded Gravel (GP)
	Silty Gravel (GM)
	Silty, Clayey Gravel (GC-GM)
	Clayey Gravel (GC)
	Well Graded Gravel with Silt (GW-GM)
	Well Graded Gravel with Clay (GW-GC)
	Poorly Graded Gravel with Silt (GP-GM)
	Poorly Graded Gravel with Clay (GP-GC)
	Well Graded Sand (SW)
	Poorly Graded Sand (SP)
	Silty Sand (SM)
	Silty, Clayey Sand (SC-SM)
	Clayey Sand (SC)
	Well Graded Sand with Silt (SW-SM)
	Well Graded Sand with Clay (SW-SC)
	Poorly Graded Sand with Silt (SP-SM)
	Poorly Graded Sand with Clay (SP-SC)
	Silt (ML)
	Silty Clay (CL-ML)
	Lean Clay (CL)
	Organic Silt (OL)
	Elastic Silt (MH)
	Fat Clay (CH)
	Organic Clay (OH)
	Shale
	Siltstone
	Coal
	Limestone
	Sandstone

Lithology Graphics are based on TVA drafting standards.

Other Graphics

Symbol	Description
	Denotes environmental analytical sample interval
	Denotes SS sample interval
	Denotes ST sample interval
	Denotes DP sample interval
	Denotes RS sample interval
	Denotes RC sample interval
	First water level reading
	Second water level reading

Common Abbreviations

Abbreviation	Definition
DP	Direct Push
HA	Hand Auger
HSA	Hollow Stem Auger
N/A	Not Applicable
NR	Not Recorded
RC	Rock Core
RQD	Rock Quality Designation
RS	Rotary Sonic
SS	Split Spoon
ST	Shelby Tube
WH	Weight of Hammer
WR	Weight of Rod

General Notes

The boring logs include sample numbering used during drilling. For assigned Environmental Analytical Sample ID numbers, see relevant Environmental Chain-of- Custody forms from the drilling date range listed on each log.

For pH readings and additional field data, see applicable field documentation (e.g., Soil pH Data Form) from the drilling date range listed on each log.

SUBSURFACE LOG

Client Borehole ID: N/A
Stantec Boring No.: **WBF-101**
Client: Tennessee Valley Authority
Boring Location: 443,876.99 N; 2,362,987.15 E NAD27 Plant Local
Project Number: 175668050
Surface Elevation: 698.7 ft
Elevation Datum: NGVD29
Project Name: WBF TDEC Order
Date Started: 6/11/19
Completed: 6/12/19
Project Location: Rhea Co, Spring City, Tennessee
Depth to Water: 10.5 ft
Date/Time: 6/12/19 12:30
Inspector: G. Budd
Logger: G. Budd
Depth to Water: N/A
Date/Time: N/A
Drilling Contractor: Stantec Consulting Services Inc.
Drill Rig Type and ID: CME 850XR, #953
Overburden Drilling and Sampling Tools (Type and Size): 4-1/4" HSA, 2" SS w/o liners
Rock Drilling and Sampling Tools (Type and Size): N/A
Overdrill Tooling (Type and Size): 8-1/4" HSA overdrill of boring
Overdrill Depth: 34.0 ft
Sampler Hammer Type: Automatic
Weight: 140 lb
Drop: 30"
Efficiency: N/A
Borehole Azimuth: N/A
Borehole Inclination (from Vertical): N/A
Reviewed By: C. Kocka
Approved By: L. Price

Lithology Depth Ft[3]	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	698.7		Top of Hole				
0.7	698.0		Crushed stone, grass and topsoill, [FILL] Limestone gravel from 0.0' to 0.4'	SS01aG	0.0 - 0.7	0.9	12-8-7
1.5	697.2			SS01bG	0.7 - 1.5		
			LEAN CLAY, CL, 7.5YR 5/6 (strong brown) and 7.5YR 6/1 (gray), stiff to medium stiff, dry, with limestone and chert gravel, [FILL]	SS02G	1.5 - 3.0	1.1	6-5-7
3.5	695.2		SANDY LEAN CLAY, CL, 7.5YR 5/6 (strong brown), low plasticity, very stiff, dry, with sandstone gravel, [FILL]	SS03aG	3.0 - 3.5	1.2	3-4-5
				SS03bG	3.5 - 4.5		
			LEAN CLAY, CL, 7.5YR 3/4 (dark brown), low to medium plasticity, soft, moist, with some very fine sand, with organics	SS04G	4.5 - 6.0	1.5	3-4-4
				SS05G	6.0 - 7.5	1.3	3-2-4
				SS06G	7.5 - 9.0	1.4	2-2-3
				SS07G	9.0 - 10.5	1.5	2-2-3
▽10.5	688.2		SANDY LEAN CLAY, CL, 7.5YR 4/6 (strong brown), low to medium plasticity, very soft to soft, moist	SS08G	10.5 - 12.0	1.5	2-1-3
				SS09G	12.0 - 13.5	1.5	1-2-2
			Clayey sand lens, wet from 13.5' to 14.0'	SS10G	13.5 - 15.0	1.4	WH-1-1
			Trace organics from 15.0' to 16.5'	SS11G	15.0 - 16.5	1.5	1-2-2
18.0	680.7			SS12G	16.5 - 18.0	1.5	1-1-2

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 7/13/20

Client Borehole ID	N/A	Stantec Boring No.	**WBF-101**
Client	Tennessee Valley Authority	Boring Location	443,876.99 N; 2,362,987.15 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	698.7 ft
		Elevation Datum	NGVD29

Depth Ft[3] (Lithology)	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft	Blows/PSI / Rec. %
			CLAYEY SAND, SC, 10YR 5/6 (yellowish brown), fine, very loose, wet	SS13G	18.0 - 19.5	1.5	WH-1-1
			Sandy clay lenses from 19.5' to 21.0'	SS14G	19.5 - 21.0	1.5	WH-WH-1
				SS15G	21.0 - 22.5	1.5	WH-1-1
				SS16G	22.5 - 24.0	1.2	WH-1-1
			With fragments of sandstone from 23.8' to 24.0' Color change to 10YR 5/1 (gray) at 24.0'	SS17G	24.0 - 25.5	1.5	WH-WH-WH
			Color change to 10YR 5/6 (yellowish brown), with sandy clay at 25.5'	SS18G	25.5 - 27.0	1.0	WH-WH-WH
				SS19G	27.0 - 28.5	1.5	WH-WH-1
29.5	669.2			SS20aG / SS20bG	28.5 - 29.5 / 29.5 - 30.0	1.5	WH-1-1
			SILTY SAND, SM, 10YR 5/1 (gray), fine, very loose, wet	SS21G	30.0 - 31.5	1.5	1-1-4
32.7	666.0		Abundant wood fragments from 31.3' to 32.7' Sandy clay lens at 32.0'	SS22aG / SS22bG	31.5 - 32.7 / 32.7 - 33.0	1.5	2-4-9
34.0	664.7		WELL GRADED SAND WITH GRAVEL, SW, 10YR 5/1 (gray), very fine to coarse, medium dense, wet, gravel subangular to subrounded	SS23aG	33.0 - 34.0	1.5	3-24-19
34.5	664.2		Shale, green gray, moderately hard, calcareous, Weathered	SS23bG	34.0 - 34.5		

No Refusal /
Bottom of Hole at 34.5 Ft.

Top of Rock = 34.0 Ft.
Top of Rock Elevation = 664.7 Ft.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 7/13/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-101A**
Client	Tennessee Valley Authority	Boring Location	443,887.54 N; 2,362,991.77 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	698.5 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	5/30/19
		Completed	5/30/19
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	11.7 ft
		Date/Time	6/4/19 16:01
Inspector	G. Budd	Depth to Water	N/A
Logger	G. Budd	Date/Time	N/A
Drilling Contractor	Hawkston (Subcontractor)	Drill Rig Type and ID	Geoprobe 3230DT
Overburden Drilling and Sampling Tools (Type and Size)	DPT-Direct Push		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	N/A	Overdrill Depth	N/A
Sampler Hammer Type	N/A	Weight	N/A
Drop	N/A	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Kocka	Approved By	L. Price

Depth Ft[3]	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	698.5		Top of Hole				
0.3	698.2		Grass and topsoil				
0.7	697.8		Limestone gravel, [FILL]				
3.3	695.2		SANDY LEAN CLAY SOME GRAVEL, CL, 7.5YR 5/6 (strong brown) and 7.5YR 6/1 (gray), dry, with limestone and chert gravel, [FILL]	DP01	0.0 - 5.0	3.7	N/A
15.0	683.5		LEAN CLAY WITH SAND, CL, 7.5YR 3/4 (dark brown), low to medium plasticity, moist Soft, with organics at 5.0'	DP02 DP03	5.0 - 10.0 10.0 - 15.0	4.8 4.7	N/A N/A
19.0	679.5		SANDY LEAN CLAY, CL, 7.5YR 3/4 (dark brown), low to medium plasticity, soft, moist	DP04	15.0 - 20.0	5.0	N/A

Depth to water symbol at 11.7 ft.

Client Borehole ID	N/A	Stantec Boring No.	**WBF-101A**
Client	Tennessee Valley Authority	Boring Location	443,887.54 N; 2,362,991.77 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	698.5 ft
		Elevation Datum	NGVD29

Depth Ft[3]	Elevation	Description
		CLAYEY SAND, SC, 7.5YR 3/4 (dark brown), fine, moist Color change to 7.5YR 4/4 (brown) at 20.0' Wet at 21.6' With manganese at 25.1' Color change to 10YR 5/1 (gray), wet at 25.2'
30.0	668.5	SILTY SAND, SM, 10YR 5/1 (gray), fine, wet
31.0	667.5	Wood
31.5	667.0	POORLY GRADED SAND, SP, 10YR 5/1 (gray), fine, wet With trace fragments of sandstone from 32.8' to 33.0'
33.0	665.5	WELL GRADED SAND WITH GRAVEL, SW, very fine to coarse, wet
34.0	664.5	Shale, green gray, hard, calcareous
35.0	663.5	Bedrock Refusal / Bottom of Hole at 35.0 Ft.

Sample[1,2] / RQD %	Depth Ft[3] / Run Ft	Rec. Ft	Blows/PSI / Rec. %
DP05	20.0 - 25.0	2.1	N/A
DP06	25.0 - 30.0	5.0	N/A
DP07	30.0 - 33.0	2.3	N/A
DP08	33.0 - 35.0	0.8	N/A

Top of Rock = 34.0 Ft.
Top of Rock Elevation = 664.5 Ft.

As-drilled boring location not surveyed. Horizontal coordinates based on field measurements. Vertical coordinates based on 2017 LiDAR surfaces.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 6/22/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-101B**
Client	Tennessee Valley Authority	Boring Location	443,892.54 N; 2,362,991.77 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	698.9 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	5/30/19
		Completed	5/30/19
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	12.6 ft
		Date/Time	6/4/19 16:03
Inspector	G. Budd	Depth to Water	N/A
Logger	G. Budd	Date/Time	N/A
Drilling Contractor	Hawkston (Subcontractor)	Drill Rig Type and ID	Geoprobe 3230DT
Overburden Drilling and Sampling Tools (Type and Size)	DPT-Direct Push		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	N/A	Overdrill Depth	N/A
Sampler Hammer Type	N/A	Weight	N/A
Drop	N/A	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Kocka	Approved By	L. Price

Lithology: Depth Ft[3]	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	698.9		Top of Hole				
0.3	698.6		Grass, topsoil				
1.2	697.7		Limestone gravel, [FILL]				
			LEAN CLAY WITH SAND, CL, 5YR 5/8 (yellowish red) and 5YR 6/1 (gray), dry, [FILL]	DP01	0.0 - 5.0	1.6	N/A
			Color change to 7.5YR 3/4 (dark brown), medium plasticity, moist, with organics at 5.3'	DP02	5.0 - 10.0	1.5	N/A
10.0	688.9		SANDY LEAN CLAY, CL, 7.5YR 3/4 (dark brown), medium plasticity, moist With trace gravel, subrounded from 10.0' to 15.0'	DP03	10.0 - 15.0	4.6	N/A
				DP04	15.0 - 20.0	3.3	N/A

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18

SUBSURFACE LOG

Client Borehole ID: N/A
Stantec Boring No. **WBF-101B**
Client: Tennessee Valley Authority
Boring Location: 443,892.54 N; 2,362,991.77 E NAD27 Plant Local
Project Number: 175668050
Surface Elevation: 698.9 ft
Elevation Datum: NGVD29

Depth Ft[3]	Elevation	Description	Sample[1,2]	Depth Ft[3]	Rec. Ft	Blows/PSI
		SANDY LEAN CLAY, CL, 7.5YR 3/4 (dark brown), medium plasticity, moist *(Continued)* With clayey sand at 20.0'	DP05	20.0 - 25.0	4.8	N/A
24.4	674.5	CLAYEY SAND, SC, 10YR 4/1 (dark gray), fine, wet				
25.2	673.7	SILTY SAND SOME CLAY, SM, 10YR 4/1 (dark gray), fine, wet	DP06	25.0 - 30.0	4.3	N/A
30.0	668.9	CLAYEY SAND, SC, 10YR 4/1 (dark gray), fine, wet	DP07	30.0 - 33.0	3.0	N/A
31.5	667.4	POORLY GRADED SAND, SP, 10YR 4/1 (dark gray), fine, wet				
33.0	665.9	Fragments of sandstone from 32.8' to 33.0'	DP08	33.0 - 34.0	0.5	N/A
34.0	664.9	WELL GRADED GRAVEL WITH SAND, GW, 10YR 5/2 (grayish brown), fine to medium, wet, subrounded to rounded				

Bedrock Refusal /
Bottom of Hole at 34.0 Ft.

As-drilled boring location not surveyed. Horizontal coordinates based on field measurements. Vertical coordinates based on 2017 LiDAR surfaces.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

SUBSURFACE LOG

Stantec | TVA

Client Borehole ID	N/A	Stantec Boring No.	**WBF-102**
Client	Tennessee Valley Authority	Boring Location	443,718.93 N; 2,362,223.94 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	721.7 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	6/18/19
		Completed	6/19/19
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	0.0 ft
		Date/Time	6/18/19 12:53
Inspector	G. Budd	Depth to Water	0.0 ft
Logger	G. Budd	Date/Time	6/19/19 12:53
Drilling Contractor	Stantec Consulting Services Inc.	Drill Rig Type and ID	CME 850XR, #953
Overburden Drilling and Sampling Tools (Type and Size)	4-1/4" HSA, 3" SS w/o liners		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	8-1/4" HSA overdrill of boring	Overdrill Depth	N/A
Sampler Hammer Type	Automatic	Weight	140 lb
Drop	30"	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Kocka	Approved By	L. Price

Depth Ft[3]	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft	Blows/PSI / Rec. %
0.0	721.7		Top of Hole				
0.4	721.3		Grass and topsoil	SS01aG	0.0 - 0.4	1.5	5-17-15
2.5	719.2		Crushed stone, clay fill and limestone gravel fill, [FILL] Trace CCR at 1.8'	SS01bG	0.4 - 1.5		
				SS02aG	1.5 - 2.5	1.3	11-12-11
5.2	716.5		LEAN CLAY, CL, 10YR 4/2 (dark grayish brown) and 10YR 4/3 (brown), low to medium plasticity, medium stiff to very stiff, dry to moist, with gray shale and limestone gravel, [FILL] Color change to 10YR 6/8 (brownish yellow) and 10YR 5/1 (gray) at 3.0'	SS02bG	2.5 - 3.0		
				SS03G	3.0 - 4.5	1.5	5-7-8
				SS04aG	4.5 - 5.2	1.5	5-6-9
13.0	708.7		SANDY LEAN CLAY SOME GRAVEL, CL, 10YR 4/4 (dark yellowish brown), medium stiff, moist, with fragments of shale, chert, limestone, and alluvial fine gravel subrounded to rounded, [FILL] Color change to 10YR 4/3 (brown) and 10YR 5/1 (gray), low plasticity, very soft to soft, subrounded at 9.0' Color change to 10YR 4/2 (dark grayish brown), with organics and some fragments of siltstone at 10.5' Color change to 7.5YR 6/8 (reddish yellow) and 7.5YR 6/1 (gray) at 12.4'	SS04bG	5.2 - 6.0		
				SS05G	6.0 - 7.5	1.2	6-7-9
				SS06G	7.5 - 9.0	1.3	4-6-7
				SS07G	9.0 - 10.5	1.5	1-3-4
				SS08G	10.5 - 12.0	1.5	2-5-6
				SS09aG	12.0 - 12.4	1.5	2-6-14
				SS09bG	12.4 - 13.0		
16.5	705.2		POORLY GRADED SAND WITH CLAY, SP, 7.5YR 6/8 (reddish yellow) and 7.5YR 6/1 (gray), fine, medium dense, dry to moist Sandstone in split spoon shoe from 16.3' to 16.5'	SS09cG	13.0 - 13.5		
				SS10G	13.5 - 15.0	1.5	8-18-19
				SS11G	15.0 - 16.5	1.5	6-6-26
18.0	703.7		POORLY GRADED SAND, SP, 7.5YR 6/8 (reddish yellow), fine to medium, medium dense, dry to moist	SS12G	16.5 - 18.0	1.5	22-19-14

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 9/21/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-102**
Client	Tennessee Valley Authority	Boring Location	443,718.93 N; 2,362,223.94 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	721.7 ft
		Elevation Datum	NGVD29

Lithology				Overburden:	Sample[1,2]	Depth Ft[3]	Rec. Ft	Blows/PSI
Depth Ft[3]	Elevation	Graphic	Description	Rock Core:	RQD %	Run Ft	Rec. Ft	Rec. %
18.9	702.8		With fragments of sandstone and quartz from 16.5' to 16.8'		SS13aG	18.0 - 18.9	1.5	7-6-8
			WELL GRADED SAND, SW, 7.5YR 6/8 (reddish yellow), very fine to coarse, loose, wet, with alluvial gravel, fine, subrounded		SS13bG	18.9 - 19.5		
20.8	700.9		LEAN CLAY, CL, 7.5YR 6/8 (reddish yellow) and 7.5YR 5/1 (gray), medium stiff to hard, moist to dry, iron oxide staining Color change to 10YR 5/2 (grayish brown) at 20.0'		SS14G	19.5 - 21.0	1.5	7-28-50
21.0	700.7		Clayey weathered siltstone					

Refusal /
Bottom of Hole at 21.0 Ft.

Top of Rock = 20.8 Ft.
Top of Rock Elevation = 700.9 Ft.

As-drilled boring location not surveyed. Horizontal coordinates based on field measurements. Vertical coordinates based on 2017 LIDAR surfaces.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 9/21/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-102A**
Client	Tennessee Valley Authority	Boring Location	443,718.93 N; 2,362,223.94 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	721.7 ft — Elevation Datum: NGVD29
Project Name	WBF TDEC Order	Date Started	5/29/19 — Completed: 5/29/19
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	N/A — Date/Time: N/A
Inspector	G. Budd — Logger: G. Budd	Depth to Water	N/A — Date/Time: N/A
Drilling Contractor	Hawkston (Subcontractor)	Drill Rig Type and ID	Geoprobe 3230DT

Overburden Drilling and Sampling Tools (Type and Size): DPT-Direct Push
Rock Drilling and Sampling Tools (Type and Size): N/A
Overdrill Tooling (Type and Size): N/A — Overdrill Depth: N/A
Sampler Hammer Type: N/A — Weight: N/A — Drop: N/A — Efficiency: N/A
Borehole Azimuth: N/A — Borehole Inclination (from Vertical): N/A
Reviewed By: C. Kocka — Approved By: L. Price

Depth Ft[3]	Elevation	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft	Blows/PSI / Rec. %
0.0	721.7	Top of Hole				
0.2	721.5	Grass and topsoil				
0.5	721.2	Crushed stone, limestone gravel, [FILL]				
1.0	720.7	WELL GRADED SAND, SW, 7.5YR 2.5/1 (black), fine to medium, dry, [CCR]				
2.0	719.7	LEAN CLAY, CL, 7.5YR 4/6 (strong brown), medium stiff, dry, trace CCR, with limestone and siltstone gravel, [FILL]	DP01	0.0 - 5.0	3.1	N/A
2.5	719.2	SANDY LEAN CLAY, CL, 10YR 4/2 (dark grayish brown), soft, moist, [FILL]				
5.0	716.7	LEAN CLAY, CL, 7.5YR 4/4 (brown), medium stiff, dry, with limestone gravel, [FILL]				
		SANDY LEAN CLAY, CL, 10YR 5/4 (yellowish brown), medium stiff, moist, with limestone gravel, subrounded to rounded, [FILL]	DP02	5.0 - 10.0	3.2	N/A
10.0	711.7	SANDY LEAN CLAY, CL, 7.5YR 4/1 (dark gray), soft, moist, abundant organics				
10.8	710.9	SANDY LEAN CLAY, CL, 10YR 5/6 (yellowish brown), stiff, moist				
11.5	710.2	CLAYEY SAND, SC, 10YR 6/6 (brownish yellow), fine, moist Low plasticity at 15.0'	DP03	10.0 - 15.0	1.8	N/A
16.0	705.7	WELL GRADED SAND WITH GRAVEL, SW, 7.5YR 6/8 (reddish yellow), very fine to coarse, moist, subrounded to rounded Chert and quartz fragments from 16.3' to 16.5' and	DP04	15.0 - 20.0	2.6	N/A

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 6/22/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-102A**
Client	Tennessee Valley Authority	Boring Location	443,718.93 N; 2,362,223.94 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	721.7 ft
		Elevation Datum	NGVD29

Depth Ft[3]	Elevation	Graphic	Description	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft	Rec. Ft	Blows/PSI / Rec. %
			16.8' to 17.0' WELL GRADED SAND WITH GRAVEL, SW, 7.5YR 6/8 (reddish yellow), very fine to coarse, moist, subrounded to rounded *(Continued)* Wet, with fragments of quartz, subangular to subrounded at 20.0'				
21.0	700.7		LEAN CLAY, CL, 10YR 5/2 (grayish brown) and 10YR 5/8 (yellowish brown), dry, with fragments of weathered siltstone	DP05	20.0 - 22.5	2.5	N/A
22.0	699.7		SILTY LEAN CLAY, CL, 10YR 6/6 (brownish yellow), medium plasticity, soft, moist				
22.3	699.4		LEAN CLAY, CL, 10YR 5/2 (grayish brown) and 10YR 5/8 (yellowish brown), dry, with fragments of weathered siltstone				
22.5	699.2		CLAYEY POORLY GRADED GRAVEL WITH SAND, GC, 10YR 5/8 (yellowish brown), fine, wet, sand is fine to coarse	DP06	22.5 - 27.5	4.0	N/A
24.2	697.5		SILTY LEAN CLAY, CL, 10YR 5/8 (yellowish brown) and 10YR 3/2 (very dark grayish brown), moist				
25.5	696.2		LEAN CLAY, CL, 10YR 5/2 (grayish brown), moist, with abundant weathered siltstone				
27.0	694.7		Siltstone, dark gray, moderately hard				
27.5	694.2						

Bedrock Refusal /
Bottom of Hole at 27.5 Ft.

Top of Rock = 27.0 Ft.
Top of Rock Elevation = 694.7 Ft.

As-drilled boring location not surveyed. Horizontal coordinates based on field measurements. Vertical coordinates based on 2017 LIDAR surfaces.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 6/22/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-102Alt**
Client	Tennessee Valley Authority	Boring Location	443,693.93 N; 2,362,223.95 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	723.4 ft — Elevation Datum NGVD29
Project Name	WBF TDEC Order	Date Started	6/19/19 — Completed 6/20/19
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	N/A — Date/Time N/A
Inspector	G. Budd — Logger G. Budd	Depth to Water	N/A — Date/Time N/A
Drilling Contractor	Stantec Consulting Services Inc.	Drill Rig Type and ID	CME 850XR, #953

Overburden Drilling and Sampling Tools (Type and Size) 4-1/4" HSA, 3" SS w/o liners

Rock Drilling and Sampling Tools (Type and Size) N/A

Overdrill Tooling (Type and Size) N/A — Overdrill Depth N/A

Sampler Hammer Type Automatic — Weight 140 lb — Drop 30" — Efficiency N/A

Borehole Azimuth N/A — Borehole Inclination (from Vertical) N/A

Reviewed By C. Kocka — Approved By L. Price

Depth Ft[3]	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft	Blows/PSI / Rec. %
0.0	723.4		Top of Hole				
0.5	722.9		Grass and topsoil	SS01G	0.0 - 1.5	1.1	5-5-9
1.5	721.9		Crushed stone, limestone gravel fill and clay				
			LEAN CLAY WITH GRAVEL, CL, 10YR 3/2 (very dark grayish brown), very stiff, moist, hydrocarbon staining, Limestone gravel, fragments of siltstone and CCR, [FILL]	SS02G	1.5 - 3.0	1.4	14-10-7
				SS03G	3.0 - 4.5	1.3	5-6-5
6.0	717.4		Wood pieces from 4.5' to 6.0'	SS04G	4.5 - 6.0	1.0	2-17-16

No Refusal /
Bottom of Hole at 6.0 Ft.

Boring abandoned at 6.0' bgs due to miscellaneous waste encountered (braided hose, chain-link fencing, hydraulic fittings)

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 6/18/20

SUBSURFACE LOG

Stantec | TVA

Client Borehole ID	N/A	Stantec Boring No.	**WBF-102Alt1**
Client	Tennessee Valley Authority	Boring Location	443,745.53 N; 2,362,234.49 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	719.5 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	6/20/19
		Completed	6/20/19
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	17.9 ft
		Date/Time	6/20/19 15:25
Inspector	G. Budd	Depth to Water	N/A
Logger	G. Budd	Date/Time	N/A
Drilling Contractor	Stantec Consulting Services Inc.	Drill Rig Type and ID	CME 850XR, #953
Overburden Drilling and Sampling Tools (Type and Size)	4-1/4" HSA, 3" SS w/o liners		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	N/A	Overdrill Depth	N/A
Sampler Hammer Type	Automatic	Weight	140 lb
Drop	30"	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Kocka	Approved By	L. Price

Lithology

Depth Ft[3]	Elevation	Description
0.0	719.5	Top of Hole
0.3	719.2	Grass and topsoil
0.6	718.9	Crushed stone, playland limestone gravel
1.5	718.0	WELL GRADED SAND, SW, 10Y 2/1 (), very fine to coarse, loose, dry, [CCR]
3.0	716.5	SANDY LEAN CLAY, CL, 10YR 5/6 (yellowish brown) and 10YR 5/1 (gray), medium stiff, moist, with fragments of limestone and siltstone, [FILL] Color change to 10YR 4/2 (dark grayish brown), with organics at 2.2'
6.0	713.5	LEAN CLAY WITH SAND, CL, 10YR 6/6 (brownish yellow) and 10YR 4/2 (dark grayish brown), low to medium plasticity, medium stiff, moist, weak HCL reaction, with abundant fragments of calcareous shale, limestone fragments, [CCR] Trace CCR from 4.5' to 5.0'
10.2	709.3	SANDY LEAN CLAY, CL, 10YR 4/3 (brown), medium stiff, moist, with fragments of siltstone, chert, limestone, alluvial subrounded to rounded, medium to coarse, gravel, organics, [FILL]
13.5	706.0	SANDY LEAN CLAY, CL, 10YR 6/8 (brownish yellow) and 10YR 5/1 (gray), medium plasticity, soft to medium stiff, moist, with fragments of siltstone Fine sand lens at 10.5' Color change to 5YR 5/8 (yellowish red) and 5YR 6/1 (gray), low plasticity, increasing sand with depth at 11.0'
15.0	704.5	CLAYEY SAND, SC, 5YR 5/8 (yellowish red) and 5YR 6/1 (gray), fine, very loose to loose, moist
		SANDY WELL GRADED GRAVEL, GW, 7.5YR 5/6 (strong brown) and 7.5YR 7/1 (light gray), very fine to coarse, medium dense to very dense, moist, iron oxide staining, alluvial fine to coarse, subrounded to rounded, gravel, with some cobbles and fragments of quartz

Samples

Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Interval	Rec. Ft	Blows/PSI / Rec. %
SS01aG	0.0 - 0.6	0.0 - 1.5	1.3	5-9-8
SS01bG	0.6 - 1.5			
SS02aG	1.5 - 2.2	1.5 - 3.0	1.5	8-7-6
SS02bG	2.2 - 3.0			
SS03G	3.0 - 4.5	3.0 - 4.5	1.5	6-9-9
SS04G	4.5 - 6.0	4.5 - 6.0	1.5	4-3-4
SS05	6.0 - 7.5	6.0 - 7.5	1.5	4-6-6
SS06G	7.5 - 9.0	7.5 - 9.0	1.5	3-6-6
SS07aG	9.0 - 10.2	9.0 - 10.5	1.5	2-5-6
SS07bG	10.2 - 10.5			
SS08aG	10.5 - 11.0	10.5 - 12.0	0.9	3-3-6
SS08bG	11.0 - 12.0			
SS09G	12.0 - 13.5	12.0 - 13.5	1.5	3-4-6
SS10G	13.5 - 15.0	13.5 - 15.0	1.5	3-4-8
SS11G	15.0 - 16.5	15.0 - 16.5	1.3	27-38-50
SS12G	16.5 - 18.0	16.5 - 18.0	1.5	22-27-31

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 6/22/20

Client Borehole ID	N/A	Stantec Boring No.	**WBF-102Alt1**
Client	Tennessee Valley Authority	Boring Location	443,745.53 N; 2,362,234.49 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	719.5 ft
		Elevation Datum	NGVD29

Lithology: Depth Ft[3]	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
19.5	700.0		Color change to 7.5YR 3/1 (very dark gray) and 7.5YR 5/8 (strong brown), wet, with some cobbles at 16.5'	SS13G	18.0 - 19.5	0.6	23-20-14
20.0	699.5		SANDY WELL GRADED GRAVEL WITH CLAY, GW-GC, 7.5YR 5/8 (strong brown), very fine to coarse, wet, alluvial fine to coarse, subrounded to rounded, gravel	SS14aG	19.5 - 20.0	1.5	5-17-21
21.0	698.5		LEAN CLAY, CL, 7.5YR 6/8 (reddish yellow) and 7.5YR 5/1 (gray), medium stiff to hard, moist to dry, iron oxide staining, clayey weathered siltstone	SS14bG	20.0 - 21.0		

Depth scale: 18, 19, 20, 21

Sample intervals: 18.0 - 19.5; 19.5 - 21.0

No Refusal /
Bottom of Hole at 21.0 Ft.

As-drilled boring location not surveyed. Horizontal coordinates based on field measurements. Vertical coordinates based on 2017 LiDAR surfaces.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 6/22/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-102Alt2 (Sonic)**
Client	Tennessee Valley Authority	Boring Location	443,745.53 N; 2,362,237.49 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	719.2 ft; Elevation Datum NGVD29
Project Name	WBF TDEC Order	Date Started	6/21/19; Completed 7/8/19
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	N/A; Date/Time N/A
Inspector	E. Smith; Logger E. Smith	Depth to Water	N/A; Date/Time N/A
Drilling Contractor	M&W Drilling (Subcontractor); Stantec	Drill Rig Type and ID	Geoprobe GV5 Sonic; CME 850XR, #953

Overburden Drilling and Sampling Tools (Type and Size) Sonic 6" Core Barrel, 8" Steel Casing; 8-1/4" HSA

Rock Drilling and Sampling Tools (Type and Size) N/A

Overdrill Tooling (Type and Size) N/A Overdrill Depth N/A

Sampler Hammer Type N/A Weight N/A Drop N/A Efficiency N/A

Borehole Azimuth N/A Borehole Inclination (from Vertical) N/A

Reviewed By B. Evans Approved By L. Price

Lithology Depth Ft[3]	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	719.2		Top of Hole				
			8-1/4" HSA was used on 6/21/19 to blind drill boring to 10.0' for the installation of a permanent, 10-inch PVC surface casing. Boring was later advanced to depth through the installed surface casing using sonic drilling methods. Refer to the boring log of adjacent boring WBF-102Alt1 for descriptions of material between 0-11.0' in the vicinity of WBF-102Alt2.				
11.0	708.2		POORLY GRADED GRAVEL WITH SILT TRACE CLAY, GP-GM, 7.5YR 5/2 (brown), very fine to fine, non-plastic, loose, wet	RS01	11.0 - 16.0	4.2	N/A
12.0	707.2		SANDY FAT CLAY, CH, 5YR 5/4 (reddish brown), very fine, high plasticity, very firm, moist, homogeneous, well graded				
14.0	705.2		GRAVELLY WELL GRADED SAND, SW, 5YR 6/3 (light reddish brown), very fine to fine, low plasticity, loose, moist, homogeneous, weak cementation, poorly graded gravel				
16.0	703.2		GRAVELLY POORLY GRADED SAND, SP, 2.5YR 5/4 (reddish brown), very fine to fine, low plasticity, dense, moist, homogeneous, moderate cementation				
17.0	702.2						

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18

Run bar: 11.0 - 16.0

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 9/21/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-102Alt2 (Sonic)**
Client	Tennessee Valley Authority	Boring Location	443,745.53 N; 2,362,237.49 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	719.2 ft
		Elevation Datum	NGVD29

Lithology			Description	Overburden:	Sample[1,2]	Depth Ft[3]	Rec. Ft	Blows/PSI
Depth Ft[3]	Elevation	Graphic		Rock Core:	RQD %	Run Ft	Rec. Ft	Rec. %
19.0	700.2		SANDY POORLY GRADED GRAVEL, GP, 2.5YR 3/1 (dark reddish gray), fine to coarse, low plasticity, loose, moist, homogeneous *(Continued)*	17.5/19.5-20190708	RS02E	16.0 - 21.0	5.0	N/A
20.0	699.2		SANDY POORLY GRADED GRAVEL, GP, 5YR 5/4 (reddish brown), fine to coarse, non to low plasticity, loose, moist, homogeneous, weak cementation					
21.0	698.2		SILTY POORLY GRADED GRAVEL, GP, 5YR 5/3 (reddish brown), fine to coarse, low plasticity, loose, wet, homogeneous, weak cementation					
			No Refusal / Bottom of Hole at 21.0 Ft.					

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 9/21/20

SUBSURFACE LOG

Client Borehole ID: N/A
Stantec Boring No.: **WBF-102B**
Client: Tennessee Valley Authority
Boring Location: 443,723.93 N; 2,362,223.94 E NAD27 Plant Local
Project Number: 175668050
Surface Elevation: 721.3 ft
Elevation Datum: NGVD29
Project Name: WBF TDEC Order
Date Started: 5/29/19
Completed: 5/30/19
Project Location: Rhea Co, Spring City, Tennessee
Depth to Water: N/A
Date/Time: N/A
Inspector: G. Budd
Logger: G. Budd
Depth to Water: N/A
Date/Time: N/A
Drilling Contractor: Hawkston (Subcontractor)
Drill Rig Type and ID: Geoprobe 3230DT
Overburden Drilling and Sampling Tools (Type and Size): DPT-Direct Push
Rock Drilling and Sampling Tools (Type and Size): N/A
Overdrill Tooling (Type and Size): N/A
Overdrill Depth: N/A
Sampler Hammer Type: N/A
Weight: N/A
Drop: N/A
Efficiency: N/A
Borehole Azimuth: N/A
Borehole Inclination (from Vertical): N/A
Reviewed By: C. Kocka
Approved By: L. Price

Depth Ft[3]	Elevation	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	721.3	Top of Hole				
0.3	721.0	Topsoil				
1.0	720.3	Limestone gravel, [FILL]				
1.5	719.8	WELL GRADED SAND, SW, 7.5YR 2.5/1 (black), fine to medium, dry, [CCR]	DP01	0.0 - 5.0	3.1	N/A
		LEAN CLAY, CL, 5YR 5/6 (yellowish red) and 10YR 5/2 (grayish brown), stiff, moist, with abundant limestone gravel, [FILL]				
		Color change to 10YR 5/6 (yellowish brown), medium stiff, with shale, limestone, and some chert gravel at 5.0'	DP02	5.0 - 10.0	2.6	N/A
10.0	711.3	SANDY LEAN CLAY, CL, 7.5YR 5/8 (strong brown), low to medium plasticity, soft, moist	DP03	10.0 - 15.0	1.9	N/A
12.5	708.8	CLAYEY SAND, SC, 10YR 6/1 (gray) and 10YR 6/6 (brownish yellow), fine, moist				
15.0	706.3	SANDY WELL GRADED GRAVEL WITH CLAY, GW-GC, 10YR 6/1 (gray) and 10YR 6/6 (brownish yellow), very fine to coarse, moist				
15.5	705.8	SANDY WELL GRADED GRAVEL, GW, 7.5YR 4/3 (brown), very fine to coarse, moist to wet, with fragments of sandstone	DP04	15.0 - 20.0	3.4	N/A

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 9/21/20

Client Borehole ID	N/A	Stantec Boring No.	**WBF-102B**
Client	Tennessee Valley Authority	Boring Location	443,723.93 N; 2,362,223.94 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	721.3 ft
		Elevation Datum	NGVD29

Lithology				Overburden:	Sample[1,2]	Depth Ft[3]		Rec. Ft	Blows/PSI
Depth Ft[3]	Elevation	Graphic	Description	Rock Core:	RQD %	Run Ft		Rec. Ft	Rec. %
20.0	701.3		Wet from 17.0' to 20.0'						
25.0	696.3		Sample not recoverable		DP05	20.0 - 25.0	20.0 - 25.0	0.0	N/A

Bedrock Refusal /
Bottom of Hole at 25.0 Ft.

As-drilled boring location not surveyed. Horizontal coordinates based on field measurements. Vertical coordinates based on 2017 LiDAR surfaces.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 9/21/20

SUBSURFACE LOG

Client Borehole ID: N/A
Client: Tennessee Valley Authority
Project Number: 175668050
Project Name: WBF TDEC Order
Project Location: Rhea Co, Spring City, Tennessee
Inspector: G. Budd Logger: G. Budd
Drilling Contractor: Stantec Consulting Services Inc.

Stantec Boring No. **WBF-103**
Boring Location: 444,765.49 N; 2,361,678.22 E NAD27 Plant Local
Surface Elevation: 721.1 ft Elevation Datum: NGVD29
Date Started: 6/6/19 Completed: 6/11/19
Depth to Water: 10.0 ft Date/Time: 6/11/19 12:28
Depth to Water: N/A Date/Time: N/A
Drill Rig Type and ID: CME 850XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4-1/4" HSA, 3" SS w/o liners
Rock Drilling and Sampling Tools (Type and Size): N/A
Overdrill Tooling (Type and Size): 8-1/4" HSA overdrill of boring Overdrill Depth: 18.5 ft
Sampler Hammer Type: Automatic Weight: 140 lb Drop: 30" Efficiency: N/A
Borehole Azimuth: N/A Borehole Inclination (from Vertical): N/A
Reviewed By: C. Kocka Approved By: L. Price

Depth Ft[3]	Elevation	Description	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft	Rec. Ft	Blows/PSI / Rec. %
0.0	721.1	Top of Hole				
0.3	720.8	Topsoil, grass	SS01G	0.0 - 1.5	1.5	8-11-9
2.6	718.5	LEAN CLAY WITH GRAVEL, CL, 7.5YR 5/8 (strong brown), medium stiff, dry, limestone gravel and fragments of siltstone, [FILL]	SS02aG	1.5 - 2.6	1.4	8-6-10
3.5	717.6	Limestone gravel, 7.5YR 5/1 (gray), [FILL]	SS02bG	2.6 - 3.0		
			SS03aG	3.0 - 3.5		
4.5	716.6	LEAN CLAY, CL, 7.5YR 5/8 (strong brown), very stiff, moist, with limestone and siltstone gravel, organics, manganese, [FILL]	SS03bG	3.5 - 4.5	1.4	25-21-24
5.6	715.5	LEAN CLAY SOME SAND, CL, 7.5YR 5/8 (strong brown) and 7.5YR 5/2 (brown), stiff, moist, with fine sand, siltstone gravel, manganese, and organics, [FILL]	SS04aG	4.5 - 5.6	1.5	10-14-15
6.0	715.1		SS04bG	5.6 - 6.0		
			SS05G	6.0 - 7.5	1.5	4-7-8
		LEAN CLAY, CL, 7.5YR 3/2 (dark brown), moist, with abundant organics	SS06G	7.5 - 9.0	1.2	3-5-6
12.2	708.9	SANDY LEAN CLAY, CL, 10YR 5/4 (yellowish brown), low plasticity, soft to medium stiff, moist, very fine sand Color change to 10YR 6/8 (brownish yellow) and 10YR 6/1 (gray), low to medium plasticity, medium still to very stiff, with fragments of sandstone, angular to subangular, increasing with depth at 9.0'	SS07G	9.0 - 10.5	1.5	5-6-7
			SS08G	10.5 - 12.0	1.5	14-19-26
15.0	706.1	POORLY GRADED SAND, SP, 10YR 6/8 (brownish yellow), fine to medium, medium dense, wet, trace fragments of weathered sandstone Color change to N 2.5/ (black) at 12.9' Color change to 10YR 5/6 (yellowish brown), loose to medium dense at 13.5', weathered sandstone fragments from 14.7' to 15.0'	SS09E	12.0 - 13.5	1.2	9-11-10
			SS10E	13.5 - 15.0	1.0	9-11-16
16.5	704.6	LEAN CLAY, CL, 10YR 5/6 (yellowish brown), very stiff to hard, dry to moist, iron oxide staining, with highly weathered siltstone	SS11G	15.0 - 16.5	1.5	21-36-32
17.0	704.1		SS12aG	16.5 - 17.0	1.5	14-32-48
		CLAYEY SAND, SC, 10YR 5/6 (yellowish brown),	SS12bG	17.0 - 18.0		

12.0/15.0-20190606

Client Borehole ID	N/A	Stantec Boring No.	**WBF-103**
Client	Tennessee Valley Authority	Boring Location	444,765.49 N; 2,361,678.22 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	721.1 ft
		Elevation Datum	NGVD29

Lithology				Overburden:	Sample[1,2]	Depth Ft[3]	Rec. Ft	Blows/PSI
Depth Ft[3]	Elevation	Graphic	Description	Rock Core:	RQD %	Run Ft	Rec. Ft	Rec. %
18								
18.5	702.6		fine to medium, wet					
			LEAN CLAY, CL, 10YR 5/6 (yellowish brown), very stiff to hard, dry to moist, iron oxide staining, with highly weathered siltstone *(Continued)*					

No Refusal /
Bottom of Hole at 18.5 Ft.

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G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-103A**
Client	Tennessee Valley Authority	Boring Location	444,760.52 N; 2,361,650.57 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	721.5 ft — Elevation Datum NGVD29
Project Name	WBF TDEC Order	Date Started	5/29/19 — Completed 5/29/19
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	7.4 ft — Date/Time 5/29/19 10:09
Inspector	G. Budd — Logger G. Budd	Depth to Water	N/A — Date/Time N/A
Drilling Contractor	Hawkston (Subcontractor)	Drill Rig Type and ID	Geoprobe 3230DT

Overburden Drilling and Sampling Tools (Type and Size) DPT-Direct Push

Rock Drilling and Sampling Tools (Type and Size) N/A

Overdrill Tooling (Type and Size) N/A — Overdrill Depth N/A

Sampler Hammer Type N/A — Weight N/A — Drop N/A — Efficiency N/A

Borehole Azimuth N/A — Borehole Inclination (from Vertical) N/A

Reviewed By C. Kocka — Approved By L. Price

Lithology Depth Ft[3]	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	721.5		Top of Hole				
0.2	721.3		Topsoil				
			SANDY LEAN CLAY, CL, 7.5YR 6/6 (reddish yellow), non to low plasticity, medium stiff, dry	DP01	0.0 - 3.5	0.7	N/A
			Color change to 10YR 5/6 (yellowish brown), moist at 3.5'	DP02	3.5 - 8.5	2.4	N/A
			Medium plasticity, with fragments of sandstone at 8.5'	DP03	8.5 - 13.5	4.0	N/A
11.5	710.0		POORLY GRADED SAND 13.5, SP, 7.5YR 5/6 (strong brown), fine, wet Color change to 7.5YR 5/6 (strong brown)at 12.6' Color change to 7.5YR 5/6 (strong brown) at 12.8'				
13.5	708.0		LEAN CLAY, CL, 5YR 4/4 (reddish brown) and 7.5YR 3/2 (dark brown), non-plastic, stiff, dry, with weathered siltstone	DP04	13.5 - 18.5	3.5	N/A
15.0	706.5		SANDY LEAN CLAY, CL, 10YR 5/6 (yellowish brown), non-plastic, medium stiff, moist				
16.1	705.4		POORLY GRADED SAND, SP, 10YR 5/6 (yellowish brown), fine, wet				

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 9/21/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-103A**
Client	Tennessee Valley Authority	Boring Location	444,760.52 N; 2,361,650.57 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	721.5 ft
		Elevation Datum	NGVD29

Depth Ft[3]	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
18.5	703.0						
18.7	702.8		CLAYEY SAND, SC, 10YR 5/6 (yellowish brown), fine, wet	DP05	18.5 - 20.0	1.0	N/A
19.1	702.4		LEAN CLAY, CL, 5YR 4/4 (reddish brown), non to low plasticity, moist				
21.5	700.0		Shale, light gray, hard, moderately weathered, dry	DP06	20.0 - 21.5	1.5	N/A

Bedrock Refusal /
Bottom of Hole at 21.5 Ft.

Top of Rock = 19.1 Ft.
Top of Rock Elevation = 702.4 Ft.

As-drilled boring location not surveyed. Horizontal coordinates based on field measurements. Vertical coordinates based on 2017 LiDAR surfaces.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 9/21/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-103B**
Client	Tennessee Valley Authority	Boring Location	444,760.53 N; 2,361,655.58 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	721.4 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	5/29/19
		Completed	5/29/19
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	9.7 ft
		Date/Time	5/29/19 11:54
Inspector	G. Budd	Depth to Water	N/A
Logger	G. Budd	Date/Time	N/A
Drilling Contractor	Hawkston (Subcontractor)	Drill Rig Type and ID	Geoprobe 3230DT
Overburden Drilling and Sampling Tools (Type and Size)	DPT-Direct Push		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	N/A	Overdrill Depth	N/A
Sampler Hammer Type	N/A	Weight	N/A
Drop	N/A	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Kocka	Approved By	L. Price

Depth Ft[3]	Elevation	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	721.4	Top of Hole				
0.3	721.1	Topsoil, [FILL]				
3.5	717.9	SANDY LEAN CLAY, CL, 10YR 5/8 (yellowish brown) and 10YR 4/1 (dark gray), dry, with siltstone and limestone gravel throughout, [FILL] Coal slag from 0.3' to 0.6'	DP01	0.0 - 5.0	4.6	N/A
3.8	717.6	Limestone gravel fill, [FILL]				
13.0	708.4	SANDY LEAN CLAY, CL, 5YR 4/4 (reddish brown), non to low plasticity, stiff, dry, [FILL] Color change to 5YR 5/6 (yellowish red), moist, iron oxide staining at 5.0' With sandstone gravel and trace organics from 5.0' to 7.0' Color change to 10YR 5/6 (yellowish brown), with fragments of sandstone at 10.0'	DP02	5.0 - 10.0	4.5	N/A
			DP03	10.0 - 15.0	5.0	N/A
14.0	707.4	POORLY GRADED SAND, SP, 7.5YR 5/8 (strong brown), fine, wet, with biotite and muscovite				
15.0	706.4	LEAN CLAY, CL, 7.5YR 3/3 (dark brown), non to low plasticity, wet, with abundant weathered siltstone				
16.3	705.1	POORLY GRADED SAND, SP, 7.5YR 4/4 (brown), fine, wet				
		LEAN CLAY, CL, 7.5YR 4/4 (brown), non to low plasticity, moist, with abundant weathered siltstone	DP04	15.0 - 19.5	4.5	N/A

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 6/22/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-103B**
Client	Tennessee Valley Authority	Boring Location	444,760.53 N; 2,361,655.58 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	721.4 ft
		Elevation Datum	NGVD29

Lithology				Overburden:	Sample[1,2]	Depth Ft[3]	Rec. Ft	Blows/PSI
Depth Ft[3]	Elevation	Graphic	Description	Rock Core:	RQD %	Run Ft	Rec. Ft	Rec. %
18.9	702.5							
19.5	701.9		Shale, pale gray, hard, dry					

Bedrock Refusal /
Bottom of Hole at 19.5 Ft.

Top of Rock = 18.9 Ft.
Top of Rock Elevation = 702.5 Ft.

As-drilled boring location not surveyed. Horizontal coordinates based on field measurements. Vertical coordinates based on 2017 LiDAR surfaces.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 6/22/20

SUBSURFACE LOG

Stantec TVA

Client Borehole ID	N/A	Stantec Boring No.	**WBF-104**
Client	Tennessee Valley Authority	Boring Location	444,336.57 N; 2,363,103.76 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	694.1 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	6/13/19
		Completed	6/13/19
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	10.2 ft
		Date/Time	6/13/19 13:20
Inspector	G. Budd	Depth to Water	N/A
Logger	G. Budd	Date/Time	N/A
Drilling Contractor	Stantec Consulting Services Inc.	Drill Rig Type and ID	CME 850XR, #953
Overburden Drilling and Sampling Tools (Type and Size)	4-1/4" HSA, 2" SS w/o liners		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	8-1/4" HSA overdrill of boring	Overdrill Depth	27.7 ft
Sampler Hammer Type	Automatic	Weight	140 lb
Drop	30"	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Kocka	Approved By	L. Price

Depth Ft[3]	Elevation	Graphic	Description	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft	Rec. Ft	Blows/PSI / Rec. %
0.0	694.1		Top of Hole				
1.5	692.6		Crushed stone, grass, topsoil, limestone gravel, chert, [FILL]	SS01G	0.0 - 1.5	0.5	3-7-5
			SANDY LEAN CLAY, CL, 10YR 2/2 (very dark brown), soft to very soft, moist to wet	SS02G	1.5 - 3.0	0.5	5-3-2
5.0	689.1		Wet from 3.0' to 4.5'	SS03G	3.0 - 4.5	0.8	WH-WH-WH
				SS04aG	4.5 - 5.0	1.2	1-1-2
			CLAYEY SAND, SC, 10YR 4/4 (dark yellowish brown), fine, very loose, moist	SS04bG	5.0 - 6.0		
				SS05G	6.0 - 7.5	0.7	WH-1-1
9.0	685.1			SS06G	7.5 - 9.0	1.0	1-WH-1
10.5	683.6		SANDY LEAN CLAY, CL, 10YR 4/4 (dark yellowish brown), low plasticity, very soft, moist Sand lens, fine from 9.3' to 9.5'	SS07G	9.0 - 10.5	0.9	WH-WH-WH
11.0	683.1			SS08aG	10.5 - 11.0	1.2	1-1-1
12.0	682.1		SILTY SAND, SM, 10YR 4/4 (dark yellowish brown) and 10YR 2/1 (black), very fine to fine, very loose, wet	SS08bG	11.0 - 12.0		
			SANDY LEAN CLAY, CL, 10YR 4/3 (brown) and 10YR 5/1 (gray), low plasticity, very soft, moist	SS09G	12.0 - 13.5	1.0	WH-1-1
			CLAYEY SAND, SC, 10YR 4/3 (brown) and 10YR 5/1 (gray), fine, very loose, moist, with organics and gravel, fine, subangular to subrounded	SS10G	13.5 - 15.0	1.1	WH-1-1
				SS11G	15.0 - 16.5	1.0	1-1-1
18.0	676.1			SS12G	16.5 - 18.0	0.5	2-4-4

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 2/9/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-104**
Client	Tennessee Valley Authority	Boring Location	444,336.57 N; 2,363,103.76 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	694.1 ft
		Elevation Datum	NGVD29

Depth Ft[3]	Elevation	Description	Sample[1,2]	Depth Ft[3]	Rec. Ft	Blows/PSI
19.5	674.6	POORLY GRADED SAND, SP, 10YR 4/4 (dark yellowish brown), fine, very loose, wet	SS13G	18.0 - 19.5	0.9	2-1-1
22.5	671.6	CLAYEY SAND, SC, 10YR 4/4 (dark yellowish brown), fine, very loose, wet	SS14G	19.5 - 21.0	0.9	1-1-2
			SS15G	21.0 - 22.5	1.5	WH-1-1
		Color change to 10YR 4/4 (dark yellowish brown) and 10YR 5/1 (gray) at 22.0'				
23.5	670.6	SANDY LEAN CLAY, CL, 10YR 4/6 (dark yellowish brown) and 10YR 5/1 (gray), very soft, moist	SS16aG	22.5 - 23.5	1.5	WH-1-2
25.5	668.6	SILTY SAND, SM, 10YR 4/1 (dark gray), fine, very loose, wet	SS16bG	23.5 - 24.0		
			SS17G	24.0 - 25.5	0.5	1-1-3
27.5	666.6	GRAVELLY WELL GRADED SAND, SW, 10YR 4/1 (dark gray), very fine to coarse, very loose, wet, with gravel, fine to medium, multicolored, subrounded	SS18G	25.5 - 27.0	0.6	2-1-2
28.5	665.6	Shale, green gray, soft to moderately hard, highly weathered, moist to dry	SS19aG	27.0 - 27.5	1.2	8-12-29
			SS19bG	27.5 - 28.5		

No Refusal /
Bottom of Hole at 28.5 Ft.

Top of Rock = 27.5 Ft.
Top of Rock Elevation = 666.6 Ft.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 2/9/20

Client Borehole ID	N/A	Stantec Boring No.	**WBF-104A**
Client	Tennessee Valley Authority	Boring Location	444,325.11 N; 2,363,121.04 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	691.2 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	5/31/19
		Completed	5/31/19
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	7.2 ft
		Date/Time	5/31/19 09:15
Inspector	G. Budd	Depth to Water	N/A
Logger	G. Budd	Date/Time	N/A
Drilling Contractor	Hawkston (Subcontractor)	Drill Rig Type and ID	Geoprobe 3230DT
Overburden Drilling and Sampling Tools (Type and Size)	DPT-Direct Push		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	N/A	Overdrill Depth	N/A
Sampler Hammer Type	N/A	Weight	N/A
Drop	N/A	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Kocka	Approved By	L. Price

Lithology Depth Ft[3]	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	691.2		Top of Hole				
0.2	691.0		Grass, topsoil				
1.0	690.2		Limestone gravel, [FILL]				
			LEAN CLAY, CL, 10YR 4/3 (brown), dry, with limestone gravel, [FILL]	DP01	0.0 - 5.0	1.9	N/A
5.3	685.9		Moist at 5.0'				
			CLAYEY SAND, SC, 10YR 4/4 (dark yellowish brown), fine	DP02	5.0 - 10.0	1.4	N/A
10.0	681.2						
			SANDY LEAN CLAY, CL, 10YR 4/3 (brown), fine, low plasticity, moist	DP03	10.0 - 15.0	2.9	N/A
				DP04	15.0 - 20.0	2.7	N/A

Depth scale: 0 – 18 ft. Water level symbol at 7.2 ft.

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-104A**
Client	Tennessee Valley Authority	Boring Location	444,325.11 N; 2,363,121.04 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	691.2 ft
		Elevation Datum	NGVD29

Lithology Depth Ft[3]	Lithology Elevation	Lithology Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Overburden: Depth Ft[3] / Rock Core: Run Ft	Overburden: Rec. Ft / Rock Core: Rec. Ft	Overburden: Blows/PSI / Rock Core: Rec. %
20.0	671.2		SANDY LEAN CLAY, CL, 10YR 4/3 (brown), fine, low plasticity, moist *(Continued)*				
22.5	668.7		POORLY GRADED SAND, SP, 10YR 4/3 (brown), fine, wet Color change to 10YR 5/2 (grayish brown) at 20.3'	DP05	20.0 - 24.0	3.7	N/A
24.0	667.2		SILTY SAND, SM, 10YR 3/1 (very dark gray), fine, wet				
26.0	665.2		WELL GRADED SAND, SW, 10YR 5/2 (grayish brown), very fine to coarse, wet, with fine gravel, subangular to subrounded	DP06	24.0 - 26.5	1.5	N/A
26.5	664.7		Shale, green gray, hard, weathered, calcareous				

Bedrock Refusal /
Bottom of Hole at 26.5 Ft.

Top of Rock = 26.0 Ft.
Top of Rock Elevation = 665.2 Ft.

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G = Geotechnical Sample Custody
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3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 2/9/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-104B**
Client	Tennessee Valley Authority	Boring Location	444,325.11 N; 2,363,116.04 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	691.2 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	5/31/19
		Completed	5/31/19
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	N/A
		Date/Time	N/A
Inspector	G. Budd	Depth to Water	N/A
Logger	G. Budd	Date/Time	N/A
Drilling Contractor	Hawkston (Subcontractor)	Drill Rig Type and ID	Geoprobe 3230DT
Overburden Drilling and Sampling Tools (Type and Size)	DPT-Direct Push		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	N/A	Overdrill Depth	N/A
Sampler Hammer Type	N/A	Weight	N/A
Drop	N/A	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Kocka	Approved By	L. Price

Lithology Depth Ft[3]	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	691.2		Top of Hole				
0.2	691.0		Grass and topsoil				
1.3	689.9		Limestone gravel, [FILL]				
5.0	686.2		SANDY LEAN CLAY, CL, 10YR 2/2 (very dark brown), dry	DP01	0.0 - 5.0	2.0	N/A
7.0	684.2		CLAYEY SAND, SC, 10YR 4/4 (dark yellowish brown), fine, moist	DP02	5.0 - 10.0	2.3	N/A
10.3	680.9		POORLY GRADED SAND, SP, 10YR 4/4 (dark yellowish brown) and 10YR 2/1 (black), fine, moist				
15.0	676.2		SANDY LEAN CLAY, CL, 10YR 4/3 (brown) and 10YR 5/1 (gray), moist	DP03	10.0 - 15.0	4.2	N/A
16.0	675.2		SILTY SAND, SM, 10YR 4/4 (dark yellowish brown), fine, wet	DP04	15.0 - 20.0	2.2	N/A
16.8	674.4		CLAYEY SAND, SC, 10YR 4/4 (dark yellowish brown), fine, wet				

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 6/22/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-104B**
Client	Tennessee Valley Authority	Boring Location	444,325.11 N; 2,363,116.04 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	691.2 ft
		Elevation Datum	NGVD29

Depth Ft[3]	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
20.5	670.7		POORLY GRADED SAND, SP, 10YR 4/4 (dark yellowish brown), fine, wet *(Continued)*				
21.8	669.4		SANDY LEAN CLAY, CL, 10YR 3/3 (dark brown) and 10YR 4/1 (dark gray), low plasticity, wet	DP05	20.0 - 25.0	5.0	N/A
24.2	667.0		CLAYEY SAND, SC, 10YR 3/3 (dark brown) and 10YR 4/1 (dark gray), fine, wet				
25.0	666.2		SILTY SAND, SM, 10YR 3/1 (very dark gray), fine, wet				
27.9	663.3		WELL GRADED SAND, SW, 10YR 3/1 (very dark gray), very fine to coarse, wet, with gravel, fine, subrounded	DP06	25.0 - 28.5	1.5	N/A
28.5	662.7		Shale, green gray, hard, calcareous				

Bedrock Refusal /
Bottom of Hole at 28.5 Ft.

Top of Rock = 27.9 Ft.
Top of Rock Elevation = 663.3 Ft.

As-drilled boring location not surveyed. Horizontal coordinates based on field measurements. Vertical coordinates based on 2017 LiDAR surfaces.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

SUBSURFACE LOG

Client Borehole ID: N/A	Stantec Boring No. **WBF-105**
Client: Tennessee Valley Authority	Boring Location: 445,050.70 N; 2,363,041.85 E NAD27 Plant Local
Project Number: 175668050	Surface Elevation: 699.8 ft — Elevation Datum: NGVD29
Project Name: WBF TDEC Order	Date Started: 6/24/19 — Completed: 6/25/19
Project Location: Rhea Co, Spring City, Tennessee	Depth to Water: N/A — Date/Time: N/A
Inspector: G. Budd — Logger: G. Budd	Depth to Water: N/A — Date/Time: N/A
Drilling Contractor: Stantec Consulting Services Inc.	Drill Rig Type and ID: CME 850XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4-1/4" HSA, 2" SS w/o liners

Rock Drilling and Sampling Tools (Type and Size): N/A

Overdrill Tooling (Type and Size): 8-1/4" HSA overdrill of boring — Overdrill Depth: 18.0 ft

Sampler Hammer Type: Automatic — Weight: 140 lb — Drop: 30" — Efficiency: N/A

Borehole Azimuth: N/A — Borehole Inclination (from Vertical): N/A

Reviewed By: C. Kocka — Approved By: L. Price

Depth Ft[3]	Elevation	Description	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft	Rec. Ft	Blows/PSI / Rec. %
0.0	699.8	Top of Hole				
1.5	698.3	Crushed stone, limestone gravel with some clay	SS01G	0.0 - 1.5	1.5	7-15-12
6.2	693.6	WELL GRADED SAND TRACE CLAY, SW, 10YR 2/1 (black), very fine to coarse, medium dense to loose, dry, [CCR]	SS02G	1.5 - 3.0	1.4	13-14-13
			SS03G	3.0 - 4.5	1.5	6-8-10
			SS04G	4.5 - 6.0	1.5	7-7-13
6.8	693.0	SANDY LEAN CLAY, CL, 5YR 4/4 (reddish brown) and 10YR 5/4 (yellowish brown), stiff, dry to moist, with fragments of siltstone, [FILL]	SS05aG	6.0 - 6.2	1.5	10-11-11
7.8	692.0		SS05bG	6.2 - 6.8		
			SS05cG	6.8 - 7.5		
9.0	690.8	WELL GRADED SAND, SW, 10YR 5/6 (yellowish brown), very fine to coarse, medium dense, moist, [FILL]	SS06aG	7.5 - 7.8	1.1	6-4-3
			SS06bG	7.8 - 9.0		
10.5	689.3	LEAN CLAY, CL, 10YR 3/2 (very dark grayish brown), soft, moist, with very fine sand and some fragments of CCR, [FILL]	SS07G	9.0 - 10.5	1.5	WH-WH-WH
12.0	687.8	SANDY LEAN CLAY, CL, 10YR 3/3 (dark brown), low plasticity, very soft, moist	SS08G	10.5 - 12.0	1.5	WH-WH-2
		SILTY SAND SOME CLAY, SM, 10YR 4/3 (brown), fine, very loose, moist	SS09G	12.0 - 13.5	1.5	WH-1-1
16.5	683.3	CLAYEY SAND, SC, 7.5YR 4/6 (strong brown), fine, very loose, moist to wet Wet from 12.5' to 13.5'	SS10G	13.5 - 15.0	1.3	1-2-4
			SS11G	15.0 - 16.5	1.3	2-3-3
		SANDY LEAN CLAY, CL, 7.5YR 4/6 (strong brown) and 7.5YR 5/1 (gray), low to medium plasticity, very soft, moist	SS12G	16.5 - 18.0	1.5	1-2-3

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 2/9/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-105**
Client	Tennessee Valley Authority	Boring Location	445,050.70 N; 2,363,041.85 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	699.8 ft
		Elevation Datum	NGVD29

Lithology				Overburden:	Sample[1,2]	Depth Ft[3]		Rec. Ft	Blows/PSI
Depth Ft[3]	Elevation	Graphic	Description	Rock Core:	RQD %	Run Ft		Rec. Ft	Rec. %
18 19 19.5	680.3				SS13G	18.0 - 19.5	18.0 - 19.5	1.5	WH-2-2

No Refusal /
Bottom of Hole at 19.5 Ft.

The boring was overdrilled to 18.0' bgs and 10-inch diameter permanent PVC surface casing was installed to a depth of 19.4' bgs. Advancement of the boring to depth will continue to depth through the permanent casing using Roto-sonic drilling methods.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

SUBSURFACE LOG

Client Borehole ID: N/A
Stantec Boring No.: **WBF-105A**
Client: Tennessee Valley Authority
Boring Location: 445,104.31 N; 2,363,036.06 E NAD27 Plant Local
Project Number: 175668050
Surface Elevation: 700.4 ft
Elevation Datum: NGVD29
Project Name: WBF TDEC Order
Date Started: 6/4/19
Completed: 6/4/19
Project Location: Rhea Co, Spring City, Tennessee
Depth to Water: N/A
Date/Time: N/A
Inspector: G. Budd
Logger: G. Budd
Depth to Water: N/A
Date/Time: N/A
Drilling Contractor: Hawkston (Subcontractor)
Drill Rig Type and ID: Geoprobe 3230DT
Overburden Drilling and Sampling Tools (Type and Size): DPT-Direct Push
Rock Drilling and Sampling Tools (Type and Size): N/A
Overdrill Tooling (Type and Size): N/A
Overdrill Depth: N/A
Sampler Hammer Type: N/A
Weight: N/A
Drop: N/A
Efficiency: N/A
Borehole Azimuth: N/A
Borehole Inclination (from Vertical): N/A
Reviewed By: C. Kocka
Approved By: L. Price

Depth Ft[3]	Elevation	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft	Blows/PSI / Rec. %
0.0	700.4	Top of Hole				
0.0 - 1.5	700.4 - 698.9	Crushed stone, limestone gravel	DP01	0.0 - 5.0	2.9	N/A
1.5 - 2.7	698.9 - 697.7	WELL GRADED SAND, SW, 10YR 2/1 (black), very fine to coarse, dry, [CCR]				
2.7 - 5.0	697.7 - 695.4	CLAYEY GRAVEL, GC, 10YR 3/3 (dark brown), fine to medium, dry, limestone gravel, [FILL]				
5.0 - 5.7	695.4 - 694.7	WELL GRADED SAND WITH CLAY, SW, 10YR 4/4 (dark yellowish brown), very fine to coarse, moist, [FILL]	DP02	5.0 - 10.0	3.1	N/A
5.7 - 6.3	694.7 - 694.1	SILTY SAND, SM, 10YR 2/2 (very dark brown), fine, moist, with trace CCR, [FILL]				
6.3 - 10.0	694.1 - 690.4	POORLY GRADED SAND WITH CLAY, SP, 7.5YR 4/3 (brown), fine, moist, [FILL]				
10.0 - 17.0	690.4 - 683.4	CLAYEY SAND, SC, 7.5YR 4/3 (brown), fine, moist to wet, [FILL] Trace CCR from 10.0' to 15.0'	DP03	10.0 - 15.0	3.5	N/A
17.0 -	683.4 -	SANDY LEAN CLAY, CL, 7.5YR 4/3 (brown) and 7.5YR 5/1 (gray), low plasticity, moist	DP04	15.0 - 20.0	3.7	N/A

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 2/9/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-105A**
Client	Tennessee Valley Authority	Boring Location	445,104.31 N; 2,363,036.06 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	700.4 ft
		Elevation Datum	NGVD29

Depth Ft[3]	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
20.0	680.4		SANDY LEAN CLAY, CL, 7.5YR 4/3 (brown) and 7.5YR 5/1 (gray), low plasticity, moist *(Continued)*				
30.5	669.9		SANDY LEAN CLAY, CL, 7.5YR 4/6 (strong brown) and 7.5YR 5/1 (gray), low to medium plasticity, moist Sand lens, wet from 26.0' to 26.2' and 28.6' to 28.8' Color change to 7.5YR 4/1 (dark gray) at 29.1' Wet at 29.5'	DP05	20.0 - 25.0	4.5	N/A
				DP06	25.0 - 30.0	4.8	N/A
31.5	668.9		SILTY SAND, SM, 7.5YR 4/1 (dark gray), very fine to fine, wet				
34.7	665.7		POORLY GRADED SAND, SP, 7.5YR 4/1 (dark gray), fine, wet With silt at 32.9'	DP07	30.0 - 35.0	4.8	N/A
35.0	665.4		Sandstone, light gray, moderately hard, moderately weathered, grading to shale				

Bedrock Refusal /
Bottom of Hole at 35.0 Ft.

Top of Rock = 34.7 Ft.
Top of Rock Elevation = 665.7 Ft.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

SUBSURFACE LOG

Client Borehole ID: N/A
Stantec Boring No.: **WBF-105B**
Client: Tennessee Valley Authority
Boring Location: 445,109.31 N; 2,363,036.06 E NAD27 Plant Local
Project Number: 175668050
Surface Elevation: 700.1 ft
Elevation Datum: NGVD29
Project Name: WBF TDEC Order
Date Started: 6/4/19
Completed: 6/4/19
Project Location: Rhea Co, Spring City, Tennessee
Depth to Water: N/A
Date/Time: N/A
Inspector: G. Budd
Logger: G. Budd
Depth to Water: N/A
Date/Time: N/A
Drilling Contractor: Hawkston (Subcontractor)
Drill Rig Type and ID: Geoprobe 3230DT
Overburden Drilling and Sampling Tools (Type and Size): DPT-Direct Push
Rock Drilling and Sampling Tools (Type and Size): N/A
Overdrill Tooling (Type and Size): N/A
Overdrill Depth: N/A
Sampler Hammer Type: N/A
Weight: N/A
Drop: N/A
Efficiency: N/A
Borehole Azimuth: N/A
Borehole Inclination (from Vertical): N/A
Reviewed By: C. Kocka
Approved By: L. Price

Depth Ft[3]	Elevation	Description	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft	Rec. Ft	Blows/PSI / Rec. %
0.0	700.1	Top of Hole				
1.2	698.9	Limestone gravel, [FILL]				
6.5	693.6	WELL GRADED SAND, SW, 10YR 2/1 (black), very fine to coarse, moist, [CCR]	DP01	0.0 - 5.0	3.1	N/A
6.8	693.3	SANDY LEAN CLAY, CL, 5YR 4/4 (reddish brown) and 5YR 5/1 (gray), low to medium plasticity, moist, with siltstone gravel, [FILL]	DP02	5.0 - 10.0	3.9	N/A
7.9	692.2	WELL GRADED SAND, SW, 10YR 5/6 (yellowish brown), very fine to medium, moist, [FILL]				
11.8	688.3	SANDY LEAN CLAY, CL, 10YR 3/3 (dark brown), low plasticity, moist, [FILL]				
16.0	684.1	SILTY SAND, SM, 10YR 5/6 (yellowish brown), fine, moist to wet Wet at 12.8'	DP03	10.0 - 15.0	3.3	N/A
17.0	683.1	CLAYEY SAND, SC, 7.5YR 4/6 (strong brown), fine, moist				
		SANDY LEAN CLAY, CL, 7.5YR 4/6 (strong brown)	DP04	15.0 - 20.0	3.6	N/A

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 6/22/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-105B**
Client	Tennessee Valley Authority	Boring Location	445,109.31 N; 2,363,036.06 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	700.1 ft — Elevation Datum NGVD29

Lithology: Depth Ft[3]	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
			and 7.5YR 5/1 (gray), low to medium plasticity, moist SANDY LEAN CLAY, CL, 7.5YR 4/6 (strong brown) and 7.5YR 5/1 (gray), low to medium plasticity, moist *(Continued)*				
22.5	677.6			DP05	20.0 - 25.0	4.7	N/A
			FAT CLAY WITH SAND, CH, 7.5YR 4/6 (strong brown) and 7.5YR 5/1 (gray), medium to high plasticity, moist				
			Medium plasticity, with maganese and organics at 25.0'				
27.8	672.3		Sand lens, wet at 27.3'	DP06	25.0 - 30.0	4.4	N/A
			SANDY LEAN CLAY, CL, 7.5YR 5/1 (gray), low plasticity, moist				
29.0	671.1						
			POORLY GRADED SAND, SP, 7.5YR 4/6 (strong brown), fine, moist to wet				
30.0	670.1		Wet at 29.5'				
30.3	669.8		Wood fragments				
			SILTY SAND, SM, 7.5YR 4/1 (dark gray), very fine to fine, wet				
32.0	668.1			DP07	30.0 - 34.5	4.5	N/A
			CLAYEY SAND, SC, 7.5YR 4/1 (dark gray), very fine to fine, wet				
34.1	666.0		Wood fragments from 34.0' to 34.1'				
34.5	665.6		Sandstone, moderately hard, moist				

Bedrock Refusal /
Bottom of Hole at 34.5 Ft.

Top of Rock = 34.1 Ft.
Top of Rock Elevation = 666.0 Ft.

As-drilled boring location not surveyed. Horizontal coordinates based on field measurements. Vertical coordinates based on 2017 LiDAR surfaces.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 6/22/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-105C**
Client	Tennessee Valley Authority	Boring Location	445,157.63 N; 2,363,103.49 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	698.6 ft — Elevation Datum: NGVD29
Project Name	WBF TDEC Order	Date Started	6/3/19 — Completed: 6/4/19
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	N/A — Date/Time: N/A
Inspector	G. Budd — Logger: G. Budd	Depth to Water	N/A — Date/Time: N/A
Drilling Contractor	Hawkston (Subcontractor)	Drill Rig Type and ID	Geoprobe 3230DT

Overburden Drilling and Sampling Tools (Type and Size) DPT-Direct Push

Rock Drilling and Sampling Tools (Type and Size) N/A

Overdrill Tooling (Type and Size) N/A — Overdrill Depth N/A

Sampler Hammer Type N/A — Weight N/A — Drop N/A — Efficiency N/A

Borehole Azimuth N/A — Borehole Inclination (from Vertical) N/A

Reviewed By C. Kocka — Approved By L. Price

Depth Ft[3]	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	698.6		Top of Hole				
2.0	696.6		Limestone gravel, [FILL]	DP01	0.0 - 5.0	4.2	N/A
3.0	695.6		WELL GRADED SAND, SW, 7.5YR 2.5/1 (black), fine to medium, dry, [CCR]				
8.5	690.1		CLAYEY GRAVEL, GC, 7.5YR 5/8 (strong brown) and 7.5YR 2.5/1 (black), very fine to coarse, dry, [FILL]	DP02	5.0 - 8.5	2.3	N/A
			WELL GRADED SAND, SW, 7.5YR 2.5/1 (black), very fine to coarse, wet, with trace gravel, fine, subrounded, [CCR]	DP03	8.5 - 13.5	2.6	N/A
				DP04	13.5 - 18.5	2.8	N/A

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-105C**
Client	Tennessee Valley Authority	Boring Location	445,157.63 N; 2,363,103.49 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	698.6 ft
		Elevation Datum	NGVD29

Lithology			Description	Overburden: Sample[1,2]	Depth Ft[3]	Rec. Ft	Blows/PSI
Depth Ft[3]	Elevation	Graphic		Rock Core: RQD %	Run Ft	Rec. Ft	Rec. %
			WELL GRADED SAND, SW, 7.5YR 2.5/1 (black), very fine to coarse, wet, with trace gravel, fine, subrounded, [CCR] *(Continued)*	DP05	18.5 - 20.0	0.6	N/A
				DP06	20.0 - 22.5	0.6	N/A
				DP07	22.5 - 25.0	0.7	N/A
27.5	671.1		Color change to 10YR 2/1 (black) and 10YR 4/2 (dark grayish brown) at 25.0'	DP08	25.0 - 27.5	0.0	N/A
28.8	669.8		WELL GRADED GRAVEL, GW, 10YR 5/3 (brown) and 10YR 4/2 (dark grayish brown), very fine to coarse, wet, subrounded to rounded, with fine to coarse sand, and organics	DP09	27.5 - 31.5	2.6	N/A
29.5	669.1		SANDY LEAN CLAY, CL, 10YR 4/2 (dark grayish brown), fine, low plasticity, wet, with fragments of wood				
30.0	668.6		GRAVELLY WELL GRADED SAND, SW, 10YR 4/2 (dark grayish brown), very fine to coarse, wet				
31.5	667.1		SANDY WELL GRADED GRAVEL, GW, 10YR 4/2 (dark grayish brown), very fine to coarse, wet				

No Refusal /
Bottom of Hole at 31.5 Ft.

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3: Depths are reported in feet below ground surface

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-105 (sonic)**
Client	Tennessee Valley Authority	Boring Location	445,050.70 N; 2,363,041.85 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	699.8 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	7/9/19
		Completed	7/9/19
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	N/A
		Date/Time	N/A
Inspector	M. Aplin	Depth to Water	N/A
Logger	E. Smith	Date/Time	N/A
Drilling Contractor	M&W Drilling (Subcontractor)	Drill Rig Type and ID	Geoprobe GV5 Sonic
Overburden Drilling and Sampling Tools (Type and Size)	Sonic 6" Core Barrel, 8" Steel Casing		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	N/A	Overdrill Depth	18.0 ft
Sampler Hammer Type	N/A	Weight	N/A
Drop	N/A	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Kocka	Approved By	L. Price

Lithology: Depth Ft[3]	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	699.8		Top of Hole				
			Boring was advanced using sonic methods without sampling. Boring was advanced to depth through 10-inch PVC permanent surface casing previously set to a depth of 19.4' in boring WBF-105. For lithologic descriptions of material from 0.0' -19.5', refer to boring log WBF-105.				

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 9/21/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-105 (sonic)**
Client	Tennessee Valley Authority	Boring Location	445,050.70 N; 2,363,041.85 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	699.8 ft
		Elevation Datum	NGVD29

Lithology: Depth Ft[3]	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Overburden: Depth Ft[3] / Rock Core: Run Ft	Rec. Ft	Overburden: Blows/PSI / Rock Core: Rec. %
20.0	679.8		HDPE plastic auger plug blocked sonic casing. No soil sample recovered.	RS01	20.0 - 30.0	0.0	N/A
30.0	669.8		GRAVELLY SILTY SAND, SM, 10YR 2/1 (black), fine to coarse, dense, moist, no odor, no staining, poorly graded	RS02	30.0 - 35.0	3.0	N/A
33.0	666.8		Shale, dark gray green to light gray green, very fine grained, moderately hard, laminated, slightly weathered, dry, no odor, no staining, glauconitic				
35.0	664.8		No Refusal / Bottom of Hole at 35.0 Ft.				

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G = Geotechnical Sample Custody
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3: Depths are reported in feet below ground surface

SUBSURFACE LOG

Client Borehole ID: N/A
Stantec Boring No.: **WBF-106**
Client: Tennessee Valley Authority
Boring Location: 445,872.50 N; 2,362,862.26 E NAD27 Plant Local
Project Number: 175668050
Surface Elevation: 701.7 ft
Elevation Datum: NGVD29
Project Name: WBF TDEC Order
Date Started: 6/26/19
Completed: 6/26/19
Project Location: Rhea Co, Spring City, Tennessee
Depth to Water: 12.1 ft
Date/Time: 6/26/19 12:35
Inspector: G. Budd
Logger: G. Budd
Depth to Water: N/A
Date/Time: N/A
Drilling Contractor: Stantec Consulting Services Inc.
Drill Rig Type and ID: CME 850XR, #953
Overburden Drilling and Sampling Tools (Type and Size): 4-1/4" HSA, 2" SS w/o liners
Rock Drilling and Sampling Tools (Type and Size): N/A
Overdrill Tooling (Type and Size): 8-1/4" HSA overdrill of boring
Overdrill Depth: 34.5 ft
Sampler Hammer Type: Automatic
Weight: 140 lb
Drop: 30"
Efficiency: N/A
Borehole Azimuth: N/A
Borehole Inclination (from Vertical): N/A
Reviewed By: C. Kocka
Approved By: L. Price

Lithology Depth Ft[3]	Lithology Elevation	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Overburden: Depth Ft[3] / Rock Core: Run Ft	Overburden: Rec. Ft / Rock Core: Rec. Ft	Overburden: Blows/PSI / Rock Core: Rec. %
0.0	701.7	Top of Hole				
0.2	701.5	Grass and topsoil				
		LEAN CLAY, CL, 5YR 5/8 (yellowish red), low plasticity, very soft, moist, with siltstone and sandstone gravel, trace CCR, [FILL]	SS01G	0.0 - 1.5	0.6	1-2-2
			SS02G	1.5 - 3.0	1.0	1-1-1
			SS03G	3.0 - 4.5	0.3	WH-WH-WH
4.8	696.9		SS04aG	4.5 - 4.8		
		SANDY LEAN CLAY, CL, 10YR 2/2 (very dark brown), low plasticity, very soft, moist, with trace organics, CCR, [FILL]	SS04bG	4.8 - 6.0	1.0	WH-1-3
6.8	694.9		SS05aG	6.0 - 6.8	1.1	1-2-2
		CLAYEY SAND, SC, 10YR 4/4 (dark yellowish brown), fine, very loose, moist to wet Trace CCR from 6.8' to 7.5' Sandstone fragments at 7.5'	SS05bG	6.8 - 7.5		
			SS06aG	7.5 - 8.3	0.5	2-1-2
			SS06bG	8.3 - 9.0		
			SS07G	9.0 - 10.5	1.2	2-2-2
			SS08G	10.5 - 12.0	1.5	1-2-2
12.0	689.7	LEAN CLAY, CL, 10YR 4/4 (dark yellowish brown), low to medium plasticity, soft to medium stiff, moist	SS09G	12.0 - 13.5	1.5	2-3-5
			SS10G	13.5 - 15.0	1.5	1-4-5
			SS11G	15.0 - 16.5	1.5	2-4-6
			SS12G	16.5 - 18.0	1.4	2-3-4

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 6/5/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-106**
Client	Tennessee Valley Authority	Boring Location	445,872.50 N; 2,362,862.26 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	701.7 ft
		Elevation Datum	NGVD29

Lithology: Depth Ft[3]	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
19.5	682.2		LEAN CLAY, CL, 10YR 4/4 (dark yellowish brown), low to medium plasticity, soft to medium stiff, moist *(Continued)* Some very fine sand, manganese at 19.0'	SS13G	18.0 - 19.5	1.5	2-2-4
25.5	676.2		FAT CLAY, CH, 10YR 4/4 (dark yellowish brown) and 10YR 6/1 (gray), medium to high plasticity, soft to medium stiff, moist, with manganese and some very fine sand, increasing with depth	SS14G	19.5 - 21.0	1.5	2-4-7
				SS15G	21.0 - 22.5	1.5	2-4-4
				SS16G	22.5 - 24.0	1.5	1-2-4
				SS17G	24.0 - 25.5	1.5	2-3-4
27.0	674.7		SANDY LEAN CLAY, CL, 10YR 4/1 (dark gray), low plasticity, soft to very soft, moist	SS18G	25.5 - 27.0	1.3	4-1-2
29.1	672.6		CLAYEY SAND, SC, 10YR 4/1 (dark gray), fine, very loose, moist to wet Wet at 28.0'	SS19G	27.0 - 28.5	1.5	WH-WH-WH
				SS20aG	28.5 - 29.1	1.5	WH-WH-1
31.5	670.2		POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 4/1 (dark gray), fine, very loose, wet Organics from 30.0' to 31.5'	SS20bG	29.1 - 30.0		
				SS21G	30.0 - 31.5	1.5	WH-WH-WH
33.0	668.7		POORLY GRADED SAND WITH SILT, SP-SM, 10YR 4/1 (dark gray), fine, very loose, wet	SS22G	31.5 - 33.0	1.2	WH-1-1
34.5	667.2		WELL GRADED GRAVEL WITH SAND, GW, 10YR 4/1 (dark gray), very fine to coarse, wet, subangular to rounded, multi colored	SS23G	33.0 - 34.5	1.5	2-10-19

No Refusal /
Bottom of Hole at 34.5 Ft.

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G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 6/5/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-106A**
Client	Tennessee Valley Authority	Boring Location	445,873.06 N; 2,362,847.92 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	704.6 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	6/5/19
		Completed	6/5/19
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	12.0 ft
		Date/Time	6/5/19 10:28
Inspector	G. Budd	Depth to Water	N/A
Logger	G. Budd	Date/Time	N/A
Drilling Contractor	Hawkston (Subcontractor)	Drill Rig Type and ID	Geoprobe 3230DT
Overburden Drilling and Sampling Tools (Type and Size)	DPT-Direct Push		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	N/A	Overdrill Depth	N/A
Sampler Hammer Type	N/A	Weight	N/A
Drop	N/A	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Kocka	Approved By	L. Price

Lithology Depth Ft[3]	Elevation	Graphic	Description	Overburden: Sample[1,2] / Rock Core: RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	704.6		Top of Hole				
0.3	704.3		Topsoil, grass				
1.2	703.4		CLAYEY GRAVEL, GC, 5YR 5/6 (yellowish red), medium to coarse, dry, limestone gravel fill, organics, [FILL]				
5.5	699.1		LEAN CLAY, CL, 7.5YR 6/8 (reddish yellow), dry to moist, with CCR, siltstone gravel, [FILL]	DP01	0.0 - 5.0	4.3	N/A
6.8	697.8		LEAN CLAY SOME SAND, CL, 7.5YR 6/8 (reddish yellow) and 7.5YR 7/1 (light gray), low plasticity, moist, with trace CCR, [FILL]				
13.5	691.1		LEAN CLAY, CL, 7.5YR 3/2 (dark brown), moist, with some very fine sand	DP02	5.0 - 10.0	4.8	N/A
				DP03	10.0 - 15.0	4.8	N/A
15.0	689.6		LEAN CLAY WITH SAND, CL, 7.5YR 4/3 (brown), low plasticity, moist, with organics				
			SANDY LEAN CLAY, CL, 10YR 4/4 (dark yellowish brown), low plasticity, with organics				
			Sand lens, fine from 17.4' to 17.5'	DP04	15.0 - 20.0	4.2	N/A

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 2/9/20

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-106A**
Client	Tennessee Valley Authority	Boring Location	445,873.06 N; 2,362,847.92 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	704.6 ft
		Elevation Datum	NGVD29

Depth Ft[3]	Elevation	Graphic	Description	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
			SANDY LEAN CLAY, CL, 10YR 4/4 (dark yellowish brown), low plasticity, with organics *(Continued)*				
22.5	682.1		SANDY LEAN CLAY, CL, 7.5YR 4/4 (brown) and 7.5YR 5/1 (gray), low to medium plasticity, moist, with abundant manganese	DP05	20.0 - 25.0	4.2	N/A
26.3	678.3		CLAYEY SAND, SC, 7.5YR 4/4 (brown) and 7.5YR 5/1 (gray), fine, moist to wet				
27.0	677.6		SANDY LEAN CLAY, CL, 7.5YR 4/4 (brown) and 7.5YR 5/1 (gray), low to medium plasticity, moist	DP06	25.0 - 30.0	4.0	N/A
			Color change to 7.5YR 4/1 (dark gray), low plasticity, wet at 30.5'	DP07	30.0 - 35.0	4.9	N/A
33.6	671.0		CLAYEY SAND, SC, 7.5YR 4/1 (dark gray), fine, wet				
34.7	669.9		Fragments of wood				
35.0	669.6		CLAYEY SAND, SC, 7.5YR 4/1 (dark gray), fine, wet				
35.4	669.2		WELL GRADED SAND, GW, 7.5YR 4/1 (dark gray), very fine to coarse, wet	DP08	35.0 - 38.6	3.6	N/A
36.8	667.8		WELL GRADED GRAVEL, GC, very fine to coarse, wet, subrounded to rounded, multicolored, with fragments of wood				
38.3	666.3		Shale, green gray, moderately hard				
38.6	666.0						

Bedrock Refusal /
Bottom of Hole at 38.6 Ft.

Top of Rock = 38.3 Ft.
Top of Rock Elevation = 666.3 Ft.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 2/9/20

SUBSURFACE LOG

Stantec TVA

Client Borehole ID	N/A	Stantec Boring No.	**WBF-106B**
Client	Tennessee Valley Authority	Boring Location	445,878.06 N; 2,362,847.92 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	704.4 ft — Elevation Datum: NGVD29
Project Name	WBF TDEC Order	Date Started	6/5/19 — Completed: 6/5/19
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	13.7 ft — Date/Time: 6/5/19 14:09
Inspector	G. Budd — Logger: G. Budd	Depth to Water	N/A — Date/Time: N/A
Drilling Contractor	Hawkston (Subcontractor)	Drill Rig Type and ID	Geoprobe 3230DT

Overburden Drilling and Sampling Tools (Type and Size): DPT-Direct Push

Rock Drilling and Sampling Tools (Type and Size): N/A

Overdrill Tooling (Type and Size): N/A — Overdrill Depth: N/A

Sampler Hammer Type: N/A — Weight: N/A — Drop: N/A — Efficiency: N/A

Borehole Azimuth: N/A — Borehole Inclination (from Vertical): N/A

Reviewed By: C. Kocka — Approved By: L. Price

Depth Ft[3]	Elevation	Description	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft	Rec. Ft	Blows/PSI / Rec. %
0.0	704.4	Top of Hole				
0.2	704.2	Topsoil, grass				
2.7	701.7	LEAN CLAY, CL, 5YR 5/8 (yellowish red), dry, with siltstone and sandstone gravel, trace CCR, [FILL]	DP01	0.0 - 5.0	4.0	N/A
8.0	696.4	SANDY LEAN CLAY, CL, 10YR 2/2 (very dark brown), low plasticity, moist, with CCR, [FILL]	DP02	5.0 - 10.0	4.9	N/A
11.6	692.8	CLAYEY SAND, SC, 10YR 4/4 (dark yellowish brown), fine, moist				
12.9	691.5	SANDY LEAN CLAY, CL, 10YR 4/4 (dark yellowish brown), low to medium plasticity, moist Sand lens, fine from 11.8' to 11.9'	DP03	10.0 - 15.0	3.3	N/A
		LEAN CLAY, CL, 10YR 4/4 (dark yellowish brown), low to medium plasticity, with some very fine sand Manganese and organics from 15.0' to 20.0'	DP04	15.0 - 20.0	5.0	N/A

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 6/22/20

Client Borehole ID	N/A	Stantec Boring No.	**WBF-106B**
Client	Tennessee Valley Authority	Boring Location	445,878.06 N; 2,362,847.92 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	704.4 ft
		Elevation Datum	NGVD29

Depth Ft[3]	Elevation	Description	Sample[1,2] (Overburden) / RQD % (Rock Core)	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
20.0	684.4					
25.0	679.4	FAT CLAY WITH SAND, CH, 10YR 4/4 (dark yellowish brown) and 10YR 6/1 (gray), medium to high plasticity, moist, with manganese and organics	DP05	20.0 - 25.0	4.8	N/A
27.6	676.8	SANDY LEAN CLAY, CL, 5YR 3/4 (dark reddish brown) and 10YR 4/1 (dark gray), low to medium plasticity, moist	DP06	25.0 - 30.0	4.9	N/A
30.0	674.4	SILTY CLAYEY SAND, SC, 10YR 4/1 (dark gray), fine, moist to wet Wet at 29.0'				
32.0	672.4	POORLY GRADED SAND, SP, 10YR 5/1 (gray), fine, wet	DP07	30.0 - 35.0	5.0	N/A
33.9	670.5	POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 5/1 (gray), fine				
34.9	669.5	POORLY GRADED GRAVEL WITH SAND, GP, 10YR 5/1 (gray), very fine to coarse, wet, subangular to rounded, multicolored				
35.0	669.4	Shale, green gray, weathered				

No Refusal /
Bottom of Hole at 35.0 Ft.

As-drilled boring location not surveyed. Horizontal coordinates based on field measurements. Vertical coordinates based on 2017 LiDAR surfaces.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 6/22/20

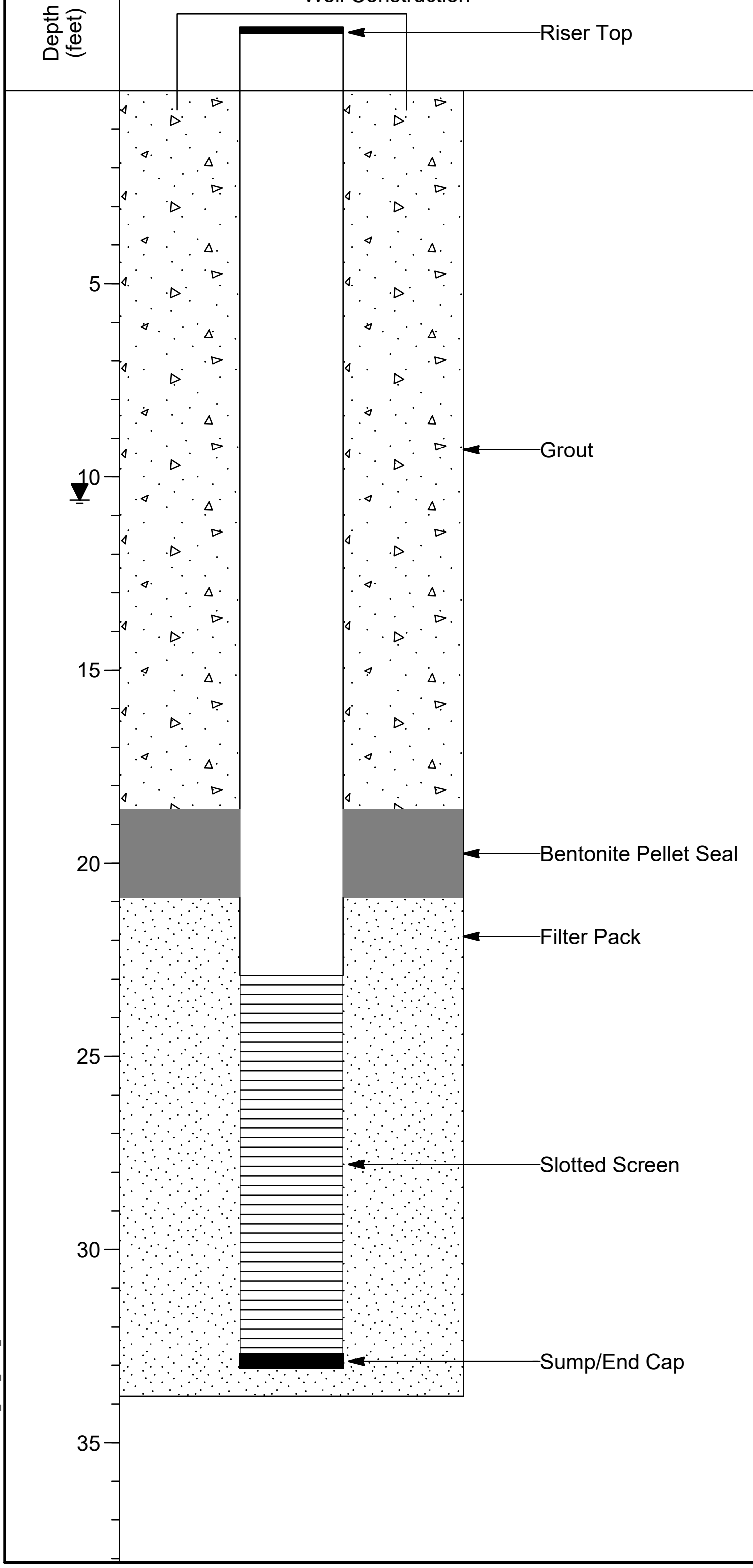
ATTACHMENT C.2

Well Installation Details

WELL INSTALLATION DETAIL	WELL / PROBEHOLE / BOREHOLE NO: **WBF-101** (Boring WBF-101) PAGE 1 OF 1

PROJECT: **WBF TDEC Order**	INSTALLATION: STARTED: **6/12/19**	COMPLETED: **6/12/19**
PROJECT NUMBER: **175668050**	LOCATION: **443,876.99 N; 2,362,987.15 E**	DATUM: **NAD27 Plant Local**
DRILLING COMPANY: **Stantec Consulting Services Inc.**	LOC. DESCRIP: **As Staked**	
DRILLING EQUIPMENT: **CME 850XR, #953**	LATITUDE: **35° 36' 18.70"**	LONGITUDE: **-84° 46' 44.09"**
DRILLING METHOD: **8-1/4" HSA overdrill of boring**	GROUND ELEV (ft): **698.7**	TOC ELEV (ft): **703.15**
SAMPLING METHOD: **4-1/4" HSA, 2" SS w/o liners**	ELEVATION DATUM: **NGVD29**	
OBSERVED BY: **G. Budd**	WELL DEPTH (ft, bgs): **33.1**	
REVIEWED BY: **J. Snider**	DTW AT COMPLETION (ft, bgs): **10.6**	
APPROVED BY: **L. Price**	BOREHOLE DIA. (in): **13.0**	WELL DIA. (in): **4.0**

Depth (feet) | Well Construction



Materials Inventory

RISER TYPE: **4" Sch 40 PVC Riser**	
RISER: TOP (AGS): **4.4 ft**	BOTTOM (BGS): **22.9 ft**
SCREEN TYPE: **5"ID x 4"ID U-Pack**	
SCREEN SLOT SIZE (in): **0.010**	
SCREEN: TOP (BGS): **22.9 ft**	BOTTOM (BGS): **32.7 ft**
END CAP: TOP (BGS): **32.7 ft**	BOTTOM (BGS): **33.1 ft**
GROUT QUANTITY: **115 gal**	
GROUT TYPE: **30% Solids Bentonite Grout**	
GROUT: TOP (BGS): **0.0 ft**	BOTTOM (BGS): **18.6 ft**
GROUT DENSITY: INITIAL (lbs/gal): **10.1**	RETURN (lbs/gal): **10.1**
BENTONITE TYPE: **1/4" PDS TR30 pellets**	
BENTONITE SEAL: TOP (BGS): **18.6 ft**	BOTTOM (BGS): **20.9 ft**
FILTER PACK - PRE-PACK AND ANNULAR SPACE: TYPE: **20/40 Mesh (Global #7)**	
FILTER PACK: TOP (BGS): **20.9 ft**	BOTTOM (BGS): **33.8 ft**

NOTES:
1) Final, as-built well detail depths measured from final surface grade (ft bgs) are listed. TVA surface pad installation activities may result in changes to the final surface grade and well riser stick-up length. As-built depths are therefore corrected to reflect these changes based on the final surveyed ground surface elevation, top of casing elevation, and measured depth of the well following pad placement.
2) For WBF-101, pad placement activities resulted in an approximate 0.1' net "increase" in the original length (depth) of the well when measured from the new final surface grade (i.e., the total length of well pipe below the new, final surface grade is greater than it was when measured from the ground surface during well installation). While the final, corrected depths (ft bgs) may differ from those originally measured during well construction, the original, as installed elevations of the various well components have not changed as a result of surface pad installation activities.
3) 4-1/4" HSA exploratory boring advanced to 34.0 ft bgs (34.1 ft bgs corrected). The total depth was 33.7 ft bgs after the auger plug was knocked out (33.8 ft bgs corrected). Boring subsequently overdrilled with 8-1/4" HSA to same depth. The sand filter pack base was placed from 33.7 to 33.0 ft bgs (33.8 to 33.1 ft bgs corrected). The measured depth of bentonite after hydration was 18.5 ft bgs (18.6 ft bgs corrected).

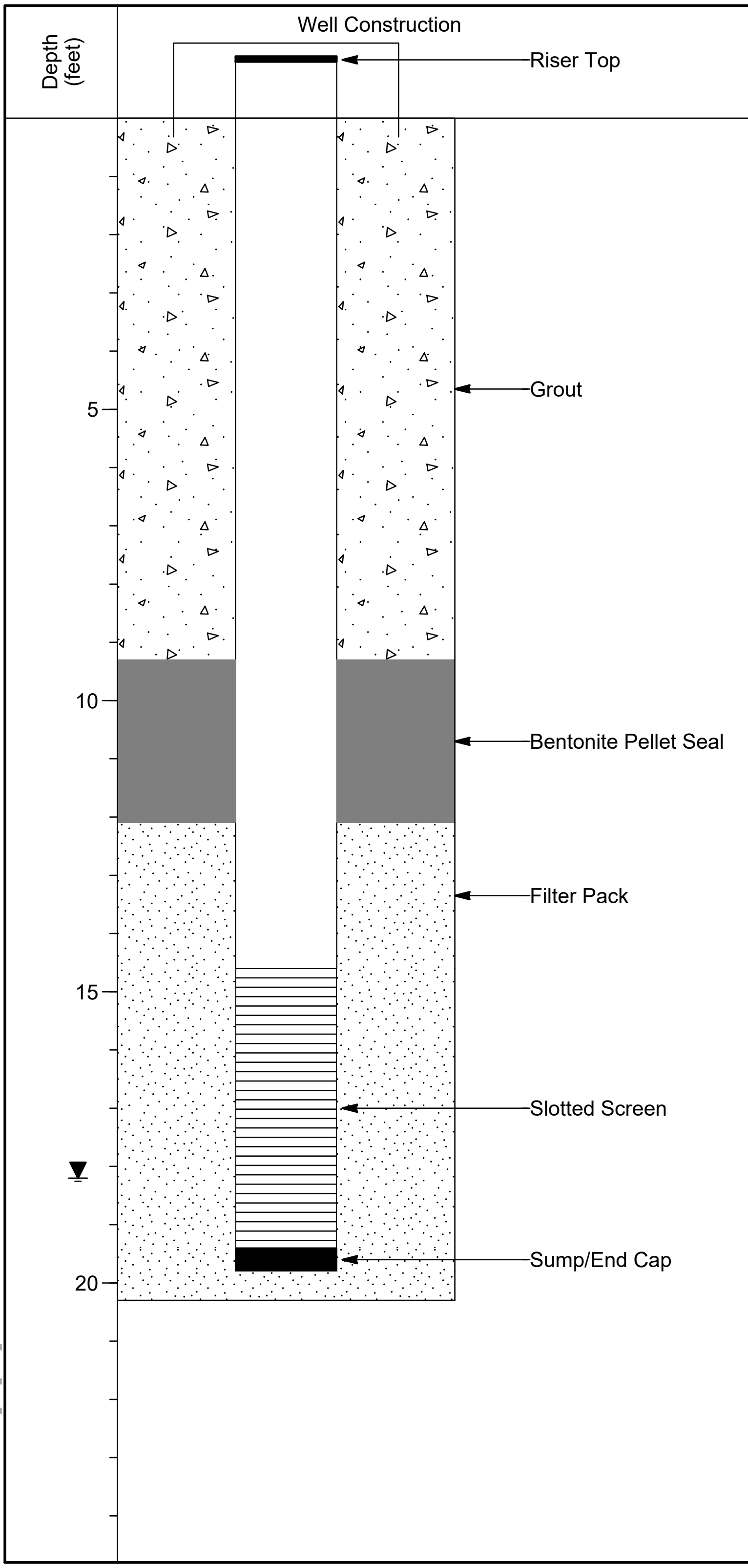
VERTICAL SCALE: AS SHOWN. HORIZONTAL SCALE: NOT TO SCALE (EXAGGERATED TO SHOW DETAIL)

WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: **WBF-102** (Boring WBF-102Alt2 (Sonic))

PROJECT: **WBF TDEC Order**	INSTALLATION: STARTED: **7/9/19** COMPLETED: **7/10/19**
PROJECT NUMBER: **175668050**	LOCATION: **443,745.53 N; 2,362,237.49 E** DATUM: **NAD27 Plant Local**
DRILLING COMPANY: **Stantec Consulting Services Inc.**	LOC. DESCRIP:
DRILLING EQUIPMENT: **Geoprobe GV5 Sonic**	LATITUDE: **35° 36' 17.49"** LONGITUDE: **-84° 46' 53.19"**
DRILLING METHOD: **Sonic 6" Core Barrel, 8" Steel Casing**	GROUND ELEV (ft): **719.2** TOC ELEV (ft): **723.98**
SAMPLING METHOD: **Sonic 6" Core Barrel, 8" Steel Casing**	ELEVATION DATUM: **NGVD29**
OBSERVED BY: **G. Budd**	WELL DEPTH (ft, bgs): **19.8**
REVIEWED BY: **C. Kocka**	DTW AT COMPLETION (ft, bgs): **18.2**
APPROVED BY: **L. Price**	BOREHOLE DIA. (in): **8.0** WELL DIA. (in): **4.0**

Well Construction



Materials Inventory

RISER TYPE: **4" Sch 40 PVC Riser**

RISER: TOP (AGS): **4.8 ft** BOTTOM (BGS): **14.6 ft**

SCREEN TYPE: **5"ID x 4"ID U-Pack**

SCREEN SLOT SIZE (in): **0.010**

SCREEN: TOP (BGS): **14.6 ft** BOTTOM (BGS): **19.4 ft**

END CAP: TOP (BGS): **19.4 ft** BOTTOM (BGS): **19.8 ft**

GROUT QUANTITY: **34 gal**

GROUT TYPE: **30% Solids Bentonite Grout**

GROUT: TOP (BGS): **0.0 ft** BOTTOM (BGS): **9.3 ft**

GROUT DENSITY:
INITIAL (lbs/gal): **10.1** RETURN (lbs/gal): **10.1**

BENTONITE TYPE: **1/4" PDS TR30 pellets**

BENTONITE SEAL:
TOP (BGS): **9.3 ft** BOTTOM (BGS): **12.1 ft**

FILTER PACK - PRE-PACK AND ANNULAR SPACE:
TYPE: **20/40 Mesh (Global #7)**

FILTER PACK: TOP (BGS): **12.1 ft** BOTTOM (BGS): **20.3 ft**

NOTES:

1) 4-1/4" HSA exploratory boring advanced to 21.0 ft bgs (20.3 ft bgs corrected). Boring subsequently overdrilled with 8-1/4" HSA to same depth. Corrected values represent the boring depth from the surveyed ground surface elevation adjacent to the pad and consider grade modifications made during pad installation.

2) Final as-built depths are listed. These corrected depths use the surveyed ground surface (GS) elevation following pad placement as the reference datum and may differ from the unknown elevation of the GS reference point used during well installation. For WBF-102, the finished grade surveyed elevation was approximately 0.7' lower than the original grade reference used when the well was installed. The position of each well component, however, has not changed relative to original elevation of the bottom of the well.

VERTICAL SCALE: AS SHOWN. HORIZONTAL SCALE: NOT TO SCALE (EXAGGERATED TO SHOW DETAIL)

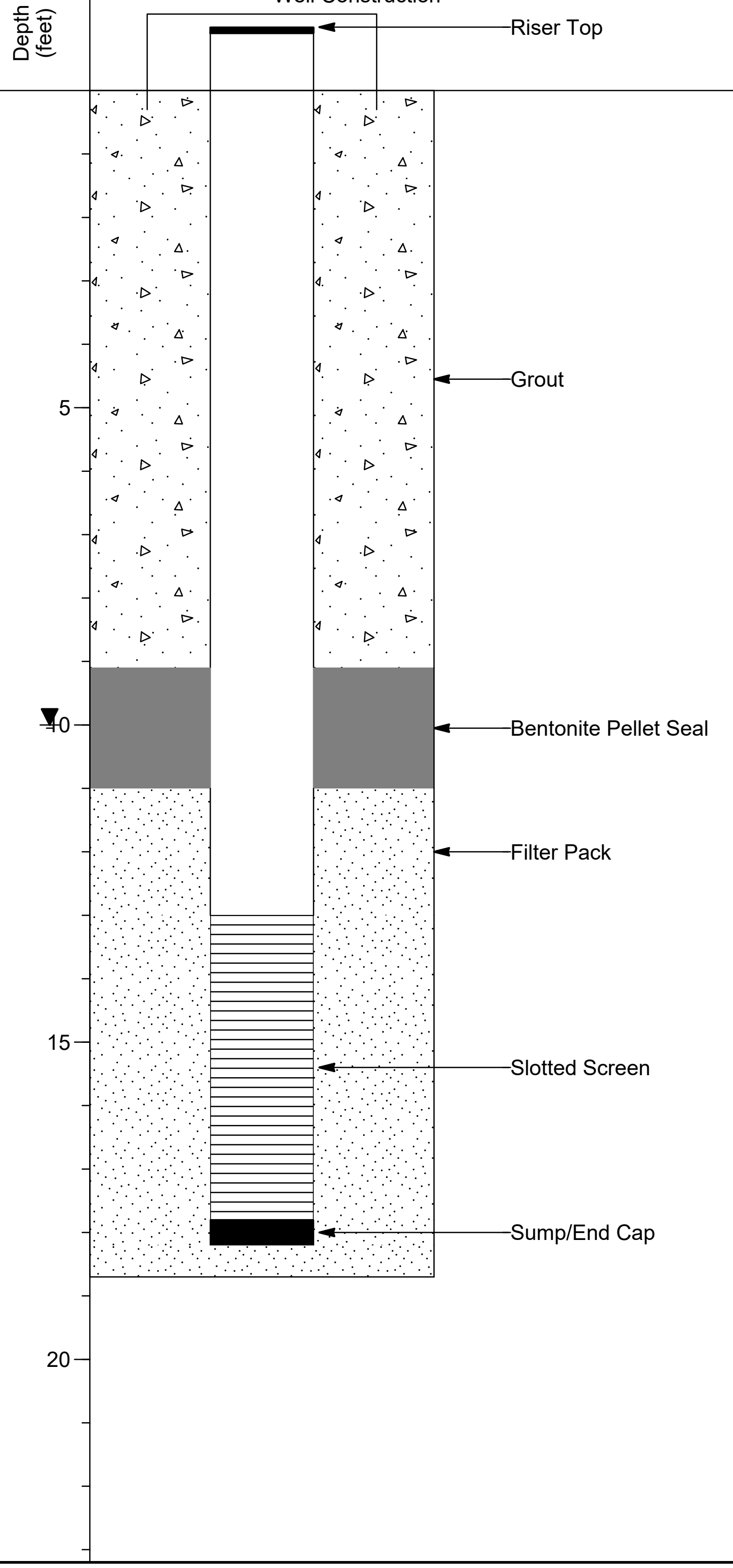
WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO:

WBF-103 (Boring WBF-103)

PROJECT: **WBF TDEC Order**	INSTALLATION: STARTED: **6/10/19** COMPLETED: **6/11/19**
PROJECT NUMBER: **175668050**	LOCATION: **444,765.49 N; 2,361,678.22 E** DATUM: **NAD27 Plant Local**
DRILLING COMPANY: **Stantec Consulting Services Inc.**	LOC. DESCRIP: **As Staked**
DRILLING EQUIPMENT: **CME 850XR, #953**	LATITUDE: **35° 36' 27.64"** LONGITUDE: **-84° 46' 59.80"**
DRILLING METHOD: **8-1/4" HSA overdrill of boring**	GROUND ELEV (ft): **721.1** TOC ELEV (ft): **725.09**
SAMPLING METHOD: **4-1/4" HSA, 3" SS w/o liners**	ELEVATION DATUM: **NGVD29**
OBSERVED BY: **G. Budd**	WELL DEPTH (ft, bgs): **18.2**
REVIEWED BY: **J. Snider**	DTW AT COMPLETION (ft, bgs): **10.0**
APPROVED BY: **L. Price**	BOREHOLE DIA. (in): **13.0** WELL DIA. (in): **4.0**

Depth (feet) | Well Construction



Materials Inventory

RISER TYPE: **4" Sch 40 PVC Riser**

RISER: TOP (AGS): **4.0 ft** BOTTOM (BGS): **13.0 ft**

SCREEN TYPE: **5"ID x 4"ID U-Pack**

SCREEN SLOT SIZE (in): **0.010**

SCREEN: TOP (BGS): **13.0 ft** BOTTOM (BGS): **17.8 ft**

END CAP: TOP (BGS): **17.8 ft** BOTTOM (BGS): **18.2 ft**

GROUT QUANTITY: **52.5 gal**

GROUT TYPE: **30% Solids Bentonite Grout**

GROUT: TOP (BGS): **0.0 ft** BOTTOM (BGS): **9.1 ft**

GROUT DENSITY:
INITIAL (lbs/gal): **10.1** RETURN (lbs/gal): **10.1**

BENTONITE TYPE: **1/4" PDS TR30 pellets**

BENTONITE SEAL:
TOP (BGS): **9.1 ft** BOTTOM (BGS): **11.0 ft**

FILTER PACK - PRE-PACK AND ANNULAR SPACE:
TYPE: **20/40 Mesh (Global #7)**

FILTER PACK: TOP (BGS): **11.0 ft** BOTTOM (BGS): **18.7 ft**

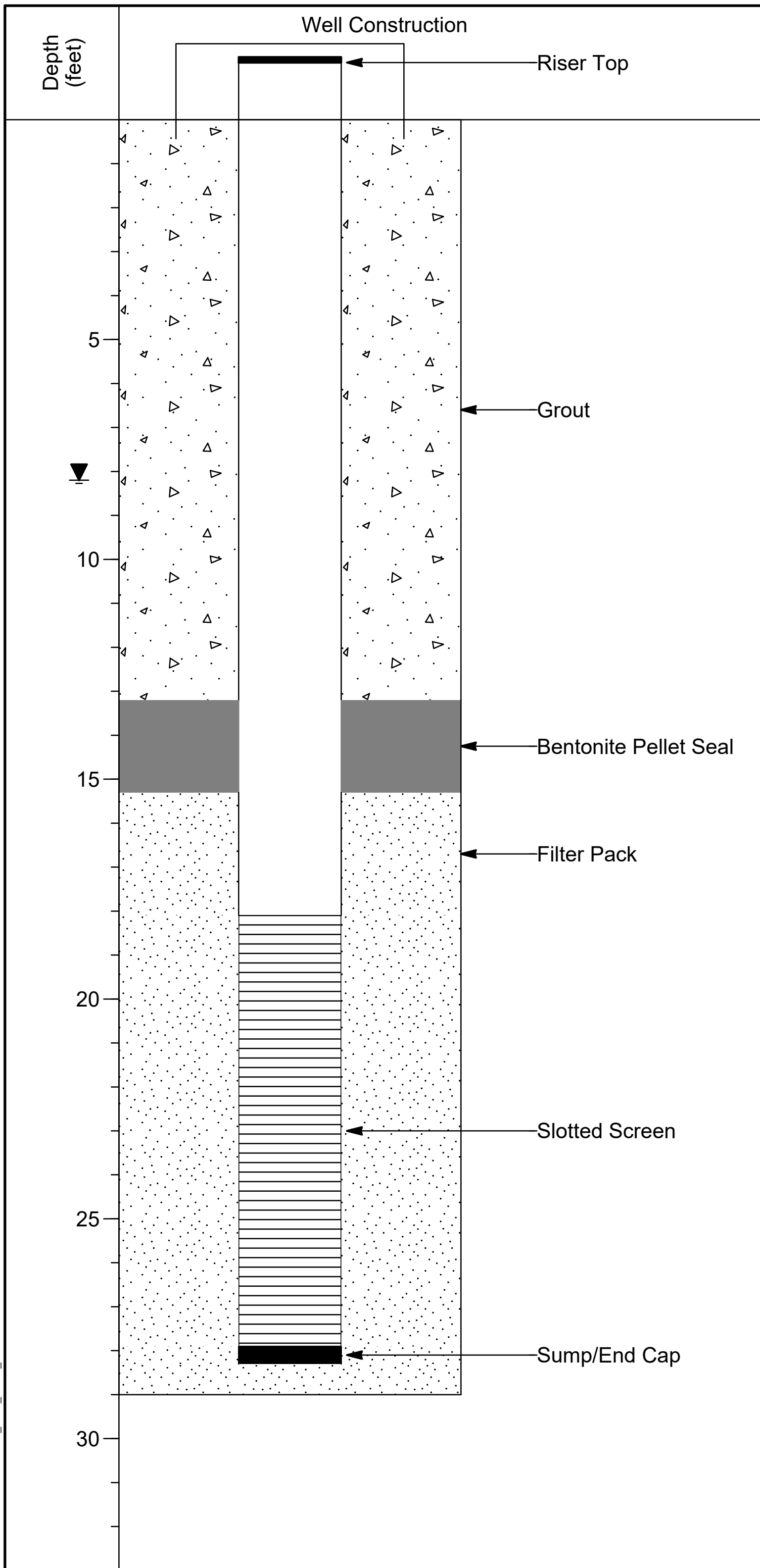
NOTES:
1) Final, as-built well detail depths measured from final surface grade (ft bgs) are listed. TVA surface pad installation activities may result in changes to the final surface grade and well riser stick-up length. As-built depths are therefore corrected to reflect these changes based on the final surveyed ground surface elevation, top of casing elevation, and measured depth of the well following pad placement.
2) For WBF-103, pad placement activities resulted in an approximate 0.2' net "increase" in the original length (depth) of the well when measured from the new final surface grade (i.e., the total length of well pipe below the new, final surface grade is greater than it was when measured from the ground surface during well installation). While the final, corrected depths (ft bgs) may differ from those originally measured during well construction, the original, as installed elevations of the various well components have not changed as a result of surface pad installation activities.
3) 4-1/4" HSA exploratory boring advanced to 18.5 ft bgs (18.7 ft bgs corrected). Boring subsequently overdrilled with 8-1/4" HSA to same depth. The sand filter pack base was placed from 18.5 to 18.0 ft bgs (18.7 to 18.2 ft bgs corrected). The measured depth of bentonite after hydration was 8.5 ft bgs (8.7 ft bgs corrected).

VERTICAL SCALE: AS SHOWN. HORIZONTAL SCALE: NOT TO SCALE (EXAGGERATED TO SHOW DETAIL)

WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: **WBF-104** (Boring WBF-104)

PROJECT: **WBF TDEC Order**	INSTALLATION: STARTED: **6/13/19** COMPLETED: **6/14/19**
PROJECT NUMBER: **175668050**	LOCATION: **444,336.57 N; 2,363,103.76 E** DATUM: **NAD27 Plant Local**
DRILLING COMPANY: **Stantec Consulting Services Inc.**	LOC. DESCRIP: **As Staked**
DRILLING EQUIPMENT: **CME 850XR, #953**	LATITUDE: **35° 36' 23.23"** LONGITUDE: **-84° 46' 42.61"**
DRILLING METHOD: **8-1/4" HSA overdrill of boring**	GROUND ELEV (ft): **694.1** TOC ELEV (ft): **697.45**
SAMPLING METHOD: **4-1/4" HSA, 2" SS w/o liners**	ELEVATION DATUM: **NGVD29**
OBSERVED BY: **G. Budd**	WELL DEPTH (ft, bgs): **28.3**
REVIEWED BY: **J. Snider**	DTW AT COMPLETION (ft, bgs): **8.2**
APPROVED BY: **L. Price**	BOREHOLE DIA. (in): **13.0** WELL DIA. (in): **4.0**



Materials Inventory

RISER TYPE: **4" Sch 40 PVC Riser**

RISER: TOP (AGS): **3.4 ft** BOTTOM (BGS): **18.1 ft**

SCREEN TYPE: **5"ID x 4"ID U-Pack**

SCREEN SLOT SIZE (in): **0.010**

SCREEN: TOP (BGS): **18.1 ft** BOTTOM (BGS): **27.9 ft**

END CAP: TOP (BGS): **27.9 ft** BOTTOM (BGS): **28.3 ft**

GROUT QUANTITY: **61 gal**

GROUT TYPE: **30% Solids Bentonite Grout**

GROUT: TOP (BGS): **0.0 ft** BOTTOM (BGS): **13.2 ft**

GROUT DENSITY:
INITIAL (lbs/gal): **10.1** RETURN (lbs/gal): **10.1**

BENTONITE TYPE: **1/4" PDS TR30 pellets**

BENTONITE SEAL:
TOP (BGS): **13.2 ft** BOTTOM (BGS): **15.3 ft**

FILTER PACK - PRE-PACK AND ANNULAR SPACE:
TYPE: **20/40 Mesh (Global #7)**

FILTER PACK: TOP (BGS): **15.3 ft** BOTTOM (BGS): **29.0 ft**

NOTES:
1) Final, as-built well detail depths measured from final surface grade (ft bgs) are listed. TVA surface pad installation activities may result in changes to the final surface grade and well riser stick-up length. As-built depths are therefore corrected to reflect these changes based on the final surveyed ground surface elevation, top of casing elevation, and measured depth of the well following pad placement.
2) For WBF-104, pad placement activities resulted in an approximate 1.3' net "increase" in the original length (depth) of the well when measured from the new final surface grade (i.e., the total length of well pipe below the new, final surface grade is greater than it was when measured from the ground surface during well installation). While the final, corrected depths (ft bgs) may differ from those originally measured during well construction, the original, as installed elevations of the various well components have not changed as a result of surface pad installation activities.
3) 4-1/4" HSA exploratory boring advanced to 28.5 ft bgs (29.8 ft bgs corrected). Boring subsequently overdrilled with 8-1/4" HSA to 27.7 ft bgs (29.0 ft bgs corrected). The sand filter pack base was placed from 27.7 to 27.0 ft bgs (29.0 to 28.3 ft bgs corrected). The measured depth of bentonite after hydration was 11.5 ft bgs (12.8 ft bgs corrected).

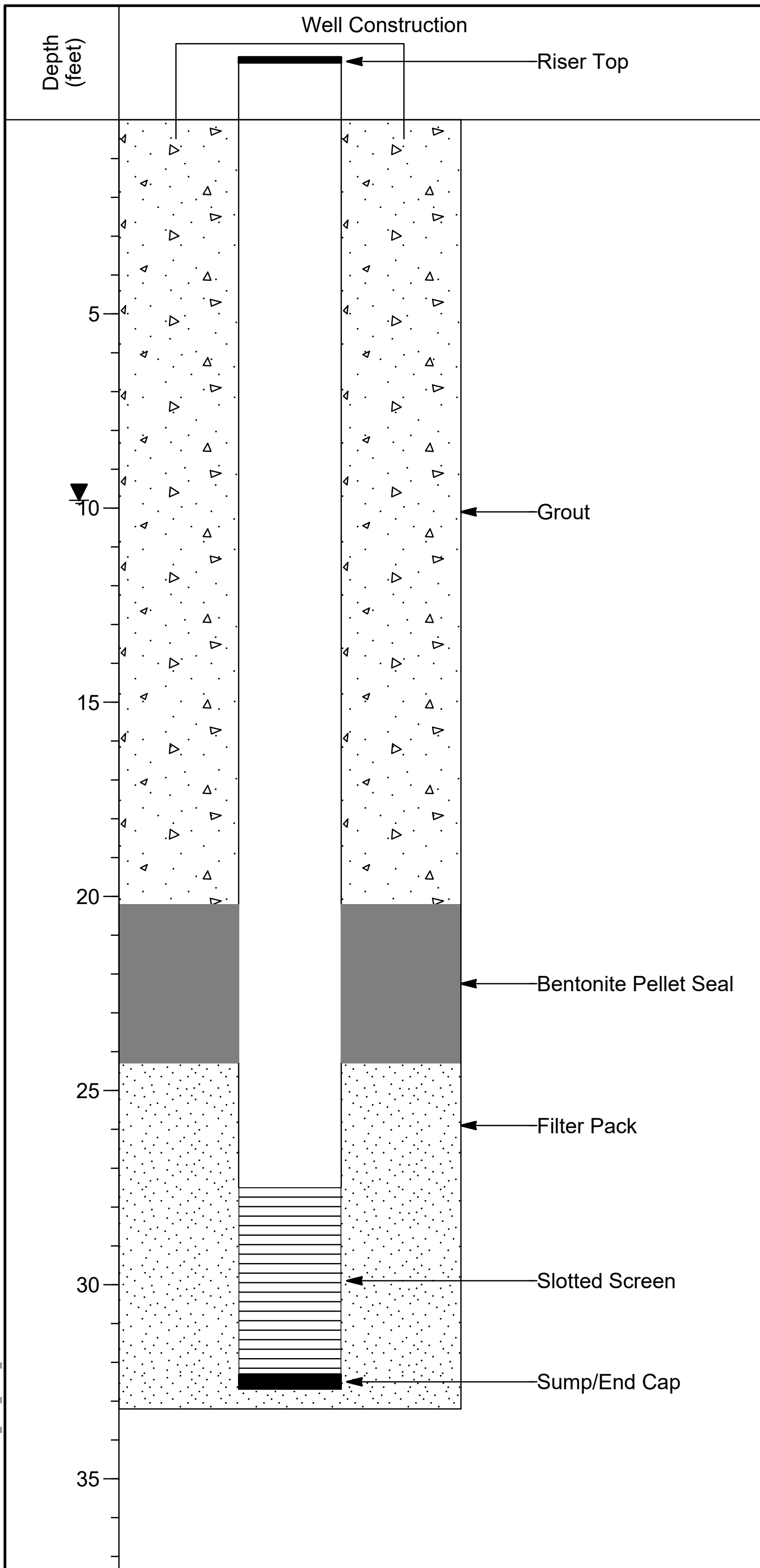
VERTICAL SCALE: AS SHOWN. HORIZONTAL SCALE: NOT TO SCALE (EXAGGERATED TO SHOW DETAIL)

WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: **WBF-105** (Boring WBF-105 (sonic))

PROJECT: **WBF TDEC Order**
PROJECT NUMBER: **175668050**
DRILLING COMPANY: **Stantec Consulting Services Inc.**
DRILLING EQUIPMENT: **Geoprobe GV5 Sonic**
DRILLING METHOD: **Sonic 6" Core Barrel, 8" Steel Casing**
SAMPLING METHOD: **Sonic 6" Core Barrel, 8" Steel Casing**
OBSERVED BY: **G. Budd**
REVIEWED BY: **C. Kocka**
APPROVED BY: **P. Dunne**

INSTALLATION: STARTED: **7/9/19** COMPLETED: **7/10/19**
LOCATION: **445,050.70 N; 2,363,041.85 E** DATUM: **NAD27 Plant Local**
LOC. DESCRIP:
LATITUDE: **35° 36' 30.30"** LONGITUDE: **-84° 46' 43.25"**
GROUND ELEV (ft): **699.8** TOC ELEV (ft): **704.50**
ELEVATION DATUM: **NGVD29**
WELL DEPTH (ft, bgs): **32.7**
DTW AT COMPLETION (ft, bgs): **9.8**
BOREHOLE DIA. (in): **8.0** WELL DIA. (in): **4.0**



Materials Inventory

RISER TYPE: **4" Sch 40 PVC Riser**

RISER: TOP (AGS): **4.7 ft** BOTTOM (BGS): **27.5 ft**

SCREEN TYPE: **5"ID x 4"ID U-Pack**

SCREEN SLOT SIZE (in): **0.010**

SCREEN: TOP (BGS): **27.5 ft** BOTTOM (BGS): **32.3 ft**

END CAP: TOP (BGS): **32.3 ft** BOTTOM (BGS): **32.7 ft**

GROUT QUANTITY: **60 gal**

GROUT TYPE: **30% Solids Bentonite Grout**

GROUT: TOP (BGS): **0.0 ft** BOTTOM (BGS): **20.2 ft**

GROUT DENSITY:
INITIAL (lbs/gal): **10.1** RETURN (lbs/gal): **10.1**

BENTONITE TYPE: **1/4" PDS TR30 pellets**

BENTONITE SEAL:
TOP (BGS): **20.2 ft** BOTTOM (BGS): **24.3 ft**

FILTER PACK - PRE-PACK AND ANNULAR SPACE:
TYPE: **20/40 Mesh (Global #7)**

FILTER PACK: TOP (BGS): **24.3 ft** BOTTOM (BGS): **33.2 ft**

NOTES:

1) Exploratory boring advanced to 35.0 ft bgs (34.2 ft bgs corrected) using 6" sonic casing. Boring subsequently over-drilled with 8" sonic casing to 18.0 ft bgs (17.2 ft bgs corrected) and a 10-inch permanent surface casing was set to 19.4 ft bgs (18.6 ft bgs corrected). Corrected values represent the boring depth from the surveyed ground surface elevation adjacent to the pad and consider grade modifications made during pad installation.

2) Final as-built depths are listed. These corrected depths use the surveyed ground surface (GS) elevation following pad placement as the reference datum and may differ from the unknown elevation of the GS reference point used during well installation. For WBF-105, the finished grade surveyed elevation was approximately 0.8' lower than the original grade reference used when the well was installed. The position of each well component, however, has not changed relative to original elevation of the bottom of the well.

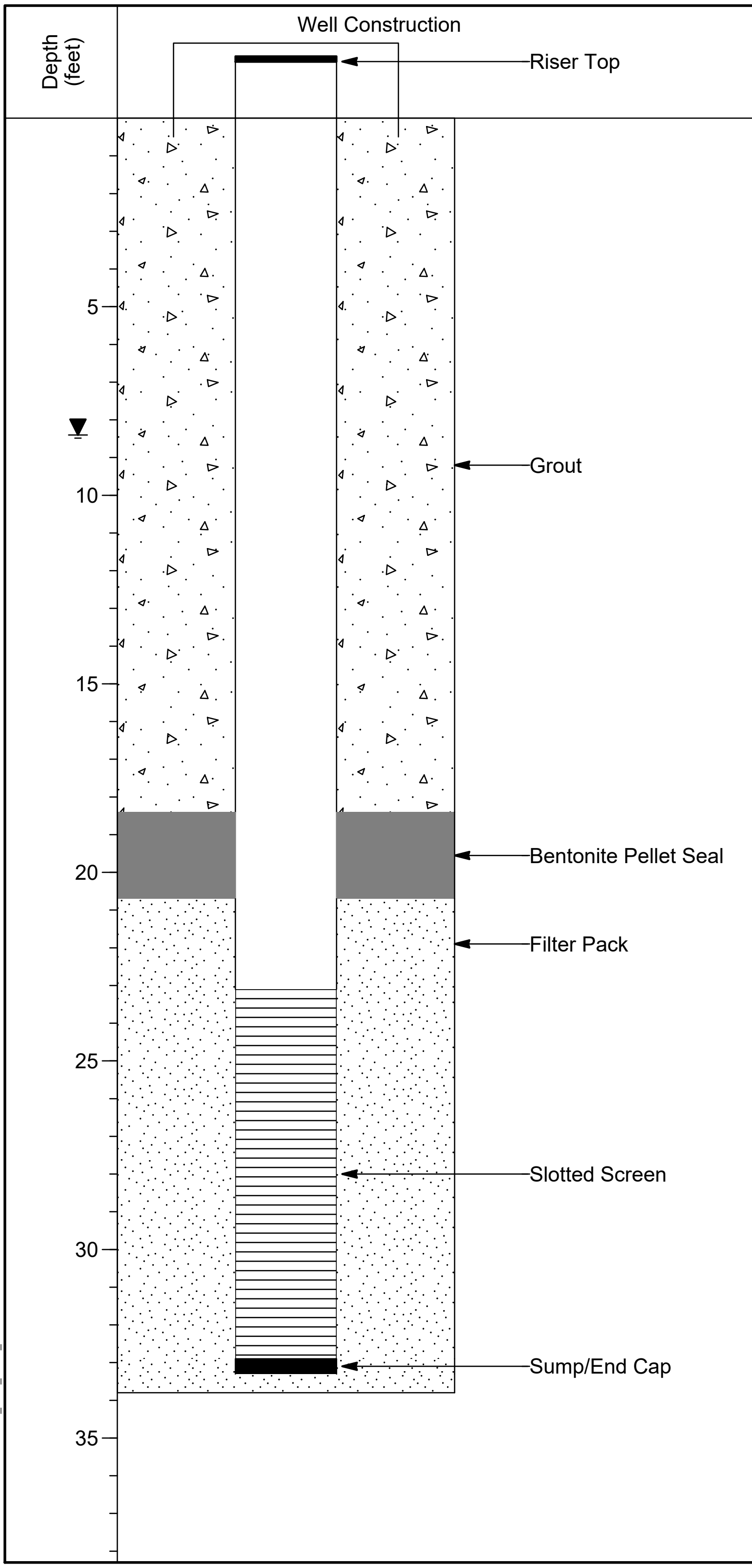
VERTICAL SCALE: AS SHOWN. HORIZONTAL SCALE: NOT TO SCALE (EXAGGERATED TO SHOW DETAIL)

WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: **WBF-106** (Boring WBF-106)

PROJECT: **WBF TDEC Order**
PROJECT NUMBER: **175668050**
DRILLING COMPANY: **Stantec Consulting Services Inc.**
DRILLING EQUIPMENT: **CME 850XR, #953**
DRILLING METHOD: **8-1/4" HSA overdrill of boring**
SAMPLING METHOD: **4-1/4" HSA, 2" SS w/o liners**
OBSERVED BY: **G. Budd**
REVIEWED BY: **C. Kocka**
APPROVED BY: **P. Dunne**

INSTALLATION: STARTED: **6/26/19** COMPLETED: **6/27/19**
LOCATION: **445,872.50 N; 2,362,862.26 E** DATUM: **NAD27 Plant Local**
LOC. DESCRIP: **Adjacent to boring WBF - 106B**
LATITUDE: **35° 36' 38.45"** LONGITUDE: **-84° 46' 45.30"**
GROUND ELEV (ft): **701.7** TOC ELEV (ft): **706.34**
ELEVATION DATUM: **NGVD29**
WELL DEPTH (ft, bgs): **33.3**
DTW AT COMPLETION (ft, bgs): **8.4**
BOREHOLE DIA. (in): **13.0** WELL DIA. (in): **4.0**



Materials Inventory

RISER TYPE: **2" Sch 40 PVC Riser**

RISER: TOP (AGS): **4.7 ft** BOTTOM (BGS): **23.1 ft**

SCREEN TYPE: **5"ID x 4"ID U-Pack**

SCREEN SLOT SIZE (in): **0.010**

SCREEN: TOP (BGS): **23.1 ft** BOTTOM (BGS): **32.9 ft**

END CAP: TOP (BGS): **32.9 ft** BOTTOM (BGS): **33.3 ft**

GROUT QUANTITY: **102 gal**

GROUT TYPE: **30% Solids Bentonite Grout**

GROUT: TOP (BGS): **0.0 ft** BOTTOM (BGS): **18.4 ft**

GROUT DENSITY:
INITIAL (lbs/gal): **10.2** RETURN (lbs/gal): **10.1**

BENTONITE TYPE: **1/4" PDS TR30 pellets**

BENTONITE SEAL:
TOP (BGS): **18.4 ft** BOTTOM (BGS): **20.7 ft**

FILTER PACK - PRE-PACK AND ANNULAR SPACE:
TYPE: **20/40 Mesh (Global #7)**

FILTER PACK: TOP (BGS): **20.7 ft** BOTTOM (BGS): **33.8 ft**

NOTES:

1) Measured depth of bentonite after hydration 18.3' bgs. Backfill below sand pack: boring was overdrilled to an uncorrected depth of 34.5' (33.7' after the auger plug was knocked out and alluvial sand and fine gravel flowed into the borehole.

2) Final, as built well detail depths are listed. These corrected depths use the surveyed ground surface (GS) elevation following pad placement as the reference datum and may differ from the elevation of the GS reference point used during well installation. For WBF-106, the surveyed elevation was approximately 0.1' higher than the original GS reference used when the well was installed. The position of each well component, however, has not changed relative to original elevation of the bottom of the well.

3) Corrected values represent boring depth from the surveyed ground surface elevation adjacent to the pad and consider grade modifications made during pad installation.

VERTICAL SCALE: AS SHOWN. HORIZONTAL SCALE: NOT TO SCALE (EXAGGERATED TO SHOW DETAIL)

APPENDIX D – PHOTOGRAPHS OF SOIL BORINGS AND MONITORING WELLS

ATTACHMENT D.1

Photographic Log of Soil Lithology

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 1

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (0.0-1.5 feet).

Photograph ID: 2

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (1.5-3.0 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 3

Photo Location: WBF-101

Photo Date: 6/11/2019

Comments: Interval (3.0-4.5 feet).

Photograph ID: 4

Photo Location: WBF-101

Photo Date: 6/11/2019

Comments: Interval (4.5-6.0 feet).

Stantec

Photographic Log

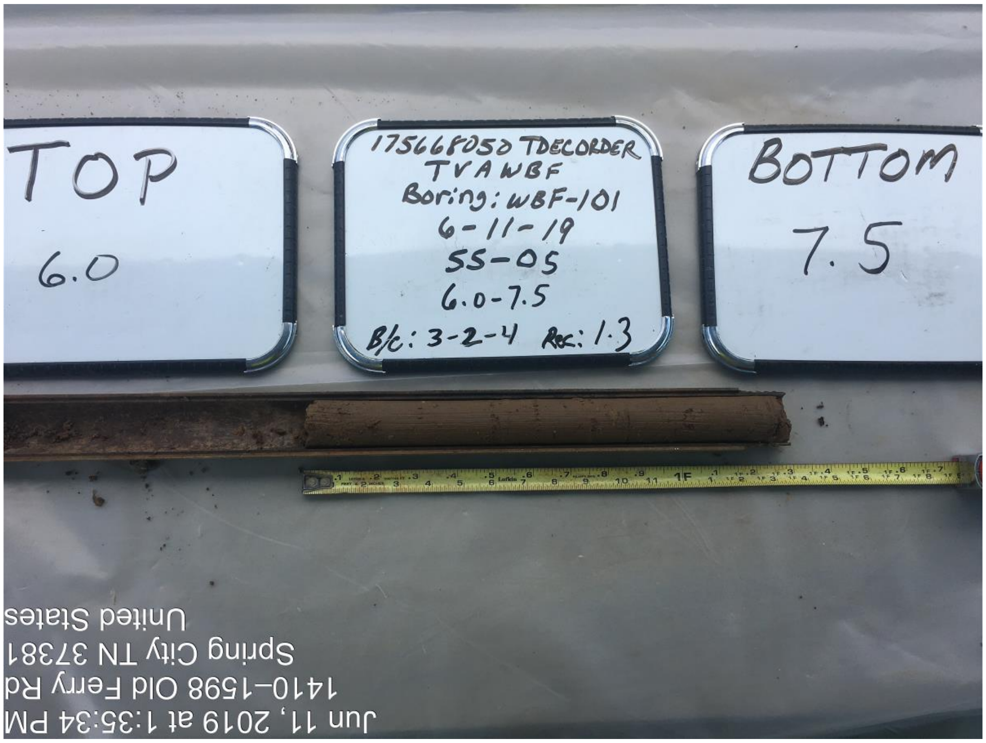
Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 5

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (6.0-7.5 feet).



Photograph ID: 6

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (7.5-9.0 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 7

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (9.0-10.5 feet).

Photograph ID: 8

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (10.5-12.0 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 9

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (12.0-13.5 feet).

Photograph ID: 10

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (13.5-15.0 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 11

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (15.0-16.5 feet).

Photograph ID: 12

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (16.5-18.0 feet).

Stantec **Photographic Log**

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 13

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (18.0-19.5 feet).

Photograph ID: 14

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (19.5-21.0 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 15

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (21.0-22.5 feet).

Photograph ID: 16

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (22.5-24.0 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 17

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (24.0-25.5 feet).

Photograph ID: 18

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (25.5-27.0 feet).

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 19

Photo Location:
WBF-101

Photo Date:
6/11/2019

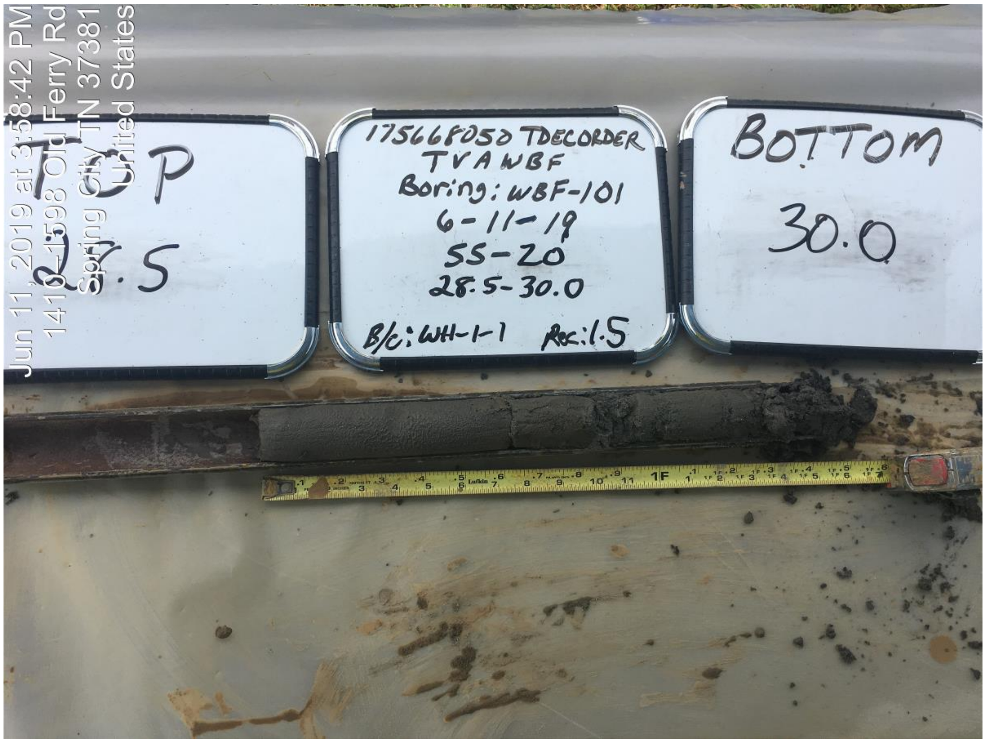
Comments:
Interval (27.0-28.5 feet).

Photograph ID: 20

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (28.5-30.0 feet).



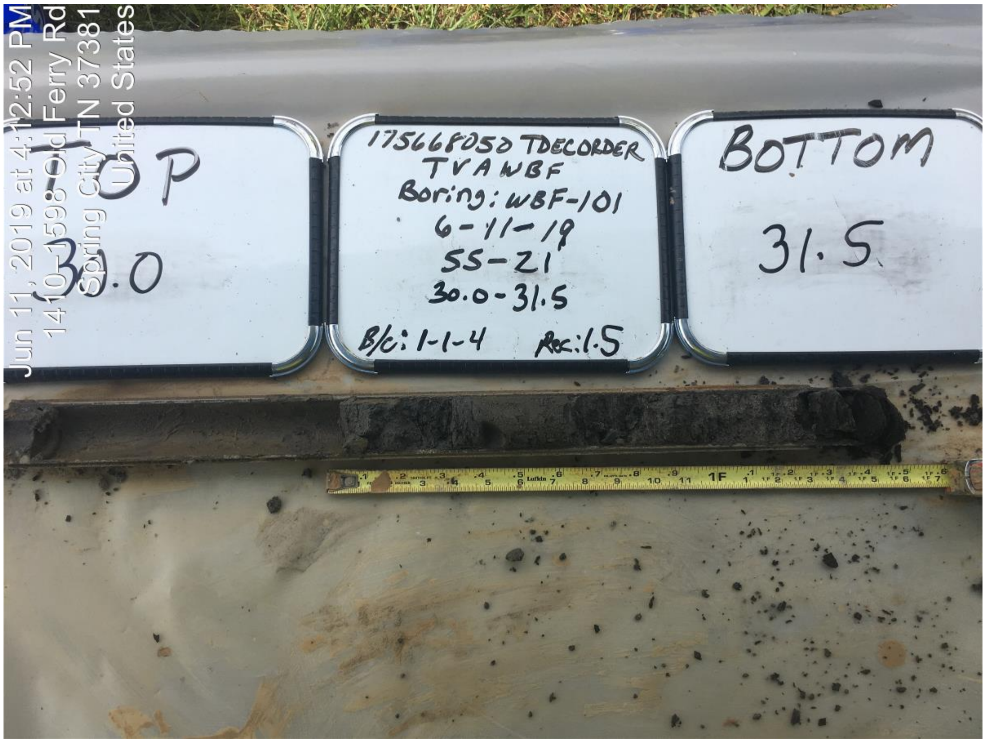
Client:	Tennessee Valley Authority	Project:	WBF TDEC Order
Site Name:	Watts Bar Fossil (WBF) Plant	Site Location:	Spring City, Tennessee

Photograph ID: 21

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (30.0-31.5 feet).



Photograph ID: 22

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (31.5-33.0 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 23

Photo Location:
WBF-101

Photo Date:
6/11/2019

Comments:
Interval (33.0-34.5 feet).

Photograph ID: 24

Photo Location:
WBF-101A

Photo Date:
5/30/2019

Comments:
Interval (0.0-5.0 feet).

Stantec

Photographic Log

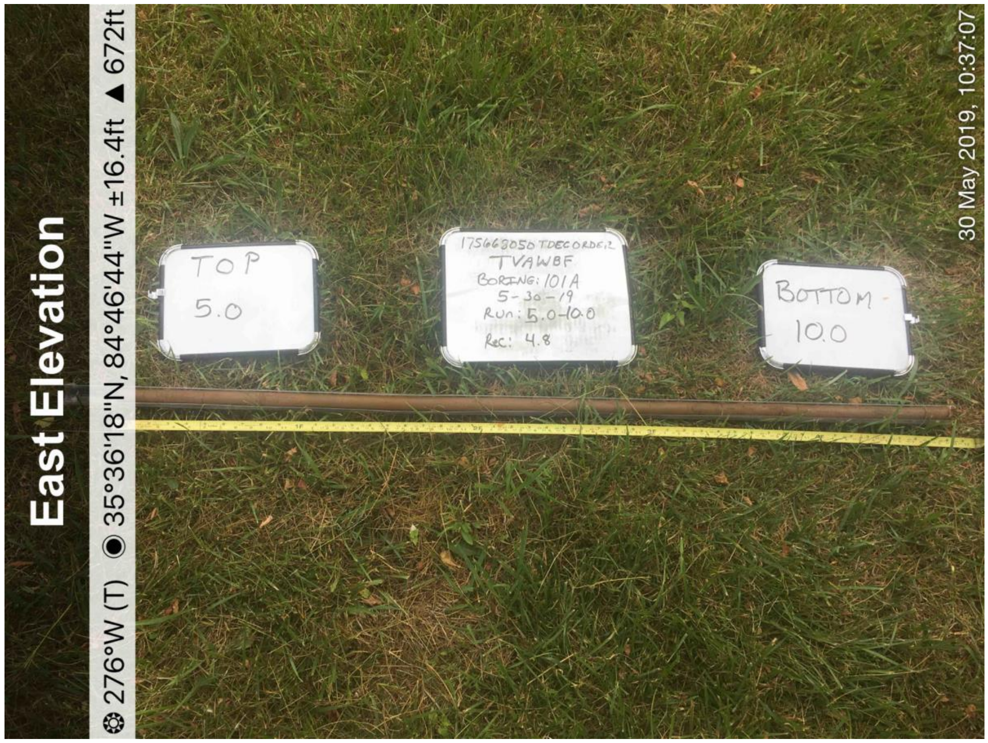
Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 25

Photo Location:
WBF-101A

Photo Date:
5/30/2019

Comments:
Interval (5.0-10.0 feet).



Photograph ID: 26

Photo Location:
WBF-101A

Photo Date:
5/30/2019

Comments:
Interval (10.0-15.0 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 27

Photo Location:
WBF-101A

Photo Date:
5/30/2019

Comments:
Interval (15.0-20.0 feet).

Photograph ID: 28

Photo Location:
WBF-101A

Photo Date:
5/30/2019

Comments:
Interval (20.0-25.0 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 29

Photo Location:
WBF-101A

Photo Date:
5/30/2019

Comments:
Interval (25.0-30.0 feet).

Photograph ID: 30

Photo Location:
WBF-101A

Photo Date:
5/30/2019

Comments:
Interval (30.0-33.0 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 31

Photo Location:
WBF-101A

Photo Date:
5/30/2019

Comments:
Interval (33.0-35.0 feet).

Photograph ID: 32

Photo Location:
WBF-101B

Photo Date:
5/30/2019

Comments:
Interval (0.0-5.0 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 33

Photo Location:
WBF-101B

Photo Date:
5/30/2019

Comments:
Interval (5.0-10.0 feet).

Photograph ID: 34

Photo Location:
WBF-101B

Photo Date:
5/30/2019

Comments:
Interval (10.0-15.0 feet).

Client:	Tennessee Valley Authority	Project:	WBF TDEC Order
Site Name:	Watts Bar Fossil (WBF) Plant	Site Location:	Spring City, Tennessee

Photograph ID: 35

Photo Location:
WBF-101B

Photo Date:
5/30/2019

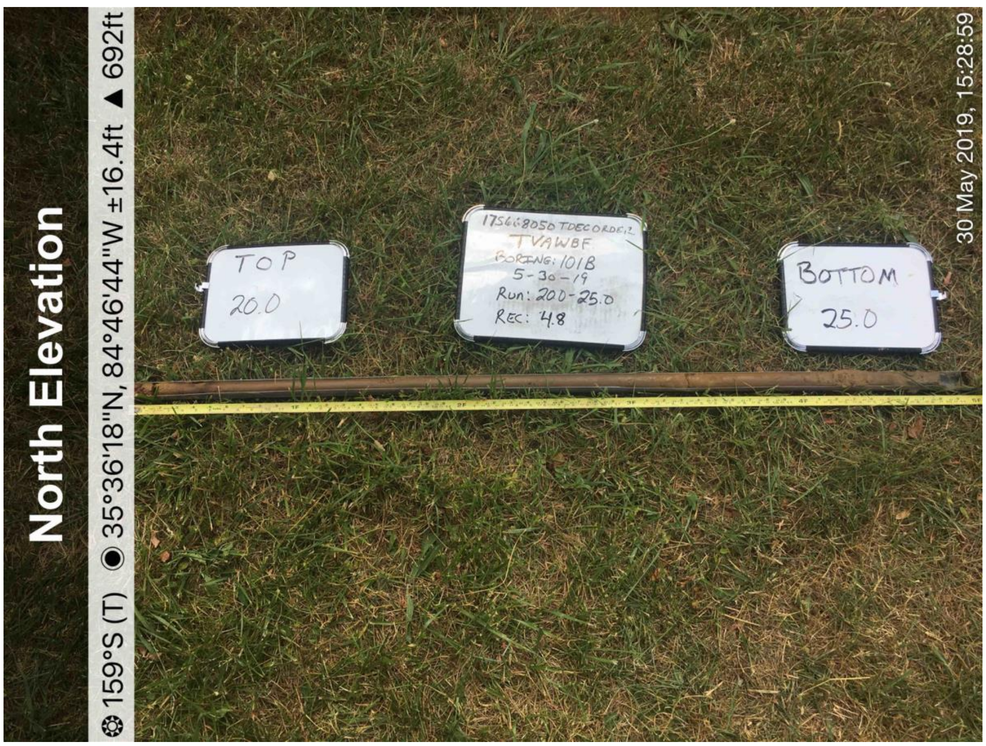
Comments:
Interval (15.0-20.0 feet).

Photograph ID: 36

Photo Location:
WBF-101B

Photo Date:
5/30/2019

Comments:
Interval (20.0-25.0 feet).



Stantec

Photographic Log

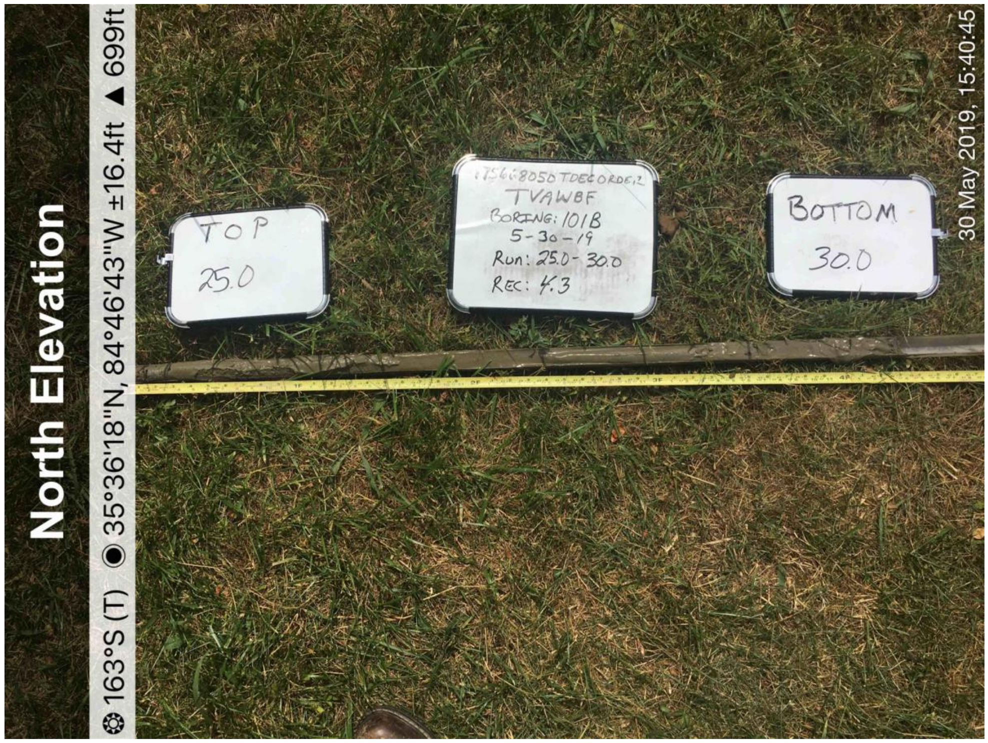
Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 37

Photo Location:
WBF-101B

Photo Date:
5/30/2019

Comments:
Interval (25.0-30.0 feet).



Photograph ID: 38

Photo Location:
WBF-101B

Photo Date:
5/30/2019

Comments:
Interval (30.0-33.0 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 39

Photo Location:
WBF-101B

Photo Date:
5/30/2019

Comments:
Interval (33.0-34.0 feet).

Photograph ID: 40

Photo Location:
WBF-102

Photo Date:
6/18/2019

Comments:
First boring location interval (0.0-1.5 feet).

Stantec

Photographic Log

Client:	Tennessee Valley Authority	Project:	WBF TDEC Order
Site Name:	Watts Bar Fossil (WBF) Plant	Site Location:	Spring City, Tennessee

Photograph ID: 41

Photo Location:
WBF-102

Photo Date:
6/18/2019

Comments:
First boring location interval (1.5-3.0 feet).

Photograph ID: 42

Photo Location:
WBF-102

Photo Date:
6/18/2019

Comments:
First boring location interval (3.0-4.5 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 43

Photo Location:
WBF-102

Photo Date:
6/18/2019

Comments:
First boring location interval (4.5-6.0 feet). Recovery on white board should be 1.5 feet.

Photograph ID: 44

Photo Location:
WBF-102

Photo Date:
6/18/2019

Comments:
First boring location interval (6.0-7.5 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 45

Photo Location:
WBF-102

Photo Date:
6/18/2019

Comments:
First boring location interval (7.5-9.0 feet).

Photograph ID: 46

Photo Location:
WBF-102

Photo Date:
6/18/2019

Comments:
First boring location interval (9.0-10.5 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 47

Photo Location:
WBF-102

Photo Date:
6/18/2019

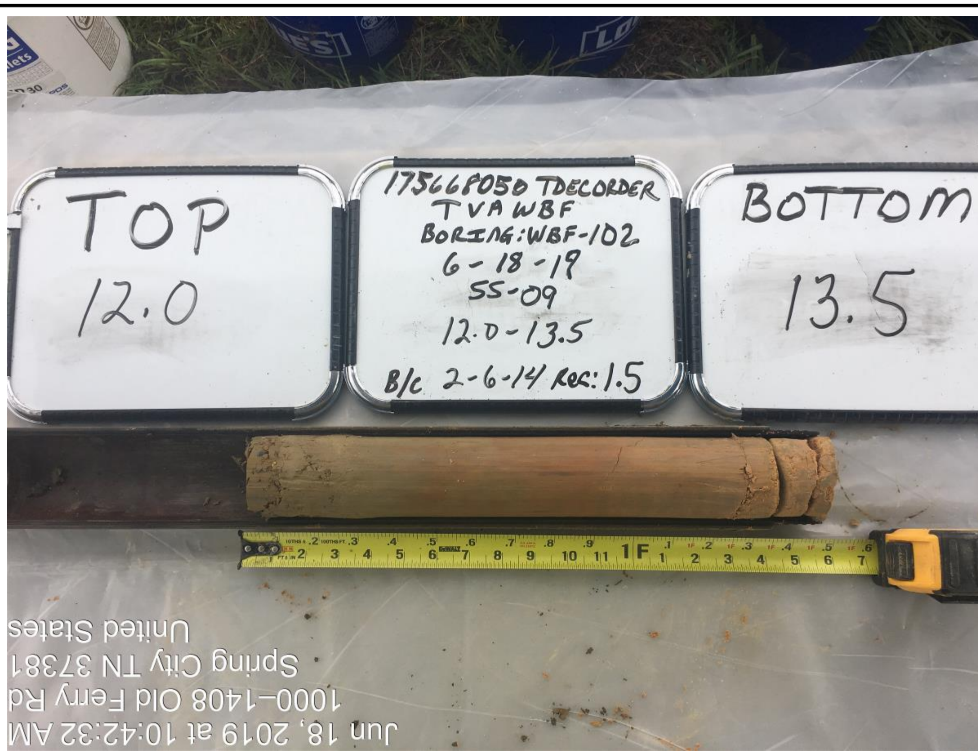
Comments:
First boring location interval (10.5-12.0 feet).

Photograph ID: 48

Photo Location:
WBF-102

Photo Date:
6/18/2019

Comments:
First boring location interval (12.0-13.5 feet).



Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 49

Photo Location:
WBF-102

Photo Date:
6/18/2019

Comments:
First boring location interval (13.5-15.0 feet).

Photograph ID: 50

Photo Location:
WBF-102

Photo Date:
6/18/2019

Comments:
First boring location interval (15.0-16.5 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 51

Photo Location:
WBF-102

Photo Date:
6/18/2019

Comments:
First boring location interval (16.5-18.0 feet).

Photograph ID: 52

Photo Location:
WBF-102

Photo Date:
6/18/2019

Comments:
First boring location interval (18.0-19.5 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 53

Photo Location:
WBF-102

Photo Date:
6/18/2019

Comments:
First boring location interval (19.5-21.0 feet). Boring refusal at 21.0 feet.

Photograph ID: 54

Photo Location:
WBF-102ALT

Photo Date:
6/19/2019

Comments:
Second boring location interval (0.0-1.5 feet). Offset 25 feet to the east of the first boring.

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 55

Photo Location:
WBF-102ALT

Photo Date:
6/19/2019

Comments:
Second boring location interval (1.5-3.0 feet).

Photograph ID: 56

Photo Location:
WBF-102ALT

Photo Date:
6/19/2019

Comments:
Second boring location interval (3.0-4.5 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 57

Photo Location:
WBF-102ALT

Photo Date:
6/20/2019

Comments:
Second boring location interval (4.5-6.0 feet).

Photograph ID: 58

Photo Location:
WBF-102ALT1

Photo Date:
6/20/2019

Comments:
Third boring location interval (0.0-1.5 feet). Offset 23 feet to the northeast of boring WBF-102A.

Stantec **Photographic Log**

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 59

Photo Location:
WBF-102ALT1

Photo Date:
6/20/2019

Comments:
Third boring location interval (1.5-3.0 feet).

Photograph ID: 60

Photo Location:
WBF-102ALT1

Photo Date:
6/20/2019

Comments:
Third boring location interval (3.0-4.5 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 61

Photo Location:
WBF-102ALT1

Photo Date:
6/20/2019

Comments:
Third boring location interval (4.5-6.0 feet).

Photograph ID: 62

Photo Location:
WBF-102ALT1

Photo Date:
6/20/2019

Comments:
Third boring location interval (6.0-7.5 feet).

Stantec **Photographic Log**

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 63

Photo Location:
WBF-102ALT1

Photo Date:
6/20/2019

Comments:
Third boring location interval (7.5-9.0 feet).

Photograph ID: 64

Photo Location:
WBF-102ALT1

Photo Date:
6/20/2019

Comments:
Third boring location interval (9.0-10.5 feet).

Stantec Photographic Log

Client:	Tennessee Valley Authority	Project:	WBF TDEC Order
Site Name:	Watts Bar Fossil (WBF) Plant	Site Location:	Spring City, Tennessee

Photograph ID: 65

Photo Location:
WBF-102ALT1

Photo Date:
6/20/2019

Comments:
Third boring location interval (10.5-12.0 feet).

Photograph ID: 66

Photo Location:
WBF-102ALT1

Photo Date:
6/20/2019

Comments:
Third boring location interval (12.0-13.5 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 67

Photo Location:
WBF-102ALT1

Photo Date:
6/20/2019

Comments:
Third boring location interval (13.5-15.0 feet).

Photograph ID: 68

Photo Location:
WBF-102ALT1

Photo Date:
6/20/2019

Comments:
Third boring location interval (15.0-16.5 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 69

Photo Location:
WBF-102ALT1

Photo Date:
6/20/2019

Comments:
Third boring location interval (16.5-18.0 feet).

Photograph ID: 70

Photo Location:
WBF-102ALT1

Photo Date:
6/20/2019

Comments:
Third boring location interval (18.0-19.5 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 71

Photo Location:
WBF-102ALT1

Photo Date:
6/20/2019

Comments:
Third boring location interval (19.5-21.0 feet).

Photograph ID: 72

Photo Location:
WBF-102ALT2 (Sonic)

Photo Date:
7/8/2019

Comments:
Photo of sonic boring location interval (0.0-21.0 feet) unavailable. Offset 3 feet east from WBF-102Alt1. Refer to photos for WBF-102Alt1.

No Photo Applicable

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 73

Photo Location:
WBF-102A

Photo Date:
5/29/2019

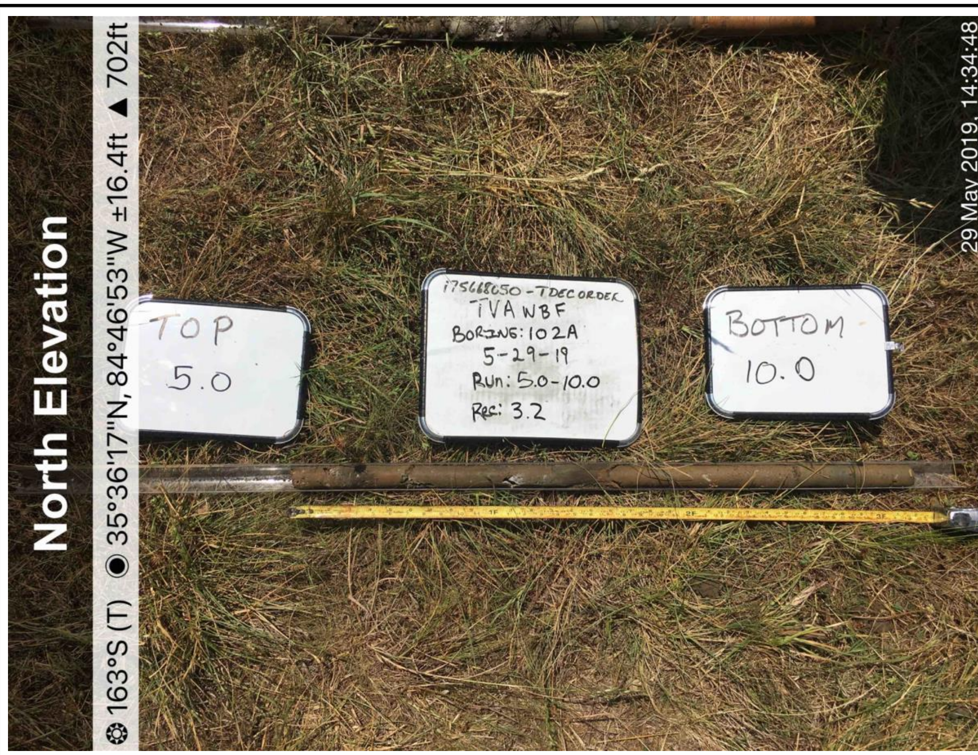
Comments:
Interval (0.0-5.0 feet).

Photograph ID: 74

Photo Location:
WBF-102A

Photo Date:
5/29/2019

Comments:
Interval (5.0-10.0 feet).



Client:	Tennessee Valley Authority	Project:	WBF TDEC Order
Site Name:	Watts Bar Fossil (WBF) Plant	Site Location:	Spring City, Tennessee

Photograph ID: 75

Photo Location:
WBF-102A

Photo Date:
5/29/2019

Comments:
Interval (10.0-15.0 feet).

Photograph ID: 76

Photo Location:
WBF-102A

Photo Date:
5/29/2019

Comments:
Interval (15.0-20.0 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 77

Photo Location:
WBF-102A

Photo Date:
5/29/2019

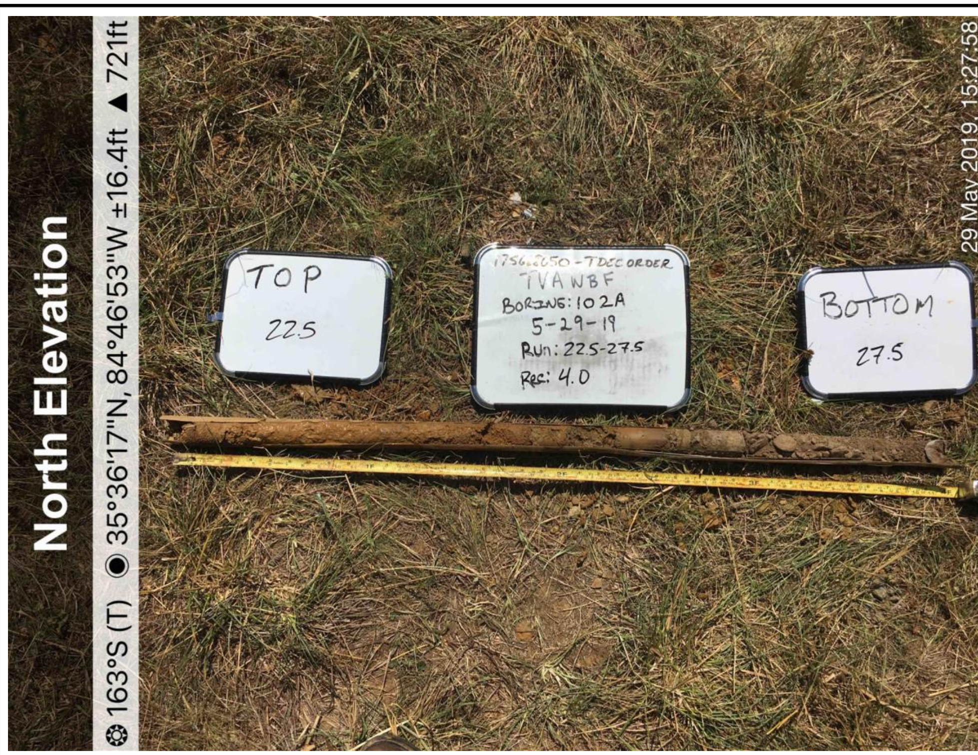
Comments:
Interval (20.0-22.5 feet).

Photograph ID: 78

Photo Location:
WBF-102A

Photo Date:
5/29/2019

Comments:
Interval (22.5-27.5 feet).



Stantec

Photographic Log

Client:	Tennessee Valley Authority	Project:	WBF TDEC Order
Site Name:	Watts Bar Fossil (WBF) Plant	Site Location:	Spring City, Tennessee

Photograph ID: 79

Photo Location:
WBF-102B

Photo Date:
5/29/2019

Comments:
Interval (0.0-5.0 feet).

Photograph ID: 80

Photo Location:
WBF-102B

Photo Date:
5/29/2019

Comments:
Interval (5.0-10.0 feet).

Client:	Tennessee Valley Authority	Project:	WBF TDEC Order
Site Name:	Watts Bar Fossil (WBF) Plant	Site Location:	Spring City, Tennessee

Photograph ID: 81

Photo Location:
WBF-102B

Photo Date:
5/29/2019

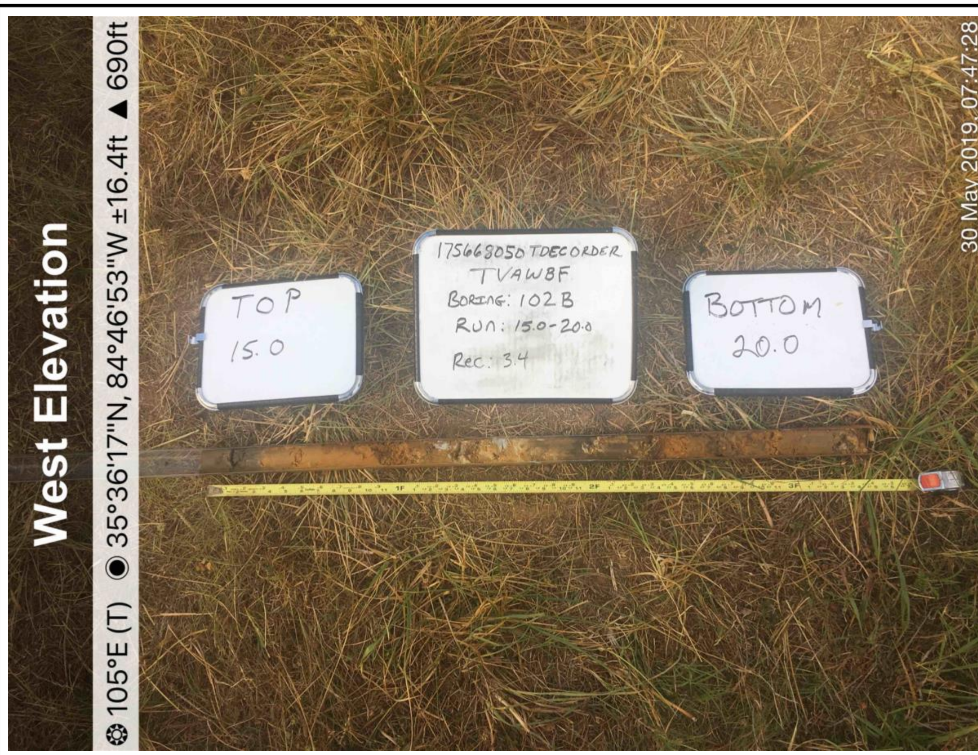
Comments:
Interval (10.0-15.0 feet).

Photograph ID: 82

Photo Location:
WBF-102B

Photo Date:
5/30/2019

Comments:
Interval (15.0-20.0 feet).



Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 83

Photo Location:
WBF-102B

Photo Date:
5/30/2019

Comments:
Interval (20.0-25.0 feet) no recovery, photo unavailable.

No Photo Applicable

Photograph ID: 84

Photo Location:
WBF-103

Photo Date:
6/6/2019

Comments:
Interval (0.0-1.5 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 85

Photo Location:
WBF-103

Photo Date:
6/6/2019

Comments:
Interval (1.5-3.0 feet).

Photograph ID: 86

Photo Location:
WBF-103

Photo Date:
6/6/2019

Comments:
Interval (3.0-4.5 feet).

Client:	Tennessee Valley Authority	Project:	WBF TDEC Order
Site Name:	Watts Bar Fossil (WBF) Plant	Site Location:	Spring City, Tennessee

Photograph ID: 87

Photo Location:
WBF-103

Photo Date:
6/6/2019

Comments:
Interval (4.5-6.0 feet).

Photograph ID: 88

Photo Location:
WBF-103

Photo Date:
6/6/2019

Comments:
Interval (6.0-7.5 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 89

Photo Location:
WBF-103

Photo Date:
6/6/2019

Comments:
Interval (7.5-9.0 feet).

Photograph ID: 90

Photo Location:
WBF-103

Photo Date:
6/6/2019

Comments:
Interval (9.0-10.5 feet).

Stantec **Photographic Log**

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 91

Photo Location:
WBF-103

Photo Date:
6/6/2019

Comments:
Interval (10.5-12.0 feet).

Photograph ID: 92

Photo Location:
WBF-103

Photo Date:
6/6/2019

Comments:
Interval (12.0-13.5 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 93

Photo Location: WBF-103

Photo Date: 6/6/2019

Comments: Interval (13.5-15.0 feet).

Photograph ID: 94

Photo Location: WBF-103

Photo Date: 6/6/2019

Comments: Interval (15.0-16.5 feet).

Client:	Tennessee Valley Authority	Project:	WBF TDEC Order
Site Name:	Watts Bar Fossil (WBF) Plant	Site Location:	Spring City, Tennessee

Photograph ID: 95

Photo Location:
WBF-103

Photo Date:
6/6/2019

Comments:
Interval (16.5-18.0 feet).

Photograph ID: 96

Photo Location:
WBF-103A

Photo Date:
5/29/2019

Comments:
Interval (0.0-3.5 feet).

Stantec

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 97

Photo Location:
WBF-103A

Photo Date:
5/29/2019

Comments:
Interval (3.5-8.5 feet).

Photograph ID: 98

Photo Location:
WBF-103A

Photo Date:
5/29/2019

Comments:
Interval (8.5-13.5 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 99

Photo Location:
WBF-103A

Photo Date:
5/29/2019

Comments:
Interval (13.5-18.5 feet).

Photograph ID: 100

Photo Location:
WBF-103A

Photo Date:
5/29/2019

Comments:
Interval (18.5-20.0 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 101

Photo Location:
WBF-103A

Photo Date:
5/29/2019

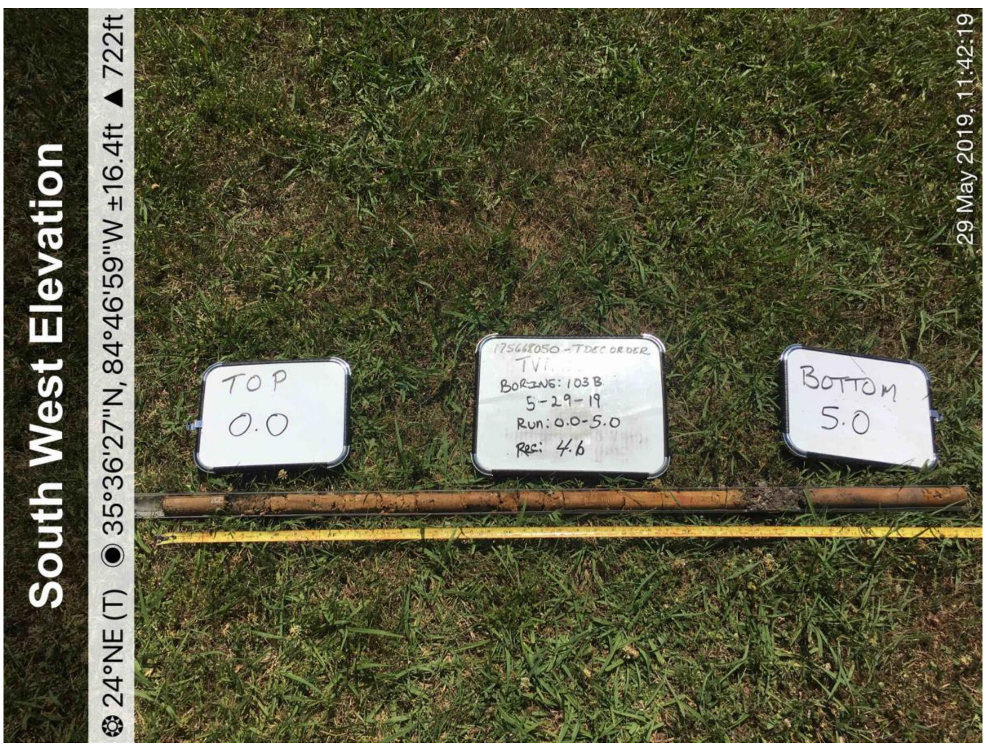
Comments:
Interval (20.0-21.5 feet).

Photograph ID: 102

Photo Location:
WBF-103B

Photo Date:
5/29/2019

Comments:
Interval (0.0-5.0 feet).



Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 103

Photo Location:
WBF-103B

Photo Date:
5/29/2019

Comments:
Interval (5.0-10.0 feet).

Photograph ID: 104

Photo Location:
WBF-103B

Photo Date:
5/29/2019

Comments:
Interval (10.0-15.0 feet). Run shown on white board should be 10.0-15.0. Bottom depth shown on white board should be 15.0.

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 105

Photo Location:
WBF-103B

Photo Date:
5/29/2019

Comments:
Interval (15.0-19.5 feet). Run shown on white board should be 15.0-19.5. Bottom depth shown on white board should be 19.5.

Photograph ID: 106

Photo Location:
WBF-104

Photo Date:
6/13/2019

Comments:
Interval (0.0-1.5 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 107

Photo Location:
WBF-104

Photo Date:
6/13/2019

Comments:
Interval (1.5-3.0 feet).

Photograph ID: 108

Photo Location:
WBF-104

Photo Date:
6/13/2019

Comments:
Interval (3.0-4.5 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 109

Photo Location:
WBF-104

Photo Date:
6/13/2019

Comments:
Interval (4.5-6.0 feet).

Photograph ID: 110

Photo Location:
WBF-104

Photo Date:
6/13/2019

Comments:
Interval (6.0-7.5 feet).

Stantec

Photographic Log

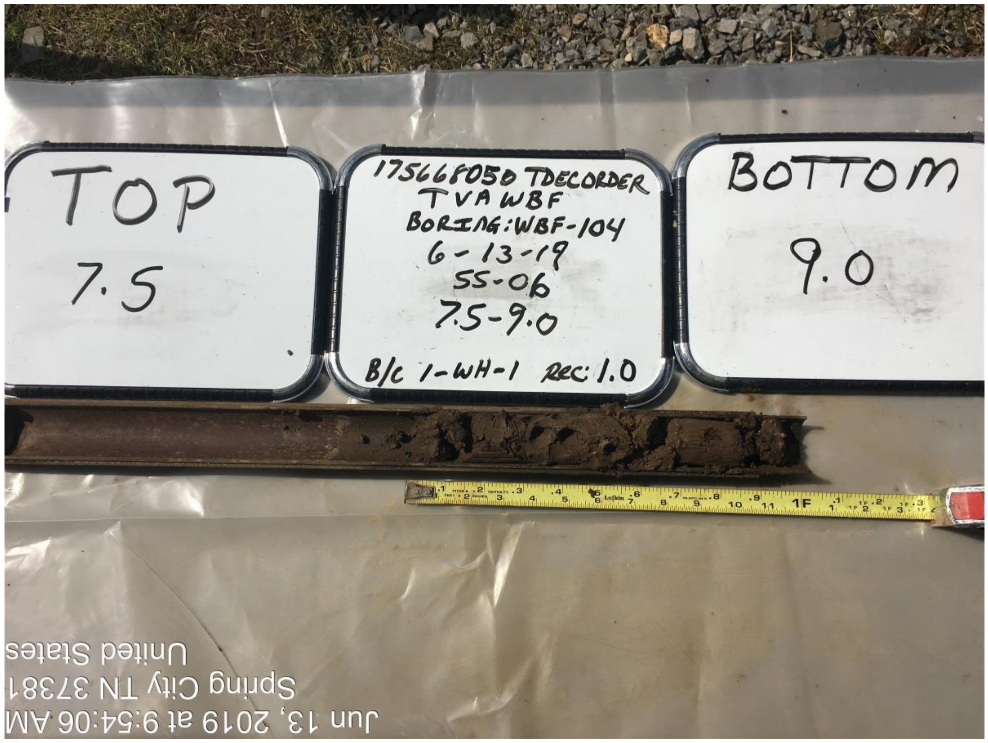
Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 111

Photo Location:
WBF-104

Photo Date:
6/13/2019

Comments:
Interval (7.5-9.0 feet).



Photograph ID: 112

Photo Location:
WBF-104

Photo Date:
6/13/2019

Comments:
Interval (9.0-10.5 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 113

Photo Location:
WBF-104

Photo Date:
6/13/2019

Comments:
Interval (10.5-12.0 feet).

Photograph ID: 114

Photo Location:
WBF-104

Photo Date:
6/13/2019

Comments:
Interval (12.0-13.5 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 115

Photo Location:
WBF-104

Photo Date:
6/13/2019

Comments:
Interval (13.5-15.0 feet).

Photograph ID: 116

Photo Location:
WBF-104

Photo Date:
6/13/2019

Comments:
Interval (15.0-16.5 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 117

Photo Location:
WBF-104

Photo Date:
6/13/2019

Comments:
Interval (16.5-18.0 feet).

Photograph ID: 118

Photo Location:
WBF-104

Photo Date:
6/13/2019

Comments:
Interval (18.0-19.5 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 119

Photo Location:
WBF-104

Photo Date:
6/13/2019

Comments:
Interval (19.5-21.0 feet).

Photograph ID: 120

Photo Location:
WBF-104

Photo Date:
6/13/2019

Comments:
Interval (21.0-22.5 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 121

Photo Location:
WBF-104

Photo Date:
6/13/2019

Comments:
Interval (22.5-24.0 feet).

Photograph ID: 122

Photo Location:
WBF-104

Photo Date:
6/13/2019

Comments:
Interval (24.0-25.5 feet).

Photographic Log

Client:	Tennessee Valley Authority	Project:	WBF TDEC Order
Site Name:	Watts Bar Fossil (WBF) Plant	Site Location:	Spring City, Tennessee

Photograph ID: 123

Photo Location:
WBF-104

Photo Date:
6/13/2019

Comments:
Interval (25.5-27.0 feet). Depth shown on white board should be 25.5-27.0.

Photograph ID: 124

Photo Location:
WBF-104

Photo Date:
6/13/2019

Comments:
Interval (27.0-28.5 feet). Blow count shown on white board should be 8-12-29.

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 125

Photo Location:
WBF-104A

Photo Date:
5/31/2019

Comments:
Interval (0.0-5.0 feet).

Photograph ID: 126

Photo Location:
WBF-104A

Photo Date:
5/31/2019

Comments:
Interval (5.0-10.0 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 127

Photo Location:
WBF-104A

Photo Date:
5/31/2019

Comments:
Interval (10.0-15.0 feet).

Photograph ID: 128

Photo Location:
WBF-104A

Photo Date:
5/31/2019

Comments:
Interval (15.0-20.0 feet).

Stantec **Photographic Log**

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 129

Photo Location:
WBF-104A

Photo Date:
5/31/2019

Comments:
Interval (20.0-24.0 feet).

Photograph ID: 130

Photo Location:
WBF-104A

Photo Date:
5/31/2019

Comments:
Interval (24.0-26.5 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 131

Photo Location:
WBF-104B

Photo Date:
5/31/2019

Comments:
Interval (0.0-5.0 feet).

Photograph ID: 132

Photo Location:
WBF-104B

Photo Date:
5/31/2019

Comments:
Interval (5.0-10.0 feet).

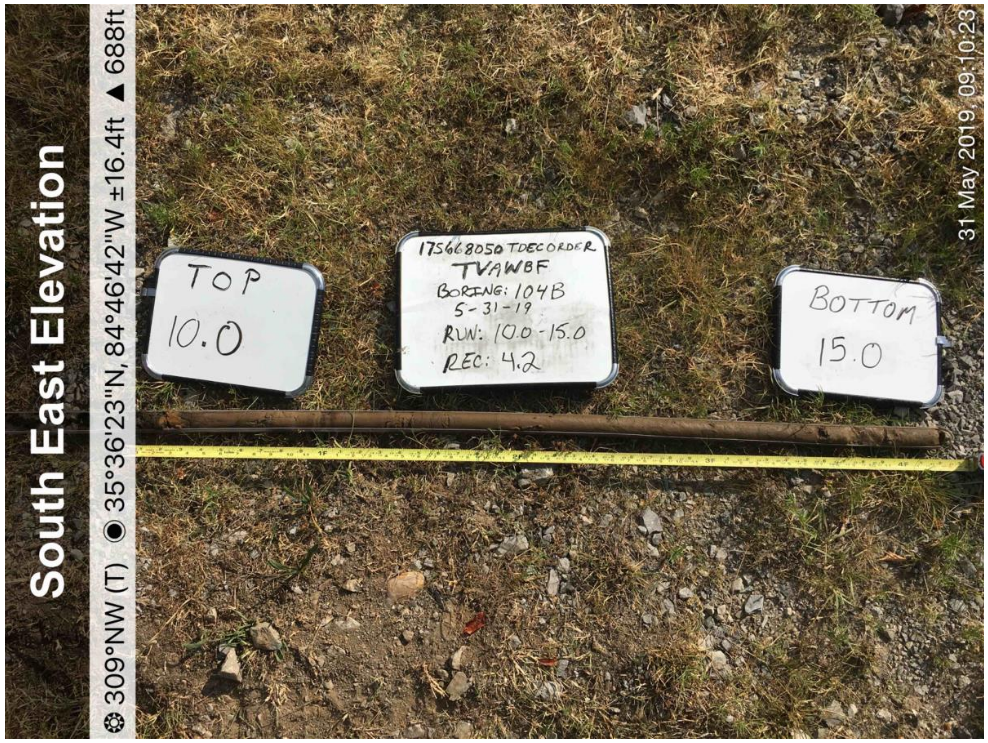
Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 133

Photo Location:
WBF-104B

Photo Date:
5/31/2019

Comments:
Interval (10.0-15.0 feet).



Photograph ID: 134

Photo Location:
WBF-104B

Photo Date:
5/31/2019

Comments:
Interval (15.0-20.0 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 135

Photo Location:
WBF-104B

Photo Date:
5/31/2019

Comments:
Interval (20.0-25.0 feet).

Photograph ID: 136

Photo Location:
WBF-104B

Photo Date:
5/31/2019

Comments:
Interval (25.0-28.5 feet).

Stantec **Photographic Log**

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 137

Photo Location:
WBF-105

Photo Date:
6/24/2019

Comments:
Interval (0.0-1.5 feet).

Photograph ID: 138

Photo Location:
WBF-105

Photo Date:
6/24/2019

Comments:
Interval (1.5-3.0 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 139

Photo Location: WBF-105

Photo Date: 6/24/2019

Comments: Interval (3.0-4.5 feet).

Photograph ID: 140

Photo Location: WBF-105

Photo Date: 6/24/2019

Comments: Interval (4.5-6.0 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 141

Photo Location:
WBF-105

Photo Date:
6/24/2019

Comments:
Interval (6.0-7.5 feet).

Photograph ID: 142

Photo Location:
WBF-105

Photo Date:
6/24/2019

Comments:
Interval (7.5-9.0 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 143

Photo Location:
WBF-105

Photo Date:
6/24/2019

Comments:
Interval (9.0-10.5 feet).

Photograph ID: 144

Photo Location:
WBF-105

Photo Date:
6/24/2019

Comments:
Interval (10.5-12.0 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 145

Photo Location:
WBF-105

Photo Date:
6/24/2019

Comments:
Interval (12.0-13.5 feet).

Photograph ID: 146

Photo Location:
WBF-105

Photo Date:
6/24/2019

Comments:
Interval (13.5-15.0 feet). Recovery shown on white board should be 1.3.

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 147

Photo Location:
WBF-105

Photo Date:
6/24/2019

Comments:
Interval (15.0-16.5 feet).

Photograph ID: 148

Photo Location:
WBF-105

Photo Date:
6/24/2019

Comments:
Interval (16.5-18.0 feet).

Client:	Tennessee Valley Authority	Project:	WBF TDEC Order
Site Name:	Watts Bar Fossil (WBF) Plant	Site Location:	Spring City, Tennessee

Photograph ID: 149	No Photo Applicable
Photo Location: WBF-105	
Photo Date: 6/24/2019	
Comments: Photo of interval (18.0-19.5 feet) unavailable.	

Photograph ID: 150	No Photo Applicable
Photo Location: WBF-105 (Sonic)	
Photo Date: 7/9/2019	
Comments: Photo of sonic boring location interval (20.0-35.0 feet) unavailable. Collocated with WBF-105. Refer to WBF-105 for photo interval (0.0-19.5 feet).	

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 151

Photo Location:
WBF-105A

Photo Date:
6/4/2019

Comments:
Interval (0.0-5.0 feet).

Photograph ID: 152

Photo Location:
WBF-105A

Photo Date:
6/4/2019

Comments:
Interval (5.0-10.0 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 153

Photo Location:
WBF-105A

Photo Date:
6/4/2019

Comments:
Interval (10.0-15.0 feet).

Photograph ID: 154

Photo Location:
WBF-105A

Photo Date:
6/4/2019

Comments:
Interval (15.0-20.0 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 155

Photo Location:
WBF-105A

Photo Date:
6/4/2019

Comments:
Interval (20.0-25.0 feet).

Photograph ID: 156

Photo Location:
WBF-105A

Photo Date:
6/4/2019

Comments:
Interval (25.0-30.0 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 157

Photo Location:
WBF-105A

Photo Date:
6/4/2019

Comments:
Interval (30.0-35.0 feet).

Photograph ID: 158

Photo Location:
WBF-105B

Photo Date:
6/4/2019

Comments:
Interval (0.0-5.0 feet).

Client:	Tennessee Valley Authority	Project:	WBF TDEC Order
Site Name:	Watts Bar Fossil (WBF) Plant	Site Location:	Spring City, Tennessee

Photograph ID: 159

Photo Location:
WBF-105B

Photo Date:
6/4/2019

Comments:
Interval (5.0-10.0 feet).

Photograph ID: 160

Photo Location:
WBF-105B

Photo Date:
6/4/2019

Comments:
Interval (10.0-15.0 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 161

Photo Location:
WBF-105B

Photo Date:
6/4/2019

Comments:
Interval (15.0-20.0 feet).

Photograph ID: 162

Photo Location:
WBF-105B

Photo Date:
6/4/2019

Comments:
Interval (20.0-25.0 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 163

Photo Location:
WBF-105B

Photo Date:
6/4/2019

Comments:
Interval (25.0-30.0 feet).

Photograph ID: 164

Photo Location:
WBF-105B

Photo Date:
6/4/2019

Comments:
Interval (30.0-34.5 feet).

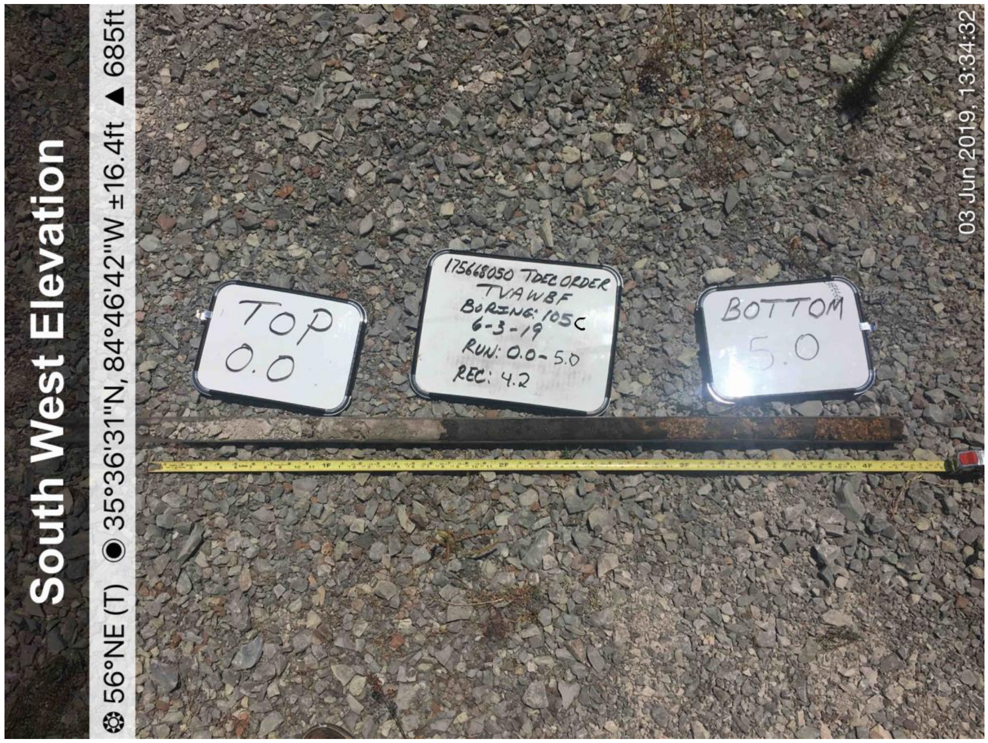
Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 165

Photo Location: WBF-105C

Photo Date: 6/3/2019

Comments: Interval (0.0-5.0 feet).



Photograph ID: 166

Photo Location: WBF-105C

Photo Date: 6/3/2019

Comments: Interval (5.0-8.5 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 167

Photo Location:
WBF-105C

Photo Date:
6/3/2019

Comments:
Interval (8.5-13.5 feet).

Photograph ID: 168

Photo Location:
WBF-105C

Photo Date:
6/3/2019

Comments:
Interval (13.5-18.5 feet). Bottom depth shown on white board should be 18.5.

Stantec **Photographic Log**

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 169

Photo Location:
WBF-105C

Photo Date:
6/4/2019

Comments:
Interval (18.5-20.0 feet).

Photograph ID: 170

Photo Location:
WBF-105C

Photo Date:
6/4/2019

Comments:
Interval (20.0-22.5 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 171

Photo Location:
WBF-105C

Photo Date:
6/4/2019

Comments:
Interval (22.5-25.0 feet).

Photograph ID: 172

Photo Location:
WBF-105C

Photo Date:
6/4/2019

Comments:
Interval (25.0-27.5 feet) no recovery, photo unavailable.

No Photo Applicable

Stantec **Photographic Log**

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 173

Photo Location:
WBF-105C

Photo Date:
6/4/2019

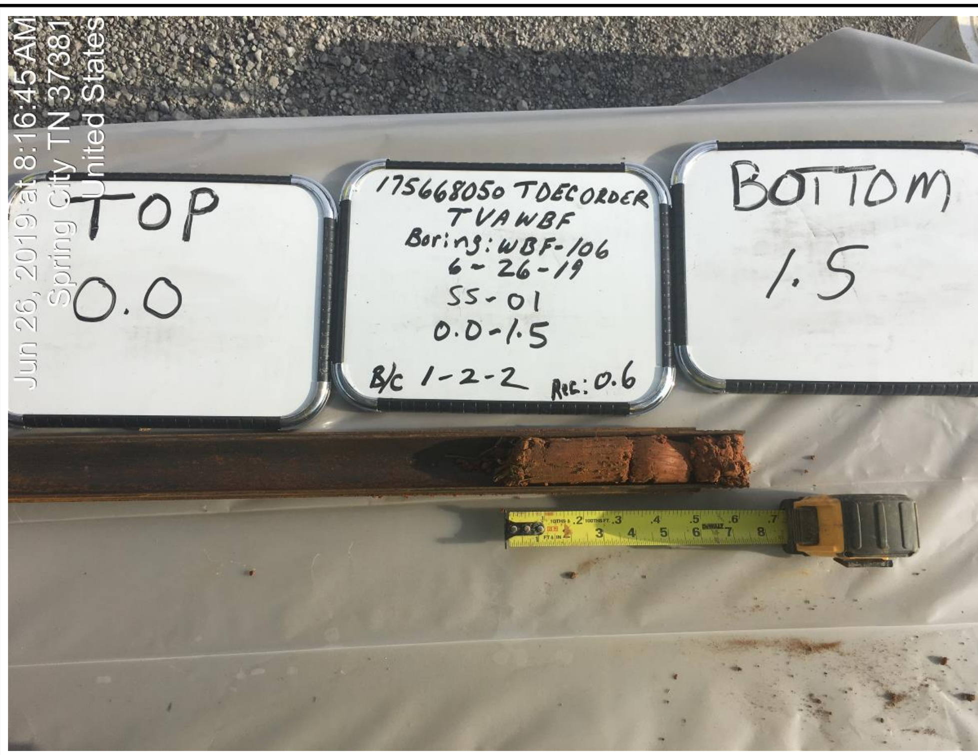
Comments:
Interval (27.5-31.5 feet).

Photograph ID: 174

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Interval (0.0-1.5 feet).



Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 175

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Interval (1.5-3.0 feet).

Photograph ID: 176

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Interval (3.0-4.5 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 177

Photo Location:
WBF-106

Photo Date:
6/26/2019

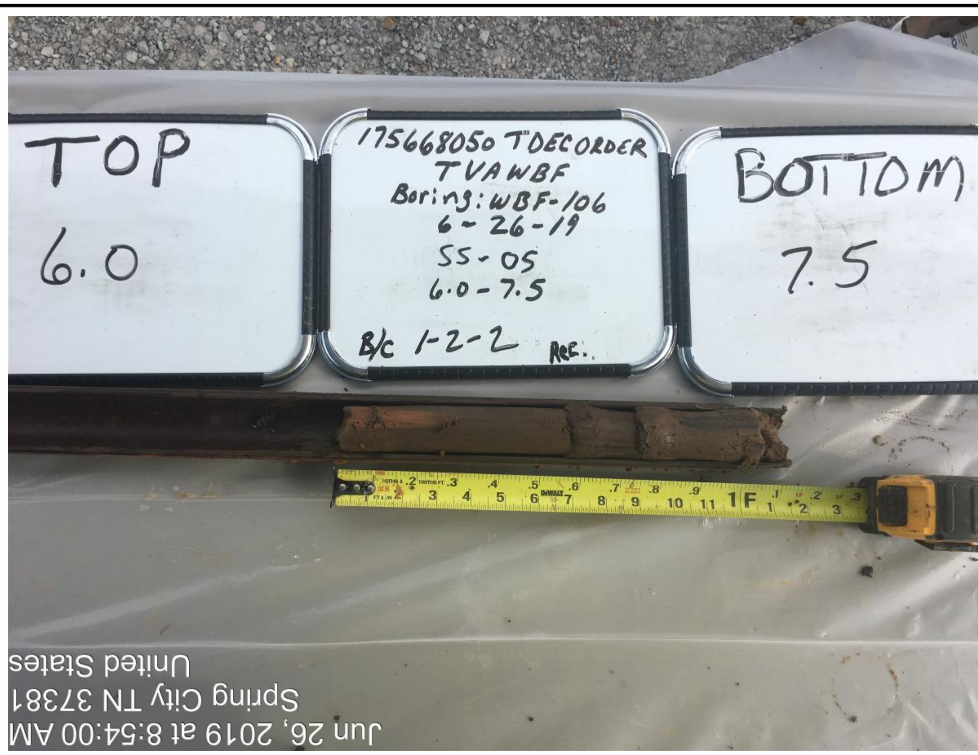
Comments:
Interval (4.5-6.0 feet).

Photograph ID: 178

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Interval (6.0-7.5 feet). Recovery on the white board should be 1.1.



Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 179

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Interval (7.5-9.0 feet).

Photograph ID: 180

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Interval (9.0-10.5 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 181

Photo Location:
WBF-106

Photo Date:
6/26/2019

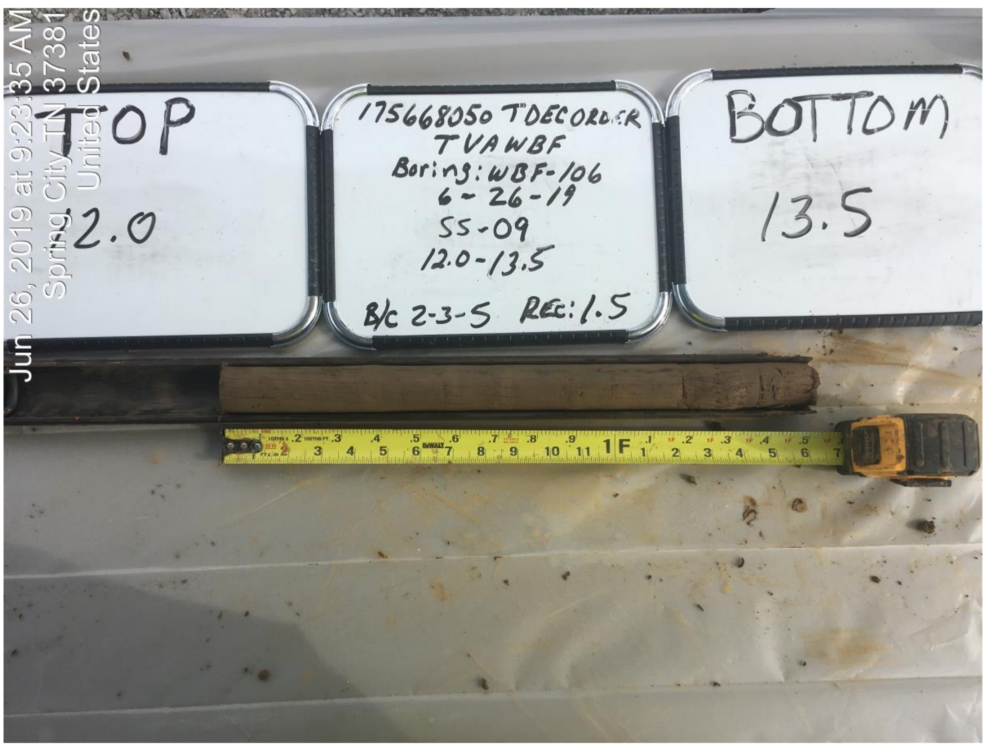
Comments:
Interval (10.5-12.0 feet). The depth shown on white board should be 10.5-12.0.

Photograph ID: 182

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Interval (12.0-13.5 feet).



Stantec **Photographic Log**

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 183

Photo Location:
WBF-106

Photo Date:
6/26/2019

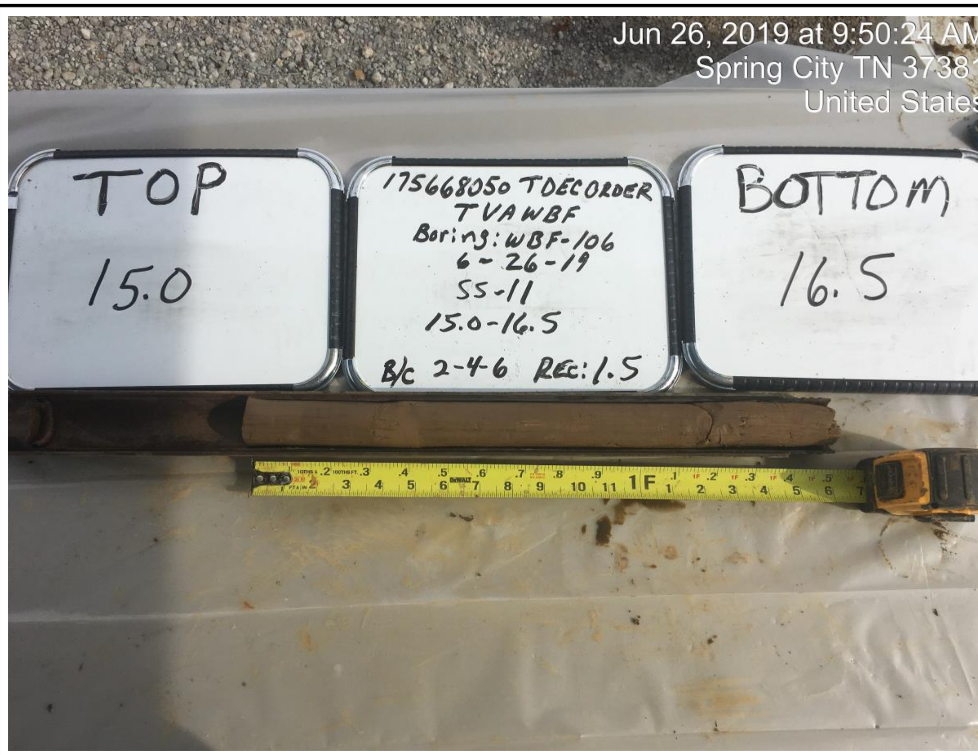
Comments:
Interval (13.5-15.0 feet).

Photograph ID: 184

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Interval (15.0-16.5 feet).



Stantec **Photographic Log**

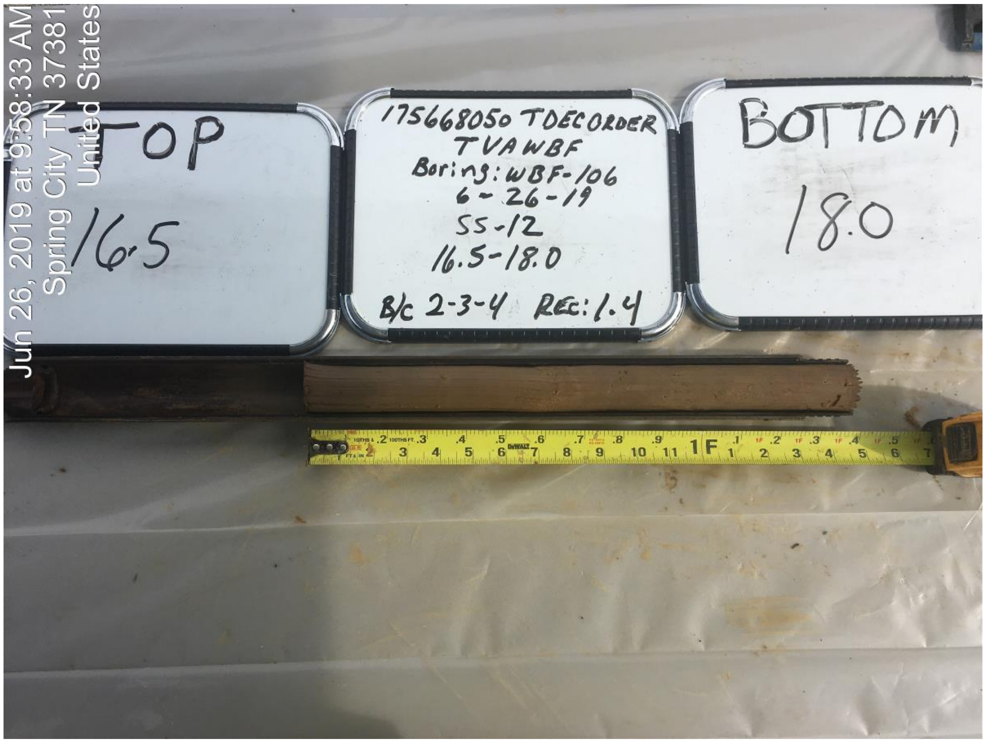
Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 185

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Interval (16.5-18.0 feet).



Photograph ID: 186

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Interval (18.0-19.5 feet).

Client:	Tennessee Valley Authority	Project:	WBF TDEC Order
Site Name:	Watts Bar Fossil (WBF) Plant	Site Location:	Spring City, Tennessee

Photograph ID: 187

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Interval (19.5-21.0 feet).

Photograph ID: 188

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Interval (21.0-22.5 feet).

Stantec **Photographic Log**

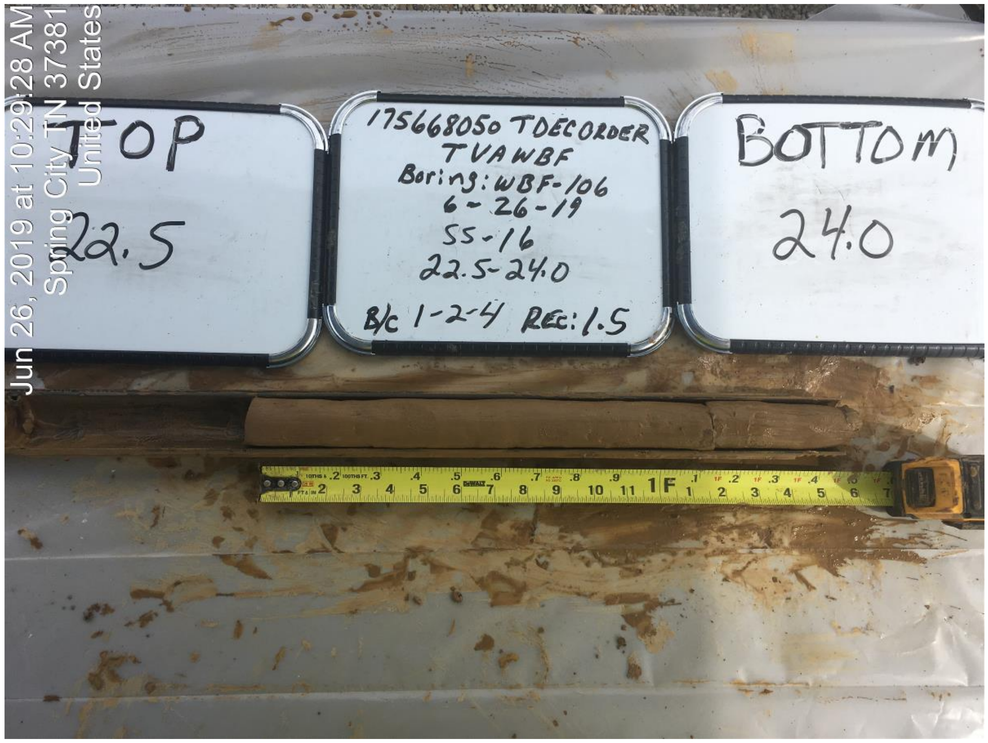
Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 189

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Interval (22.5-24.0 feet).



Photograph ID: 190

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Interval (24.0-25.5 feet).

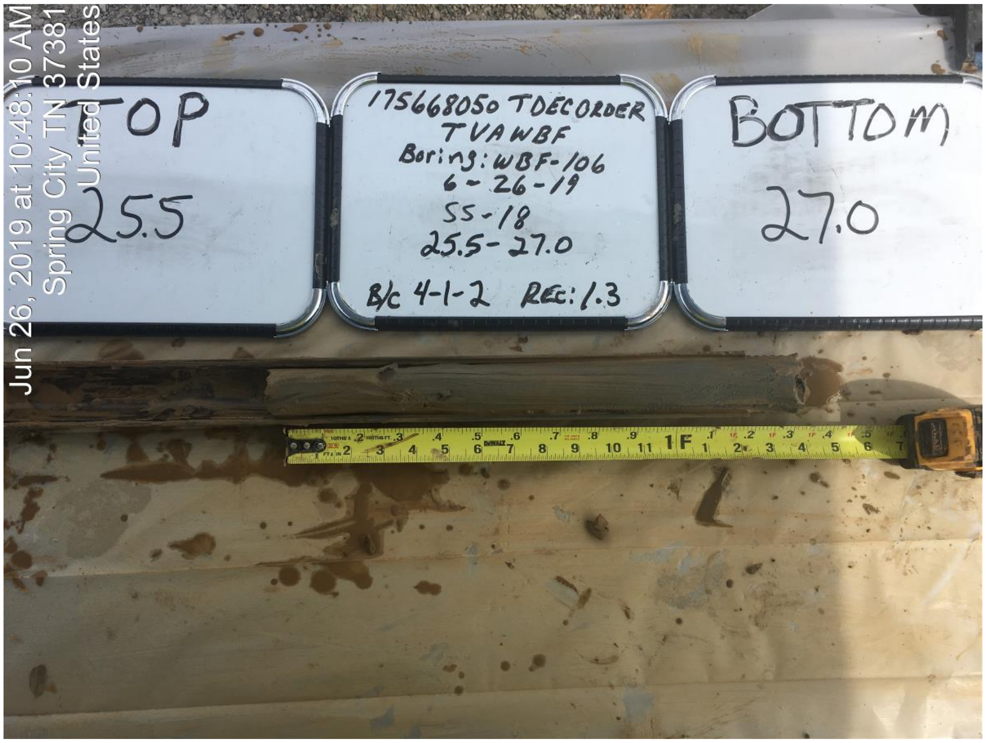
Client:	Tennessee Valley Authority	Project:	WBF TDEC Order
Site Name:	Watts Bar Fossil (WBF) Plant	Site Location:	Spring City, Tennessee

Photograph ID: 191

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Interval (25.5-27.0 feet).



Photograph ID: 192

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Interval (27.0-28.5 feet).

Stantec **Photographic Log**

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 193

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Interval (28.5-30.0 feet).

Photograph ID: 194

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Interval (30.0-31.5 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 195

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Interval (31.5-33.0 feet).

Photograph ID: 196

Photo Location:
WBF-106

Photo Date:
6/26/2019

Comments:
Photo of interval (33.0-34.5 feet) unavailable.

No Photo Applicable

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 197

Photo Location:
WBF-106A

Photo Date:
6/5/2019

Comments:
Interval (0.0-5.0 feet).

Photograph ID: 198

Photo Location:
WBF-106A

Photo Date:
6/5/2019

Comments:
Interval (5.0-10.0 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 199

Photo Location:
WBF-106A

Photo Date:
6/5/2019

Comments:
Interval (10.0-15.0 feet).

Photograph ID: 200

Photo Location:
WBF-106A

Photo Date:
6/5/2019

Comments:
Photo of interval (15.0-20.0 feet) unavailable.

No Photo Applicable

Client:	Tennessee Valley Authority	Project:	WBF TDEC Order
Site Name:	Watts Bar Fossil (WBF) Plant	Site Location:	Spring City, Tennessee

Photograph ID: 201

Photo Location:
WBF-106A

Photo Date:
6/5/2019

Comments:
Interval (20.0-25.0 feet).

Photograph ID: 202

Photo Location:
WBF-106A

Photo Date:
6/5/2019

Comments:
Interval (25.0-30.0 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 203

Photo Location:
WBF-106A

Photo Date:
6/5/2019

Comments:
Interval (30.0-35.0 feet).

Photograph ID: 204

Photo Location:
WBF-106A

Photo Date:
6/5/2019

Comments:
Interval (35.0-38.6 feet).

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 205

Photo Location:
WBF-106B

Photo Date:
6/5/2019

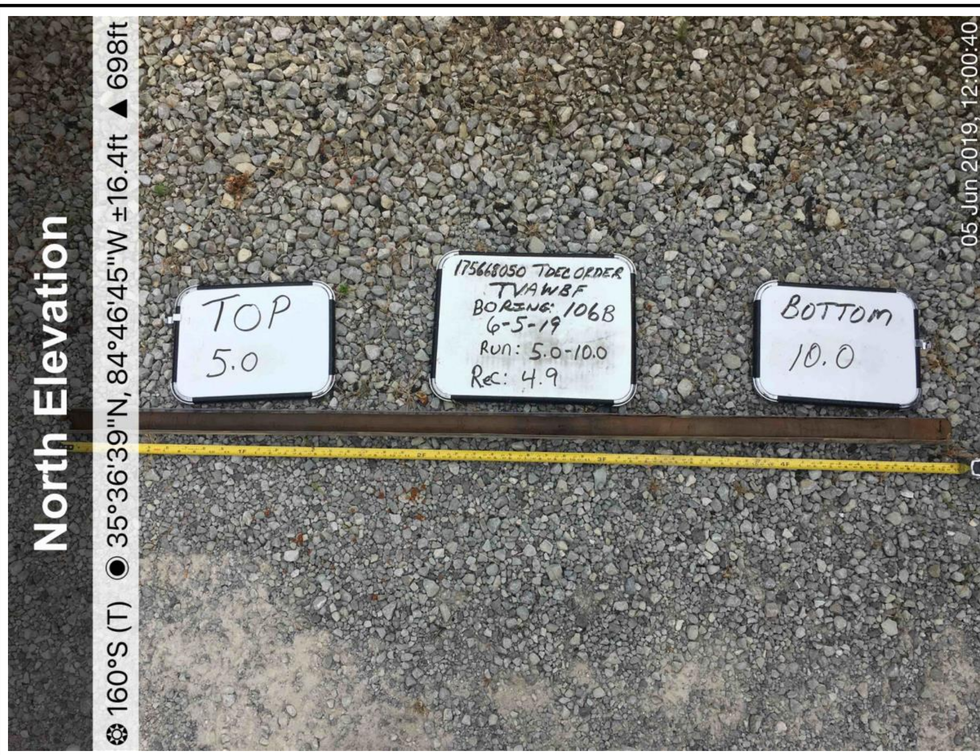
Comments:
Interval (0.0-5.0 feet).

Photograph ID: 206

Photo Location:
WBF-106B

Photo Date:
6/5/2019

Comments:
Interval (5.0-10.0 feet).



Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 207

Photo Location:
WBF-106B

Photo Date:
6/5/2019

Comments:
Interval (10.0-15.0 feet).

Photograph ID: 208

Photo Location:
WBF-106B

Photo Date:
6/5/2019

Comments:
Interval (15.0-20.0 feet).

Client:	Tennessee Valley Authority	Project:	WBF TDEC Order
Site Name:	Watts Bar Fossil (WBF) Plant	Site Location:	Spring City, Tennessee

Photograph ID: 209

Photo Location:
WBF-106B

Photo Date:
6/5/2019

Comments:
Interval (20.0-25.0 feet).

Photograph ID: 210

Photo Location:
WBF-106B

Photo Date:
6/5/2019

Comments:
Interval (25.0-30.0 feet).

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 211

Photo Location:
WBF-106B

Photo Date:
6/5/2019

Comments:
Interval (30.0-35.0 feet).

ATTACHMENT D.2

Photographic Log of Monitoring Wells

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 1

Photo Location:
WBF-101

Photo Date:
1/9/2020

Comments:
Completion of monitoring well WBF-101. Well was installed in boring WBF-101.

Photograph ID: 2

Photo Location:
WBF-102

Photo Date:
1/9/2020

Comments:
Completion of monitoring well WBF-102. Well was installed in boring WBF-102Alt2(Sonic).

Stantec **Photographic Log**

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 3

Photo Location:
WBF-103

Photo Date:
1/9/2020

Comments:
Completion of monitoring well WBF-103. Well was installed in boring WBF-103.

Photograph ID: 4

Photo Location:
WBF-104

Photo Date:
1/9/2020

Comments:
Completion of monitoring well WBF-104. Well was installed in boring WBF-104.

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**WBF TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 5

Photo Location:
WBF-105

Photo Date:
1/9/2020

Comments:
Completion of monitoring well WBF-105. Well was installed in boring WBF-105/WBF-105(Sonic).

Photograph ID: 6

Photo Location:
WBF-106

Photo Date:
1/9/2020

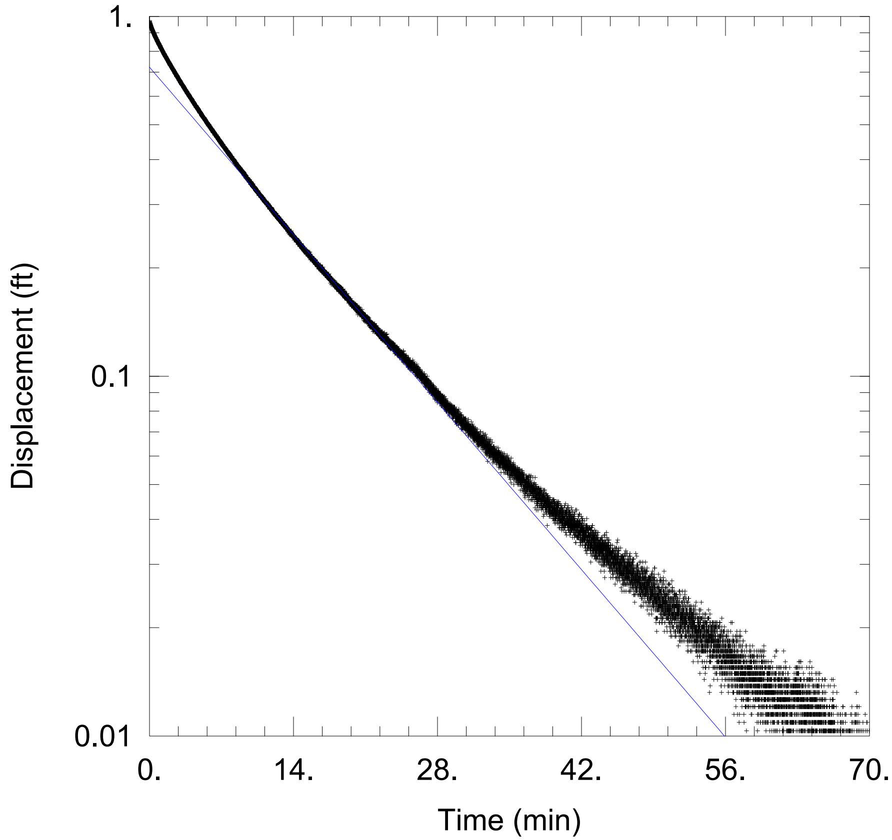
Comments:
Completion of monitoring well WBF-106. Well was installed in boring WBF-106.

APPENDIX E – SLUG TEST RESULTS

Slug Test Results
Hydrogeological Investigation
TVA WBF Plant

Well ID	Test	Test Date	Bouwer-Rice Hydraulic Conductivity (ft/day)	Bouwer-Rice Hydraulic Conductivity (cm/sec)
WBF-101	Falling Head 1	10/10/2019	0.5574	1.97E-04
	Falling Head 2		0.6050	2.13E-04
	Falling Head 3		0.4877	1.72E-04
	Rising Head 1		0.5466	1.93E-04
	Rising Head 2		0.5249	1.85E-04
	Rising Head 3		0.5249	1.85E-04
WBF-103	Falling Head 1	10/10/2019	20.10	7.09E-03
	Falling Head 2	10/11/2019	20.73	7.31E-03
	Falling Head 3	10/11/2019	20.43	7.21E-03
	Rising Head 1	10/10/2019	20.50	7.23E-03
	Rising Head 2	10/11/2019	20.78	7.33E-03
	Rising Head 3	10/11/2019	20.99	7.40E-03
WBF-104	Falling Head 1	10/9/2019	0.7549	2.66E-04
	Falling Head 2	10/9/2019	0.7126	2.51E-04
	Falling Head 3	10/10/2019	0.5379	1.90E-04
	Rising Head 1	10/9/2019	0.5977	2.11E-04
	Rising Head 2	10/9/2019	0.6548	2.31E-04
	Rising Head 3	10/10/2019	0.5818	2.05E-04
WBF-105	Falling Head 1	10/9/2019	1.288	4.54E-04
	Falling Head 2		1.265	4.46E-04
	Falling Head 3		1.575	5.56E-04
	Rising Head 1		1.215	4.29E-04
	Rising Head 2		1.205	4.25E-04
	Rising Head 3		1.692	5.97E-04
WBF-106	Falling Head 1	10/8/2019	0.7830	2.76E-04
	Falling Head 2		0.6935	2.45E-04
	Falling Head 3		0.7872	2.78E-04
	Rising Head 1		0.7632	2.69E-04
	Rising Head 2		0.7868	2.78E-04
	Rising Head 3		0.7751	2.73E-04

Notes
ft/day - feet per day
cm/sec - centimeters per second
Slug test data analysis was completed using AQTESOLV™, Version 4.50 Professional



WBF-101 FH1

Data Set: C:\...\WBF-101_FH1.aqt
Date: 10/18/19 Time: 13:10:52

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-101
Test Date: 10/10/19

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

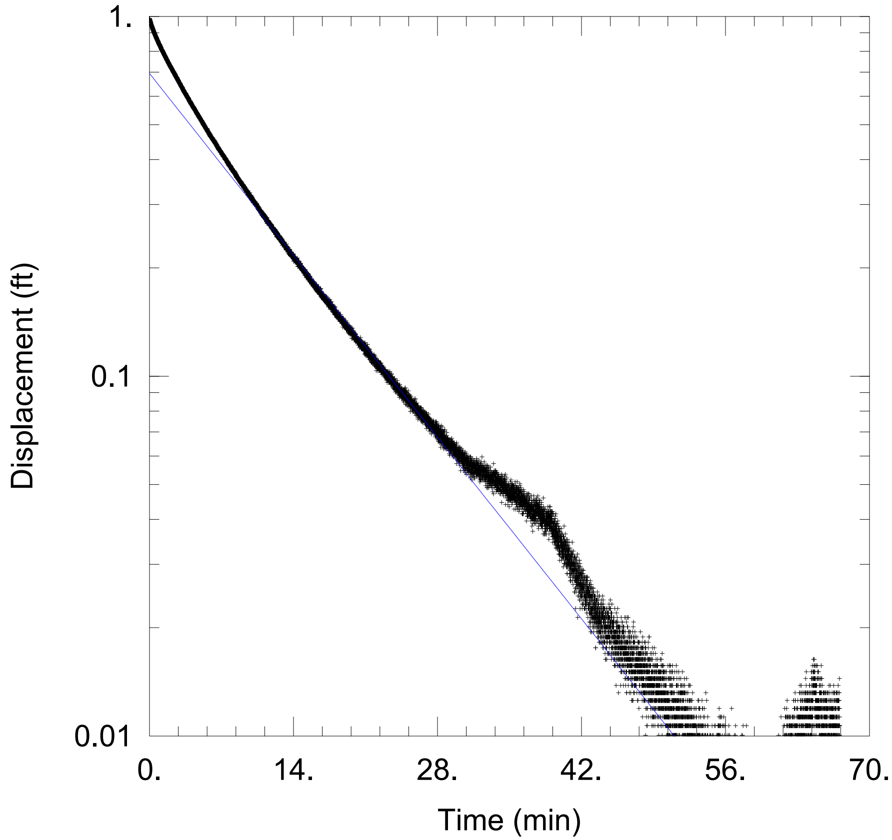
K = 0.5574 ft/day
y0 = 0.7224 ft

AQUIFER DATA

Saturated Thickness: 14.67 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-101)

Initial Displacement: 1. ft
Total Well Penetration Depth: 20.09 ft
Casing Radius: 0.167 ft
Static Water Column Height: 20.09 ft
Screen Length: 9.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-101 FH2

Data Set: C:\...\WBF-101_FH2.aqt
Date: 10/18/19 Time: 13:10:38

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-101
Test Date: 10/10/19

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.605 ft/day
y0 = 0.6941 ft

AQUIFER DATA

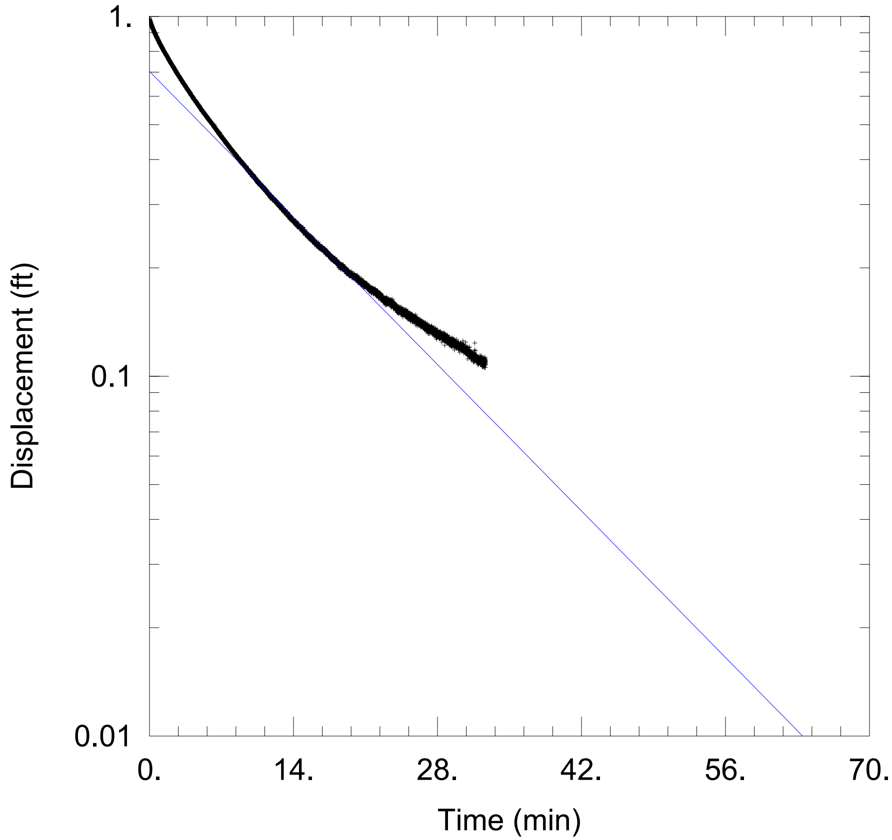
Saturated Thickness: 14.67 ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-101)

Initial Displacement: 1. ft
Total Well Penetration Depth: 20.09 ft
Casing Radius: 0.167 ft

Static Water Column Height: 20.09 ft
Screen Length: 9.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-101 FH3

Data Set: C:\...\WBF-101_FH3.aqt
Date: 10/18/19 Time: 13:10:27

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-101
Test Date: 10/10/19

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.4877 ft/day
y0 = 0.7034 ft

AQUIFER DATA

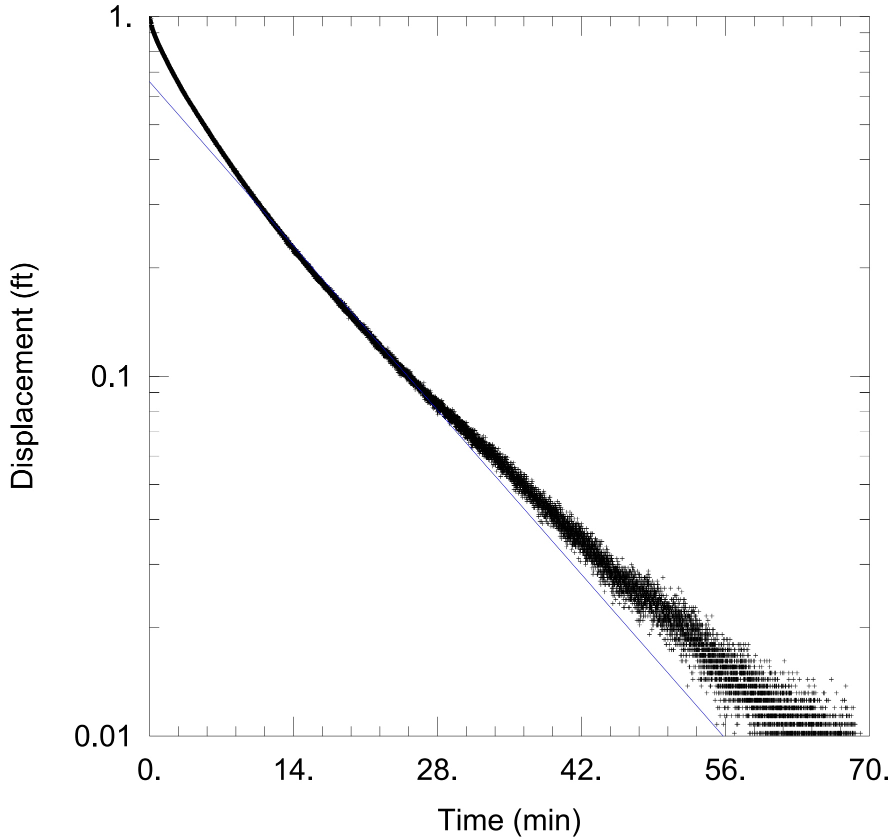
Saturated Thickness: 14.67 ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-101)

Initial Displacement: 1. ft
Total Well Penetration Depth: 20.09 ft
Casing Radius: 0.167 ft

Static Water Column Height: 20.09 ft
Screen Length: 9.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-101 RH1

Data Set: C:\...\WBF-101_RH1.aqt
Date: 10/18/19 Time: 13:10:15

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-101
Test Date: 10/10/19

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

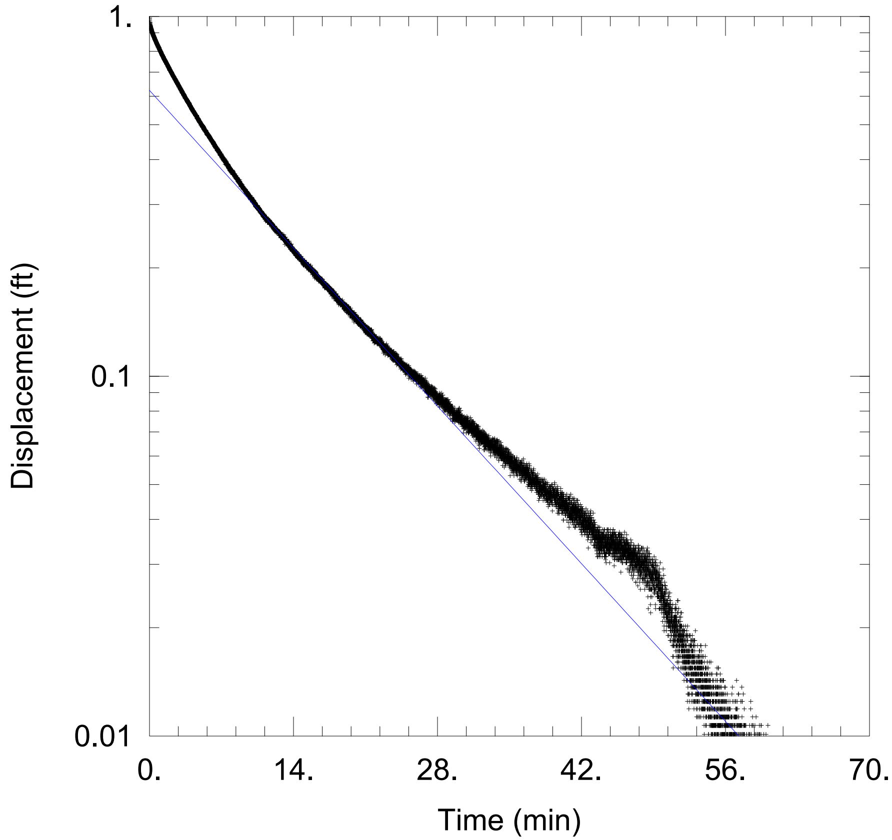
K = 0.5466 ft/day
y0 = 0.6585 ft

AQUIFER DATA

Saturated Thickness: 14.67 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-101)

Initial Displacement: 1. ft
Total Well Penetration Depth: 20.09 ft
Casing Radius: 0.167 ft
Static Water Column Height: 20.09 ft
Screen Length: 9.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-101 RH2

Data Set: C:\...\WBF-101_RH2.aqt
Date: 10/18/19 Time: 13:10:01

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-101
Test Date: 10/10/19

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

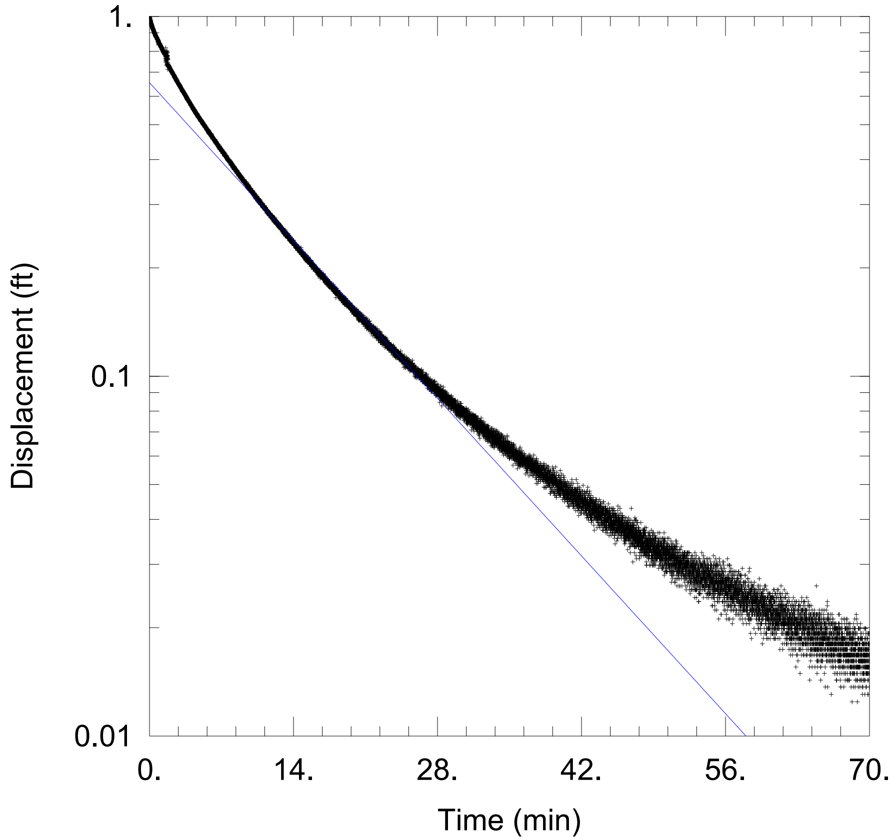
K = 0.5249 ft/day
y0 = 0.6226 ft

AQUIFER DATA

Saturated Thickness: 14.67 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-101)

Initial Displacement: 1. ft
Total Well Penetration Depth: 20.09 ft
Casing Radius: 0.167 ft
Static Water Column Height: 20.09 ft
Screen Length: 9.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-101 RH3

Data Set: C:\...\WBF-101_RH3.aqt
Date: 10/18/19 Time: 13:09:48

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-101
Test Date: 10/10/19

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

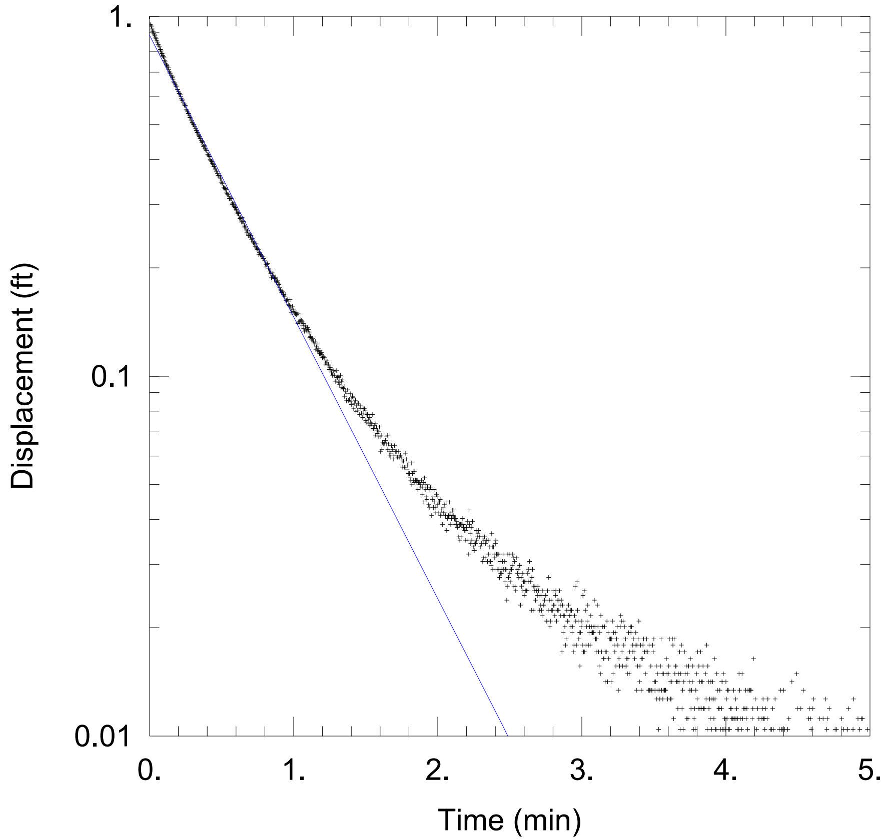
K = 0.5249 ft/day
y0 = 0.6543 ft

AQUIFER DATA

Saturated Thickness: 14.67 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-101)

Initial Displacement: 1. ft
Total Well Penetration Depth: 20.09 ft
Casing Radius: 0.167 ft
Static Water Column Height: 20.09 ft
Screen Length: 9.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-103 FH1

Data Set: C:\...\WBF-103_FH1.aqt
Date: 10/18/19 Time: 13:09:10

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-103
Test Date: 10/10/19

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 20.1 ft/day
y0 = 0.8857 ft

AQUIFER DATA

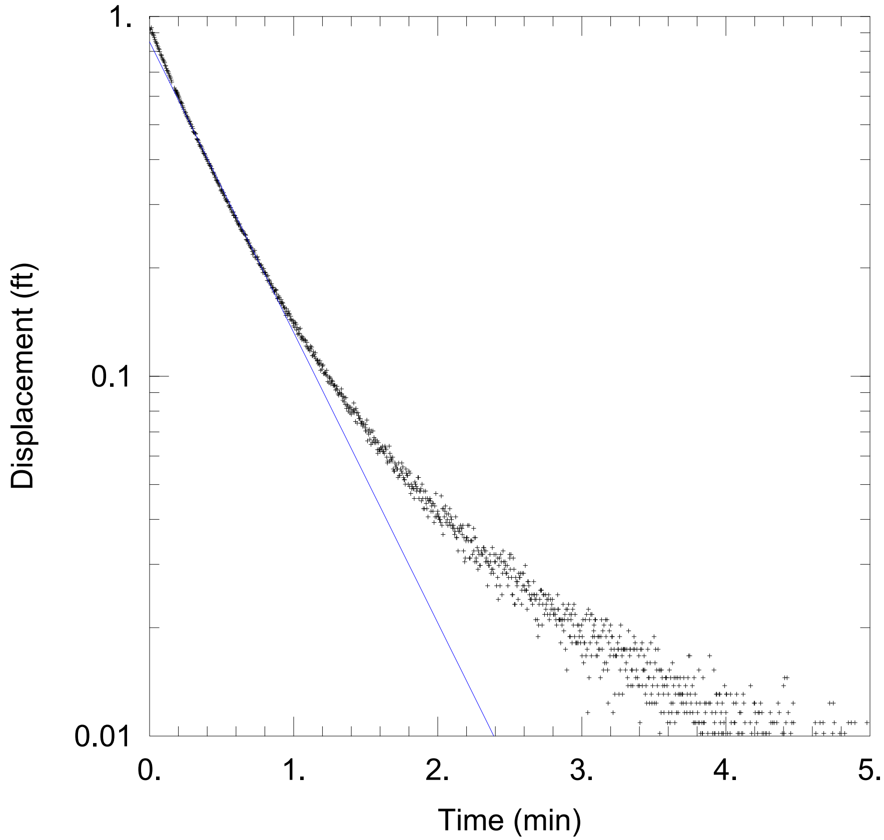
Saturated Thickness: 5.59 ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-103)

Initial Displacement: 1. ft
Total Well Penetration Depth: 6.16 ft
Casing Radius: 0.167 ft

Static Water Column Height: 6.16 ft
Screen Length: 4.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-103 FH2

Data Set: C:\...\WBF-103_FH2.aqt
Date: 10/18/19 Time: 13:08:55

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-103
Test Date: 10/11/19

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

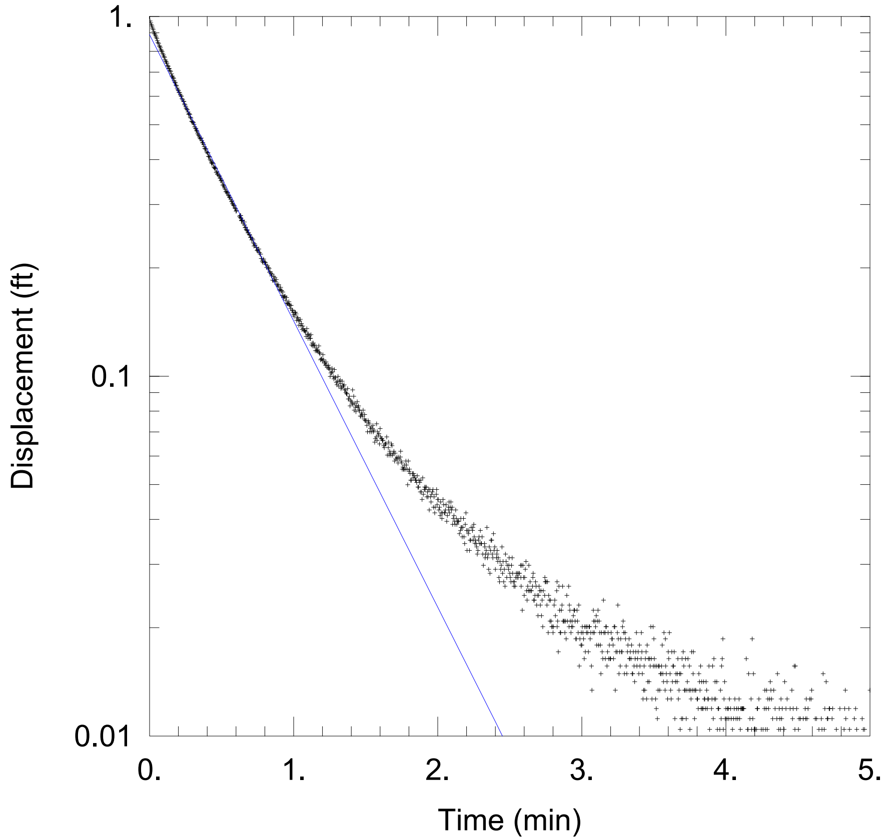
K = 20.73 ft/day
y0 = 0.849 ft

AQUIFER DATA

Saturated Thickness: 5.59 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-103)

Initial Displacement: 1. ft
Total Well Penetration Depth: 6.16 ft
Casing Radius: 0.167 ft
Static Water Column Height: 6.16 ft
Screen Length: 4.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-103 FH3

Data Set: C:\...\WBF-103_FH3.aqt
Date: 10/18/19 Time: 13:08:41

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-103
Test Date: 10/11/19

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

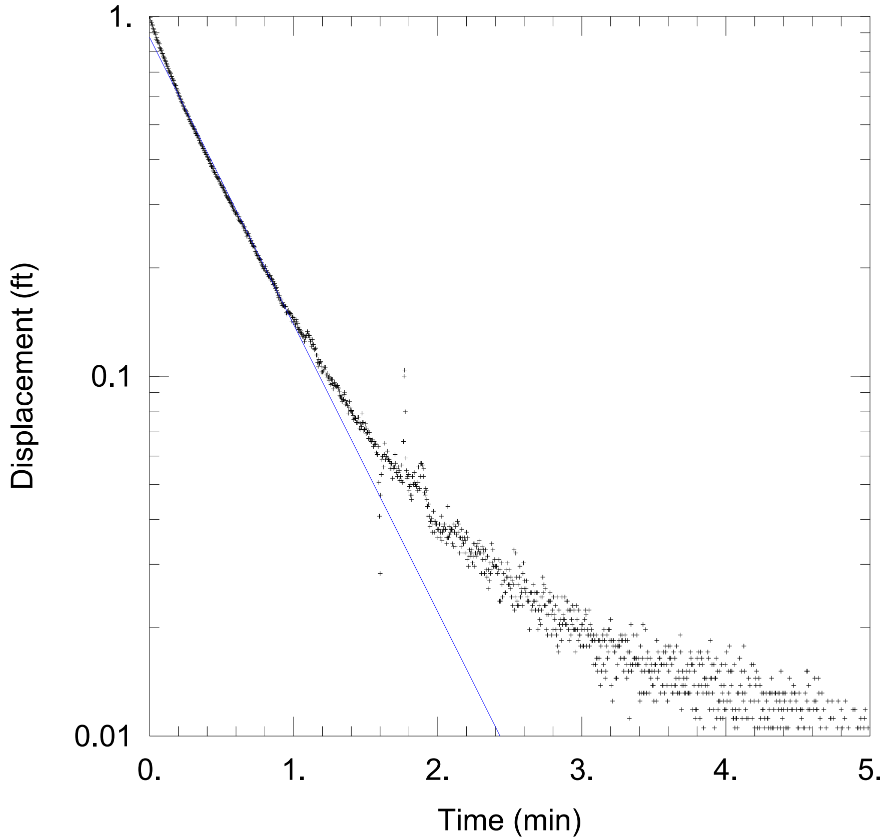
K = 20.43 ft/day
y0 = 0.8895 ft

AQUIFER DATA

Saturated Thickness: 5.59 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-103)

Initial Displacement: 1. ft
Total Well Penetration Depth: 6.16 ft
Casing Radius: 0.167 ft
Static Water Column Height: 6.16 ft
Screen Length: 4.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-103 RH1

Data Set: C:\...\WBF-103_RH1.aqt
Date: 10/18/19 Time: 13:08:25

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-103
Test Date: 10/10/19

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

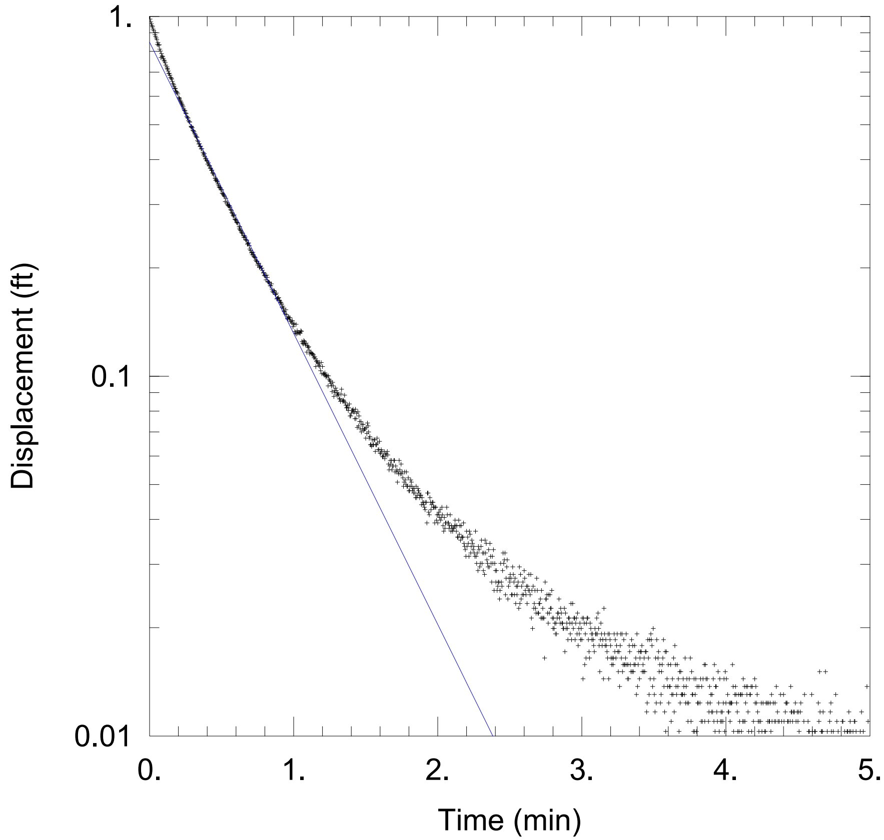
K = 20.5 ft/day
y0 = 0.8742 ft

AQUIFER DATA

Saturated Thickness: 5.59 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-103)

Initial Displacement: 1. ft
Total Well Penetration Depth: 6.16 ft
Casing Radius: 0.167 ft
Static Water Column Height: 6.16 ft
Screen Length: 4.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-103 RH2

Data Set: C:\...\WBF-103_RH2.aqt
Date: 10/18/19 Time: 13:08:08

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-103
Test Date: 10/11/19

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

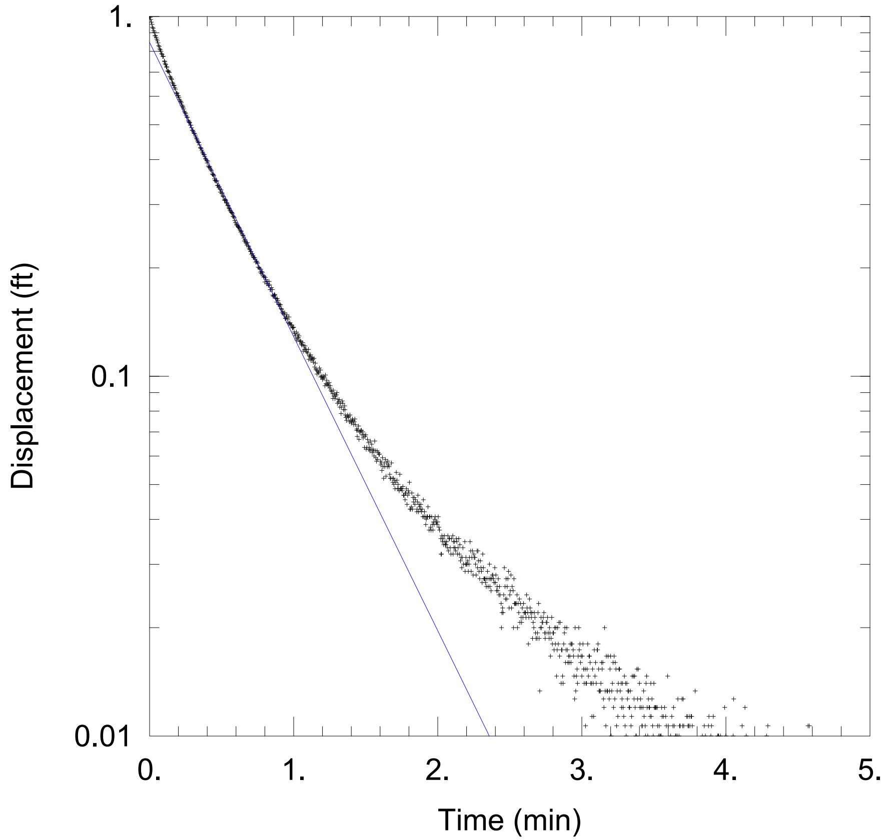
K = 20.78 ft/day
y0 = 0.8478 ft

AQUIFER DATA

Saturated Thickness: 5.59 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-103)

Initial Displacement: 1. ft
Total Well Penetration Depth: 6.16 ft
Casing Radius: 0.167 ft
Static Water Column Height: 6.16 ft
Screen Length: 4.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-103 RH3

Data Set: C:\...\WBF-103_RH3.aqt
Date: 10/18/19 Time: 13:07:48

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-103
Test Date: 10/11/19

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

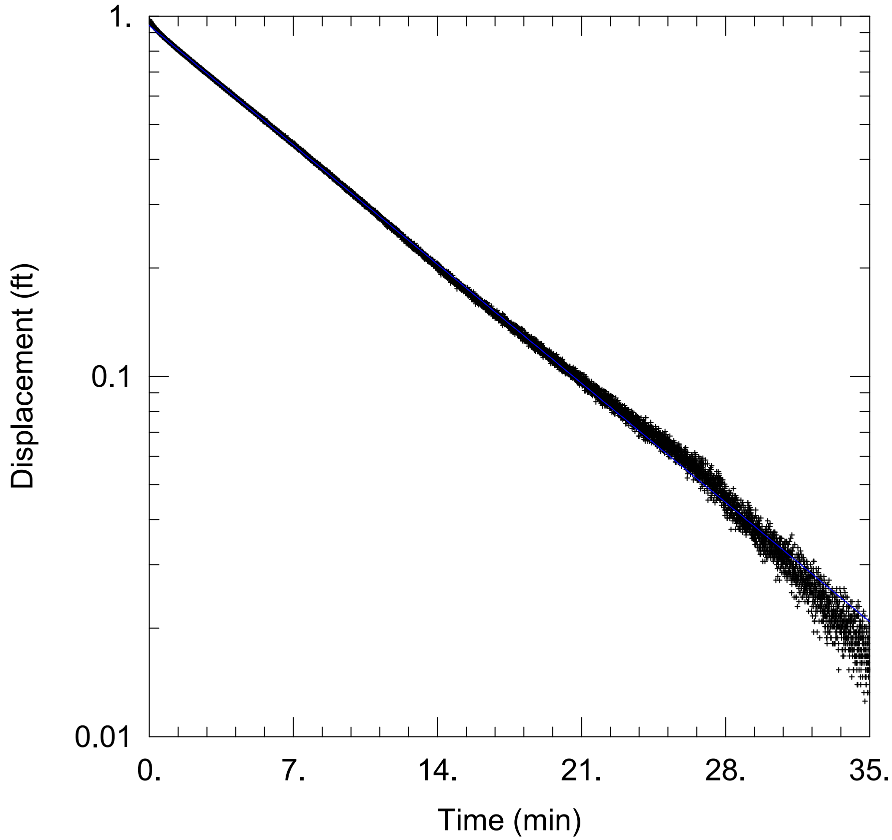
K = 20.99 ft/day
y0 = 0.847 ft

AQUIFER DATA

Saturated Thickness: 5.59 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-103)

Initial Displacement: 1. ft
Total Well Penetration Depth: 6.16 ft
Casing Radius: 0.167 ft
Static Water Column Height: 6.16 ft
Screen Length: 4.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-104 FH1

Data Set: Z:\Slug Tests\TVA-WBF\Charts\WBF-104_FH1.aqt
Date: 11/19/19 Time: 13:21:07

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-104
Test Date: 10/9/19

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.7549 ft/day
y0 = 0.941 ft

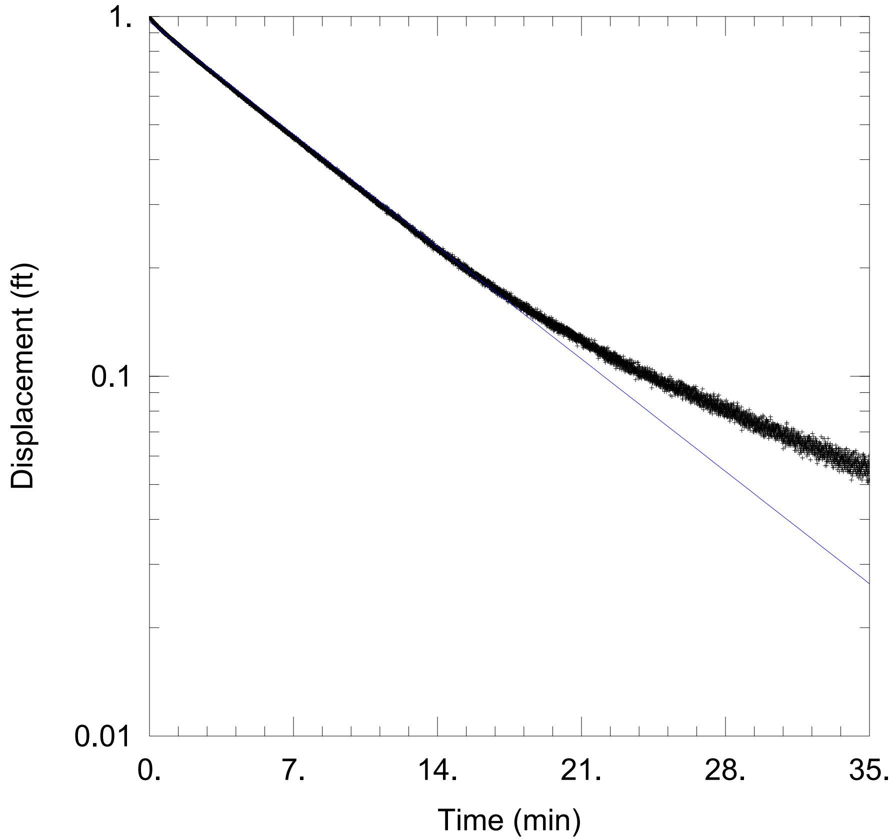
AQUIFER DATA

Saturated Thickness: 15.32 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-104)

Initial Displacement: 1. ft
Total Well Penetration Depth: 15.32 ft
Casing Radius: 0.167 ft

Static Water Column Height: 15.32 ft
Screen Length: 9.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-104 FH2

Data Set: C:\...\WBF-104_FH2.aqt
Date: 10/18/19 Time: 12:31:41

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-104
Test Date: 10/9/19

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

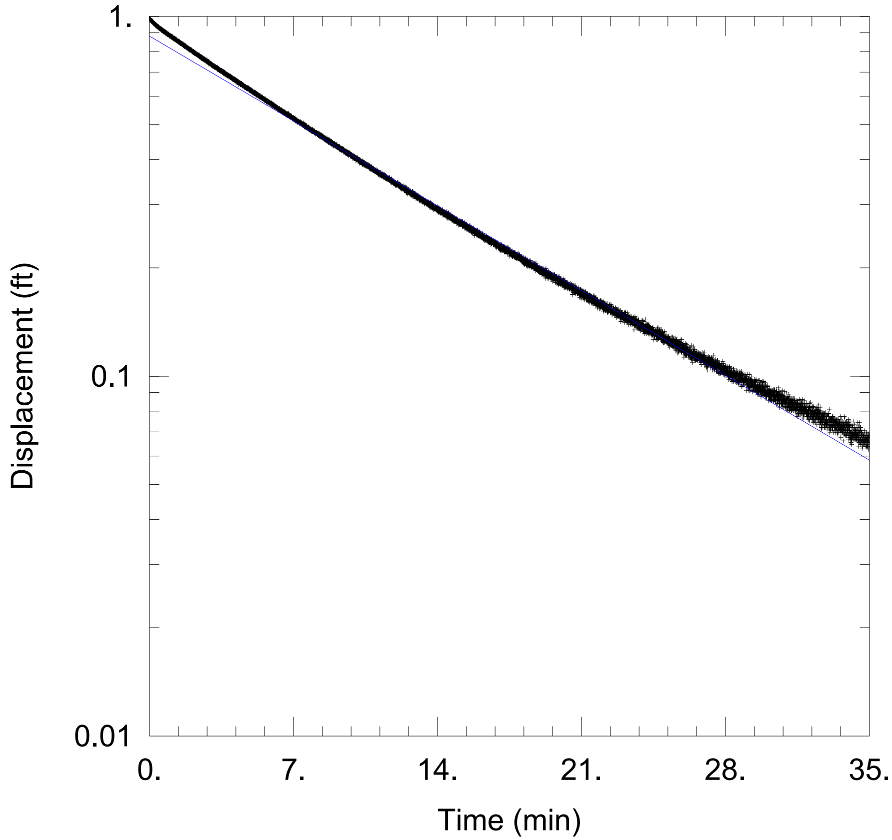
K = 0.7126 ft/day
y0 = 0.9651 ft

AQUIFER DATA

Saturated Thickness: 15.32 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-104)

Initial Displacement: 1. ft
Total Well Penetration Depth: 15.32 ft
Casing Radius: 0.167 ft
Static Water Column Height: 15.32 ft
Screen Length: 9.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-104 FH3

Data Set: C:\...\WBF-104_FH3.aqt
Date: 10/18/19 Time: 12:33:03

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-104
Test Date: 10/10/19

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

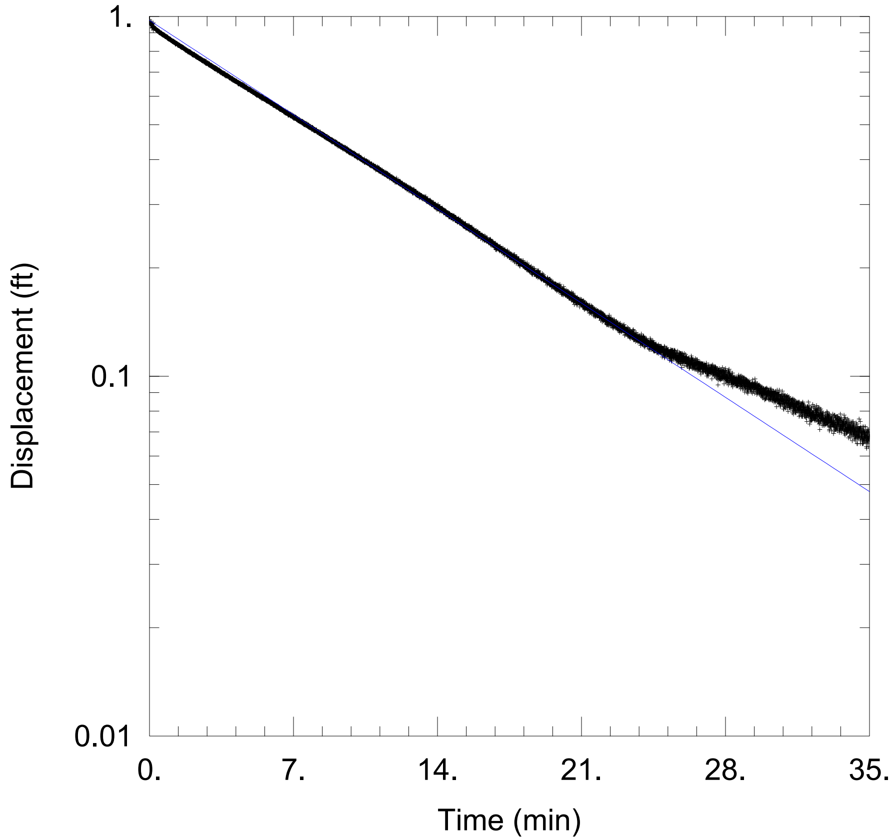
K = 0.5379 ft/day
y0 = 0.8817 ft

AQUIFER DATA

Saturated Thickness: 15.32 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-104)

Initial Displacement: 1. ft
Total Well Penetration Depth: 15.32 ft
Casing Radius: 0.167 ft
Static Water Column Height: 15.32 ft
Screen Length: 9.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-104 RH1

Data Set: C:\...\WBF-104_RH1.aqt
Date: 10/18/19 Time: 12:36:01

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-104
Test Date: 10/9/19

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

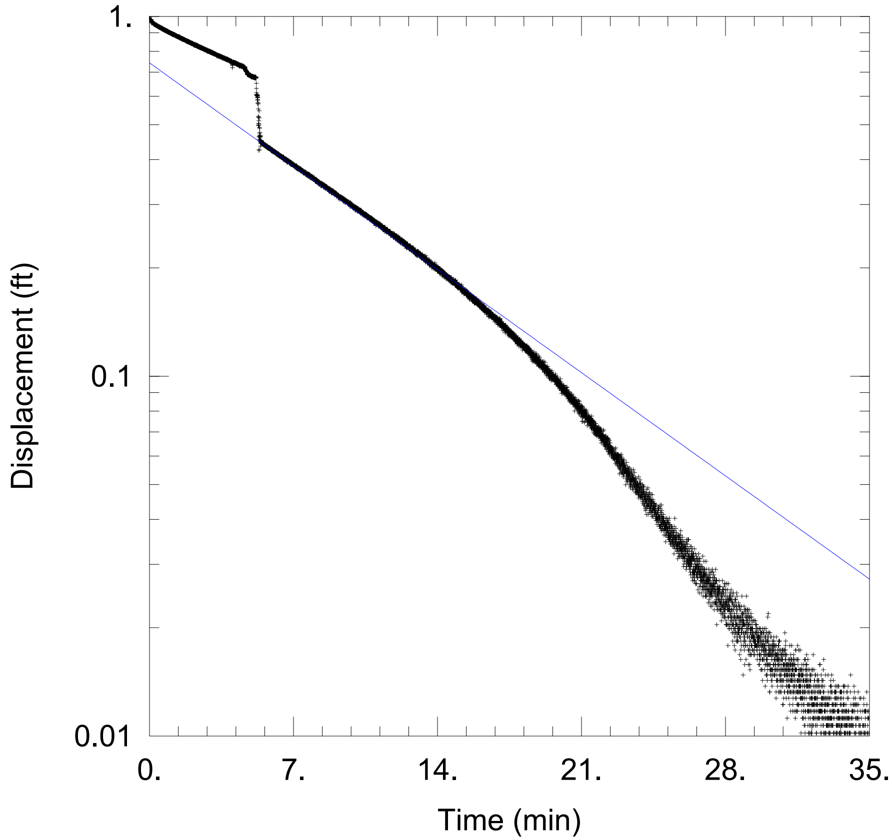
K = 0.5977 ft/day
y0 = 0.9751 ft

AQUIFER DATA

Saturated Thickness: 15.32 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-104)

Initial Displacement: 1. ft
Total Well Penetration Depth: 15.32 ft
Casing Radius: 0.167 ft
Static Water Column Height: 15.32 ft
Screen Length: 9.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-104 RH2

Data Set: C:\...\WBF-104_RH2.aqt
Date: 10/18/19 Time: 12:35:14

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-104
Test Date: 10/9/19

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

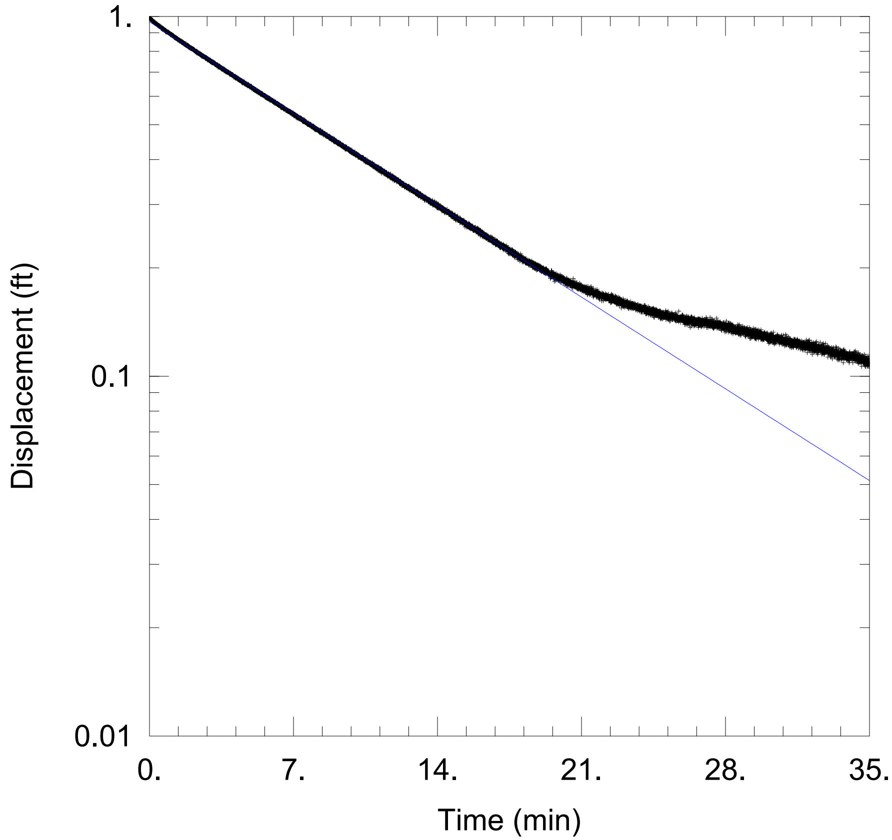
K = 0.6548 ft/day
y0 = 0.7427 ft

AQUIFER DATA

Saturated Thickness: 15.32 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-104)

Initial Displacement: 1. ft
Total Well Penetration Depth: 15.32 ft
Casing Radius: 0.167 ft
Static Water Column Height: 15.32 ft
Screen Length: 9.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-104 RH3

Data Set: C:\...\WBF-104_RH3.aqt
Date: 10/18/19 Time: 12:34:20

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-104
Test Date: 10/10/19

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

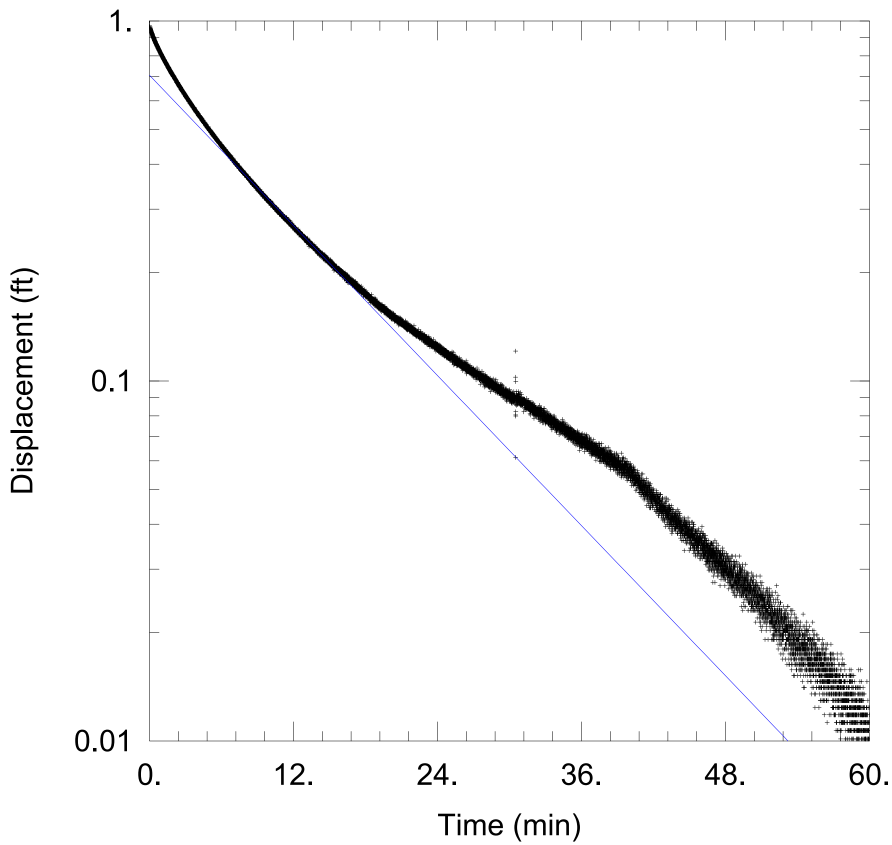
K = 0.5818 ft/day
y0 = 0.9657 ft

AQUIFER DATA

Saturated Thickness: 15.32 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-104)

Initial Displacement: 1. ft
Total Well Penetration Depth: 15.32 ft
Casing Radius: 0.167 ft
Static Water Column Height: 15.32 ft
Screen Length: 9.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-105 FH1

Data Set: C:\...\WBF-105_FH1.aqt
Date: 10/18/19 Time: 12:40:38

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-105
Test Date: 10/9/19

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

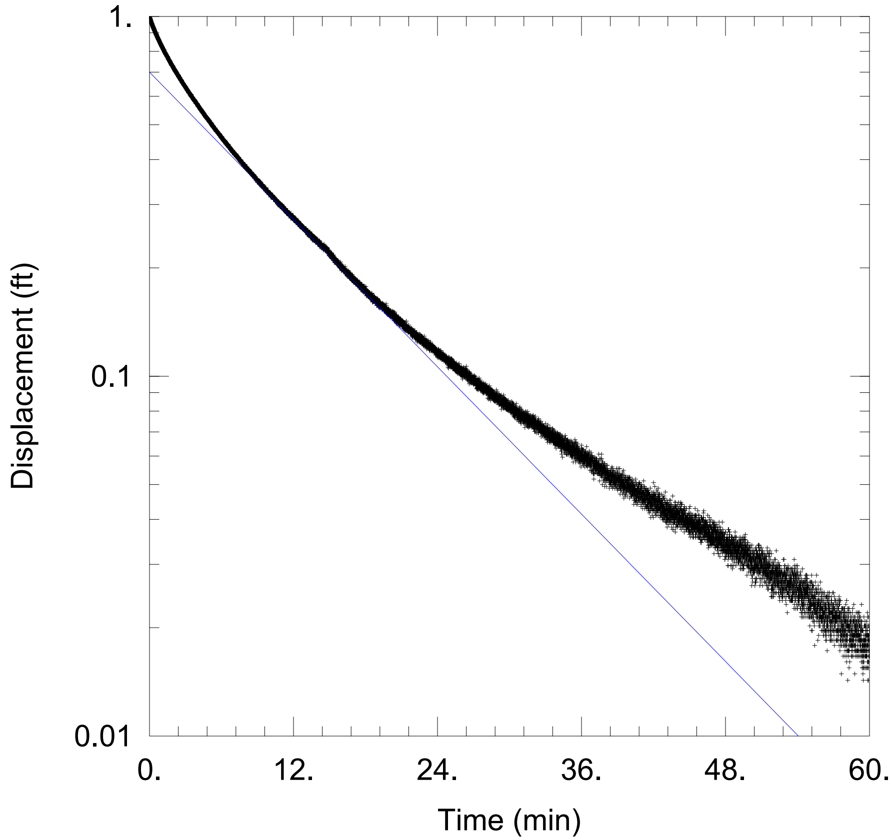
K = 1.288 ft/day
y0 = 0.7062 ft

AQUIFER DATA

Saturated Thickness: 22.34 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-105)

Initial Displacement: 1. ft
Total Well Penetration Depth: 22.34 ft
Casing Radius: 0.167 ft
Static Water Column Height: 22.34 ft
Screen Length: 4.8 ft
Well Radius: 0.333 ft
Gravel Pack Porosity: 0.



WBF-105 FH2

Data Set: C:\...\WBF-105_FH2.aqt
Date: 10/18/19 Time: 12:41:23

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-105
Test Date: 10/9/19

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

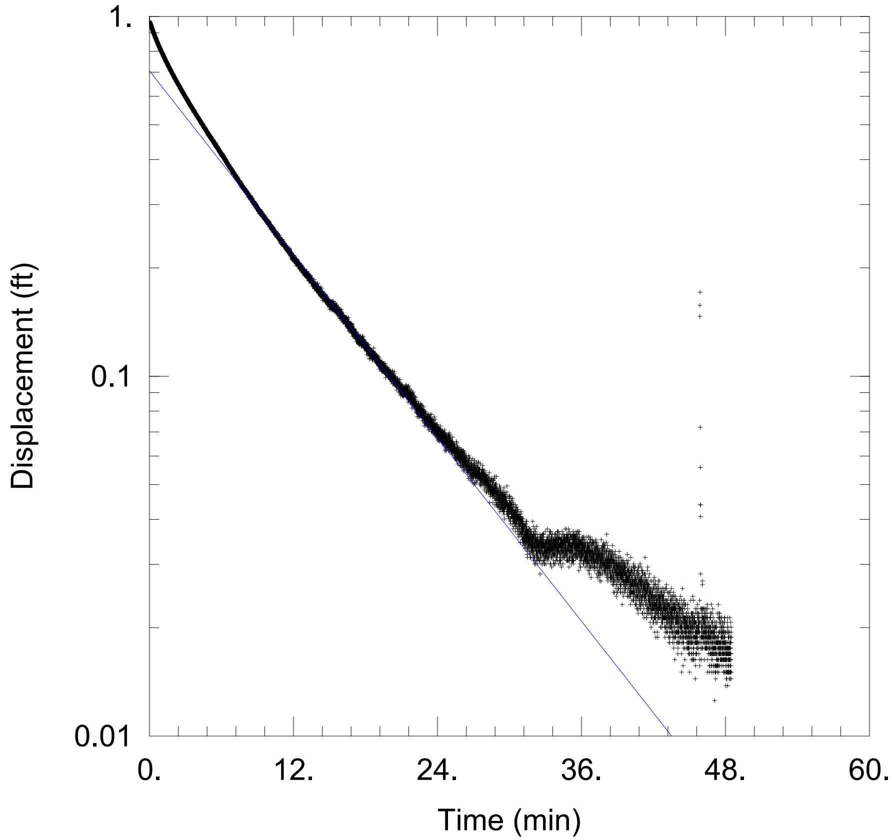
K = 1.265 ft/day
y0 = 0.7002 ft

AQUIFER DATA

Saturated Thickness: 22.34 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-105)

Initial Displacement: 1. ft
Total Well Penetration Depth: 22.34 ft
Casing Radius: 0.167 ft
Static Water Column Height: 22.34 ft
Screen Length: 4.8 ft
Well Radius: 0.333 ft
Gravel Pack Porosity: 0.



WBF-105 FH3

Data Set: C:\...\WBF-105_FH3.aqt
Date: 10/18/19 Time: 12:42:37

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-105
Test Date: 10/9/19

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

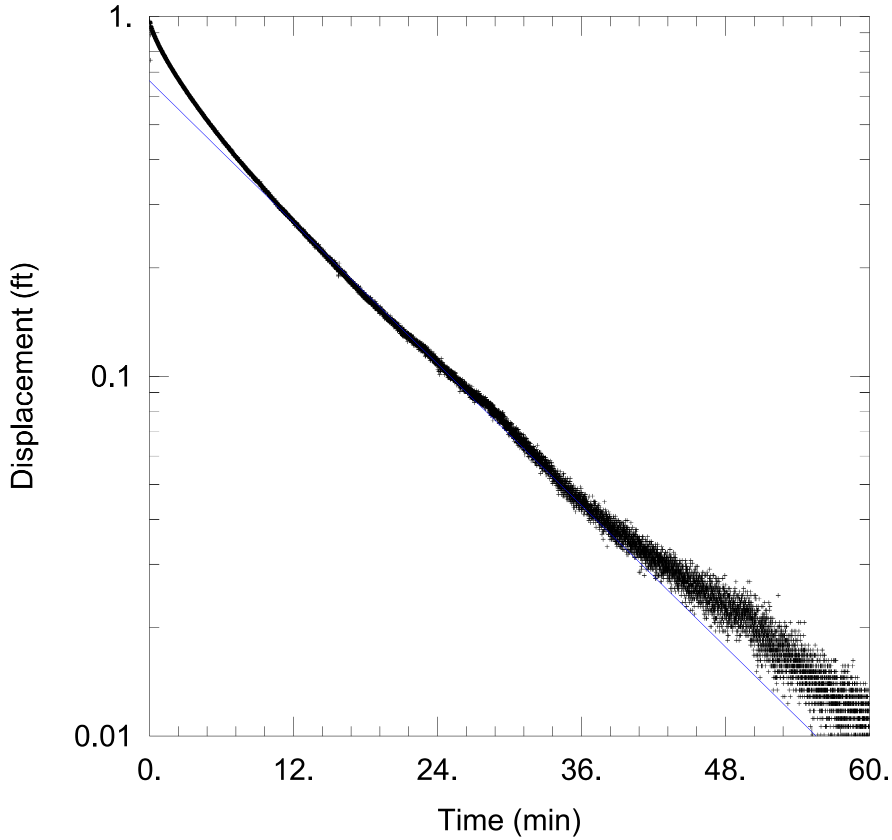
K = 1.575 ft/day
y0 = 0.7055 ft

AQUIFER DATA

Saturated Thickness: 22.34 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-105)

Initial Displacement: 1. ft
Total Well Penetration Depth: 22.34 ft
Casing Radius: 0.167 ft
Static Water Column Height: 22.34 ft
Screen Length: 4.8 ft
Well Radius: 0.333 ft
Gravel Pack Porosity: 0.



WBF-105 RH1

Data Set: C:\...\WBF-105_RH1.aqt
Date: 10/18/19 Time: 12:45:00

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-105
Test Date: 10/9/19

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 1.215 ft/day
y0 = 0.6621 ft

AQUIFER DATA

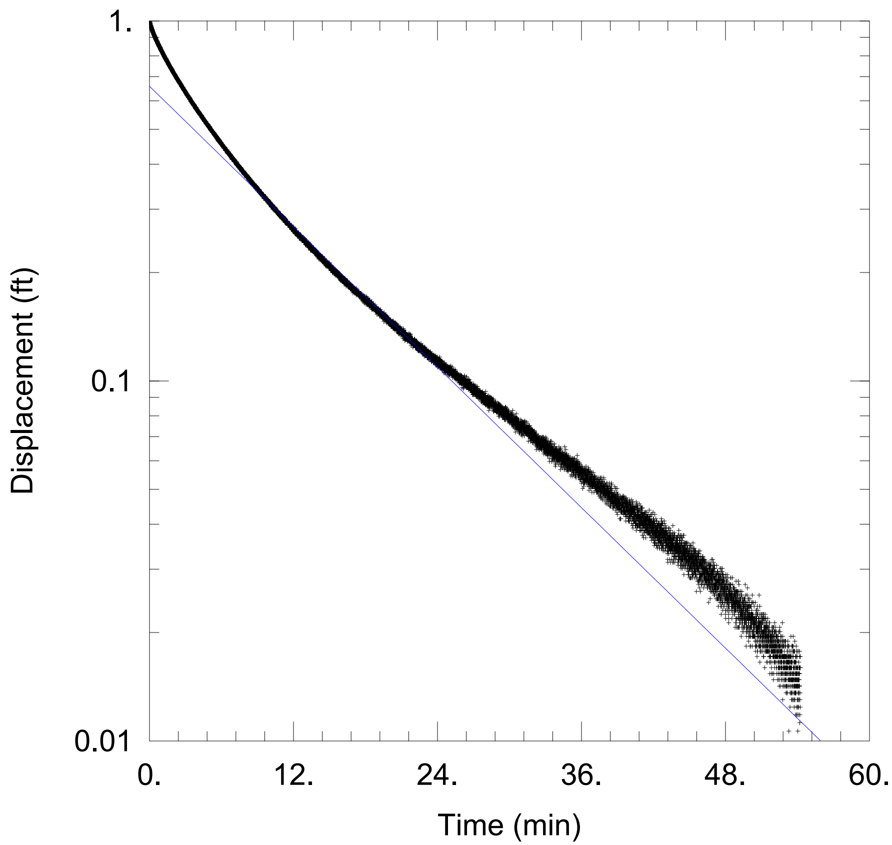
Saturated Thickness: 22.34 ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-105)

Initial Displacement: 1. ft
Total Well Penetration Depth: 22.34 ft
Casing Radius: 0.167 ft

Static Water Column Height: 22.34 ft
Screen Length: 4.8 ft
Well Radius: 0.333 ft
Gravel Pack Porosity: 0.



WBF-105 RH2

Data Set: C:\...\WBF-105_RH2.aqt
Date: 10/18/19 Time: 12:44:14

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-105
Test Date: 10/9/19

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

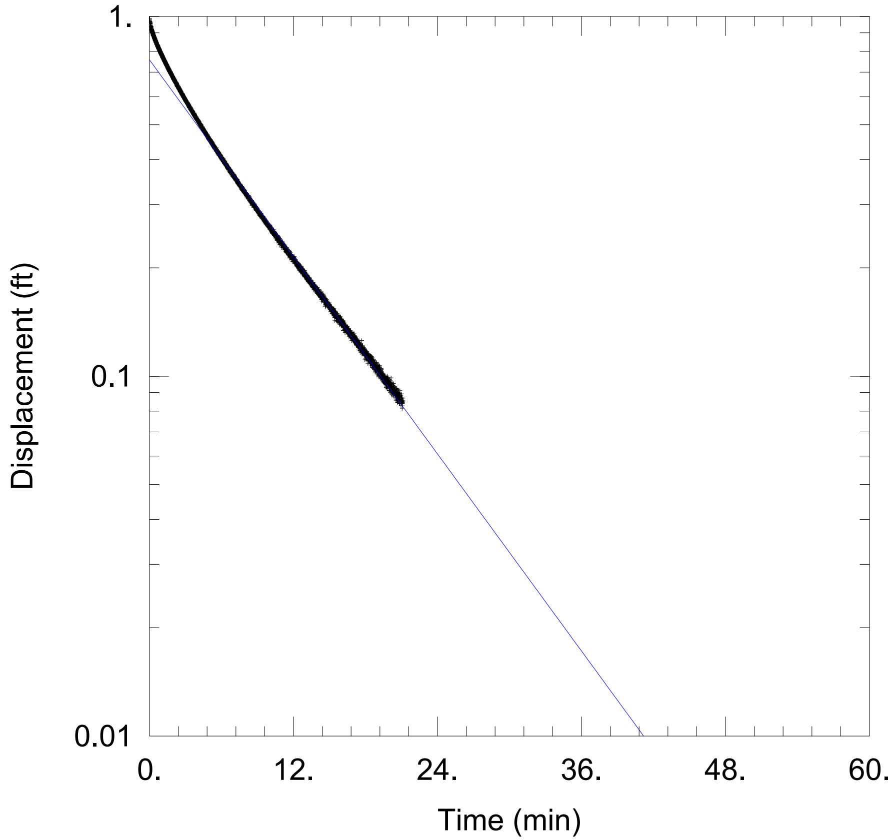
K = 1.205 ft/day
y0 = 0.6585 ft

AQUIFER DATA

Saturated Thickness: 22.34 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-105)

Initial Displacement: 1. ft
Total Well Penetration Depth: 22.34 ft
Casing Radius: 0.167 ft
Static Water Column Height: 22.34 ft
Screen Length: 4.8 ft
Well Radius: 0.333 ft
Gravel Pack Porosity: 0.



WBF-105 RH3

Data Set: C:\...\WBF-105_RH3.aqt
Date: 10/18/19 Time: 12:43:23

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-105
Test Date: 10/9/19

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

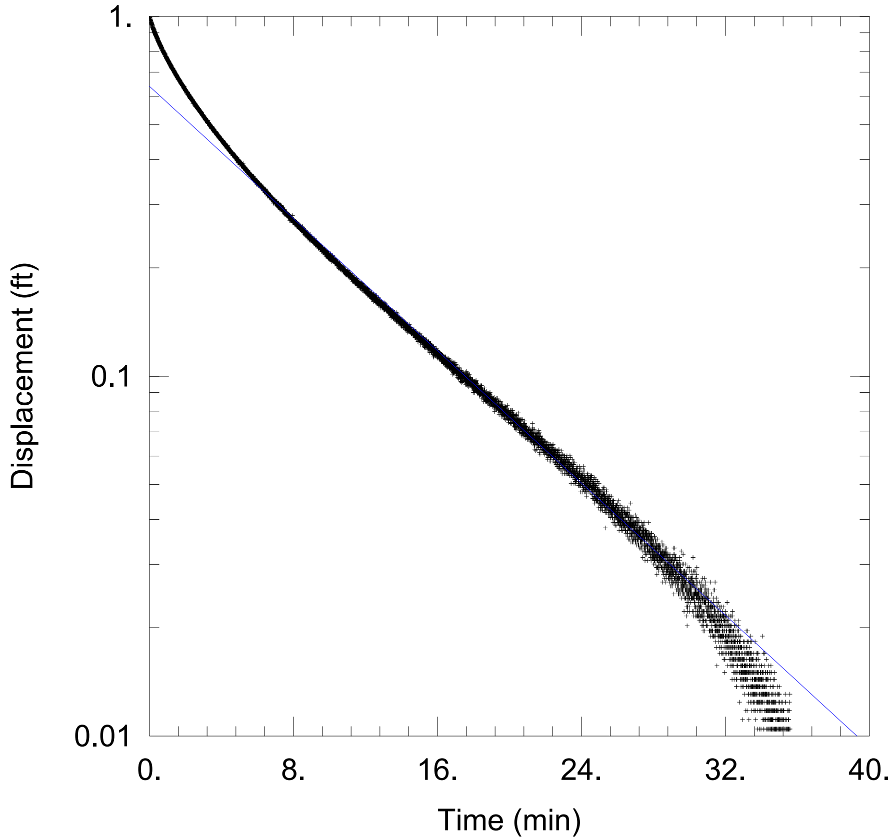
K = 1.692 ft/day
y0 = 0.7572 ft

AQUIFER DATA

Saturated Thickness: 22.34 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-105)

Initial Displacement: 1. ft
Total Well Penetration Depth: 22.34 ft
Casing Radius: 0.167 ft
Static Water Column Height: 22.34 ft
Screen Length: 4.8 ft
Well Radius: 0.333 ft
Gravel Pack Porosity: 0.



WBF-106 FH1

Data Set: C:\...\CA-38BR_FH1.aqt
Date: 10/09/19 Time: 13:47:46

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-106
Test Date: 10/08/19

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.783 ft/day
y0 = 0.6392 ft

AQUIFER DATA

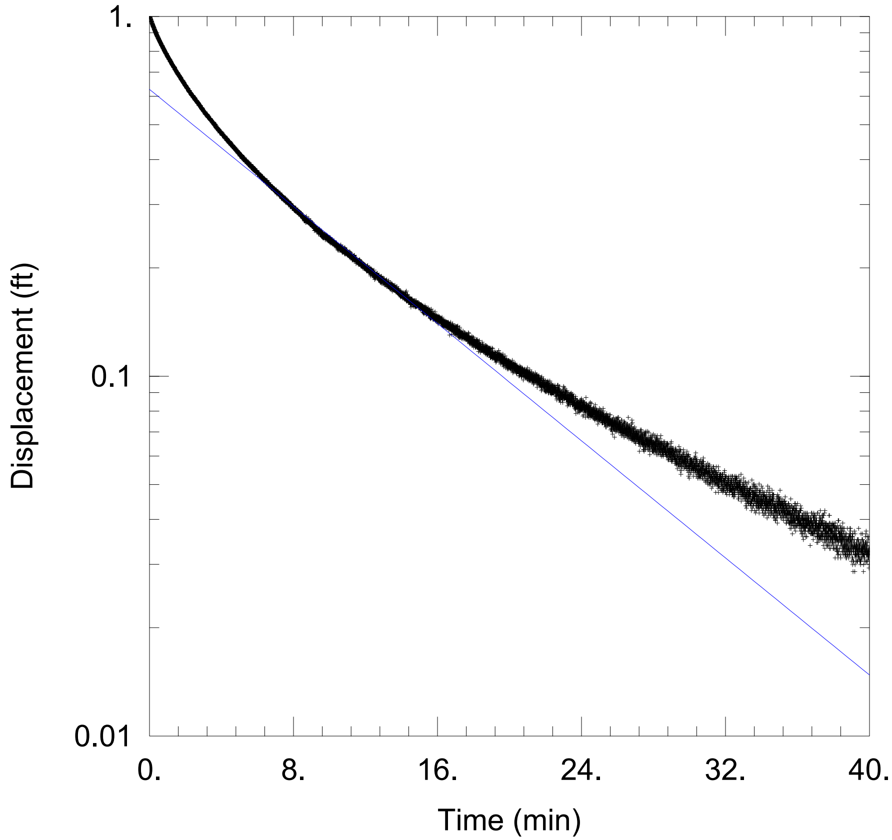
Saturated Thickness: 22.16 ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-106)

Initial Displacement: 1. ft
Total Well Penetration Depth: 22.16 ft
Casing Radius: 0.167 ft

Static Water Column Height: 22.16 ft
Screen Length: 9.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-106 FH2

Data Set: C:\...\CA-38BR_FH2.aqt
Date: 10/09/19 Time: 13:48:47

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-106
Test Date: 10/08/19

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.6935 ft/day
y0 = 0.6269 ft

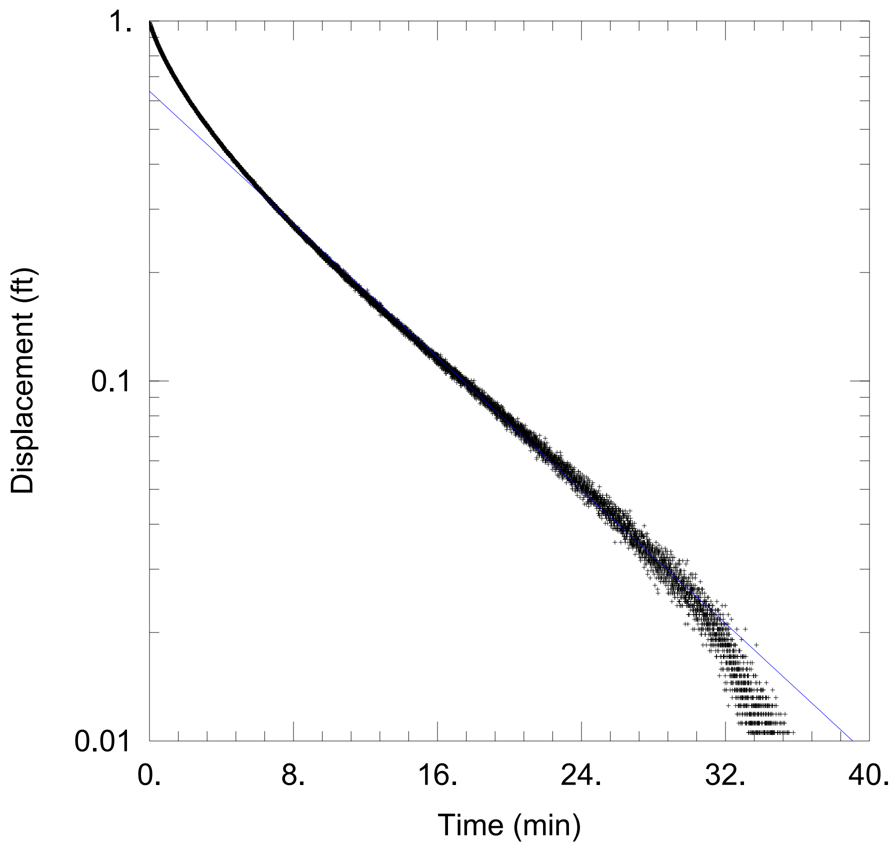
AQUIFER DATA

Saturated Thickness: 22.16 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-106)

Initial Displacement: 1. ft
Total Well Penetration Depth: 22.16 ft
Casing Radius: 0.167 ft

Static Water Column Height: 22.16 ft
Screen Length: 9.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-106 FH3

Data Set: C:\...\CA-38BR_FH3.aqt
Date: 10/09/19 Time: 13:49:26

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-106
Test Date: 10/08/19

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

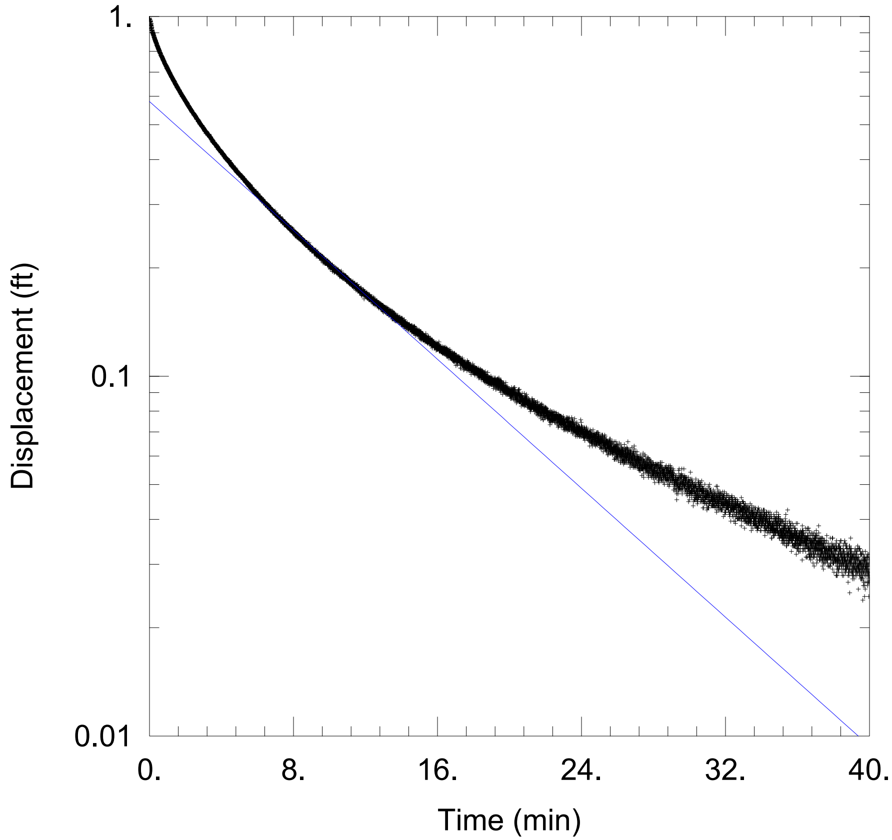
K = 0.7872 ft/day
y0 = 0.6378 ft

AQUIFER DATA

Saturated Thickness: 22.16 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-106)

Initial Displacement: 1. ft
Total Well Penetration Depth: 22.16 ft
Casing Radius: 0.167 ft
Static Water Column Height: 22.16 ft
Screen Length: 9.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-106 RH1

Data Set: C:\...\CA-38BR_RH1.aqt
Date: 10/09/19 Time: 13:50:48

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-106
Test Date: 10/08/19

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

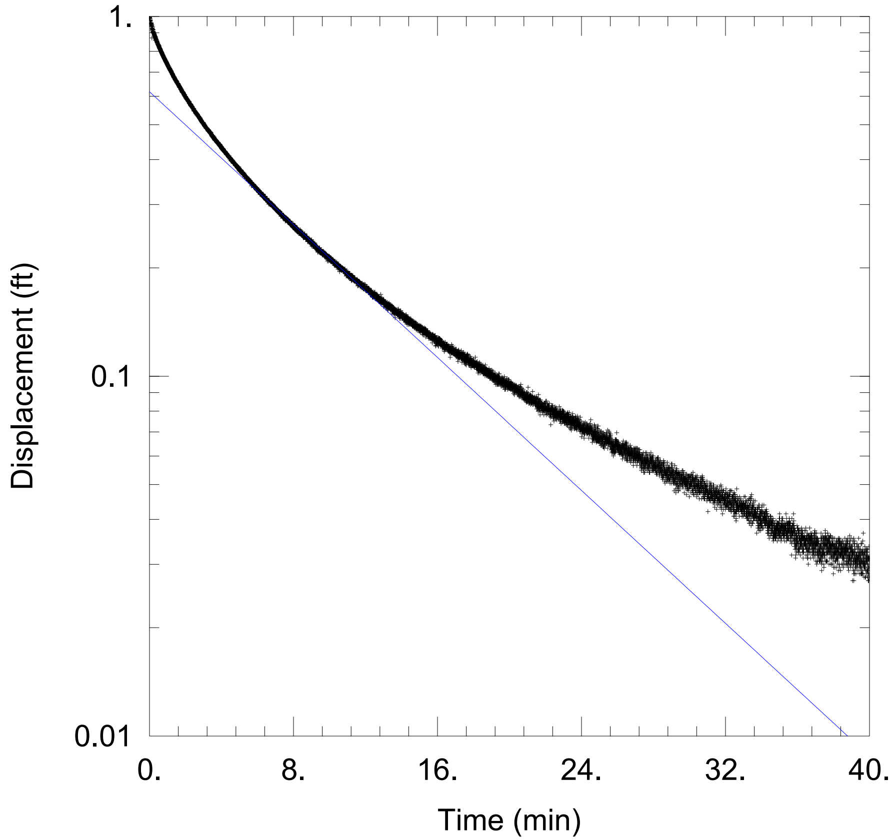
K = 0.7632 ft/day
y0 = 0.58 ft

AQUIFER DATA

Saturated Thickness: 22.16 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-106)

Initial Displacement: 1. ft
Total Well Penetration Depth: 22.16 ft
Casing Radius: 0.167 ft
Static Water Column Height: 22.16 ft
Screen Length: 9.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-106 RH2

Data Set: C:\...\CA-38BR_RH2.aqt
Date: 10/09/19 Time: 13:52:03

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-106
Test Date: 10/08/19

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.7868 ft/day
y0 = 0.6175 ft

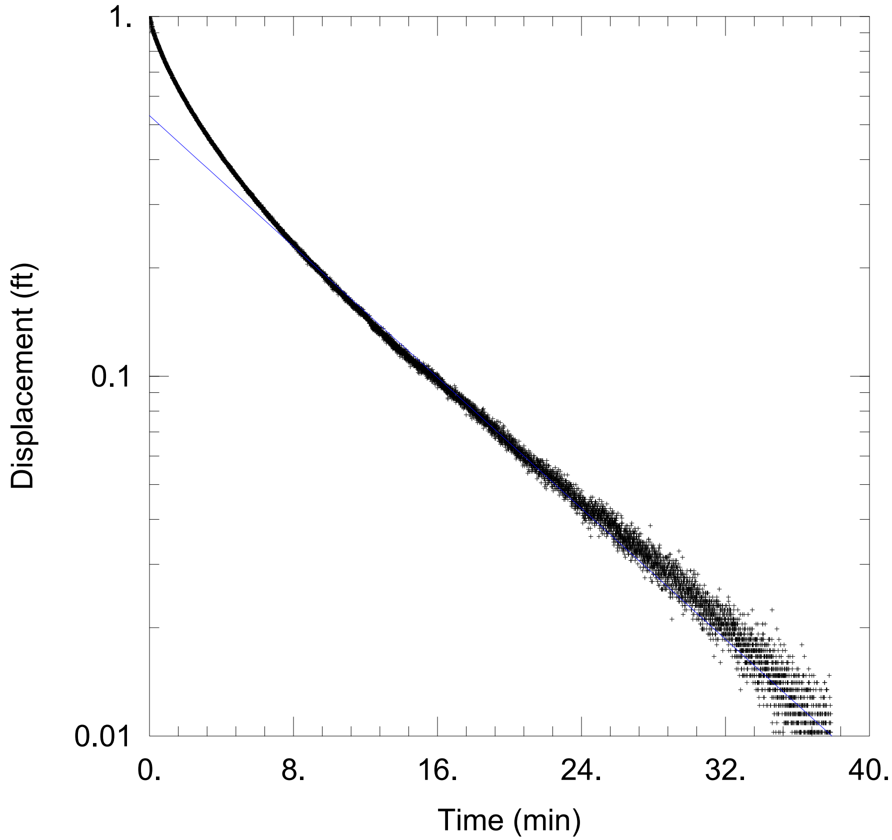
AQUIFER DATA

Saturated Thickness: 22.16 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-106)

Initial Displacement: 1. ft
Total Well Penetration Depth: 22.16 ft
Casing Radius: 0.167 ft

Static Water Column Height: 22.16 ft
Screen Length: 9.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.



WBF-106 RH3

Data Set: C:\...\CA-38BR_RH3.aqt
Date: 10/09/19 Time: 13:53:23

PROJECT INFORMATION

Company: Stantec
Client: TVA-WBF
Project: 175668050
Location: Spring City, TN
Test Well: WBF-106
Test Date: 10/08/19

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.7751 ft/day
y0 = 0.5299 ft

AQUIFER DATA

Saturated Thickness: 22.16 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (WBF-106)

Initial Displacement: 1. ft
Total Well Penetration Depth: 22.16 ft
Casing Radius: 0.167 ft
Static Water Column Height: 22.16 ft
Screen Length: 9.8 ft
Well Radius: 0.542 ft
Gravel Pack Porosity: 0.

APPENDIX H.3

GROUNDWATER INVESTIGATION EVENT #1 SAMPLING AND ANALYSIS REPORT

Watts Bar Fossil Plant
Groundwater Investigation Event #1
Sampling and Analysis Report

TDEC Commissioner's Order:
Environmental Investigation Plan
Watts Bar Fossil Plant
Spring City, Tennessee

April 23, 2021

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

Revision Record

Revision	Description	Date
0	Submittal to TDEC	April 23, 2021

Sign-off Sheet

This document entitled Watts Bar Fossil Plant Groundwater Investigation Event #1 Sampling and Analysis Report was prepared by Stantec Consulting Services Inc. (“Stantec”) for the account of Tennessee Valley Authority (the “Client”). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec’s professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by ____________________________

Michael J. Winkler, Geologic Associate

Reviewed by ____________________________

Carole M. Farr, Senior Principal Geologist

Approved by ____________________________

Rebekah Brooks, Principal Hydrogeologist

Table of Contents

Abbreviations

CCR	Coal Combustion Residuals
CCR Parameters	Constituents listed in Appendices III and IV of 40 CFR 257 and five inorganic constituents included in Appendix I of Tennessee Rule 0400-11-01-.04
CFR	Code of Federal Regulations
COC	Chain-of-Custody
DO	Dissolved Oxygen
EAR	Environmental Assessment Report
EIP	Environmental Investigation Plan
ENV	Environmental
EnvStds	Environmental Standards, Inc.
Event #1	Groundwater investigation sampling event performed August 26-28, 2019
FSP	Field Sampling Personnel
ft	Feet
GEL	GEL Laboratories LLC
ID	Identification
IDW	Investigation Derived Waste
mg/L	Milligrams per Liter
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
ORP	Oxidation-Reduction Potential
PPE	Personal Protective Equipment
QAPP	Quality Assurance Project Plan
QC	Quality Control
SAP	Sampling and Analysis Plan
SAR	Sampling and Analysis Report
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Commissioner's Order No. OGC15-0177
TestAmerica	Eurofins TestAmerica Inc.
TI	Technical Instruction
TVA	Tennessee Valley Authority
WBF Plant	Watts Bar Fossil Plant

1.0 INTRODUCTION

Stantec Consulting Services Inc. (Stantec) has prepared this sampling and analysis report (SAR) on behalf of the Tennessee Valley Authority (TVA) to document the completion of activities related to a groundwater investigation sampling event performed August 26-28, 2019 (Event #1) at TVA's Watts Bar Fossil Plant (WBF Plant) located in Spring City, Tennessee.

The purpose of the groundwater investigation, upon completion of six groundwater sampling events, is to characterize groundwater conditions at the WBF Plant in support of fulfilling the requirements for the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA (TDEC 2015). The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee.

The purpose of this SAR is to document the work completed during groundwater sampling Event #1 of 6 total events and to present the information and data collected during the execution of the Groundwater Investigation Sampling and Analysis Plan (SAP) (Stantec 2018a). This SAR is not intended to provide conclusions or evaluations of results. The scope of the groundwater investigation represented herein was conducted pursuant to the SAP and is part of a larger environmental investigation at the WBF Plant. The data provided in this SAR are not inclusive of other programmatic data that exist for the site. The evaluation of the results will include data from the six groundwater sampling events and consider other aspects of the environmental investigation, as well as data collected under other State and/or coal combustion residuals (CCR) programs. This evaluation will be presented in the Environmental Assessment Report (EAR).

Event #1 activities were performed in general accordance with the following documents developed by TVA to support fulfilling the requirements of the TDEC Order at the WBF Plant:

- *Groundwater Investigation SAP* (Stantec 2018a)
- *Environmental Investigation Plan (EIP)* (Stantec 2018b)
- *Quality Assurance Project Plan (QAPP)* (Environmental Standards, Inc. 2018).

The Groundwater Investigation SAP was updated based on TVA- and TDEC-approved Programmatic- and Project-specific changes. Minor variations in scope and procedures from those outlined in the SAP occurred during field activities due to field conditions and programmatic updates and are referenced in Section 3.6.

Event #1 is the first in a series of six planned sampling events for the groundwater investigation. Stantec performed the field work activities for this event. Laboratory analysis of constituents was performed by GEL Laboratories LLC (GEL) in Charleston, South Carolina (radium samples only) and Eurofins TestAmerica, Inc. (TestAmerica) in Pittsburgh, Pennsylvania (other analytes). Quality assurance oversight

on data acquisition protocols, sampling practices, and data validation or verification was performed by Environmental Standards, Inc. (EnvStds) under direct contract to TVA.

This report summarizes the groundwater investigation activities for Event #1. The remaining sampling events will be completed before overall conclusions and findings about the groundwater investigation and groundwater conditions at the WBF Plant are made and documented in the EAR.

2.0 OBJECTIVE AND SCOPE

The primary objectives of the groundwater investigation conducted pursuant to the Groundwater Investigation SAP (which includes six sampling events) are to characterize existing groundwater quality and to evaluate groundwater flow conditions at the WBF Plant in response to the TDEC Order. The approach to characterizing the groundwater conditions is to:

- Collect groundwater samples for chemical analyses to evaluate the potential presence of constituents related to CCR in groundwater
- Measure groundwater and surface water elevations for subsequent evaluation of direction and rate of groundwater flow.

The scope of work intended to achieve the objectives of the groundwater investigation consists of six sampling events at a frequency of one event every two months for one year to characterize seasonal groundwater quality and flow direction. This report describes the activities related to Event #1, performed in August 2019, the scope of which included:

- Collecting groundwater and surface water level measurements
- Collecting field measurements of groundwater quality parameters
- Collecting groundwater samples and associated quality control (QC) samples for laboratory analysis.

These activities were carried out after the installation of permanent monitoring wells specified in the Groundwater Investigation SAP. Details of the monitoring well installation activities are provided in the WBF Plant Hydrogeological Investigation SAR.

In addition, pore water measurements from piezometers and temporary wells installed in the CCR units at the WBF Plant are presented in this SAR for comparison with groundwater data. Temporary well and piezometer installation activities are described in the WBF Plant Exploratory Drilling SAR, and temporary well gauging and sampling information is provided in the WBF Plant CCR Material Characteristics SAR.

3.0 FIELD ACTIVITIES

Groundwater investigation field activities for Event #1 were conducted August 26-28, 2019. Stantec performed groundwater level measurements and sample collection activities based on guidance and specifications in TVA's Environmental (ENV) Technical Instructions (TIs), the SAP, the QAPP, and applicable United States Environmental Protection Agency documents except as noted in the Variations section of this report. As part of TVA's commitment to generate representative and reliable data, data validation and/or verification of laboratory analytical results were performed by EnvStds under direct contract with TVA. EnvStds also conducted audits of field activities and provided quality reviews of field documentation.

During Event #1, Stantec conducted the following field activities:

- Measured groundwater levels at six monitoring wells installed for the TDEC Order and four monitoring wells and three piezometers installed for other environmental programs (10 total monitoring wells)
- Measured pore water levels at four temporary wells and three piezometers installed in the CCR units
- Measured the surface water level at one location in the Tennessee River
- Collected groundwater samples from six monitoring wells installed for the TDEC Order
- Recorded field measurements of groundwater quality parameters during purging and stabilization at the sampled monitoring wells
- Collected QC samples including one field duplicate, one matrix spike/matrix spike duplicate, two field blanks, and one equipment blank
- Shipped the collected samples to GEL in Charleston, South Carolina, and TestAmerica in Pittsburgh, Pennsylvania.

Details on each activity are presented in the sections below.

3.1 WORK LOCATIONS

The TDEC Order CCR units at the WBF Plant (Ash Pond and Slag Disposal Area) as well as the monitoring wells, temporary wells, and piezometers sampled and/or gauged during Event #1 are shown on Exhibit A.1 in Appendix A. TVA is currently sampling groundwater at the WBF Plant for the National Pollutant Discharge Elimination System (NPDES) permit closure program. Monitoring wells that are sampled as part of other environmental programs are not sampled as part of the groundwater investigation for the TDEC Order.

Groundwater levels were measured in TDEC Order monitoring wells as well as in select additional wells and piezometers from other environmental programs, as shown in Table B.1a in Appendix B, to provide information to prepare groundwater contour maps for this SAR and the WBF Plant EAR. Pore water levels measured in temporary wells and piezometers installed in the CCR units are presented in Table B.1b. Groundwater and pore water elevations are shown on Exhibits A.2 and A.3 in Appendix A. Groundwater elevation contours are depicted on Exhibit A.2, and pore water elevation contours are depicted on Exhibit A.3.

Groundwater analytical and field duplicate samples were collected from the TDEC Order groundwater investigation monitoring wells as shown in Table B.2 in Appendix B. Groundwater analytical data collected for the TDEC Order and the NPDES permit closure program, which includes wells MW-1, MW-2, MW-3, and WBF-100, will be provided in the EAR.

3.2 DOCUMENTATION

Stantec maintained field documentation in accordance with ENV-TI-05.80.03, *Field Record Keeping*, and the QAPP. Field activities and data were recorded on program-specific field forms. Health and safety forms were completed in accordance with TVA and Stantec health and safety requirements. Additional information regarding field documentation is provided below.

3.2.1 Field Forms

Stantec used program-specific field forms to record field observations and data for specific activities. Field forms used during the groundwater investigation included:

- *Daily Field Activity Log*
- *Monitoring Well Inspection Checklist*
- *Equipment Calibration Form*
- *Groundwater Level Measurement Form*
- *Vibrating Wire Piezometer Measurement Form*
- *Groundwater Sampling Form*
- *Chain-of-Custody (COC)*.

3.2.1.1 Daily Field Activity Log

Stantec field sampling personnel (FSP) recorded field activities, observations, and data on a *Daily Field Activity Log* to chronologically document the field program. Deviations from the SAP, TIs, or QAPP were documented on the *Daily Field Activity Log*.

3.2.1.2 Monitoring Well Inspection Checklist

Prior to measuring water levels, Stantec FSP inspected each monitoring well for damage or indications that the well integrity had been compromised in accordance with ENV-TI-05.80.21, *Monitoring Well Inspection and Maintenance.* Inspection results were documented on a *Monitoring Well Inspection Checklist*. No signs of damage or necessary repairs were noted during Event #1.

3.2.1.3 Equipment Calibration Form

Stantec FSP performed daily calibration of the water quality meter and turbidity meter and documented the results on an *Equipment Calibration Form*. The form documented the calibration results for temperature, turbidity, specific conductance, pH, dissolved oxygen (DO), and oxidation-reduction potential (ORP), and verified that the field instruments' sensors were operating within acceptance criteria. Refer to Section 3.2.2 for additional details on equipment calibration procedures.

3.2.1.4 Groundwater Level Measurement Form

Stantec FSP recorded groundwater level field measurement data on a *Groundwater Level Measurement Form* in accordance with ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*. The form includes the monitoring well identification (ID), time, and depth to water measured from a standardized reference point on the top of each well casing, recorded in feet (ft) below top of casing.

3.2.1.5 Vibrating Wire Piezometer Measurement Form

Stantec FSP recorded field measurement data on a *Vibrating Wire Piezometer Measurement Form*. The form includes the vibrating wire piezometer ID, serial number, time, digits, temperature, and length of the wire in ft. The readings were used to calculate the pressure head (ft of water) above the vibrating wire sensor to obtain the groundwater or pore water elevation.

3.2.1.6 Groundwater Sampling Form

Stantec FSP recorded the depth to water, purge flow rate, volume of groundwater purged, temperature, pH, specific conductance, DO, ORP, turbidity, color of water, and other observations during groundwater purging and sampling activities at each monitoring well in accordance with ENV-TI-05.80.42, *Groundwater Sampling*. Field measurements were recorded on a *Groundwater Sampling Form*. The form also documents the time intervals between measurement of field parameters, low-flow extraction rates, water level drawdown, and water quality parameter measurements until stabilization criteria were met.

3.2.1.7 Chain-of-Custody

Stantec FSP completed *COC* documentation for each groundwater sample collected. The sample ID, sample location, type of sample, sampling date and time, analyses requested, sample pH, and sample custody record were recorded on the *COC*. The Field Team Leader reviewed the *COC* for completeness, and the FSP conducted a QC check of samples in each cooler compared to sample IDs on the corresponding *COC*. *COCs* were completed in accordance with ENV-TI-05.80.02, *Sample Labeling and Custody*.

3.2.2 Equipment Calibration

Field instruments used to collect, generate, or measure water quality parameters were calibrated each day prior to use as specified in the SAP, QAPP, and ENV-TI-05.80.46, *Field Measurement Using a Multi-Parameter Sonde.* Afternoon calibration verifications were performed to evaluate if these instruments remained within acceptance criteria during sampling. Temperature and barometric pressure instrument readings were verified using a calibrated National Institute of Standards and Technology traceable thermometer and National Weather Service (via mesowest.utah.edu) barometric pressure readings for Lovell Field (KCHA) in Chattanooga, Tennessee, respectively. Additional details regarding equipment calibration were recorded on an *Equipment Calibration Form*, as described in Section 3.2.1.3.

3.3 SAMPLING METHODS

The following sections present monitoring well data collection and sampling procedures used during Event #1.

3.3.1 Static Water Level Measurements

FSP measured static groundwater levels at 10 monitoring wells and pore water levels at three temporary wells in accordance with ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*. On August 26, 2019, static groundwater and pore water level readings were measured and recorded to the nearest 0.01 ft from a reference point on the top of each well casing using an electronic water level indicator. Water level indicator probes were decontaminated prior to the first use and between measurements, and the decontamination was documented as specified in ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination.* Depth to groundwater and pore water measurements were recorded on a *Groundwater Level Measurement Form*.

Three groundwater and three pore water measurements were also obtained from transducers installed within six total piezometers. There was no groundwater level measured in piezometer WBF-B03B during the gauging event because the sensor was not recording data.

Additionally, a surface water level measurement for the Tennessee River was provided by TVA using the reading recorded closest to noon for the tailwater level below the Watts Bar Dam. The surface water staff gauge location is indicated on Exhibit A.1 in Appendix A.

Groundwater level data and pore water level data are shown in Tables B.1a and B.1b, respectively, in Appendix B. A groundwater elevation contour map based on groundwater measurements in wells and piezometers, along with pore water elevations, is included as Exhibit A.2 in Appendix A. Similarly, a pore water elevation contour map based on pore water measurements in wells and piezometers, along with groundwater elevations, is included as Exhibit A.3 in Appendix A.

3.3.2 Groundwater Purging & Sampling

Analytical and field duplicate samples (as specified in the SAP) were collected from six monitoring wells as shown in Table B.2 in Appendix B. Monitoring wells were purged using dedicated bladder pumps equipped with dedicated tubing using low-flow purging and sampling techniques as specified in ENV-TI-05.80.42, *Groundwater Sampling*.

During the purging process, water quality field parameters including pH, specific conductance, temperature, ORP, and DO were measured using water quality meters (YSI ProPlus with flow-through cell) and recorded on field forms. Depth to water and turbidity were measured and recorded using decontaminated electronic water-level indicators (Heron Dipper-T) and calibrated turbidimeters (Hach 2100Q). Field parameters were measured and recorded on *Groundwater Sampling Forms* during purging until readings were stabilized as specified in the SAP. Well purging was considered complete when three consecutive readings were within the following stabilization limits:

- pH – ± 0.1 Standard Units
- Specific Conductance – ± 5% microSiemens per centimeter
- Turbidity – Less than 10 Nephelometric Turbidity Units (NTUs) or ± 10% for values above 10 NTUs
- DO – Less than 0.5 milligrams per Liter (mg/L) or ± 10% for values above 0.5 mg/L.

For five of the monitoring wells (WBF-101, WBF-103 through WBF-106), after water quality stabilization criteria were achieved, the final field parameter results were recorded, purging was discontinued, and a sample was collected as specified in the SAP. One monitoring well (WBF-102) achieved stabilization, but exhibited low yield and had insufficient water volume to collect the sample. In accordance with the SAP, the sampling team discontinued purging after standing water was removed. The well was capped, locked, and allowed to recover overnight. The following morning, a depth to water measurement indicated that sufficient recovery had occurred (a minimum of 80% of its initial water column height within the casing) to collect the sample. The low-flow pumping rate was re-established, one set of water quality parameters was recorded, and then the groundwater sample was collected.

Laboratory-provided, pre-preserved sample containers were filled directly from the pump discharge line. Turbidity readings at the wells stabilized below 10 NTUs, therefore samples were not collected for dissolved metals analysis. FSP wore new, clean nitrile gloves when handling sample containers and did not touch the interior of containers or container caps. New gloves were used when handling each sample. When filling sample bottles, care was taken to minimize sample aeration (i.e., water was directed down the inner walls of the sample bottle) and to avoid overfilling and diluting preservatives. Each sample bottle was capped before filling the next bottle. Following completion of sampling, final turbidity measurements were made.

Sample containers were labeled and handled in accordance with ENV-TI-05.80.02, *Sample Labeling and Custody.* FSP secured caps on each bottle, attached a custody seal across the cap, and placed the bottles in a cooler on ice within 15 minutes of collection*.* QC samples were collected in accordance with ENV-TI-05.80.04, *Field Sampling Quality Control.*

Groundwater samples were analyzed for the CCR-related constituents listed in Appendices III and IV of 40 Code of Federal Regulations (CFR) 257. In addition, five inorganic constituents listed in Appendix I of Tennessee Rule 0400-11-01-.04 and not included in the 40 CFR 257 Appendices III and IV were analyzed to maintain continuity with TDEC environmental programs. These additional TDEC Appendix I constituents included copper, nickel, silver, vanadium, and zinc. The combined federal CCR Appendices III and IV constituents and TDEC Appendix I inorganic constituents will hereafter be referred to collectively as "CCR Parameters." For geochemical evaluation, major cations/anions not included in the CCR Parameters were included in the analyses. The additional geochemical parameters included bicarbonate, carbonate, magnesium, potassium, and sodium.

3.4 INVESTIGATION DERIVED WASTE

Investigation derived waste (IDW) generated during groundwater investigation activities included:

- Used calibration solutions
- Purge water
- Decontamination fluids
- Disposable personal protective equipment (PPE)
- General trash.

IDW was handled in accordance with ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*; ENV-TI-05.80.42, *Groundwater Sampling* (purge water); the WBF Plant-specific waste management plan; and local, state, and federal regulations. Transportation and disposal of IDW was coordinated with WBF Plant facility management. Used calibration solution was containerized and stored for disposal as directed by the WBF Plant facility management. Purge water and decontamination fluids were containerized for later disposal as specified in the WBF Plant-specific waste management plan. Used disposable PPE (e.g., nitrile gloves) and general trash generated throughout the day were placed in garbage bags and disposed of in a general trash dumpster onsite at the end of each day.

3.5 SAMPLE SHIPMENT

Samples were packed and shipped under *COC* procedures specified in ENV-TI-05.80.06, *Handling and Shipping of Samples*. The samples were shipped by FedEx to GEL in Charleston, South Carolina (radium samples only), and to TestAmerica in Pittsburgh, Pennsylvania (other analytes). The laboratories submitted sample receipt confirmation forms to EnvStds for review and confirmation.

3.6 VARIATIONS

The proposed scope and procedures for the groundwater investigation were outlined in the SAP, QAPP, and applicable TVA TIs as detailed in the sections above. No variations in scope or procedures were documented during field activities.

4.0 SUMMARY

The data presented in this report are only for groundwater investigation sampling Event #1 at the WBF Plant. The scope of work for Event #1 was to:

- Collect groundwater samples for chemical analyses to assist with subsequent evaluation of the potential presence of CCR-related constituents in groundwater
- Measure groundwater and surface water elevations to assist with subsequent evaluation of groundwater flow direction and rate after multiple data sets have been collected.

In addition, pore water measurements from piezometers and temporary wells installed in the CCR units at the WBF Plant are presented in this SAR for comparison with groundwater data.

Event #1 included collecting groundwater level measurements at 10 monitoring wells and three piezometers; pore water measurements at four temporary wells and three piezometers in the CCR units; and a surface water measurement at one gauge located in the Tennessee River. Groundwater and surface water measurements and elevations are provided in Table B.1a, and pore water measurements and elevations are provided in Table B.1b and depicted on Exhibits A.2 and A.3.

Groundwater quality measurements and groundwater analytical samples were collected at six monitoring wells as summarized in Table B.2. Groundwater quality parameters were recorded during purging. Stabilization criteria for pH, specific conductance, turbidity, and DO were achieved at the six sampling locations. Well WBF-102 was sampled as a low yield well on August 28, 2019 due to insufficient water volume following field parameter stabilization on August 27, 2019. The final stabilized measurements prior to initiating sample collection are presented in Table B.3.

Groundwater analytical data for CCR Parameters and geochemical parameters are presented in Table B.4. Analytical data for radium analyses are presented in Table B.5. Analytical data were reported by GEL and TestAmerica, and then validated or verified by EnvStds.

Stantec has completed Event #1 of the groundwater investigation at the WBF Plant in Spring City, Tennessee, in accordance with the Groundwater Investigation SAP as documented herein. The data collected during Event #1 are usable for reporting and evaluation in the EAR and meet the objectives of the TDEC Order EIP. The complete datasets from the six groundwater sampling events will be evaluated along with data collected under other TDEC Order SAPs, as well as data collected under other State and CCR programs. This evaluation will be provided in the EAR.

5.0 REFERENCES

Environmental Standards, Inc. 2018. *Quality Assurance Project Plan for the Tennessee Valley Authority Watts Bar Fossil Plant Environmental Investigation*. Revision 2. November 2018.

Stantec Consulting Services Inc. (Stantec). 2018a. *Groundwater Investigation Sampling and Analysis Plan, Watts Bar Fossil Plant.* Revision 3. Prepared for Tennessee Valley Authority. November 19, 2018.

Stantec. 2018b. *Environmental Investigation Plan, Watts Bar Fossil Plant.* Revision 3. Prepared for Tennessee Valley Authority. November 19, 2018.

Tennessee Department of Environment and Conservation. 2015. *Commissioner's Order No. OGC15-0177.*

Tennessee Valley Authority (TVA). ENV-TI-05.80.02, *Sample Labeling and Custody*.

TVA. ENV-TI-05.80.03, *Field Record Keeping*.

TVA. ENV-TI-05.80.04, *Field Sampling Quality Control*.

TVA. ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*.

TVA. ENV-TI-05.80.06, *Handling and Shipping of Samples*.

TVA. ENV-TI-05.80.21, *Monitoring Well Inspection and Maintenance*.

TVA. ENV-TI-05.80.42, *Groundwater Sampling*.

TVA. ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*.

TVA. ENV-TI-05.80.46, *Field Measurement Using a Multi-Parameter Sonde*.

APPENDIX A - EXHIBITS

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Exhibit No.
A.1

Title
Monitoring Well Network

Client/Project
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2021-04-20
Technical Review by MW on 2021-04-20

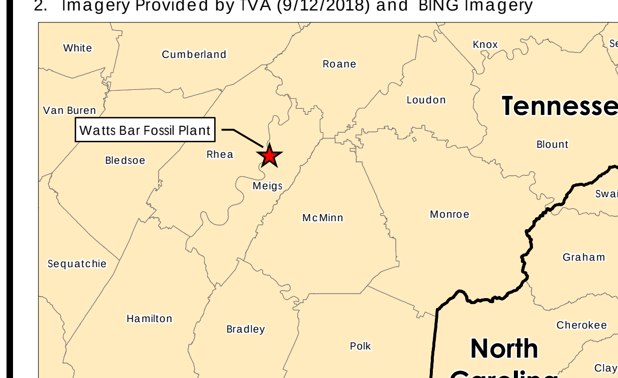
0 150 300 450 600 Feet
1:1,800 (At original document size of 22x34)

Legend

- Groundwater Investigation Monitoring Well
- Other Monitoring Well
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary Well within CCR Material
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

CCR: Coal combustion residuals

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery



Stantec TVA

Exhibit No.

A.2

Title

Groundwater Elevation Contour Map, Event #1 (August 26, 2019)

Client/Project

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location 175668050

Spring City, Tennessee

Prepared by DMB on 2021-04-20
Technical Review by MD on 2021-04-20

0 150 300 450 600 Feet

1:1,800 (At original document size of 22x34)

Legend

- Groundwater Investigation Monitoring Well groundwater elevation in feet above mean sea level (ft amsl)
- Other Monitoring Well groundwater elevation in ft amsl
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary well in CCR pore water elevation in ft amsl; value not used for contouring
- Interpolated Groundwater Contour (5 ft interval; elevations are in ft amsl)
- Groundwater Contour (5 ft interval; elevations are in ft amsl)
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

CCR: Coal combustion residuals

River Gauge (Not Shown - See Note 4) surface water elevation in ft amsl

*Groundwater elevation displayed but not used as input for contouring due to factors such as well construction or being screened in a different hydrogeologic unit.

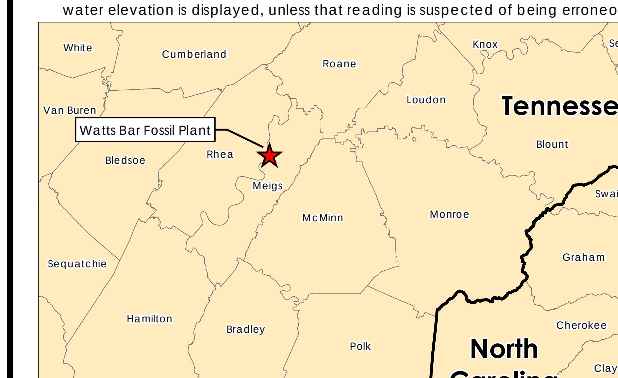
** Piezometer was not collecting groundwater measurements during this monitoring event.

*** Nested VWPZ sensors monitoring pore water and groundwater elevations in the same borehole, and the location is shown by a single symbol.

dry: water was not detected

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery
3. Groundwater contours were created using Surfer Version 16.1.350 (December 13, 2018) and manual adjustment
4. Surface water elevation is measured from the tailwater reading from Watts Bar Dam located ~4,000 ft North of well WBF-106
5. For PZ's with multiple instruments in CCR material, the reading with the highest pore water elevation is displayed, unless that reading is suspected of being erroneous.



Stantec TVA

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Exhibit No.

A.3

Title

Pore Water Elevation Contour Map, Event #1 (August 26, 2019)

Client/Project

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location

Spring City, Tennessee

175668050

Prepared by DMB on 2021-04-20
Technical Review by MD on 2021-04-20

0 150 300 450 600 Feet

1:1,800 (At original document size of 22x34)

Legend

- Groundwater Investigation Monitoring Well
  groundwater elevation in feet above mean sea level (ft amsl); value not used for contouring
- Other Monitoring Well
  groundwater elevation in ft amsl; value not used for contouring
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary well in CCR
  pore water elevation in ft amsl
- Pore water Contour (2 ft interval; elevations are in ft amsl)
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

CCR: Coal combustion residuals

River Gauge (Not Shown - See Note 4) surface water elevation in ft amsl

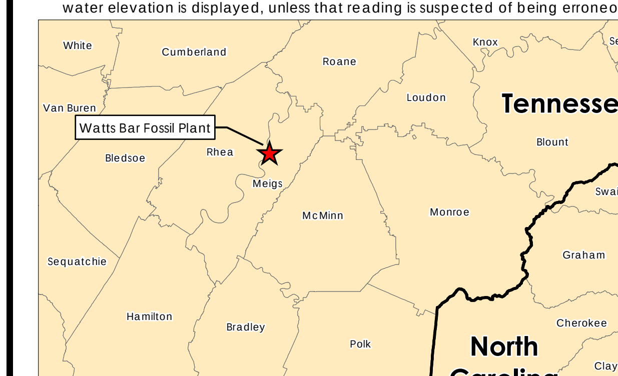
*Groundwater elevation displayed but not used as input for contouring due to factors such as well construction or being screened in a different hydrogeologic unit.

*** Nested VWPZ sensors monitoring pore water and groundwater elevations in the same borehole, and the location is shown by a single symbol.

dry: water was not detected

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery
3. Pore water contours were created with manual adjustment using Surfer Version 16 (December 13, 2018)
4. Surface water elevation is measured from the tailwater reading from Watts Bar Dam located ~4,000 ft North of well WBF-106
5. For PZ's with multiple instruments in CCR material, the reading with the highest pore water elevation is displayed, unless that reading is suspected of being erroneous.



Stantec TVA

U:\TVA-EP\175668050_WBF_WorkPlans\gis\mxd\GW_Tech_Memo\WBF_GWTechMemo_FigA3_PorewaterContour_wPZ_Event1_porewater.mxd Revised: 2021-04-20 By: mbough

APPENDIX B - TABLES

TABLE B.1a – Groundwater Level Measurements
Watts Bar Fossil Plant
August 2019

UNID	Well / Piezometer ID	Date Measured	Depth to Groundwater	Top of Casing Elevation	Groundwater Elevation	Piezometer Ground Surface Elevation	Piezometer Sensor Elevation	Piezometer Sensor Depth	Screened Interval	Screened / Piezometer Sensor Formation
			ft btoc	ft msl	ft msl	ft msl	ft msl	ft bgs	ft btoc	
Monitoring Wells										
WBF-00-GW-43-001	MW-1	26-Aug-19	8.58	711.92	703.34	n/a	n/a	n/a	23.3 - 33.3	Alluvial silts and clays
WBF-00-GW-43-002	MW-2	26-Aug-19	20.04	704.29	684.25	n/a	n/a	n/a	22.7 - 32.4	Alluvial sand
WBF-00-GW-43-003	MW-3	26-Aug-19	12.95	696.22	683.27	n/a	n/a	n/a	21.6 - 31.6	Alluvial sand
WBF-00-GW-43-004	WBF-100	26-Aug-19	42.75	741.49	698.74	n/a	n/a	n/a	47.7 - 57.8	Alluvial sand / alluvial silts and clays
WBF-00-GW-43-005	WBF-101	26-Aug-19	15.70	703.15	687.45	n/a	n/a	n/a	27.3 - 37.1	Alluvial clay and silts / alluvial sand
WBF-00-GW-43-006	WBF-102	26-Aug-19	22.37	723.98	701.61	n/a	n/a	n/a	19.4 - 24.2	Alluvial sand with clay
WBF-00-GW-43-007	WBF-103	26-Aug-19	14.96	725.09	710.13	n/a	n/a	n/a	17.0 - 21.8	Alluvial sand with clay / alluvial sand
WBF-00-GW-43-008	WBF-104	26-Aug-19	14.11	697.45	683.34	n/a	n/a	n/a	21.5 - 31.3	Alluvial clay and silts / alluvial sand
WBF-00-GW-43-009	WBF-105	26-Aug-19	13.56	704.50	690.94	n/a	n/a	n/a	32.2 - 37.0	Alluvial silty sand
WBF-00-GW-43-010	WBF-106	26-Aug-19	14.24	706.34	692.10	n/a	n/a	n/a	27.8 - 37.6	Alluvial clay / alluvial silty sand and alluvial sand
Piezometers										
n/a	WBF-B02C	26-Aug-19	11.9	n/a	707.2	719.1	680.5	38.6	n/a	Alluvial sandy silt
n/a	WBF-B03B	29-Aug-19	NM	n/a	NM	699.9	665.9	34.0	n/a	Alluvial sand with silt and gravel
n/a	WBF-B04C	26-Aug-19	13.4	n/a	700.0	713.4	668.4	45.0	n/a	Alluvial silty sand / alluvial sandy gravel
n/a	WBF-B05C	26-Aug-19	12.4	n/a	704.8	717.2	668.2	49.0	n/a	Alluvial silty sand
Surface Water Gauge										
Tennessee River	n/a	26-Aug-19	n/a	n/a	683.79	n/a	n/a	n/a	n/a	n/a

Notes:

bgs	below ground surface
btoc	below top of casing
ft	feet
ID	identification
msl	mean sea level
n/a	not applicable
NM	not measured
UNID	Unique Numerical Identification

1. Top of casing elevations, screened intervals, and screened formations were obtained from the TVA Well Inventory Log provided by TVA.
2. Tennessee River data point is the reading closest to noon recorded by the automated staff gauge provided by TVA.
3. Ground surface elevations, groundwater elevations, and piezometer data were obtained from geotechnical instrumentation database. Piezometer sensor formations were obtained from boring logs. Data from vibrating wire piezometers were averaged for the measurement date.
4. Depth to groundwater in piezometers and groundwater elevations at all locations are calculated values. Accuracy of piezometer data is to 0.1 ft.
5. Groundwater level was not measured in the piezometer as noted above because the sensor was not recording data.

TABLE B.1b – Pore Water Level Measurements
Watts Bar Fossil Plant
August 2019

Temporary Well / Piezometer ID	Date Measured	Depth to Pore Water	Top of Casing Elevation	Pore Water Elevation	Piezometer Ground Surface Elevation	Piezometer Sensor Elevation	Piezometer Sensor Depth	Screened Interval	Screened / Piezometer Sensor Formation
		ft btoc	ft msl	ft msl	ft msl	ft msl	ft bgs	ft bgs	
Temporary Wells									
WBF-TW02	26-Aug-19	dry	718.34	dry	n/a	n/a	n/a	9.1 - 18.9	CCR
WBF-TW03	26-Aug-19	18.09	721.19	703.10	n/a	n/a	n/a	15.8 - 25.6	CCR
WBF-TW04	26-Aug-19	12.85	719.27	706.42	n/a	n/a	n/a	7.5 - 17.3	CCR
WBF-TW05	26-Aug-19	14.37	717.97	703.60	n/a	n/a	n/a	11.5 - 16.3	CCR
Piezometers									
WBF-B02A	26-Aug-19	8.0	n/a	711.1	719.1	699.5	19.6	n/a	CCR
WBF-B04A	26-Aug-19	9.4	n/a	704.0	713.4	696.4	17.0	n/a	CCR
WBF-B05A	26-Aug-19	13.2	n/a	704.0	717.2	696.2	21.0	n/a	CCR

Notes:

bgs	below ground surface
btoc	below top of casing
CCR	coal combustion residuals
dry	water was not detected
ft	feet
ID	identification
msl	mean sea level
n/a	not applicable

1. Top of casing elevations, screened intervals, and screened formations were obtained from boring logs, well details, and well survey data.

2. For piezometers, ground surface elevations, pore water elevations, and piezometer data were obtained from geotechnical instrumentation database. Piezometer sensor formations were obtained from boring logs. Data from vibrating wire piezometers were averaged for the measurement date.

3. Depth to pore water in piezometers and pore water elevations at all locations are calculated values. Accuracy of piezometer data is to 0.1 ft.

4. Screened interval shown for temporary wells is below ground surface when drilled.

TABLE B.2 – Summary of Groundwater Samples
Watts Bar Fossil Plant
August 2019

			Analysis Type								
Location ID	**Sample ID**	**Sample Type**	Field Parameters	Total Metals	Total Mercury	Anions	Alkalinity	Total Dissolved Solids	Radium-226	Radium-228	Radium-226+228
WBF-101	WBF-GW-005-20190827	Normal Environmental Sample	x	x	x	x	x	x	x	x	x
WBF-102	WBF-GW-006-20190828	Normal Environmental Sample	x	x	x	x	x	x	x	x	x
WBF-103	WBF-GW-007-20190827	Normal Environmental Sample	x	x	x	x	x	x	x	x	x
WBF-104	WBF-GW-008-20190827	Normal Environmental Sample	x	x	x	x	x	x	x	x	x
WBF-105	WBF-GW-009-20190828	Normal Environmental Sample	x	x	x	x	x	x	x	x	x
WBF-106	WBF-GW-010-20190828	Normal Environmental Sample	x	x	x	x	x	x	x	x	x
	WBF-GW-DUP01-20190828	Field Duplicate Sample		x	x	x	x	x	x	x	x

Notes:

Total and Dissolved Metals	SW-846 6020A
Total and Dissolved Mercury	SW-846 7470A
Anions	SW-846 9056A
Alkalinity	SM2320B
Total Dissolved Solids	SM2540C
Radium-226	EPA 903.0
Radium-228	EPA 904.0
Radium-226+228	CALC
ID	identification

1. Field and laboratory quality control sample results except for field duplicates are not included in report tables but were used for data validation.

TABLE B.3 – Summary of Groundwater Quality Parameters
Watts Bar Fossil Plant
August 2019

Sample Location Sample Date Sample ID Sample Depth Sample Type Level of Review	Units	WBF-101 27-Aug-19 WBF-GW-005-20190827 32.2 ft Normal Environmental Sample Final QC Review	WBF-102 28-Aug-19 WBF-GW-006-20190828 23 ft Normal Environmental Sample Final QC Review	WBF-103 27-Aug-19 WBF-GW-007-20190827 19.5 ft Normal Environmental Sample Final QC Review	WBF-104 27-Aug-19 WBF-GW-008-20190827 26.4 ft Normal Environmental Sample Final QC Review	WBF-105 28-Aug-19 WBF-GW-009-20190828 35.1 ft Normal Environmental Sample Final QC Review	WBF-106 28-Aug-19 WBF-GW-010-20190828 32.6 ft Normal Environmental Sample Final QC Review
Field Parameters							
Dissolved Oxygen	%	7.2	8.0	11.4	21.0	4.0	2.5
Dissolved Oxygen	mg/L	0.64	0.74	1.04	1.82	0.35	0.24
ORP	mV	-105.8	55.4	248.0	149.0	-125.0	-66.5
pH (field)	SU	6.67	6.38	5.48	5.50	6.53	6.32
Specific Cond. (Field)	uS/cm	666	1,551	989.7	2,645	972	1,122
Temperature, Water (C)	DEG C	21.5	19.7	19.8	22.4	21.6	20.4
Turbidity, field	NTU	6.59	1.22	1.56	1.81	4.32	8.15

Notes:

%	percent
Cond.	conductance
DEG C	degrees Celsius
ft	feet below top of casing
ID	identification
mg/L	milligrams per Liter
mV	milliVolts
NTU	Nephelometric Turbidity Unit
ORP	Oxidation Reduction Potential, measured using a silver reference electrode which has a standard potential of 200 mV
SU	Standard Units
uS/cm	microSiemens per centimeter

1. Well WBF-102 had insufficient water for sampling following stabilization of water quality parameters on August 27, 2019. Field parameters shown above are final stabilized parameters from August 27, 2019. The groundwater level in the well recovered to 80% of its initial static level and was sampled on August 28, 2019.

TABLE B.4 - Groundwater Analytical Results for Metals, Anions, and General Chemistry
Watts Bar Fossil Plant
August 2019

Sample Location				WBF-101	WBF-102	WBF-103	WBF-104	WBF-105	WBF-106	
Sample Date				27-Aug-19	28-Aug-19	27-Aug-19	27-Aug-19	28-Aug-19	28-Aug-19	28-Aug-19
Sample ID				WBF-GW-005-20190827	WBF-GW-006-20190828	WBF-GW-007-20190827	WBF-GW-008-20190827	WBF-GW-009-20190828	WBF-GW-010-20190828	WBF-GW-DUP01-20190828
Sample Depth				32.2 ft	23 ft	19.5 ft	26.4 ft	35.1 ft	32.6 ft	32.6 ft
Sample Type				Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample
Level of Review	Units	EPA MCLs	CCR Rule GWPS	Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified
Total Metals										
Antimony	ug/L	6[A]	n/v	<0.378	<0.378	<0.378	<0.378	0.563 U*	<0.378	<0.378
Arsenic	ug/L	10[A]	n/v	1.31	0.495 J	<0.323	0.701 J	1.32	1.70	1.72
Barium	ug/L	2,000[A]	n/v	466	61.5	120	21.1	112	51.4	51.0
Beryllium	ug/L	4[A]	n/v	0.213 J	<0.182	<0.182	0.182 J	<0.182	<0.182	<0.182
Boron	ug/L	n/v	n/v	51.8 U*	105 U*	80.2 U*	4,940	52.3 U*	57.7 U*	43.1 U*
Cadmium	ug/L	5[A]	n/v	<0.125	0.178 J	<0.125	**7.60[A]**	<0.125	<0.125	<0.125
Calcium	ug/L	n/v	n/v	105,000	309,000	21,600	581,000	127,000	161,000	163,000
Chromium	ug/L	100[A]	n/v	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53	1.61 J
Cobalt	ug/L	n/v	6[B]	0.782	**11.1[B]**	1.03	**437[B]**	0.151 J	2.19	2.13
Copper	ug/L	n/v	n/v	<0.627	1.02 J	<0.627	1.06 J	0.930 J	<0.627	0.723 J
Lead	ug/L	n/v	15[B]	<0.128	<0.128	<0.128	0.232 J	<0.128	0.251 J	0.226 J
Lithium	ug/L	n/v	40[B]	<3.39	3.46 U*	<3.39	5.98 U*	5.46 U*	3.81 U*	4.42 U*
Magnesium	ug/L	n/v	n/v	13,600	55,800	4,670	69,700	19,100	34,800	35,000
Mercury	ug/L	2[A]	n/v	0.160 J	<0.101	<0.101	<0.101	<0.101	<0.101	<0.101
Molybdenum	ug/L	n/v	100[B]	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610
Nickel	ug/L	100(TN MCL)[A]	n/v	<0.336	2.21	2.70	65.6	<0.336	0.359 J	0.469 J
Potassium	ug/L	n/v	n/v	919	1,580	4,450	1,610	894	1,010	1,020
Selenium	ug/L	50[A]	n/v	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51
Silver	ug/L	100(TN MCL)[A]	n/v	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177
Sodium	ug/L	n/v	n/v	10,600	11,800	5,830	29,800	29,700	31,600	31,700
Thallium	ug/L	2[A]	n/v	0.190 J	<0.148	<0.148	<0.148	<0.148	<0.148	<0.148
Vanadium	ug/L	n/v	n/v	<0.991	1.57	0.999 J	1.02	<0.991	<0.991	1.07
Zinc	ug/L	n/v	n/v	3.88 U*	6.25 U*	6.70 U*	102	4.51 U*	5.44 U*	5.06 U*
Anions										
Chloride	mg/L	n/v	n/v	4.60	19.8	5.63	5.03	4.24	3.30	3.38
Fluoride	mg/L	4[A]	n/v	0.0587 J	0.0439 J	<0.0263	<0.0658	0.0790 J	0.0899 J	0.0861 J
Sulfate	mg/L	n/v	n/v	193	664	84.7	1,970	341	527	527
General Chemistry										
Alkalinity, Bicarbonate	mg/L	n/v	n/v	157	367	60.4	70.3	173	140	138
Alkalinity, Carbonate	mg/L	n/v	n/v	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
Alkalinity, Total as CaCO3	mg/L	n/v	n/v	157	367	60.4	70.3	173	140	138
Total Dissolved Solids	mg/L	n/v	n/v	425	1,280	184	2,720	654	878	895

Notes:

A	EPA Maximum Contaminant Level
B	CCR Rule GWPS (Federal Register / Vol. 83, No. 146 / Monday, July 30, 2018 / Rules and Regulations)
n/v	No standard/guideline value
6.5[A]	Concentration is greater than or equal to the indicated standard.
<0.03	analyte was not detected at a concentration greater than the Method Detection Limit
-	parameter not analyzed / not available
ft	feet below top of casing
ID	identification
J	quantitation is approximate due to limitations identified during data validation
mg/L	milligrams per Liter
U*	result should be considered "not detected" because it was detected in an associated field or laboratory blank at a similar level
ug/L	micrograms per Liter
(TN MCL)	Tennessee Maximum Contaminant Level

1. Level of review is defined in the Quality Assurance Project Plan.

Stantec

TABLE B.5 – Groundwater Analytical Results for Radiological Parameters
Watts Bar Fossil Plant
August 2019

Sample Location				WBF-101	WBF-102	WBF-103	WBF-104	WBF-105	WBF-106	
Sample Date				27-Aug-19	28-Aug-19	27-Aug-19	27-Aug-19	28-Aug-19	28-Aug-19	28-Aug-19
Sample ID				WBF-GW-005-20190827	WBF-GW-006-20190828	WBF-GW-007-20190827	WBF-GW-008-20190827	WBF-GW-009-20190828	WBF-GW-010-20190828	WBF-GW-DUP01-20190828
Sample Depth				32.2 ft	23 ft	19.5 ft	26.4 ft	35.1 ft	32.6 ft	32.6 ft
Sample Type				Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample
Level of Review				Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified
	Units	EPA MCLs	CCR Rule GWPS							
Radiological Parameters										
Radium-226	pCi/L	n/v	n/v	0.624 +/-(0.579)U	0.477 +/-(0.594)U	0.539 +/-(0.601)U	0.541 +/-(0.608)U	0.847 +/-(0.698)U	0.623 +/-(0.591)U	0.342 +/-(0.539)U
Radium-228	pCi/L	n/v	n/v	0.535 +/-(0.466)U	0.225 +/-(0.389)U	0.208 +/-(0.347)U	-0.0176 +/-(0.367)U	0.0921 +/-(0.352)U	0.519 +/-(0.407)U	0.260 +/-(0.446)U
Radium-226+228	pCi/L	5[A]	n/v	1.16 +/-(0.743)U	0.702 +/-(0.710)U	0.747 +/-(0.694)U	0.541 +/-(0.710)U	0.939 +/-(0.782)U	1.14 +/-(0.718)U	0.602 +/-(0.700)U

Notes:

A	EPA Maximum Contaminant Level
B	CCR Rule GWPS (Federal Register / Vol. 83, No. 146 / Monday, July 30, 2018 / Rules and Regulations)
n/v	No standard/guideline value
ft	feet below top of casing
ID	identification
pCi/L	picoCurie per Liter
U	not detected

1. Level of review is defined in the Quality Assurance Project Plan.

APPENDIX H.4

GROUNDWATER INVESTIGATION EVENT #2 SAMPLING AND ANALYSIS REPORT

Watts Bar Fossil Plant Groundwater Investigation Event #2 Sampling and Analysis Report

TDEC Commissioner's Order:
Environmental Investigation Plant
Watts Bar Fossil Plant
Spring City, Tennessee

April 23, 2021

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

Revision Record

Revision	Description	Date
0	Submittal to TDEC	April 23, 2021

Sign-off Sheet

This document entitled Watts Bar Fossil Plant Groundwater Investigation Event #2 Sampling and Analysis Report was prepared by Stantec Consulting Services Inc. ("Stantec") for the account of Tennessee Valley Authority (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

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Rebekah Brooks, Principal Hydrogeologist.

Table of Contents

Abbreviations

CCR	Coal Combustion Residuals
CCR Parameters	Constituents listed in Appendices III and IV of 40 CFR 257 and five inorganic constituents included in Appendix I of Tennessee Rule 0400-11-01-.04
CEC	Civil and Environmental Consultants, Inc.
CFR	Code of Federal Regulations
COC	Chain-of-Custody
DO	Dissolved Oxygen
EAR	Environmental Assessment Report
EIP	Environmental Investigation Plan
ENV	Environmental
EnvStds	Environmental Standards, Inc.
Event #2	Groundwater investigation sampling event performed October 28-31, 2019
FSP	Field Sampling Personnel
ft	Feet
GEL	GEL Laboratories LLC
ID	Identification
IDW	Investigation Derived Waste
mg/L	Milligrams per Liter
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
ORP	Oxidation-Reduction Potential
PPE	Personal Protective Equipment
QAPP	Quality Assurance Project Plan
QC	Quality Control
SAP	Sampling and Analysis Plan
SAR	Sampling and Analysis Report
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Commissioner’s Order No. OGC15-0177
TestAmerica	Eurofins TestAmerica Inc.
TI	Technical Instruction
TVA	Tennessee Valley Authority
WBF Plant	Watts Bar Fossil Plant

1.0 INTRODUCTION

Stantec Consulting Services Inc. (Stantec) has prepared this sampling and analysis report (SAR) on behalf of the Tennessee Valley Authority (TVA) to document the completion of activities related to a groundwater investigation sampling event performed October 28-31, 2019 (Event #2) at TVA's Watts Bar Fossil Plant (WBF Plant) located in Spring City, Tennessee.

The purpose of the groundwater investigation, upon completion of six groundwater sampling events, is to characterize groundwater conditions at the WBF Plant in support of fulfilling the requirements for the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA (TDEC 2015). The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee.

The purpose of this SAR is to document the work completed during groundwater sampling Event #2 of 6 total events and to present the information and data collected during the execution of the Groundwater Investigation Sampling and Analysis Plan (SAP) (Stantec 2018a). This SAR is not intended to provide conclusions or evaluations of results. The scope of the groundwater investigation represented herein was conducted pursuant to the SAP and is part of a larger environmental investigation at the WBF Plant. The data provided in this SAR are not inclusive of other programmatic data that exist for the site. The evaluation of the results will include data from the six groundwater sampling events and consider other aspects of the environmental investigation, as well as data collected under other State and/or coal combustion residuals (CCR) programs. This evaluation will be presented in the Environmental Assessment Report (EAR).

Event #2 activities were performed in general accordance with the following documents developed by TVA to support fulfilling the requirements of the TDEC Order at the WBF Plant.

- *Groundwater Investigation SAP* (Stantec 2018a)
- *Environmental Investigation Plan (EIP)* (Stantec 2018b)
- *Quality Assurance Project Plan (QAPP)* (Environmental Standards, Inc. 2018).

The Groundwater Investigation SAP was updated based on TVA- and TDEC-approved Programmatic- and Project-specific changes. Minor variations in scope and procedures from those outlined in the SAP occurred during field activities due to field conditions and programmatic updates and are referenced in Section 3.6.

Event #2 is the second in a series of six planned sampling events for the groundwater investigation. Stantec performed the field work activities for this event. Laboratory analysis of constituents was performed by GEL Laboratories LLC (GEL) in Charleston, South Carolina (radium samples only) and Eurofins TestAmerica, Inc. (TestAmerica) in Pittsburgh, Pennsylvania (other analytes). Quality assurance

oversight on data acquisition protocols, sampling practices, and data validation or verification was performed by Environmental Standards, Inc. (EnvStds) under direct contract to TVA.

This report summarizes the groundwater investigation activities for Event #2. The remaining sampling events will be completed before overall conclusions and findings about the groundwater investigation and groundwater conditions at the WBF Plant are made and documented in the EAR.

2.0 OBJECTIVE AND SCOPE

The primary objectives of the groundwater investigation conducted pursuant to the Groundwater Investigation SAP (which includes six sampling events) are to characterize existing groundwater quality and to evaluate groundwater flow conditions at the WBF Plant in response to the TDEC Order. The approach to characterizing the groundwater conditions is to:

- Collect groundwater samples for chemical analyses to evaluate the potential presence of constituents related to CCR in groundwater
- Measure groundwater and surface water elevations for subsequent evaluation of direction and rate of groundwater flow.

The scope of work intended to achieve the objectives of the groundwater investigation consists of six sampling events at a frequency of one event every two months for one year to characterize seasonal groundwater quality and flow direction. This report describes the activities related to Event #2, performed in October 2019, the scope of which included:

- Collecting groundwater and surface water level measurements
- Collecting field measurements of groundwater quality parameters
- Collecting groundwater samples and associated quality control (QC) samples for laboratory analysis.

These activities were carried out after the installation of permanent monitoring wells specified in the Groundwater Investigation SAP. Details of the monitoring well installation activities are provided in the WBF Plant Hydrogeological Investigation SAR.

In addition, pore water measurements from piezometers and temporary wells installed in the CCR units at the WBF Plant are presented in this SAR for comparison with groundwater data. Temporary well and piezometer installation activities are described in the WBF Plant Exploratory Drilling SAR, and temporary well gauging and sampling information is provided in the WBF Plant CCR Material Characteristics SAR.

3.0 FIELD ACTIVITIES

Groundwater investigation field activities for Event #2 were conducted October 28-31, 2019. Stantec performed groundwater level measurements and sample collection activities based on guidance and specifications in TVA's Environmental (ENV) Technical Instructions (TIs), the SAP, the QAPP, and applicable United States Environmental Protection Agency documents except as noted in the Variations section of this report. As part of TVA's commitment to generate representative and reliable data, data validation and/or verification of laboratory analytical results were performed by EnvStds under direct contract with TVA. EnvStds also conducted audits of field activities and provided quality reviews of field documentation. In addition, on behalf of TDEC, Civil and Environmental Consultants, Inc. (CEC) collected split groundwater samples during this sampling event. Additional information regarding CEC split sample collection is provided in Section 3.3.2.

During Event #2, Stantec conducted the following field activities:

- Measured groundwater levels at six monitoring wells installed for the TDEC Order and three monitoring wells and four piezometers installed for other environmental programs (nine total monitoring wells)
- Measured pore water levels at four temporary wells and three piezometers installed in the CCR units
- Measured the surface water level at one location in the Tennessee River
- Collected groundwater samples from six monitoring wells installed for the TDEC Order
- Recorded field measurements of groundwater quality parameters during purging and stabilization at the sampled monitoring wells
- Collected QC samples including one field duplicate, one matrix spike/matrix spike duplicate, three field blanks, two equipment blanks, and one tubing blank
- Shipped the collected samples to GEL in Charleston, South Carolina, and TestAmerica in Pittsburgh, Pennsylvania.

Details on each activity are presented in the sections below.

3.1 WORK LOCATIONS

The TDEC Order CCR units at the WBF Plant (Ash Pond and Slag Disposal Area) as well as the monitoring wells, temporary wells, and piezometers sampled and/or gauged during Event #2 are shown on Exhibit A.1 in Appendix A. TVA is currently sampling groundwater at the WBF Plant for the National Pollutant Discharge Elimination System (NPDES) permit closure program. Monitoring wells that are sampled as part of other environmental programs are not sampled as part of the groundwater investigation for the TDEC Order.

Groundwater levels were measured in TDEC Order monitoring wells as well as in select additional wells and piezometers from other environmental programs, as shown in Table B.1a in Appendix B, to provide information to prepare groundwater contour maps for this SAR and the WBF Plant EAR. Pore water levels measured in temporary wells and piezometers installed in the CCR units are presented in Table B.1b. Groundwater and pore water elevations are shown on Exhibits A.2 and A.3 in Appendix A. Groundwater elevation contours are depicted on Exhibit A.2, and pore water elevation contours are depicted on Exhibit A.3.

Groundwater analytical and field duplicate samples were collected from the TDEC Order groundwater investigation monitoring wells as shown in Table B.2 in Appendix B. Groundwater analytical data collected for the TDEC Order and the NPDES permit closure program, which includes wells MW-1, MW-2, MW-3, and WBF-100, will be provided in the EAR.

3.2 DOCUMENTATION

Stantec maintained field documentation in accordance with ENV-TI-05.80.03, *Field Record Keeping*, and the QAPP. Field activities and data were recorded on program-specific field forms. Health and safety forms were completed in accordance with TVA and Stantec health and safety requirements. Additional information regarding field documentation is provided below.

3.2.1 Field Forms

Stantec used program-specific field forms to record field observations and data for specific activities. Field forms used during the groundwater investigation included:

- *Daily Field Activity Log*
- *Monitoring Well Inspection Checklist*
- *Equipment Calibration Form*
- *Groundwater Level Measurement Form*
- *Vibrating Wire Piezometer Measurement Form*
- *Groundwater Sampling Form*
- *Chain-of-Custody (COC).*

3.2.1.1 Daily Field Activity Log

Stantec field sampling personnel (FSP) recorded field activities, observations, and data on a *Daily Field Activity Log* to chronologically document the field program. Deviations from the SAP, TIs, or QAPP were documented on the *Daily Field Activity Log*.

3.2.1.2 Monitoring Well Inspection Checklist

Prior to measuring water levels, Stantec FSP inspected each monitoring well for damage or indications that the well integrity had been compromised in accordance with ENV-TI-05.80.21, *Monitoring Well Inspection and Maintenance.* Inspection results were documented on a *Monitoring Well Inspection Checklist*. No signs of damage or necessary repairs were noted during Event #2.

3.2.1.3 Equipment Calibration Form

Stantec FSP performed daily calibration of the water quality meter and turbidity meter and documented the results on an *Equipment Calibration Form*. The form documented the calibration results for temperature, turbidity, specific conductance, pH, dissolved oxygen (DO), and oxidation-reduction potential (ORP), and verified that the field instruments' sensors were operating within acceptance criteria. Refer to Section 3.2.2 for additional details on equipment calibration procedures.

3.2.1.4 Groundwater Level Measurement Form

Stantec FSP recorded groundwater level field measurement data on a *Groundwater Level Measurement Form* in accordance with ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*. The form includes the monitoring well identification (ID), time, and depth to water measured from a standardized reference point on the top of each well casing, recorded in feet (ft) below top of casing.

3.2.1.5 Vibrating Wire Piezometer Measurement Form

Stantec FSP recorded field measurement data on a *Vibrating Wire Piezometer Measurement Form*. The form includes the vibrating wire piezometer ID, serial number, time, digits, temperature, and length of the wire in ft. The readings were used to calculate the pressure head (ft of water) above the vibrating wire sensor to obtain the groundwater or pore water elevation.

3.2.1.6 Groundwater Sampling Form

Stantec FSP recorded the depth to water, purge flow rate, volume of groundwater purged, temperature, pH, specific conductance, DO, ORP, turbidity, color of water, and other observations during groundwater purging and sampling activities at each monitoring well in accordance with ENV-TI-05.80.42, *Groundwater Sampling*. Field measurements were recorded on a *Groundwater Sampling Form*. The form also documents the time intervals between measurement of field parameters, low-flow extraction rates, water level drawdown, and water quality parameter measurements until stabilization criteria were met.

3.2.1.7 Chain-of-Custody

Stantec FSP completed *COC* documentation for each groundwater sample collected. The sample ID, sample location, type of sample, sampling date and time, analyses requested, sample pH, and sample custody record were recorded on the *COC*. The Field Team Leader reviewed the *COC* for completeness, and the FSP conducted a QC check of samples in each cooler compared to sample IDs on the corresponding *COC*. *COCs* were completed in accordance with ENV-TI-05.80.02, *Sample Labeling and Custody*.

3.2.2 Equipment Calibration

Field instruments used to collect, generate, or measure water quality parameters were calibrated each day prior to use as specified in the SAP, QAPP, and ENV-TI-05.80.46, *Field Measurement Using a Multi-Parameter Sonde.* Afternoon calibration verifications were performed to evaluate if these instruments remained within acceptance criteria during sampling. Temperature and barometric pressure instrument readings were verified using a calibrated National Institute of Standards and Technology traceable thermometer and National Weather Service (via mesowest.utah.edu) barometric pressure readings for Lovell Field (KCHA) in Chattanooga, Tennessee, respectively. Additional details regarding equipment calibration were recorded on an *Equipment Calibration Form*, as described in Section 3.2.1.3.

3.3 SAMPLING METHODS

The following sections present monitoring well data collection and sampling procedures used during Event #2.

3.3.1 Static Water Level Measurements

FSP measured static groundwater levels at nine monitoring wells and pore water levels at four temporary wells in accordance with ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*. On October 28, 2019, static groundwater and pore water level readings were measured and recorded to the nearest 0.01 ft from a reference point on the top of each well casing using an electronic water level indicator. Water level indicator probes were decontaminated prior to the first use and between measurements, and the decontamination was documented as specified in ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination.* Depth to groundwater and pore water measurements were recorded on a *Groundwater Level Measurement Form*. A groundwater level measurement could not be obtained at monitoring well MW-2 because the water level was below the dedicated pump intake depth.

Groundwater and pore water measurements were also obtained from transducers installed within four piezometers and three piezometers, respectively. Additionally, a surface water level measurement for the Tennessee River was provided by TVA using the reading recorded closest to noon for the tailwater level below the Watts Bar Dam. The surface water staff gauge location is indicated on Exhibit A.1 in Appendix A.

Groundwater level data and pore water level data are shown in Tables B.1a and B.1b, respectively, in Appendix B. A groundwater elevation contour map based on groundwater measurements in wells and piezometers, along with pore water elevations, is included as Exhibit A.2 in Appendix A. Similarly, a pore water elevation contour map based on pore water measurements in wells and piezometers, along with groundwater elevations, is included as Exhibit A.3 in Appendix A.

3.3.2 Groundwater Purging & Sampling

Analytical and field duplicate samples (as specified in the SAP) were collected from six monitoring wells as shown in Table B.2 in Appendix B. Split samples collected by CEC during Event #2 are also identified in Table B.2. Monitoring wells were purged using dedicated bladder pumps equipped with dedicated tubing using low-flow purging and sampling techniques as specified in ENV-TI-05.80.42, *Groundwater Sampling*. One exception occurred at well WBF-102 where the initial depth to water was below the dedicated pump intake depth. Therefore, a decontaminated, non-dedicated pump and new disposable tubing were used to obtain that groundwater sample in accordance with ENV-TI-05.80.42.

During the purging process, water quality field parameters including pH, specific conductance, temperature, ORP, and DO were measured using water quality meters (YSI ProPlus with flow-through cell) and recorded on field forms. Depth to water and turbidity were measured and recorded using decontaminated electronic water-level indicators (Heron Dipper-T) and calibrated turbidimeters (Hach 2100Q). Field parameters were measured and recorded on *Groundwater Sampling Forms* during purging until readings were stabilized as specified in the SAP. As approved by TDEC, the specific conductance and turbidity stabilization limits were revised to the values below to meet overall programmatic objectives for groundwater investigations at the WBF Plant. Well purging was considered complete when three consecutive readings were within the following stabilization limits:

- pH – ± 0.1 Standard Units
- Specific Conductance – ± 3% microSiemens per centimeter
- Turbidity – Less than five Nephelometric Turbidity Units (NTUs) or ± 10% for values above five NTUs
- DO – Less than 0.5 milligrams per Liter (mg/L) or ± 10% for values above 0.5 mg/L.

After water quality stabilization criteria were achieved, the final field parameter results were recorded, purging was discontinued, and a sample was collected as specified in the SAP. Laboratory-provided, pre-preserved sample containers were filled directly from the pump discharge line. Turbidity readings at the wells stabilized below five NTUs, therefore samples were not collected for dissolved metals analysis. FSP wore new, clean nitrile gloves when handling sample containers and did not touch the interior of containers or container caps. New gloves were used when handling each sample. When filling sample bottles, care was taken to minimize sample aeration (i.e., water was directed down the inner walls of the sample bottle) and to avoid overfilling and diluting preservatives. Each sample bottle was capped before filling the next bottle. Following completion of sampling, final field parameter measurements were recorded.

Sample containers were labeled and handled in accordance with ENV-TI-05.80.02, *Sample Labeling and Custody.* FSP secured caps on each bottle, attached a custody seal across the cap, and placed the bottles in a cooler on ice within 15 minutes of collection. QC samples were collected in accordance with ENV-TI-05.80.04, *Field Sampling Quality Control.*

Groundwater samples were analyzed for the CCR-related constituents listed in Appendices III and IV of 40 Code of Federal Regulations (CFR) 257. In addition, five inorganic constituents listed in Appendix I of Tennessee Rule 0400-11-01-.04 and not included in the 40 CFR 257 Appendices III and IV were analyzed to maintain continuity with TDEC environmental programs. These additional TDEC Appendix I constituents included copper, nickel, silver, vanadium, and zinc. The combined federal CCR Appendices III and IV constituents and TDEC Appendix I inorganic constituents will hereafter be referred to collectively as “CCR Parameters.” For geochemical evaluation, major cations/anions not included in the CCR Parameters were included in the analyses. The additional geochemical parameters included bicarbonate, carbonate, magnesium, potassium, and sodium.

3.4 INVESTIGATION DERIVED WASTE

Investigation derived waste (IDW) generated during groundwater investigation activities included:

- Used calibration solutions
- Purge water
- Decontamination fluids
- Disposable personal protective equipment (PPE)
- General trash.

IDW was handled in accordance with ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*; ENV-TI-05.80.42, *Groundwater Sampling* (purge water); the WBF Plant-specific waste management plan; and local, state, and federal regulations. Transportation and disposal of IDW was coordinated with WBF Plant facility management. Used calibration solution was containerized and stored for disposal as directed by the WBF Plant facility management. Purge water and decontamination fluids were containerized for later disposal as specified in the WBF Plant-specific waste management plan. Used disposable PPE (e.g., nitrile gloves) and general trash generated throughout the day were placed in garbage bags and disposed of in a general trash dumpster onsite at the end of each day.

3.5 SAMPLE SHIPMENT

Samples were packed and shipped under *COC* procedures specified in ENV-TI-05.80.06, *Handling and Shipping of Samples*. The samples were shipped by FedEx to GEL in Charleston, South Carolina (radium samples only), and to TestAmerica in Pittsburgh, Pennsylvania (other analytes). The laboratories submitted sample receipt confirmation forms to EnvStds for review and confirmation.

3.6 VARIATIONS

The proposed scope and procedures for the groundwater investigation were outlined in the SAP, QAPP, and applicable TVA TIs as detailed in the sections above. Variations in scope or procedures discussed with TDEC and/or TVA, changes based on field conditions, or additional field sampling performed to complete the scope of work in the SAP are described in the following sections. As discussed below, these variations do not impact the overall usability and representativeness of the dataset provided in this SAR for groundwater investigation sampling Event #2 at the WBF Plant.

3.6.1 Variations in Scope

Variations in scope are provided below.

- On October 28, 2019, a static water level measurement was not obtained at well MW-2 because the depth to water was below the dedicated pump intake. A groundwater contour map was prepared based on available static groundwater level measurements made during Event #2 for evaluation in the EAR.

3.6.2 Variations in Procedures

Variations in procedures occurring in the field are provided below.

- As approved by TDEC, the specific conductance and turbidity stabilization limits were revised to meet overall programmatic objectives for groundwater investigations.

4.0 SUMMARY

The data presented in this report are only for groundwater investigation sampling Event #2 at the WBF Plant. The scope of work for Event #2 was to:

- Collect groundwater samples for chemical analyses to assist with subsequent evaluation of the potential presence of CCR-related constituents in groundwater
- Measure groundwater and surface water elevations to assist with subsequent evaluation of groundwater flow direction and rate after multiple data sets have been collected.

In addition, pore water measurements from piezometers and temporary wells installed in the CCR units at the WBF Plant are presented in this SAR for comparison with groundwater data.

Event #2 included collecting groundwater level measurements at nine monitoring wells and four piezometers, pore water measurements at four temporary wells and three piezometers in the CCR units, and a surface water measurement at one gauge located in the Tennessee River. Groundwater and surface water measurements and elevations are provided in Table B.1a, and pore water measurements and elevations are provided in Table B.1b and depicted on Exhibits A.2 and A.3.

Groundwater quality measurements and groundwater analytical samples were collected at six monitoring wells as summarized in Table B.2. Groundwater quality parameters were recorded during purging. Stabilization criteria for pH, specific conductance, turbidity, and DO were achieved at each sampling location. The final measurements prior to initiating sample collection are presented in Table B.3.

Groundwater analytical data for CCR Parameters and geochemical parameters are presented in Table B.4. Analytical data for radium analyses are presented in Table B.5. Analytical data were reported by GEL and TestAmerica, and then validated and/or verified by EnvStds.

Stantec has completed Event #2 of the groundwater investigation at the WBF Plant in Spring City, Tennessee, in accordance with the Groundwater Investigation SAP as documented herein. The data collected during Event #2 are usable for reporting and evaluation in the EAR and meet the objectives of the TDEC Order EIP. The complete datasets from the six groundwater sampling events will be evaluated along with data collected under other TDEC Order SAPs, as well as data collected under other State and CCR programs. This evaluation will be provided in the EAR.

5.0 REFERENCES

Environmental Standards, Inc. 2018. *Quality Assurance Project Plan for the Tennessee Valley Authority Watts Bar Fossil Plant Environmental Investigation*. Revision 2. November 2018.

Stantec Consulting Services Inc. (Stantec). 2018a. *Groundwater Investigation Sampling and Analysis Plan, Watts Bar Fossil Plant.* Revision 3. Prepared for Tennessee Valley Authority. November 19, 2018.

Stantec. 2018b. *Environmental Investigation Plan, Watts Bar Fossil Plant.* Revision 3. Prepared for Tennessee Valley Authority. November 19, 2018.

Tennessee Department of Environment and Conservation. 2015. *Commissioner's Order No. OGC15-0177.*

Tennessee Valley Authority (TVA). ENV-TI-05.80.02, *Sample Labeling and Custody*.

TVA. ENV-TI-05.80.03, *Field Record Keeping*.

TVA. ENV-TI-05.80.04, *Field Sampling Quality Control*.

TVA. ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*.

TVA. ENV-TI-05.80.06, *Handling and Shipping of Samples*.

TVA. ENV-TI-05.80.21, *Monitoring Well Inspection and Maintenance*.

TVA. ENV-TI-05.80.42, *Groundwater Sampling*.

TVA. ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*.

TVA. ENV-TI-05.80.46, *Field Measurement Using a Multi-Parameter Sonde*.

APPENDIX A - EXHIBITS

Exhibit No.

A.1

Title

Monitoring Well Network

Client/Project

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location 175668050

Spring City, Tennessee

Prepared by MB on 2021-04-20
Technical Review by MW on 2021-04-20

0 150 300 450 600 Feet

1:1,800 (At original document size of 22x34)

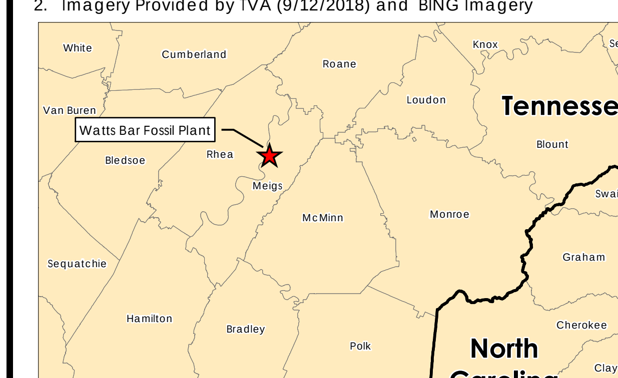
Legend

- Groundwater Investigation Monitoring Well
- Other Monitoring Well
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary Well within CCR Material
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery



Stantec TVA

Exhibit No.

A.2

Title

Groundwater Elevation Contour Map, Event #2 (October 28, 2019)

Client/Project

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location 175668050

Spring City, Tennessee

Prepared by DMB on 2021-04-20
Technical Review by MD on 2021-04-20

0 150 300 450 600 Feet

1:1,800 (At original document size of 22x34)

Legend

- Groundwater Investigation Monitoring Well groundwater elevation in feet above mean sea level (ft amsl)
- Other Monitoring Well groundwater elevation in ft amsl
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary well in CCR pore water elevation in ft amsl; value not used for contouring
- Interpolated Groundwater Contour (5 ft interval; elevations are in ft amsl)
- Groundwater Contour (5 ft interval; elevations are in ft amsl)
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

CCR: Coal combustion residuals

River Gauge (Not Shown - See Note 4) surface water elevation in ft amsl

< Groundwater elevations are rounded to nearest foot to constrain potential elevation when depth to groundwater could not be measured.

*Groundwater elevation displayed but not used as input for contouring due to factors such as well construction or being screened in a different hydrogeologic unit.

*** Nested VWPZ sensors monitoring pore water and groundwater elevations in the same borehole, and the location is shown by a single symbol.

dry: water was not detected

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery
3. Groundwater contours were created using Surfer Version 16.1.350 (December 13, 2018) and manual adjustment
4. Surface water elevation is measured from the tailwater reading from Watts Bar Dam located ~4,000 ft North of well WBF-106
5. For PZ's with multiple instruments in CCR material, the reading with the highest pore water elevation is displayed, unless that reading is suspected of being erroneous.

Stantec TVA

Exhibit No.
A.3

Title

Pore Water Elevation Contour Map, Event #2 (October 28, 2019)

Client/Project

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location: Spring City, Tennessee

175668050
Prepared by DMB on 2021-04-20
Technical Review by MD on 2021-04-20

0 150 300 450 600 Feet
1:1,800 (At original document size of 22x34)

Legend

- Groundwater Investigation Monitoring Well: groundwater elevation in feet above mean sea level (ft amsl); value not used for contouring
- Other Monitoring Well: groundwater elevation in ft amsl; value not used for contouring
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary well in CCR: pore water elevation in ft amsl
- Pore water Contour (2 ft interval; elevations are in ft amsl)
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash

CCR: Coal combustion residuals

River Gauge (Not Shown - See Note 4) surface water elevation in ft amsl

< Groundwater elevations are rounded to nearest foot to constrain potential elevation when depth to groundwater could not be measured.

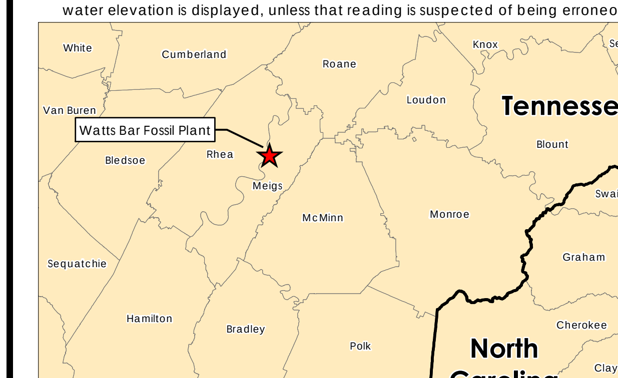
*Groundwater elevation displayed but not used as input for contouring due to factors such as well construction or being screened in a different hydrogeologic unit.

*** Nested VWPZ sensors monitoring pore water and groundwater elevations in the same borehole, and the location is shown by a single symbol.

dry: water was not detected

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery
3. Pore water contours were created with manual adjustment using Surfer Version 16 (December 13, 2018)
4. Surface water elevation is measured from the tailwater reading from Watts Bar Dam located ~4,000 ft North of well WBF-106
5. For PZ's with multiple instruments in CCR material, the reading with the highest pore water elevation is displayed, unless that reading is suspected of being erroneous.



Stantec TVA

APPENDIX B - TABLES

TABLE B.1a – Groundwater Level Measurements
Watts Bar Fossil Plant
October 2019

UNID	Well / Piezometer ID	Date Measured	Depth to Groundwater	Top of Casing Elevation	Groundwater Elevation	Piezometer Ground Surface Elevation	Piezometer Sensor Elevation	Piezometer Sensor Depth	Screened Interval	Screened / Piezometer Sensor Formation
			ft btoc	ft msl	ft msl	ft msl	ft msl	ft bgs	ft btoc	
Monitoring Wells										
WBF-00-GW-43-001	MW-1	28-Oct-19	9.03	711.92	702.89	n/a	n/a	n/a	23.3 - 33.3	Alluvial silts and clays
WBF-00-GW-43-002	MW-2	28-Oct-19	NM	704.29	NM	n/a	n/a	n/a	22.7 - 32.4	Alluvial sand
WBF-00-GW-43-003	MW-3	28-Oct-19	14.68	696.22	681.54	n/a	n/a	n/a	21.6 - 31.6	Alluvial sand
WBF-00-GW-43-004	WBF-100	28-Oct-19	43.53	741.49	697.96	n/a	n/a	n/a	47.7 - 57.8	Alluvial sand / alluvial silts and clays
WBF-00-GW-43-005	WBF-101	28-Oct-19	17.35	703.15	685.80	n/a	n/a	n/a	27.3 - 37.1	Alluvial clay and silts / alluvial sand
WBF-00-GW-43-006	WBF-102	28-Oct-19	23.25	723.98	700.73	n/a	n/a	n/a	19.4 - 24.2	Alluvial sand with clay
WBF-00-GW-43-007	WBF-103	28-Oct-19	14.83	725.09	710.26	n/a	n/a	n/a	17.0 - 21.8	Alluvial sand with clay / alluvial sand
WBF-00-GW-43-008	WBF-104	28-Oct-19	15.65	697.45	681.80	n/a	n/a	n/a	21.5 - 31.3	Alluvial clay and silts / alluvial sand
WBF-00-GW-43-009	WBF-105	28-Oct-19	15.13	704.50	689.37	n/a	n/a	n/a	32.2 - 37.0	Alluvial silty sand
WBF-00-GW-43-010	WBF-106	28-Oct-19	15.01	706.34	691.33	n/a	n/a	n/a	27.8 - 37.6	Alluvial clay / alluvial silty sand and alluvial sand
Piezometers										
n/a	WBF-B02C	28-Oct-19	13.3	n/a	705.8	719.1	680.5	38.6	n/a	Alluvial sandy silt
n/a	WBF-B03B	28-Oct-19	4.7	n/a	695.2	699.9	665.9	34.0	n/a	Alluvial sand with silt and gravel
n/a	WBF-B04C	28-Oct-19	14.7	n/a	698.7	713.4	668.4	45.0	n/a	Alluvial silty sand / alluvial sandy gravel
n/a	WBF-B05C	28-Oct-19	13.7	n/a	703.5	717.2	668.2	49.0	n/a	Alluvial silty sand
Surface Water Gauge										
Tennessee River	n/a	28-Oct-19	n/a	n/a	681.88	n/a	n/a	n/a	n/a	n/a

Notes:

bgs	below ground surface
btoc	below top of casing
ft	feet
ID	identification
msl	mean sea level
n/a	not applicable
NM	not measured
UNID	Unique Numerical Identification

1. Top of casing elevations, screened intervals, and screened formations were obtained from the TVA Well Inventory Log provided by TVA.
2. Tennessee River data point is the reading closest to noon recorded by the automated staff gauge provided by TVA.
3. Ground surface elevations, groundwater elevations, and piezometer data were obtained from geotechnical instrumentation database. Piezometer sensor formations were obtained from boring logs. Data from vibrating wire piezometers were averaged for the measurement date.
4. Depth to groundwater in piezometers and groundwater elevations at all locations are calculated values. Accuracy of piezometer data is to 0.1 ft.
5. A groundwater level was not measured in well MW-2 because the meter was obstructed by the pump.

TABLE B.1b – Pore Water Level Measurements
Watts Bar Fossil Plant
October 2019

Temporary Well / Piezometer ID	Date Measured	Depth to Pore Water	Top of Casing Elevation	Pore Water Elevation	Piezometer Ground Surface Elevation	Piezometer Sensor Elevation	Piezometer Sensor Depth	Screened Interval	Screened / Piezometer Sensor Formation
		ft btoc	ft msl	ft msl	ft msl	ft msl	ft bgs	ft bgs	
Temporary Wells									
WBF-TW02	28-Oct-19	dry	718.34	dry	n/a	n/a	n/a	9.1 - 18.9	CCR
WBF-TW03	28-Oct-19	19.91	721.19	701.28	n/a	n/a	n/a	15.8 - 25.6	CCR
WBF-TW04	28-Oct-19	14.42	719.27	704.85	n/a	n/a	n/a	7.5 - 17.3	CCR
WBF-TW05	28-Oct-19	16.15	717.97	701.82	n/a	n/a	n/a	11.5 - 16.3	CCR
Piezometers									
WBF-B02A	28-Oct-19	11.1	n/a	708.0	719.1	699.5	19.6	n/a	CCR
WBF-B04A	28-Oct-19	11.2	n/a	702.2	713.4	696.4	17.0	n/a	CCR
WBF-B05A	28-Oct-19	14.9	n/a	702.3	717.2	696.2	21.0	n/a	CCR

Notes:

bgs	below ground surface
btoc	below top of casing
CCR	coal combustion residuals
dry	water was not detected
ft	feet
ID	identification
msl	mean sea level
n/a	not applicable

1. Top of casing elevations, screened intervals, and screened formations were obtained from boring logs, well details, and well survey data.

2. For piezometers, ground surface elevations, pore water elevations, and piezometer data were obtained from geotechnical instrumentation database. Piezometer sensor formations were obtained from boring logs. Data from vibrating wire piezometers were averaged for the measurement date.

3. Depth to pore water in piezometers and pore water elevations at all locations are calculated values. Accuracy of piezometer data is to 0.1 ft.

4. Screened interval shown for temporary wells is below ground surface when drilled.

TABLE B.2 – Summary of Groundwater Samples
Watts Bar Fossil Plant
October 2019

			Analysis Type								
Location ID	**Sample ID**	**Sample Type**	Field Parameters	Total Metals	Total Mercury	Anions	Alkalinity	Total Dissolved Solids	Radium-226	Radium-228	Radium-226+228
WBF-101	WBF-GW-005-20191031	Normal Environmental Sample	x	x	x	x	x	x	x	x	x
WBF-102	WBF-GW-006-20191030	Normal Environmental Sample	x	x	x	x	x	x	x	x	x
WBF-103	WBF-GW-007-20191029	Normal Environmental Sample	x	x	x	x	x	x	x	x	x
WBF-104	WBF-GW-008-20191029	Normal Environmental Sample	x	x	x	x	x	x	x	x	x
WBF-105	WBF-GW-009-20191030	Normal Environmental Sample	x	x	x	x	x	x	x	x	x
WBF-106	WBF-GW-010-20191030	Normal Environmental Sample	x	x	x	x	x	x	x	x	x
	WBF-GW-DUP01-20191030	Field Duplicate Sample		x	x	x	x	x	x	x	x

Notes:

Total and Dissolved Metals	SW-846 6020A
Total and Dissolved Mercury	SW-846 7470A
Anions	EPA 300.0/SW 9056
Alkalinity	SM2320B
Total Dissolved Solids	SM2540C
Radium-226	EPA 903.0
Radium-228	EPA 904.0
Radium-226+228	CALC
ID	identification

1. Field and laboratory quality control sample results except for field duplicates are not included in report tables but were used for data validation.
2. CEC collected split samples from WBF-103, WBF-104 and WBF-105.

TABLE B.3 – Summary of Groundwater Quality Parameters
Watts Bar Fossil Plant
October 2019

Sample Location Sample Date Sample ID Sample Depth Sample Type Level of Review	Units	WBF-101 31-Oct-19 WBF-GW-005-20191031 32.2 ft Normal Environmental Sample Final QC Review	WBF-102 30-Oct-19 WBF-GW-006-20191030 23.9 ft Normal Environmental Sample Final QC Review	WBF-103 29-Oct-19 WBF-GW-007-20191029 19.5 ft Normal Environmental Sample Final QC Review	WBF-104 29-Oct-19 WBF-GW-008-20191029 26.4 ft Normal Environmental Sample Final QC Review	WBF-105 30-Oct-19 WBF-GW-009-20191030 35.1 ft Normal Environmental Sample Final QC Review	WBF-106 30-Oct-19 WBF-GW-010-20191030 32.6 ft Normal Environmental Sample Final QC Review
Field Parameters							
Dissolved Oxygen	%	4.3	24.2	2.5	7.8	2.8	5.1
Dissolved Oxygen	mg/L	0.41	2.26	0.22	0.70	0.26	0.48
ORP	mV	-34.1	35.0	23.9	5.1	-46.4	48.3
pH (field)	SU	6.65	6.60	5.68	5.48	6.51	5.59
Specific Cond. (Field)	uS/cm	667	1,253	299.5	2,147	964	984
Temperature, Water (C)	DEG C	20.2	19.3	21.5	21.7	19.2	19.6
Turbidity, field	NTU	0.39	2.74	4.17	0.13	4.81	2.01

Notes:

%	percent
Cond.	conductance
DEG C	degrees Celsius
ft	feet below top of casing
ID	identification
mg/L	milligrams per Liter
mV	milliVolts
NTU	Nephelometric Turbidity Unit
ORP	Oxidation Reduction Potential, measured using a silver reference electrode which has a standard potential of 200 mV
SU	Standard Units
uS/cm	microSiemens per centimeter

TABLE B.4 - Groundwater Analytical Results for Metals, Anions, and General Chemistry
Watts Bar Fossil Plant
October 2019

Sample Location	Units	EPA MCLs	CCR Rule GWPS	WBF-101	WBF-102	WBF-103	WBF-104	WBF-105	WBF-106	
Sample Date				31-Oct-19	30-Oct-19	29-Oct-19	29-Oct-19	30-Oct-19	30-Oct-19	30-Oct-19
Sample ID				WBF-GW-005-20191031	WBF-GW-006-20191030	WBF-GW-007-20191029	WBF-GW-008-20191029	WBF-GW-009-20191030	WBF-GW-010-20191030	WBF-GW-DUP01-20191030
Sample Depth				32.2 ft	23.9 ft	19.5 ft	26.4 ft	35.1 ft	32.6 ft	32.6 ft
Sample Type				Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample
Level of Review				Validated	Validated	Validated	Validated	Validated	Validated	Validated
Total Metals										
Antimony	ug/L	6[A]	n/v	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378
Arsenic	ug/L	10[A]	n/v	1.68	0.468 J	0.324 J	0.594 J	1.54	0.733 J	0.735 J
Barium	ug/L	2,000[A]	n/v	416	60.6	155	27.3	101	34.4	33.6
Beryllium	ug/L	4[A]	n/v	0.317 U*	<0.182	<0.182	<0.182	<0.182	<0.182	<0.182
Boron	ug/L	n/v	n/v	<38.6	90.8	52.2 J	3,750	56.1 J	260	261
Cadmium	ug/L	5[A]	n/v	<0.125	0.127 J	<0.125	**10.5[A]**	<0.125	0.958 J	1.05
Calcium	ug/L	n/v	n/v	105,000	212,000	36,400	442,000	135,000	162,000	166,000
Chromium	ug/L	100[A]	n/v	<1.53	2.74 U*	2.04 U*	1.70 U*	2.04 U*	1.76 U*	1.96 U*
Cobalt	ug/L	n/v	6[B]	1.20	1.15	2.34	**379[B]**	0.113 J	**80.7[B]**	**79.2[B]**
Copper	ug/L	n/v	n/v	<0.627	2.06 U*	1.22 U*	2.10 U*	1.02 U*	1.71 U*	0.894 U*
Lead	ug/L	n/v	15[B]	<0.128	<0.128	<0.128	0.178 J	<0.128	0.137 J	0.348 J
Lithium	ug/L	n/v	40[B]	4.23 J	<3.39	<3.39	4.06 J	<3.39	3.83 J	4.36 J
Magnesium	ug/L	n/v	n/v	14,200	31,000	7,390	53,900	19,400	24,500	24,400
Mercury	ug/L	2[A]	n/v	<0.101	0.564	<0.101	<0.101	<0.101	<0.101	<0.101
Molybdenum	ug/L	n/v	100[B]	<0.610	0.713 J	<0.610	<0.610	<0.610	<0.610	<0.610
Nickel	ug/L	100(TN MCL)[A]	n/v	0.532 U*	1.31 U*	3.16	66.9	<0.336	15.8	16.1
Potassium	ug/L	n/v	n/v	1,040	2,350	6,530	1,660	915	5,300	5,290
Selenium	ug/L	50[A]	n/v	<1.51	5.48	<1.51	<1.51	<1.51	<1.51	<1.51
Silver	ug/L	100(TN MCL)[A]	n/v	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177
Sodium	ug/L	n/v	n/v	11,100	58,800	11,600	35,700	30,500	8,840	8,890
Thallium	ug/L	2[A]	n/v	0.692 U*	<0.148	<0.148	<0.148	<0.148	<0.148	<0.148
Vanadium	ug/L	n/v	n/v	<0.991	1.68	1.22 U*	1.18 U*	1.01	1.01	<0.991
Zinc	ug/L	n/v	n/v	<3.22	7.24 U*	8.94 U*	113	<3.22	42.1	39.9
Anions										
Chloride	mg/L	n/v	n/v	5.15	18.5	4.51	5.53	5.21	4.15	4.32
Fluoride	mg/L	4[A]	n/v	0.0602 U*	0.0415 U*	0.0443 U*	0.0411 U*	0.0741 U*	0.0783 U*	0.0789 U*
Sulfate	mg/L	n/v	n/v	158	545	71.3	1,380	335	511	515
General Chemistry										
Alkalinity, Bicarbonate	mg/L	n/v	n/v	147	246	78.2	60.7	153	35.4	35.2
Alkalinity, Carbonate	mg/L	n/v	n/v	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
Alkalinity, Total as CaCO3	mg/L	n/v	n/v	147	246	78.2	60.7	153	35.4	35.2
Total Dissolved Solids	mg/L	n/v	n/v	427	1,140	196	2,130	657	793	794

Notes:

A	EPA Maximum Contaminant Level
B	CCR Rule GWPS (Federal Register / Vol. 83, No. 146 / Monday, July 30, 2018 / Rules and Regulations)
n/v	No standard/guideline value
6.5[A]	Concentration is greater than or equal to the indicated standard.
<0.03	analyte was not detected at a concentration greater than the Method Detection Limit
-	parameter not analyzed / not available
ft	feet below top of casing
ID	identification
J	quantitation is approximate due to limitations identified during data validation
mg/L	milligrams per Liter
U*	result should be considered “not detected” because it was detected in an associated field or laboratory blank at a similar level
ug/L	micrograms per Liter
(TN MCL)	Tennessee Maximum Contaminant Level

1. Level of review is defined in the Quality Assurance Project Plan.

Stantec

TABLE B.5 – Groundwater Analytical Results for Radiological Parameters
Watts Bar Fossil Plant
October 2019

Sample Location				WBF-101	WBF-102	WBF-103	WBF-104	WBF-105	WBF-106	
Sample Date				31-Oct-19	30-Oct-19	29-Oct-19	29-Oct-19	30-Oct-19	30-Oct-19	30-Oct-19
Sample ID				WBF-GW-005-20191031	WBF-GW-006-20191030	WBF-GW-007-20191029	WBF-GW-008-20191029	WBF-GW-009-20191030	WBF-GW-010-20191030	WBF-GW-DUP01-20191030
Sample Depth				32.2 ft	23.9 ft	19.5 ft	26.4 ft	35.1 ft	32.6 ft	32.6 ft
Sample Type				Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample
Level of Review				Validated	Validated	Validated	Validated	Validated	Validated	Validated
	Units	EPA MCLs	CCR Rule GWPS							
Radiological Parameters										
Radium-226	pCi/L	n/v	n/v	0.688 +/-(0.448)	0.553 +/-(0.462)U	0.543 +/-(0.584)U	0.325 +/-(0.383)U	0.310 +/-(0.364)U	0.411 +/-(0.399)U	0.322 +/-(0.433)U
Radium-228	pCi/L	n/v	n/v	0.260 +/-(0.349)U	-0.0587 +/-(0.214)U	0.302 +/-(0.310)U	0.150 +/-(0.271)U	0.507 +/-(0.366)U	0.192 +/-(0.277)U	0.214 +/-(0.273)U
Radium-226+228	pCi/L	5[A]	n/v	0.947 +/-(0.568)J	0.553 +/-(0.509)U	0.845 +/-(0.661)U	0.476 +/-(0.469)U	0.817 +/-(0.516)U	0.603 +/-(0.486)U	0.535 +/-(0.512)U

Notes:

A	EPA Maximum Contaminant Level
B	CCR Rule GWPS (Federal Register / Vol. 83, No. 146 / Monday, July 30, 2018 / Rules and Regulations)
n/v	No standard/guideline value
ft	feet below top of casing
ID	identification
J	quantitation is approximate due to limitations identified during data validation
pCi/L	picoCurie per Liter
U	not detected

1. Level of review is defined in the Quality Assurance Project Plan.

APPENDIX H.5

GROUNDWATER INVESTIGATION EVENT #3 SAMPLING AND ANALYSIS REPORT

Watts Bar Fossil Plant
Groundwater Investigation Event #3
Sampling and Analysis Report

TDEC Commissioner's Order:
Environmental Investigation Plant
Watts Bar Fossil Plant
Spring City, Tennessee

July 2, 2021

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

Revision Record

Revision	Description	Date
0	Submittal to TDEC	April 23, 2021
1	Addresses June 8, 2021 TDEC Review Comments and Issued for TDEC	July 2, 2021

Sign-off Sheet

This document entitled Watts Bar Fossil Plant Groundwater Investigation Event #3 Sampling and Analysis Report was prepared by Stantec Consulting Services Inc. ("Stantec") for the account of Tennessee Valley Authority (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by ______________________________

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Reviewed by ______________________________

Carolyn Sexton, Senior Hydrogeologist

Approved by ______________________________

Rebekah Brooks, Principal Hydrogeologist

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LIST OF APPENDICES

Abbreviations

CCR	Coal Combustion Residuals
CCR Parameters	Constituents listed in Appendices III and IV of 40 CFR 257 and five inorganic constituents included in Appendix I of Tennessee Rule 0400-11-01-.04
CFR	Code of Federal Regulations
COC	Chain-of-Custody
DO	Dissolved Oxygen
EAR	Environmental Assessment Report
EIP	Environmental Investigation Plan
ENV	Environmental
EnvStds	Environmental Standards, Inc.
Event #3	Groundwater investigation sampling event performed January 6-9, 2020
FSP	Field Sampling Personnel
ft	Feet
GEL	GEL Laboratories LLC
ID	Identification
IDW	Investigation Derived Waste
mg/L	Milligrams per Liter
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
ORP	Oxidation-Reduction Potential
PPE	Personal Protective Equipment
QAPP	Quality Assurance Project Plan
QC	Quality Control
SAP	Sampling and Analysis Plan
SAR	Sampling and Analysis Report
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Commissioner’s Order No. OGC15-0177
TestAmerica	Eurofins TestAmerica Inc.
TI	Technical Instruction
TVA	Tennessee Valley Authority
WBF Plant	Watts Bar Fossil Plant

1.0 INTRODUCTION

Stantec Consulting Services Inc. (Stantec) has prepared this sampling and analysis report (SAR) on behalf of the Tennessee Valley Authority (TVA) to document the completion of activities related to a groundwater investigation sampling event performed January 6-9, 2020 (Event #3) at TVA's Watts Bar Fossil Plant (WBF Plant) located in Spring City, Tennessee.

The purpose of the groundwater investigation, upon completion of six groundwater sampling events, is to characterize groundwater conditions at the WBF Plant in support of fulfilling the requirements for the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA (TDEC 2015). The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee.

The purpose of this SAR is to document the work completed during groundwater sampling Event #3 of 6 total events and to present the information and data collected during the execution of the Groundwater Investigation Sampling and Analysis Plan (SAP) (Stantec 2018a). This SAR is not intended to provide conclusions or evaluations of results. The scope of the groundwater investigation represented herein was conducted pursuant to the SAP and is part of a larger environmental investigation at the WBF Plant. The data provided in this SAR are not inclusive of other programmatic data that exist for the site. The evaluation of the results will include data from the six groundwater sampling events and consider other aspects of the environmental investigation, as well as data collected under other State and/or coal combustion residuals (CCR) programs. This evaluation will be presented in the Environmental Assessment Report (EAR).

Event #3 activities were performed in general accordance with the following documents developed by TVA to support fulfilling the requirements of the TDEC Order at the WBF Plant.

- *Groundwater Investigation SAP* (Stantec 2018a)
- *Environmental Investigation Plan (EIP)* (Stantec 2018b)
- *Quality Assurance Project Plan (QAPP)* (Environmental Standards, Inc. 2018).

The Groundwater Investigation SAP was updated based on TVA- and TDEC-approved Programmatic- and Project-specific changes. Minor variations in scope and procedures from those outlined in the SAP occurred during field activities due to field conditions and programmatic updates and are referenced in Section 3.6.

Event #3 is the third in a series of six planned sampling events for the groundwater investigation. Stantec performed the field work activities for this event. Laboratory analysis of constituents was performed by GEL Laboratories LLC (GEL) in Charleston, South Carolina (radium samples only) and Eurofins TestAmerica, Inc. (TestAmerica) in Pittsburgh, Pennsylvania (other analytes). Quality assurance oversight

on data acquisition protocols, sampling practices, and data validation or verification was performed by Environmental Standards, Inc. (EnvStds) under direct contract to TVA.

This report summarizes the groundwater investigation activities for Event #3. The remaining sampling events will be completed before overall conclusions and findings about the groundwater investigation and groundwater conditions at the WBF Plant are made and documented in the EAR.

2.0 OBJECTIVE AND SCOPE

The primary objectives of the groundwater investigation conducted pursuant to the Groundwater Investigation SAP (which includes six sampling events) are to characterize existing groundwater quality and to evaluate groundwater flow conditions at the WBF Plant in response to the TDEC Order. The approach to characterizing the groundwater conditions is to:

- Collect groundwater samples for chemical analyses to evaluate the potential presence of constituents related to CCR in groundwater
- Measure groundwater and surface water elevations for subsequent evaluation of direction and rate of groundwater flow.

The scope of work intended to achieve the objectives of the groundwater investigation consists of six sampling events at a frequency of one event every two months for one year to characterize seasonal groundwater quality and flow direction. This report describes the activities related to Event #3, performed in January 2020, the scope of which included:

- Collecting groundwater and surface water level measurements
- Collecting field measurements of groundwater quality parameters
- Collecting groundwater samples and associated quality control (QC) samples for laboratory analysis.

These activities were carried out after the installation of permanent monitoring wells specified in the Groundwater Investigation SAP. Details of the monitoring well installation activities are provided in the WBF Plant Hydrogeological Investigation SAR.

In addition, pore water measurements from piezometers and temporary wells installed in the CCR units at the WBF Plant are presented in this SAR for comparison with groundwater data. Temporary well and piezometer installation activities are described in the WBF Plant Exploratory Drilling SAR, and temporary well gauging and sampling information is provided in the WBF Plant CCR Material Characteristics SAR.

3.0 FIELD ACTIVITIES

Groundwater investigation field activities for Event #3 were conducted January 6-9, 2020. Stantec performed groundwater level measurements and sample collection activities based on guidance and specifications in TVA's Environmental (ENV) Technical Instructions (TIs), the SAP, the QAPP, and applicable United States Environmental Protection Agency documents except as noted in the Variations section of this report. As part of TVA's commitment to generate representative and reliable data, data validation and/or verification of laboratory analytical results were performed by EnvStds under direct contract with TVA. EnvStds also provided quality reviews of field documentation.

During Event #3, Stantec conducted the following field activities:

- Measured groundwater levels at six monitoring wells installed for the TDEC Order and four monitoring wells and four piezometers installed for other environmental programs (10 total monitoring wells)
- Measured pore water levels at four temporary wells and three piezometers installed in the CCR units
- Measured the surface water level at one location in the Tennessee River
- Collected groundwater samples from six monitoring wells installed for the TDEC Order
- Recorded field measurements of groundwater quality parameters during purging and stabilization at the sampled monitoring wells
- Collected QC samples including one field duplicate, one matrix spike/matrix spike duplicate, three field blanks, and one equipment blank
- Shipped the collected samples to GEL in Charleston, South Carolina, and TestAmerica in Pittsburgh, Pennsylvania.

Details on each activity are presented in the sections below.

3.1 WORK LOCATIONS

The TDEC Order CCR units at the WBF Plant (Ash Pond and Slag Disposal Area) as well as the monitoring wells, temporary wells, and piezometers sampled and/or gauged during Event #3 are shown on Exhibit A.1 in Appendix A. TVA is currently sampling groundwater at the WBF Plant for the National Pollutant Discharge Elimination System (NPDES) permit closure program. Monitoring wells that are sampled as part of other environmental programs are not sampled as part of the groundwater investigation for the TDEC Order.

Groundwater levels were measured in TDEC Order monitoring wells as well as in select additional wells and piezometers from other environmental programs, as shown in Table B.1a in Appendix B, to provide information to prepare groundwater contour maps for this SAR and the WBF Plant EAR. Pore water levels measured in temporary wells and piezometers installed in the CCR units are presented in Table B.1b. Groundwater and pore water elevations are shown on Exhibits A.2 and A.3 in Appendix A. Groundwater elevation contours are depicted on Exhibit A.2 and pore water elevation contours are depicted on Exhibit A.3.

Groundwater analytical and field duplicate samples were collected from the TDEC Order groundwater investigation monitoring wells as shown in Table B.2 in Appendix B. Groundwater analytical data collected for the TDEC Order and the NPDES permit closure program, which includes wells MW-1, MW-2, MW-3, and WBF-100, will be provided in the EAR.

3.2 DOCUMENTATION

Stantec maintained field documentation in accordance with ENV-TI-05.80.03, *Field Record Keeping*, and the QAPP. Field activities and data were recorded on program-specific field forms. Health and safety forms were completed in accordance with TVA and Stantec health and safety requirements. Additional information regarding field documentation is provided below.

3.2.1 Field Forms

Stantec used program-specific field forms to record field observations and data for specific activities. Field forms used during the groundwater investigation included:

- *Daily Field Activity Log*
- *Monitoring Well Inspection Checklist*
- *Equipment Calibration Form*
- *Groundwater Level Measurement Form*
- *Vibrating Wire Piezometer Measurement Form*
- *Groundwater Sampling Form*
- *Chain-of-Custody (COC).*

3.2.1.1 Daily Field Activity Log

Stantec field sampling personnel (FSP) recorded field activities, observations, and data on a *Daily Field Activity Log* to chronologically document the field program. Deviations from the SAP, TIs, or QAPP were documented on the *Daily Field Activity Log*.

3.2.1.2 Monitoring Well Inspection Checklist

Prior to measuring water levels, Stantec FSP inspected each monitoring well for damage or indications that the well integrity had been compromised in accordance with ENV-TI-05.80.21, *Monitoring Well*

Inspection and Maintenance. Inspection results were documented on a *Monitoring Well Inspection Checklist*. No signs of damage or necessary repairs were noted during Event #3.

3.2.1.3 Equipment Calibration Form

Stantec FSP performed daily calibration of the water quality meter and turbidity meter and documented the results on an *Equipment Calibration Form*. The form documented the calibration results for temperature, turbidity, specific conductance, pH, dissolved oxygen (DO), and oxidation-reduction potential (ORP), and verified that the field instruments' sensors were operating within acceptance criteria. Refer to Section 3.2.2 for additional details on equipment calibration procedures.

3.2.1.4 Groundwater Level Measurement Form

Stantec FSP recorded groundwater level field measurement data on a *Groundwater Level Measurement Form* in accordance with ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*. The form includes the monitoring well identification (ID), time, and depth to water measured from a standardized reference point on the top of each well casing, recorded in feet (ft) below top of casing.

3.2.1.5 Vibrating Wire Piezometer Measurement Form

Stantec FSP recorded field measurement data on a *Vibrating Wire Piezometer Measurement Form*. The form includes the vibrating wire piezometer ID, serial number, time, digits, temperature, and length of the wire in feet. The readings were used to calculate the pressure head (ft of water) above the vibrating wire sensor to obtain the groundwater or pore water elevation.

3.2.1.6 Groundwater Sampling Form

Stantec FSP recorded the depth to water, purge flow rate, volume of groundwater purged, temperature, pH, specific conductance, DO, ORP, turbidity, color of water, and other observations during groundwater purging and sampling activities at each monitoring well in accordance with ENV-TI-05.80.42, *Groundwater Sampling*. Field measurements were recorded on a *Groundwater Sampling Form*. The form also documents the time intervals between measurement of field parameters, low-flow extraction rates, water level drawdown, and water quality parameter measurements until stabilization criteria were met.

3.2.1.7 Chain-of-Custody

Stantec FSP completed *COC* documentation for each groundwater sample collected. The sample ID, sample location, type of sample, sampling date and time, analyses requested, sample pH, and sample custody record were recorded on the *COC*. The Field Team Leader reviewed the *COC* for completeness, and the FSP conducted a QC check of samples in each cooler compared to sample IDs on the corresponding *COC*. *COCs* were completed in accordance with ENV-TI-05.80.02, *Sample Labeling and Custody*.

3.2.2 Equipment Calibration

Field instruments used to collect, generate, or measure water quality parameters were calibrated each day prior to use as specified in the SAP, QAPP, and ENV-TI-05.80.46, *Field Measurement Using a Multi-Parameter Sonde.* Afternoon calibration verifications were performed to evaluate if these instruments remained within acceptance criteria during sampling. Temperature and barometric pressure instrument readings were verified using a calibrated National Institute of Standards and Technology traceable thermometer and National Weather Service (via mesowest.utah.edu) barometric pressure readings for Lovell Field (KCHA) in Chattanooga, Tennessee, respectively. Additional details regarding equipment calibration were recorded on an *Equipment Calibration Form*, as described in Section 3.2.1.3.

3.3 SAMPLING METHODS

The following sections present monitoring well data collection and sampling procedures used during Event #3.

3.3.1 Static Water Level Measurements

FSP measured static groundwater levels at 10 monitoring wells and pore water levels at four temporary wells in accordance with ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*. On January 6-7, 2020, static groundwater and pore water level readings were measured and recorded to the nearest 0.01 ft from a reference point on the top of each well casing using an electronic water level indicator. Water level indicator probes were decontaminated prior to the first use and between measurements, and the decontamination was documented as specified in ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination.* Depth to groundwater and pore water measurements were recorded on a *Groundwater Level Measurement Form*.

Groundwater and pore water measurements were also obtained from transducers installed within four piezometers and three piezometers, respectively. Additionally, a surface water level measurement for the Tennessee River was provided by TVA using the reading recorded closest to noon for the tailwater level below the Watts Bar Dam. The surface water staff gauge location is indicated on Exhibit A.1 in Appendix A.

Groundwater level data and pore water level data are shown in Tables B.1a and B.1b, respectively, in Appendix B. A groundwater elevation contour map based on groundwater measurements in wells and piezometers, along with pore water elevations, is included as Exhibit A.2 in Appendix A. Similarly, a pore water elevation contour map based on pore water measurements in wells and piezometers, along with groundwater elevations, is included as Exhibit A.3 in Appendix A.

3.3.2 Groundwater Purging & Sampling

Analytical and field duplicate samples (as specified in the SAP) were collected from six monitoring wells as shown in Table B.2 in Appendix B. Monitoring wells were purged using dedicated bladder pumps equipped with dedicated tubing using low-flow purging and sampling techniques as specified in ENV-TI-05.80.42, *Groundwater Sampling*.

During the purging process, water quality field parameters including pH, specific conductance, temperature, ORP, and DO were measured using water quality meters (YSI ProPlus with flow-through cell) and recorded on field forms. Depth to water and turbidity were measured and recorded using decontaminated electronic water-level indicators (Heron Dipper-T) and calibrated turbidimeters (Hach 2100Q). Field parameters were measured and recorded on *Groundwater Sampling Forms* during purging until readings were stabilized as specified in the SAP. As approved by TDEC, the specific conductance and turbidity stabilization limits were revised to the values below to meet overall programmatic objectives for groundwater investigations at the WBF Plant. Well purging was considered complete when three consecutive readings were within the following stabilization limits:

- pH – ± 0.1 Standard Units
- Specific Conductance – ± 3% microSiemens per centimeter
- Turbidity – Less than 5 Nephelometric Turbidity Units (NTUs) or ± 10% for values above 5 NTUs
- DO – Less than 0.5 milligrams per Liter (mg/L) or ± 10% for values above 0.5 mg/L.

After water quality stabilization criteria were achieved, the final field parameter results were recorded, purging was discontinued, and a sample was collected as specified in the SAP. Turbidity readings at the wells stabilized below 5 NTUs, therefore samples were not collected for dissolved metals analysis.

Laboratory-provided, pre-preserved sample containers were filled directly from the pump discharge line. FSP wore new, clean nitrile gloves when handling sample containers and did not touch the interior of containers or container caps. New gloves were used when handling each sample. When filling sample bottles, care was taken to minimize sample aeration (i.e., water was directed down the inner walls of the sample bottle) and to avoid overfilling and diluting preservatives. Each sample bottle was capped before filling the next bottle. Following completion of sampling, final field parameter measurements were recorded.

Sample containers were labeled and handled in accordance with ENV-TI-05.80.02, *Sample Labeling and Custody.* FSP secured caps on each bottle, attached a custody seal across the cap, and placed the bottles in a cooler on ice within 15 minutes of collection. QC samples were collected in accordance with ENV-TI-05.80.04, *Field Sampling Quality Control.*

Groundwater samples were analyzed for the CCR-related constituents listed in Appendices III and IV of 40 Code of Federal Regulations (CFR) 257. In addition, five inorganic constituents listed in Appendix I of Tennessee Rule 0400-11-01-.04 and not included in the 40 CFR 257 Appendices III and IV were analyzed to maintain continuity with TDEC environmental programs. These additional TDEC Appendix I constituents included copper, nickel, silver, vanadium, and zinc. The combined federal CCR Appendices III and IV constituents and TDEC Appendix I inorganic constituents will hereafter be referred to collectively as “CCR Parameters.” For geochemical evaluation, major cations/anions not included in the CCR Parameters were included in the analyses. The additional geochemical parameters included bicarbonate, carbonate, magnesium, potassium, and sodium.

3.4 INVESTIGATION DERIVED WASTE

Investigation derived waste (IDW) generated during groundwater investigation activities included:

- Used calibration solutions
- Purge water
- Decontamination fluids
- Disposable personal protective equipment (PPE)
- General trash.

IDW was handled in accordance with ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*; ENV-TI-05.80.42, *Groundwater Sampling* (purge water); the WBF Plant-specific waste management plan; and local, state, and federal regulations. Transportation and disposal of IDW was coordinated with WBF Plant facility management. Used calibration solution was containerized and stored for disposal as directed by the WBF Plant facility management. Purge water and decontamination fluids were containerized for later disposal as specified in the WBF Plant-specific waste management plan. Used disposable PPE (e.g., nitrile gloves) and general trash generated throughout the day were placed in garbage bags and disposed of in a general trash dumpster onsite at the end of each day.

3.5 SAMPLE SHIPMENT

Samples were packed and shipped under *COC* procedures specified in ENV-TI-05.80.06, *Handling and Shipping of Samples*. The samples were shipped by FedEx to GEL in Charleston, South Carolina (radium samples only), and to TestAmerica in Pittsburgh, Pennsylvania (other analytes). The laboratories submitted sample receipt confirmation forms to EnvStds for review and confirmation.

3.6 VARIATIONS

The proposed scope and procedures for the groundwater investigation were outlined in the SAP, QAPP, and applicable TVA TIs as detailed in the sections above. Variations in scope or procedures discussed with TDEC and/or TVA, changes based on field conditions, or additional field sampling performed to complete the scope of work in the SAP are described in the following sections. As discussed below, these variations do not impact the overall usability and representativeness of the dataset provided in this SAR for the groundwater investigation sampling Event #3 at the WBF Plant.

3.6.1 Variations in Scope

There were no variations in scope during the groundwater investigation sampling Event #3 at the WBF Plant.

3.6.2 Variations in Procedures

Variations in procedures occurring in the field are provided below.

- As approved by TDEC, the specific conductance and turbidity stabilization limits were revised to meet overall programmatic objectives for groundwater investigations.
- On January 6-7, 2020, the depth to static groundwater level measurements at the monitoring wells were not all collected within a single day; however, they were collected within a span of less than 24 hours.
- pH 4 and pH 10 were not within the afternoon calibration verification acceptance criteria on January 7, 2020. These calibration variations were evaluated as part of the data validation/verification process performed by EnvStds.

4.0 SUMMARY

The data presented in this report are only for groundwater investigation sampling Event #3 at the WBF Plant. The scope of work for Event #3 was to:

- Collect groundwater samples for chemical analyses to assist with subsequent evaluation of the potential presence of CCR-related constituents in groundwater
- Measure groundwater and surface water elevations to assist with subsequent evaluation of groundwater flow direction and rate after multiple data sets have been collected.

In addition, pore water measurements from piezometers and temporary wells installed in the CCR units at the WBF Plant are presented in this SAR for comparison with groundwater data.

Event #3 included collecting groundwater level measurements at 10 monitoring wells and four piezometers, pore water measurements at four temporary wells and three piezometers in the CCR units, and a surface water measurement at one gauge located in the Tennessee River. Groundwater and surface water measurements and elevations are provided in Table B.1a, and pore water measurements and elevations are provided in Table B.1b, and depicted on Exhibits A.2 and A.3.

Groundwater quality measurements and groundwater analytical samples were collected at six monitoring wells as summarized in Table B.2. Groundwater quality parameters were recorded during purging. Stabilization criteria for pH, specific conductance, turbidity, and DO were achieved at each sampling location. The final measurements prior to initiating sample collection are presented in Table B.3.

Groundwater analytical data for CCR Parameters and geochemical parameters are presented in Table B.4. Analytical data for radium analyses are presented in Table B.5. Analytical data were reported by GEL and TestAmerica, and then validated and/or verified by EnvStds.

Stantec has completed Event #3 of the groundwater investigation at the WBF Plant in Spring City, Tennessee, in accordance with the Groundwater Investigation SAP as documented herein. The data collected during Event #3 are usable for reporting and evaluation in the EAR and meet the objectives of the TDEC Order EIP. The complete datasets from the six groundwater sampling events will be evaluated along with data collected under other TDEC Order SAPs, as well as data collected under other State and CCR programs. This evaluation will be provided in the EAR.

5.0 REFERENCES

Environmental Standards, Inc. 2018. *Quality Assurance Project Plan for the Tennessee Valley Authority Watts Bar Fossil Plant Environmental Investigation*. Revision 2. November 2018.

Stantec Consulting Services Inc. (Stantec). 2018a. *Groundwater Investigation Sampling and Analysis Plan, Watts Bar Fossil Plant.* Revision 3. Prepared for Tennessee Valley Authority. November 19, 2018.

Stantec. 2018b. *Environmental Investigation Plan, Watts Bar Fossil Plant.* Revision 3. Prepared for Tennessee Valley Authority. November 19, 2018.

Tennessee Department of Environment and Conservation. 2015. *Commissioner's Order No. OGC15-0177.*

Tennessee Valley Authority (TVA). ENV-TI-05.80.02, *Sample Labeling and Custody*.

TVA. ENV-TI-05.80.03, *Field Record Keeping*.

TVA. ENV-TI-05.80.04, *Field Sampling Quality Control*.

TVA. ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*.

TVA. ENV-TI-05.80.06, *Handling and Shipping of Samples*.

TVA. ENV-TI-05.80.21, *Monitoring Well Inspection and Maintenance*.

TVA. ENV-TI-05.80.42, *Groundwater Sampling*.

TVA. ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*.

TVA. ENV-TI-05.80.46, *Field Measurement Using a Multi-Parameter Sonde*.

APPENDIX A - EXHIBITS

Exhibit No.
A.1

Title
Monitoring Well Network

Client/Project
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location 175668050
Spring City, Tennessee
Prepared by MB on 2021-04-20
Technical Review by MW on 2021-04-20

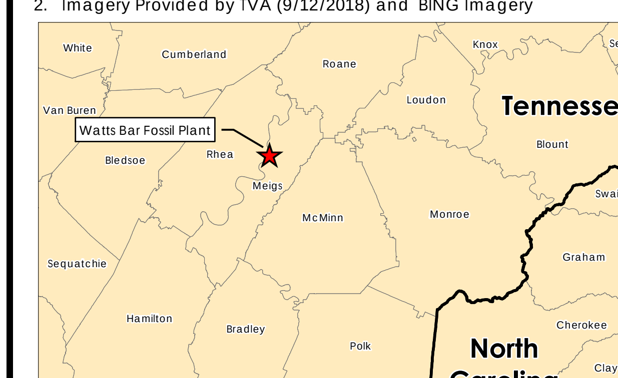
0 150 300 450 600 Feet
1:1,800 (At original document size of 22x34)

Legend

- Groundwater Investigation Monitoring Well
- Other Monitoring Well
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary Well within CCR Material
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

CCR: Coal combustion residuals

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery



Stantec TVA

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

Exhibit No.
A.2

Title
Groundwater Elevation Contour Map, Event #3 (January 6-7, 2020)

Client/Project
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location
Spring City, Tennessee

175668050
Prepared by DMB on 2021-06-15
Technical Review by MD on 2021-06-15

0 150 300 450 600 Feet
1:1,800 (At original document size of 22x34)

Legend

- Groundwater Investigation Monitoring Well groundwater elevation in feet above mean sea level (ft amsl)
- Other Monitoring Well groundwater elevation in ft amsl
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary well in CCR pore water elevation in ft amsl; value not used for contouring
- Interpolated Groundwater Contour (5 ft interval; elevations are in ft amsl)
- Groundwater Contour (5 ft interval; elevations are in ft amsl)
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

CCR: Coal combustion residuals

River Gauge (Not Shown - See Note 4) surface water elevation in ft amsl

*Groundwater elevation displayed but not used as input for contouring due to factors such as well construction or being screened in a different hydrogeologic unit.

*** Nested VWPZ sensors monitoring pore water and groundwater elevations in the same borehole, and the location is shown by a single symbol.

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery
3. Groundwater contours were created using Surfer Version 16.1.350 (December 13, 2018) and manual adjustment
4. Surface water elevation is measured from the tailwater reading from Watts Bar Dam located ~4,000 ft North of well WBF-106
5. For PZ's with multiple instruments in CCR material, the reading with the highest pore water elevation is displayed, unless that reading is suspected of being erroneous.
6. Although gauging occurred on January 6 and 7, 2020, the river surface elevation for January 6, 2020 is shown and was used for preparing contours.

Stantec TVA

Exhibit No.
A.3

Title
Pore water Elevation Contour Map, Event #3 (January 6-7, 2020)

Client/Project
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location
Spring City, Tennessee

175668050
Prepared by DMB on 2021-04-20
Technical Review by MD on 2021-04-20

0 150 300 450 600 Feet
1:1,800 (At original document size of 22x34)

Legend

- Groundwater Investigation Monitoring Well groundwater elevation in feet above mean sea level (ft amsl); value not used for contouring
- Other Monitoring Well groundwater elevation in ft amsl; value not used for contouring
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary well in CCR pore water elevation in ft amsl
- Pore water Contour (2 ft interval; elevations are in ft amsl)
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

CCR: Coal combustion residuals

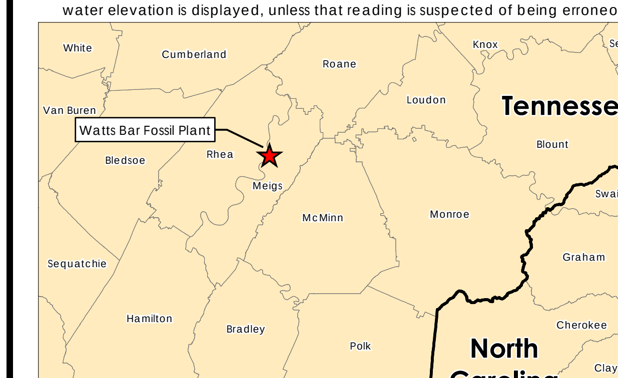
River Gauge (Not Shown - See Note 4) surface water elevation in ft amsl

*Groundwater elevation displayed but not used as input for contouring due to factors such as well construction or being screened in a different hydrogeologic unit.

*** Nested VWPZ sensors monitoring pore water and groundwater elevations in the same borehole, and the location is shown by a single symbol.

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery
3. Pore water contours were created with manual adjustment using Surfer Version 16 (December 13, 2018)
4. Surface water elevation is measured from the tailwater reading from Watts Bar Dam located ~4,000 ft North of well WBF-106
5. For PZ's with multiple instruments in CCR material, the reading with the highest pore water elevation is displayed, unless that reading is suspected of being erroneous.



Stantec TVA

U:\TVA-EP\175668050_WBF_WorkPlans\gis\mxd\GW_Tech_Memo\WBF_GWTechMemo_FigA3_PorewaterContour_wPZ_Event3_porewater.mxd Revised: 2021-04-20 By: mbough

APPENDIX B - TABLES

TABLE B.1a – Groundwater Level Measurements
Watts Bar Fossil Plant
January 2020

UNID	Well / Piezometer ID	Date Measured	Depth to Groundwater	Top of Casing Elevation	Groundwater Elevation	Piezometer Ground Surface Elevation	Piezometer Sensor Elevation	Piezometer Sensor Depth	Screened Interval	Screened / Piezometer Sensor Formation
			ft btoc	ft msl	ft msl	ft msl	ft msl	ft bgs	ft btoc	
Monitoring Wells										
WBF-00-GW-43-001	MW-1	7-Jan-20	6.31	711.92	705.61	n/a	n/a	n/a	23.3 - 33.3	Alluvial silts and clays
WBF-00-GW-43-002	MW-2	6-Jan-20	20.74	704.29	683.55	n/a	n/a	n/a	22.7 - 32.4	Alluvial sand
WBF-00-GW-43-003	MW-3	6-Jan-20	12.89	696.22	683.33	n/a	n/a	n/a	21.6 - 31.6	Alluvial sand
WBF-00-GW-43-004	WBF-100	7-Jan-20	41.88	741.49	699.61	n/a	n/a	n/a	47.7 - 57.8	Alluvial sand / alluvial silts and clays
WBF-00-GW-43-005	WBF-101	6-Jan-20	15.00	703.15	688.15	n/a	n/a	n/a	27.3 - 37.1	Alluvial clay and silts / alluvial sand
WBF-00-GW-43-006	WBF-102	7-Jan-20	21.02	723.98	702.96	n/a	n/a	n/a	19.4 - 24.2	Alluvial sand with clay
WBF-00-GW-43-007	WBF-103	7-Jan-20	13.74	725.09	711.35	n/a	n/a	n/a	17.0 - 21.8	Alluvial sand with clay / alluvial sand
WBF-00-GW-43-008	WBF-104	6-Jan-20	13.75	697.45	683.70	n/a	n/a	n/a	21.5 - 31.3	Alluvial clay and silts / alluvial sand
WBF-00-GW-43-009	WBF-105	6-Jan-20	12.94	704.50	691.56	n/a	n/a	n/a	32.2 - 37.0	Alluvial silty sand
WBF-00-GW-43-010	WBF-106	6-Jan-20	13.08	706.34	693.26	n/a	n/a	n/a	27.8 - 37.6	Alluvial clay / alluvial silty sand and alluvial sand
Piezometers										
n/a	WBF-B02C	7-Jan-20	10.6	n/a	708.5	719.1	680.5	38.6	n/a	Alluvial sandy silt
n/a	WBF-B03B	7-Jan-20	2.7	n/a	697.2	699.9	665.9	34.0	n/a	Alluvial sand with silt and gravel
n/a	WBF-B04C	7-Jan-20	12.5	n/a	700.9	713.4	668.4	45.0	n/a	Alluvial silty sand / alluvial sandy gravel
n/a	WBF-B05C	7-Jan-20	11.1	n/a	706.1	717.2	668.2	49.0	n/a	Alluvial silty sand
Surface Water Gauge										
Tennessee River	n/a	6-Jan-20	n/a	n/a	685.07	n/a	n/a	n/a	n/a	n/a
Tennessee River	n/a	7-Jan-20	n/a	n/a	685.15	n/a	n/a	n/a	n/a	n/a

Notes:

bgs	below ground surface
btoc	below top of casing
ft	feet
ID	identification
msl	mean sea level
n/a	not applicable
UNID	Unique Numerical Identification

1. Top of casing elevations, screened intervals, and screened formations were obtained from the TVA Well Inventory Log provided by TVA.
2. Tennessee River data point is the reading closest to noon recorded by the automated staff gauge provided by TVA. Elevations for both days of gauging are included, but only the datum for January 6 was used for preparing contour maps.
3. Ground surface elevations, groundwater elevations, and piezometer data were obtained from geotechnical instrumentation database. Piezometer sensor formations were obtained from boring logs. Data from vibrating wire piezometers were averaged for the measurement date.
4. Depth to groundwater in piezometers and groundwater elevations at all locations are calculated values. Accuracy of piezometer data is to 0.1 ft.

TABLE B.1b – Pore Water Level Measurements
Watts Bar Fossil Plant
January 2020

Temporary Well / Piezometer ID	Date Measured	Depth to Pore Water	Top of Casing Elevation	Pore Water Elevation	Piezometer Ground Surface Elevation	Piezometer Sensor Elevation	Piezometer Sensor Depth	Screened Interval	Screened / Piezometer Sensor Formation
		ft btoc	ft msl	ft msl	ft msl	ft msl	ft bgs	ft bgs	
Temporary Wells									
WBF-TW02	7-Jan-20	23.09	718.34	695.25	n/a	n/a	n/a	9.1 - 18.9	CCR
WBF-TW03	7-Jan-20	17.31	721.19	703.88	n/a	n/a	n/a	15.8 - 25.6	CCR
WBF-TW04	7-Jan-20	11.65	719.27	707.62	n/a	n/a	n/a	7.5 - 17.3	CCR
WBF-TW05	7-Jan-20	14.59	717.97	703.38	n/a	n/a	n/a	11.5 - 16.3	CCR
Piezometers									
WBF-B02A	7-Jan-20	8.3	n/a	710.8	719.1	699.5	19.6	n/a	CCR
WBF-B04A	7-Jan-20	9.3	n/a	704.1	713.4	696.4	17.0	n/a	CCR
WBF-B05A	7-Jan-20	13.0	n/a	704.2	717.2	696.2	21.0	n/a	CCR

Notes:

bgs	below ground surface
btoc	below top of casing
CCR	coal combustion residuals
ft	feet
ID	identification
msl	mean sea level
n/a	not applicable

1. Top of casing elevations, screened intervals, and screened formations were obtained from boring logs, well details, and well survey data.

2. For piezometers, ground surface elevations, pore water elevations, and piezometer data were obtained from geotechnical instrumentation database. Piezometer sensor formations were obtained from boring logs. Data from vibrating wire piezometers were averaged for the measurement date.

3. Depth to pore water in piezometers and pore water elevations at all locations are calculated values. Accuracy of piezometer data is to 0.1 ft.

4. Screened interval shown for temporary wells is below ground surface when drilled.

TABLE B.2 – Summary of Groundwater Samples
Watts Bar Fossil Plant
January 2020

Location ID	Sample ID	Sample Type	Field Parameters	Total Metals	Total Mercury	Anions	Alkalinity	Total Dissolved Solids	Radium-226	Radium-228	Radium-226+228
			Analysis Type								
WBF-101	WBF-GW-005-20200109	Normal Environmental Sample	x	x	x	x	x	x	x	x	x
WBF-102	WBF-GW-006-20200108	Normal Environmental Sample	x	x	x	x	x	x	x	x	x
WBF-103	WBF-GW-007-20200107	Normal Environmental Sample	x	x	x	x	x	x	x	x	x
WBF-104	WBF-GW-008-20200107	Normal Environmental Sample	x	x	x	x	x	x	x	x	x
WBF-105	WBF-GW-009-20200108	Normal Environmental Sample	x	x	x	x	x	x	x	x	x
WBF-106	WBF-GW-010-20200108	Normal Environmental Sample	x	x	x	x	x	x	x	x	x
	WBF-GW-DUP01-20200108	Field Duplicate Sample		x	x	x	x	x	x	x	x

Notes:

Total and Dissolved Metals	SW-846 6020A
Total and Dissolved Mercury	SW-846 7470A
Anions	EPA 300.0/SW 9056
Alkalinity	SM2320B
Total Dissolved Solids	SM2540C
Radium-226	EPA 903.0
Radium-228	EPA 904.0
Radium-226+228	CALC
ID	identification

1. Field and laboratory quality control sample results except for field duplicates are not included in report tables but were used for data validation.

TABLE B.3 – Summary of Groundwater Quality Parameters
Watts Bar Fossil Plant
January 2020

Sample Location		WBF-101	WBF-102	WBF-103	WBF-104	WBF-105	WBF-106
Sample Date		9-Jan-20	8-Jan-20	7-Jan-20	7-Jan-20	8-Jan-20	8-Jan-20
Sample ID		WBF-GW-005-20200109	WBF-GW-006-20200108	WBF-GW-007-20200107	WBF-GW-008-20200107	WBF-GW-009-20200108	WBF-GW-010-20200108
Sample Depth		32.2 ft	23 ft	19.5 ft	26.4 ft	35.1 ft	32.6 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Level of Review	Units	Final QC Review	Final QC Review	Final QC Review	Final QC Review	Final QC Review	Final QC Review
Field Parameters							
Dissolved Oxygen	%	3.8	59.0	13.5	7.2	3.3	5.5
Dissolved Oxygen	mg/L	0.38	5.80	1.26	0.79	0.34	0.54
ORP	mV	-44.8	64.1	326.3	266.4	-102.9	121.0
pH (field)	SU	6.43	6.93	5.79	5.78	6.69	5.46
Specific Cond. (Field)	uS/cm	1,026	547.3	352.4	1,313	1,034	1,071
Temperature, Water (C)	DEG C	15.3	16.9	17.4	15.5	15.3	16.6
Turbidity, field	NTU	4.92	0.63	4.63	0.35	4.58	4.95

Notes:

%	percent
Cond.	conductance
DEG C	degrees Celsius
ft	feet below top of casing
ID	identification
mg/L	milligrams per Liter
mV	milliVolts
NTU	Nephelometric Turbidity Unit
ORP	Oxidation Reduction Potential, measured using a silver reference electrode which has a standard potential of 200 mV
SU	Standard Units
uS/cm	microSiemens per centimeter

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TABLE B.4 - Groundwater Analytical Results for Metals, Anions, and General Chemistry
Watts Bar Fossil Plant
January 2020

Sample Location				WBF-101	WBF-102	WBF-103	WBF-104	WBF-105	WBF-106	
Sample Date				9-Jan-20	8-Jan-20	7-Jan-20	7-Jan-20	8-Jan-20	8-Jan-20	8-Jan-20
Sample ID				WBF-GW-005-20200109	WBF-GW-006-20200108	WBF-GW-007-20200107	WBF-GW-008-20200107	WBF-GW-009-20200108	WBF-GW-010-20200108	WBF-GW-DUP01-20200108
Sample Depth				32.2 ft	23 ft	19.5 ft	26.4 ft	35.1 ft	32.6 ft	32.6 ft
Sample Type				Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample
Level of Review	Units	EPA MCLs	CCR Rule GWPS	Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified
Total Metals										
Antimony	ug/L	6[A]	n/v	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378
Arsenic	ug/L	10[A]	n/v	2.18 U*	0.866 U*	0.781 U*	0.872 U*	1.70 U*	1.02 U*	0.848 U*
Barium	ug/L	2,000[A]	n/v	141	36.7	76.4	23.2	110	30.2	30.5
Beryllium	ug/L	4[A]	n/v	<0.182	0.486 U*	0.235 U*	0.198 U*	0.238 U*	0.642 U*	0.566 U*
Boron	ug/L	n/v	n/v	547	60.2 J	58.8 J	1,910	<38.6	237	235
Cadmium	ug/L	5[A]	n/v	0.695 J	<0.217	<0.217	**6.08[A]**	<0.217	0.980 J	0.938 J
Calcium	ug/L	n/v	n/v	157,000	89,300	40,200	208,000	132,000	163,000	166,000
Chromium	ug/L	100[A]	n/v	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53
Cobalt	ug/L	n/v	6[B]	**73.3[B]**	<0.134	4.44	**167[B]**	0.262 U*	**78.4[B]**	**79.5[B]**
Copper	ug/L	n/v	n/v	<0.627	1.71 U*	<0.627	<0.627	0.736 U*	<0.627	1.98 U*
Lead	ug/L	n/v	15[B]	<0.128	<0.128	<0.128	<0.128	<0.128	<0.128	<0.128
Lithium	ug/L	n/v	40[B]	<3.39	4.23 J	<3.39	<3.39	<3.39	3.93 J	3.88 J
Magnesium	ug/L	n/v	n/v	22,700	13,100	8,290	25,500	20,600	25,200	25,500
Mercury	ug/L	2[A]	n/v	<0.101	<0.101	<0.101	<0.101	<0.101	<0.101	<0.101
Molybdenum	ug/L	n/v	100[B]	<0.610	4.32 J	<0.610	<0.610	<0.610	<0.610	<0.610
Nickel	ug/L	100(TN MCL)[A]	n/v	10.5	1.27 U*	3.40 U*	32.2	0.865 U*	16.5	16.2
Potassium	ug/L	n/v	n/v	1,310	3,210	7,500	909	857	5,440	5,490
Selenium	ug/L	50[A]	n/v	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51
Silver	ug/L	100(TN MCL)[A]	n/v	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177
Sodium	ug/L	n/v	n/v	13,800	7,430	10,200	14,500	29,400	7,350	7,430
Thallium	ug/L	2[A]	n/v	<0.148	<0.148	0.649 U*	<0.148	<0.148	0.570 U*	0.205 U*
Vanadium	ug/L	n/v	n/v	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991
Zinc	ug/L	n/v	n/v	23.4	<3.22	4.66 J	48.0	<3.22	35.5	35.1
Anions										
Chloride	mg/L	n/v	n/v	5.67	4.53	4.58	2.95	5.59	4.90	4.56
Fluoride	mg/L	4[A]	n/v	0.0396 J	0.0989 J	0.0362 J	0.0777 J	0.0722 J	0.0584 J	0.0508 J
Sulfate	mg/L	n/v	n/v	355	90.2 J	86.6	726	350 J	524 J	570 J
General Chemistry										
Alkalinity, Bicarbonate	mg/L	n/v	n/v	148	226	73.5	41.9	136	34.0	34.7
Alkalinity, Carbonate	mg/L	n/v	n/v	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
Alkalinity, Total as CaCO3	mg/L	n/v	n/v	148	226	73.5	41.9	136	34.0	34.7
Total Dissolved Solids	mg/L	n/v	n/v	695	386	230	1,050	710	891	847

Notes:

A	EPA Maximum Contaminant Level
B	CCR Rule GWPS (Federal Register / Vol. 83, No. 146 / Monday, July 30, 2018 / Rules and Regulations)
n/v	No standard/guideline value
6.5[A]	Concentration is greater than or equal to the indicated standard.
<0.03	analyte was not detected at a concentration greater than the Method Detection Limit
-	parameter not analyzed / not available
ft	feet below top of casing
ID	identification
J	quantitation is approximate due to limitations identified during data validation
mg/L	milligrams per Liter
U*	result should be considered “not detected” because it was detected in an associated field or laboratory blank at a similar level
ug/L	micrograms per Liter
(TN MCL)	Tennessee Maximum Contaminant Level

1. Level of review is defined in the Quality Assurance Project Plan.

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TABLE B.5 – Groundwater Analytical Results for Radiological Parameters
Watts Bar Fossil Plant
January 2020

Sample Location				WBF-101	WBF-102	WBF-103	WBF-104	WBF-105	WBF-106	
Sample Date				9-Jan-20	8-Jan-20	7-Jan-20	7-Jan-20	8-Jan-20	8-Jan-20	8-Jan-20
Sample ID				WBF-GW-005-20200109	WBF-GW-006-20200108	WBF-GW-007-20200107	WBF-GW-008-20200107	WBF-GW-009-20200108	WBF-GW-010-20200108	WBF-GW-DUP01-20200108
Sample Depth				32.2 ft	23 ft	19.5 ft	26.4 ft	35.1 ft	32.6 ft	32.6 ft
Sample Type				Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample
Level of Review				Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified
	Units	EPA MCLs	CCR Rule GWPS							
Radiological Parameters										
Radium-226	pCi/L	n/v	n/v	0.627 +/-(0.524)U	-0.225 +/-(0.407)U	0.440 +/-(0.542)U	-0.0750 +/-(0.402)U	0.301 +/-(0.538)U	0.823 +/-(0.675)U	0.768 +/-(0.632)U
Radium-228	pCi/L	n/v	n/v	0.289 +/-(0.304)U	0.213 +/-(0.328)U	0.134 +/-(0.352)U	0.0847 +/-(0.313)U	0.229 +/-(0.357)U	0.511 +/-(0.398)U	-0.0265 +/-(0.258)U
Radium-226+228	pCi/L	5[A]	n/v	0.916 +/-(0.606)U	0.213 +/-(0.522)U	0.574 +/-(0.646)U	0.0847 +/-(0.510)U	0.530 +/-(0.645)U	1.33 +/-(0.784)U	0.768 +/-(0.682)U

Notes:

A	EPA Maximum Contaminant Level
B	CCR Rule GWPS (Federal Register / Vol. 83, No. 146 / Monday, July 30, 2018 / Rules and Regulations)
n/v	No standard/guideline value
ft	feet below top of casing
ID	identification
pCi/L	picoCurie per Liter
U	not detected

1. Level of review is defined in the Quality Assurance Project Plan.

APPENDIX H.6

GROUNDWATER INVESTIGATION EVENT #4 SAMPLING AND ANALYSIS REPORT

Watts Bar Fossil Plant
Groundwater Investigation Event #4
Sampling and Analysis Report

TDEC Commissioner's Order:
Environmental Investigation Plant
Watts Bar Fossil Plant
Spring City, Tennessee

April 23, 2021

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

Revision Record

Revision	Description	Date
0	Submittal to TDEC	April 23, 2021

Sign-off Sheet

This document entitled Watts Bar Fossil Plant Groundwater Investigation Event #4 Sampling and Analysis Report was prepared by Stantec Consulting Services Inc. ("Stantec") for the account of Tennessee Valley Authority (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by ______________________________

Michael J. Winkler, Geologic Associate

Reviewed by ______________________________

Carolyn Sexton, Senior Hydrogeologist

Approved by ______________________________

Rebekah Brooks, Principal Hydrogeologist

Table of Contents

Abbreviations

CCR	Coal Combustion Residuals
CCR Parameters	Constituents listed in Appendices III and IV of 40 CFR 257 and five inorganic constituents included in Appendix I of Tennessee Rule 0400-11-01-.04
CFR	Code of Federal Regulations
COC	Chain-of-Custody
DO	Dissolved Oxygen
EAR	Environmental Assessment Report
EIP	Environmental Investigation Plan
ENV	Environmental
EnvStds	Environmental Standards, Inc.
Event #4	Groundwater investigation sampling event performed March 2-4, 2020
FSP	Field Sampling Personnel
ft	Feet
GEL	GEL Laboratories LLC
ID	Identification
IDW	Investigation Derived Waste
mg/L	Milligrams per Liter
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
ORP	Oxidation-Reduction Potential
PPE	Personal Protective Equipment
QAPP	Quality Assurance Project Plan
QC	Quality Control
SAP	Sampling and Analysis Plan
SAR	Sampling and Analysis Report
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Commissioner’s Order No. OGC15-0177
TestAmerica	Eurofins TestAmerica Inc.
TI	Technical Instruction
TVA	Tennessee Valley Authority
WBF Plant	Watts Bar Fossil Plant

1.0 INTRODUCTION

Stantec Consulting Services Inc. (Stantec) has prepared this sampling and analysis report (SAR) on behalf of the Tennessee Valley Authority (TVA) to document the completion of activities related to a groundwater investigation sampling event performed March 2-4, 2020 (Event #4) at TVA's Watts Bar Fossil Plant (WBF Plant) located in Spring City, Tennessee.

The purpose of the groundwater investigation, upon completion of six groundwater sampling events, is to characterize groundwater conditions at the WBF Plant in support of fulfilling the requirements for the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA (TDEC 2015). The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee.

The purpose of this SAR is to document the work completed during groundwater sampling Event #4 of 6 total events and to present the information and data collected during the execution of the Groundwater Investigation Sampling and Analysis Plan (SAP) (Stantec 2018a). This SAR is not intended to provide conclusions or evaluations of results. The scope of the groundwater investigation represented herein was conducted pursuant to the SAP and is part of a larger environmental investigation at the WBF Plant. The data provided in this SAR are not inclusive of other programmatic data that exist for the site. The evaluation of the results will include data from the six groundwater sampling events and consider other aspects of the environmental investigation, as well as data collected under other State and/or coal combustion residuals (CCR) programs. This evaluation will be presented in the Environmental Assessment Report (EAR).

Event #4 activities were performed in general accordance with the following documents developed by TVA to support fulfilling the requirements of the TDEC Order at the WBF Plant.

- *Groundwater Investigation SAP* (Stantec 2018a)
- *Environmental Investigation Plan (EIP)* (Stantec 2018b)
- *Quality Assurance Project Plan (QAPP)* (Environmental Standards, Inc. 2018).

The Groundwater Investigation SAP was updated based on TVA- and TDEC-approved Programmatic- and Project-specific changes. Minor variations in scope and procedures from those outlined in the SAP occurred during field activities due to field conditions and programmatic updates and are referenced in Section 3.6.

Event #4 is the fourth in a series of six planned sampling events for the groundwater investigation. Stantec performed the field work activities for this event. Laboratory analysis of constituents was performed by GEL Laboratories LLC (GEL) in Charleston, South Carolina (radium samples only) and Eurofins TestAmerica, Inc. (TestAmerica) in Pittsburgh, Pennsylvania (other analytes). Quality assurance

oversight on data acquisition protocols, sampling practices, and data validation or verification was performed by Environmental Standards, Inc. (EnvStds) under direct contract to TVA.

This report summarizes the groundwater investigation activities for Event #4. The remaining sampling events will be completed before overall conclusions and findings about the groundwater investigation and groundwater conditions at the WBF Plant are made and documented in the EAR.

2.0 OBJECTIVE AND SCOPE

The primary objectives of the groundwater investigation conducted pursuant to the Groundwater Investigation SAP (which includes six sampling events) are to characterize existing groundwater quality and to evaluate groundwater flow conditions at the WBF Plant in response to the TDEC Order. The approach to characterizing the groundwater conditions is to:

- Collect groundwater samples for chemical analyses to evaluate the potential presence of constituents related to CCR in groundwater
- Measure groundwater and surface water elevations for subsequent evaluation of direction and rate of groundwater flow.

The scope of work intended to achieve the objectives of the groundwater investigation consists of six sampling events at a frequency of one event every two months for one year to characterize seasonal groundwater quality and flow direction. This report describes the activities related to Event #4, performed in March 2020, the scope of which included:

- Collecting groundwater and surface water level measurements
- Collecting field measurements of groundwater quality parameters
- Collecting groundwater samples and associated quality control (QC) samples for laboratory analysis.

These activities were carried out after the installation of permanent monitoring wells specified in the Groundwater Investigation SAP. Details of the monitoring well installation activities are provided in the WBF Plant Hydrogeological Investigation SAR.

In addition, pore water measurements from piezometers and temporary wells installed in the CCR units at the WBF Plant are presented in this SAR for comparison with groundwater data. Temporary well and piezometer installation activities are described in the WBF Plant Exploratory Drilling SAR, and temporary well gauging and sampling information is provided in the WBF Plant CCR Material Characteristics SAR.

3.0 FIELD ACTIVITIES

Groundwater investigation field activities for Event #4 were conducted March 2-4, 2020. Stantec performed groundwater level measurements and sample collection activities based on guidance and specifications in TVA's Environmental (ENV) Technical Instructions (TIs), the SAP, the QAPP, and applicable United States Environmental Protection Agency documents except as noted in the Variations section of this report. As part of TVA's commitment to generate representative and reliable data, data validation and/or verification of laboratory analytical results were performed by EnvStds under direct contract with TVA. EnvStds also conducted audits of field activities and provided quality reviews of field documentation.

During Event #4, Stantec conducted the following field activities:

- Measured groundwater levels at six monitoring wells installed for the TDEC Order and four monitoring wells and four piezometers installed for other environmental programs (10 total monitoring wells)
- Measured pore water levels at four temporary wells and three piezometers installed in the CCR units
- Measured the surface water level at one location in the Tennessee River
- Collected groundwater samples from six monitoring wells installed for the TDEC Order
- Recorded field measurements of groundwater quality parameters during purging and stabilization at the sampled monitoring wells
- Collected QC samples including one field duplicate, one matrix spike/matrix spike duplicate, two field blanks, one equipment blank, one filter blank, and one tubing blank
- Shipped the collected samples to GEL in Charleston, South Carolina, and TestAmerica in Pittsburgh, Pennsylvania.

Details on each activity are presented in the sections below.

3.1 WORK LOCATIONS

The TDEC Order CCR units at the WBF Plant (Ash Pond and Slag Disposal Area) as well as the monitoring wells, temporary wells, and piezometers sampled and/or gauged during Event #4 are shown on Exhibit A.1 in Appendix A. TVA is currently sampling groundwater at the WBF Plant for the National Pollutant Discharge Elimination System (NPDES) permit closure program. Monitoring wells that are sampled as part of other environmental programs are not sampled as part of the groundwater investigation for the TDEC Order.

Groundwater levels were measured in TDEC Order monitoring wells as well as in select additional wells and piezometers from other environmental programs, as shown in Table B.1a in Appendix B, to provide information to prepare groundwater contour maps for this SAR and the WBF Plant EAR. Pore water levels measured in temporary wells and piezometers installed in the CCR units are presented in Table B.1b. Groundwater and pore water elevations are shown on Exhibits A.2 and A.3 in Appendix A. Groundwater elevation contours are depicted on Exhibit A.2 and pore water elevation contours are depicted on Exhibit A.3.

Groundwater analytical and field duplicate samples were collected from the TDEC Order groundwater investigation monitoring wells as shown in Table B.2 in Appendix B. Groundwater analytical data collected for the TDEC Order and the NPDES permit closure program, which includes wells MW-1, MW-2, MW-3, and WBF-100, will be provided in the EAR.

3.2 DOCUMENTATION

Stantec maintained field documentation in accordance with ENV-TI-05.80.03, *Field Record Keeping*, and the QAPP. Field activities and data were recorded on program-specific field forms. Health and safety forms were completed in accordance with TVA and Stantec health and safety requirements. Additional information regarding field documentation is provided below.

3.2.1 Field Forms

Stantec used program-specific field forms to record field observations and data for specific activities. Field forms used during the groundwater investigation included:

- *Daily Field Activity Log*
- *Monitoring Well Inspection Checklist*
- *Equipment Calibration Form*
- *Groundwater Level Measurement Form*
- *Vibrating Wire Piezometer Measurement Form*
- *Groundwater Sampling Form*
- *Chain-of-Custody (COC).*

3.2.1.1 Daily Field Activity Log

Stantec field sampling personnel (FSP) recorded field activities, observations, and data on a *Daily Field Activity Log* to chronologically document the field program. Deviations from the SAP, TIs, or QAPP were documented on the *Daily Field Activity Log*.

3.2.1.2 Monitoring Well Inspection Checklist

Prior to measuring water levels, Stantec FSP inspected each monitoring well for damage or indications that the well integrity had been compromised in accordance with ENV-TI-05.80.21, *Monitoring Well Inspection and Maintenance.* Inspection results were documented on a *Monitoring Well Inspection Checklist*. No signs of damage or necessary repairs were noted during Event #4.

3.2.1.3 Equipment Calibration Form

Stantec FSP performed daily calibration of the water quality meter and turbidity meter and documented the results on an *Equipment Calibration Form*. The form documented the calibration results for temperature, turbidity, specific conductance, pH, dissolved oxygen (DO), and oxidation-reduction potential (ORP), and verified that the field instruments' sensors were operating within acceptance criteria. Refer to Section 3.2.2 for additional details on equipment calibration procedures.

3.2.1.4 Groundwater Level Measurement Form

Stantec FSP recorded groundwater level field measurement data on a *Groundwater Level Measurement Form* in accordance with ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*. The form includes the monitoring well identification (ID), time, and depth to water measured from a standardized reference point on the top of each well casing, recorded in feet (ft) below top of casing.

3.2.1.5 Vibrating Wire Piezometer Measurement Form

Stantec FSP recorded field measurement data on a *Vibrating Wire Piezometer Measurement Form*. The form includes the vibrating wire piezometer ID, serial number, time, digits, temperature, and length of the wire in feet. The readings were used to calculate the pressure head (ft of water) above the vibrating wire sensor to obtain the groundwater or pore water elevation.

3.2.1.6 Groundwater Sampling Form

Stantec FSP recorded the depth to water, purge flow rate, volume of groundwater purged, temperature, pH, specific conductance, DO, ORP, turbidity, color of water, and other observations during groundwater purging and sampling activities at each monitoring well in accordance with ENV-TI-05.80.42, *Groundwater Sampling*. Field measurements were recorded on a *Groundwater Sampling Form*. The form also documents the time intervals between measurement of field parameters, low-flow extraction rates, water level drawdown, and water quality parameter measurements until stabilization criteria were met.

3.2.1.7 Chain-of-Custody

Stantec FSP completed *COC* documentation for each groundwater sample collected. The sample ID, sample location, type of sample, sampling date and time, analyses requested, sample pH, and sample custody record were recorded on the *COC*. The Field Team Leader reviewed the *COC* for completeness, and the FSP conducted a QC check of samples in each cooler compared to sample IDs on the corresponding *COC*. *COCs* were completed in accordance with ENV-TI-05.80.02, *Sample Labeling and Custody*.

3.2.2 Equipment Calibration

Field instruments used to collect, generate, or measure water quality parameters were calibrated each day prior to use as specified in the SAP, QAPP, and ENV-TI-05.80.46, *Field Measurement Using a Multi-Parameter Sonde.* Afternoon calibration verifications were performed to evaluate if these instruments remained within acceptance criteria during sampling. Temperature and barometric pressure instrument readings were verified using a calibrated National Institute of Standards and Technology traceable thermometer and National Weather Service (via mesowest.utah.edu) barometric pressure readings for Lovell Field (KCHA) in Chattanooga, Tennessee, respectively. Additional details regarding equipment calibration were recorded on an *Equipment Calibration Form*, as described in Section 3.2.1.3.

3.3 SAMPLING METHODS

The following sections present monitoring well data collection and sampling procedures used during Event #4.

3.3.1 Static Water Level Measurements

FSP measured static groundwater levels at 10 monitoring wells and pore water levels at four temporary wells in accordance with ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*. On March 2, 2020, static groundwater and pore water level readings were measured and recorded to the nearest 0.01 ft from a reference point on the top of each well casing using an electronic water level indicator. Water level indicator probes were decontaminated prior to the first use and between measurements, and the decontamination was documented as specified in ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination.* Depth to groundwater and pore water measurements were recorded on a *Groundwater Level Measurement Form*.

Groundwater and pore water measurements were also obtained from transducers installed within four piezometers and three piezometers, respectively. Additionally, a surface water level measurement for the Tennessee River was provided by TVA using the reading recorded closest to noon for the tailwater level below the Watts Bar Dam. The surface water staff gauge location is indicated on Exhibit A.1 in Appendix A.

Groundwater level data and pore water level data are shown in Tables B.1a and B.1b, respectively, in Appendix B. A groundwater elevation contour map based on groundwater measurements in wells and piezometers, along with pore water elevations, is included as Exhibit A.2 in Appendix A. Similarly, a pore water elevation contour map based on pore water measurements in wells and piezometers, along with groundwater elevations, is included as Exhibit A.3 in Appendix A.

3.3.2 Groundwater Purging & Sampling

Analytical and field duplicate samples (as specified in the SAP) were collected from six monitoring wells as shown in Table B.2 in Appendix B. Monitoring wells were purged using dedicated bladder pumps equipped with dedicated tubing using low-flow purging and sampling techniques as specified in ENV-TI-05.80.42, *Groundwater Sampling*.

During the purging process, water quality field parameters including pH, specific conductance, temperature, ORP, and DO were measured using water quality meters (YSI ProPlus with flow-through cell) and recorded on field forms. Depth to water and turbidity were measured and recorded using decontaminated electronic water-level indicators (Heron Dipper-T) and calibrated turbidimeters (Hach 2100Q). Field parameters were measured and recorded on *Groundwater Sampling Forms* during purging until readings were stabilized as specified in the SAP. As approved by TDEC, the specific conductance and turbidity stabilization limits were revised to the values below to meet overall programmatic objectives for groundwater investigations at the WBF Plant. Well purging was considered complete when three consecutive readings were within the following stabilization limits:

- pH – ± 0.1 Standard Units
- Specific Conductance – ± 3% microSiemens per centimeter
- Turbidity – Less than 5 Nephelometric Turbidity Units (NTUs) or ± 10% for values above 5 NTUs
- DO – Less than 0.5 milligrams per Liter (mg/L) or ± 10% for values above 0.5 mg/L.

After water quality stabilization criteria were achieved, the final field parameter results were recorded, purging was discontinued, and a sample was collected as specified in the SAP. Due to a final turbidity reading higher than 5 NTUs at well WBF-101, an additional sample was collected at that well and submitted to the laboratory for dissolved metals analysis.

Laboratory-provided, pre-preserved sample containers were filled directly from the pump discharge line with the exception of the dissolved metals sample, which was collected via a new 0.45-micron disposable inline filter attached to the end of the discharge line to field filter the sample. FSP wore new, clean nitrile gloves when handling sample containers and did not touch the interior of containers or container caps. New gloves were used when handling each sample. When filling sample bottles, care was taken to minimize sample aeration (i.e., water was directed down the inner walls of the sample bottle) and to avoid overfilling and diluting preservatives. Each sample bottle was capped before filling the next bottle. Following completion of sampling, final field parameter measurements were recorded.

Sample containers were labeled and handled in accordance with ENV-TI-05.80.02, *Sample Labeling and Custody.* FSP secured caps on each bottle, attached a custody seal across the cap, and placed the bottles in a cooler on ice within 15 minutes of collection. QC samples were collected in accordance with ENV-TI-05.80.04, *Field Sampling Quality Control.*

Groundwater samples were analyzed for the CCR-related constituents listed in Appendices III and IV of 40 Code of Federal Regulations (CFR) 257. In addition, five inorganic constituents listed in Appendix I of Tennessee Rule 0400-11-01-.04 and not included in the 40 CFR 257 Appendices III and IV were analyzed to maintain continuity with TDEC environmental programs. These additional TDEC Appendix I constituents included copper, nickel, silver, vanadium, and zinc. The combined federal CCR Appendices III and IV constituents and TDEC Appendix I inorganic constituents will hereafter be referred to collectively as “CCR Parameters.” For geochemical evaluation, major cations/anions not included in the CCR Parameters were included in the analyses. The additional geochemical parameters included bicarbonate, carbonate, magnesium, potassium, and sodium.

3.4 INVESTIGATION DERIVED WASTE

Investigation derived waste (IDW) generated during groundwater investigation activities included:

- Used calibration solutions
- Purge water
- Decontamination fluids
- Disposable personal protective equipment (PPE)
- General trash.

IDW was handled in accordance with ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*; ENV-TI-05.80.42, *Groundwater Sampling* (purge water); the WBF Plant-specific waste management plan; and local, state, and federal regulations. Transportation and disposal of IDW was coordinated with WBF Plant facility management. Used calibration solution was containerized and stored for disposal as directed by the WBF Plant facility management. Purge water and decontamination fluids were containerized for later disposal as specified in the WBF Plant-specific waste management plan. Used disposable PPE (e.g., nitrile gloves) and general trash generated throughout the day were placed in garbage bags and disposed of in a general trash dumpster onsite at the end of each day.

3.5 SAMPLE SHIPMENT

Samples were packed and shipped under *COC* procedures specified in ENV-TI-05.80.06, *Handling and Shipping of Samples*. The samples were shipped by FedEx to GEL in Charleston, South Carolina (radium samples only), and to TestAmerica in Pittsburgh, Pennsylvania (other analytes). The laboratories submitted sample receipt confirmation forms to EnvStds for review and confirmation.

3.6 VARIATIONS

The proposed scope and procedures for the groundwater investigation were outlined in the SAP, QAPP, and applicable TVA TIs as detailed in the sections above. Variations in scope or procedures discussed with TDEC and/or TVA, changes based on field conditions, or additional field sampling performed to complete the scope of work in the SAP are described in the following sections. As discussed below, these variations do not impact the overall usability and representativeness of the dataset provided in this SAR for the groundwater investigation sampling Event #4 at the WBF Plant.

3.6.1 Variations in Scope

There were no variations in scope during the groundwater investigation sampling Event #4 at the WBF Plant.

3.6.2 Variations in Procedures

Variations in procedures occurring in the field are provided below.

- As approved by TDEC, the specific conductance and turbidity stabilization limits were revised to meet overall programmatic objectives for groundwater investigations.

4.0 SUMMARY

The data presented in this report are only for groundwater investigation sampling Event #4 at the WBF Plant. The scope of work for Event #4 was to:

- Collect groundwater samples for chemical analyses to assist with subsequent evaluation of the potential presence of CCR-related constituents in groundwater
- Measure groundwater and surface water elevations to assist with subsequent evaluation of groundwater flow direction and rate after multiple data sets have been collected.

In addition, pore water measurements from piezometers and temporary wells installed in the CCR units at the WBF Plant are presented in this SAR for comparison with groundwater data.

Event #4 included collecting groundwater level measurements at 10 monitoring wells and four piezometers, pore water measurements at four temporary wells and three piezometers in the CCR units, and a surface water measurement at one gauge located in the Tennessee River. Groundwater and surface water measurements and elevations are provided in Table B.1a, and pore water measurements and elevations are provided in Table B.1b, and depicted on Exhibits A.2 and A.3.

Groundwater quality measurements and groundwater analytical samples were collected at six monitoring wells as summarized in Table B.2. Groundwater quality parameters were recorded during purging. Stabilization criteria for pH, specific conductance, turbidity, and DO were achieved at each sampling location. The final measurements prior to initiating sample collection are presented in Table B.3.

Groundwater analytical data for CCR Parameters and geochemical parameters are presented in Table B.4. Analytical data for radium analyses are presented in Table B.5. Analytical data were reported by GEL and TestAmerica, and then validated and/or verified by EnvStds.

Stantec has completed Event #4 of the groundwater investigation at the WBF Plant in Spring City, Tennessee, in accordance with the Groundwater Investigation SAP as documented herein. The data collected during Event #4 are usable for reporting and evaluation in the EAR and meet the objectives of the TDEC Order EIP. The complete datasets from the six groundwater sampling events will be evaluated along with data collected under other TDEC Order SAPs, as well as data collected under other State and CCR programs. This evaluation will be provided in the EAR.

5.0 REFERENCES

Environmental Standards, Inc. 2018. *Quality Assurance Project Plan for the Tennessee Valley Authority Watts Bar Fossil Plant Environmental Investigation*. Revision 2. November 2018.

Stantec Consulting Services Inc. (Stantec). 2018a. *Groundwater Investigation Sampling and Analysis Plan, Watts Bar Fossil Plant.* Revision 3. Prepared for Tennessee Valley Authority. November 19, 2018.

Stantec. 2018b. *Environmental Investigation Plan, Watts Bar Fossil Plant.* Revision 3. Prepared for Tennessee Valley Authority. November 19, 2018.

Tennessee Department of Environment and Conservation. 2015. *Commissioner's Order No. OGC15-0177.*

Tennessee Valley Authority (TVA). ENV-TI-05.80.02, *Sample Labeling and Custody*.

TVA. ENV-TI-05.80.03, *Field Record Keeping*.

TVA. ENV-TI-05.80.04, *Field Sampling Quality Control*.

TVA. ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*.

TVA. ENV-TI-05.80.06, *Handling and Shipping of Samples*.

TVA. ENV-TI-05.80.21, *Monitoring Well Inspection and Maintenance*.

TVA. ENV-TI-05.80.42, *Groundwater Sampling*.

TVA. ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*.

TVA. ENV-TI-05.80.46, *Field Measurement Using a Multi-Parameter Sonde*.

APPENDIX A - EXHIBITS

Exhibit No.

A.1

Title

Monitoring Well Network

Client/Project

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location

Spring City, Tennessee

175668050

Prepared by MB on 2021-04-20
Technical Review by MW on 2021-04-20

0 150 300 450 600 Feet

1:1,800 (At original document size of 22x34)

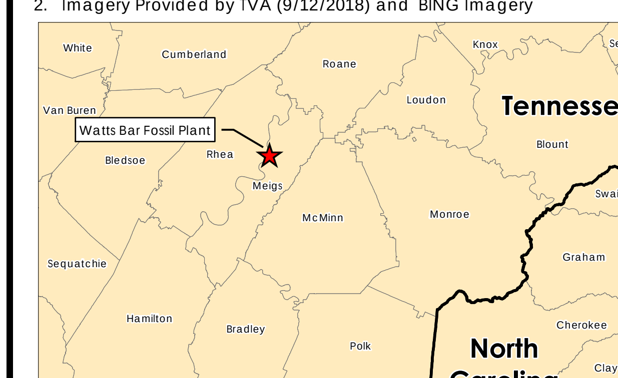
Legend

- Groundwater Investigation Monitoring Well
- Other Monitoring Well
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary Well within CCR Material
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery



Stantec TVA

Exhibit No.
A.2

Title
Groundwater Elevation Contour Map, Event #4 (March 2, 2020)

Client/Project
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location: Spring City, Tennessee

175668050
Prepared by DMB on 2021-04-20
Technical Review by MD on 2021-04-20

0 150 300 450 600 Feet
1:1,800 (At original document size of 22x34)

Legend

- Groundwater Investigation Monitoring Well groundwater elevation in feet above mean sea level (ft amsl)
- Other Monitoring Well groundwater elevation in ft amsl
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary well in CCR pore water elevation in ft amsl; value not used for contouring
- Interpolated Groundwater Contour (5 ft interval; elevations are in ft amsl)
- Groundwater Contour (5 ft interval; elevations are in ft
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond
- Consolidated and Capped CCR Area
- Drainage Improvements Area; Stormwater Pond (Former Ash

CCR: Coal combustion residuals

River Gauge (Not Shown - See Note 4) surface water elevation in ft amsl

*Groundwater elevation displayed but not used as input for contouring due to factors such as well construction or being screened in a different hydrogeologic unit.

*** Nested VWPZ sensors monitoring pore water and groundwater elevations in the same borehole, and the location is shown by a single symbol.

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery
3. Groundwater contours were created using Surfer Version 16.1.350 (December 13, 2018) and manual adjustment
4. Surface water elevation is measured from the tailwater reading from Watts Bar Dam located ~4,000 ft North of well WBF-106
5. For PZ's with multiple instruments in CCR material, the reading with the highest pore water elevation is displayed, unless that reading is suspected of being erroneous.

Stantec TVA

Exhibit No.

A.3

Title

Pore Water Elevation Contour Map, Event #4 (March 2, 2020)

Client/Project

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location 175668050

Spring City, Tennessee

Prepared by DMB on 2021-04-20
Technical Review by MD on 2021-04-20

0 150 300 450 600 Feet

1:1,800 (At original document size of 22x34)

Legend

- Groundwater Investigation Monitoring Well — groundwater elevation in feet above mean sea level (ft amsl); value not used for contouring
- Other Monitoring Well — groundwater elevation in ft amsl; value not used for contouring
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary well in CCR — pore water elevation in ft amsl
- Interpolated Pore water Contour (2 ft interval; elevations are in ft amsl)
- Pore water Contour (2 ft interval; elevations are in ft amsl)
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

CCR: Coal combustion residuals

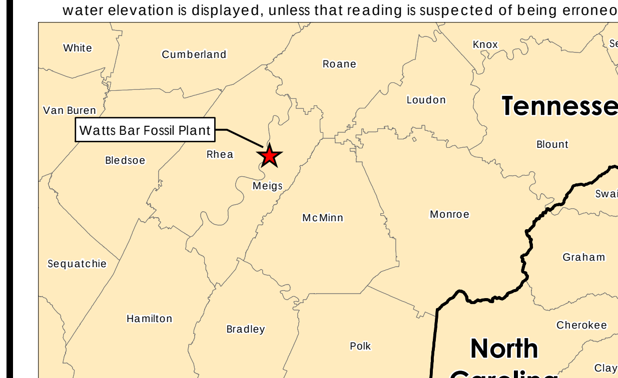
River Gauge (Not Shown - See Note 4) surface water elevation in ft amsl

*Groundwater elevation displayed but not used as input for contouring due to factors such as well construction or being screened in a different hydrogeologic unit.

*** Nested VWPZ sensors monitoring pore water and groundwater elevations in the same borehole, and the location is shown by a single symbol.

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery
3. Pore water contours were created with manual adjustment using Surfer Version 16 (December 13, 2018)
4. Surface water elevation is measured from the tailwater reading from Watts Bar Dam located ~4,000 ft North of well WBF-106
5. For PZ's with multiple instruments in CCR material, the reading with the highest pore water elevation is displayed, unless that reading is suspected of being erroneous.



Stantec TVA

U:\TVA-EP\175668050_WBF_WorkPlans\gis\mxd\GW_Tech_Memo\WBF_GWTechMemo_FigA3_PorewaterContour_wPZ_Event4_porewater.mxd Revised: 2021-04-20 By: mbough

APPENDIX B - TABLES

TABLE B.1a – Groundwater Level Measurements
Watts Bar Fossil Plant
March 2020

UNID	Well / Piezometer ID	Date Measured	Depth to Groundwater	Top of Casing Elevation	Groundwater Elevation	Piezometer Ground Surface Elevation	Piezometer Sensor Elevation	Piezometer Sensor Depth	Screened Interval	Screened / Piezometer Sensor Formation
			ft btoc	ft msl	ft msl	ft msl	ft msl	ft bgs	ft btoc	
Monitoring Wells										
WBF-00-GW-43-001	MW-1	2-Mar-20	5.56	711.92	706.36	n/a	n/a	n/a	23.3 - 33.3	Alluvial silts and clays
WBF-00-GW-43-002	MW-2	2-Mar-20	17.91	704.29	686.38	n/a	n/a	n/a	22.7 - 32.4	Alluvial sand
WBF-00-GW-43-003	MW-3	2-Mar-20	10.73	696.22	685.49	n/a	n/a	n/a	21.6 - 31.6	Alluvial sand
WBF-00-GW-43-004	WBF-100	2-Mar-20	40.89	741.49	700.60	n/a	n/a	n/a	47.7 - 57.8	Alluvial sand / alluvial silts and clays
WBF-00-GW-43-005	WBF-101	2-Mar-20	13.14	703.15	690.01	n/a	n/a	n/a	27.3 - 37.1	Alluvial clay and silts / alluvial sand
WBF-00-GW-43-006	WBF-102	2-Mar-20	19.75	723.98	704.23	n/a	n/a	n/a	19.4 - 24.2	Alluvial sand with clay
WBF-00-GW-43-007	WBF-103	2-Mar-20	14.19	725.09	710.90	n/a	n/a	n/a	17.0 - 21.8	Alluvial sand with clay / alluvial sand
WBF-00-GW-43-008	WBF-104	2-Mar-20	11.88	697.45	685.57	n/a	n/a	n/a	21.5 - 31.3	Alluvial clay and silts / alluvial sand
WBF-00-GW-43-009	WBF-105	2-Mar-20	11.48	704.50	693.02	n/a	n/a	n/a	32.2 - 37.0	Alluvial silty sand
WBF-00-GW-43-010	WBF-106	2-Mar-20	12.67	706.34	693.67	n/a	n/a	n/a	27.8 - 37.6	Alluvial clay / alluvial silty sand and alluvial sand
Piezometers										
n/a	WBF-B02C	2-Mar-20	9.3	n/a	709.8	719.1	680.5	38.6	n/a	Alluvial sandy silt
n/a	WBF-B03B	2-Mar-20	1.6	n/a	698.3	699.9	665.9	34.0	n/a	Alluvial sand with silt and gravel
n/a	WBF-B04C	2-Mar-20	11.3	n/a	702.1	713.4	668.4	45.0	n/a	Alluvial silty sand / alluvial sandy gravel
n/a	WBF-B05C	2-Mar-20	9.8	n/a	707.4	717.2	668.2	49.0	n/a	Alluvial silty sand
Surface Water Gauge										
Tennessee River	n/a	2-Mar-20	n/a	n/a	684.44	n/a	n/a	n/a	n/a	n/a

Notes:

bgs	below ground surface
btoc	below top of casing
ft	feet
ID	identification
msl	mean sea level
n/a	not applicable
UNID	Unique Numerical Identification

1. Top of casing elevations, screened intervals, and screened formations were obtained from the TVA Well Inventory Log provided by TVA.
2. Tennessee River data point is the reading closest to noon recorded by the automated staff gauge provided by TVA.
3. Ground surface elevations, groundwater elevations, and piezometer data were obtained from geotechnical instrumentation database. Piezometer sensor formations were obtained from boring logs. Data from vibrating wire piezometers were averaged for the measurement date.
4. Depth to groundwater in piezometers and groundwater elevations at all locations are calculated values. Accuracy of piezometer data is to 0.1 ft.

TABLE B.1b – Pore Water Level Measurements
Watts Bar Fossil Plant
March 2020

Temporary Well / Piezometer ID	Date Measured	Depth to Pore Water	Top of Casing Elevation	Pore Water Elevation	Piezometer Ground Surface Elevation	Piezometer Sensor Elevation	Piezometer Sensor Depth	Screened Interval	Screened / Piezometer Sensor Formation
		ft btoc	ft msl	ft msl	ft msl	ft msl	ft bgs	ft bgs	
Temporary Wells									
WBF-TW02	2-Mar-20	23.13	718.34	695.21	n/a	n/a	n/a	9.1 - 18.9	CCR
WBF-TW03	2-Mar-20	14.55	721.19	706.64	n/a	n/a	n/a	15.8 - 25.6	CCR
WBF-TW04	2-Mar-20	9.59	719.27	709.68	n/a	n/a	n/a	7.5 - 17.3	CCR
WBF-TW05	2-Mar-20	11.89	717.97	706.08	n/a	n/a	n/a	11.5 - 16.3	CCR
Piezometers									
WBF-B02A	2-Mar-20	7.2	n/a	711.9	719.1	699.5	19.6	n/a	CCR
WBF-B04A	2-Mar-20	7.1	n/a	706.3	713.4	696.4	17.0	n/a	CCR
WBF-B05A	2-Mar-20	10.1	n/a	707.1	717.2	696.2	21.0	n/a	CCR

Notes:

bgs	below ground surface
btoc	below top of casing
CCR	coal combustion residuals
ft	feet
ID	identification
msl	mean sea level
n/a	not applicable

1. Top of casing elevations, screened intervals, and screened formations were obtained from boring logs, well details, and well survey data.
2. For piezometers, ground surface elevations, pore water elevations, and piezometer data were obtained from geotechnical instrumentation database. Piezometer sensor formations were obtained from boring logs. Data from vibrating wire piezometers were averaged for the measurement date.
3. Depth to pore water in piezometers and pore water elevations at all locations are calculated values. Accuracy of piezometer data is to 0.1 ft.
4. Screened interval shown for temporary wells is below ground surface when drilled.

TABLE B.2 – Summary of Groundwater Samples
Watts Bar Fossil Plant
March 2020

			Analysis Type										
Location ID	**Sample ID**	**Sample Type**	Field Parameters	Total Metals	Dissolved Metals	Total Mercury	Dissolved Mercury	Anions	Alkalinity	Total Dissolved Solids	Radium-226	Radium-228	Radium-226+228
WBF-101	WBF-GW-005-20200303	Normal Environmental Sample	x	x	x	x	x	x	x	x	x	x	x
WBF-102	WBF-GW-006-20200303	Normal Environmental Sample	x	x		x		x	x	x	x	x	x
WBF-103	WBF-GW-007-20200303	Normal Environmental Sample	x	x		x		x	x	x	x	x	x
WBF-104	WBF-GW-008-20200304	Normal Environmental Sample	x	x		x		x	x	x	x	x	x
WBF-105	WBF-GW-009-20200304	Normal Environmental Sample	x	x		x		x	x	x	x	x	x
WBF-106	WBF-GW-010-20200304	Normal Environmental Sample	x	x		x		x	x	x	x	x	x
	WBF-GW-DUP01-20200304	Field Duplicate Sample		x		x		x	x	x	x	x	x

Notes:

Total and Dissolved Metals	SW-846 6020A
Total and Dissolved Mercury	SW-846 7470A
Anions	EPA 300.0/SW846 9056
Alkalinity	SM2320B
Total Dissolved Solids	SM2540C
Radium-226	EPA 903.0
Radium-228	EPA 904.0
Radium-226+228	CALC
ID	identification

1. Field and laboratory quality control sample results except for field duplicates are not included in report tables but were used for data validation.

TABLE B.3 – Summary of Groundwater Quality Parameters
Watts Bar Fossil Plant
March 2020

Sample Location		WBF-101	WBF-102	WBF-103	WBF-104	WBF-105	WBF-106
Sample Date		3-Mar-20	3-Mar-20	3-Mar-20	4-Mar-20	4-Mar-20	4-Mar-20
Sample ID		WBF-GW-005-20200303	WBF-GW-006-20200303	WBF-GW-007-20200303	WBF-GW-008-20200304	WBF-GW-009-20200304	WBF-GW-010-20200304
Sample Depth		32.2 ft	23 ft	19.5 ft	26.4 ft	35.1 ft	32.6 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Level of Review	Units	Final QC Review	Final QC Review	Final QC Review	Final QC Review	Final QC Review	Final QC Review
Field Parameters							
Dissolved Oxygen	%	2.8	36.9	21.5	4.0	1.9	2.9
Dissolved Oxygen	mg/L	0.27	3.60	2.14	0.40	0.18	0.27
ORP	mV	28.7	76.1	121.6	102.4	-119.0	64.2
pH (field)	SU	5.76	6.98	5.52	5.54	6.70	5.61
Specific Cond. (Field)	uS/cm	1,508	527.7	153.9	1,904	892	891
Temperature, Water (C)	DEG C	17.6	16.9	15.9	15.0	17.1	17.0
Turbidity, field	NTU	18.1	0.36	0.86	1.45	4.45	3.97

Notes:

%	percent
Cond.	conductance
DEG C	degrees Celsius
ft	feet below top of casing
ID	identification
mg/L	milligrams per Liter
mV	milliVolts
NTU	Nephelometric Turbidity Unit
ORP	Oxidation Reduction Potential, measured using a silver reference electrode which has a standard potential of 200 mV
SU	Standard Units
uS/cm	microSiemens per centimeter

TABLE B.4 - Groundwater Analytical Results for Metals, Anions, and General Chemistry
Watts Bar Fossil Plant
March 2020

Sample Location				WBF-101	WBF-102	WBF-103	WBF-104	WBF-105	WBF-106	
Sample Date				3-Mar-20	3-Mar-20	3-Mar-20	4-Mar-20	4-Mar-20	4-Mar-20	4-Mar-20
Sample ID				WBF-GW-005-20200303	WBF-GW-006-20200303	WBF-GW-007-20200303	WBF-GW-008-20200304	WBF-GW-009-20200304	WBF-GW-010-20200304	WBF-GW-DUP01-20200304
Sample Depth				32.2 ft	23 ft	19.5 ft	26.4 ft	35.1 ft	32.6 ft	32.6 ft
Sample Type				Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample
Level of Review	Units	EPA MCLs	CCR Rule GWPS	Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified
Total Metals										
Antimony	ug/L	6[A]	n/v	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378
Arsenic	ug/L	10[A]	n/v	1.94	0.483 J	<0.313	0.318 J	1.35	0.468 J	0.576 J
Barium	ug/L	2,000[A]	n/v	34.1	50.5	83.2	43.4	97.4	33.2	33.0
Beryllium	ug/L	4[A]	n/v	0.338 J	<0.182	<0.182	0.229 J	<0.182	<0.182	<0.182
Boron	ug/L	n/v	n/v	2,030	60.5 J	<38.6	3,570	49.7 J	212	217
Cadmium	ug/L	5[A]	n/v	3.76	<0.217	<0.217	**7.28[A]**	<0.217	0.354 J	0.375 J
Calcium	ug/L	n/v	n/v	302,000	99,300	17,800	450,000	133,000	161,000	161,000
Chromium	ug/L	100[A]	n/v	<1.53	<1.53	1.55 J	<1.53	<1.53	<1.53	<1.53
Cobalt	ug/L	n/v	6[B]	**297[B]**	<0.134	1.12	**256[B]**	<0.134	**72.4[B]**	**73.4[B]**
Copper	ug/L	n/v	n/v	<0.627	0.670 J	2.92	<0.627	<0.627	<0.627	<0.627
Lead	ug/L	n/v	15[B]	0.238 J	<0.128	6.21	<0.128	<0.128	<0.128	0.208 J
Lithium	ug/L	n/v	40[B]	3.80 J	<3.39	<3.39	<3.39	<3.39	<3.39	<3.39
Magnesium	ug/L	n/v	n/v	39,900	12,800	4,110	52,800	19,300	23,000	23,300
Mercury	ug/L	2[A]	n/v	<0.101	<0.101	<0.101	<0.101	<0.101	<0.101	<0.101
Molybdenum	ug/L	n/v	100[B]	<0.610	2.86 J	<0.610	<0.610	<0.610	<0.610	<0.610
Nickel	ug/L	100 (TN MCL)[A]	n/v	47.3	<0.336	1.66	51.0	<0.336	13.8	14.0
Potassium	ug/L	n/v	n/v	2,400	2,720	4,060	1,340	832	4,720	4,770
Selenium	ug/L	50[A]	n/v	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51
Silver	ug/L	100 (TN MCL)[A]	n/v	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177
Sodium	ug/L	n/v	n/v	23,600	9,430	5,370	23,300	29,300	8,240	8,250
Thallium	ug/L	2[A]	n/v	<0.148	0.237 J	<0.148	<0.148	<0.148	<0.148	<0.148
Vanadium	ug/L	n/v	n/v	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991
Zinc	ug/L	n/v	n/v	145	<3.22	9.38	91.1	<3.22	34.4	36.2
Dissolved Metals										
Antimony	ug/L	6[A]	n/v	<0.378	-	-	-	-	-	-
Arsenic	ug/L	10[A]	n/v	1.76	-	-	-	-	-	-
Barium	ug/L	2,000[A]	n/v	35.1	-	-	-	-	-	-
Beryllium	ug/L	4[A]	n/v	0.269 J	-	-	-	-	-	-
Boron	ug/L	n/v	n/v	2,000	-	-	-	-	-	-
Cadmium	ug/L	5[A]	n/v	3.30	-	-	-	-	-	-
Calcium	ug/L	n/v	n/v	299,000	-	-	-	-	-	-
Chromium	ug/L	100[A]	n/v	<1.53	-	-	-	-	-	-
Cobalt	ug/L	n/v	6[B]	**295[B]**	-	-	-	-	-	-
Copper	ug/L	n/v	n/v	<0.627	-	-	-	-	-	-
Lead	ug/L	n/v	15[B]	<0.128	-	-	-	-	-	-
Lithium	ug/L	n/v	40[B]	3.69 J	-	-	-	-	-	-
Magnesium	ug/L	n/v	n/v	38,900	-	-	-	-	-	-
Mercury	ug/L	2[A]	n/v	<0.101	-	-	-	-	-	-
Molybdenum	ug/L	n/v	100[B]	<0.610	-	-	-	-	-	-
Nickel	ug/L	100 (TN MCL)[A]	n/v	48.4	-	-	-	-	-	-
Potassium	ug/L	n/v	n/v	2,320	-	-	-	-	-	-
Selenium	ug/L	50[A]	n/v	<1.51	-	-	-	-	-	-
Silver	ug/L	100 (TN MCL)[A]	n/v	<0.177	-	-	-	-	-	-
Sodium	ug/L	n/v	n/v	23,700	-	-	-	-	-	-
Thallium	ug/L	2[A]	n/v	<0.148	-	-	-	-	-	-
Vanadium	ug/L	n/v	n/v	<0.991	-	-	-	-	-	-
Zinc	ug/L	n/v	n/v	143	-	-	-	-	-	-
Anions										
Chloride	mg/L	n/v	n/v	6.33	8.42	5.51	5.54	5.52	4.88	4.86
Fluoride	mg/L	4[A]	n/v	0.0557 J	0.0816 J	0.0276 J	0.0368 J	0.0530 J	0.0267 J	0.0291 J
Sulfate	mg/L	n/v	n/v	884	141	67.4	1,510	347	550	522
General Chemistry										
Alkalinity, Bicarbonate	mg/L	n/v	n/v	81.6	210	36.7	49.4	109	10.9 J	20.6 J
Alkalinity, Carbonate	mg/L	n/v	n/v	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
Alkalinity, Total as CaCO3	mg/L	n/v	n/v	81.6	210	36.7	49.4	109	10.9 J	20.6 J
Total Dissolved Solids	mg/L	n/v	n/v	1,340	464	162	1,720	640	791	794

Notes:

A	EPA Maximum Contaminant Level
B	CCR Rule GWPS (Federal Register / Vol. 83, No. 146 / Monday, July 30, 2018 / Rules and Regulations)
n/v	No standard/guideline value
6.5[A]	Concentration is greater than or equal to the indicated standard.
<0.03	analyte was not detected at a concentration greater than the Method Detection Limit
-	parameter not analyzed / not available
ft	feet below top of casing
ID	identification
J	quantitation is approximate due to limitations identified during data validation
mg/L	milligrams per Liter
ug/L	micrograms per Liter
(TN MCL)	Tennessee Maximum Contaminant Level

1. Level of review is defined in the Quality Assurance Project Plan.

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TABLE B.5 – Groundwater Analytical Results for Radiological Parameters
Watts Bar Fossil Plant
March 2020

Sample Location				WBF-101	WBF-102	WBF-103	WBF-104	WBF-105	WBF-106	
Sample Date				3-Mar-20	3-Mar-20	3-Mar-20	4-Mar-20	4-Mar-20	4-Mar-20	4-Mar-20
Sample ID				WBF-GW-005-20200303	WBF-GW-006-20200303	WBF-GW-007-20200303	WBF-GW-008-20200304	WBF-GW-009-20200304	WBF-GW-010-20200304	WBF-GW-DUP01-20200304
Sample Depth				32.2 ft	23 ft	19.5 ft	26.4 ft	35.1 ft	32.6 ft	32.6 ft
Sample Type				Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample
Level of Review	Units	EPA MCLs	CCR Rule GWPS	Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified
Radiological Parameters										
Radium-226	pCi/L	n/v	n/v	0.639 +/-(0.605)U	0.910 +/-(0.681)U	0.537 +/-(0.554)U	1.20 +/-(0.727)	1.33 +/-(0.785)	0.433 +/-(0.540)U	0.558 +/-(0.618)U
Radium-228	pCi/L	n/v	n/v	0.0791 +/-(0.323)U	0.484 +/-(0.425)U	0.215 +/-(0.435)U	0.166 +/-(0.354)U	0.182 +/-(0.247)U	0.179 +/-(0.247)U	0.326 +/-(0.460)U
Radium-226+228	pCi/L	5[A]	n/v	0.718 +/-(0.686)U	1.39 +/-(0.802)U	0.752 +/-(0.704)U	1.36 +/-(0.808)J	1.51 +/-(0.823)J	0.612 +/-(0.594)U	0.884 +/-(0.770)U

Notes:

A	EPA Maximum Contaminant Level
B	CCR Rule GWPS (Federal Register / Vol. 83, No. 146 / Monday, July 30, 2018 / Rules and Regulations)
n/v	No standard/guideline value
ft	feet below top of casing
ID	identification
J	quantitation is approximate due to limitations identified during data validation
pCi/L	picoCurie per Liter
U	not detected

1. Level of review is defined in the Quality Assurance Project Plan.

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APPENDIX H.7

GROUNDWATER INVESTIGATION EVENT #5 SAMPLING AND ANALYSIS REPORT

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Watts Bar Fossil Plant
Groundwater Investigation Event #5
Sampling and Analysis Report

TDEC Commissioner’s Order:
Environmental Investigation Plant
Watts Bar Fossil Plant
Spring City, Tennessee

April 23, 2021

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

TVA

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

Revision Record

Revision	Description	Date
0	Submittal to TDEC	April 23, 2021

Sign-off Sheet

This document entitled Watts Bar Fossil Plant Groundwater Investigation Event #5 Sampling and Analysis Report was prepared by Stantec Consulting Services Inc. ("Stantec") for the account of Tennessee Valley Authority (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by ______________________

Michael J. Winkler, Geologic Associate

Reviewed by ______________________

Carolyn Sexton, Senior Hydrogeologist

Approved by ______________________

Rebekah Brooks, Principal Hydrogeologist

Table of Contents

Abbreviations

CCR	Coal Combustion Residuals
CCR Parameters	Constituents listed in Appendices III and IV of 40 CFR 257 and five inorganic constituents included in Appendix I of Tennessee Rule 0400-11-01-.04
CEC	Civil and Environmental Consultants, Inc.
CFR	Code of Federal Regulations
COC	Chain-of-Custody
DO	Dissolved Oxygen
EAR	Environmental Assessment Report
EIP	Environmental Investigation Plan
ENV	Environmental
EnvStds	Environmental Standards, Inc.
Event #5	Groundwater investigation sampling event performed April 27-29, 2020
FSP	Field Sampling Personnel
ft	Feet
GEL	GEL Laboratories LLC
ID	Identification
IDW	Investigation Derived Waste
mg/L	Milligrams per Liter
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
ORP	Oxidation-Reduction Potential
PPE	Personal Protective Equipment
QAPP	Quality Assurance Project Plan
QC	Quality Control
SAP	Sampling and Analysis Plan
SAR	Sampling and Analysis Report
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Commissioner’s Order No. OGC15-0177
TestAmerica	Eurofins TestAmerica Inc.
TI	Technical Instruction
TVA	Tennessee Valley Authority
WBF Plant	Watts Bar Fossil Plant

1.0 INTRODUCTION

Stantec Consulting Services Inc. (Stantec) has prepared this sampling and analysis report (SAR) on behalf of the Tennessee Valley Authority (TVA) to document the completion of activities related to a groundwater investigation sampling event performed April 27-29, 2020 (Event #5) at TVA's Watts Bar Fossil Plant (WBF Plant) located in Spring City, Tennessee.

The purpose of the groundwater investigation, upon completion of six groundwater sampling events, is to characterize groundwater conditions at the WBF Plant in support of fulfilling the requirements for the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA (TDEC 2015). The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee.

The purpose of this SAR is to document the work completed during groundwater sampling Event #5 of 6 total events and to present the information and data collected during the execution of the Groundwater Investigation Sampling and Analysis Plan (SAP) (Stantec 2018a). This SAR is not intended to provide conclusions or evaluations of results. The scope of the groundwater investigation represented herein was conducted pursuant to the SAP and is part of a larger environmental investigation at the WBF Plant. The data provided in this SAR are not inclusive of other programmatic data that exist for the site. The evaluation of the results will include data from the six groundwater sampling events and consider other aspects of the environmental investigation, as well as data collected under other State and/or coal combustion residuals (CCR) programs. This evaluation will be presented in the Environmental Assessment Report (EAR).

Event #5 activities were performed in general accordance with the following documents developed by TVA to support fulfilling the requirements of the TDEC Order at the WBF Plant.

- *Groundwater Investigation SAP* (Stantec 2018a)
- *Environmental Investigation Plan (EIP)* (Stantec 2018b)
- *Quality Assurance Project Plan (QAPP)* (Environmental Standards, Inc. 2018).

The Groundwater Investigation SAP was updated based on TVA- and TDEC-approved Programmatic- and Project-specific changes. Minor variations in scope and procedures from those outlined in the SAP occurred during field activities due to field conditions and programmatic updates and are referenced in Section 3.6.

Event #5 is the fifth in a series of six planned sampling events for the groundwater investigation. Stantec performed the field work activities for this event. Laboratory analysis of constituents was performed by GEL Laboratories LLC (GEL) in Charleston, South Carolina (radium samples only) and Eurofins TestAmerica, Inc. (TestAmerica) in Pittsburgh, Pennsylvania (other analytes). Quality assurance oversight

on data acquisition protocols, sampling practices, and data validation or verification was performed by Environmental Standards, Inc. (EnvStds) under direct contract to TVA.

This report summarizes the groundwater investigation activities for Event #5. The remaining sampling event will be completed before overall conclusions and findings about the groundwater investigation and groundwater conditions at the WBF Plant are made and documented in the EAR.

2.0 OBJECTIVE AND SCOPE

The primary objectives of the groundwater investigation conducted pursuant to the Groundwater Investigation SAP (which includes six sampling events) are to characterize existing groundwater quality and to evaluate groundwater flow conditions at the WBF Plant in response to the TDEC Order. The approach to characterizing the groundwater conditions is to:

- Collect groundwater samples for chemical analyses to evaluate the potential presence of constituents related to CCR in groundwater
- Measure groundwater and surface water elevations for subsequent evaluation of direction and rate of groundwater flow.

The scope of work intended to achieve the objectives of the groundwater investigation consists of six sampling events at a frequency of one event every two months for one year to characterize seasonal groundwater quality and flow direction. This report describes the activities related to Event #5, performed in April 2020, the scope of which included:

- Collecting groundwater and surface water level measurements
- Collecting field measurements of groundwater quality parameters
- Collecting groundwater samples and associated quality control (QC) samples for laboratory analysis.

These activities were carried out after the installation of permanent monitoring wells specified in the Groundwater Investigation SAP. Details of the monitoring well installation activities are provided in the WBF Plant Hydrogeological Investigation SAR.

In addition, pore water measurements from piezometers and temporary wells installed in the CCR units at the WBF Plant are presented in this SAR for comparison with groundwater data. Temporary well and piezometer installation activities are described in the WBF Plant Exploratory Drilling SAR, and temporary well gauging and sampling information is provided in the WBF Plant CCR Material Characteristics SAR.

3.0 FIELD ACTIVITIES

Groundwater investigation field activities for Event #5 were conducted April 27-29, 2020. Stantec performed groundwater level measurements and sample collection activities based on guidance and specifications in TVA's Environmental (ENV) Technical Instructions (TIs), the SAP, the QAPP, and applicable United States Environmental Protection Agency documents except as noted in the Variations section of this report. As part of TVA's commitment to generate representative and reliable data, data validation and/or verification of laboratory analytical results were performed by EnvStds under direct contract with TVA. EnvStds also conducted audits of field activities and provided quality reviews of field documentation. In addition, on behalf of TDEC, Civil and Environmental Consultants, Inc. (CEC) collected split groundwater samples during this sampling event. Additional information regarding CEC split sample collection is provided in Section 3.3.2.

During Event #5, Stantec conducted the following field activities:

- Measured groundwater levels at six monitoring wells installed for the TDEC Order and four monitoring wells and four piezometers installed for other environmental programs (10 total monitoring wells)
- Measured pore water levels at four temporary wells and three piezometers installed in the CCR units
- Measured the surface water level at one location in the Tennessee River
- Collected groundwater samples from six monitoring wells installed for the TDEC Order
- Recorded field measurements of groundwater quality parameters during purging and stabilization at the sampled monitoring wells
- Collected QC samples including one field duplicate, one matrix spike/matrix spike duplicate, three field blanks, one equipment blank, one filter blank, and one tubing blank
- Shipped the collected samples to GEL in Charleston, South Carolina, and TestAmerica in Pittsburgh, Pennsylvania.

Details on each activity are presented in the sections below.

3.1 WORK LOCATIONS

The TDEC Order CCR units at the WBF Plant (Ash Pond and Slag Disposal Area) as well as the monitoring wells, temporary wells, and piezometers sampled and/or gauged during Event #5 are shown on Exhibit A.1 in Appendix A. TVA is currently sampling groundwater at the WBF Plant for the National Pollutant Discharge Elimination System (NPDES) permit closure program. Monitoring wells that are sampled as part of other environmental programs are not sampled as part of the groundwater investigation for the TDEC Order.

Groundwater levels were measured in TDEC Order monitoring wells as well as in select additional wells and piezometers from other environmental programs, as shown in Table B.1a in Appendix B, to provide information to prepare groundwater contour maps for this SAR and the WBF Plant EAR. Pore water levels measured in temporary wells and piezometers installed in the CCR units are presented in Table B.1b. Groundwater and pore water elevations are shown on Exhibits A.2 and A.3 in Appendix A. Groundwater elevation contours are depicted on Exhibit A.2 and pore water elevation contours are depicted on Exhibit A.3.

Groundwater analytical and field duplicate samples were collected from the TDEC Order groundwater investigation monitoring wells as shown in Table B.2 in Appendix B. Groundwater analytical data collected for the TDEC Order and the NPDES permit closure program, which includes wells MW-1, MW-2, MW-3, and WBF-100, will be provided in the EAR.

3.2 DOCUMENTATION

Stantec maintained field documentation in accordance with ENV-TI-05.80.03, *Field Record Keeping*, and the QAPP. Field activities and data were recorded on program-specific field forms. Health and safety forms were completed in accordance with TVA and Stantec health and safety requirements. Additional information regarding field documentation is provided below.

3.2.1 Field Forms

Stantec used program-specific field forms to record field observations and data for specific activities. Field forms used during the groundwater investigation included:

- *Daily Field Activity Log*
- *Monitoring Well Inspection Checklist*
- *Equipment Calibration Form*
- *Groundwater Level Measurement Form*
- *Vibrating Wire Piezometer Measurement Form*
- *Groundwater Sampling Form*
- *Chain-of-Custody (COC).*

3.2.1.1 Daily Field Activity Log

Stantec field sampling personnel (FSP) recorded field activities, observations, and data on a *Daily Field Activity Log* to chronologically document the field program. Deviations from the SAP, TIs, or QAPP were documented on the *Daily Field Activity Log*.

3.2.1.2 Monitoring Well Inspection Checklist

Prior to measuring water levels, Stantec FSP inspected each monitoring well for damage or indications that the well integrity had been compromised in accordance with ENV-TI-05.80.21, *Monitoring Well Inspection and Maintenance.* Inspection results were documented on a *Monitoring Well Inspection Checklist*. Stantec documented observations and conditions on a well inspection form for this event.

3.2.1.3 Equipment Calibration Form

Stantec FSP performed daily calibration of the water quality meter and turbidity meter and documented the results on an *Equipment Calibration Form*. The form documented the calibration results for temperature, turbidity, specific conductance, pH, dissolved oxygen (DO), and oxidation-reduction potential (ORP), and verified that the field instruments' sensors were operating within acceptance criteria. Refer to Section 3.2.2 for additional details on equipment calibration procedures.

3.2.1.4 Groundwater Level Measurement Form

Stantec FSP recorded groundwater level field measurement data on a *Groundwater Level Measurement Form* in accordance with ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*. The form includes the monitoring well identification (ID), time, and depth to water measured from a standardized reference point on the top of each well casing, recorded in feet (ft) below top of casing.

3.2.1.5 Vibrating Wire Piezometer Measurement Form

Stantec FSP recorded field measurement data on a *Vibrating Wire Piezometer Measurement Form*. The form includes the vibrating wire piezometer ID, serial number, time, digits, temperature, and length of the wire in ft. The readings were used to calculate the pressure head (ft of water) above the vibrating wire sensor to obtain the groundwater or pore water elevation.

3.2.1.6 Groundwater Sampling Form

Stantec FSP recorded the depth to water, purge flow rate, volume of groundwater purged, temperature, pH, specific conductance, DO, ORP, turbidity, color of water, and other observations during groundwater purging and sampling activities at each monitoring well in accordance with ENV-TI-05.80.42, *Groundwater Sampling*. Field measurements were recorded on a *Groundwater Sampling Form*. The form also documents the time intervals between measurement of field parameters, low-flow extraction rates, water level drawdown, and water quality parameter measurements until stabilization criteria were met.

3.2.1.7 Chain-of-Custody

Stantec FSP completed *COC* documentation for each groundwater sample collected. The sample ID, sample location, type of sample, sampling date and time, analyses requested, sample pH, and sample custody record were recorded on the *COC*. The Field Team Leader reviewed the *COC* for completeness, and the FSP conducted a QC check of samples in each cooler compared to sample IDs on the corresponding *COC*. *COCs* were completed in accordance with ENV-TI-05.80.02, *Sample Labeling and Custody*.

3.2.2 Equipment Calibration

Field instruments used to collect, generate, or measure water quality parameters were calibrated each day prior to use as specified in the SAP, QAPP, and ENV-TI-05.80.46, *Field Measurement Using a Multi-Parameter Sonde.* Afternoon calibration verifications were performed to evaluate if these instruments remained within acceptance criteria during sampling. Temperature and barometric pressure instrument readings were verified using a calibrated National Institute of Standards and Technology traceable thermometer and National Weather Service (via mesowest.utah.edu) barometric pressure readings for Lovell Field (KCHA) in Chattanooga, Tennessee, respectively. Additional details regarding equipment calibration were recorded on an *Equipment Calibration Form*, as described in Section 3.2.1.3.

3.3 SAMPLING METHODS

The following sections present monitoring well data collection and sampling procedures used during Event #5.

3.3.1 Static Water Level Measurements

FSP measured static groundwater levels at 10 monitoring wells and pore water levels at four temporary wells in accordance with ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*. On April 27, 2020, static groundwater and pore water level readings were measured and recorded to the nearest 0.01 ft from a reference point on the top of each well casing using an electronic water level indicator. Water level indicator probes were decontaminated prior to the first use and between measurements, and the decontamination was documented as specified in ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination.* Depth to groundwater and pore water measurements were recorded on a *Groundwater Level Measurement Form*.

Groundwater and pore water measurements were also obtained from transducers installed within four piezometers and three piezometers, respectively. Additionally, a surface water level measurement for the Tennessee River was provided by TVA using the reading recorded closest to noon for the tailwater level below the Watts Bar Dam. The surface water staff gauge location is indicated on Exhibit A.1 in Appendix A.

Groundwater level data and pore water level data are shown in Tables B.1a and B.1b, respectively, in Appendix B. A groundwater elevation contour map based on groundwater measurements in wells and piezometers, along with pore water elevations, is included as Exhibit A.2 in Appendix A. Similarly, a pore water elevation contour map based on pore water measurements in wells and piezometers, along with groundwater elevations, is included as Exhibit A.3 in Appendix A.

3.3.2 Groundwater Purging & Sampling

Analytical and field duplicate samples (as specified in the SAP) were collected from six monitoring wells as shown in Table B.2 in Appendix B. Split samples collected by CEC during Event #5 are also identified in Table B.2. Monitoring wells were purged using dedicated bladder pumps equipped with dedicated tubing using low-flow purging and sampling techniques as specified in ENV-TI-05.80.42, *Groundwater Sampling*.

During the purging process, water quality field parameters including pH, specific conductance, temperature, ORP, and DO were measured using water quality meters (YSI ProPlus with flow-through cell) and recorded on field forms. Depth to water and turbidity were measured and recorded using decontaminated electronic water-level indicators (Heron Dipper-T) and calibrated turbidimeters (Hach 2100Q). Field parameters were measured and recorded on *Groundwater Sampling Forms* during purging until readings were stabilized as specified in the SAP. As approved by TDEC, the specific conductance and turbidity stabilization limits were revised to the values below to meet overall programmatic objectives for groundwater investigations at the WBF Plant. Well purging was considered complete when three consecutive readings were within the following stabilization limits:

- pH – ± 0.1 Standard Units
- Specific Conductance – ± 3% microSiemens per centimeter
- Turbidity – Less than five Nephelometric Turbidity Units (NTUs) or ± 10% for values above five NTUs
- DO – Less than 0.5 milligrams per Liter (mg/L) or ± 10% for values above 0.5 mg/L.

After water quality stabilization criteria were achieved, the final field parameter results were recorded, purging was discontinued, and a sample was collected as specified in the SAP. Due to final turbidity readings higher than five NTUs at wells WBF-101 and WBF-106, an additional sample was collected at each of those wells and submitted to the laboratory for dissolved metals analysis.

Laboratory-provided, pre-preserved sample containers were filled directly from the pump discharge line with the exception of the dissolved metals samples, which were collected via new 0.45-micron disposable inline filters attached to the end of the discharge lines to field filter the samples. FSP wore new, clean nitrile gloves when handling sample containers and did not touch the interior of containers or container caps. New gloves were used when handling each sample. When filling sample bottles, care was taken to minimize sample aeration (i.e., water was directed down the inner walls of the sample bottle) and to avoid overfilling and diluting preservatives. Each sample bottle was capped before filling the next bottle. Following completion of sampling, final field parameter measurements were recorded.

Sample containers were labeled and handled in accordance with ENV-TI-05.80.02, *Sample Labeling and Custody.* FSP secured caps on each bottle, attached a custody seal across the cap, and placed the bottles in a cooler on ice within 15 minutes of collection*.* QC samples were collected in accordance with ENV-TI-05.80.04, *Field Sampling Quality Control.*

Groundwater samples were analyzed for the CCR-related constituents listed in Appendices III and IV of 40 Code of Federal Regulations (CFR) 257. In addition, five inorganic constituents listed in Appendix I of Tennessee Rule 0400-11-01-.04 and not included in the 40 CFR 257 Appendices III and IV were analyzed to maintain continuity with TDEC environmental programs. These additional TDEC Appendix I constituents included copper, nickel, silver, vanadium, and zinc. The combined federal CCR Appendices III and IV constituents and TDEC Appendix I inorganic constituents will hereafter be referred to collectively as “CCR Parameters.” For geochemical evaluation, major cations/anions not included in the CCR Parameters were included in the analyses. The additional geochemical parameters included bicarbonate, carbonate, magnesium, potassium, and sodium.

3.4 INVESTIGATION DERIVED WASTE

Investigation derived waste (IDW) generated during groundwater investigation activities included:

- Used calibration solutions
- Purge water
- Decontamination fluids
- Disposable personal protective equipment (PPE)
- General trash.

IDW was handled in accordance with ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*; ENV-TI-05.80.42, *Groundwater Sampling* (purge water); the WBF Plant-specific waste management plan; and local, state, and federal regulations. Transportation and disposal of IDW was coordinated with WBF Plant facility management. Used calibration solution was containerized and stored for disposal as directed by the WBF Plant facility management. Purge water and decontamination fluids were containerized for later disposal as specified in the WBF Plant-specific waste management plan. Used disposable PPE (e.g., nitrile gloves) and general trash generated throughout the day were placed in garbage bags and disposed of in a general trash dumpster onsite at the end of each day.

3.5 SAMPLE SHIPMENT

Samples were packed and shipped under *COC* procedures specified in ENV-TI-05.80.06, *Handling and Shipping of Samples*. The samples were shipped by FedEx to GEL in Charleston, South Carolina (radium samples only), and to TestAmerica in Pittsburgh, Pennsylvania (other analytes). The laboratories submitted sample receipt confirmation forms to EnvStds for review and confirmation.

3.6 VARIATIONS

The proposed scope and procedures for the groundwater investigation were outlined in the SAP, QAPP, and applicable TVA TIs as detailed in the sections above. Variations in scope or procedures discussed with TDEC and/or TVA, changes based on field conditions, or additional field sampling performed to complete the scope of work in the SAP are described in the following sections. As discussed below, these variations do not impact the overall usability and representativeness of the dataset provided in this SAR for groundwater investigation sampling Event #5 at the WBF Plant.

3.6.1 Variations in Scope

There were no variations in scope during the groundwater investigation sampling Event #5 at the WBF Plant.

3.6.2 Variations in Procedures

Variations in procedures occurring in the field are provided below.

- As approved by TDEC, the specific conductance and turbidity stabilization limits were revised to meet overall programmatic objectives for groundwater investigations.

4.0 SUMMARY

The data presented in this report are only for groundwater investigation sampling Event #5 at the WBF Plant. The scope of work for Event #5 was to:

- Collect groundwater samples for chemical analyses to assist with subsequent evaluation of the potential presence of CCR-related constituents in groundwater
- Measure groundwater and surface water elevations to assist with subsequent evaluation of groundwater flow direction and rate after multiple data sets have been collected.

In addition, pore water measurements from piezometers and temporary wells installed in the CCR units at the WBF Plant are presented in this SAR for comparison with groundwater data.

Event #5 included collecting groundwater level measurements at 10 monitoring wells and four piezometers, pore water measurements at four temporary wells and three piezometers in the CCR units, and a surface water measurement at one gauge located in the Tennessee River. Groundwater and surface water measurements and elevations are provided in Table B.1a, and pore water measurements and elevations are provided in Table B.1b and depicted on Exhibits A.2 and A.3.

Groundwater quality measurements and groundwater analytical samples were collected at six monitoring wells as summarized in Table B.2. Groundwater quality parameters were recorded during purging. Stabilization criteria for pH, specific conductance, turbidity, and DO were achieved at each sampling location. The final measurements prior to initiating sample collection are presented in Table B.3.

Groundwater analytical data for CCR Parameters and geochemical parameters are presented in Table B.4. Analytical data for radium analyses are presented in Table B.5. Analytical data were reported by GEL and TestAmerica, and then validated and/or verified by EnvStds.

Stantec has completed Event #5 of the groundwater investigation at the WBF Plant in Spring City, Tennessee, in accordance with the Groundwater Investigation SAP as documented herein. The data collected during Event #5 are usable for reporting and evaluation in the EAR and meet the objectives of the TDEC Order EIP. The complete datasets from the six groundwater sampling events will be evaluated along with data collected under other TDEC Order SAPs, as well as data collected under other State and CCR programs. This evaluation will be provided in the EAR.

5.0 REFERENCES

Environmental Standards, Inc. 2018. *Quality Assurance Project Plan for the Tennessee Valley Authority Watts Bar Fossil Plant Environmental Investigation*. Revision 2. November 2018.

Stantec Consulting Services Inc. (Stantec). 2018a. *Groundwater Investigation Sampling and Analysis Plan, Watts Bar Fossil Plant.* Revision 3. Prepared for Tennessee Valley Authority. November 19, 2018.

Stantec. 2018b. *Environmental Investigation Plan, Watts Bar Fossil Plant.* Revision 3. Prepared for Tennessee Valley Authority. November 19, 2018.

Tennessee Department of Environment and Conservation. 2015. *Commissioner's Order No. OGC15-0177.*

Tennessee Valley Authority (TVA). ENV-TI-05.80.02, *Sample Labeling and Custody*.

TVA. ENV-TI-05.80.03, *Field Record Keeping*.

TVA. ENV-TI-05.80.04, *Field Sampling Quality Control*.

TVA. ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*.

TVA. ENV-TI-05.80.06, *Handling and Shipping of Samples*.

TVA. ENV-TI-05.80.21, *Monitoring Well Inspection and Maintenance*.

TVA. ENV-TI-05.80.42, *Groundwater Sampling*.

TVA. ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*.

TVA. ENV-TI-05.80.46, *Field Measurement Using a Multi-Parameter Sonde*.

APPENDIX A - EXHIBITS

Exhibit No.
A.1

Title
Monitoring Well Network

Client/Project
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2021-04-20
Technical Review by MW on 2021-04-20

0 150 300 450 600 Feet
1:1,800 (At original document size of 22x34)

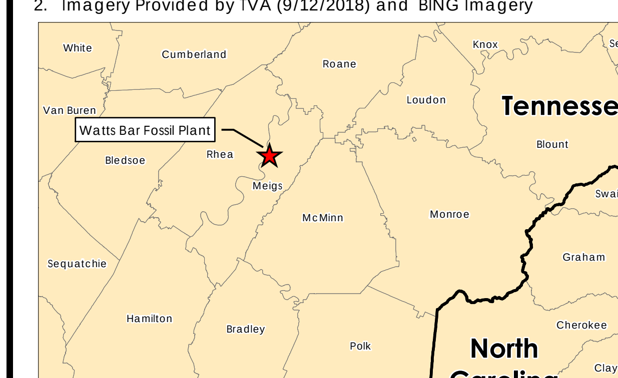
Legend

- Groundwater Investigation Monitoring Well
- Other Monitoring Well
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary Well within CCR Material
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery



Stantec TVA

U:\TVA-EP\175668050_WBF_WorkPlans\gis\mxd\GW_Tech_Memo\WBF_GWTechMemo_FigA1_GroundwaterContour_wPZ_porewaterEv1.5.mxd Revised: 2021-04-20 By: mbough

Exhibit No.
A.2

Title

Groundwater Elevation Contour Map, Event #5 (April 27, 2020)

Client/Project

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location 175668050

Spring City, Tennessee

Prepared by DMB on 2021-04-20
Technical Review by MD on 2021-04-20

0 150 300 450 600 Feet

1:1,800 (At original document size of 22x34)

Legend

- Groundwater Investigation Monitoring Well groundwater elevation in feet above mean sea level (ft amsl)
- Other Monitoring Well groundwater elevation in ft amsl
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary well in CCR pore water elevation in ft amsl; value not used for contouring
- Interpolated Groundwater Contour (5 ft interval; elevations are in ft amsl)
- Groundwater Contour (5 ft interval; elevations are in ft
- 2018 Imagery Boundary
- CCR Unit Area
- Closed Metal Cleaning Pond
- Consolidated and Capped CCR Area
- Drainage Improvements Area; Stormwater Pond (Former Ash

CCR: Coal combustion residuals

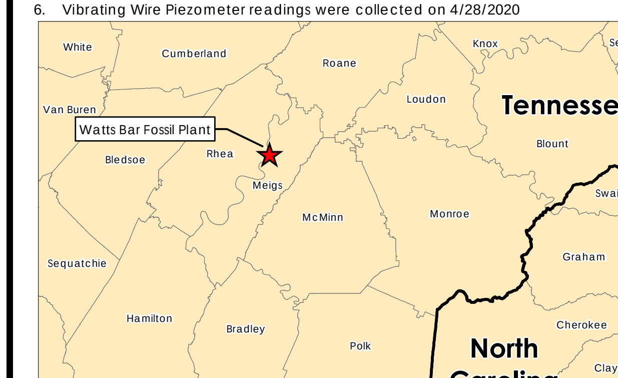
River Gauge (Not Shown - See Note 4) surface water elevation in ft amsl

*Groundwater elevation displayed but not used as input for contouring due to factors such as well construction or being screened in a different hydrogeologic unit.

*** Nested VWPZ sensors monitoring pore water and groundwater elevations in the same borehole, and the location is shown by a single symbol.

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery
3. Groundwater contours were created using Surfer Version 16.1.350 (December 13, 2018) and manual adjustment
4. Surface water elevation is measured from the tailwater reading from Watts Bar Dam located ~4,000 ft North of well WBF-106
5. For PZ's with multiple instruments in CCR material, the reading with the highest pore water elevation is displayed, unless that reading is suspected of being erroneous.
6. Vibrating Wire Piezometer readings were collected on 4/28/2020



Stantec TVA

Exhibit No.

A.3

Title

Pore Water Elevation Contour Map, Event #5 (April 27, 2020)

Client/Project

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location

Spring City, Tennessee

175668050

Prepared by DMB on 2021-04-20
Technical Review by MD on 2021-04-20

0 150 300 450 600 Feet

1:1,800 (At original document size of 22x34)

Legend

- Groundwater Investigation Monitoring Well groundwater elevation in feet above mean sea level (ft amsl); value not used for contouring
- Other Monitoring Well groundwater elevation in ft amsl; value not used for contouring
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary well in CCR pore water elevation in ft amsl
- Interpolated Pore water Contour (2 ft interval; elevations are in ft amsl)
- Pore water Contour (2 ft interval; elevations are in ft amsl)
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

CCR: Coal combustion residuals

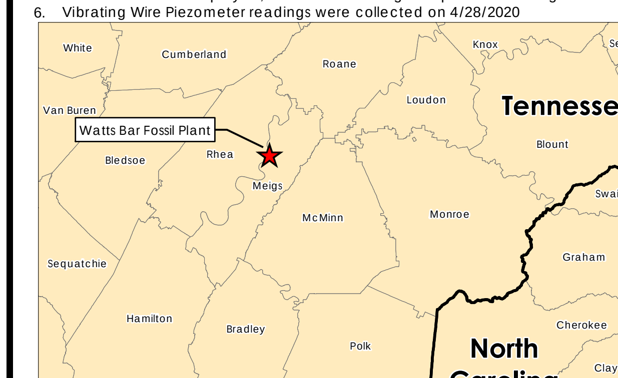
River Gauge (Not Shown - See Note 4) surface water elevation in ft amsl

*Groundwater elevation displayed but not used as input for contouring due to factors such as well construction or being screened in a different hydrogeologic unit.

*** Nested VWPZ sensors monitoring pore water and groundwater elevations in the same borehole, and the location is shown by a single symbol.

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery
3. Pore water contours were created with manual adjustment using Surfer Version 16 (December 13, 2018)
4. Surface water elevation is measured from the tailwater reading from Watts Bar Dam located ~4,000 ft North of well WBF-106
5. For PZ's with multiple instruments in CCR material, the reading with the highest pore water elevation is displayed, unless that reading is suspected of being erroneous.
6. Vibrating Wire Piezometer readings were collected on 4/28/2020



Stantec TVA

U:\TVA-EP\175668050_WBF_WorkPlans\gis\mxd\GW_Tech_Memo\WBF_GWTechMemo_FigA3_PorewaterContour_wPZ_Event5_porewater.mxd Revised: 2021-04-20 By: mbough

APPENDIX B - TABLES

TABLE B.1a – Groundwater Level Measurements
Watts Bar Fossil Plant
April 2020

UNID	Well / Piezometer ID	Date Measured	Depth to Groundwater	Top of Casing Elevation	Groundwater Elevation	Piezometer Ground Surface Elevation	Piezometer Sensor Elevation	Piezometer Sensor Depth	Screened Interval	Screened / Piezometer Sensor Formation
			ft btoc	ft msl	ft msl	ft msl	ft msl	ft bgs	ft btoc	
Monitoring Wells										
WBF-00-GW-43-001	MW-1	27-Apr-20	5.82	711.92	706.10	n/a	n/a	n/a	23.3 - 33.3	Alluvial silts and clays
WBF-00-GW-43-002	MW-2	27-Apr-20	18.15	704.29	686.14	n/a	n/a	n/a	22.7 - 32.4	Alluvial sand
WBF-00-GW-43-003	MW-3	27-Apr-20	10.81	696.22	685.41	n/a	n/a	n/a	21.6 - 31.6	Alluvial sand
WBF-00-GW-43-004	WBF-100	27-Apr-20	40.96	741.49	700.53	n/a	n/a	n/a	47.7 - 57.8	Alluvial sand / alluvial silts and clays
WBF-00-GW-43-005	WBF-101	27-Apr-20	13.48	703.15	689.67	n/a	n/a	n/a	27.3 - 37.1	Alluvial clay and silts / alluvial sand
WBF-00-GW-43-006	WBF-102	27-Apr-20	19.77	723.98	704.21	n/a	n/a	n/a	19.4 - 24.2	Alluvial sand with clay
WBF-00-GW-43-007	WBF-103	27-Apr-20	14.50	725.09	710.59	n/a	n/a	n/a	17.0 - 21.8	Alluvial sand with clay / alluvial sand
WBF-00-GW-43-008	WBF-104	27-Apr-20	11.89	697.45	685.56	n/a	n/a	n/a	21.5 - 31.3	Alluvial clay and silts / alluvial sand
WBF-00-GW-43-009	WBF-105	27-Apr-20	11.51	704.50	692.99	n/a	n/a	n/a	32.2 - 37.0	Alluvial silty sand
WBF-00-GW-43-010	WBF-106	27-Apr-20	12.64	706.34	693.70	n/a	n/a	n/a	27.8 - 37.6	Alluvial clay / alluvial silty sand and alluvial sand
Piezometers										
n/a	WBF-B02C	28-Apr-20	9.7	n/a	709.4	719.1	680.5	38.6	n/a	Alluvial sandy silt
n/a	WBF-B03B	28-Apr-20	2.0	n/a	697.9	699.9	665.9	34.0	n/a	Alluvial sand with silt and gravel
n/a	WBF-B04C	28-Apr-20	11.5	n/a	701.9	713.4	668.4	45.0	n/a	Alluvial silty sand / alluvial sandy gravel
n/a	WBF-B05C	28-Apr-20	10.1	n/a	707.1	717.2	668.2	49.0	n/a	Alluvial silty sand
Surface Water Gauge										
Tennessee River	n/a	27-Apr-20	n/a	n/a	683.98	n/a	n/a	n/a	n/a	n/a

Notes:

bgs	below ground surface
btoc	below top of casing
ft	feet
ID	identification
msl	mean sea level
n/a	not applicable
UNID	Unique Numerical Identification

1. Top of casing elevations, screened intervals, and screened formations were obtained from the TVA Well Inventory Log provided by TVA.
2. Tennessee River data point is the reading closest to noon recorded by the automated staff gauge provided by TVA.
3. Ground surface elevations, groundwater elevations, and piezometer data were obtained from geotechnical instrumentation database. Piezometer sensor formations were obtained from boring logs. Data from vibrating wire piezometers were averaged for the measurement date.
4. Depth to groundwater in piezometers and groundwater elevations at all locations are calculated values. Accuracy of piezometer data is to 0.1 ft.

TABLE B.1b – Pore Water Level Measurements
Watts Bar Fossil Plant
April 2020

Temporary Well / Piezometer ID	Date Measured	Depth to Pore Water	Top of Casing Elevation	Pore Water Elevation	Piezometer Ground Surface Elevation	Piezometer Sensor Elevation	Piezometer Sensor Depth	Screened Interval	Screened / Piezometer Sensor Formation
		ft btoc	ft msl	ft msl	ft msl	ft msl	ft bgs	ft bgs	
Temporary Wells[1]									
WBF-TW02	27-Apr-20	23.04	718.34	695.30	n/a	n/a	n/a	9.1 - 18.9	CCR
WBF-TW03	27-Apr-20	10.00	721.19	711.19	n/a	n/a	n/a	15.8 - 25.6	CCR
WBF-TW04	27-Apr-20	14.92	719.27	704.35	n/a	n/a	n/a	7.5 - 17.3	CCR
WBF-TW05	27-Apr-20	11.70	717.97	706.27	n/a	n/a	n/a	11.5 - 16.3	CCR
Piezometers[2]									
WBF-B02A	28-Apr-20	7.6	n/a	711.5	719.1	699.5	19.6	n/a	CCR
WBF-B04A	28-Apr-20	6.8	n/a	706.6	713.4	696.4	17.0	n/a	CCR
WBF-B05A	28-Apr-20	10.5	n/a	706.7	717.2	696.2	21.0	n/a	CCR

Notes:

bgs	below ground surface
btoc	below top of casing
CCR	coal combustion residuals
ft	feet
ID	identification
msl	mean sea level
n/a	not applicable

1. Top of casing elevations, screened intervals, and screened formations were obtained from boring logs, well details, and well survey data.

2. For piezometers, ground surface elevations, pore water elevations, and piezometer data were obtained from geotechnical instrumentation database. Piezometer sensor formations were obtained from boring logs. Data from vibrating wire piezometers were averaged for the measurement date.

3. Depth to pore water in piezometers and pore water elevations at all locations are calculated values. Accuracy of piezometer data is to 0.1 ft.

4. Screened interval shown for temporary wells is below ground surface when drilled.

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TABLE B.2 – Summary of Groundwater Samples
Watts Bar Fossil Plant
April 2020

			Analysis Type										
Location ID	**Sample ID**	**Sample Type**	Field Parameters	Total Metals	Dissolved Metals	Total Mercury	Dissolved Mercury	Anions	Alkalinity	Total Dissolved Solids	Radium-226	Radium-228	Radium-226+228
WBF-101	WBF-GW-005-20200429	Normal Environmental Sample	x	x	x	x	x	x	x	x	x	x	x
WBF-102	WBF-GW-006-20200427	Normal Environmental Sample	x	x		x		x	x	x	x	x	x
WBF-103	WBF-GW-007-20200428	Normal Environmental Sample	x	x		x		x	x	x	x	x	x
WBF-104	WBF-GW-008-20200428	Normal Environmental Sample	x	x		x		x	x	x	x	x	x
WBF-105	WBF-GW-009-20200428	Normal Environmental Sample	x	x		x		x	x	x	x	x	x
WBF-106	WBF-GW-010-20200429	Normal Environmental Sample	x	x	x	x	x	x	x	x	x	x	x
	WBF-GW-DUP01-20200429	Field Duplicate Sample		x	x	x	x	x	x	x	x	x	x

Notes:

Total and Dissolved Metals	SW-846 6020A
Total and Dissolved Mercury	SW-846 7470A
Anions	EPA 300.0/SW846 9056
Alkalinity	SM2320B
Total Dissolved Solids	SM2540C
Radium-226	EPA 903.0
Radium-228	EPA 904.0
Radium-226+228	CALC
ID	identification

1. Field and laboratory quality control sample results except for field duplicates are not included in report tables but were used for data validation.
2. CEC collected split samples from WBF-103, WBF-104 and WBF-105.

TABLE B.3 – Summary of Groundwater Quality Parameters
Watts Bar Fossil Plant
April 2020

Sample Location		WBF-101	WBF-102	WBF-103	WBF-104	WBF-105	WBF-106
Sample Date		29-Apr-20	27-Apr-20	28-Apr-20	28-Apr-20	28-Apr-20	29-Apr-20
Sample ID		WBF-GW-005-20200429	WBF-GW-006-20200427	WBF-GW-007-20200428	WBF-GW-008-20200428	WBF-GW-009-20200428	WBF-GW-010-20200429
Sample Depth		32.2 ft	23 ft	19.5 ft	26.4 ft	35.1 ft	32.6 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Level of Review	Units	Final QC Review	Final QC Review	Final QC Review	Final QC Review	Final QC Review	Final QC Review
Field Parameters							
Dissolved Oxygen	%	6.2	27.8	17.6	8.5	3.0	4.6
Dissolved Oxygen	mg/L	0.66	2.70	1.84	0.83	0.27	0.44
ORP	mV	-54.6	69.8	237.6	145.9	-116.1	3.2
pH (field)	SU	6.48	6.62	5.15	5.48	6.52	6.07
Specific Cond. (Field)	uS/cm	859	739	178.0	2,150	1,016	1,086
Temperature, Water (C)	DEG C	18.2	17.0	15.8	17.4	19.5	18.5
Turbidity, field	NTU	59.8	0.27	0.78	0.76	4.50	58.7

Notes:

%	percent
Cond.	conductance
DEG C	degrees Celsius
ft	feet below top of casing
ID	identification
mg/L	milligrams per Liter
mV	milliVolts
NTU	Nephelometric Turbidity Unit
ORP	Oxidation Reduction Potential, measured using a silver reference electrode which has a standard potential of 200 mV
SU	Standard Units
uS/cm	microSiemens per centimeter

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TABLE B.4 - Groundwater Analytical Results for Metals, Anions, and General Chemistry
Watts Bar Fossil Plant
April 2020

Sample Location				WBF-101	WBF-102	WBF-103	WBF-104	WBF-105	WBF-106	
Sample Date				29-Apr-20	27-Apr-20	28-Apr-20	28-Apr-20	28-Apr-20	29-Apr-20	29-Apr-20
Sample ID				WBF-GW-005-20200429	WBF-GW-006-20200427	WBF-GW-007-20200428	WBF-GW-008-20200428	WBF-GW-009-20200428	WBF-GW-010-20200429	WBF-GW-DUP01-20200429
Sample Depth				32.2 ft	23 ft	19.5 ft	26.4 ft	35.1 ft	32.6 ft	
Sample Type				Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample
Level of Review	Units	EPA MCLs	CCR Rule GWPS	Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified	Final-Verified
Total Metals										
Antimony	ug/L	6[A]	n/v	1.07 U*	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378
Arsenic	ug/L	10[A]	n/v	1.19 U*	0.464 U*	<0.313	0.559 U*	1.27 U*	0.921 U*	0.921 U*
Barium	ug/L	2,000[A]	n/v	238	52.2	70.5	38.3	101	27.7	27.6
Beryllium	ug/L	4[A]	n/v	<0.182	<0.182	<0.182	0.200 U*	<0.182	<0.182	<0.182
Boron	ug/L	n/v	n/v	90.4	42.0 J	<38.6	3,420	47.8 J	66.4 J	51.5 J
Cadmium	ug/L	5[A]	n/v	0.414 U*	<0.217	<0.217	**6.87[A]**	<0.217	<0.217	<0.217
Calcium	ug/L	n/v	n/v	126,000	131,000	20,600	456,000	140,000	160,000	160,000
Chromium	ug/L	100[A]	n/v	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53
Cobalt	ug/L	n/v	6[B]	**6.82 J[B]**	<0.134	0.903 U*	**249[B]**	0.212 U*	**25.9[B]**	**26.3[B]**
Copper	ug/L	n/v	n/v	4.36 U*	0.804 U*	<0.627	0.878 U*	<0.627	3.89 U*	2.33 U*
Lead	ug/L	n/v	15[B]	0.158 U*	<0.128	<0.128	0.218 U*	<0.128	0.138 U*	0.131 U*
Lithium	ug/L	n/v	40[B]	<3.39	5.63 U*	4.97 U*	7.07 U*	6.41 U*	<3.39	<3.39
Magnesium	ug/L	n/v	n/v	16,400	18,000	4,660	52,800	19,200	28,400	28,400
Mercury	ug/L	2[A]	n/v	<0.130	0.543	<0.130	<0.130	<0.130	<0.130	<0.130
Molybdenum	ug/L	n/v	100[B]	<0.610	1.62 U*	<0.610	<0.610	<0.610	<0.610	<0.610
Nickel	ug/L	100 (TN MCL)[A]	n/v	1.72 U*	0.362 U*	1.38 U*	50.2	<0.336	4.57	4.69
Potassium	ug/L	n/v	n/v	1,150	2,690	4,050	1,390	911	2,740	2,750
Selenium	ug/L	50[A]	n/v	<1.51	2.48 J	<1.51	<1.51	<1.51	<1.51	<1.51
Silver	ug/L	100 (TN MCL)[A]	n/v	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177
Sodium	ug/L	n/v	n/v	11,500	12,300	5,540	22,200	29,600	27,900	27,900
Thallium	ug/L	2[A]	n/v	0.281 U*	0.148 U*	<0.148	0.231 U*	<0.148	0.153 U*	<0.148
Vanadium	ug/L	n/v	n/v	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991
Zinc	ug/L	n/v	n/v	8.02	<3.22	<3.22	87.5	<3.22	10.8	11.2
Dissolved Metals										
Antimony	ug/L	6[A]	n/v	0.528 J	-	-	-	-	<0.378	<0.378
Arsenic	ug/L	10[A]	n/v	1.15	-	-	-	-	0.852 J	0.780 J
Barium	ug/L	2,000[A]	n/v	224	-	-	-	-	26.8	28.1
Beryllium	ug/L	4[A]	n/v	<0.182	-	-	-	-	<0.182	<0.182
Boron	ug/L	n/v	n/v	113	-	-	-	-	61.8 J	49.8 J
Cadmium	ug/L	5[A]	n/v	0.364 J	-	-	-	-	<0.217	<0.217
Calcium	ug/L	n/v	n/v	125,000	-	-	-	-	157,000	163,000
Chromium	ug/L	100[A]	n/v	<1.53	-	-	-	-	<1.53	<1.53
Cobalt	ug/L	n/v	6[B]	**8.82 J[B]**	-	-	-	-	**26.0[B]**	**26.6[B]**
Copper	ug/L	n/v	n/v	3.66 U*	-	-	-	-	3.95 U*	2.99 U*
Lead	ug/L	n/v	15[B]	0.169 J	-	-	-	-	<0.128	<0.128
Lithium	ug/L	n/v	40[B]	<3.39	-	-	-	-	<3.39	<3.39
Magnesium	ug/L	n/v	n/v	16,300	-	-	-	-	27,900	28,700
Mercury	ug/L	2[A]	n/v	<0.130	-	-	-	-	<0.130	<0.130
Molybdenum	ug/L	n/v	100[B]	<0.610	-	-	-	-	<0.610	<0.610
Nickel	ug/L	100 (TN MCL)[A]	n/v	1.48	-	-	-	-	4.62	4.55
Potassium	ug/L	n/v	n/v	1,110	-	-	-	-	2,710	2,790
Selenium	ug/L	50[A]	n/v	<1.51	-	-	-	-	<1.51	<1.51
Silver	ug/L	100 (TN MCL)[A]	n/v	<0.177	-	-	-	-	<0.177	<0.177
Sodium	ug/L	n/v	n/v	11,400	-	-	-	-	27,300	28,200
Thallium	ug/L	2[A]	n/v	0.406 J	-	-	-	-	<0.148	<0.148
Vanadium	ug/L	n/v	n/v	<0.991	-	-	-	-	<0.991	<0.991
Zinc	ug/L	n/v	n/v	7.95	-	-	-	-	11.4	11.1
Anions										
Chloride	mg/L	n/v	n/v	6.31	12.2	5.26	5.55	5.68	4.50	4.84
Fluoride	mg/L	4[A]	n/v	0.0985 U*	0.126 U*	0.0450 U*	0.0622 U*	0.115 U*	0.132 U*	0.140 U*
Sulfate	mg/L	n/v	n/v	238	194	61.6	1,280	329	453	465
General Chemistry										
Alkalinity, Bicarbonate	mg/L	n/v	n/v	126	252	44.4	55.5	110	77.1	69.2
Alkalinity, Carbonate	mg/L	n/v	n/v	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
Alkalinity, Total as CaCO3	mg/L	n/v	n/v	126	252	44.4	55.5	110	77.1	69.2
Total Dissolved Solids	mg/L	n/v	n/v	551	562	183	2,000	668	862	836

Notes:

A	EPA Maximum Contaminant Level
B	CCR Rule GWPS (Federal Register / Vol. 83, No. 146 / Monday, July 30, 2018 / Rules and Regulations)
n/v	No standard/guideline value
6.5[A]	Concentration is greater than or equal to the indicated standard.
<0.03	analyte was not detected at a concentration greater than the Method Detection Limit
-	parameter not analyzed / not available
ft	feet below top of casing
ID	identification
J	quantitation is approximate due to limitations identified during data validation
mg/L	milligrams per Liter
U*	result should be considered “not detected” because it was detected in an associated field or laboratory blank at a similar level
ug/L	micrograms per Liter
(TN MCL)	Tennessee Maximum Contaminant Level

1. Level of review is defined in the Quality Assurance Project Plan.

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TABLE B.5 – Groundwater Analytical Results for Radiological Parameters
Watts Bar Fossil Plant
April 2020

Sample Location Sample Date Sample ID Sample Depth Sample Type Level of Review	Units	EPA MCLs	CCR Rule GWPS	WBF-101 29-Apr-20 WBF-GW-005-20200429 32.2 ft Normal Environmental Sample Final-Verified	WBF-102 27-Apr-20 WBF-GW-006-20200427 23 ft Normal Environmental Sample Final-Verified	WBF-103 28-Apr-20 WBF-GW-007-20200428 19.5 ft Normal Environmental Sample Final-Verified	WBF-104 28-Apr-20 WBF-GW-008-20200428 26.4 ft Normal Environmental Sample Final-Verified	WBF-105 28-Apr-20 WBF-GW-009-20200428 35.1 ft Normal Environmental Sample Final-Verified	WBF-106 29-Apr-20 WBF-GW-010-20200429 32.6 ft Normal Environmental Sample Final-Verified	WBF-106 29-Apr-20 WBF-GW-DUP01-20200429 Field Duplicate Sample Final-Verified
Radiological Parameters										
Radium-226	pCi/L	n/v	n/v	0.405 +/-(0.583)U	0.310 +/-(0.517)U	0.561 +/-(0.480)U	0.309 +/-(0.502)U	0.886 +/-(0.639)	1.21 +/-(0.751)J	0.213 +/-(0.523)UJ
Radium-228	pCi/L	n/v	n/v	0.287 +/-(0.283)U	0.290 +/-(0.322)U	-0.00991 +/-(0.351)U	0.449 +/-(0.298)	0.350 +/-(0.281)U	0.575 +/-(0.387)	0.151 +/-(0.313)U
Radium-226+228	pCi/L	5[A]	n/v	0.691 +/-(0.648)U	0.600 +/-(0.609)U	0.561 +/-(0.594)U	0.758 +/-(0.584)J	1.24 +/-(0.698)J	1.78 +/-(0.845)J	0.364 +/-(0.609)UJ

Notes:

[A] EPA Maximum Contaminant Level
[B] CCR Rule GWPS (Federal Register / Vol. 83, No. 146 / Monday, July 30, 2018 / Rules and Regulations)
n/v No standard/guideline value
ft feet below top of casing
ID identification
J quantitation is approximate due to limitations identified during data validation
pCi/L picoCurie per Liter
U not detected

1. Level of review is defined in the Quality Assurance Project Plan.

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APPENDIX H.8

GROUNDWATER INVESTIGATION EVENT #6 SAMPLING AND ANALYSIS REPORT

Watts Bar Fossil Plant Groundwater Investigation Event #6 Sampling and Analysis Report

TDEC Commissioner's Order:
Environmental Investigation Plant
Watts Bar Fossil Plant
Spring City, Tennessee

April 23, 2021

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

Revision Record

Revision	Description	Date
0	Submittal to TDEC	April 23, 2021

Sign-off Sheet

This document entitled Watts Bar Fossil Plant Groundwater Investigation Event #6 Sampling and Analysis Report was prepared by Stantec Consulting Services Inc. (“Stantec”) for the account of Tennessee Valley Authority (the “Client”). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec’s professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

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Approved by ______________________________

Rebekah Brooks, Principal Hydrogeologist

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LIST OF APPENDICES

APPENDIX A - EXHIBITS

APPENDIX B - TABLES

Abbreviations

CCR	Coal Combustion Residuals
CCR Parameters	Constituents listed in Appendices III and IV of 40 CFR 257 and five inorganic constituents included in Appendix I of Tennessee Rule 0400-11-01-.04
CFR	Code of Federal Regulations
COC	Chain-of-Custody
DO	Dissolved Oxygen
EAR	Environmental Assessment Report
EIP	Environmental Investigation Plan
ENV	Environmental
EnvStds	Environmental Standards, Inc.
Event #6	Groundwater investigation sampling event performed July 6-8, 2020
FSP	Field Sampling Personnel
ft	Feet
GEL	GEL Laboratories LLC
ID	Identification
IDW	Investigation Derived Waste
mg/L	Milligrams per Liter
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
ORP	Oxidation-Reduction Potential
PPE	Personal Protective Equipment
QAPP	Quality Assurance Project Plan
QC	Quality Control
SAP	Sampling and Analysis Plan
SAR	Sampling and Analysis Report
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Commissioner’s Order No. OGC15-0177
TestAmerica	Eurofins TestAmerica Inc.
TI	Technical Instruction
TVA	Tennessee Valley Authority
WBF Plant	Watts Bar Fossil Plant

1.0 INTRODUCTION

Stantec Consulting Services Inc. (Stantec) has prepared this sampling and analysis report (SAR) on behalf of the Tennessee Valley Authority (TVA) to document the completion of activities related to a groundwater investigation sampling event performed July 6-8, 2020 (Event #6) at TVA's Watts Bar Fossil Plant (WBF Plant) located in Spring City, Tennessee.

The purpose of the groundwater investigation, upon completion of six groundwater sampling events, is to characterize groundwater conditions at the WBF Plant in support of fulfilling the requirements for the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA (TDEC 2015). The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee.

The purpose of this SAR is to document the work completed during groundwater sampling Event #6 of 6 total events and to present the information and data collected during the execution of the Groundwater Investigation Sampling and Analysis Plan (SAP) (Stantec 2018a). This SAR is not intended to provide conclusions or evaluations of results. The scope of the groundwater investigation represented herein was conducted pursuant to the SAP and is part of a larger environmental investigation at the WBF Plant. The data provided in this SAR are not inclusive of other programmatic data that exist for the site. The evaluation of the results will include data from the six groundwater sampling events and consider other aspects of the environmental investigation, as well as data collected under other State and/or coal combustion residuals (CCR) programs. This evaluation will be presented in the Environmental Assessment Report (EAR).

Event #6 activities were performed in general accordance with the following documents developed by TVA to support fulfilling the requirements of the TDEC Order at the WBF Plant.

- *Groundwater Investigation SAP* (Stantec 2018a)
- *Environmental Investigation Plan (EIP)* (Stantec 2018b)
- *Quality Assurance Project Plan (QAPP)* (Environmental Standards, Inc. 2018).

The Groundwater Investigation SAP was updated based on TVA- and TDEC-approved Programmatic- and Project-specific changes. Minor variations in scope and procedures from those outlined in the SAP occurred during field activities due to field conditions and programmatic updates and are referenced in Section 3.6.

Event #6 is the last in a series of six planned sampling events for the groundwater investigation. Stantec performed the field work activities for this event. Laboratory analysis of constituents was performed by GEL Laboratories LLC (GEL) in Charleston, South Carolina (radium samples only) and Eurofins TestAmerica, Inc. (TestAmerica) in Pittsburgh, Pennsylvania (other analytes). Quality assurance

oversight on data acquisition protocols, sampling practices, and data validation or verification was performed by Environmental Standards, Inc. (EnvStds) under direct contract to TVA.

This report summarizes the groundwater investigation activities for Event #6. Overall conclusions and findings about the groundwater investigation and groundwater conditions at the WBF Plant will be made and documented in the EAR.

2.0 OBJECTIVE AND SCOPE

The primary objectives of the groundwater investigation conducted pursuant to the Groundwater Investigation SAP (which includes six sampling events) are to characterize existing groundwater quality and to evaluate groundwater flow conditions at the WBF Plant in response to the TDEC Order. The approach to characterizing the groundwater conditions is to:

- Collect groundwater samples for chemical analyses to evaluate the potential presence of constituents related to CCR in groundwater
- Measure groundwater and surface water elevations for subsequent evaluation of direction and rate of groundwater flow.

The scope of work intended to achieve the objectives of the groundwater investigation consists of six sampling events at a frequency of one event every two months for one year to characterize seasonal groundwater quality and flow direction. This report describes the activities related to Event #6, performed in July 2020, the scope of which included:

- Collecting groundwater and surface water level measurements
- Collecting field measurements of groundwater quality parameters
- Collecting groundwater samples and associated quality control (QC) samples for laboratory analysis.

These activities were carried out after the installation of permanent monitoring wells specified in the Groundwater Investigation SAP. Details of the monitoring well installation activities are provided in the WBF Plant Hydrogeological Investigation SAR.

In addition, pore water measurements from piezometers and temporary wells installed in the CCR units at the WBF Plant are presented in this SAR for comparison with groundwater data. Temporary well and piezometer installation activities are described in the WBF Plant Exploratory Drilling SAR, and temporary well gauging and sampling information is provided in the WBF Plant CCR Material Characteristics SAR.

3.0 FIELD ACTIVITIES

Groundwater investigation field activities for Event #6 were conducted July 6-8, 2020. Stantec performed groundwater level measurements and sample collection activities based on guidance and specifications in TVA's Environmental (ENV) Technical Instructions (TIs), the SAP, the QAPP, and applicable United States Environmental Protection Agency documents except as noted in the Variations section of this report. As part of TVA's commitment to generate representative and reliable data, data validation and/or verification of laboratory analytical results were performed by EnvStds under direct contract with TVA. EnvStds also provided quality reviews of field documentation.

During Event #6, Stantec conducted the following field activities:

- Measured groundwater levels at six monitoring wells installed for the TDEC Order and four monitoring wells and nine piezometers installed for other environmental programs (10 total monitoring wells)
- Measured pore water levels at four temporary wells and four piezometers installed in the CCR units
- Measured the surface water level at one location in the Tennessee River
- Collected groundwater samples from six monitoring wells installed for the TDEC Order
- Recorded field measurements of groundwater quality parameters during purging and stabilization at the sampled monitoring wells
- Collected QC samples including one field duplicate, one matrix spike/matrix spike duplicate, two field blanks, one equipment blank, one filter blank, and one tubing blank
- Shipped the collected samples to GEL in Charleston, South Carolina, and TestAmerica in Pittsburgh, Pennsylvania.

Details on each activity are presented in the sections below.

3.1 WORK LOCATIONS

The TDEC Order CCR units at the WBF Plant (Ash Pond and Slag Disposal Area) as well as the monitoring wells, temporary wells, and piezometers sampled and/or gauged during Event #6 are shown on Exhibit A.1 in Appendix A. TVA is currently sampling groundwater at the WBF Plant for the National Pollutant Discharge Elimination System (NPDES) permit closure program. Monitoring wells that are sampled as part of other environmental programs are not sampled as part of the groundwater investigation for the TDEC Order.

Groundwater levels were measured in TDEC Order monitoring wells as well as in select additional wells and piezometers from other environmental programs, as shown in Table B.1a in Appendix B, to provide information to prepare groundwater contour maps for this SAR and the WBF Plant EAR. Pore water levels measured in temporary wells and piezometers installed in the CCR units are presented in Table B.1b. Groundwater and pore water elevations are shown on Exhibits A.2 and A.3 in Appendix A. Groundwater elevation contours are depicted on Exhibit A.2 and pore water elevation contours are depicted on Exhibit A.3.

Groundwater analytical and field duplicate samples were collected from the TDEC Order groundwater investigation monitoring wells as shown in Table B.2 in Appendix B. Groundwater analytical data collected for the TDEC Order and the NPDES permit closure program, which includes wells MW-1, MW-2, MW-3, and WBF-100, will be provided in the EAR.

3.2 DOCUMENTATION

Stantec maintained field documentation in accordance with ENV-TI-05.80.03, *Field Record Keeping*, and the QAPP. Field activities and data were recorded on program-specific field forms. Health and safety forms were completed in accordance with TVA and Stantec health and safety requirements. Additional information regarding field documentation is provided below.

3.2.1 Field Forms

Stantec used program-specific field forms to record field observations and data for specific activities. Field forms used during the groundwater investigation included:

- *Daily Field Activity Log*
- *Monitoring Well Inspection Checklist*
- *Equipment Calibration Form*
- *Groundwater Level Measurement Form*
- *Vibrating Wire Piezometer Measurement Form*
- *Groundwater Sampling Form*
- *Chain-of-Custody (COC).*

3.2.1.1 Daily Field Activity Log

Stantec field sampling personnel (FSP) recorded field activities, observations, and data on a *Daily Field Activity Log* to chronologically document the field program. Deviations from the SAP, TIs, or QAPP were documented on the *Daily Field Activity Log*.

3.2.1.2 Monitoring Well Inspection Checklist

Prior to measuring water levels, Stantec FSP inspected each monitoring well for damage or indications that the well integrity had been compromised in accordance with ENV-TI-05.80.21, *Monitoring Well*

Inspection and Maintenance. Inspection results were documented on a *Monitoring Well Inspection Checklist*. Stantec documented observations and conditions on a well inspection form for this event.

3.2.1.3 Equipment Calibration Form

Stantec FSP performed daily calibration of the water quality meter and turbidity meter and documented the results on an *Equipment Calibration Form*. The form documented the calibration results for temperature, turbidity, specific conductance, pH, dissolved oxygen (DO), and oxidation-reduction potential (ORP), and verified that the field instruments' sensors were operating within acceptance criteria. Refer to Section 3.2.2 for additional details on equipment calibration procedures.

3.2.1.4 Groundwater Level Measurement Form

Stantec FSP recorded groundwater level field measurement data on a *Groundwater Level Measurement Form* in accordance with ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*. The form includes the monitoring well identification (ID), time, and depth to water measured from a standardized reference point on the top of each well casing, recorded in feet (ft) below top of casing.

3.2.1.5 Vibrating Wire Piezometer Measurement Form

Stantec FSP recorded field measurement data on a *Vibrating Wire Piezometer Measurement Form*. The form includes the vibrating wire piezometer ID, serial number, time, digits, temperature, and length of the wire in feet. The readings were used to calculate the pressure head (ft of water) above the vibrating wire sensor to obtain the groundwater or pore water elevation.

3.2.1.6 Groundwater Sampling Form

Stantec FSP recorded the depth to water, purge flow rate, volume of groundwater purged, temperature, pH, specific conductance, DO, ORP, turbidity, color of water, and other observations during groundwater purging and sampling activities at each monitoring well in accordance with ENV-TI-05.80.42, *Groundwater Sampling*. Field measurements were recorded on a *Groundwater Sampling Form*. The form also documents the time intervals between measurement of field parameters, low-flow extraction rates, water level drawdown, and water quality parameter measurements until stabilization criteria were met.

3.2.1.7 Chain-of-Custody

Stantec FSP completed *COC* documentation for each groundwater sample collected. The sample ID, sample location, type of sample, sampling date and time, analyses requested, sample pH, and sample custody record were recorded on the *COC*. The Field Team Leader reviewed the *COC* for completeness, and the FSP conducted a QC check of samples in each cooler compared to sample IDs on the corresponding *COC*. *COCs* were completed in accordance with ENV-TI-05.80.02, *Sample Labeling and Custody*.

3.2.2 Equipment Calibration

Field instruments used to collect, generate, or measure water quality parameters were calibrated each day prior to use as specified in the SAP, QAPP, and ENV-TI-05.80.46, *Field Measurement Using a Multi-Parameter Sonde.* Afternoon calibration verifications were performed to evaluate if these instruments remained within acceptance criteria during sampling. Temperature and barometric pressure instrument readings were verified using a calibrated National Institute of Standards and Technology traceable thermometer and National Weather Service (via mesowest.utah.edu) barometric pressure readings for Lovell Field (KCHA) in Chattanooga, Tennessee, respectively. Additional details regarding equipment calibration were recorded on an *Equipment Calibration Form*, as described in Section 3.2.1.3.

3.3 SAMPLING METHODS

The following sections present monitoring well data collection and sampling procedures used during Event #6.

3.3.1 Static Water Level Measurements

FSP measured static groundwater levels at 10 monitoring wells and pore water levels at four temporary wells in accordance with ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*. On July 6, 2020, static groundwater and pore water level readings were measured and recorded to the nearest 0.01 ft from a reference point on the top of each well casing using an electronic water level indicator. Water level indicator probes were decontaminated prior to the first use and between measurements, and the decontamination was documented as specified in ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination.* Depth to groundwater and pore water measurements were recorded on a *Groundwater Level Measurement Form*.

Groundwater and pore water measurements were also obtained from transducers installed within nine piezometers and four piezometers, respectively. Additionally, a surface water level measurement for the Tennessee River was provided by TVA using the reading recorded closest to noon for the tailwater level below the Watts Bar Dam. The surface water staff gauge location is indicated on Exhibit A.1 in Appendix A.

Groundwater level data and pore water level data are shown in Tables B.1a and B.1b, respectively, in Appendix B. A groundwater elevation contour map based on groundwater measurements in wells and piezometers, along with pore water elevations, is included as Exhibit A.2 in Appendix A. Similarly, a pore water elevation contour map based on pore water measurements in wells and piezometers, along with groundwater elevations, is included as Exhibit A.3 in Appendix A.

3.3.2 Groundwater Purging & Sampling

Analytical and field duplicate samples (as specified in the SAP) were collected from six monitoring wells as shown in Table B.2 in Appendix B. Monitoring wells were purged using dedicated bladder pumps equipped with dedicated tubing using low-flow purging and sampling techniques as specified in ENV-TI-05.80.42, *Groundwater Sampling*.

During the purging process, water quality field parameters including pH, specific conductance, temperature, ORP, and DO were measured using water quality meters (YSI ProPlus with flow-through cell) and recorded on field forms. Depth to water and turbidity were measured and recorded using decontaminated electronic water-level indicators (Heron Dipper-T) and calibrated turbidimeters (Hach 2100Q). Field parameters were measured and recorded on *Groundwater Sampling Forms* during purging until readings were stabilized as specified in the SAP. As approved by TDEC, the specific conductance and turbidity stabilization limits were revised to the values below to meet overall programmatic objectives for groundwater investigations at the WBF Plant. Well purging was considered complete when three consecutive readings were within the following stabilization limits:

- pH – ± 0.1 Standard Units
- Specific Conductance – ± 3% microSiemens per centimeter
- Turbidity – Less than 5 Nephelometric Turbidity Units (NTUs) or ± 10% for values above 5 NTUs
- DO – Less than 0.5 milligrams per Liter (mg/L) or ± 10% for values above 0.5 mg/L.

After water quality stabilization criteria were achieved, the final field parameter results were recorded, purging was discontinued, and a sample was collected as specified in the SAP. Due to final turbidity readings higher than 5 NTUs at wells WBF-101 and WBF-106, an additional sample was collected at each of those wells and submitted to the laboratory for dissolved metals analysis.

Laboratory-provided, pre-preserved sample containers were filled directly from the pump discharge line with the exception of the dissolved metals samples, which were collected via new 0.45-micron disposable inline filters attached to the end of the discharge lines to field filter the samples. FSP wore new, clean nitrile gloves when handling sample containers and did not touch the interior of containers or container caps. New gloves were used when handling each sample. When filling sample bottles, care was taken to minimize sample aeration (i.e., water was directed down the inner walls of the sample bottle) and to avoid overfilling and diluting preservatives. Each sample bottle was capped before filling the next bottle. Following completion of sampling, final field parameter measurements were recorded.

Sample containers were labeled and handled in accordance with ENV-TI-05.80.02, *Sample Labeling and Custody.* FSP secured caps on each bottle, attached a custody seal across the cap, and placed the bottles in a cooler on ice within 15 minutes of collection. QC samples were collected in accordance with ENV-TI-05.80.04, *Field Sampling Quality Control.*

Groundwater samples were analyzed for the CCR-related constituents listed in Appendices III and IV of 40 Code of Federal Regulations (CFR) 257. In addition, five inorganic constituents listed in Appendix I of Tennessee Rule 0400-11-01-.04 and not included in the 40 CFR 257 Appendices III and IV were analyzed to maintain continuity with TDEC environmental programs. These additional TDEC Appendix I constituents included copper, nickel, silver, vanadium, and zinc. The combined federal CCR Appendices III and IV constituents and TDEC Appendix I inorganic constituents will hereafter be referred to collectively as “CCR Parameters.” For geochemical evaluation, major cations/anions not included in the

CCR Parameters were included in the analyses. The additional geochemical parameters included bicarbonate, carbonate, magnesium, potassium, and sodium.

3.4 INVESTIGATION DERIVED WASTE

Investigation derived waste (IDW) generated during groundwater investigation activities included:

- Used calibration solutions
- Purge water
- Decontamination fluids
- Disposable personal protective equipment (PPE)
- General trash.

IDW was handled in accordance with ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*; ENV-TI-05.80.42, *Groundwater Sampling* (purge water); the WBF Plant-specific waste management plan; and local, state, and federal regulations. Transportation and disposal of IDW was coordinated with WBF Plant facility management. Used calibration solution was containerized and stored for disposal as directed by the WBF Plant facility management. Purge water and decontamination fluids were containerized for later disposal as specified in the WBF Plant-specific waste management plan. Used disposable PPE (e.g., nitrile gloves) and general trash generated throughout the day were placed in garbage bags and disposed of in a general trash dumpster onsite at the end of each day.

3.5 SAMPLE SHIPMENT

Samples were packed and shipped under *COC* procedures specified in ENV-TI-05.80.06, *Handling and Shipping of Samples*. The samples were shipped by FedEx to GEL in Charleston, South Carolina (radium samples only), and to TestAmerica in Pittsburgh, Pennsylvania (other analytes). The laboratories submitted sample receipt confirmation forms to EnvStds for review and confirmation.

3.6 VARIATIONS

The proposed scope and procedures for the groundwater investigation were outlined in the SAP, QAPP, and applicable TVA TIs as detailed in the sections above. Variations in scope or procedures discussed with TDEC and/or TVA, changes based on field conditions, or additional field sampling performed to complete the scope of work in the SAP are described in the following sections. As discussed below, these variations do not impact the overall usability and representativeness of the dataset provided in this SAR for the groundwater investigation sampling Event #6 at the WBF Plant.

3.6.1 Variations in Scope

There were no variations in scope during the groundwater investigation sampling Event #6 at the WBF Plant.

3.6.2 Variations in Procedures

Variations in procedures occurring in the field are provided below.

- As approved by TDEC, the specific conductance and turbidity stabilization limits were revised to meet overall programmatic objectives for groundwater investigations.

4.0 SUMMARY

The data presented in this report are only for groundwater investigation sampling Event #6 at the WBF Plant. The scope of work for Event #6 was to:

- Collect groundwater samples for chemical analyses to assist with subsequent evaluation of the potential presence of CCR-related constituents in groundwater
- Measure groundwater and surface water elevations to assist with subsequent evaluation of groundwater flow direction and rate after multiple data sets have been collected.

In addition, pore water measurements from piezometers and temporary wells installed in the CCR units at the WBF Plant are presented in this SAR for comparison with groundwater data.

Event #6 included collecting groundwater level measurements at 10 monitoring wells and nine piezometers, pore water measurements at four temporary wells and four piezometers in the CCR units, and a surface water measurement at one gauge located in the Tennessee River. Groundwater and surface water measurements and elevations are provided in Table B.1a, and pore water measurements and elevations are provided in Table B.1b, and depicted on Exhibits A.2 and A.3.

Groundwater quality measurements and groundwater analytical samples were collected at six monitoring wells as summarized in Table B.2. Groundwater quality parameters were recorded during purging. Stabilization criteria for pH, specific conductance, turbidity, and DO were achieved at each sampling location. The final measurements prior to initiating sample collection are presented in Table B.3.

Groundwater analytical data for CCR Parameters and geochemical parameters are presented in Table B.4. Analytical data for radium analyses are presented in Table B.5. Analytical data were reported by GEL and TestAmerica, and then validated and/or verified by EnvStds.

Stantec has completed Event #6 of the groundwater investigation at the WBF Plant in Spring City, Tennessee, in accordance with the Groundwater Investigation SAP as documented herein. The data collected during Event #6 are usable for reporting and evaluation in the EAR and meet the objectives of the TDEC Order EIP. The complete datasets from the six groundwater sampling events will be evaluated along with data collected under other TDEC Order SAPs, as well as data collected under other State and CCR programs. This evaluation will be provided in the EAR.

5.0 REFERENCES

Environmental Standards, Inc. 2018. *Quality Assurance Project Plan for the Tennessee Valley Authority Watts Bar Fossil Plant Environmental Investigation*. Revision 2. November 2018.

Stantec Consulting Services Inc. (Stantec). 2018a. *Groundwater Investigation Sampling and Analysis Plan, Watts Bar Fossil Plant.* Revision 3. Prepared for Tennessee Valley Authority. November 19, 2018.

Stantec. 2018b. *Environmental Investigation Plan, Watts Bar Fossil Plant.* Revision 3. Prepared for Tennessee Valley Authority. November 19, 2018.

Tennessee Department of Environment and Conservation. 2015. *Commissioner's Order No. OGC15-0177.*

Tennessee Valley Authority (TVA). ENV-TI-05.80.02, *Sample Labeling and Custody*.

TVA. ENV-TI-05.80.03, *Field Record Keeping*.

TVA. ENV-TI-05.80.04, *Field Sampling Quality Control*.

TVA. ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*.

TVA. ENV-TI-05.80.06, *Handling and Shipping of Samples*.

TVA. ENV-TI-05.80.21, *Monitoring Well Inspection and Maintenance*.

TVA. ENV-TI-05.80.42, *Groundwater Sampling*.

TVA. ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*.

TVA. ENV-TI-05.80.46, *Field Measurement Using a Multi-Parameter Sonde*.

APPENDIX A - EXHIBITS

Exhibit No.

A.1

Title

Monitoring Well Network

Client/Project

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location 175668050

Spring City, Tennessee

Prepared by MB on 2021-04-20
Technical Review by MW on 2021-04-20

0 150 300 450 600 Feet

1:1,800 (At original document size of 22x34)

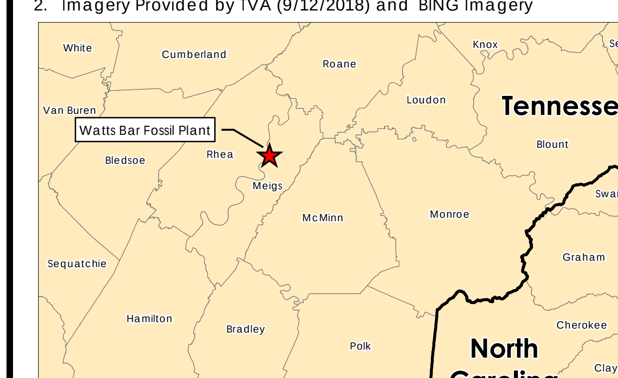
Legend

- Groundwater Investigation Monitoring Well
- Other Monitoring Well
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary Well within CCR Material
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery



Stantec TVA

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Exhibit No.

A.2

Title

Groundwater Elevation Contour Map, Event #6 (July 6, 2020)

Client/Project

Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location 175668050

Spring City, Tennessee

Prepared by DMB on 2021-04-20
Technical Review by MD on 2021-04-20

0 150 300 450 600 Feet

1:1,800 (At original document size of 22x34)

Legend

- Groundwater Investigation Monitoring Well groundwater elevation in feet above mean sea level (ft amsl)
- Other Monitoring Well groundwater elevation in ft amsl
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary well in CCR pore water elevation in ft amsl; value not used for contouring
- Interpolated Groundwater Contour (5 ft interval; elevations are in ft amsl)
- Groundwater Contour (5 ft interval; elevations are in ft
- 2018 Imagery Boundary
- CCR Unit Area
- Closed Metal Cleaning Pond
- Consolidated and Capped CCR Area
- Drainage Improvements Area; Stormwater Pond (Former Ash

CCR: Coal combustion residuals

River Gauge (Not Shown - See Note 4) surface water elevation in ft amsl

*Groundwater elevation displayed but not used as input for contouring due to factors such as well construction or being screened in a different hydrogeologic unit.

*** Nested VWPZ sensors monitoring pore water and groundwater elevations in the same borehole, and the location is shown by a single symbol.

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery
3. Groundwater contours were created using Surfer Version 16.1.350 (December 13, 2018) and manual adjustment
4. Surface water elevation is measured from the tailwater reading from Watts Bar Dam located ~4,000 ft North of well WBF-106
5. For PZ's with multiple instruments in CCR material, the reading with the highest pore water elevation is displayed, unless that reading is suspected of being erroneous.

Stantec TVA

Exhibit No.
A.3

Title
Pore Water Elevation Contour Map, Event #6 (July 6, 2020)

Client/Project
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location
Spring City, Tennessee

175668050
Prepared by DMB on 2021-04-20
Technical Review by MD on 2021-04-20

0 150 300 450 600 Feet
1:1,800 (At original document size of 22x34)

Legend

- Groundwater Investigation Monitoring Well: groundwater elevation in feet above mean sea level (ft amsl); value not used for contouring
- Other Monitoring Well: groundwater elevation in ft amsl; value not used for contouring
- Piezometer, groundwater label in blue text, (e.g., WBF-B02C) pore water label in yellow highlighted black text (e.g., WBF-B02A)
- Temporary well in CCR: pore water elevation in ft amsl
- Interpolated Pore water Contour (2 ft interval; elevations are in ft amsl)
- Pore water Contour (2 ft interval; elevations are in ft amsl)
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

CCR: Coal combustion residuals

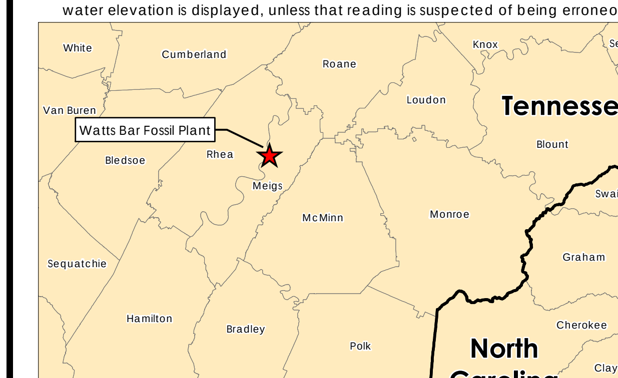
River Gauge (Not Shown - See Note 4) surface water elevation in ft amsl

*Groundwater elevation displayed but not used as input for contouring due to factors such as well construction or being screened in a different hydrogeologic unit.

*** Nested VWPZ sensors monitoring pore water and groundwater elevations in the same borehole, and the location is shown by a single symbol.

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery
3. Pore water contours were created with manual adjustment using Surfer Version 16 (December 13, 2018)
4. Surface water elevation is measured from the tailwater reading from Watts Bar Dam located ~4,000 ft North of well WBF-106
5. For PZ's with multiple instruments in CCR material, the reading with the highest pore water elevation is displayed, unless that reading is suspected of being erroneous.



Stantec TVA

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APPENDIX B - TABLES

TABLE B.1a – Groundwater Level Measurements
Watts Bar Fossil Plant
July 2020

UNID	Well / Piezometer ID	Date Measured	Depth to Groundwater	Top of Casing Elevation	Groundwater Elevation	Piezometer Ground Surface Elevation	Piezometer Sensor Elevation	Piezometer Sensor Depth	Screened Interval	Screened / Piezometer Sensor Formation
			ft btoc	ft msl	ft msl	ft msl	ft msl	ft bgs	ft btoc	
Monitoring Wells										
WBF-00-GW-43-001	MW-1	6-Jul-20	7.95	711.92	703.97	n/a	n/a	n/a	23.3 - 33.3	Alluvial silts and clays
WBF-00-GW-43-002	MW-2	6-Jul-20	20.20	704.29	684.09	n/a	n/a	n/a	22.7 - 32.4	Alluvial sand
WBF-00-GW-43-003	MW-3	6-Jul-20	12.72	696.22	683.50	n/a	n/a	n/a	21.6 - 31.6	Alluvial sand
WBF-00-GW-43-004	WBF-100	6-Jul-20	42.25	741.49	699.24	n/a	n/a	n/a	47.7 - 57.8	Alluvial sand / alluvial silts and clays
WBF-00-GW-43-005	WBF-101	6-Jul-20	15.30	703.15	687.85	n/a	n/a	n/a	27.3 - 37.1	Alluvial clay and silts / alluvial sand
WBF-00-GW-43-006	WBF-102	6-Jul-20	21.55	723.98	702.43	n/a	n/a	n/a	19.4 - 24.2	Alluvial sand with clay
WBF-00-GW-43-007	WBF-103	6-Jul-20	15.25	725.09	709.84	n/a	n/a	n/a	17.0 - 21.8	Alluvial sand with clay / alluvial sand
WBF-00-GW-43-008	WBF-104	6-Jul-20	13.91	697.45	683.54	n/a	n/a	n/a	21.5 - 31.3	Alluvial clay and silts / alluvial sand
WBF-00-GW-43-009	WBF-105	6-Jul-20	12.70	704.50	691.80	n/a	n/a	n/a	32.2 - 37.0	Alluvial silty sand
WBF-00-GW-43-010	WBF-106	6-Jul-20	13.79	706.34	692.55	n/a	n/a	n/a	27.8 - 37.6	Alluvial clay / alluvial silty sand and alluvial sand
Piezometers										
n/a	WBF-B02C	6-Jul-20	11.3	n/a	707.8	719.1	680.5	38.6	n/a	Alluvial sandy silt
n/a	WBF-B03B	6-Jul-20	3.1	n/a	696.8	699.9	665.9	34.0	n/a	Alluvial sand with silt and gravel
n/a	WBF-B04C	6-Jul-20	12.8	n/a	700.6	713.4	668.4	45.0	n/a	Alluvial silty sand / alluvial sandy gravel
n/a	WBF-B05C	6-Jul-20	11.7	n/a	705.5	717.2	668.2	49.0	n/a	Alluvial silty sand
n/a	WBF-B12B	6-Jul-20	4.9	n/a	694.5	699.4	674.4	25.0	n/a	Alluvial sandy silt
n/a	WBF-B13B	6-Jul-20	9.2	n/a	690.4	699.6	674.6	25.0	n/a	Alluvial sandy silt
n/a	WBF-B14B	6-Jul-20	12.7	n/a	688.2	700.9	676.1	24.8	n/a	Alluvial silty sand
n/a	WBF-B15B	6-Jul-20	3.8	n/a	710.9	714.7	692.7	22.0	n/a	Alluvial clayey gravel
n/a	WBF-B16B	6-Jul-20	3.1	n/a	710.5	713.6	692.6	21.0	n/a	Shale
Surface Water Gauge										
Tennessee River	n/a	6-Jul-20	n/a	n/a	683.13	n/a	n/a	n/a	n/a	n/a

Notes:

bgs	below ground surface
btoc	below top of casing
ft	feet
ID	identification
msl	mean sea level
n/a	not applicable
UNID	Unique Numerical Identification

1. Top of casing elevations, screened intervals, and screened formations were obtained from the TVA Well Inventory Log provided by TVA.
2. Tennessee River data point is the reading closest to noon recorded by the automated staff gauge provided by TVA.
3. Ground surface elevations, groundwater elevations, and piezometer data were obtained from geotechnical instrumentation database. Piezometer sensor formations were obtained from boring logs. Data from vibrating wire piezometers were averaged for the measurement date.
4. Depth to groundwater in piezometers and groundwater elevations at all locations are calculated values. Accuracy of piezometer data is to 0.1 ft.

TABLE B.1b – Pore Water Level Measurements
Watts Bar Fossil Plant
July 2020

Temporary Well / Piezometer ID	Date Measured	Depth to Pore Water	Top of Casing Elevation	Pore Water Elevation	Piezometer Ground Surface Elevation	Piezometer Sensor Elevation	Piezometer Sensor Depth	Screened Interval	Screened / Piezometer Sensor Formation
		ft btoc	ft msl	ft msl	ft msl	ft msl	ft bgs	ft bgs	
Temporary Wells									
WBF-TW02	6-Jul-20	23.05	718.34	695.29	n/a	n/a	n/a	9.1 - 18.9	CCR
WBF-TW03	6-Jul-20	17.87	721.19	703.32	n/a	n/a	n/a	15.8 - 25.6	CCR
WBF-TW04	6-Jul-20	12.00	719.27	707.27	n/a	n/a	n/a	7.5 - 17.3	CCR
WBF-TW05	6-Jul-20	13.20	717.97	704.77	n/a	n/a	n/a	11.5 - 16.3	CCR
Piezometers									
WBF-B02A	6-Jul-20	9.0	n/a	710.1	719.1	699.5	19.6	n/a	CCR
WBF-B04A	6-Jul-20	8.3	n/a	705.1	713.4	696.4	17.0	n/a	CCR
WBF-B05A	6-Jul-20	12.0	n/a	705.2	717.2	696.2	21.0	n/a	CCR
WBF-B15A	6-Jul-20	3.1	n/a	711.6	714.7	704.7	10.0	n/a	CCR

Notes:

bgs	below ground surface
btoc	below top of casing
CCR	coal combustion residuals
ft	feet
ID	identification
msl	mean sea level
n/a	not applicable

1. Top of casing elevations, screened intervals, and screened formations were obtained from boring logs, well details, and well survey data.

2. For piezometers, ground surface elevations, pore water elevations, and piezometer data were obtained from geotechnical instrumentation database. Piezometer sensor formations were obtained from boring logs. Data from vibrating wire piezometers were averaged for the measurement date.

3. Depth to pore water in piezometers and pore water elevations at all locations are calculated values. Accuracy of piezometer data is to 0.1 ft.

4. Screened interval shown for temporary wells is below ground surface when drilled.

TABLE B.2 – Summary of Groundwater Samples
Watts Bar Fossil Plant
July 2020

			Analysis Type										
Location ID	**Sample ID**	**Sample Type**	Field Parameters	Total Metals	Dissolved Metals	Total Mercury	Dissolved Mercury	Anions	Alkalinity	Total Dissolved Solids	Radium-226	Radium-228	Radium-226+228
WBF-101	WBF-GW-005-20200707	Normal Environmental Sample	x	x	x	x	x	x	x	x	x	x	x
WBF-102	WBF-GW-006-20200707	Normal Environmental Sample	x	x		x		x	x	x	x	x	x
WBF-103	WBF-GW-007-20200707	Normal Environmental Sample	x	x		x		x	x	x	x	x	x
WBF-104	WBF-GW-008-20200708	Normal Environmental Sample	x	x		x		x	x	x	x	x	x
	WBF-GW-DUP01-20200708	Field Duplicate Sample		x		x		x	x	x	x	x	x
WBF-105	WBF-GW-009-20200707	Normal Environmental Sample	x	x		x		x	x	x	x	x	x
WBF-106	WBF-GW-010-20200708	Normal Environmental Sample	x	x	x	x	x	x	x	x	x	x	x

Notes:

Total and Dissolved Metals	SW-846 6020A
Total and Dissolved Mercury	SW-846 7470A
Anions	EPA 300.0/SW846 9056
Alkalinity	SM2320B
Total Dissolved Solids	SM2540C
Radium-226	EPA 903.0
Radium-228	EPA 904.0
Radium-226+228	CALC
ID	identification

1. Field and laboratory quality control sample results except for field duplicates are not included in report tables but were used for data validation.

TABLE B.3 – Summary of Groundwater Quality Parameters
Watts Bar Fossil Plant
July 2020

Sample Location		WBF-101	WBF-102	WBF-103	WBF-104	WBF-105	WBF-106
Sample Date		7-Jul-20	7-Jul-20	7-Jul-20	8-Jul-20	7-Jul-20	8-Jul-20
Sample ID		WBF-GW-005-20200707	WBF-GW-006-20200707	WBF-GW-007-20200707	WBF-GW-008-20200708	WBF-GW-009-20200707	WBF-GW-010-20200708
Sample Depth		32.2 ft	23 ft	19.5 ft	26.4 ft	35.1 ft	32.6 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Level of Review	Units	Final QC Review	Final QC Review	Final QC Review	Final QC Review	Final QC Review	Final QC Review
Field Parameters							
Dissolved Oxygen	%	4.3	7.0	12.7	6.3	4.2	3.3
Dissolved Oxygen	mg/L	0.38	0.65	1.19	0.60	0.36	0.30
ORP	mV	-87.6	197.9	139.9	149.3	-97.8	-44.9
pH (field)	SU	6.66	6.52	5.21	5.34	6.52	6.13
Specific Cond. (Field)	uS/cm	843	1,305	184.0	2,741	1,070	1,174
Temperature, Water (C)	DEG C	21.4	18.4	20.5	20.9	23.5	21.0
Turbidity, field	NTU	18.0	0.72	2.99	0.41	3.78	6.95

Notes:

%	percent
Cond.	conductance
DEG C	degrees Celsius
ft	feet below top of casing
ID	identification
mg/L	milligrams per Liter
mV	milliVolts
NTU	Nephelometric Turbidity Unit
ORP	Oxidation Reduction Potential, measured using a silver reference electrode which has a standard potential of 200 mV
SU	Standard Units
uS/cm	microSiemens per centimeter

TABLE B.4 - Groundwater Analytical Results for Metals, Anions, and General Chemistry
Watts Bar Fossil Plant
July 2020

Sample Location				WBF-101	WBF-102	WBF-103	WBF-104		WBF-105	WBF-106
Sample Date				7-Jul-20	7-Jul-20	7-Jul-20	8-Jul-20	8-Jul-20	7-Jul-20	8-Jul-20
Sample ID				WBF-GW-005-20200707	WBF-GW-006-20200707	WBF-GW-007-20200707	WBF-GW-008-20200708	WBF-GW-DUP01-20200708	WBF-GW-009-20200707	WBF-GW-010-20200708
Sample Depth				32.2 ft	23 ft	19.5 ft	26.4 ft		35.1 ft	32.6 ft
Sample Type				Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample
Level of Review	Units	EPA MCLs	CCR Rule GWPS	Validated	Validated	Validated	Validated	Validated	Validated	Validated
Total Metals										
Antimony	ug/L	6[A]	n/v	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378
Arsenic	ug/L	10[A]	n/v	0.922 J	0.393 J	<0.313	0.685 U*	0.658 U*	1.39	1.66 U*
Barium	ug/L	2,000[A]	n/v	334	42.9	81.7	33.8	34.7	96.1	35.9
Beryllium	ug/L	4[A]	n/v	<0.182	0.261 U*	<0.182	0.309 J	0.332 J	0.347 U*	<0.182
Boron	ug/L	n/v	n/v	42.5 J	58.6 J	41.8 J	4,260 J	4,500 J	47.8 J	65.2 U*
Cadmium	ug/L	5[A]	n/v	<0.217	<0.217	<0.217	**8.14[A]**	**8.32[A]**	<0.217	0.218 J
Calcium	ug/L	n/v	n/v	114,000	220,000	17,600	576,000	587,000	128,000	158,000
Chromium	ug/L	100[A]	n/v	<1.53	<1.53	<1.53	<1.53	<1.53	10.9 U*	<1.53
Cobalt	ug/L	n/v	6[B]	0.462 J	<0.134	0.905	**365[B]**	**373[B]**	<0.134	**10.3[B]**
Copper	ug/L	n/v	n/v	<0.627	<0.627	<0.627	<0.627	<0.627	<0.627	<0.627
Lead	ug/L	n/v	15[B]	<0.128	<0.128	<0.128	0.214 U*	0.217 U*	<0.128	0.223 U*
Lithium	ug/L	n/v	40[B]	<3.39	<3.39	<3.39	3.59 J	4.10 J	<3.39	<3.39
Magnesium	ug/L	n/v	n/v	15,200	34,100	4,030	64,500	65,700	18,100	29,800
Mercury	ug/L	2[A]	n/v	<0.130	1.23	<0.130	<0.130	<0.130	<0.130	<0.130
Molybdenum	ug/L	n/v	100[B]	<0.610	<0.610	<0.610	<0.610	<0.610	1.40 J	<0.610
Nickel	ug/L	100 (TN MCL)[A]	n/v	<0.336	0.726 U*	2.33 U*	67.5	69.3	0.360 U*	1.79 U*
Potassium	ug/L	n/v	n/v	968	1,560	3,520	1,640	1,670	891	1,580
Selenium	ug/L	50[A]	n/v	<1.51	2.45 J	<1.51	<1.51	<1.51	<1.51	<1.51
Silver	ug/L	100 (TN MCL)[A]	n/v	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177
Sodium	ug/L	n/v	n/v	10,300	14,100	6,220	26,200	26,000	27,500	29,200
Thallium	ug/L	2[A]	n/v	<0.148	0.263 J	<0.148	0.209 U*	0.250 U*	0.294 J	0.307 U*
Vanadium	ug/L	n/v	n/v	<0.991	<0.991	<0.991	<0.991	<0.991	1.40	<0.991
Zinc	ug/L	n/v	n/v	9.61	4.14 J	6.65	125	126	4.39 J	6.09
Dissolved Metals										
Antimony	ug/L	6[A]	n/v	<0.378	-	-	-	-	-	<0.378
Arsenic	ug/L	10[A]	n/v	0.739 J	-	-	-	-	-	1.60
Barium	ug/L	2,000[A]	n/v	346	-	-	-	-	-	34.5
Beryllium	ug/L	4[A]	n/v	<0.182	-	-	-	-	-	<0.182
Boron	ug/L	n/v	n/v	38.9 J	-	-	-	-	-	55.8 U*
Cadmium	ug/L	5[A]	n/v	<0.217	-	-	-	-	-	<0.217
Calcium	ug/L	n/v	n/v	114,000	-	-	-	-	-	152,000
Chromium	ug/L	100[A]	n/v	2.13 U*	-	-	-	-	-	<1.53
Cobalt	ug/L	n/v	6[B]	0.410 J	-	-	-	-	-	**9.84[B]**
Copper	ug/L	n/v	n/v	<0.627	-	-	-	-	-	<0.627
Lead	ug/L	n/v	15[B]	<0.128	-	-	-	-	-	0.185 J
Lithium	ug/L	n/v	40[B]	<3.39	-	-	-	-	-	<3.39
Magnesium	ug/L	n/v	n/v	15,300	-	-	-	-	-	29,300
Mercury	ug/L	2[A]	n/v	<0.130	-	-	-	-	-	<0.130
Molybdenum	ug/L	n/v	100[B]	<0.610	-	-	-	-	-	<0.610
Nickel	ug/L	100 (TN MCL)[A]	n/v	<0.336	-	-	-	-	-	1.75
Potassium	ug/L	n/v	n/v	977	-	-	-	-	-	1,500
Selenium	ug/L	50[A]	n/v	<1.51	-	-	-	-	-	<1.51
Silver	ug/L	100 (TN MCL)[A]	n/v	<0.177	-	-	-	-	-	<0.177
Sodium	ug/L	n/v	n/v	10,300	-	-	-	-	-	29,300
Thallium	ug/L	2[A]	n/v	<0.148	-	-	-	-	-	0.257 U*
Vanadium	ug/L	n/v	n/v	<0.991	-	-	-	-	-	<0.991
Zinc	ug/L	n/v	n/v	10.3	-	-	-	-	-	6.41
Anions										
Chloride	mg/L	n/v	n/v	7.05	25.8	5.63	7.08	7.06	6.02	4.96
Fluoride	mg/L	4[A]	n/v	0.110 U*	0.0629 U*	0.0669 U*	0.149 U*	0.158 U*	0.132 U*	0.133 U*
Sulfate	mg/L	n/v	n/v	240	452	60.8	1,750	1,770	349	481
General Chemistry										
Alkalinity, Bicarbonate	mg/L	n/v	n/v	129	301	36.7	55.1	54.4	115	122
Alkalinity, Carbonate	mg/L	n/v	n/v	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
Alkalinity, Total as CaCO3	mg/L	n/v	n/v	129	301	36.7	55.1	54.4	115	122
Total Dissolved Solids	mg/L	n/v	n/v	509	1,040	152	2,810	2,720	709	885

Notes:

A	EPA Maximum Contaminant Level
B	CCR Rule GWPS (Federal Register / Vol. 83, No. 146 / Monday, July 30, 2018 / Rules and Regulations)
n/v	No standard/guideline value
6.5[A]	Concentration is greater than or equal to the indicated standard.
<0.03	analyte was not detected at a concentration greater than the Method Detection Limit
-	parameter not analyzed / not available
ft	feet below top of casing
ID	identification
J	quantitation is approximate due to limitations identified during data validation
mg/L	milligrams per Liter
U*	result should be considered "not detected" because it was detected in an associated field or laboratory blank at a similar level
ug/L	micrograms per Liter
(TN MCL)	Tennessee Maximum Contaminant Level

1. Level of review is defined in the Quality Assurance Project Plan.

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TABLE B.5 – Groundwater Analytical Results for Radiological Parameters
Watts Bar Fossil Plant
July 2020

Sample Location				WBF-101	WBF-102	WBF-103	WBF-104		WBF-105	WBF-106
Sample Date				7-Jul-20	7-Jul-20	7-Jul-20	8-Jul-20	8-Jul-20	7-Jul-20	8-Jul-20
Sample ID				WBF-GW-005-20200707	WBF-GW-006-20200707	WBF-GW-007-20200707	WBF-GW-008-20200708	WBF-GW-DUP01-20200708	WBF-GW-009-20200707	WBF-GW-010-20200708
Sample Depth				32.2 ft	23 ft	19.5 ft	26.4 ft		35.1 ft	32.6 ft
Sample Type				Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample
Level of Review				Validated	Validated	Validated	Validated	Validated	Validated	Validated
	Units	EPA MCLs	CCR Rule GWPS							
Radiological Parameters										
Radium-226	pCi/L	n/v	n/v	0.0206 +/-(0.395)U	0.475 +/-(0.565)U	-0.0548 +/-(0.389)U	0.500 +/-(0.523)U	0.370 +/-(0.552)U	0.522 +/-(0.527)U	0.461 +/-(0.509)U
Radium-228	pCi/L	n/v	n/v	0.269 +/-(0.298)U	0.474 +/-(0.381)U	0.430 +/-(0.354)U	0.502 +/-(0.415)U	0.903 +/-(0.434)	0.792 +/-(0.451)	-0.116 +/-(0.432)U
Radium-226+228	pCi/L	5[A]	n/v	0.290 +/-(0.495)U	0.949 +/-(0.681)U	0.430 +/-(0.526)U	1.00 +/-(0.668)U	1.27 +/-(0.702)J	1.31 +/-(0.694)J	0.461 +/-(0.668)U

Notes:

A EPA Maximum Contaminant Level
B CCR Rule GWPS (Federal Register / Vol. 83, No. 146 / Monday, July 30, 2018 / Rules and Regulations)
n/v No standard/guideline value
ft feet below top of casing
ID identification
J quantitation is approximate due to limitations identified during data validation
pCi/L picoCurie per Liter
U not detected

1. Level of review is defined in the Quality Assurance Project Plan.

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APPENDIX H.9
TECHNICAL EVALUATION OF WATER USE SURVEY

Appendix H.9 - Technical Evaluation of Water Use Survey

TDEC Commissioner's Order:
Environmental Assessment Report
Watts Bar Fossil Plant
Spring City, Tennessee

March 31, 2024

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

REVISION LOG

Revision	Description	Date
0	Submittal to TDEC	November 7, 2023
1	Addresses January 31, 2024 TDEC Review Comments and Issued for TDEC	March 31, 2024

Sign-off Sheet

This document entitled Appendix H.9 - Technical Evaluation of Water Use Survey was prepared by Stantec Consulting Services Inc. ("Stantec") for the account of Tennessee Valley Authority (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by Stuart Gross

Stu Gross, Senior Project Manager

Reviewed by J E Griggs

John Griggs, Senior Principal

Approved by Carole M. Farr

Carole M. Farr, PG, Senior Principal Geologist

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LIST OF EXHIBITS

Abbreviations

EAR	Environmental Assessment Report.
EIP	Environmental Investigation Plan
GIS	Geographic Information System
NRC	Nuclear Regulatory Commission
Stantec	Stantec Consulting Services Inc.
Survey Area	WBF Plant ½-mile boundary
the Survey	Desktop Survey
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Commissioner’s Order OGC15-0177
TVA	Tennessee Valley Authority
US	United States
USGS	United States Geological Survey
WBF Plant	Watts Bar Fossil Plant
WBN	Watts Bar Nuclear

1.0 INTRODUCTION

Stantec Environmental Consulting Services, Inc (Stantec), on behalf of the Tennessee Valley Authority (TVA), has prepared this technical evaluation appendix to summarize applicable historical and recent water use survey information in the area surrounding TVA's Watts Bar Fossil Plant (WBF Plant) in Spring City, Tennessee. This technical appendix provides a detailed evaluation of this information for the Environmental Assessment Report (EAR) in support of fulfilling the requirements for the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order OGC15-0177 (TDEC Order) Program (TDEC 2015).

2.0 WATER USE SURVEY

As part of the Environmental Investigation Plan (EIP) (TVA 2018), TDEC required TVA to conduct a water use survey to determine if surface water or groundwater (water wells or springs) are being used by local residents or by TVA as domestic water supplies. In 2008, TVA conducted a survey of domestic water supplies within a 1-mile boundary of the WBF Plant. In response to the TDEC Order, TVA agreed to update the 2008 survey by reviewing the state database to identify existing private water wells or surface water supplies within ½-mile of the boundary of the WBF Plant, including water well inventory records on file with TDEC for Rhea and Meigs Counties. This area is referred to herein as the Survey Area and is illustrated on Exhibit H.9-1. The results of the updated Water Use Survey are presented in this appendix.

2.1 UPDATED WATER USE SURVEY

The first step of the Water Use Survey was a desktop survey (the Survey) to identify potentially usable private wells and springs. The Survey included: reviewing well logs obtained from TDEC, historical hydrogeologic reports provided by TVA and aerial photographs; and contacting public water supply providers in the vicinity of the WBF Plant. The goal of the Survey was to identify potential and known wells or springs within the Survey Area. Details of the Survey are provided in the following sections.

2.1.1 Data Sources and Evaluation

The following information and historical reports were obtained and reviewed:

- TVA - Potential Groundwater Quality Impacts at TVA Steam Plants, Report No. WR28-2-520-119 (TVA 1982) (herein referred to as the "1982 TVA report")
- United States Nuclear Regulatory Commission (US NRC) Watts Bar Nuclear Plant Unit 2 - Final Environmental Statement (US NRC 2013) (herein referred to as the "2013 NRC report")
- TVA - Watts Bar Nuclear Plant Unit 2 Final Supplemental Environmental Impact Statement for the Completion and Operation of Unit 2 (TVA 2007) (herein referred to as the "2007 TVA report")

- United States Geological Survey (USGS) Public Water-Supply Systems and Associated Water Use in Tennessee, 2005 (Robinson & Brooks 2010)
- PowerPoint presentation for Watts Bar Fossil Plant (TVA 2016)
- November 2019 Aerial Photographs (Google Earth 2020)

The following documents, obtained from government agencies, were also reviewed:

- Parcel data received from Meigs and Rhea Counties (Meigs County 2020) (Rhea County 2020)
- Well construction information received from Luke Ewing, TDEC Division of Water Resources, Drinking Water Unit (Ewing 2020)
- USGS National Water Information System online mapping database (USGS 2020)
- Watts Bar Utility 872 - 2019 Water Quality Data Report (WBUD 2019)
- North Utility District of Rhea County Water Quality Report 2019 (NUDRC 2020)
- Local Public Water Supply Information
  - Telephone Interview – Wesley Barger, Watts Bar Utility District (Barger 2020)
  - Email Communication – Jerry Harris, Town of Decatur Water System (Harris 2020)
  - Email Communication – Danah Thunquist, Spring City (Thunquist 2020)

2.1.1.1 Desktop Survey Results

The findings from the main data sources reviewed as part of this Survey are presented below.

Public Water Service Providers

Public water surrounding the WBF Plant is supplied by three separate public water districts; the Town of Decatur Water System, the Watts Bar Utility District, and the Town of Spring City Water Utility. However, only the Watts Bat Utility District is believed to provide water to the WBF Plant. The public water services provided the following information:

- Jerry Harris with the Town of Decatur Water System reported that the northern extent of their service area is greater than two miles south of the WBF Plant and does not extend into the Survey Area.
- Wesley Barger with the Watts Bar Utility District provided information of water mains extending into or near the Survey Area. The data was incomplete, but a water main appears to be present west of the Survey Area which extends into the existing Watts Bar Nuclear facility. Mr. Barger did not provide information regarding the Utility District’s water source; however, the USGS reported that the district obtains potable water from two wells located more than two miles northwest of the

WBF Plant (Brooks & Robinson 2010). The Watts Bar Utility District is the only area public water supplier whose service area extends into the Survey Area.

- The Town of Spring City did not respond to Stantec's request for information. However, publicly available information suggests that their service area is more than three miles northwest of the WBF Plant.

Table H.9-1 summarizes the identified public water suppliers.

Meigs and Rhea County Parcel Information

Stantec obtained complete parcel information from Rhea County in electronic format and assimilated the information into Stantec's geographic information system (GIS) database for the land surrounding the WBF Plant. Parcel information for Meigs County was obtained by review of online GIS parcel data available on the Meigs County website. Stantec used this data to populate Table H.9-2 which includes six parcels partially or fully within the Survey Area. The parcel information included the following water supply classifications:

- Individual (3 parcels)
- Public (3 parcels).

The 3 parcels listed as having an "individual" water supply are parcels that have no known connection to a municipal water supply. The 3 parcels identified as having a "public" water supply are served by a municipal water supply or have no known water supply.

TDEC Water Well Logs

TDEC provided an electronic list of the recorded water well logs within and near the Survey Area (Ewing 2020). Some well logs included the well depth and other well construction details. Stantec geo-referenced the listed latitude/longitude of each well log using GIS to plot the well locations on a map. The provided coordinates were imported into GIS "as is" without modification. No TDEC well logs were identified in the Survey Area.

Historical Reports

Stantec reviewed available reports prepared by TVA and US NRC for references of potable water supplies and use within the vicinity of the WBF Plant. The 1982 TVA report stated the following, "*At Watts Bar, the potable water is supplied by three wells located 2.5 miles northwest of the plant site..*" The 2007 TVA report stated that potable water is provided to the WBF Plant by the Watts Bar Utility District. The 2013 US NRC report stated the following, "*No water supply wells are located on the WBN site….The Watts Bar Utility District provides potable water for the WBN site. The utility withdraws water from wells approximately 4.0 km (2.5 mi) from the site.*" Neither report included a potable water use study. During April 2016, TVA presented a PowerPoint presentation summarizing the history of the WBF Plant. The presentation included discussion of a previous groundwater use survey (believed to be the 2008 survey referenced in the EIP) conducted for an area within a 1-mile radius of the WBF Plant and concluded that the nearest drinking water wells were at least four miles from the WBF Plant and that domestic private or public drinking water sampling was not necessary. No potable wells were identified within the Survey Area in the historical reports.

Recent Aerial Photograph Review

Stantec reviewed the November 2019 Google Earth© aerial photograph (most recent photograph available) to identify buildings or structures (i.e., residences, businesses) in the Survey Area that are likely to require a potable water source. If a parcel was identified by Meigs or Rhea counties as having an "individual" water source and a building was present, then it was assumed that a private well used for domestic or business purposes was present at the parcel. Alternatively, if a parcel was identified with an "individual" listing but no evidence of recent or current buildings or structures was observed, then it was considered unlikely for a private well to be present or currently in use at the parcel. Based on the aerial review, no buildings or other structures were observed on the three parcels identified as having "individual" water sources. Therefore, no potential wells were identified in the Survey Area in the aerial photograph review.

2.1.1.2 Summary of Desktop Survey Findings

Based on the results of the Survey, no wells or springs potentially used for domestic or business purposes were identified in the Survey Area, as shown on Exhibit H.9-1.

3.0 REFERENCES

Barger, Wesley (Watts Bar Utility District). (2020). Telephone Interview with Rex Key (Stantec), June 29, 2020.

Ewing, Luke (TDEC Division of Water Resources, Drinking Water Unit). (2020). Email to Rex Key (Stantec). June 25, 2020.

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TABLES

Table H.9-1 – WBF Plant Area Public Water Service Providers
Watts Bar Fossil Plant

Public Water Supply Provider	Service Area in Relation to WBF Plant	Does Service Area Extend into Survey Area (Yes/No)	Water Source/Intake Location	Distance of Source/Intake from WBF Plant Survey Area
Watts Bar Utility District	West	Yes - supplies potable water directly to WBF Plant	Potable water sourced from at least two wells	> 2 miles northwest
Town of Decatur Water System	South	No	"Eaves Spring"	3.5 miles south
Town of Spring City Water System	Northwest	No	Piney River	7.5 miles northwest (upstream)

Table H.9-2 – WBF Plant Parcel Data Inside Survey Area
Watts Bar Fossil Plant

OWNER	PARCEL ADDRESS	PARCEL ID	MEIGS/RHEA COUNTY GIS WATER SERVICE DESIGNATION	RECENT AERIAL PHOTOGRAPH REVIEW NOTES	POTENTIAL PRIVATE WELLS/SPRINGS IDENTIFIED ON PARCEL AND INSIDE SURVEY AREA	TDEC WELL LOG NUMBER	TVA REPORT WELL ID
TENNESSEE VALLEY AUTHORITY	STATE HWY 68	019 021.00 (Meigs County)	Individual	No Building/Structure	No	none	none
SCHMIEL SARA GLENDA ETAL/ TRACY EDWARD EDGEMON	RIVER RD	024 002.00 (Meigs County)	Individual	No Building/Structure	No	none	none
RAY RONNIE D ETAL JUDY C RAY	RIVER RD	024 003.04 (Meigs County)	Individual	No Building/Structure	No	none	none
CEMETERY LEUTY	MORRISON LN	072 057 00700 000 2020 (Rhea County)	Public	No Building/Structure	No	none	none
TENNESSEE VALLEY AUTHORITY	MORRISON LN	072 057 00800 000 2020 (Rhea County)	Public	No Building/Structure	No	none	none
TENNESSEE VALLEY AUTHORITY (STEAM PLANT)	WATTS BAR HWY	072 057 01600 000 2020 (Rhea County)	Public	No Building/Structure	No	none	none

EXHIBIT

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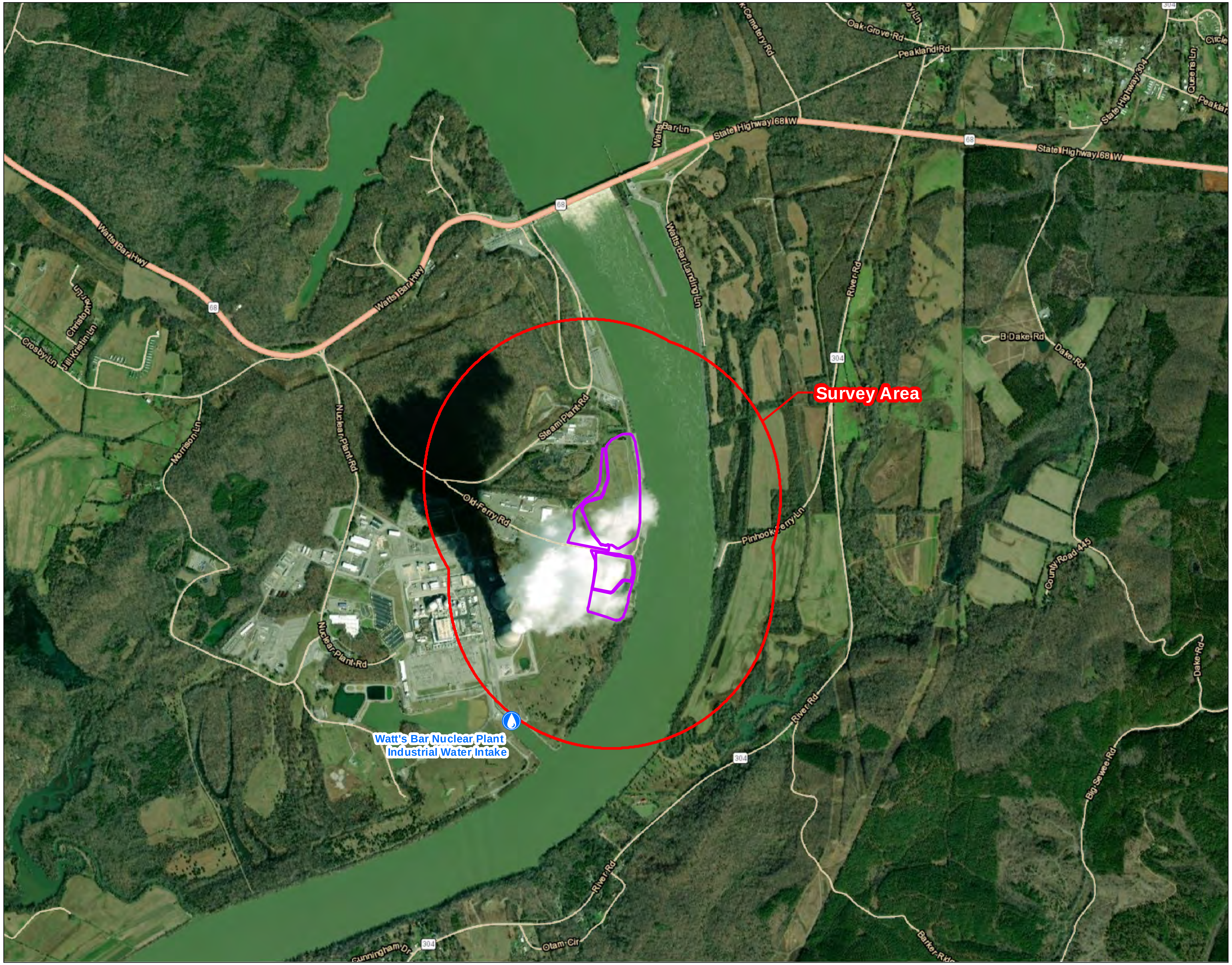

Exhibit No.

H.9-1

Title

WBF Survey Area

Client/Project 175668050

Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location

Rhea/Meigs County, Tennessee

Prepared by LB on 2022-06-13
Technical Review by CHH on 2022-06-13
Internal Review by CF on 2022-06-13

N

0 2,000 4,000 Feet

(At original document size of 11x17)
1:24,000

Legend

Unit Boundary

CCR Unit Area 1/2 mile radius

Notes

1. Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
2. Data Sources:
3. Background: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Esri, HERE, Garmin, (c) OpenStreetMap contributors

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