

**2017 Annual Groundwater
Monitoring and Corrective
Action Report**



Tennessee Valley Authority
Bull Run Fossil Plant Dry Fly Ash
Stack Lateral Expansion CCR Unit



Prepared for:
Tennessee Valley Authority
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January 31, 2018

January 31, 2018

Reference: 2017 Annual Groundwater Monitoring Report
TVA Bull Run Fossil Plant Dry Fly Ash Stack Lateral Expansion CCR Unit

This report documents 2017 groundwater monitoring activities as required under the Federal coal combustion residuals (CCR) rules (the CCR Rule; 40 CFR 257.90(e)) at the Tennessee Valley Authority (TVA) Bull Run Fossil Plant (BRF) Dry Fly Ash Stack Lateral Expansion CCR Unit. TVA established a groundwater monitoring network and program at the BRF Dry Fly Ash Stack Lateral Expansion CCR Unit in accordance with 40 CFR 257.90. During 2017, TVA performed the following groundwater monitoring activities:

- A required groundwater quality monitoring network was established and certified by a qualified Professional Engineer as required by 40 CFR 257.91.
- Monitoring wells were video-logged and resurveyed to confirm accuracy in the documented well construction records.
- A groundwater quality sampling and analysis program was developed and implemented as required by 40 CFR 257.90.
- The required baseline monitoring of network wells was initiated and independent baseline samples, as required by 40 CFR 247.94(b), were collected with the exception of well MWC.
- The sampling and analysis for the first detection monitoring event was completed in October 2017 in accordance with the CCR Rule [40 CFR 257.93 and 257.94(a)].
- Statistical analysis of baseline data was performed in accordance with the CCR Rule.
- Limited baseline monitoring was conducted for background well MWC¹ during the first-year phase of the TVA Groundwater Quality Monitoring Program as the well was added to the network later in 2017 as a future well to support the background data set. MWC will have baseline sampling conducted in 2018. This has no effect on the statistical analysis and reliability of the determinations provided in this report.
- No other problems were encountered during the first-year phase of the TVA groundwater quality monitoring program and therefore, no further action has been recommended except for the planned key activities for 2018 that are outlined below.

The projected key activities for 2018 are:

- Eight baseline samples will be collected and analyzed for well MWC.
- Statistical procedures of the detection monitoring event were performed in accordance with the CCR Rule 40 CFR 257.93(h). Although not required to be included in this 2017 Annual Groundwater Monitoring and Corrective Action Report, TVA has provided the January 15, 2018 determination of any statistically significant increases (SSIs) over background for the first detection monitoring event as shown in Table 1.
- Perform confirmation of SSIs via retesting procedures and error checking. Investigate whether the SSI over background resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality as specified in 40 CFR 257.94(e)(2).
- Perform an alternate source demonstration in accordance with 40 CFR 257.94(e)(2).
- Establish an assessment monitoring program in accordance with 40 CFR 257.94(e)(1) where applicable, if unable to establish that SSIs were the result of another source or the result of an error.

¹ Monitoring well MWC was added to the well network later in 2017 as a future well to support the baseline data set.

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TVA Bull Run Fossil Plant Dry Fly Ash Stack Lateral Expansion CCR Unit
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- Perform further field and desktop Site-Characterization Investigations to improve the BRF Conceptual Site Model (CSM).
- Continue semi-annual detection monitoring of the certified groundwater monitoring network consistent with 40 CFR 257.94 for the 2018 Annual Groundwater Monitoring and Corrective Action Report.
- Continue and improve TVA's third-party Quality Assurance Program to evaluate groundwater analytical data using best practices concerning field methods and validation techniques, as well as the application of the most appropriate statistical methods.
- Review new data as it becomes available and implement changes to the groundwater monitoring program as necessary to maintain compliance with 40 CFR 257.90 through 257.98.
- Comply with recordkeeping requirements as specified in 40 CFR 257.105(h), notification requirements specified in 40 CFR 257.106(h) and internet requirements specified in 40 CFR 257.107(h).

GROUNDWATER MONITORING WELL NETWORK

The monitoring well network for the BRF Dry Fly Ash Stack Lateral Expansion CCR Unit consists of two background wells (I and MWC) and three downgradient wells (BRF-107, J, and MW-3H/P-3). The downgradient wells are installed at the waste boundary. Figure 1 is an aerial photograph that shows the groundwater monitoring well locations. As previously mentioned, MWC was added to the network during the network certification process and will be sampled for baseline and detection monitoring as a new well in 2018. The monitoring well network was designed for a single CCR Unit (Dry Fly Ash Stack Lateral Expansion).

No monitoring wells were installed or decommissioned during the 2017 reporting period. The certification of the groundwater monitoring system required under 40 CFR 257.91(f) is included in the facility operating record and on the CCR Compliance Data and Information website: <https://www.tva.gov/Environment/Environmental-Stewardship/Coal-Combustion-Residuals>.

GROUNDWATER SAMPLING AND LABORATORY ANALYTICAL TESTING

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

The first round of detection monitoring was completed in compliance with 40 CFR 257.94. Groundwater sampling results are summarized in Table 1. Baseline groundwater samples were obtained between November 2016 and September 2017. Baseline groundwater sampling results are summarized in Table 2. A summary of groundwater sample locations, well designations, analytes sampled, sampling dates, and monitoring program status is provided in Table 3.

Baseline data for both Appendix III and IV constituents were required to be collected prior to the establishment of upper prediction limits (UPLs) or Groundwater Protection Standards (GWPS). Under a CCR-required assessment monitoring program, GWPS will be established in accordance with 40 CFR 257.95(h), at which time maximum contaminant levels (MCLs) may or may not be considered the appropriate GWPS depending on background well concentrations for each

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Appendix IV constituent. The appropriate GWPS will establish the assessment groundwater monitoring program and any assessment of corrective measures.

Groundwater elevations were measured in each monitoring well immediately prior to purging during each sampling event as required by 40 CFR 257.93(c). Groundwater elevations and Clinch River surface water elevations are summarized in Table 4. Groundwater flow directions were determined for each sampling event, and a generalized depiction of groundwater flow direction is illustrated on Figure 2. The regional groundwater directional flow at BRF is influenced by the Clinch River to the west/southwest of the site and then locally by Worthington Branch that runs to the south of the BRF Dry Fly Ash Stack Lateral Expansion at the base of Bull Run Ridge. Worthington Branch flows west-southwest, discharging to the Clinch River. The primary groundwater flow direction is to the west/southwest toward the Clinch River. Locally, groundwater flows south-southeast beneath the BRF Dry Fly Ash Stack Lateral Expansion towards Worthington Branch.

The uppermost aquifer at the BRF Dry Fly Ash Stack Lateral Expansion CCR Unit consists of a very thin layer of residuum overlain by fractured Chickamauga Limestone. Groundwater occurrence is variable and controlled by series of interconnected bedrock fractures shallower than 300 feet (AECOM, 2015).

Hydraulic conductivity testing was performed in the uppermost aquifer, and the results are summarized in Table 5. Testing data indicates the uppermost aquifer has a geometric mean hydraulic conductivity of 1.39×10^{-4} centimeters per second (cm/sec) (AECOM, 2015; AECOM, 2017). Linear groundwater flow velocity was calculated for the uppermost aquifer using:

- the geometric mean hydraulic conductivity calculated from hydraulic testing;
- horizontal hydraulic gradients measured during the implementation of the groundwater sampling and analysis program, ranging from 0.0135 to 0.0237 feet per foot (ft/ft); and,
- an effective porosity of approximately 0.25 to 1% (AECOM, 2015).

The average linear flow velocity in the uppermost aquifer ranges from approximately 195 to 342 feet per year.

The groundwater monitoring data was evaluated using statistical procedures as required by 40 CFR 257.93(f) through 257.93(h). The statistical method certification is included in the facility operating record and the CCR Compliance Data and Information website. Background groundwater quality was established for the background monitoring wells.

NARRATIVE DISCUSSION OF ANY TRANSITION BETWEEN MONITORING PROGRAMS

In January 2018 TVA evaluated the groundwater monitoring data for SSIs over background levels for the constituents listed in Appendix III² as required by 40 CFR 257.93(h). Although not required to be included in this 2017 Annual Groundwater Monitoring and Corrective Action Report concerning the preceding calendar year, TVA has provided the January 15, 2018 determination (based on the current dataset) of any SSIs over background for the first detection monitoring event. The groundwater analytical results from the initial round of detection monitoring indicated SSIs of Appendix III CCR constituents at the downgradient monitoring wells. TVA plans to perform confirmation of the SSIs via retesting procedures and error checking and investigate whether the SSI over background resulted from error in sampling, analysis, statistical evaluation, or natural

² Appendix III CCR Constituents: boron, calcium, chloride, fluoride, pH, sulfate, and total dissolved solids (TDS)

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January 31, 2018

variation in groundwater quality as specified in 40 CFR 257.94(e)(2). TVA also plans to perform investigations to determine whether a source other than the CCR materials contained in the BRF Dry Fly Ash Stack Lateral Expansion are the cause of any verified SSI over background as specified in 40 CFR 257.94(e)(2). If TVA is unable to demonstrate that the SSI was a result of error or another source, then an Assessment Monitoring Program will be established and implemented as specified in 40 CFR 257.95.

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TVA Bull Run Fossil Plant Dry Fly Ash Stack Lateral Expansion CCR Unit
January 31, 2018

LIMITATIONS

This document entitled 2017 Annual Groundwater Monitoring and Corrective Action Report was prepared by Stantec Consulting Services Inc. ("Stantec") for the Tennessee Valley Authority (the "Client"). The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec relied upon data and information supplied to it by the client.

Prepared by 
(signature)

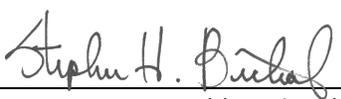
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References:

AECOM, 2015. Part II Permit Application Hydrogeologic Site Investigation CCP Proposal Landfill. June 12, 2015.
AECOM, 2017. Hydrogeological Characterization Report (Draft). March 2017.

Attachments:

Figure 1 – Map with CCR Unit Background and Downgradient Wells

Figure 2 – Generalized Groundwater Flow Direction Map

Table 1 – Detection Monitoring Groundwater Sampling Results

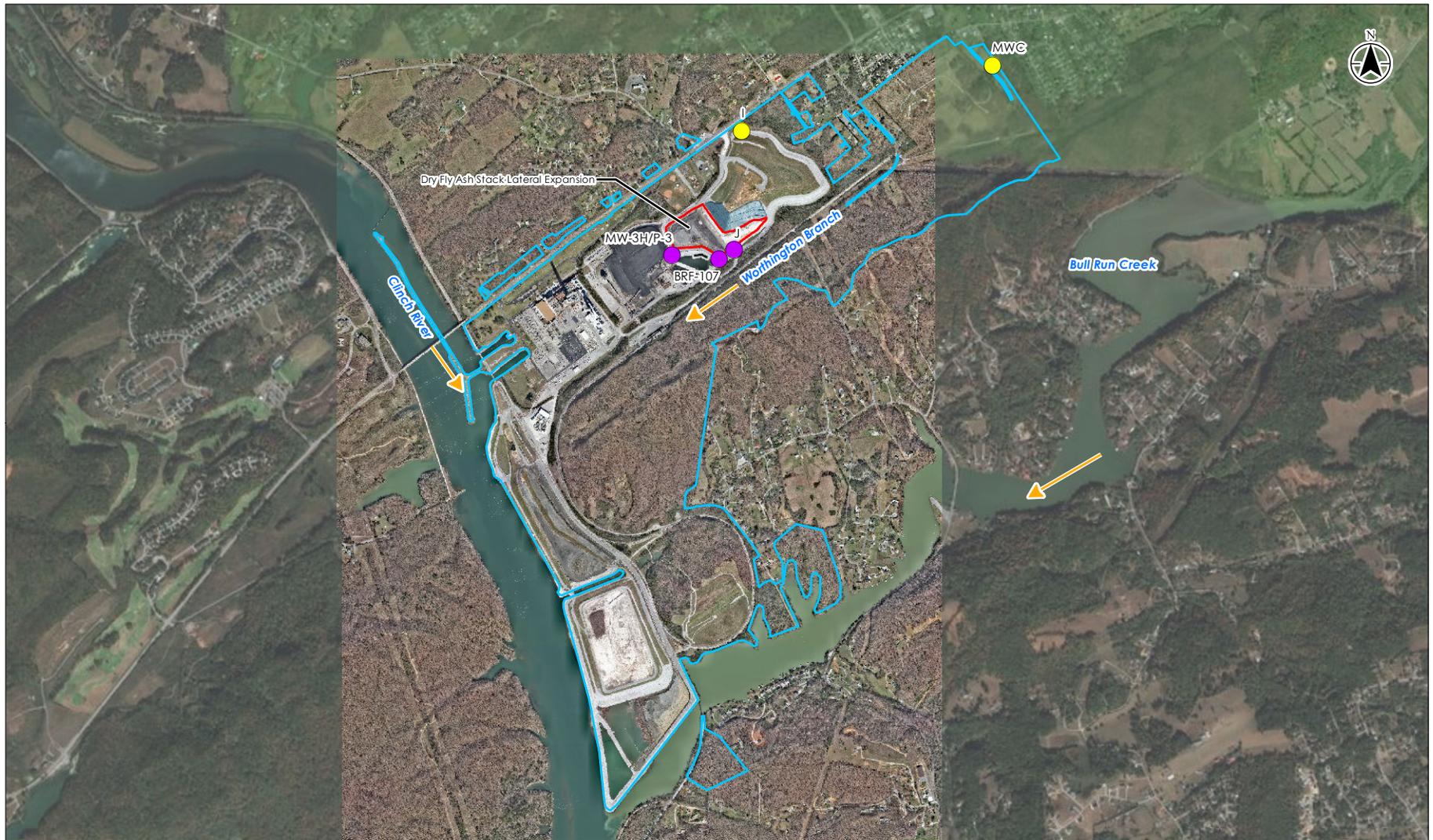
Table 2 – Baseline Groundwater Sampling Results

Table 3 – Groundwater Sampling Summary

Table 4 – Groundwater and Surface Water Elevation Summary

Table 5 – Hydraulic Conductivity Data Summary

FIGURES



- Background Well
- Downgradient Well
- CCR Unit Subject to CCR Rule
- TVA Property Boundary



Notes
 1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
 2. Imagery Source: Tucker Mapping Solutions, INC (2017-03-14) and Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Project Location
 Claxton
 Anderson County,
 Tennessee

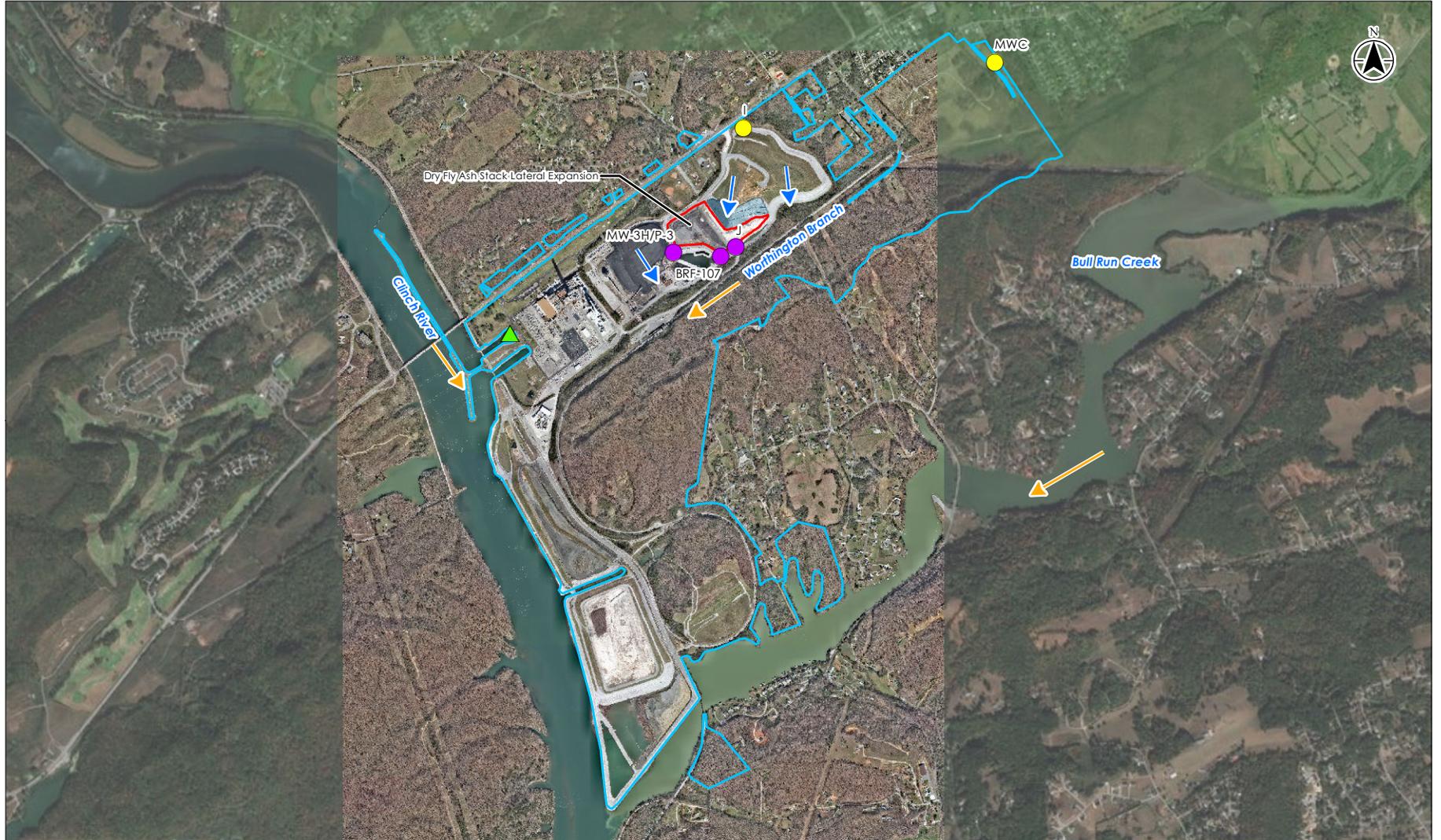
182603174
 Prepared by WSW on 2018-01-30
 Technical Review by MD on 2018-01-30
 Independent Review by JK on 2018-01-30

Client/Project
 Tennessee Valley Authority
 Bull Run Fossil Plant
 CCR Rule

Figure No.
 1

Title
 Map with CCR Unit Background
 and Downgradient Wells

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



Notes
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 2. Imagery Source: Tucker Mapping Solutions, INC (2017-03-14) and Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Project Location
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 Prepared by WSW on 2018-01-30
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Client/Project
 Tennessee Valley Authority
 Bull Run Fossil Plant
 CCR Rule

Figure No.

2

Title

**Generalized Groundwater
 Flow Direction Map**

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

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TABLES

TABLE 1
Detection Monitoring Groundwater Sampling Results

Bull Run Fossil Plant
Claxton, Tennessee

Constituent	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	TDS
Unit	mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
BTV (UPL)	0.107	91.5	28.6	0.117	6.77 – 7.62*	7.28	396
Well ID	First Detection Monitoring Round Results (for samples taken on October 2, 2017)						
BRF-107	<u>0.726</u>	<u>193</u>	9.39	0.0386	6.84	<u>216</u>	<u>714</u>
J	<u>3.25</u>	<u>280</u>	9.03	0.0458	6.96	<u>657</u>	<u>1,200</u>
MW-3H/P-3	<u>0.748</u>	38.4	11.7	<u>0.379</u>	7.56	<u>61.0</u>	392
I	0.0315	80.4	28.3	0.0465	7.19	4.10	329

Notes:

Bold and underlined concentration indicates an SSI over background

SSI - Statistically Significant Increase

BTV - Background Threshold Values

UPL - Upper Prediction Limit

TDS - Total Dissolved Solids

mg/L - milligrams per liter

SU - Standard Unit

Well I is a background monitoring well. Sampling data included to document detection monitoring groundwater sampling results.

* indicates the lower bound of the range is the lower prediction limit (LPL). The upper bound is the UPL.

TABLE 2
Baseline Groundwater Sampling Results

Bull Run Fossil Plant
Claxton, Tennessee

Monitoring Well		BRF-107																					
Sample Date	03-Nov-16		10-Jan-17		01-Feb-17		03-Mar-17		28-Mar-17		17-Apr-17		16-May-17		12-Jun-17		07-Jul-17		31-Jul-17		11-Sep-17		
Sample Type	Baseline																						
Location/Well ID	BRF-107																						
Sample ID	BRF-GW-010-11032016		BRF-GW-010-01102017		BRF-GW-010-02012017		BRF-GW-010-03032017		BRF-GW-010-03282017		BRF-GW-010-04172017		BRF-GW-010-05162017		BRF-GW-010-06122017		BRF-GW-010-07072017		BRF-GW-010-07312017		BRF-GW-010-09112017		
Well Designation	Downgradient																						
Analyte	Units	Result	Q	Result	Q																		
Total Metals																							
Antimony	mg/L	< 0.0000213	U	< 0.0000213	UJ	< 0.000523	U*	< 0.000543	U*	0.00103	J	< 0.000443	U	< 0.000443	U	< 0.000443	UJ	< 0.000443	U	< 0.000443	U	< 0.000605	U*
Arsenic	mg/L	< 0.000118	U	0.000137	J	< 0.000220	U	< 0.000220	U	0.000279	J	< 0.000220	U	0.000301	J	0.000529	J	0.000290	J	< 0.000323	U*	< 0.000279	U*
Barium	mg/L	0.0548		0.0546		0.0503		0.0537		0.0532		0.0511		0.0604		0.0540		0.0525		0.0548		0.0542	
Beryllium	mg/L	< 0.000102	U	< 0.000102	U	< 0.000131	U																
Boron	mg/L	0.743		0.735		0.704	J	0.702		0.674		0.459		0.743	J	0.608		0.714		0.604		0.672	
Cadmium	mg/L	< 0.000152	U	< 0.000152	U	< 0.0000781	U																
Calcium	mg/L	202		203		186		186		175		175		210		202		189		187		196	
Chromium	mg/L	< 0.000339	U	< 0.000339	U	< 0.000378	U																
Cobalt	mg/L	< 0.000138	U*	< 0.000164	U*	< 0.000121	U*	0.000233	J	0.000283	J	0.000143	J	0.000188	J	0.000169	J	0.000223	J	0.000159	J	0.000228	J
Lead	mg/L	< 0.0000675	U	< 0.0000675	U	< 0.000318	U																
Lithium	mg/L	0.00835		< 0.00952	U*	< 0.00765	U*	0.00608		0.00666		0.00495	J	< 0.00411	U*	0.00554		0.00642		< 0.00850	U*	< 0.00568	U*
Mercury	mg/L	< 0.0000521	U	0.0000526	J	< 0.0000521	UJ	< 0.0000653	U	< 0.0000653	UJ	< 0.0000653	U										
Molybdenum	mg/L	< 0.000873	U	< 0.000873	U	< 0.000593	U	0.000811	J	0.000817	J	< 0.000593	U	< 0.000593	U	< 0.000593	U	< 0.000593	UJ	< 0.000593	U	< 0.000593	U
Selenium	mg/L	< 0.000348	U	< 0.000348	U	< 0.000127	U																
Thallium	mg/L	< 0.0000360	U	< 0.0000360	U	< 0.0000531	U	< 0.0000610	U*	< 0.0000531	U	< 0.0000531	U	< 0.000152	U*	< 0.0000531	U	< 0.0000531	U	< 0.0000531	U	< 0.0000531	U
Radium 226 + radium 228	pCi/L	1.45	J	0.270	U	0.562	U	0.701	U	0.512	UJ	0.653	UJ	0.267	U	0.950	J	0.702	U	0.630	UJ	0.326	UJ
Anions																							
Chloride	mg/L	7.12		6.48		7.86		7.36		7.85		7.63		6.70		7.76		7.76		8.00		7.82	
Fluoride	mg/L	< 0.0624	U*	0.0768	J	< 0.0782	U*	0.0466	J	0.0905	J	0.0714	J	0.0541	J	0.103		< 0.0948	U*	0.0579	J	0.0673	J
Sulfate	mg/L	210		226		230		248		247		236		216		250		236		226		195	
General Chemistry																							
Total Dissolved Solids	mg/L	689		697		693		709		740		682		728		716		778		694		727	
Field pH																							
pH (field)	SU	6.99		6.88		6.81		6.91		6.87		6.92		6.81		6.82		6.87		6.89		6.85	

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

TABLE 2
Baseline Groundwater Sampling Results

Bull Run Fossil Plant
Claxton, Tennessee

Monitoring Well		I																					
Sample Date	03-Nov-16		09-Jan-17		31-Jan-17		28-Feb-17		27-Mar-17		17-Apr-17		15-May-17		12-Jun-17		06-Jul-17		31-Jul-17		11-Sep-17		
Sample Type	Baseline																						
Location/Well ID	I		I		I		I		I		I		I		I		I		I		I		
Sample ID	BRF-GW-014-11032016		BRF-GW-014-01092017		BRF-GW-014-01312017		BRF-GW-014-02282017		BRF-GW-014-03272017		BRF-GW-014-04172017		BRF-GW-014-05152017		BRF-GW-014-06122017		BRF-GW-014-07062017		BRF-GW-014-07312017		BRF-GW-014-09112017		
Well Designation	Background																						
Analyte	Units	Result	Q	Result	Q																		
Total Metals																							
Antimony	mg/L	< 0.0000213	U	< 0.0000213	UJ	< 0.000746	U*	< 0.00109	U*	< 0.000443	U	0.000464	J	< 0.000443	U	< 0.000793	U*						
Arsenic	mg/L	< 0.000236	U*	0.000203	J	< 0.000388	U*	0.000342	J	0.000402	J	0.000366	J	0.000402	J	0.000552	J	0.000411	J	< 0.000405	U*	< 0.000486	U*
Barium	mg/L	0.0704		0.0707		0.0644		0.0657		0.0632		0.0620		0.0738		0.0632		0.0633		0.0665		0.0650	
Beryllium	mg/L	< 0.000102	U	< 0.000102	U	< 0.000131	U																
Boron	mg/L	0.0348		0.0317	J	0.0321	J	0.0584	J	0.0273	J	0.0215	J	0.0327	J	0.0319	J	0.0912		0.0366	J	< 0.0362	U*
Cadmium	mg/L	< 0.000152	U	< 0.000152	U	< 0.0000781	U	0.000102	J	< 0.0000781	U												
Calcium	mg/L	83.8		84.0		80.0		78.6		75.3		78.1		89.1		77.2		79.5		81.2		82.0	
Chromium	mg/L	< 0.000339	U	0.000455	J	< 0.000378	U	< 0.000378	U														
Cobalt	mg/L	< 0.0000218	U	0.0000310	J	< 0.0000947	U	0.000190	J	< 0.0000947	U	< 0.0000947	U	< 0.0000947	U								
Lead	mg/L	< 0.0000675	U	< 0.0000675	U	< 0.000318	U																
Lithium	mg/L	0.0141		< 0.0162	U*	< 0.0151	U*	0.0133		0.0118		0.0109		< 0.0108	U*	0.0119		0.0123		< 0.0150	U*	< 0.0114	U*
Mercury	mg/L	< 0.0000521	U	< 0.0000521	UJ	< 0.0000521	UJ	< 0.0000653	U	< 0.0000653	UJ	< 0.0000653	U										
Molybdenum	mg/L	< 0.000873	U	< 0.00112	U*	< 0.000647	U*	< 0.000593	U	0.000678	J	< 0.000593	UJ	< 0.000593	U	< 0.000593	U						
Selenium	mg/L	< 0.000348	U	< 0.000348	U	< 0.000127	U																
Thallium	mg/L	< 0.0000360	U	0.000112	J	0.000126	J	< 0.0000531	U	0.0000750	J	< 0.0000531	U	< 0.000168	U*	< 0.0000531	U						
Radium 226 + radium 228	pCi/L	1.07	U	0.203	U	0.628	U	0.0650	U	0.0818	UJ	0.893	U*	0.231	U	0.472	U	1.33	U*	0.621	UJ	0.732	UJ
Anions																							
Chloride	mg/L	20.6		22.9		24.2		23.8		25.2		24.5		19.9		24.9		23.9		24.7		24.4	
Fluoride	mg/L	< 0.0778	U*	0.0618	J	< 0.0950	U*	0.0538	J	0.0978	J	0.0825	J	0.0558	J	0.0929	J	< 0.0766	U*	0.0725	J	0.0692	J
Sulfate	mg/L	3.81		4.96		5.59		5.25		5.24		5.09		3.88		6.35		5.05		5.24		5.14	
General Chemistry																							
Total Dissolved Solids	mg/L	314		317		335		325		356		324		367		342		374		297		332	
Field pH																							
pH (field)	SU	7.38		7.34		7.27		7.26		7.13		7.22		7.12		7.04		6.94		7.15		7.16	

Notes:
 NA - Not Available
 Q - Data Qualifier
 U* - Result should be considered "not-detected" because it was detected in a rinsate blank or laboratory blank at a similar level
 J - Quantitation is approximate due to limitations identified during data validation
 UJ - Analyte not detected, but the reporting limit may or may not be higher due to a bias identified during data validation
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 mg/L - milligrams per liter
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**TABLE 2
Baseline Groundwater Sampling Results**

Bull Run Fossil Plant
Claxton, Tennessee

Monitoring Well		J																					
Sample Date	08-Nov-16		10-Jan-17		01-Feb-17		01-Mar-17		27-Mar-17		18-Apr-17		16-May-17		12-Jun-17		07-Jul-17		01-Aug-17		11-Sep-17		
Sample Type	Baseline																						
Location/Well ID	J		J		J		J		J		J		J		J		J		J		J		
Sample ID	BRF-GW-015-11082016		BRF-GW-015-01102017		BRF-GW-015-02012017		BRF-GW-015-03012017		BRF-GW-015-03272017		BRF-GW-015-04182017		BRF-GW-015-05162017		BRF-GW-015-06122017		BRF-GW-015-07072017		BRF-GW-015-08012017		BRF-GW-015-09112017		
Well Designation	Downgradient																						
Analyte	Units	Result	Q	Result	Q																		
Total Metals																							
Antimony	mg/L	< 0.000325	U*	< 0.000213	UJ	< 0.000499	U*	< 0.000832	U*	< 0.000443	U	< 0.000443	U	< 0.000443	U	< 0.000443	UJ	< 0.000443	U	< 0.000638	U*		
Arsenic	mg/L	< 0.000187	U*	0.000131	J	< 0.000220	U	< 0.000220	U	< 0.000220	U	0.000248	J	0.000514	J	0.000794	J	0.000295	J	< 0.000290	U*	< 0.000304	U*
Barium	mg/L	0.0345		0.0398		0.0351		0.0355		0.0370		0.0337		0.0409		0.0380		0.0347		0.0361		0.0362	
Beryllium	mg/L	< 0.000102	U	< 0.000102	U	< 0.000131	U																
Boron	mg/L	2.65		2.86		2.89	J	2.55		2.69		1.63		3.03	J	2.56		2.59		2.48		2.57	
Cadmium	mg/L	< 0.000152	U	< 0.000152	U	< 0.0000781	U																
Calcium	mg/L	245	J	286		271		262		265		246		301		263		262		272		282	
Chromium	mg/L	< 0.000339	UJ	< 0.000339	U	< 0.000378	U																
Cobalt	mg/L	0.0000490	J	< 0.0000530	U*	< 0.0000947	U	< 0.0000947	U	< 0.0000947	U	0.0000950	J	< 0.0000947	U	< 0.0000947	U						
Lead	mg/L	0.0000750	J	< 0.0000675	U	< 0.0000318	U	< 0.0000318	U	< 0.0000318	U	0.000357	J	< 0.0000318	U	< 0.0000318	U						
Lithium	mg/L	0.0103		< 0.0155	U*	< 0.0151	U*	0.0139		0.0123		0.0121		< 0.0123	U*	0.0132		0.0137		0.0133		< 0.0129	U*
Mercury	mg/L	< 0.0000521	U	< 0.0000521	UJ	< 0.0000521	UJ	< 0.0000653	U	< 0.0000653	UJ	< 0.0000653	U										
Molybdenum	mg/L	< 0.000873	U	< 0.000873	U	< 0.000629	U*	< 0.000611	U*	< 0.000593	U	< 0.000593	U	< 0.000593	U	< 0.000593	UJ	< 0.000593	UJ	< 0.000593	U	0.000602	J
Selenium	mg/L	< 0.000117	U*	0.000954	J	0.00235	J	< 0.000127	U	0.00149	J	< 0.000127	U	< 0.000127	U								
Thallium	mg/L	< 0.0000360	U	< 0.0000360	U	< 0.0000531	U																
Radium 226 + radium 228	pCi/L	0.202	U	0.460	U	0.793	U	0.681	U	0.287	UJ	0.616	U*	0.329	U	0.0632	U	0.419	U	0.381	UJ	0.209	UJ
Anions																							
Chloride	mg/L	4.38		7.65		7.91		7.29		7.53		7.87		6.19		8.50		8.33		8.30		9.28	
Fluoride	mg/L	< 0.0642	U*	0.0905	J	< 0.0726	U*	0.0717	J	0.0759	J	0.0739	J	0.0552	J	0.0979	J	< 0.0812	U*	0.0572	J	0.0726	J
Sulfate	mg/L	576		549		630		651		676		642		625		646		657		598		643	
General Chemistry																							
Total Dissolved Solids	mg/L	1150		1160		1130		1170		1210		1110		1200		1190		1250		1170		1200	
Field pH																							
pH (field)	SU	7.00		7.02		6.95		6.98		7.03		6.96		6.89		6.95		6.96		6.90		6.98	

Notes:

NA - Not Available

Q - Data Qualifier

U* - Result should be considered "not-detected" because it was detected in a rinsate blank or laboratory blank at a similar level

J - Quantitation is approximate due to limitations identified during data validation

UJ - Analyte not detected, but the reporting limit may or may not be higher due to a bias identified during data validation

U - Analyte not detected

mg/L - milligrams per liter

pCi/L - picoCurie per liter

SU - Standard Unit

TABLE 2
Baseline Groundwater Sampling Results

Bull Run Fossil Plant
Claxton, Tennessee

Monitoring Well		MW-3H/P-3																					
Sample Date	08-Nov-16		10-Jan-17		01-Feb-17		03-Mar-17		28-Mar-17		18-Apr-17		16-May-17		13-Jun-17		07-Jul-17		31-Jul-17		11-Sep-17		
Sample Type	Baseline																						
Location/Well ID	MW-3H/P-3																						
Sample ID	BRF-GW-030-11082016		BRF-GW-030-01102017		BRF-GW-030-02012017		BRF-GW-030-03032017		BRF-GW-030-03282017		BRF-GW-030-04182017		BRF-GW-030-05162017		BRF-GW-030-06132017		BRF-GW-030-07072017		BRF-GW-030-07312017		BRF-GW-030-09112017		
Well Designation	Downgradient																						
Analyte	Units	Result	Q	Result	Q																		
Total Metals																							
Antimony	mg/L	< 0.000189	U*	< 0.0000213	UJ	< 0.000677	U*	< 0.000607	U*	< 0.000443	U	0.000460	J	< 0.000443	U	< 0.000443	UJ	< 0.000443	U	< 0.000443	U	< 0.000652	U*
Arsenic	mg/L	< 0.000118	U	< 0.000118	U	< 0.000220	U	0.000239	J	0.000236	J	0.000229	J	< 0.000220	U	< 0.000245	U*						
Barium	mg/L	0.169		0.188		0.171		0.173		0.176		0.176		0.209		0.180		0.185		0.181		0.175	
Beryllium	mg/L	< 0.000102	U	< 0.000102	U	< 0.000131	U																
Boron	mg/L	0.619		0.692		0.713	J	0.680		0.514		0.484		0.747	J	0.624		0.663		0.611		0.653	
Cadmium	mg/L	< 0.000152	U	< 0.000152	U	< 0.0000781	U																
Calcium	mg/L	38.4		32.4		37.6		38.6		36.8		40.2		36.7		34.1		38.9		37.4		37.6	
Chromium	mg/L	< 0.000339	U	< 0.000339	U	< 0.000378	U																
Cobalt	mg/L	< 0.0000218	U	< 0.0000230	U*	< 0.0000947	U	< 0.0000947	U														
Lead	mg/L	< 0.0000675	U	< 0.0000675	U	< 0.000318	U																
Lithium	mg/L	0.0616		0.0705		0.0672		0.0660		0.0612		0.0640		0.0647		0.0654		0.0596		0.0596		0.0629	
Mercury	mg/L	< 0.0000521	U	< 0.0000521	UJ	< 0.0000521	UJ	< 0.0000653	U	< 0.0000653	UJ	< 0.0000653	U										
Molybdenum	mg/L	< 0.000873	U	< 0.000873	U	< 0.000593	U	< 0.000593	U	< 0.000593	U	0.000764	J	< 0.000593	U	< 0.000593	U	< 0.000593	UJ	< 0.000593	U	< 0.000593	U
Selenium	mg/L	< 0.000348	U	< 0.000348	U	< 0.00127	U																
Thallium	mg/L	< 0.0000360	U	< 0.0000360	U	< 0.0000531	U	< 0.000177	U*	< 0.0000531	U	< 0.0000531	U										
Radium 226 + radium 228	pCi/L	0.648	U	0.214	U	0.809	U	0.832	U	0.257	UJ	1.04	U*	0.723	U	0.387	U	0.518	U	1.36	U*	0.748	UJ
Anions																							
Chloride	mg/L	8.11		9.07		11.2		10.4		11.4		10.9		8.18		11.2		10.9		10.9		10.9	
Fluoride	mg/L	< 0.449	U*	0.462		0.490	J	0.351		0.566	J	0.531		0.468		0.590		0.503		0.528		0.483	
Sulfate	mg/L	56.5		60.5		58.5		60.7		62.7		60.1		57.8		65.6		61.0		60.9		59.1	
General Chemistry																							
Total Dissolved Solids	mg/L	398		399		403		400		422		387		400		389		453		377		415	
Field pH																							
pH (field)	SU	7.61		7.63		7.53		7.65		7.54		7.58		7.52		7.34		7.58		7.58		7.57	

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

TABLE 3
Groundwater Sampling Summary

Bull Run Fossil Plant
Claxton, Tennessee

Well ID	Well Designation	Number of Baseline Samples Collected	Baseline / Background Sample Dates											Number of Detection Samples Collected	Detection Monitoring: October 2, 2017	Detection Monitoring Program	
			November 3-8, 2016	January 9-10, 2017	January 31-February 1, 2017	February 28-March 3, 2017	March 27-28, 2017	April 17-18, 2017	May 15-16, 2017	June 12-13, 2017	July 6-7, 2017	July 31-August 1, 2017	September 11, 2017				
BRF-107	Downgradient	11	X	X	X	X	X	X	X	X	X	X	X	X	1	X	Detection Monitoring - 257.94(a) - Appendix III Constituents
I	Background	11	X	X	X	X	X	X	X	X	X	X	X	X	1	X	Detection Monitoring - 257.94(a) - Appendix III Constituents
J	Downgradient	11	X	X	X	X	X	X	X	X	X	X	X	X	1	X	Detection Monitoring - 257.94(a) - Appendix III Constituents
MW-3H/ P-3	Downgradient	11	X	X	X	X	X	X	X	X	X	X	X	X	1	X	Detection Monitoring - 257.94(a) - Appendix III Constituents
MWC	Background	1*	X												1	X	Detection Monitoring - 257.94(a) - Appendix III Constituents

Notes:
 Baseline groundwater samples analyzed for Appendix III and Appendix IV constituents
 Appendix III Constituents - boron, calcium, chloride, fluoride, pH, sulfate, total dissolved solids (TDS)
 Appendix IV Constituents - antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, fluoride, lead, lithium, mercury, molybdenum, selenium, thallium, radium 226 and 228 combined
 *Monitoring well MWC was added to the network later in 2017 as a future well to support the background data set

TABLE 4
Groundwater and Surface Water Elevation Summary

Bull Run Fossil Plant
Claxton, Tennessee

Groundwater Elevation Collection Date		02-Nov-16	09-Jan-17	31-Jan-17	28-Feb-17	27-Mar-17	17-Apr-17	15-May-17	12-Jun-17	06-Jul-17	31-Jul-17	11-Sep-17	02-Oct-17
Monitoring Well	Units	Baseline	Detection										
BRF-107	ft-MSL	810.97	811.65	811.85	814.52	811.96	812.20	812.16	812.02	812.42	812.14	812.43	811.98
I	ft-MSL	866.23	870.38	870.95	870.85	871.71	871.19	871.40	870.96	871.58	867.81	871.04	869.87
J	ft-MSL	812.10	813.68	813.92	813.18	814.08	814.03	814.34	814.35	814.82	814.33	814.39	813.35
MW-3H/P-3	ft-MSL	819.97	820.21	820.60	820.50	820.76	820.74	820.81	821.12	821.17	821.22	821.25	821.10

Surface Water Elevation Collection Date		02-Nov-16	09-Jan-17	31-Jan-17	28-Feb-17	27-Mar-17	17-Apr-17	15-May-17	12-Jun-17	06-Jul-17	31-Jul-17	11-Sep-17	02-Oct-17
Clinch River	Units	Baseline	Detection										
Staff Gauge - Morning	ft-MSL	793.88	793.97	793.89	791.36	794.18	793.60	794.09	794.15	794.25	794.13	793.54	NM
Staff Gauge - Afternoon	ft-MSL	793.91	794.06	793.78	790.73	794.07	793.53	794.01	793.93	794.15	793.92	793.07	NM
Average Staff Gauge	ft-MSL	793.90	794.02	793.84	791.05	794.13	793.57	794.05	794.04	794.20	794.03	793.31	NM

Notes:
ft-MSL: feet above mean sea level
NM: Not Measured

TABLE 5
Hydraulic Conductivity Data Summary

Bull Run Fossil Plant
 Claxton, Tennessee

Well ID	Well Designation	Pumping Test Hydraulic Conductivity (cm/sec)
I	Background	4.80E-05
MW-3H/ P-3	Downgradient	1.20E-04
F45R	Overburden/Bedrock	5.80E-04
MWJ	Bedrock	1.13E-04
Geometric Mean of Hydraulic Conductivity (cm/sec)		1.39E-04

Notes:

cm/sec - centimeters per second

NA - Not available

Sources for Hydrogeologic Evaluation Included in the Text:

*Part II Permit Application Hydrogeologic Site Investigation CCP
 Proposal Landfill. AECOM June 12, 2015*

*Hydrogeological Characterization Report (Draft) AECOM March
 2017*

Non-CCR monitoring wells used to calculate geometrical mean of hydraulic conductivity.