Environmental Investigation Plan
Watts Bar Fossil Plant

Revision 3

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

November 19, 2018

REVISION LOG

Revision	Description	Date
0	Issued for TDEC Review	November 15, 2016
1	Issued for TDEC Review	February 9, 2018
2	Addresses May 16, 2018 TDEC Review Comments and Issued for TDEC Review	July 6, 2018
3	Addresses Applicable Programmatic Revisions and Issued for TDEC Approval	November 19, 2018

ENVIRONMENTAL INVESTIGATION PLAN
WATTS BAR FOSSIL PLANT

TITLE AND APPROVAL PAGE

Title of Plan: Environmental Investigation Plan
Watts Bar Fossil Plant
Tennessee Valley Authority
Spring City, Tennessee

Prepared By: Tennessee Valley Authority

Effective Date: November 19, 2018

Revision 3

Bryan Wells
TVA Compliance Point of Contact

11/19/18
Date

TVA Technical Point of Contact

11/19/18
Date

Investigation Project Manager

11/19/18
Date

Rock J. Vitale Digitally signed by Rock J. Vitale
DN: cn=Rock J. Vitale, o, ou,
email=rvitale@envstd.com, c=US
Date: 2018.11.14 12:27:10 -05'00'

QA Oversight Manager

Date

Charles L. Head
TDEC Senior Advisor

Date

Robert Wilkinson
TDEC CCR Technical Manager

Date

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Abbreviations

APE	Areas of Potential Concern
BTV	Background Threshold Value
CARA	Corrective Action/Risk Assessment
CCR	Coal Combustion Residuals
CCR Rule	EPA Final Rule on Disposal of Coal Combustion Residuals from Electric Utilities
CFR	Code of Federal Regulations
CPT	Cone Penetration Test
DMP	Data Management Plan
DPT	Direct Push Technology
EAR	Environmental Assessment Report
EIP	Environmental Investigation Plan
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GPS	Global Positioning System
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
Order	Commissioner's Order OGC15-0177
PLM	Polarized Light Microscopy
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control

SAP	Sampling and Analysis Plan
SPP	Standard Programs and Processes
STPs	Shovel Test Pits
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Commissioner's Order OGC15-0177
TVA	Tennessee Valley Authority
USGS	United States Geological Survey
WBF	Watts Bar Fossil Plant

1.0 INTRODUCTION

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at Watts Bar Fossil Plant (WBF) on April 27, 2016, at which time TVA briefed TDEC on its Coal Combustion Residual (CCR) management plans at WBF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On June 14, 2016, TDEC issued a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 22, 2017, TDEC issued a second follow-up letter to TVA regarding the TDEC Order and EIP submittal dates. On November 15, 2016, TVA submitted WBF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

1.1 PURPOSE

The purpose of this EIP is to comply with Section VII.A.d. of the TDEC Order. This section requires TVA, upon receiving any request for additional information from TDEC, to develop an EIP for each site that, when implemented, will provide the information necessary to "fully identify the extent of soil, surface water, and ground water contamination by CCR." The responses and tentative schedule set forth in this EIP correspond to each individual task in TDEC's information request letters for WBF dated June 14, 2016 and June 22, 2017. The Environmental Assessment Report (EAR) will be submitted at a later date, following completion of the environmental investigation identified in the EIP. The EAR will provide "an analysis of the extent of soil, surface water, and ground water contamination by CCR at the site" and thus will provide the information, analyses, and/or evaluations responsive to TDEC's information requests and the TDEC Order.

1.2 MULTI-SITE ORDER TIMELINE

By way of background, a summary of events related to the TDEC Order is provided below:

- TDEC issued Commissioner's Order OGC15-0177 to TVA on August 6, 2015.
- On September 22, 2015, TDEC and TVA met to discuss the Order. During the meeting, TDEC submitted a list of questions to be addressed at each Investigation Conference.

- On April 15, 2016, TVA provided TDEC with an Investigation Conference Data Transmittal for WBF. This transmittal included approximately 19 historic and technical documents in electronic and hard copy form, as well as a file directory. TVA also has made the information available to attorneys for environmental advocacy groups who have requested access.

- TVA held the Investigation Conference at WBF on April 27, 2016. The Investigation Conference included a site reconnaissance and presentation that addressed the questions provided by TDEC on September 22, 2015.

- On June 14, 2016, TDEC provided an Investigation Conference Response Letter for WBF. The letter requested additional data, and the EIP. The list of questions and environmental investigative tasks to be addressed in the EIP is included in the letter. The deadline for submittal of the WBF EIP was set for November 15, 2016.

- On November 15, 2016, TVA submitted Revision 0 of the EIP to TDEC.

- On June 22, 2017, TDEC provided a follow-up letter documenting conference dates and EIP delivery dates. While the letter stated TDEC would provide additional comments on the WBF EIP Revision 0, no additional comments were provided. The deadline for the submittal of the revised WBF EIP was set for February 9, 2018.

- On February 9, 2018, TVA submitted Revision 1 of the EIP to TDEC.

- On May 16, 2018, TDEC provided a follow-up letter documenting comments on the WBF EIP Revision 1. The deadline for the submittal of the revised WBF EIP was set for July 6, 2018.

- On July 6, 2018, TVA submitted Rev 2 of the EIP to TDEC.

- TDEC hosted a meeting with interested parties on August 23, 2018, to discuss the proposed EIP before the public comment period stated in the Order.

- TVA provided public notice of the EIP published in a manner specified by TDEC and allowed a minimum of 30 days for public comment. The public comment period for EIP Rev 2 began on September 5, 2018, and concluded on October 19, 2018.

- TDEC and TVA hosted a public comment meeting in Sweetwater, Tennessee on September 20, 2018.

- TVA provided responses to public comments to TDEC on October 29, 2018.

- On November 8, 2018 TDEC and TVA reviewed proposed changes to be incorporated into EIP Rev 3.

1.3 EIP IMPLEMENTATION (INVESTIGATION)

A summary of the proposed EIP process is provided below and is included in the proposed EIP schedule in Appendix A:

- TDEC will review and approve WBF EIP Rev 3, or will provide TVA a list of comments to be addressed in a subsequent future EIP revision.

- TVA will address additional comments from TDEC as they become available, submitting additional revisions and repeating the process until TDEC approves the EIP and schedule. For the purpose of the schedule provided in Appendix A, a second set of comments from TDEC, prior to approval, have been incorporated into the implementation timeline. If TDEC does not submit additional comments, the schedule will be updated accordingly.

- TVA will work with TDEC to revise the EIP and schedule accordingly.

- TVA will implement the EIP by conducting the investigation in accordance with the approved plan and schedule.

- Within 60 days of completion of EIP activities, TVA will submit an EAR to TDEC. The EAR is described in Section 5.0.

Refer to Appendix A for additional details regarding the implementation schedule.

1.4 WBF BACKGROUND INFORMATION

1.4.1 Site History

TVA constructed WBF from 1940 to 1945, with the first two units commencing operations in 1942. The third unit became operational in 1943, while the fourth (and final) unit became operational in 1945 (TVA 1949). As part of the adjacent Watts Bar Dam construction, railroad corridors were elevated above the existing ground. Using the railroad embankments as perimeter dikes, the initial CCR disposal area (Slag Disposal Area) was operated for the disposal of wet-sluiced bottom ash, fly ash, and boiler slag (slag) materials. WBF operated from the early 1940's until 1957, at which point the plant was idled. WBF resumed power generation in 1970, and operated until 1982 when all four units were retired.

As part of the preparations to resume power generation, the southern clay dike of the Slag Disposal Area was raised in 1969. In 1974, a new clay perimeter dike was constructed south of the Slag Disposal Area, forming the Ash Pond. The two CCR disposal units were operated until WBF was retired in 1982.

A Chemical Pond was also constructed in 1978, however, operation records indicate the area was not used for CCR disposal. As outlined in this EIP (Appendix F Exploratory Drilling SAP), the structural fill placed during capping of the Chemical Pond will be investigated.

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 Chemical Pond were closed under TDEC Permit TNR190741 with soil caps. 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 around the Slag Disposal Area.

TVA demolished the main powerhouse of WBF in 2012, and closed the Ash Pond in 2015 under TDEC Permit TN0005461. As part of the closure, CCR materials were excavated from the southern portion of the Ash Pond (Figure 1) and consolidated/capped in the northern portion of the Ash Pond using a geosynthetic and soil cap (CDM Smith 2015).

Figure 1. Excavation and Consolidation of CCR during Pond Closure (CDM Smith 2015)

The southern portion of the former Ash Pond was converted into an NPDES-permitted stormwater pond (TNR058427) for the site. A clay divider dike was constructed between the capped portion of the Ash Pond and the stormwater pond (Figure 2) (CDM Smith 2015).

Figure 2. Stormwater Pond and Ash Pond Divider Dike (CDM Smith 2015)

As of October 19, 2015 (the effective date of the Environmental Protection Agency (EPA) Final Rule on Disposal of Coal Combustion Residuals from Electric Utilities – EPA 2015a (CCR Rule)), the Ash Pond and the Slag Disposal Area were not receiving CCRs, were not impounding water, and had been previously closed. As a result, these units are not subject to the CCR Rule.

1.4.2 Archaeological Sites

Within the WBF Study Area, TVA has identified three previously recorded archaeological sites through multiple permitting, investigation, and design efforts. Based on available information, the archaeological sites – 40RH001, 40RH005, and 40RH006 – cover a large portion of the WBF Study Area. As such, proposed activities disturbing native soils within the archaeological sites will likely result in, at a minimum, additional permitting delays associated with National Environmental Policy Act (NEPA) reviews. Permitting activities may include archaeological mapping reviews and shovel test pits (STPs) to identify areas of potential effect (APE), such as those shown on Figure 3 (TVA 2014). Field activities associated with the Investigation may need to be reduced, or relocated, if they are proposed to disturb native soils in the archaeological sites. As part of the Investigation, these areas will be further delineated on mapping in the EAR, similar to those shown on Figure 3.

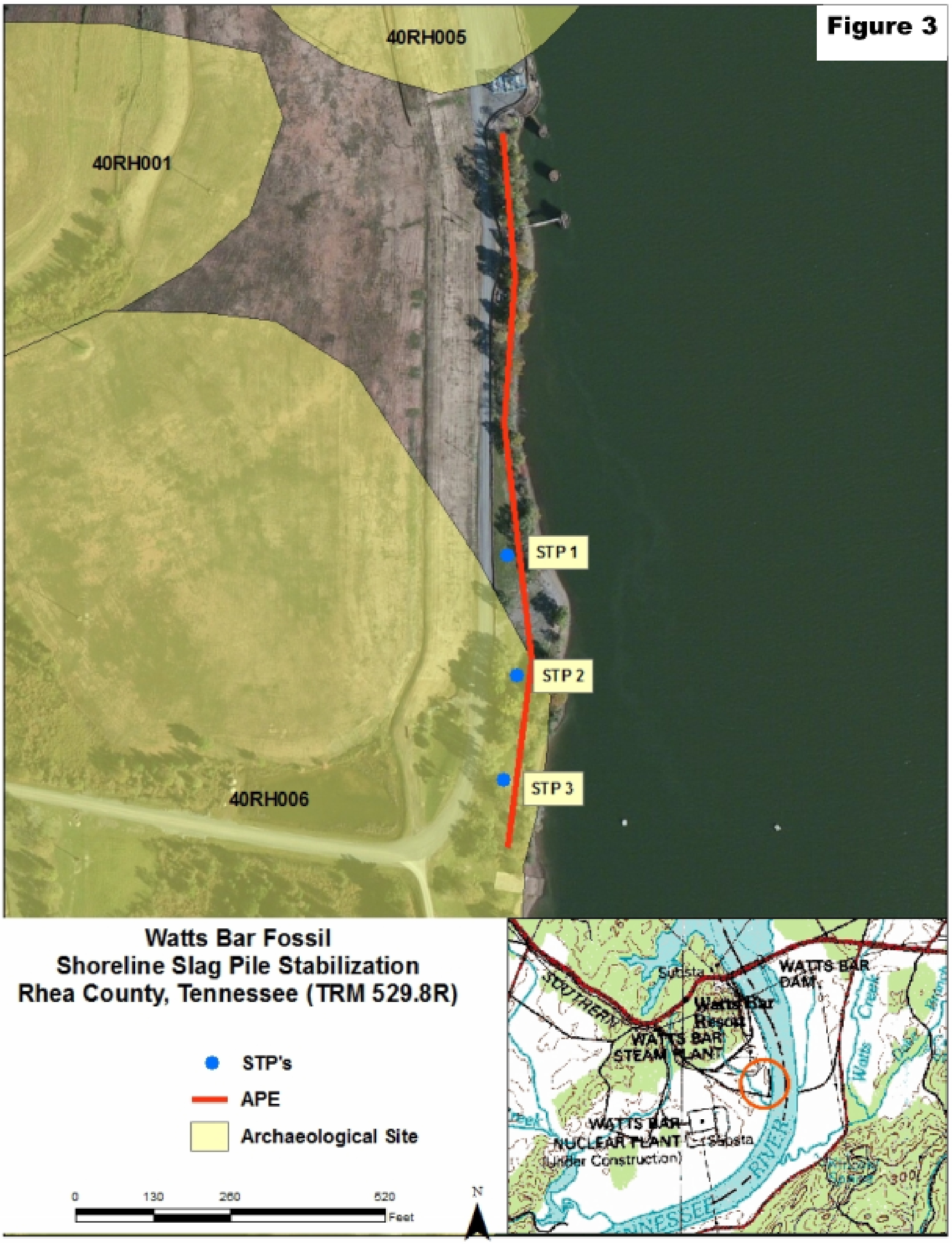


Figure 3. Archaeological Sites (TVA 2014)

2.0 APPROACH

The following describes TVA's overall approach for planning and conducting the EIP.

2.1 EIP DEVELOPMENT AND STRUCTURE

Responses to each TDEC information request will be developed by:

1. **Stating clear objectives and goals of the EIP Response.**
   This will be accomplished by re-stating each original information request from TDEC and identifying specific objectives for developing the information necessary to satisfy that request.
2. **Focusing on the objectives and desired outcomes of the EIP.**
   Each response will identify specific deliverables or information to respond to the request.
3. **Leveraging existing and ongoing data collection efforts, where available.** TVA has completed many studies at WBF and has ongoing programs for TDEC permitting requirements that can be used to help address TDEC's information requests. A summary of work already completed, ongoing or planned, and how this information can support the EIP activities is included in the response to the appropriate tasks.
4. **Conducting on-site and/or off-site studies, activities, plans and analyses in support of the EIP tasks as needed.**
   TVA will work with TDEC to develop and execute Sampling and Analysis Plans (SAPs) to develop new data where needed to respond to TDEC's information requests. The SAPs will provide detailed plans for conducting those studies to obtain new data and will describe how it will be used to respond to specific information requests. The SAPs will be structured as independent documents that guide the work of the SAP execution teams. The SAPs will document and communicate:

   - Background information
   - Objectives
   - Health and safety program
   - Plant-specific field investigation approaches and procedures
   - Data analysis approaches and procedures
   - Reporting approaches and deliverables
   - Quality assurance/quality control (QA/QC) objectives and program

- Schedules
- Assumptions and limitations

A summary of each SAP will be provided in the response to corresponding information requests. The SAPs are included as appendices to the EIP; therefore, a list of proposed SAPs can be found in the Table of Contents. Field implementation may result in minor modifications of approaches. If this occurs, changes from the procedures specified in SAPs will be communicated to TDEC and documented in the EAR. TVA will notify TDEC of problems that impede the successful completion of the field activities described in the EIP and SAPs.

Where appropriate, a phased approach will be used to execute the EIP and SAP activities. For this approach, existing and ongoing studies will be used to develop additional plans; a broad study or test will then be used to pinpoint the location of a targeted study or test when needed.

5. **Revising the EIP to address TDEC and public comments.**
TDEC and public comments will be addressed in each EIP revision, as appropriate; however, to maintain clarity, these comments will not be listed in the EIP document. Regulatory correspondence is provided as Appendix B. Public comments will be included in Appendix V. TVA will work with TDEC and revise the EIP until a final version is approved.

Section 3, TDEC Site Specific Environmental Investigation Requests, addresses eight site-specific questions from TDEC's Investigation Conference Response Letter. TDEC's information requests are shown in italics. The numbering sequence and format for the requested information provided in TDEC's Letter is provided in its original form. Section 4, TDEC General Guidelines for EIP, was formatted to correlate with TDEC's General Guidelines, which correspond to 36 general information requests. Similar to Section 3, these TDEC information requests are shown in italics. This format will enhance clarity and cross-referencing between the two documents.

During the Investigation and EAR process, TVA will provide monthly progress reports to TDEC. The progress reports will include schedule updates, percent completion on various tasks, and tasks that have been completed. The periodic submittal of schedule and status updates to TDEC is intended to help communication between TVA and TDEC throughout the investigation.

2.2 PROPOSED SCHEDULE

A proposed EIP schedule is provided in Appendix A that assumes work will begin when TDEC approves the EIP, which will occur after the public comment and resolution period. The schedule numbering matches each information request in the sequence presented in TDEC's Investigation Conference Response Letter and provides the following:

- A timetable for the investigation and EAR submittal
- An outline of the activities required to respond to each information request
- Planned start and finish dates for each activity

Since, in most cases, TVA will use information from ongoing and planned studies for other programs to help respond to TDEC's requests, the EIP schedule incorporates TVA's milestone dates for those studies. Consequently, should postponement of a key milestone date occur for such a study that also is on the EIP critical path, it will impact EIP and EAR schedules. Should that occur, TVA may request a time extension for impacted deadlines. Requests for a time extension will include supporting information to demonstrate appropriate cause, if applicable. Any plans for construction will be subject to the completion of all necessary NEPA reviews.

2.3 QUALITY ASSURANCE/QUALITY CONTROL

The WBF environmental investigation Quality Assurance Project Plan (WBF QAPP) in Appendix C has been developed to ensure that the WBF investigation objectives are met by TVA and its contractors through the generation of fully documented, high-quality, reliable investigative/analytical data. The WBF QAPP describes Quality Assurance (QA) procedures and Quality Control (QC) measures to be applied to investigation activities. The WBF QAPP governs the investigation-specific SAPs along with TVA Technical Instructions.

The WBF QAPP describes the QA implementation for the investigation and identifies the obligations of the various entities responsible for generating environmental data. The WBF QAPP describes the generation and use of environmental data associated with the investigation and is applicable to sampling and monitoring programs associated with the project.

The WBF QAPP establishes an overall environmental QA framework for the investigation and provides quantitative quality objectives for analytical data generated under the investigation. Requirements associated with various analyses; data generation, data reduction, and data management; and results reporting are stipulated therein.

The WBF QAPP addresses the following items:

- Project organizational structure, roles, and responsibilities
- QA objectives
- Training requirements
- Field and laboratory documentation requirements
- Sample collection, handling, and preservation
- Chain-of-Custody procedures
- Field and laboratory instrumentation and equipment calibration and maintenance
- Preventive maintenance procedures and schedules
- Laboratory procedures
- Analytical methods requirements
- Sample analysis, data reduction, validation, and reporting
- QC sample types and frequency
- QA performance and system audits
- Data assessment procedures, including processing, interpretation, and presentation
- Corrective actions
- QA reports to management

Additional investigation-specific QC requirements are presented in the associated SAPs. The WBF QAPP attachments present requirements and quantitative objectives for analytical data for each investigation. Analytical data intended for use under the WBF investigation will be managed in a database in accordance with the Data Management Plan for the TVA Multi-Site Order.

2.4 DATA MANAGEMENT PLAN

In order to address the logistics and technical challenges of managing analytical data generated to address the requirements set forth in the TDEC Order, TVA has developed an Environmental Investigation Data Management Plan (DMP). On March 8, 2018, TVA submitted a revised DMP (Appendix D) which responded to comments provided by TDEC in an email dated February 7. 2018. The DMP has been developed to provide structure to support TVA and Field Sampling Personnel in the pre-planning, analysis, and reporting activities identified as part of the TDEC Order.

The DMP is intended for use on TVA's seven Tennessee facilities associated with the TDEC Order, and includes the following items:

- Data Management Team structure
- Data Management Process and requirements
- EQuIS Quality and Data Management System
- System Management and Administration

3.0 TDEC SITE SPECIFIC ENVIRONMENTAL INVESTIGATION REQUESTS

TDEC requested that TVA provide responses to the following information requests presented below in the numbering sequence format of the Investigation Conference Response Letter. The information requests from TDEC are printed in italics to distinguish them from TVA's responses.

3.1 GENERAL INFORMATION

3.1.1 TDEC Site Information Request No. 1

TVA shall provide additional information regarding the potentiometric surface (ground water flow rate and direction) under and near the site's waste boundaries. The potentiometric surfaces included in the groundwater monitoring reports are limited in coverage. Coverage includes a portion of the Ash Pond Area and does not take include the Slag Disposal Area (Historic Fly Ash Pond). TVA shall include in its TVA Watts Bar Environmental Investigation Plan (EIP) the information that it used to determine the location of additional monitoring wells around all waste boundaries on site. TVA shall identify the location and number of borings/ground water monitoring wells that will be installed to better characterization and monitoring the Watts Bar site in the EIP.

TVA Response

TVA has other ongoing activities underway at WBF for National Pollutant Discharge Elimination System (NPDES) permit closure requirements that included the installation of monitoring wells and collection of groundwater levels and samples for the Ash Pond. The information provided by that program will be used to respond to TDEC's Site Information Requests related to the identification of background and downgradient groundwater monitoring locations for the Ash Pond unit. The monitoring well network currently in place for the Ash Pond is shown on Exhibit 2 (Appendix E). The Ash Pond network includes background monitoring well MW-1, potential background monitoring well WBF-100, and downgradient monitoring wells MW-2 and MW-3. Monitoring wells are screened within the unconsolidated materials above bedrock. TVA will incorporate pertinent data from that investigation that meets the QA/QC requirements of the WBF QAPP into the identification of proposed monitoring well locations.

As part of TVA's ongoing activities at WBF, one new potential background monitoring well (WBF-100) was installed in the unconsolidated materials above bedrock. Monitoring well WBF-100 was installed up-gradient of the unit in a similar geological setting as the Ash Pond well network.

TVA is in the process of obtaining and reviewing data to determine if existing wells may be suitable for use as background monitoring locations for the groundwater monitoring network. TVA will continue to collect groundwater elevation data and groundwater quality samples from existing monitoring wells and review the analytical results as a part of NPDES permit closure requirements. If TVA determines that the existing wells are suitable for use in the EIP monitoring well network, then TVA will propose them to TDEC for concurrence that they are appropriate background groundwater monitoring locations. TVA will communicate with TDEC on the rationale, and supporting data and information for selecting each background location prior to finalizing the monitoring well networks.

TVA has developed an approach to define the hydrogeological characterization around the Ash Pond and Slag Disposal Area. This approach is an iterative investigation and is a cooperative effort with TDEC. TVA would prefer to complete the initial phase of the investigation and jointly review the results with TDEC to identify data gaps. If data gaps exist, TVA will fill those gaps with additional investigation in collaboration with TDEC.

In addition to the investigations discussed above, TVA plans to install six monitoring wells under the supervision of a Tennessee licensed Professional Geologist at preliminarily identified locations in the saturated sand and gravel layer above bedrock within 150 meters of the boundary of the Ash Pond and Slag Disposal Area as part of this investigation. The monitoring well borings will also be logged by a Tennessee licensed Professional Geologist. At WBF, the overburden generally consists of alluvial deposits of silt and clay underlain by a layer of sand and gravel. The alluvial deposits are underlain by weathered bedrock. Based on previous investigation activities conducted at WBF for the Ash Pond (TVA 2013, Stantec 2017), groundwater may be present in the sand and gravel layer above bedrock but is less likely to be present in the overlying silt and clay matrix. West of the Ash Pond, this sand and gravel layer may be thin or absent and, therefore, may make it difficult to locate suitable monitoring wells in the overburden in this area. Similar subsurface conditions were observed near the Slag Disposal Area based on previous investigations (TVA 1949, Law Environmental 1989, Law Engineering 1991, TVA 2013). The sand and gravel layer is present east/northeast of the Slag Disposal Area near the river and generally absent west of the Slag Disposal Area near the Plant buildings. As a result, sand and gravel may not be present in the overburden west of the Ash Pond and Slag Disposal Area and installation of useful monitoring wells in the sand and gravel may not be possible. Additionally, the Slag Disposal Area may contain beneficially used CCR material that extends east near the western Chickamauga Lake/Tennessee River shoreline. If the CCR material extends near the shoreline, then useful monitoring wells in the overburden may not be possible. As discussed in Section 4.4.6 and the Exploratory Drilling SAP (Appendix F), additional soil borings are proposed to investigate subsurface conditions on the eastern edge of the Slag Disposal Area.

The locations of the proposed soil borings and monitoring wells are constrained by documented archaeological sites near the eastern portion of WBF as discussed in Section 1.4.2. Data collected from the soil boring investigation will be used to evaluate appropriate and accessible downgradient well locations.

One background well (WBF-102) and one downgradient well (WBF-101) are proposed near the Ash Pond to supplement the current monitoring well network. One background well (WBF-103) and three downgradient wells (WBF-104, WBF-105 and WBF-106) are proposed near the Slag Disposal Area. Exhibit 3 (Appendix E) shows the locations of the proposed wells.

The proposed background monitoring well location (WBF-102) for the Ash Pond was selected in an up-gradient location based on groundwater elevation data showing groundwater flow to the east/southeast (TVA 2015) and lithologic information regarding the presence of the sand and gravel layer. The downgradient location (WBF-101) was selected to provide a downgradient sampling location based on groundwater flow to the east/southeast and lithologic information regarding the presence of the sand and gravel layer.

The proposed background monitoring well location (WBF-103) for the Slag Disposal Area was selected in a potential up-gradient location based on current groundwater elevation data from the Ash Pond monitoring well network and ground surface topography showing groundwater flow and general topographic slope to the east/southeast. The three downgradient well locations (WBF-104, WBF-105 and WBF-106) were selected to provide downgradient sampling locations based on groundwater flow to the east/southeast and lithologic information regarding the presence of the sand and gravel layer.

Additional details regarding the installation of these wells is provided in the Hydrogeological Investigation SAP (Appendix G).

The SAP includes descriptions of drilling methods and soil logging procedures necessary to achieve the scope of the exploration and that will comply with local, state, and federal standards as well as the requirements within the TDEC EIP request letter. The sampling plan also includes an implementation schedule, which outlines when the monitoring wells will be constructed and developed to provide representative groundwater samples. The results of the hydrogeological characterization will be provided in the EAR.

The new proposed monitoring wells will be used to describe subsurface lithology and collect groundwater levels and samples from the alluvial sand and gravel. Groundwater samples will be analyzed for the CCR constituents listed in 40 CFR Part 257, Appendices III and IV, along with additional parameters required by the state groundwater monitoring program (copper, nickel, silver, vanadium, and zinc) to evaluate groundwater chemistry. These constituents will be hereafter referred to as “CCR Parameters”.

In addition, groundwater samples will be analyzed for major cations/anions and total alkalinity. Sampling procedures and parameters are provided in the Groundwater Investigation SAP provided in Appendix H. Piper diagrams will be used to classify groundwater samples according to their major ionic composition. Groundwater sample results from background and downgradient monitoring wells will be included in the evaluation. Additional Piper diagram comparisons of individual CCR units or geological formations may be included based on the results of the hydrogeological investigation.

If, after completion of the above referenced investigations and others included in this EIP, data gaps exist, then TVA, in communication with TDEC, will perform additional investigations to fill those data gaps. The results of the investigations will be reported in the EAR.

The selection of background and downgradient monitoring wells proposed in this EIP will be finalized after monitoring bimonthly for one year (six sampling events) to evaluate if the wells are appropriate network monitoring wells. TVA will provide this evaluation, including updated groundwater contour maps showing current groundwater flow conditions, to TDEC for input and concurrence prior to finalizing the monitoring well networks for each CCR unit.

If alternative well locations are required, then the data collected as part of this investigation will be reviewed to propose appropriate locations or well screen interval depths. The proposed well locations and rationale for construction details will be provided to TDEC for review and comment prior to installation.

3.1.2 TDEC Site Information Request No. 2

The boring logs presented for the 3 Monitoring Wells do not match. Please clarify what the well logs actually represent.

TVA Response

The boring logs for MW-1, MW-2 and MW-3 included in the Investigation Conference presentation are associated with the current monitoring wells installed at the Ash Pond in 2014. The well construction diagrams included in the presentation for B-1/MW-1 and B-3/MW-3 were erroneously included in the presentation and are associated with former temporary observation wells installed in 2011-2012. Temporary observation wells B-1/MW-1 and B-3/MW-3 could not be located during monitoring well inspection activities and appear to have been closed. These former wells appear to have been located near the current downgradient wells (MW-1 and MW-3).

The well locations are included in Exhibit 4 (Appendix E). Well construction details for MW-1, MW-2 and MW-3 installed in 2014 are included in Appendix I.

3.1.3 TDEC Site Information Request No. 3

TVA shall organize information from all borings/ground water monitoring wells to provide site characterization to support current ground water monitoring program. The inventory of this information shall be included in the EIP. All data gathered from the installation borings/ground water monitoring wells shall be included in the Environmental Assessment Report (EAR) for the site.

TVA Response

TVA has compiled current and available (at the time of the submittal of this EIP) groundwater sampling results into a database, including the following categories of parameters:

- Chemical
- Physical
- Groundwater elevation

The database includes previously installed and closed groundwater monitoring wells at the site. This information was provided as part of the Investigation Conference and is also provided in Appendix J in tabular form. TVA may use these historical data for qualitative purposes, but will use such data only after evaluating it in accordance with the QAPP. In addition, a figure showing existing and closed monitoring wells that correspond to the tables is included in Exhibit 4 (Appendix E). In addition to the analytical data, information on the construction and locations of groundwater monitoring wells (newly installed or closed) will be researched, collected, reviewed, and compiled for the EAR.

Data collected during the hydrogeological investigation activities described in Section 3.1.1 will be provided to TDEC in the EAR.

3.1.4 TDEC Site Information Request No. 4

TVA shall include in the EIP a schedule for the installation of additional borings/groundwater monitoring wells as well as a map identifying the boring/ground water monitoring locations.

TVA Response

A map showing proposed boring/monitoring well locations to be used as part of the hydrogeological investigation activities described in Section 3.1.1 is included in Exhibit 3 (Appendix E). A tentative schedule for implementation of this activity is provided in Appendix A, as well as in the Hydrogeological Investigation SAP.

3.1.5 TDEC Site Information Request No. 5

Existing or additional site characterization shall include a discussion of fluctuations in ground water elevations that may be connected to Chickamauga Lake levels, seasonal variations, or other factors.

TVA Response

TVA will review and evaluate existing and new data for groundwater and Chickamauga Lake/Tennessee River elevations, including groundwater elevation data collected during implementation of the hydrogeological investigation and data for Chickamauga Lake/Tennessee River elevations collected concurrently with measurement of groundwater elevations. The investigation will include measurement of water levels at the surface water gauging station currently installed at the tailrace of Watts Bar Dam in Chickamauga Lake/Tennessee River. Groundwater level measurements will be collected from existing and new monitoring wells and piezometers. The measuring schedule and methods for measuring water levels are included in the Groundwater Investigation SAP (Appendix H). TVA will review the compiled information and evaluate the correlation between groundwater and surface water elevations, seasonal variations, or other causes. The information and evaluation will be reported in the EAR.

3.1.6 TDEC Site Information Request No. 6

Existing or additional site characterization shall estimate the amount of CCR material that is below the highest recorded ground water potentiometric surface.

TVA Response

TVA will use existing data and the information obtained from the hydrogeological characterization discussed in Section 3.1.1 to develop a response to this information request. Groundwater level measurements will be collected from existing and new monitoring wells and piezometers for a 1-year monitoring period to develop groundwater contour maps.

TVA will use these maps to evaluate the location of CCR material in relation to groundwater. If applicable, TVA will provide a three-dimensional model of the Ash Pond and Slag Disposal Area being developed in response to the information requested in Section 4.1.5 to estimate CCR material volumes below the highest recorded groundwater surface.

TVA will summarize this information and provide supporting documentation in the EAR.

3.1.7 TDEC Site Information Request No. 7

Characterization of the site's hydrogeology is needed better evaluate Red-Water seeps. The seeps remained active after the closure of the Slag Disposal Area (Historic Fly Ash Pond). This suggests that the hydraulic driver for the seeps may not be related to infiltration of storm water through the closure cap and into the waste mass.

TVA Response

The hydrogeology of the WBF site will be characterized as discussed in Section 3.1.1. That characterization will include an evaluation of the potential for seeps to develop. Information on the overall hydrogeology of the Slag Disposal Area in relation to the potential for seeps to develop will be provided in the EAR.

In addition, a surface water drainage improvement project was completed in 2015. Improvements included the mitigation of three non-flowing seepage areas between the Slag Disposal Area and the Tennessee River, improvements to reduce infiltration through the cap, and drainage improvements to reduce ponded water around the perimeter of the Slag Disposal Area. The seepage areas were reportedly not flowing during or after the 2015 mitigation was completed.

3.1.8 TDEC Site Information Request No. 8

The ground water flow regime and soil pore pressures need to be better understood as potential driving forces for documented seeps. Groundwater recharge in the closed Slag Disposal Area needs to be better understood. Areas of investigation are as follows:

a. *Possible influences in site hydrology under and near the site's waste boundary based on its proximity to Watts Bar Dam.*

b. *Natural occurring springs that may have existed in the area prior to development of the disposal areas.*

c. *Dewatering measures and the effectiveness of the measures prior to closure of the Slag Disposal Area.*

d. *How well the closure cap is functioning; is the cap significantly reducing surface water infiltration into the waste mass.*

e. *TVA shall provide representative soil and water sample results for the constituents (Appendices III and IV of the Federal CCR rule) found in proximity to the Red-Water seeps.*

TVA Response

This Information Request is similar to those discussed in 3.1.1, 3.1.5, 3.1.6, and 3.1.7.

a. Refer to Sections 3.1.1 and 3.1.7 for a discussion of the proposed approach to understanding the hydrogeology of the WBF site.

b. Historically, no springs have been located on site and are not currently anticipated to be encountered. Refer to 4.3.5 for a discussion on if springs are observed during the investigation.

c. Grading improvements were made during the closure to increase drainage from the Slag Disposal Area. Refer to Sections 3.1.1 and 3.1.6 for a discussion of the proposed approach to understanding the groundwater of the WBF site.

d. Refer to Sections 3.1.1, 3.1.5, and 3.1.6 for a discussion of the proposed approach to understanding the groundwater of the WBF site and understanding the effects of the recent improvements to the cap and surface water drainage in the vicinity of the Slag Disposal Area.

e. Although there are currently no active seeps, a Seep SAP, including an investigation for active seeps, has been developed and will be implemented per Section 4.5.5.

4.0 TDEC GENERAL GUIDELINES FOR EIP

4.1 A. SITE INFORMATION

TVA shall provide information about CCR storage and disposal sites at the TVA Fossil Plant. TDEC expects TVA to include how it will provide the following information about each TVA Fossil Plant site as a part of its EIP:

4.1.1 A.1 TDEC Site Information Request No. 1

All information about the natural chemistry of the soils in the area of the TVA Fossil Plant. This includes the naturally occurring levels of metals and other CCR constituents present in the soil. TVA shall propose, in the EIP, the collection of soil samples within a one-mile radius of the specific fossil plant to supplement the information gained from local soil studies, reports or soil profiles. Of particular interest are all constituents listed in the federal CCR regulations Appendix 3 Detection Monitoring and Appendix 4 Assessment Monitoring found on page 21500 of the Friday, April 17, 2015 Federal Register (Appendices 3 and 4 CCR constituents)

TVA shall report the levels of naturally occurring CCR constituents as reported in existing documents and the results of soil samples collected per a TDEC Approved EIS in the (EAR) for that site. TVA shall submit maps that identify the location of soil samples in proximity to the TVA Fossil Plant when the EAR is submitted.

TVA Response

TDEC has requested the characterization of the local soils in a one-mile radius of WBF to evaluate the background levels of constituents of concern, previously defined as CCR Parameters.

TVA has prepared a Background Soil SAP (Appendix K) to characterize background soils on TVA property in the vicinity of the TVA WBF Plant. The approach in characterizing the background soils is to identify locations where naturally occurring, in-situ, native soils are present, yet unaffected by CCR material. Soil samples will be analyzed for the CCR Parameters to determine the naturally occurring constituent levels. The surficial soil at each location will additionally be analyzed for percent ash to determine the presence or absence of windblown CCR.

This Background Soil SAP establishes the procedures necessary to conduct investigation activities associated with the sampling and analysis of background soils. Exhibit 5 (Appendix E) depicts the locations of twelve proposed background soil sampling locations.

Exhibit 6 (Appendix E) shows the locations of the proposed background soil sampling locations overlain by a United States Department of Agriculture soil map, which depicts surficial soil types. The locations were selected based on access, current hydrogeologic knowledge, and the sample location criteria previously set forth by TDEC.

Proposed sampling locations were evaluated for past placement of CCR material on those areas and to our knowledge, CCR material has not been placed in these areas. Areas known or expected to be in contact with CCR constituents during rain events, flood events, or currently being influenced by downgradient of groundwater flow from WBF were additionally excluded.

Prior to mobilization for sample collection, the twelve sampling locations will be verified using the global positioning system (GPS). If necessary, sampling points may be slightly adjusted to the closest possible location that can be safely accessed. If a proposed boring location is discovered to have accessibility restrictions related to agricultural, cultural, biological, or other similar limiting factors, then a replacement boring will be proposed at a location that will meet the study's goals with approval from TDEC

An initial grab sample representing the surficial soils (i.e., top six inches) will be collected by hand auger and submitted for laboratory analysis of percent ash by polarized light microscopy (PLM) in addition to CCR Parameters. Borings will then be advanced using a direct push technology (DPT) drill rig equipped with five-foot, 3.25 inch outside diameter probe rods, or equivalent technology. In collecting soil samples, borings will be extended until refusal. Grab samples will be collected from the mid-point of each five-feet boring interval. The mid-point for grab samples will be the mid-point based on recovery.

If soils are expected to be hard to recover during core retrieval, core catchers will be used to prevent loss of sample material. Composite samples are not proposed.

If a change in lithology, such as a change in residuum, colluvium, alluvium, etc., occurs within a core interval, separate grab samples will be collected from the mid-point of both lithologies in the core. Samples collected by DPT will be sent to the laboratory to be analyzed for CCR Parameters. A complete description of the sampling methods and protocols is provided in the Background Soil SAP (Appendix K).

In addition to the soil data that will be collected from the proposed sampling locations, TVA will review the background soil data previously collected during the 2015 installation of background monitoring well WBF-100, and TVA will collect soil samples through the well screen interval at locations of proposed background monitoring wells. Background soil samples collected as part of these efforts will be reviewed in accordance with the QAPP and analytical results will be compiled in the EAR if the quality of the data is acceptable.

Once sampling has been completed and analytical results have been received, the analytical data for background soil will be evaluated and addressed in the EAR. In doing so TVA proposes to utilize Background Threshold Values (BTVs) as the method to statistically evaluate and quantify site specific background concentrations for CCR Parameters. BTVs will be calculated for each soil horizon and/or geologic unit using a statistical population consisting of a minimum of ten soil samples from each unit. If a particular horizon or geologic unit is under represented in the statistical population, additional borings will be installed.

BTVs are calculated using sampling data collected from unimpacted site-specific reference areas and represent an upper threshold of background concentration(s) expected to exist naturally in an environment similar to that of WBF.

The choice of BTVs (Upper Confidence Limit, Upper Threshold Limit, Upper Prediction Limits) will be determined based on characteristics of the data (e.g. sample size, statistical distribution). All statistical analyses will be conducted utilizing the latest version of EPA ProUCL software (currently version 5.1.0) and consistent with ProUCL Technical Guidance Document (EPA 2015b).

4.1.2 A.2 TDEC Site Information Request No. 2

TVA shall propose a sampling plan to determine the leachability of CCR constituents from CCR material in surface Impoundments, landfills, and non-registered sites at each TVA site. The plan should include sampling points at each disposal area and at different depths in each disposal area. TVA shall describe sample collection methods, sample transport, analytical methodology and the qualifications of the laboratory selected to perform the analyses.

TVA Response

As requested, the proposed leachability study will involve the implementation of a CCR Material Characteristics SAP (Appendix L), and an evaluation of CCR Parameters from pore water samples and CCR material samples.

The CCR Material Characteristics SAP will help determine the leachability of CCR constituents from material in a CCR unit. The approach will include the collection and analysis of both pore water and CCR material from the consolidated and capped area of the former Ash Pond and the Slag Disposal Area.

Five temporary wells will be installed at locations proposed in Exhibit 11 (Appendix E), then filtered and unfiltered pore water samples will be collected from the phreatic zone at the base of a unit to obtain in-situ leaching information for the material. The pore water analyses will provide real-time measurements of constituents that have leached from the CCR material into the unit.

Samples of CCR material will be collected from the soil borings advanced prior to installing the temporary wells from both the saturated and unsaturated zones in the CCR unit. These samples will be analyzed for the CCR Parameters, after application of the most applicable method based on emerging science in the industry, which could include the Synthetic Precipitation Leaching Procedure method. Total organic carbon, iron, and manganese have been added to the CCR Parameters list as specific parameters of interest under this SAP.

The CCR Material Characteristics SAP will provide procedures necessary to conduct the sampling of pore water and CCR material in the CCR units, and methods to analyze them for the CCR Parameters list. Proposed activities will include the following major tasks:

- Verify proposed sampling locations using GPS
- Develop temporary wells in the ash disposal area (drilling and installation procedures of the temporary wells are outlined in the Exploratory Drilling SAP – Appendix F)
- Collect CCR material samples during installation of the temporary wells
- Collect pore water samples from the temporary wells
- Conduct laboratory testing and analysis

Sample collection methods, sample transport, and analytical methodology will be addressed in the CCR Material Characteristics SAP and the WBF QAPP. Laboratory qualifications will be addressed in the WBF QAPP. Once sampling is complete and analytical results have been received, the CCR material leaching results will be compared to the pore water data and evaluated for trends. Results, conclusions, and recommendations will be provided in the EAR.

4.1.3 A.3 TDEC Site Information Request No. 3

Information about the area surrounding the TVA Fossil Plant location before the TVA Fossil Plant was constructed. TVA shall provide in its EIP, geologic maps before the impoundment was created; if an impoundment is adjacent to the TVA Fossil Plant site. TVA discuss topographic maps from the pre-embayment time period and how these maps will be used to identify surface water features such as springs, the original flow of surface streams, etc. in the Environmental Assessment Report (EAR);

TVA Response

Chickamauga Dam was completed downstream of the Watts Bar Steam Plant in 1940, and the Plant was completed in January 1942. Available geologic mapping consisting of the *East-Central Sheet Geologic Map of Tennessee* (Hardeman 1966) and the Geologic Map of the Decatur Quadrangle (Lemiszki 2008) show the area surrounding the plant after the CCR units were constructed. TVA will review these maps along with the 1935 United States Geological Survey (USGS) Topographic Map of the Decatur Quadrangle and 1942 USGS Topographic Map of the Decatur Quadrangle from the pre-embayment time period. These maps are provided as Exhibits 7 through 9 (Appendix E).

TVA also plans to review the following drawings which show pre-construction topography for the Study Area. These drawings are provided in Appendix M.

- Drawing 10N200 shows original surface elevations at the Slag Disposal Area.
- Drawing10W243 R0 show original surface elevations at the Ash Pond.

TVA will review the maps and drawings during the Investigation and discuss surface water features and the flow direction of streams before the Plant was constructed in the EAR.

4.1.4 A.4 TDEC Site Information Request No. 4

Discuss if construction design information for original CCR surface impoundments; specifically, any construction drawings or engineering plans are available. It is important to identify the surface elevation and location of surface impoundments, landfills or non-registered disposal areas when originally constructed. TVA should explain if/how the information to identify the materials used to construct these disposal areas.

TVA Response

TVA plans to use information from the following documents to summarize the design and materials used to construct the Ash Pond and Slag Disposal Area.

- **Pre-construction Topographic Maps:** TVA will use the maps and drawings referenced in Section 4.1.3 which show pre-construction topography.
- **Construction Drawings:** Drawings 10N245 through 10N247 depict the construction of the Ash Pond. Drawing 10W243 R0 depicts the original and raised configurations of the Slag Disposal Area dikes.
- **Record Drawings:** As-built closure plans and surveys (Ash Pond 10W254 Drawing Series, CDM Smith, 2015 and Slag Disposal Area Maintenance 10W426 Drawing Series, AECOM, 2016) provide plan views and cross sections for the closed configurations of the Ash Pond and Slag Disposal Area.

- **Geotechnical Reports:** CDM Smith (2012a and 2012c) reports provide stability sections which depict the configuration of the Ash Pond dikes as well as material descriptions and classifications for the dikes. Boring locations from these reports are provided as Exhibit 10 in Appendix E. TVA (2007) includes seven Geoprobe® borings that were advanced through the top of CCR material surface to help identify the thickness of the CCR material in the Slag Disposal Area.

In TDEC's WBF EIP Revision 1 comments (see Appendix B), additional information is requested regarding the potential for preferential seepage pathways through the foundation soils via stream channels that were present prior to development of the Slag Disposal Area. Exhibit 11 (Appendix E) shows the pre-construction channel crossing the CCR unit perimeter at two different locations.

There is limited information available on how the foundation was prepared during original perimeter dike construction. It is unclear if more pervious stream deposits were present, and if so whether they were excavated or otherwise treated prior to placing fill. TVA Drawing 10W243 (Appendix M) notes that soft surficial soils were to be removed in areas under new fill (i.e., new perimeter dikes) to a depth that would support heavy earthmoving equipment without rutting or heaving.

Additional field work is proposed to better characterize the uppermost foundation soils in the vicinity of the mapped, pre-construction stream channel. At or near each stream crossing location along the perimeter dike system, a series of closely spaced Cone Penetration Test (CPT) soundings is proposed. The CPT data, correlated to existing nearby boring logs, can be used to differentiate relatively sandy (i.e., more pervious) foundation soils, if present. The proposed CPT layout is shown on Exhibit 11 and the detailed plan is presented in the Exploratory Drilling SAP (Appendix F).

TVA will summarize the design and materials used to construct these units and identify the original surface elevation at the location of these CCR units in the EAR. Additional field work, as outlined in the Exploratory Drilling SAP (Appendix F), will be performed and will provide supplemental data for this request. The supplemental data will be presented in the EAR.

4.1.5 A.5 TDEC Site Information Request No. 5

Discuss the information available and additional information that will be gathered to provide a three-dimensional profile of the CCR materials from the current elevation of all surface impoundments, landfills and/or non-registered disposal sites to the natural occurring surface below each structure. Also discuss how TVA plans to provide an estimated amount of CCR material disposed within each structure and the total amount of CCR material disposed at each site.

Discuss the methods that TVA will use to provide drawings (to scale) that illustrate the height, length and breadth of the CCR disposal areas in relation to the naturally occurring features of each site. Comprehensively define the amount and location off CCR material at each site.

Also discuss how TVA plans to provide an estimated amount of CCR material disposed within each structure and the total amount of CCR material disposed at each site. Discuss the methods that TVA will use to provide drawings (to scale) that illustrate the height, length and breadth of the CCR disposal areas in relation to the naturally occurring features of each site.

TVA Response

TVA prepared a Material Quantity SAP, provided as Appendix N, to describe the methods TVA will use during the Investigation to answer TDEC's information requests regarding CCR unit geometry, CCR material quantity, groundwater elevations, saturation levels, and subsurface conditions with respect to the Slag Disposal Area and the Ash Pond.

Three-Dimensional Models

TVA will develop three-dimensional models to estimate the amount and location of CCR materials at the Slag Disposal Area and Ash Pond Area using the data summarized below which includes data from the proposed borings discussed herein and in the Exploratory Drilling SAP.

1. Ground and conventional aerial survey data will be used with record drawings to model features such as a soil cap and riprap layers.

2. Record drawings provided in CDM Smith (2015) approximate the final grade and upper and lower CCR surfaces in the Ash Pond. Closure drawings prepared by TVA (2009a, 2009b) approximate the final grade and upper CCR surface in the Slag Disposal Area. Record drawings provided in AECOM (2016) for drainage improvements at the Slag Disposal Area also show the final grade.

3. Data from proposed borings shown on Exhibit 11 (Appendix E) will be used to supplement existing borings shown in Exhibit 12 to model the upper CCR surface.

4. Data from the proposed CPT soundings shown on Exhibit 11 along the sheet pile dock area to the east of the Slag Disposal Area will be used to quantify the volume of beneficial reuse CCR material used as backfill in the construction of the sheet pile dock area and to improve spatial coverage for CCR thickness, water levels, foundation type and thickness, and top of bedrock elevations.

5. Pre-construction topographic information from USGS Decatur Quadrangles dated 1935 and 1942, TVA Drawings 10N240, 10W243, and 10N245 “Fly Ash Disposal Area Drawings,” and 10N200 and 1210N92 “General Plans”, and data from borings that penetrated the lower CCR surface shown on Exhibits 11 and 12 will be used to model the lower CCR surface.

6. CDM Smith (2012a and 2012c) reports provide stability sections and boring logs which depict the upper and lower CCR surfaces in the Ash Pond.

7. Data from proposed auger and CPT borings shown on Exhibit 11 will be used to supplement data from the existing borings shown on Exhibit 13 to model the surface of foundation soils underlying each site.

8. Data from proposed auger and CPT borings shown on Exhibits 3 and 11 that encounter top of bedrock or CPT refusal will be used to supplement data from the existing borings shown on Exhibit 14 model the top of bedrock surface.

9. Estimated piezometric levels of saturation elevations in CCR will be incorporated into the models.

10. Estimated groundwater elevations will be incorporated into the models.

As documented in the Evaluation of Existing Geotechnical Data (Appendix O), TVA evaluated the adequacy of the existing data, listed above, in responding to information requests regarding CCR location and quantity. TVA concluded that existing borings that penetrated the lower boundary of CCR shown on Exhibit 12 provide sufficient spatial coverage to develop a three-dimensional model and volumetric estimates for the Ash Pond Area. Additional borings are proposed at the Slag Disposal Area to provide additional CCR thickness information and geotechnical data.

Drawings

Once the three-dimensional model has been generated, it will be used to produce drawings showing the following:

- Subsurface material types, properties, elevations, and thickness from the ground surface to top of bedrock
- Upper and lower CCR surfaces and CCR thickness for each facility
- Top of bedrock contours
- Estimated piezometric saturation levels, contours, and river stage
- Estimated groundwater elevation contours

- Plan view showing areas where CCR material is below the highest recorded ground water potentiometric surface
- Estimated extent of clay foundation between CCR and bedrock and estimated groundwater elevation

Volumetric Estimates

The three-dimensional model will be generated using software capable of rendering three-dimensional surfaces and calculating volumes such as Autodesk's AutoCAD Civil 3D or ArcGIS. Environmental Visualization Software may also be used to visualize the three-dimensional model of the facilities. Other software packages may be utilized as appropriate. The following volumetric estimates will be calculated:

- Total volume of CCR in each CCR unit
- Volume of CCR below estimated piezometric saturation levels
- Volume of CCR below estimated groundwater elevations
- Volume of CCR above estimated piezometric saturation levels
- Volume of CCR above estimated groundwater elevations

The total volume of CCR at the Plant will also be estimated. These volumetric estimates will be calculated using two software models to validate the model and results.

Reporting

The results of the CCR material quantity assessment, including the three-dimensional model of the facilities, drawings, and volumetric estimates will be incorporated into the EAR.

4.1.6 A.6 TDEC Site Information Request No. 6

Describe the method TVA shall use to provide a water balance analysis for active surface impoundments at each TVA site. This should include all wastewater and surface water runoff entering the impoundment from the TVA site and the amount of water discharged from the surface impoundment(s) into receiving streams at the NPDES permitted discharge point. TVA shall also describe briefly how it will determine the transpiration rate of water from the surface impoundment(s) into the atmosphere;

TVA Response
The CCR units at WBF are currently closed, and the coal-fired units at WBF were retired in 1982. The request for a water balance analysis for active surface impoundments is not applicable.

4.2 B. WATER USE SURVEY

As a part of the Environmental Assessment, TVA is required to conduct a water use survey. The purpose of the water use survey is to determine if any surface water or ground water (water wells or springs) are being used by local residents or by TVA as domestic water supplies.

4.2.1 B.1 TDEC Water Use Survey Request No. 1

TVA shall describe how it will conduct a water use survey within ½ mile of the boundary of the TVA site. TVA shall describe how it will determine the construction, depth and location of private water wells identified in the survey.

If TVA determines local surface water and/or ground water is used as a source of domestic water supply within a ½ mile radius of the TVA site, the EIP shall include an offsite ground water and surface water sampling plan as a part of the EIP.

TVA Response
TVA conducted a survey of domestic water supplies within one mile of the boundary of the WBF property in 2008. The survey will be updated to explore the possibility that new domestic water supplies have been installed since the time of the previous survey.

TVA will update previous studies by reviewing the state database to identify existing private water wells or surface water supplies within 1/2 mile of the boundary of the WBF property, including water well inventory records on file with TDEC for Rhea and Meigs Counties. TVA will also review water supply information on file for the City of Spring City to identify water service hookup locations in the search area. TVA-owned property will be included in the water use survey as shown on Exhibit 15 in Appendix E. The updated information will be provided in the EAR.

4.3 C. GROUNDWATER MONITORING AND MAPPING

The EPA CCR rules specify constituents that should be included for analysis for ground water sampling. The constituents for Ground Water Detection Monitoring are listed in Appendix 3 of the EPA CCR regulations and the constituents for Ground Water Assessment Monitoring are listed in Appendix 4 of the EPA CCR regulations. TDEC is requiring TVA to include a description of the ground water monitoring plan it will implement at each TVA site. All ground water samples collected as a part of the Ground Water Monitoring Plan shall be analyzed for the CCR constituents listed in Appendices 3 and 4 of the federal CCR regulations. Items to include in the EIP are:

4.3.1 C.1 TDEC Groundwater Monitoring and Mapping Request No. 1

A discussion of all ground water monitoring wells TVA has installed/abandoned/closed at the TVA site as well and any springs that have been monitored at the TVA site or adjacent to the TVA site. TVA shall discuss the data it TVA has generated from historical sampling of ground water monitoring wells and springs. TVA shall include all ground water monitoring construction information, location and historical ground water monitoring data in each TVA site's EAR.

TVA Response

This information request is similar to TDEC Information Requests 1 and 3. Refer to Sections 3.1.1 and 3.1.3 for the response to this request.

4.3.2 C.2 TDEC Groundwater Monitoring and Mapping Request No. 2

A discussion of the location of at least two background ground water monitoring wells including the reasons for proposed their proposed location.

TVA Response

This information request is similar to TDEC Information Request 1. Refer to Section 3.1.1 for the response to this request.

4.3.3 C.3 TDEC Groundwater Monitoring and Mapping Request No. 3

A discussion of additional ground water monitoring wells that will be installed to complete a ground water monitoring network at the TVA site around all surface impoundments, landfills and/or non-registered disposal sites; including the location of existing or proposed ground water monitoring wells down gradient of all CCR disposal areas on the TVA site. TVA shall propose a ground water monitoring network that will provide data to develop a TVA site wide ground water potentiometric surface map. TVA shall ensure that the ground water monitoring locations (current and proposed) in the EIP will accurately determine groundwater flow and direction.

TVA Response

This Information Request is similar to Information Request 1. Refer to Section 3.1.1 for the response to this request.

4.3.4 C.4 TDEC Groundwater Monitoring and Mapping Request No. 4

A discussion of the construction methods TVA will use to install additional ground water monitoring wells. This includes drilling method, methods and personnel for logging cuttings and cores, well construction and well development. A scaled diagram of a properly completed monitoring well shall be provided in the EIP.

TVA Response

This Information Request is similar to other information requests that are addressed in Sections 3.1.1 and 4.3.2. Refer to those sections and the Hydrogeological Investigation SAP (Appendix G) for details on proposed drilling, logging, well construction and well development methods.

4.3.5 C.5 TDEC Groundwater Monitoring and Mapping Request No. 5

A ground water monitoring plan for sampling all wells and springs included in the monitoring network. This should include the methods TVA shall use to collect ground water samples, the analytical methods to be used for ground water sample analyses, methods for sample transport from point of collection to the laboratory and identification and qualification of the laboratory (ies) that will perform sample analyses.

TVA Response

The Groundwater Investigation SAP (Appendix H) provides the methods that TVA will use to collect groundwater samples, analytical methods, chain-of-custody procedures, packaging, shipping and transportation requirements.

Additional information regarding laboratories to be used for analysis of the samples is provided in the QAPP (Appendix C).

Historically, no springs have been located on site and are not currently anticipated to be encountered. If observed, TVA's inspection program will identify and document the new springs that will be added to the groundwater monitoring plan in the groundwater monitoring network.

4.3.6 C.6 TDEC Groundwater Monitoring and Mapping Request No. 6

Describe any existing information available and additional data needed to develop a map which identifies the current ground water surface elevation under the landfill(s), surface impoundment(s) and/or non-registered site(s). If additional data is needed to provide ground water elevations across the TVA site, below the footprint of the landfill(s), surface impoundment(s) and/or non-registered site(s), describe the methods TVA plans to use to collect the data. TVA shall collect sufficient data to create a map that clearly delineates the ground water surface in the Ash Pond Areas such that (1) the CCR material between the original ground surface and the top of the current ground water table is defined and (2) CCR material between the current ground water surface and the surface elevation of the CCR disposal area is clearly defined. TVA shall also collect pore water samples from CCR material that is below the current ground water surface and from CCR material that is below the projected ground water surface with closure in place. TDEC has not determined that closure in place is a corrective action option at any TVA site; however; this information is needed should TVA propose closure in place.

TVA Response

The request regarding the estimation of the amount of CCR material below the groundwater surface is similar to the information requested in Sections 3.1.1, 3.1.6 and 4.1.5. Refer to those sections for preparation of groundwater contour maps and estimating the three-dimensional profile of CCR material.

The request regarding the collection of pore water samples is similar to the information requested in Section 4.1.2.

4.3.7 C.7 TDEC Groundwater Monitoring and Mapping Request No. 7

Describe how TVA will define ground water contaminant plumes identified using currently available ground water monitoring data and new ground water monitoring data gathered from the installation and sampling of new ground water monitoring wells.

TVA shall also discuss its strategy to determine the extent of any CCR constituent plume should the initial ground water monitoring network not define the full extent of the CCR constituent ground water plume at the TVA site. This should include the science it will use to extend its ground water monitoring network.

TVA Response

As discussed in Section 3.1.1, the initial phase of the environmental investigation is to characterize the site by assessing current subsurface conditions at WBF. Potential groundwater impacts will be identified by collecting background and downgradient groundwater samples. TVA will use industry-accepted methods for delineating the extent of CCR constituents, if needed, and will install additional wells in appropriate locations based on groundwater flow conditions.

Methodologies and procedures for installing monitoring wells are provided in the Hydrogeological Investigation SAP (Appendix G). Monitoring wells will be monitored bi-monthly for one year.

TVA may propose additional methods of evaluation, such as groundwater flow and transport models, as appropriate and guided by sound scientific principles based on the data collected. The proposed investigation is designed to collect groundwater data representative of site conditions that would be needed as input into models. The exact approach will depend on the data collected and will be proposed after evaluation of the data collected during the environmental investigation.

4.4 D. TVA SITE CONDITIONS

4.4.1 D.1 TDEC Site Conditions Request No. 1

Discuss all current information available about the geologic lithology (formations, bedding planes, etc.) and their relevance to natural seeps, springs and karst features on the TVA site; including the CCR disposal areas. Some limestone formations are very susceptible to solution channeling, especially when they have been disturbed through natural events or construction activities such as blasting. TVA shall describe the methods it will use to determine whether solution channeling has occurred at and near the soil/rock interface;

TVA Response

Existing geological characterization data, including boring logs from previous geotechnical work and related reports (e.g., Fox 1942, CDM Smith 2012a/2012b/2012c, Stantec 2017), as well as construction and facility performance records will be reviewed. The review will focus on information related to geologic lithology, geologic features, solution channeling, and/or springs at the WBF site. The response will discuss how the geologic lithology influences the construction and performance of the different units.

Available information indicates that the CCR units at WBF are underlain predominantly by shale and interbedded shale/limestone (TVA 1949; CDM Smith 2012c). The rock cores drilled in the vicinity of the Ash Pond indicated thin to very thin bedding. Due to this thin bedding of alternating shale/limestone, these materials are not expected to develop extensive karst features.

No known geologic sinkholes or karst features have been identified at WBF in the available historical construction reports, drawings, inspections or geotechnical explorations. Further, natural seeps or springs have not been identified at WBF.

A summary of the pertinent existing and new information will be provided in the EAR.

4.4.2 D.2 TDEC Site Conditions Request No. 2

Discuss all current information about the geologic structure below the TVA site and how it may be used to help determine if faults and/or fractures have been identified in the subsurface. TVA shall describe the methods it will use to collect additional data (faults, fractures, bedding planes, karst features, etc.) to determine whether faulting and fracturing has impacted and/or controls groundwater movement. Describe how TVA will determine if identified faults, fractures, bedding planes, karst features, etc. are filled to the point that they limit or eliminate ground water flow.

TVA Response

The information required for this response is similar to that for D.1 (Section 4.4.1). TVA will use existing data and reports to describe the geologic structure beneath the CCR units with a focus on faults, fractures, and bedding planes.

The locations of known faults near WBF will be provided based on existing literature. Observations regarding fractures and bedding planes identified in rock cores collected during previous investigations (CDM Smith 2012c) will be summarized in the EAR. TVA will use this and other information from historical construction reports, drawings, inspections and explorations to describe the geologic structure below WBF, including the proximity of faults below the CCR units and the degree of infilling of fractures and bedding planes. The understanding of the geologic structure will be combined with hydrogeological information to evaluate its influence on groundwater flow. This evaluation will be provided in the EAR.

4.4.3 D.3 TDEC Site Conditions Request No. 3

Discuss existing data available to TVA to map top of bedrock; i.e. existing boring and ground water monitoring well construction data. TVA shall describe the methods (surface geophysics; installation of borings/ground water monitoring wells) it will use to collect additional data to map top of bedrock. The EIP shall include a description of the data collection methods TVA will use to determine the thickness and types of natural material overlying bedrock as well as the top of bedrock contours. For all new soil borings, TVA shall provide the location of the borings, the information used to determine boring location, the drilling method to be used, how the borings will be logged. Logging shall be performed by a Professional Geologist licensed to practice in Tennessee.

Logs shall provide the following information when presented in the EAR; soil type, depth and changes, identify geologic formations, depth of formation, karst features, fractures, bedding planes, and any other pertinent information. TVA shall provide an example of a boring log in the EIP.

TVA Response

This request is similar to Section 4.1.5 which also requests mapping of subsurface materials at the site from the current elevation of the CCR units to the original (natural) surface elevation. Therefore, the model developed as discussed in Section 4.1.5 will be used to address this request.

Top of rock was encountered in 34 borings located in the footprint of the Powerhouse as documented by TVA (1949). Bedrock was encountered in 6 borings during the CDM Smith 2012 geotechnical exploration of the Ash Pond. Supplemental top of rock data will be obtained from the proposed installation of wells (Section 3.1.1) and proposed geotechnical borings (Section 4.4.6). TVA will incorporate this top of rock data into the three-dimensional model of the CCR units discussed in Section 4.1.5. Historical well and boring locations from TVA (1949) and CDM Smith (2012a, 2012c) are provided as Exhibits 2, 4, and 10 in Appendix E.

TVA will use the three-dimensional model to estimate the thickness and type of overburden and provide top of bedrock contours in the EAR. The model and supporting documentation will also be provided in the EAR.

4.4.4 D.4 TDEC Site Conditions Request No. 4

When/if TVA divided original Coal Combustion Residual (fly ash, bottom ash and gypsum) surface impoundments into individual units (surface impoundments, non-registered disposal areas and or landfills), TVA shall discuss where this has happened on each TVA site. As a part of the EAR, TVA shall discuss the source of information reviewed to provide the specifications of those structural changes.

Discuss if there are as built drawings or engineering plans for the modifications TVA has made at each site made. If there is not existing information that describes the structural changes in the original surface impoundment(s) or non-registered site(s), TVA shall discuss in the EIP how it will collect the information needed to document structural changes over time. This information is needed in determining the structural and seismic stability of each TVA site.

TVA Response

The Ash Pond and Slag Disposal Area were constructed as two separate units. Neither of these two units were later subdivided into smaller units; therefore, this information request does not apply to the WBF EIP.

4.4.5 D.5 TDEC Site Conditions Request No. 5

Stipulate whether there are any as-built designs for the interface between the originally disposed CCR material and any disposal structures constructed above the original disposal area.

TVA Response

No disposal structures were constructed over the Ash Pond or Slag Disposal Area; therefore, this information request is not applicable to the WBF EIP.

4.4.6 D.6 TDEC Site Conditions Request No. 6

TVA shall discuss any existing stability calculations for final permitted design elevation for all landfills. Unless TDEC specifies otherwise, TVA shall conduct new stability calculations for all landfills, surface impoundments and/or non-registered disposal sites. The EIP shall describe the method TVA will use to determine structural stability. TVA shall provide stability calculations for each disposal area based upon (1) the permitted final elevation or planned final elevation for each landfill, (2) the current elevation for all surface impoundments and/or (3) the current elevation for all non-registered disposal location.

TVA Response

As described below and in the Stability SAP (Appendix P), new stability analyses will be performed where necessary to address this information request. Otherwise, the existing data is sufficient to establish appropriate shear strengths and stability results for static and seismic load cases. The summaries of existing geotechnical data in Appendix O (Evaluation of Existing Geotechnical Data) demonstrate that existing data is representative and suitable to support the stability analyses.

The load cases to be evaluated in the stability analyses are based on conventional practice and appropriate industry standards for landfills and surface impoundments, as applicable.

- Static, long-term (i.e., normal operation conditions) global stability
- Static, long-term veneer (i.e., final cover) stability
- Seismic, pseudostatic global stability
- Seismic, pseudostatic veneer stability
- Seismic, post-earthquake global stability (includes a preceding liquefaction triggering assessment)

The proposed assessment framework will comply with the overall goals of the TDEC Multi-Site Order as outlined in several Information Requests in Section D of the General Guidelines for EIPs. In general, the program may consist of geotechnical explorations (field and laboratory), followed by analysis. Data from previous geotechnical explorations (field and laboratory) and existing static/seismic stability analyses are available to fulfill certain components of this information request.

Specific data that is available and outstanding data needs for each unit are described below. Where proposed below, the stability evaluation analysis methodology and acceptance criteria are in the Stability SAP (Appendix P). The analyses will be submitted in the EAR.

Based on the amount and context of data available to support a response, additional field work is anticipated at the Slag Disposal Area to answer this information request. Refer to the Exploratory Drilling SAP (Appendix F) for more information.

Ash Pond: Existing analyses are available for the Ash Pond, from the following sources:

- CDM Smith (2013): Proposed closure conditions evaluated for static, long-term global and seismic pseudostatic global slope stability.

The above analyses are adequate to represent the closed conditions for global stability. A summary of these analyses will be included in the EAR. Note that static long-term veneer, seismic pseudostatic veneer, liquefaction triggering, and seismic post-earthquake global analyses are not available for the existing closed conditions, and will be performed in accordance with the Stability SAP (Appendix P). A summary of these analyses will be included in the EAR.

Slag Disposal Area: Existing analyses are not available for the Slag Disposal Area. The above listed static and seismic analyses will be performed for the existing (closed) conditions in accordance with the Stability SAP (Appendix P). A summary of these analyses will be included in the EAR.

4.4.7 D.7 TDEC Site Conditions Request No. 7

TVA shall specify how it will determine the construction methods and properties of the drainage layers between each "stacked layer" for permitted CCR landfills; including where the drainage layer discharges.

TVA Response

Ash Pond and Slag Disposal Area: These units are not permitted CCR landfills, and do not have drainage layers; therefore, this information request does not apply to these units.

4.4.8 D.8 TDEC Site Conditions Request No. 8

TVA shall review Section VI.D.5 (page 21373) of the section of the Federal CCR Preamble that describes areas of concern regarding overfill at landfills. TVA shall explain how it will determine if there are potential overfill situations for each surface impoundment/landfill at the TVA site.

TVA Response

The Ash Pond and Slag Disposal Area do not meet the definition of an overfill per the CCR Rule, i.e., "a new CCR landfill constructed over a closed CCR surface impoundment," 40 CFR § 257.53. Therefore, this information request does not apply to WBF.

Regarding the Ash Pond and Slag Disposal Area, it should be noted that the EPA excluded from regulation inactive CCR landfills, § 257.50(d), as well as CCR surface impoundments that no longer impound water and that are "capped or otherwise maintained," 80 Fed. Reg. at page 21343. EPA explained in its preamble that this exclusion is due to the lower risk associated with such units. Section VI.A.5 (page 21342) of the preamble states:

> "As noted, EPA's risk assessment shows that the highest risks are associated with CCR surface impoundments due to the hydraulic head imposed by impounded water. Dewatered CCR surface impoundments will no longer be subjected to hydraulic head so the risk of releases, including the risk that the unit will leach into the groundwater, would be no greater than those from CCR landfills. Similarly, the requirements of this rule do not apply to inactive CCR landfills—which are CCR landfills that do not accept waste after the effective date of the regulations. The Agency is not aware of any damage cases associated with inactive CCR landfills, and as noted, the risks of release from such units are significantly lower than CCR surface impoundments or active CCR landfills. In the absence of this type of evidence, and consistent with the proposal, the Agency has decided not to cover these units in this final rule."

Throughout their service life, TVA has constructed and operated the Ash Pond and Slag Disposal Area in compliance with the state and/or federal regulatory frameworks in effect at the time.

The Ash Pond and Slag Disposal Area are surface impoundments that no longer impound water as defined by the CCR Rule. The CCR Rule became effective in 2015, and does not apply retroactively to these units.

4.4.9 D.9 TDEC Site Conditions Request No. 9

Discuss current information/data that is available to estimate the shear strength of the CCR materials in the landfill(s), surface impoundment(s) and/or nonregistered sites. If there is not sufficient data available to determine shear strength, describe the methods TVA shall use to collect this data.

If there is existing data collected during installation of soil/rock borings or construction of ground water monitoring wells, provide a brief description of this data and how it will be presented for use in the EIP.

TVA Response

Ash Pond: Recent geotechnical explorations at the Ash Pond have characterized the CCR materials present in this unit. Shear strengths for CCR materials were developed based on laboratory testing and typical values (CDM Smith 2012a, 2012b, 2013) as described in the Evaluation of Existing Geotechnical Data (Appendix O).

A review of the referenced existing (i.e., closed) stability analyses shows that due to the location of the CCR in the cross sections, this material did not significantly influence the perimeter dike slope stability results. When evaluating the suitability of existing stability analyses to address the TDEC Order information requests, the use of shear strengths based on typical/published values will be considered. Factors to be considered include the sensitivity (or lack thereof) of the analysis to the strength and the degree of conservatism of the published value relative to the site-specific materials. The EAR will present a summary of the existing data and a characterization of the CCR shear strength for this unit.

Slag Disposal Area: Limited data is available for the CCR materials in the Slag Disposal Area. Additional explorations are proposed to obtain CCR data to support shear strength development. Undisturbed samples will be obtained and tested in the laboratory for shear strength parameters. Penetration resistance data will be collected and can be used to supplement the laboratory testing. Refer to the Exploratory Drilling SAP (Appendix F) for more information.

4.4.10 D.10 TDEC Site Conditions Request No. 10

TVA shall provide static, seismic and liquefaction analysis in accordance with 257.63 and 257.73 of the Federal CCR regulations for final permitted design elevations for Landfills that are defined by the Federal Regulations as overfills. If the analyses have not been completed, then TVA shall provide analyses for each landfill based upon either the permitted final elevation for each or for the planned final elevation for each; should TVA decide it does not need to use the entire permitted capacity of any permitted CCR landfill.

TVA shall identify and analyze the critical cross section(s) and document that the modeling represents the actual field conditions at the cross section location(s). TVA shall also address foundation settlement of these Landfills.

TVA Response

As noted in Section 4.4.8, none of the WBF CCR units in the Study Area meet the definition of an overfill per the CCR Rule. Therefore, this information request does not apply to WBF.

4.4.11 D.11 TDEC Site Conditions Request No. 11

TVA shall discuss any current dam safety analysis performed at the TVA site for all landfills, surface impoundments and/or non-registered disposal areas. If dam safety analysis has not been performed for each disposal area or if TDEC determines the dam safety analysis is inadequate, then TVA shall describe the method(s) it will use to determine the "dam safety factor" for all disposal areas at the TVA site.

TVA Response

The Ash Pond and Slag Disposal Area do not constitute dams, as defined by TVA Standard Programs and Processes (SPP) manual on Dam Safety (TVA-SPP-27.0). Likewise, these perimeter dikes do not constitute dams under Federal Emergency Management Agency (FEMA) guidelines, which consider both dam height and impounding capacity. The above-listed units at WBF no longer have the capacity to impound 50 acre-feet or more, thus they do not meet the definition of a dam. Therefore, this information request does not apply to these units.

However, the perimeter dike of the Ash Pond has historically been included in TVA's Dam Safety Program. TVA has applicable SPPs that govern the safety analysis for dams and impoundments. TVA utilizes procedural standards for managing dam safety activities and support. Objectives of the program include:

- Ensure dams and impoundments are designed, constructed, operated, maintained, and repaired in accordance with the Federal Guidelines for Dam Safety and TVA Procedures
- Maintain a Dam Safety Independent Review Board to provide technical expertise and guidance
- Perform assessments to provide quality assurance
- Prepare programmatic performance metrics and reporting including the biennial report to FEMA
- Provide a forum for dam safety related communications, lessons learned and best practices sharing
- Facilitate consistent and effective administration of dam safety work through management of the Dam Safety Steering Committee, with the goal of efficiently reducing TVA's overall dam safety risk.

TVA has completed, or will perform, slope stability evaluations for each CCR unit in the Study Area as outlined in Section 4.4.6 of this EIP. These evaluations include the stability of the perimeter dike system, where present, of each unit. TVA has also performed, or will perform, assessments of the disposal areas in accordance with Item D.13 of the TDEC

General Guidelines, which include structural stability and safety factor assessments. See Section 4.4.13 for a description of these assessments. These assessments will be provided in the EAR.

4.4.12 D.12 TDEC Site Conditions Request No. 12

TVA shall discuss any current information or assessments regarding seismic stability for the TVA site, including existing seismic analysis for each surface impoundment(s), landfill(s) and/or non-registered site(s) s at the TVA site. TVA shall describe in the EIP the method it will use to determine the size of the seismic event that would cause structural failure for entire area of the surface impoundments, landfills and/or non-registered disposal sites at the TVA site. The seismic analysis method proposed by TVA shall provide seismic data comparable to the requirements for seismic analysis in the federal CCR regulations at CFR 257.63. The seismic analysis plan shall determine the seismic stability of the entire TVA site and any improvements need to ensure seismic stability for the site, as it exists today and for closure in place. Soils below the surface impoundments and landfill shall be evaluated for liquefaction potential. If these soils are found to be susceptible to liquefaction, stability calculations shall be performed which account for liquefaction.

TVA Response

The industry standard practice for seismic analysis during design is to select an earthquake return period that is appropriate for a particular scenario. The design condition is then evaluated for adequate performance under the design earthquake(s).

As noted in Section 4.4.6, an industry-standard structural stability evaluation will be performed. The program will consider static and seismic slope stability, as well as liquefaction triggering, as applicable. Existing and proposed seismic stability assessments are outlined in Section 4.4.6. Proposed analyses will be performed per the Stability SAP (Appendix P). Existing and proposed slope stability analysis cross section locations are shown on Figure 1 in Appendix P. Results will be presented in the EAR.

4.4.13 D.13 TDEC Site Conditions Request No. 13

TVA shall discuss how the structural integrity of the entire area of CCR disposal (surface impoundment(s), landfill(s) and non-registered sites) shall be determined. TVA shall include in the EIP the methods and models it will use to evaluate structural integrity as discussed in CFR 257.73(d) and (e).

TVA Response

The WBF Study Area is not subject to the CCR Rule for active units (see Section 4.4.8). While the units are not subject to CFR 257.73(d) or (e), the Closure/Post-Closure Plans for the Slag Disposal Area (TVA 2007) and the Ash Pond (TVA 2013) addressed many aspects of structural integrity listed in the CCR Rule CFR 257.73(d) such as erosion protection and vegetative cover.

TVA further promotes structural integrity of the units by performing routine inspections and by evaluating proper abandonment of hydraulic structures and pipe penetrations through the unit perimeter. A summary of the structural evaluations will be presented in the EAR. Additionally, the stability program described in Sections 4.4.6 and 4.4.12 will consider the safety factor aspects of the CCR Rule CFR 257.73(e) such as static and seismic stability.

The Stability SAP (Appendix P) for the Study Area (described in Section 4.4.6) will present the analysis methodology and acceptance criteria for the evaluation.

4.4.14 D.14 TDEC Site Conditions Request No. 14

Discuss any current information available that may be used to determine the ability of the local geology to provide sufficient structural stability for the existing surface impoundments, landfills and/or non-registered disposal areas at the TVA site as well as any disposal area considered for closure in place. TDEC anticipates there will not be sufficient existing structural stability information for this analysis.

Describe the methods TVA shall employ to collect data that may be used to determine the capability of the geologic formation at the TVA site to provide structurally sound/load bearing strength for existing CCR disposal areas as well as for those disposal areas should TVA consider closure in place of those areas.

TVA Response

TVA will review the available bedrock data from several sources, including historic geologic lithology data and mapping, construction data, and rock core data, to evaluate the ability of the geologic formations underlying the Study Area to provide structural stability for these units in their existing (closed) condition. Relevant information from Sections 4.4.1 and 4.4.2, including results of proposed investigations, will also be taken into consideration. The existing and proposed data are expected to be sufficient for this evaluation, which will be provided in the EAR.

4.5 E. SURFACE WATER IMPACTS

Because of the long operating history of the TVA Fossil Plants, there have been potential opportunities for CCR materials to move into surface water and for dissolved CCR constituents to migrate via ground water flow into surface water. As a part of the EIP, TVA shall describe how it will determine if CCR material and/or dissolved CCR constituents have entered surface water at or adjacent to TVA sites. TVA shall also describe in the EIP how it will assess any impact CCR material and/or dissolved CCR constituents may have on water quality and/or the impact on fish and aquatic life.

4.5.1 E.1 TDEC Surface Water Impacts Request No. 1

TVA shall discuss any current information it has for the TVA site that identifies CCR deposition on the streambed for surface water on the TVA site or surface water adjacent to the TVA site.

TVA Response

TVA is not aware of releases of CCR materials from WBF to the Tennessee River. The WBF plant was permanently shut down in 1982 and the CCR units have been capped. TVA conducts aquatic community studies per its NPDES permit requirements associated with the current nuclear plant, and TVA will continue to conduct a records search for additional sediment and surface water investigations of the Tennessee River. Existing data will be reviewed and evaluated in accordance with the WBF QAPP, along with the new data obtained from the proposed benthic study discussed in Section 4.5.2 and the proposed surface water study discussed in Section 4.5.5. Results of this evaluation will be addressed in the EAR.

4.5.2 E.2 TDEC Surface Water Impacts Request No. 2

TVA shall describe in the EIP the methods it will use to determine if CCR material has moved from the TVA site into surface water on the TVA site or adjacent to the TVA site. TVA shall propose a procedure for sampling the streambed for CCR material. TVA shall describe sample collection methods, sample preservation and sample analysis methods for CCR materials.

All samples shall be analyzed for the CCR constituents listed in Appendices 3 and 4 of the federal CCR regulations. Further, TVA shall propose how it will test sediment and CCR samples taken from riverbeds to determine if CCR constituents dissolve into surface water.

TVA Response

A Benthic SAP (Appendix Q) has been prepared to determine if CCR material has moved into surface water (see Section 4.5.5 for the Surface Stream Characterization Study), to characterize sediment in streambeds for the CCR Parameters, and to assess whether CCR has been deposited on the streambed.

The objectives of the sediment characterization study include:

- Delineation of CCR material deposited on streambeds; and
- Assessment of potential transport of CCR constituents from CCR units to surface streams on or adjacent to the TVA site.

The sediment characterization study will include the following steps:

1. Research and review existing documentation on sediment analyses;

2. Finalize a sediment sampling location map;
3. Finalize Benthic SAP;
4. Record sediment sample locations using the GPS during the investigation;
5. Collect and analyze sediment samples per a two-phased approach in accordance with the SAP;
6. Review and evaluate existing and new analytical data; and
7. Prepare the EAR.

A two-phased approach is proposed in conducting the sediment characterization study, as provided in the Sediment SAP. Phase 1 will include:

- Conduct three Vibracore borings along each of seven transects in the Tennessee River to six-foot depth or refusal, whichever comes first.
- Collect samples of top six inches of sediment at each sampling location (for a total of twenty-one samples).
- Collect grab samples of remainder of each sediment core, segregated by soil types. Native soils will not be collected, since the focus is on deposited sediment material.
- Analyze samples for percent ash, using PLM.
- Analyze the top six-inch sediment samples for CCR Parameters.
- Hold the deeper sediment samples for potential future analyses in Phase 2 (if >20% ash in the shallower samples).

A map of proposed sediment sampling locations for Phase 1 is provided as Exhibit 16 (Appendix E), and a complete description of the sampling methods and protocols is provided in the Benthic SAP.

Quantitative benthic macroinvertebrate (invertebrate) samples will be collected during Phase 1 and are included in the Benthic SAP in Appendix Q. The benthic invertebrate samples will be collected along transects at the locations depicted on Exhibit 17 (Appendix E). The results of the quantitative sampling will be used to assess the status of the benthic community. The benthic invertebrate evaluation will also include collecting composite samples of mayfly nymphs from locations within the areas indicated on Exhibit 18 (Appendix E). Composite adult mayfly samples will be collected by direct removal from vegetation or other structures along the shoreline or by use of sweep nets. The mayfly nymphs (collected for both depuration and non-depuration) and adult mayflies will be submitted for laboratory analysis of metals included in the CCR Parameters list (excluding radium). The mayfly analytical results will be used in conjunction with sediment and fish tissue data to evaluate contaminant bioaccumulation.

Should ash in an individual Phase 1 sediment sample exceed 20 percent, Phase 2 sediment sampling will be implemented for that location, and would include:

- Analysis of held sediment core sample(s) at sampling locations that exceeded the 20 percent ash content for the CCR Parameters.
- Preparation of sampling location map showing new sampling locations adjacent to and including the original coring location(s) exhibiting a greater than 20 percent ash content.
- Analysis of new sediment core samples for the CCR Parameters and percent ash.

A Phase 2 sediment sample location map will be prepared for any new sampling locations, and Phase 2 sediment samples will be collected and analyzed for the CCR Parameters and percent ash. Phase 2 sampling will follow the same sampling methods and protocols as Phase 1.

Once sampling is complete and analytical results have been received for the required phases of the study, the results will be evaluated in accordance with the QAPP and reported in the EAR.

4.5.3 E.3 TDEC Surface Water Impacts Request No. 3

TVA shall describe how streambed sample results will be used to develop a map identifying the location of CCR material on the streambed and the depth of the CCR material on the streambed.

TVA Response

If CCR material is found during the sampling conducted as described in 4.5.2, the results will be used to prepare maps showing the distribution and depth of CCR material in the Tennessee River adjacent to WBF. The maps and volume estimates will be presented in the EAR.

4.5.4 E.4 TDEC Surface Water Impacts Request No. 4

TVA shall discuss any current information it has for the TVA site that identifies the movement of ground water with dissolved CCR constituents into surface streams on or adjacent to the TVA site. This includes any surface water analyses TVA has performed for samples taken from the seeps and surface stream(s).

TVA Response

In conjunction with a study to determine the effect of WBF on ichthyoplankton, water quality samples were collected in the summer of 1996 & 1997 at four locations near WBF and analyzed for pH, turbidity, total solids, dissolved solids, ammonia, nitrogen, nitrate-nitrite nitrogen, organic nitrogen, total phosphorus, dissolved phosphorus, total organic carbon, COD, total alkalinity, and chlorophyll-a. The study generally concluded that the range of WBF operational data points fall well within the range of preoperational data. Additional sampling associated with this study occurred during April, August, and September 1996 & 1997 - one mid-depth grab sample was collected from four locations in the vicinity of WBF for metals analysis, including calcium, magnesium, arsenic, boron, cadmium, chromium, copper, iron, lead nickel, zinc, aluminum, selenium, mercury, and hardness. Data plots of preoperational and operational data indicate that operational metals values are well within the variability of the preoperational data.

Limited water quality data was collected along three transects in conjunction with biological monitoring conducted upstream and downstream of WBF in October 2015. Water quality parameters collected included temperature, pH, Conductivity, and DO at several depths along each transect. No additional water quality data has been identified.

TVA will provide a discussion of any current information identifying the movement of groundwater with dissolved CCR constituents into surface streams, on or adjacent to the site, in the EAR. Former seeps have been monitored for structural concerns, but historically have not been sampled for the CCR Parameters. There are currently no active seeps at the facility.

4.5.5 E.5 TDEC Surface Water Impacts Request No. 5

TVA shall propose a plan to collect and analyze water samples from seeps and surface stream(s) on the TVA site and/or adjacent to the TVA site. This plan shall include sampling locations, sample collection methods, sample preservation and transport and methods for sample analysis. All samples shall be analyzed for the CCR constituents listed in Appendices 3 and 4 of the federal CCR regulations.

TVA Response

This response has been broken into two parts, one addressing seeps and one addressing surface streams.

Seep Characterization Study and Associated SAP

TDEC has requested a sampling plan to characterize seeps on the TVA site and/or adjacent to the TVA site at WBF, for the CCR Parameters. To this end, TVA will investigate mitigated and active seeps or areas historically noted as seeps that have occurred in the CCR unit dikes and berms.

The analytical results from located seep water and soil samples will be evaluated and the information provided to help inform assessment of potential movement of groundwater with dissolved CCR Parameters into surface streams on or adjacent to the TVA site, as requested in Section 4.5.4.

CCR operations ceased in 1982 with the plant's shutdown. The Slag Disposal Area and Chemical Pond Area closed in 2009 under Permit TNR190741. In 2015, three non-flowing seeps were repaired between the Slag Disposal Area and the Tennessee River, through a Drainage Improvement Project. Excavation into the three areas indicated dry conditions and no observed flows or saturated materials. Currently there are no active seeps at the site. A historic seepage summary is provided in Appendix R.

The objective of the seep characterization study is to assess the potential for transport of CCR constituents from CCR units to surface streams on or adjacent to the TVA site by water from seeps.

TVA's approach in conducting the seep characterization study consists of the following steps:

1. Research and review existing documentation on the location of historical seeps
2. Investigate site for active seeps
3. Identify location of active seeps on a map
4. Implement Seep SAP (Appendix S) based on active seep location map
5. Collect seep soil and/or water samples from active seeps
6. Record sample location using GPS
7. Analyze seep soil and/or water samples (taken from active seeps) for CCR Parameters per the Seep SAP in accordance with the WBF QAPP
8. Review and evaluate existing and new analytical data
9. Prepare the EAR

As part of the Seep SAP (Appendix S), a seep investigation will be conducted to discover whether active seeps or continued seepage from mitigated seep areas are present and will focus on repaired seep areas. Field investigation will include inspecting dike areas below the perimeter ditch for the following signs of potential seepage:

- Soil and/or vegetation discoloration

- Flowing water
- Unnatural saturation of the soil
- Plant growth

Inspection of mitigated areas may require the use of a boat since mitigation riprap often extends to the bank and/or waterline. The inspection will include examining the bank at the base of the riprap to determine if there are continuing water discharges at those locations. In addition, the stream channel and surface water at the water's edge shall be field-tested for pH, temperature, dissolved oxygen and conductivity using a multiparameter Sonde. By using the protocol outlined in the Seep SAP, if field testing indicates a significant difference between the stream channel samples and samples adjacent to the stream bank, further investigation will be required to determine if there is a seepage flow that is not visible.

Should active seeps be discovered, a seep sampling location map will be finalized and placed in the Seep SAP. Field sampling activities will include verifying the seep sampling location(s) using GPS and collecting seep soil and seep water samples as described in the Seep SAP. Filtered and unfiltered water samples will be taken. Samples will be analyzed for the CCR Parameters. A complete description of the sampling methods and protocols is provided in the Seep SAP (Appendix S).

Once sampling is complete and analytical results have been received, the CCR Parameters analyses for the seep samples will be evaluated in accordance with the WBF QAPP. The evaluation and seepage history will be reported in the EAR.

Surface Stream Characterization Study and Associated SAP

TDEC has requested a sampling plan to characterize surface streams on and/or adjacent to WBF for the CCR Parameters. TVA will obtain surface stream samples from the Tennessee River. The analytical results from the surface stream samples will be evaluated and the information provided to address the discussion on identifying the movement of groundwater with dissolved CCR Parameters into surface streams on or adjacent to the TVA site, as requested in Section 4.5.4.

The purpose of the Surface Stream SAP (Appendix T) is to characterize water quality on or adjacent to the WBF plant for CCR constituents.

A two-phased approach is proposed for conducting the surface stream characterization study as described below.

Phase 1:

- Collection of general water quality parameters in-situ using a Hydrolab® multi-probe water quality meter along seven sampling locations in the Tennessee River. Hydrolab data will be evaluated in the field to determine the presence of thermal stratification across the transects. As described below, water quality samples will be collected from the thalweg (deepest point), right bank, and left bank of each transect. Based on the results of field measurements, one of the following sample plans will be implemented:

- If thermally stratified, collect near-bottom (epibenthic) sample 0.5 m above streambed, mid-hypolimnion sample (midway between bottom of thermocline and streambed), mid-epilimnion sample (midway between top of thermocline and water surface, and near-surface (0.5 m depth) sample.

- If not thermally stratified, collect epibenthic, mid-depth, and surface water samples from each location along the sampling transect.

- For waterbodies that may not have adequate depth to collect multiple samples from the water column, the field sampling team may adjust the number of samples to accommodate. Similarly, if the width of the waterbody along a sampling transect is not sufficient to support the collection of multiple samples along the transect, the field sampling team may adjust the procedure accordingly.

Samples will be analyzed for total and dissolved CCR Parameters. A map of proposed surface stream sampling locations is provided in Exhibit 19 (Appendix E).

Sample locations often correspond with sample locations as described in the Benthic SAP and Fish Tissue SAP. To account for seasonal variations, two surface stream sampling events are proposed.

Phase 2

Phase 2 of surface stream sampling will be conducted if there is an exceedance of 20% ash content (based on PLM analysis) in one or more of the sediment samples collected in accordance with the Benthic SAP (Appendix Q). Phase 2 will consist of collecting additional surface stream samples from the location(s) where greater than 20% ash occurs. Several surface stream sample transects at the location(s) with greater than 20% ash content may be necessary to delineate the extent of potential impacts. Should this second phase be implemented, a new sampling location map will be developed. Phase 2 sampling procedures will remain the same as those described in this SAP. Only the sampling locations will differ.

Once sampling is complete and analytical results have been received for the required phases of study, the CCR Parameters analyses for the surface stream samples will be evaluated in accordance with the QAPP and reported in the EAR.

4.5.6 E.6 TDEC Surface Water Impacts Request No. 6

TVA shall describe how seep and stream sample results will be used to develop a map identifying the location of seep and stream sampling points and the results of the analyses. This map shall also include the location of any public water intakes within 1 mile of the downstream side of the TVA site.

TVA Response

Once surface stream and seep sample results have been received, maps will be developed identifying the location of the sampling points, along with the analytical results. Each map will include the location of any public water intakes within 1 mile of the downstream side of the TVA site, and placed in the respective Seep and Surface Stream sections of the EAR.

4.5.7 E.7 TDEC Surface Water Impacts Request No. 7

TVA shall provide a brief discussion of any studies conducted by TVA or any other agency to determine if CCR materials or dissolved CCR constituents have impacted fish and/or aquatic life.

TVA Response

TVA presented results of biological monitoring, specifically from the Tennessee River to TDEC in the Investigation Conference (Slides 84-94) and Investigation Conference Data Transmittal. TVA has collected and analyzed biological data upstream and downstream of its fossil-fueled power plants to assess health and structure of the aquatic communities surrounding them. These data include monitoring of fish and benthic invertebrate communities, and visual encounter surveys for wildlife along the shoreline.

TVA will discuss in the EAR the studies and the results of the fish and benthic invertebrate sampling summarized in previously completed historical biological monitoring reports. The biological monitoring data and information described will be summarized in the EAR.

4.5.8 E.8 TDEC Surface Water Impacts Request No. 8

Upon a determination by TDEC of the need to assess the impact of CCR material in surface streams or migration of ground water containing dissolved CCR constituents, TVA shall provide a plan to study the impact of CCR materials and/or constituents on fish and/or aquatic life in surface streams on the TVA site or adjacent to the TVA site.

TVA Response

A Fish Tissue SAP (Appendix U) has been prepared to help assess the potential impact of the WBF site activities on fish and/or aquatic life in surface streams adjacent to the site, and to assist in providing an overall view of WBF site conditions.

The objective of the fish tissue sampling is to characterize moisture content and metals from the CCR constituent list (excluding radium), and strontium in fish tissues collected near WBF. Three surface water reaches have been selected for the collection of fish and associated fish tissue as shown in Exhibit 20 (Appendix E).

These five sites are strategically located based on access, current hydrogeologic knowledge, and the greatest expectation of successfully capturing target fish species. The results from the analysis of fish tissue will be used to determine whether fish in the immediate vicinity and downstream of WBF have higher concentrations of CCR-related constituents than fish from reference locations not adjacent to or downstream from WBF. The results from implementation of this SAP will be evaluated and addressed in the EAR.

Other biological studies TVA will include as part of the investigation include a benthic invertebrate study developed to assess the status of the benthic community, and a bioaccumulation study on mayflies. These biological studies are included in the Benthic SAP (see Section 4.5.2).

5.0 ENVIRONMENTAL ASSESSMENT REPORT (EAR)

The EIP and EAR process is described in the TDEC Order. Within 60 days of completion of the EIP activities, TVA will submit the EAR to TDEC. The EAR will address the list of tasks required by TDEC in its response to the Investigation Conference meeting.

TDEC will review the report to evaluate whether the tasks have been fully addressed in helping determine whether there are unacceptable risks resulting from the management and disposal of CCR. The EIP and EAR process will be repeated until TDEC concludes that there is sufficient information to adequately characterize the extent of CCR contamination in the soil, surface water, and groundwater at the site.

Upon approval of the EAR by TDEC, TVA will then submit within 60 days, a Corrective Action/Risk Assessment (CARA) Plan. The CARA Plan will specify the actions TVA will take at the site and the basis of those actions. Corrective measures may include (1) soil, surface water, and groundwater remediation, (2) risk assessment and institutional controls, or (3) no further corrective action.

6.0 REFERENCES

AECOM (2016). "Slag Disposal Area Maintenance - TVA Project 901670 - Construction Record Documentation Report (Rev. 0)." Prepared for Tennessee Valley Authority. January 18.

CDM Smith (2012a). “Report – Revision No. 1, Existing Conditions Stability Analyses, Ash Pond Area at Watts Bar Fossil Plant.” Prepared for Tennessee Valley Authority. April 30.

CDM Smith (2012b). “Ash Pond Breaching Project Work Plan 1.” Calculation No. GENWBFFESCDX0000002012001005, Revision 0. Prepared for Tennessee Valley Authority. August 17.

CDM Smith (2012c). “Geotechnical Design Memorandum, Watts Bar Fossil Plant Coal Combustion Products Closure Project, Phase 2 – Ash/Stilling Pond Breaching Project.” Internal memorandum. August 17.

CDM Smith (2013). “WBF Ash Closure Project – Preliminary Slope Stability Analyses.” Calculation Form, Revision 2. October 15.

CDM Smith (2015). “Construction Record Documentation Report, Workplan 2: Ash Pond Closure Project, WBF-10W254-WP-2”. March.

Environmental Protection Agency (EPA). 2015a. “Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule.” Federal Register, Vol. 80, No. 74, Part II, Environmental Protection Agency, 40 CFR Parts 257 and 261. April 17.

Environmental Protection Agency (EPA). 2015b. “ProUCL Version 5.1 User Guide. Statistical Software for Environmental Applications for Data Sets and without Nondetect Observations.” October 2015.

Fox, PP (1942). “Watts Bar Steam Plant, Exploration and Geology of Foundation.” Prepared for Tennessee Valley Authority, Water Control Planning Department, Geologic Division. April.

Hardeman, WD (1966). “Geologic Map of Tennessee [East Central Sheet].” Tennessee Division of Geology.

Law Engineering, Incorporated. (1991). “Watts Bar Fossil Plant, Report of Environmental Services”. January.

Law Environmental, Inc. (1989). “Tennessee Valley Authority, Watts Bar Fossil Plant, Report for Preliminary Detection Assessment”. December.

Lemiszki, PJ (2008). "Geologic Map of the Decatur Quadrangle, Tennessee." Tennessee Division of Geology.

Stantec (2017). "Groundwater Optimization - Phase 3, Watts Bar Fossil Plant". Prepared for Tennessee Valley Authority. March 2017.

Tennessee Valley Authority (1949). "The Watts Bar Steam Plant, A Comprehensive Report on the Planning, Design, Construction, and Initial Operation of the Watts Bar Steam Plant." Technical Report No. 8.

Tennessee Valley Authority (2007). "Tennessee Valley Authority, Watts Bar Fossil Plant, Closure and Post-Closure Plan, Slag Processing and Pond Area." Revision 0. April.

Tennessee Valley Authority. (2009a). "Watts Bar Slag Processing and Pond Area Closure." Drawing Series 10W425.

Tennessee Valley Authority (2009b). "Tennessee Valley Authority, Watts Bar Fossil Plant, Watts Bar Slag Processing and Pond Area Closure." Revision 0. August.

Tennessee Valley Authority (2013). "Tennessee Valley Authority, Watts Bar Fossil Facility, NPDES Permit No. TN0005461, Ash Pond Closure Plan". November.

Tennessee Valley Authority (2014). "Tennessee Valley Authority, Ash Pond-River Bank Stabilization, Watts Bar Fossil Facility, Rhea County, Tennessee". November.

Tennessee Valley Authority (2015). "Tennessee Valley Authority, Watts Bar Fossil Plant, Ash Pond Closure (NPDES TN0005461) Groundwater Monitoring Report Submittal for January 2015 Sampling". March.

Tennessee Valley Authority (2016). "Biological Monitoring of the Tennessee River near Watts Bar Nuclear Plant Discharge, Autumn 2015". May.

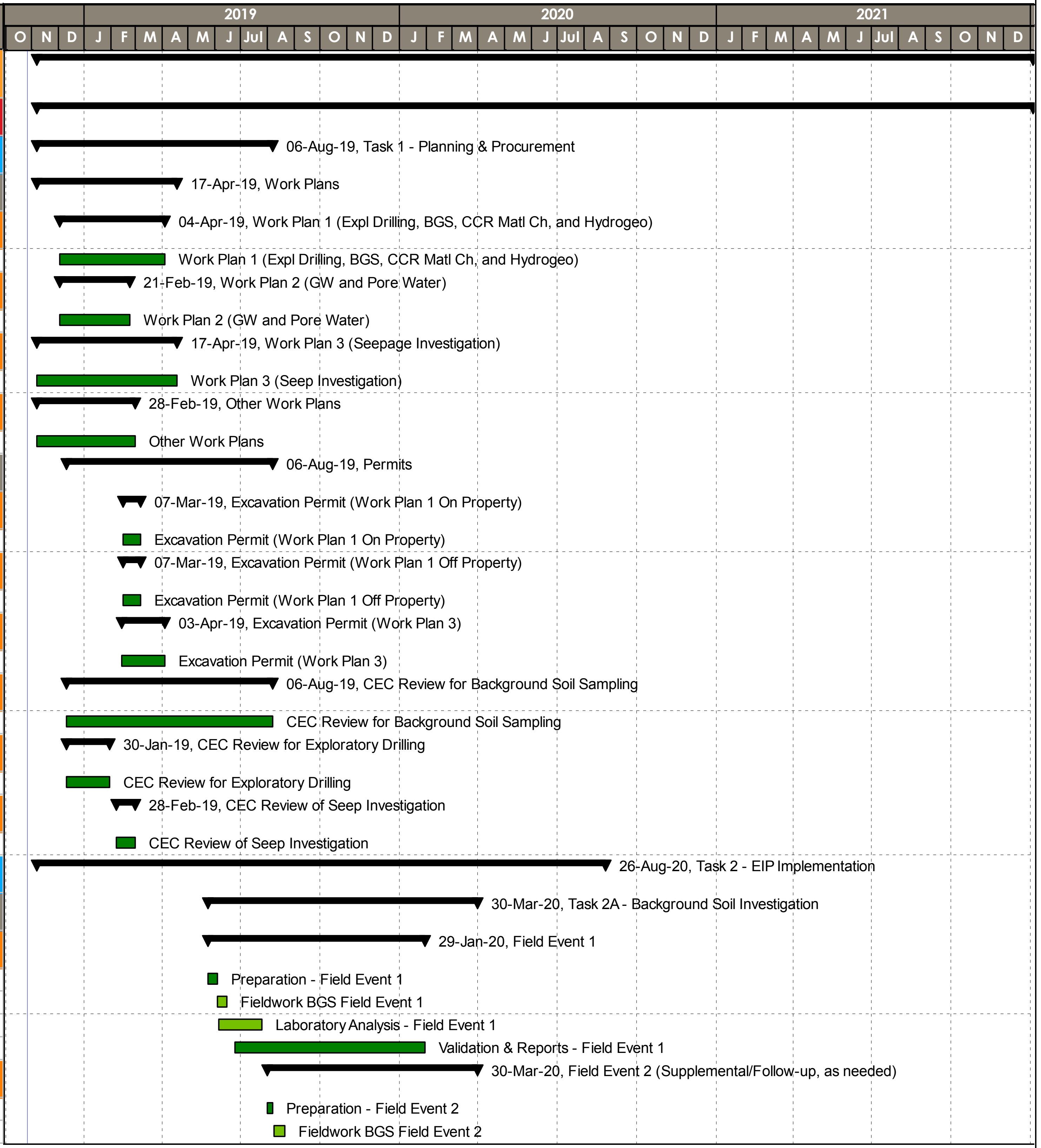
United States Geological Survey (USGS). 1935. USGS Topographic Map of the Decatur Quadrangle.

United States Geological Survey (USGS). 1942. USGS Topographic Map of the Decatur Quadrangle

APPENDIX A
SCHEDULE

ST612103-003 TDEC Order WBF Phase 2-TDEC Reporting

Activity ID	Activity Name	Remaining Duration	Start	Finish
TDEC Order WBF Phase 2		790d	07-Nov-18	03-Jan-22
Environmental Investigation		790d	07-Nov-18	03-Jan-22
Task 1 - Planning & Procurement		187d	07-Nov-18	06-Aug-19
Work Plans		110d	07-Nov-18	17-Apr-19
Work Plan 1 (Expl Drilling, BGS, CCR Matl Ch, and Hyd		85d	03-Dec-18	04-Apr-19
STN-11015	Work Plan 1 (Expl Drilling, BGS, CCR Matl Ch, and Hydrogeo)	85d	03-Dec-18	04-Apr-19
Work Plan 2 (GW and Pore Water)		55d	03-Dec-18	21-Feb-19
STN-11115	Work Plan 2 (GW and Pore Water)	55d	03-Dec-18	21-Feb-19
Work Plan 3 (Seepage Investigation)		110d	07-Nov-18	17-Apr-19
STN-11315	Work Plan 3 (Seep Investigation)	110d	07-Nov-18	17-Apr-19
Other Work Plans		76d	07-Nov-18	28-Feb-19
STN-11415	Other Work Plans	76d	07-Nov-18	28-Feb-19
Permits		166d	10-Dec-18	06-Aug-19
Excavation Permit (Work Plan 1 On Property)		15d	14-Feb-19	07-Mar-19
STN-12115	Excavation Permit (Work Plan 1 On Property)	15d	14-Feb-19	07-Mar-19
Excavation Permit (Work Plan 1 Off Property)		15d	14-Feb-19	07-Mar-19
STN-12215	Excavation Permit (Work Plan 1 Off Property)	15d	14-Feb-19	07-Mar-19
Excavation Permit (Work Plan 3)		35d	13-Feb-19	03-Apr-19
STN-98370	Excavation Permit (Work Plan 3)	35d	13-Feb-19	03-Apr-19
CEC Review for Background Soil Sampling		166d	10-Dec-18	06-Aug-19
STN-12615	CEC Review for Background Soil Sampling	166d	10-Dec-18	06-Aug-19
CEC Review for Exploratory Drilling		35d	10-Dec-18	30-Jan-19
STN-12715	CEC Review for Exploratory Drilling	35d	10-Dec-18	30-Jan-19
CEC Review of Seep Investigation		16d	06-Feb-19	28-Feb-19
STN-12815	CEC Review of Seep Investigation	16d	06-Feb-19	28-Feb-19
Task 2 - EIP Implementation		453d	07-Nov-18	26-Aug-20
Task 2A - Background Soil Investigation		212d	24-May-19	30-Mar-20
Field Event 1		170d	24-May-19	29-Jan-20
STN-21096	Preparation - Field Event 1	6d	24-May-19	03-Jun-19
STN-21010	Fieldwork BGS Field Event 1	10d	03-Jun-19*	14-Jun-19
TVA-21020	Laboratory Analysis - Field Event 1	36d	05-Jun-19	25-Jul-19
STN-21098	Validation & Reports - Field Event 1	150d	24-Jun-19	29-Jan-20
Field Event 2 (Supplemental/Follow-up, as needed)		166d	31-Jul-19	30-Mar-20
STN-21196	Preparation - Field Event 2	6d	31-Jul-19	07-Aug-19
STN-21100	Fieldwork BGS Field Event 2	10d	08-Aug-19	21-Aug-19



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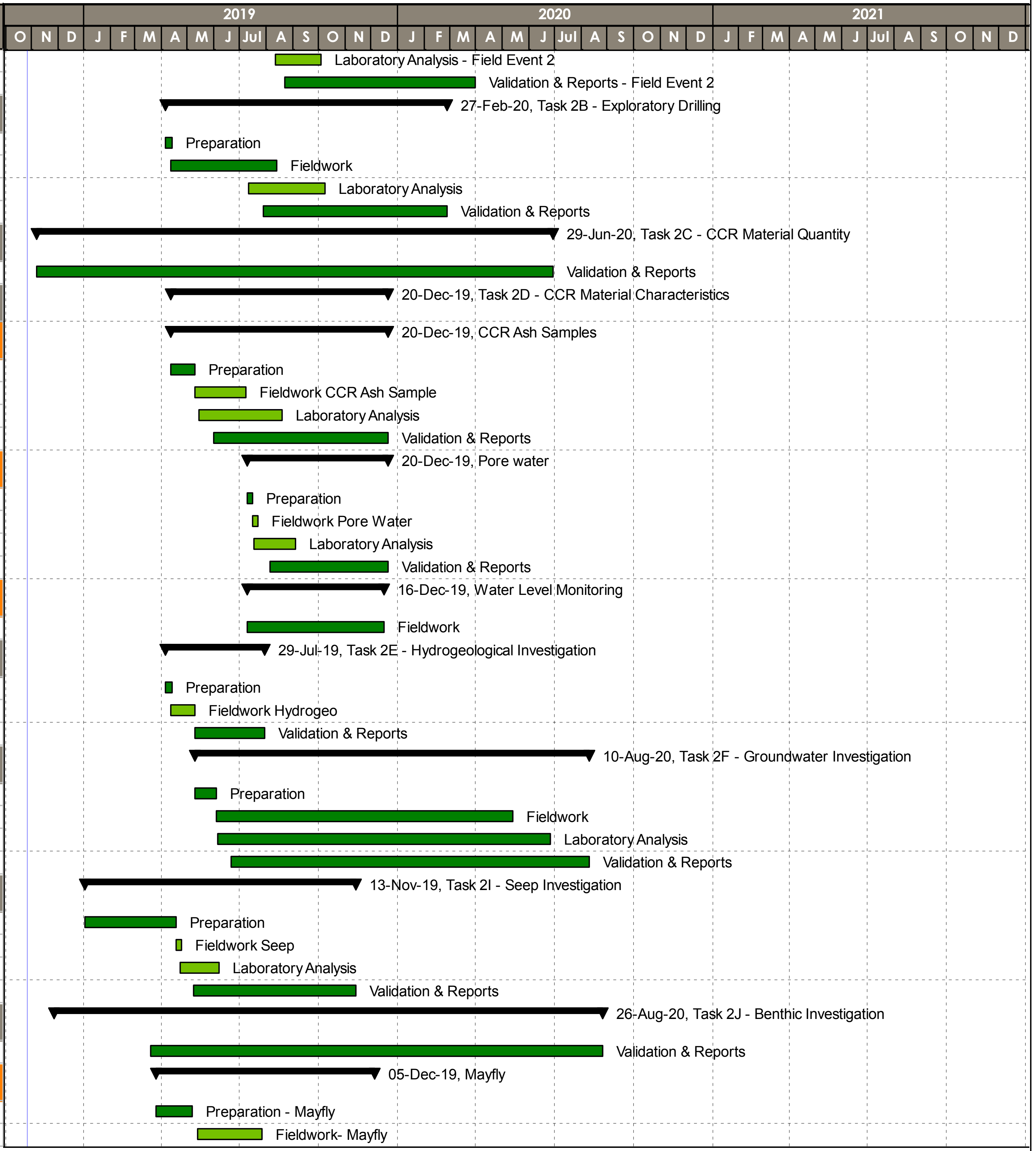
Layout: Execution Schedule EIP (WBS) TDEC

Data Date:27-Oct-18
Print Date:14-Nov-18

ST612103-003 TDEC Order WBF Phase 2-TDEC Reporting

Activity ID	Activity Name	Remaining Duration	Start	Finish
TVA-21110	Laboratory Analysis - Field Event 2	38d	12-Aug-19	03-Oct-19
STN-21198	Validation & Reports - Field Event 2	150d	22-Aug-19	30-Mar-20
Task 2B - Exploratory Drilling		225d	05-Apr-19	27-Feb-20
STN-22096	Preparation	6d	05-Apr-19	12-Apr-19
STN-22097	Fieldwork	85d	12-Apr-19	12-Aug-19
STN-22040	Laboratory Analysis	63d	11-Jul-19	08-Oct-19
STN-22098	Validation & Reports	146d	29-Jul-19	27-Feb-20
Task 2C - CCR Material Quantity		412d	07-Nov-18	29-Jun-20
STN-23098	Validation & Reports	412d	07-Nov-18	29-Jun-20
Task 2D - CCR Material Characteristics		175d	12-Apr-19	20-Dec-19
CCR Ash Samples		175d	12-Apr-19	20-Dec-19
STN-24096	Preparation	21d	12-Apr-19	10-May-19
STN-24010	Fieldwork CCR Ash Sample	40d	10-May-19	08-Jul-19
TVA-24020	Laboratory Analysis	68d	14-May-19	19-Aug-19
STN-24098	Validation & Reports	141d	31-May-19	20-Dec-19
Pore water		115d	09-Jul-19	20-Dec-19
STN-24094	Preparation	6d	09-Jul-19	16-Jul-19
STN-24110	Fieldwork Pore Water	5d	16-Jul-19	22-Jul-19
TVA-24120	Laboratory Analysis	33d	18-Jul-19	03-Sep-19
STN-24099	Validation & Reports	96d	05-Aug-19	20-Dec-19
Water Level Monitoring		111d	09-Jul-19	16-Dec-19
STN-24097	Fieldwork	111d	09-Jul-19	16-Dec-19
Task 2E - Hydrogeological Investigation		80d	05-Apr-19	29-Jul-19
STN-25096	Preparation	6d	05-Apr-19	12-Apr-19
STN-25010	Fieldwork Hydrogeo	20d	12-Apr-19	09-May-19
STN-25098	Validation & Reports	55d	10-May-19	29-Jul-19
Task 2F - Groundwater Investigation		315d	10-May-19	10-Aug-20
STN-26096	Preparation	16d	10-May-19	03-Jun-19
STN-26097	Fieldwork	240d	03-Jun-19	14-May-20
STN-26098	Laboratory Analysis	268d	05-Jun-19	26-Jun-20
STN-26099	Validation & Reports	286d	21-Jun-19	10-Aug-20
Task 2I - Seep Investigation		219d	02-Jan-19	13-Nov-19
STN-29096	Preparation	75d	02-Jan-19	18-Apr-19
STN-29110	Fieldwork Seep	5d	18-Apr-19	24-Apr-19
TVA-29120	Laboratory Analysis	33d	22-Apr-19	06-Jun-19
STN-29098	Validation & Reports	131d	08-May-19	13-Nov-19
Task 2J - Benthic Investigation		442d	26-Nov-18	26-Aug-20
STN-29A098	Validation & Reports	365d	19-Mar-19	26-Aug-20
Mayfly		178d	25-Mar-19	05-Dec-19
STN-29202	Preparation - Mayfly	31d	25-Mar-19	06-May-19
TVA-29210	Fieldwork- Mayfly	53d	13-May-19*	26-Jul-19



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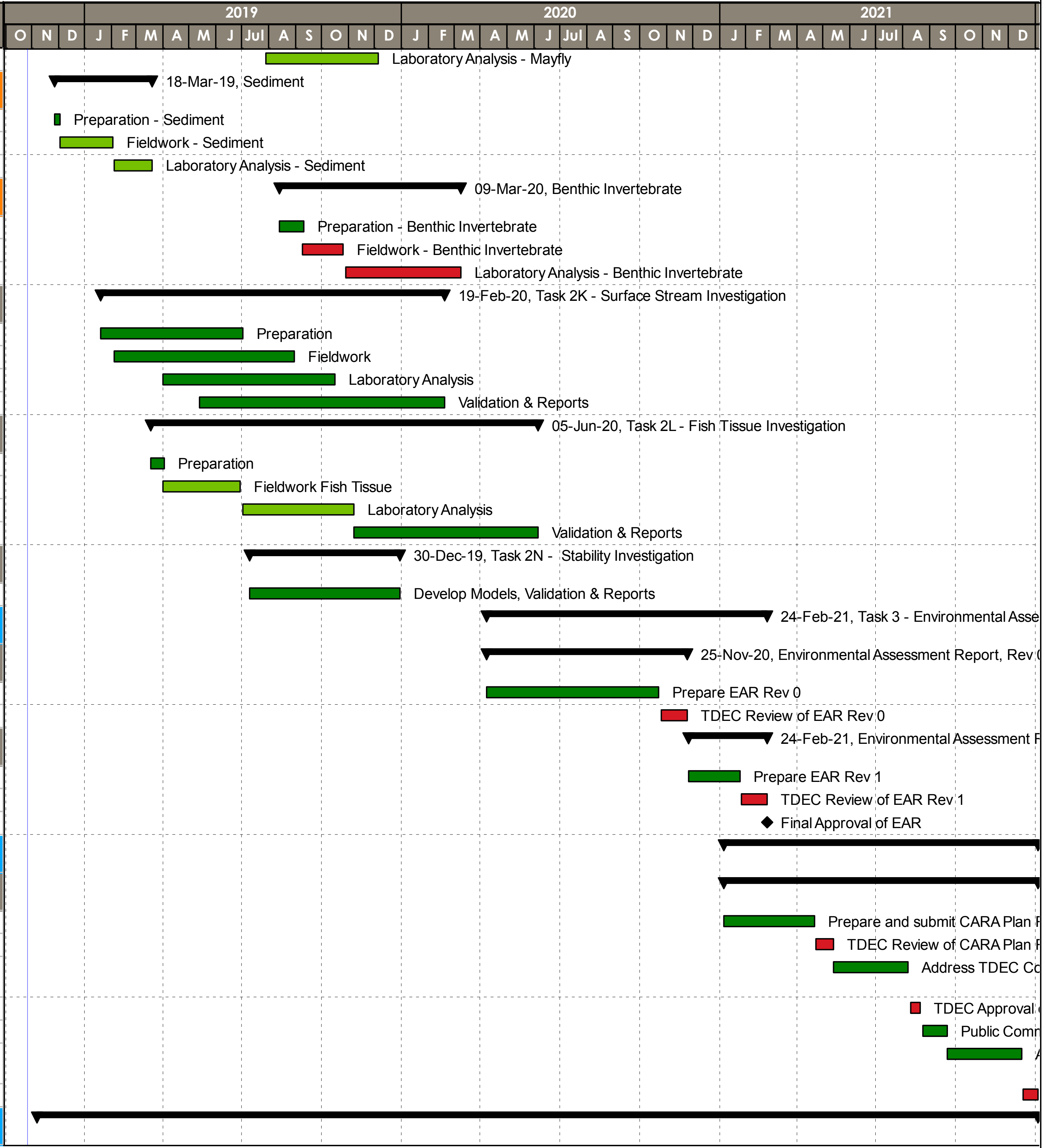
Data Date:27-Oct-18
Print Date:14-Nov-18

ST612103-003 TDEC Order WBF Phase 2-TDEC Reporting

Activity ID	Activity Name	Remaining Duration	Start	Finish
TVA-29212	Laboratory Analysis - Mayfly	90d	29-Jul-19	05-Dec-19
Sediment		77d	26-Nov-18	18-Mar-19
STN-29216	Preparation - Sediment	6d	26-Nov-18	03-Dec-18
TVA-29221	Fieldwork - Sediment	42d	03-Dec-18*	01-Feb-19
TVA-29222	Laboratory Analysis - Sediment	30d	04-Feb-19	18-Mar-19
Benthic Invertebrate		142d	13-Aug-19	09-Mar-20
STN-29227	Preparation - Benthic Invertebrate	19d	13-Aug-19	09-Sep-19
TVA-29228	Fieldwork - Benthic Invertebrate	34d	09-Sep-19*	25-Oct-19
TVA-29232	Laboratory Analysis - Benthic Invertebrate	90d	28-Oct-19	09-Mar-20
Task 2K - Surface Stream Investigation		272d	18-Jan-19	19-Feb-20
STN-29330	Preparation	114d	18-Jan-19	01-Jul-19
STN-29332	Fieldwork	147d	04-Feb-19	30-Aug-19
TVA-29342	Laboratory Analysis	138d	01-Apr-19	15-Oct-19
STN-29362	Validation & Reports	193d	13-May-19	19-Feb-20
Task 2L - Fish Tissue Investigation		309d	18-Mar-19	05-Jun-20
STN-29509	Preparation	11d	18-Mar-19	01-Apr-19
TVA-29510	Fieldwork Fish Tissue	64d	01-Apr-19*	28-Jun-19
TVA-29520	Laboratory Analysis	90d	01-Jul-19	06-Nov-19
STN-29522	Validation & Reports	145d	07-Nov-19	05-Jun-20
Task 2N - Stability Investigation		120d	09-Jul-19	30-Dec-19
STN-29760	Develop Models, Validation & Reports	120d	09-Jul-19	30-Dec-19
Task 3 - Environmental Assessment Report (EAR)		222d	07-Apr-20	24-Feb-21
Environmental Assessment Report, Rev 0		162d	07-Apr-20	25-Nov-20
STN-31096	Prepare EAR Rev 0	140d	07-Apr-20	23-Oct-20
STN-31150	TDEC Review of EAR Rev 0	22d	26-Oct-20	25-Nov-20
Environmental Assessment Report, Rev 1		60d	27-Nov-20	24-Feb-21
STN-32096	Prepare EAR Rev 1	39d	27-Nov-20	25-Jan-21
STN-32170	TDEC Review of EAR Rev 1	21d	26-Jan-21	24-Feb-21
STN-32180	Final Approval of EAR	0d		24-Feb-21
Task 10 - CARA		249d	06-Jan-21	03-Jan-22
Meetings & Deliverables		249d	06-Jan-21	03-Jan-22
STN-98254	Prepare and submit CARA Plan Rev 0 for TDEC Review	74d	06-Jan-21	21-Apr-21
TVA-98255	TDEC Review of CARA Plan Rev 0	15d	22-Apr-21	12-May-21
STN-98256	Address TDEC Comments on CARA Plan Rev 0, Prepare and submit Rev 1 to TDEC	60d	13-May-21	06-Aug-21
TVA-98295	TDEC Approval of CARA Plan Rev 1	10d	09-Aug-21	20-Aug-21
STN-98296	Public Comment Period	20d	23-Aug-21	20-Sep-21
STN-98298	Address Public Comments on CARA Plan Rev 1 and Prepare CARA Plan Rev 2 for TDEC	60d	21-Sep-21	16-Dec-21
TVA-98345	TDEC Final Approval of CARA Plan Rev 2	10d	17-Dec-21	03-Jan-22
Task 11 - Project Communications & Reporting		790d	07-Nov-18	03-Jan-22



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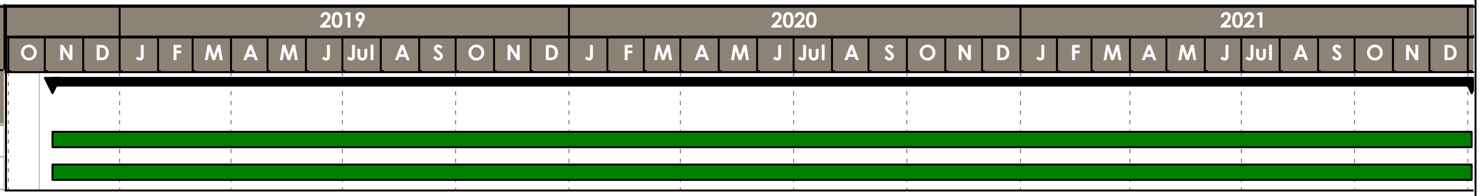
ST612103-003   TDEC Order WBF Phase 2-TDEC Reporting

Activity ID	Activity Name	Remaining Duration	Start	Finish
Task 11A - TDEC Updates		790d	07-Nov-18	03-Jan-22
TVA-96110	TDEC Monthly Progress Reports	790d	07-Nov-18	03-Jan-22
TVA-96120	TDEC Progress Update Meetings (Quarterly)	790d	07-Nov-18	03-Jan-22



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Layout: Execution Schedule EIP (WBS) TDEC

Data Date:27-Oct-18
Print Date:14-Nov-18

APPENDIX B
REGULATORY CORRESPONDENCE

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
CHATTANOOGA ENVIRONMENTAL FIELD OFFICE
540 McCALLIE AVENUE, SUITE 550
CHATTANOOGA, TENNESSEE 37402
PHONE (423) 634-5745 STATEWIDE 1-888-891-8332 FAX (423) 634-6389

July10, 2007

Mr. John E. Dizer, P.E.
Tennessee Valley Authority
Environmental Affairs
1101 Market Street
Chattanooga, TN 37402-7011

Re: TVA Watts Bar Fossil Plant
Slag Processing and Ash Pond Area
Closure and Post-Closure Plan Approval

Dear Mr. Dizer:

Following a field inspection by Guy Moose and Joe Hartman with this Division, TVA submitted a Closure and Post-Closure Plan for the slag processing and ash pond area at the TVA Watts Bar Fossil Plant near Spring City, Rhea County, Tennessee.

The plan has been reviewed by personnel in this office for compliance with the rules and regulations promulgated under the Tennessee Solid Waste Disposal Act, TCA 68-211-101, et seq. The plan is hereby approved. One copy is being returned to you with this letter, and copies are being retained for our Nashville and Chattanooga files.

Please notify this office when the closure is complete, so that a final inspection can be scheduled.

Signed: Joe Hartman
Joe Hartman
Solid Waste Field Supervisor

Approved: G M. Moose
Guy M. Moose
Program Manager

Enclosure: Closure and Post-Closure Plan

cc: Division of Solid Waste Management, Nashville

DIVISION OF WATER POLLUTION CONTROL
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
321 Rosa Parks Blvd., 11th Floor, TN Tower
NASHVILLE TN 37243

April 7, 2014

Mr. Terry E. Cheek, Senior Manager
Water Permits and Compliance
Tennessee Valley Authority
1101 Market Street BR4A
Chattanooga, TN

Subject: **Approval of Ash Pond Closure Plan – Former Watts Bar Fossil Facility**
NPDES Permit No. TN0005461
Spring City, Rhea County, Tennessee

Dear Mr. Cheek:

In this letter, the Divisions of Water Resources and Solid Waste Management (DSWM) provide our review comments on the subject plan. These comments include observations from the recent site visits by TDEC staff. We have observed progress toward dewatering of the ash pond and construction of the new spillway with TSS control measures.

Accordingly, TDEC approves the subject plan as required by Part IV of the NPDES permit, and with the following conditions:

1) The ash pond closure schedule at Attachment B must be revised to include a task for implementation of Groundwater Monitoring prior to closure.
2) Section 5, Closure Requirements, must identify that quarterly updates of closure activities will continue to be submitted to the Division of Water Resources with Discharge Monitoring Reports until the ash pond has been dewatered, converted to a stormwater pond, and regulated under SWM rules. At the time of transmittal of these updates, TVA can also provide findings from semi-annual groundwater monitoring shown in Sec. 5.2.
3) Special attention must be placed on dewatering operations during the ash pond closure to minimize discharge of coal ash and total suspended solids.

The recent proposal to reroute runoff and groundwater seeps around the project, as described in Mr. Markum's email of February 12, 2014, is a positive step toward minimizing solids discharges. Should you have questions on the above conditions, , please contact Mr. Bob Alexander at (615) 532-0659 or by E-mail at Robert.Alexander@tn.gov.

Sincerely:

Vojin Janjić
Manager, Permit Section

CC w/ Encl: DWPC, Permit Section & Chattanooga Environmental Field Office
Div. of Solid Waste Management, Attn: Glen Pugh and Tal Kitchen

Chuck Head, Senior Advisor
Bureau of Environment
TN Department of Environment & Conservation
William R. Snodgrass - TN Tower
312 Rosa L. Parks Ave., 2nd Floor
Nashville, TN 37243
615 532-0998
chuck.head@tn.gov

Robert J. Martineau, Jr.
Commissioner

Bill Haslam
Governor

June 14, 2016

Mr. Paul Pearman, Project Manager
Tennessee Valley Authority
1101 Market Street
Chattanooga, TN 37402

RE: TVA Watts Barr Fossil Plant
Environmental Investigation Plan

Dear Mr. Pearman:

This letter serves as a follow-up to our meeting with the Tennessee Valley Authority (TVA) on April 27th 2016 regarding the TVA Watts Bar Fossil Plant (TVA Watts Bar). This meeting fulfilled Section VII.A.a. of Commissioner's Order OGC15-0177 (the Order). The TN Department of Environment and Conservation (TDEC) appreciates the time and effort of your staff and consultants in presenting a summary of the geologic, hydrologic, analytical, engineering and historic data for TVA Watts Bar. Our staff found the information presented to be more easily understood than by reviewing all the written records for the site and greatly appreciated the opportunity to ask questions and to discuss technical issues. TVA Watts Bar is a dormant CCR disposal site adjacent to Watts Bar Reservoir.

Our staff members met following the Watts Bar meeting to discuss what we learned about the site and identified additional information needed from TVA about this site to fully understand its current status and the amount and location of all CCR material disposed at the site. Section VII.A.b. of the Order requires TDEC, after the initial TDEC/TVA on-site meeting to provide TVA with a written response identifying additional work and/or information needed at each TVA CCR site. TVA is required to submit this information in its proposed Environmental Investigation Plan (EIP).

TDEC has specific questions about the disposal of CCR material at the TVA Watts Bar site. Those questions are listed below. You will also find attached to this letter a guidance document (Attachment A) which contains a general description of the items that should be addressed in the Environmental Investigation Plan for each TVA Fossil Plant (active and closed).

TVA Watts Bar Specific Questions and Concerns

1. TVA shall provide additional information regarding the potentiometric surface (ground water flow rate and direction) under and near the site's waste boundaries. The potentiometric surfaces included in the groundwater monitoring reports are limited in coverage. Coverage includes a portion of the Ash Pond Area and does not take include the Slag Disposal Area (Historic Fly Ash Pond). TVA shall include in its TVA Watts Bar Environmental Investigation Plan (EIP) the information that it used to determine the location of additional monitoring wells around all waste boundaries on site. TVA shall identify the location and number of borings/ground water monitoring wells that will be installed to better characterization and monitoring the Watts Bar site in the EIP.

2. The boring logs presented for the 3 Monitoring Wells do not match. Please clarify what the well logs actually represent.

3. TVA shall organize information from all borings/ground water monitoring wells to provide site characterization to support current ground water monitoring program. The inventory of this information shall be included in the EIP. All data gathered from the installation borings/ground water monitoring wells shall be included in the Environmental Assessment Report (EAR) for the site.

4. TVA shall include in the EIP a schedule for the installation of additional borings/groundwater monitoring wells as well as a map identifying the boring/ground water monitoring locations.

5. Existing or additional site characterization shall include a discussion of fluctuations in ground water elevations that may be connected to Chickamauga Lake levels, seasonal variations or other factors.

6. Existing or additional site characterization shall estimate the amount of CCR material that is below the highest recorded ground water potentiometric surface.

7. Characterization of the site's hydrogeology is needed better evaluate Red-Water seeps. The seeps remained active after the closure of the Slag Disposal Area (Historic Fly Ash Pond). This suggests that the hydraulic driver for the seeps may not be related to infiltration of storm water through the closure cap and into the waste mass.

8. The ground water flow regime and soil pore pressures need to be better understood as potential driving forces for documented seeps. Groundwater recharge in the closed Slag Disposal Area needs to be better understood. Areas of investigation are as follows:

    a. Possible influences in site hydrology under and near the site's waste boundary based on its proximity to Watts Bar Dam.

    b. Natural occurring springs that may have existed in the area prior to development of the disposal areas.

    c. Dewatering measures and the effectiveness of the measures prior to closure of the Slag Disposal Area.

    d. How well the closure cap is functioning; is the cap significantly reducing surface water infiltration into the waste mass.

    e. TVA shall provide representative soil and water sample results for the constituents (Appendices III and IV of the Federal CCR rule) found in proximity to the Red-Water seeps.

TVA shall submit the proposed EIP for the TVA Watts Bar site on or before close of business on November 15, 2016.

It is our goal to work with TVA to ensure the environmental investigation of the TVA Watts Bar site is complete, accurate and timely. Please review the Watts Bar specific questions presented in this letter and Attachment A as you prepare the draft Watts Bar EIP. If you or staff members have any questions, please contact us.

Sincerely,

Chuck Head

Chuck Head

CC:	Shari Meghreblian, Ph. D.	Tisha C. Benton	Wilbourne C. Markham, Jr., P.E.
	E. Joseph Sanders	Britton Dotson	Samuel Hixson
	Patrick J. Flood, P.E.	Glen Pugh	Neil Carricker

Appendix A

General Guidelines for Environmental Investigation Plans

TVA Fossil Plants

TDEC anticipates that the 1st iteration of each TVA Environmental Investigation Plan (EIP) will generate comments and/or questions from TDEC as the review is conducted. TDEC recognizes that each TVA site will have differences due to local geology and plant operation. TDEC believes providing TVA with the guidance for the scope of work for the EIP will significantly limit review time and increase the pace of environmental investigation work at each TVA site. This guidance document is divided into 5 sections based upon different aspects of the TVA Fossil Plants that must be fully environmentally assessed to accurately characterize the site as required in the TN Department of Environment and Conservation (TDEC) and Tennessee Valley Authority Multi-site Order (Order). TDEC believes that successful implementation of the EIP and completion of the corresponding Environmental Assessment Report (EAR) shall provide sufficient information to determine the most appropriate corrective action options to address any environmental and/or public health concerns.

Environmental Investigation Plan Guidance

A. Site Information

TVA shall provide information about CCR storage and disposal sites at the TVA Fossil Plant. TDEC expects TVA to include how it will provide the following information about each TVA Fossil Plant site as a part of its EIP:

1. All information about the natural chemistry of the soils in the area of the TVA Fossil Plant. This includes the naturally occurring levels of metals and other CCR constituents present in the soil. TVA shall propose, in the EIP, the collection of soil samples within a one-mile radius of the specific fossil plant to supplement the information gained from local soil studies, reports or soil profiles. Of particular interest are all constituents listed in the federal CCR regulations Appendix 3 Detection Monitoring and Appendix 4 Assessment Monitoring found on page 21500 of the Friday, April 17, 2015 Federal Register (Appendices 3 and 4 CCR constituents)

   TVA shall report the levels of naturally occurring CCR constituents as reported in existing documents and the results of soil samples collected per a TDEC Approved EIS in the (EAR) for that site. TVA shall submit maps that identify the location of soil samples in proximity to the TVA Fossil Plant when the EAR is submitted.

2. TVA shall propose a sampling plan to determine the leachability of CCR constituents from CCR material in surface Impoundments, landfills and non-registered sites at each TVA site. The plan should include sampling points at each disposal area and at different depths in each disposal area. TVA shall describe sample collection methods, sample transport, analytical methodology and the qualifications of the laboratory selected to perform the analyses.

3. Information about the area surrounding the TVA Fossil Plant location before the TVA Fossil Plant was constructed. TVA shall provide in its EIP, geologic maps before the impoundment was created; if an impoundment is adjacent to the TVA Fossil Plant site. TVA discuss topographic maps from the pre-embayment time period and how these maps will be used to identify surface water features such as springs, the original flow of surface streams, etc. in the Environmental Assessment Report (EAR);

4. Discuss if construction design information for original CCR surface impoundments; specifically any construction drawings or engineering plans are available. It is important to identify the surface elevation and location of surface impoundments, landfills or non-registered disposal areas when originally constructed. TVA should explain if/how the information to identify the materials used to construct these disposal areas.

5. Discuss the information available and additional information that will be gathered to provide a three-dimensional profile of the CCR materials from the current elevation of all surface impoundments, landfills and/or non-registered disposal sites to the natural occurring surface below each structure. Also discuss how TVA plans to provide an estimated amount of CCR material disposed within each structure and the total amount of CCR material disposed at each site. Discuss the methods that TVA will use to provide drawings (to scale) that illustrate the height, length and breadth of the CCR disposal areas in relation to the naturally occurring features of each site. Comprehensively define the amount and location off CCR material at each site.

   Also discuss how TVA plans to provide an estimated amount of CCR material disposed within each structure and the total amount of CCR material disposed at each site. Discuss the methods that TVA will use to provide drawings (to scale) that illustrate the height, length and breadth of the CCR disposal areas in relation to the naturally occurring features of each site.

6. Describe the method TVA shall use to provide a water balance analysis for active surface impoundments at each TVA site. This should include all wastewater and surface water runoff entering the impoundment from the TVA site and the amount of water discharged from the surface impoundment(s) into receiving streams at the NPDES permitted discharge point. TVA shall also describe briefly how it will determine the transpiration rate of water from the surface impoundment(s) into the atmosphere;

B. Water Use Survey

As a part of the Environmental Assessment, TVA is required to conduct a water use survey. The purpose of the water use survey is to determine if any surface water or ground water (water wells or springs) are being used by local residents or by TVA as domestic water supplies. TVA shall describe how it will conduct a water use survey within ½ mile of the boundary of the TVA site.

TVA shall describe how it will determine the construction, depth and location of private water wells identified in the survey. If TVA determines local surface water and/or ground water is used as a source of domestic water supply within a ½ mile radius of the TVA site, the EIP shall include an offsite ground water and surface water sampling plan as a part of the EIP.

C. Groundwater Monitoring and Mapping

The EPA CCR rules specify constituents that should be included for analysis for ground water sampling. The constituents for Ground Water Detection Monitoring are listed in Appendix 3 of the EPA CCR regulations and the constituents for Ground Water Assessment Monitoring are listed in Appendix 4 of the EPA CCR regulations. TDEC is requiring TVA to include a description of the ground water monitoring plan it will implement at each TVA site. All ground water samples collected as a part of the Ground Water Monitoring Plan shall be analyzed for the CCR constituents listed in **Appendices** 3 and 4 of the federal CCR regulations. Items to include in the EIP are:

1. A discussion of all ground water monitoring wells TVA has installed/abandoned/closed at the TVA site as well and any springs that have been monitored at the TVA site or adjacent to the TVA site. TVA shall discuss the data it TVA has generated from historical sampling of ground water monitoring wells and springs. TVA shall include all ground water monitoring construction information, location and historical ground water monitoring data in each TVA site's EAR.

2. A discussion of the location of at least two background ground water monitoring wells including the reasons for proposed their proposed location.

3. A discussion of additional ground water monitoring wells that will be installed to complete a ground water monitoring network at the TVA site around all surface impoundments, landfills and/or non-registered disposal sites; including the location of existing or proposed ground water monitoring wells down gradient of all CRCR disposal areas on the TVA site . TVA shall propose a ground water monitoring network that will provide data to develop a TVA site wide ground water potentiometric surface map. TVA shall ensure that the ground water monitoring locations (current and proposed) in the EIP will accurately determine groundwater flow and direction.

4. A discussion of the construction methods TVA will use to install additional ground water monitoring wells. This includes drilling method, methods and personnel for logging cuttings and cores, well construction and well development. A scaled diagram of a properly completed monitoring well shall be provided in the EIP

5. A ground water monitoring plan for sampling all wells and springs included in the monitoring network. This should include the methods TVA shall use to collect ground water samples, the analytical methods to be used for ground water sample analyses, methods for sample transport from point of collection to the laboratory and identification and qualification of the laboratory (ies) that will perform sample analyses.

6. Describe any existing information available and additional data needed to develop a map which identifies the current ground water surface elevation under the landfill(s), surface impoundment(s) and/or non-registered site(s). If additional data is needed to provide ground water elevations across the TVA site, below the footprint of the landfill(s), surface impoundment(s) and/or non-registered site(s), describe the methods TVA plans to use to collect the data. TVA shall collect sufficient data to create a map that clearly delineates the ground water surface in the ash disposal areas such that (1) the CCR material between the original ground surface and the top of the current ground water table is defined and (2) CCR material between the current ground water surface and the surface elevation of the CCR disposal area is clearly defined. TVA shall also collect pore water samples from CCR material that is below the current ground water surface and from CCR material that is below the projected ground water surface with closure in place. TDEC has not determined that closure in place is a corrective action option at any TVA site; however; this information is needed should TVA propose closure in place. 7.

7. Describe how TVA will define ground water contaminant plumes identified using currently available ground water monitoring data and new ground water monitoring data gathered from the installation and sampling of new ground water monitoring wells. TVA shall also discuss its strategy to determine the extent of any CCR constituent plume should the initial ground water monitoring network not define the full extent of the CCR constituent ground water plume at the TVA site. This should include the science it will use to extend its ground water monitoring network.

D. TVA Site Conditions

1. Discuss all current information available about the geologic lithology (formations, bedding planes, etc.) and their relevance to natural seeps, springs and karst features on the TVA site; including the CCR disposal areas. Some limestone formations are very susceptible to solution channeling, especially when they have been disturbed through natural events or construction activities such as blasting. TVA shall describe the methods it will use to determine whether solution channeling has occurred at and near the soil/rock interface;

2. Discuss all current information about the geologic structure below the TVA site and how it may be used to help determine if faults and/or fractures have been identified in the subsurface. TVA shall describe the methods it will use to collect additional data (faults, fractures, bedding planes, karst features, etc.) to determine whether faulting and fracturing has impacted and/or controls groundwater movement. Describe how TVA will determine if identified faults, fractures, bedding planes, karst features, etc. are filled to the point that they limit or eliminate ground water flow.

3. Discuss existing data available to TVA to map top of bedrock; i.e. existing boring and ground water monitoring well construction data. TVA shall describe the methods (surface geophysics; installation of borings/ground water monitoring wells) it will use to collect additional data to

map top of bedrock. The EIP shall include a description of the data collection methods TVA will use to determine the thickness and types of natural material overlying bedrock as well as the top of bedrock contours. For all new soil borings, TVA shall provide the location of the borings, the information used to determine boring location, the drilling method to be used, how the borings will be logged. Logging shall be performed by a Professional Geologist licensed to practice in Tennessee. Logs shall provide the following information when presented in the EAR; soil type, depth and changes, identify geologic formations, depth of formation, karst features, fractures, bedding planes, and any other pertinent information. TVA shall provide an example of a boring log in the EIP.

4. When/if TVA divided original Coal Combustion Residual (fly ash, bottom ash and gypsum) surface impoundments into individual units (surface impoundments, non-registered disposal areas and or landfills), TVA shall discuss where this has happened on each TVA site. As a part of the EAR, TVA shall discuss the source of information reviewed to provide the specifications of those structural changes. Discuss if there are as built drawings or engineering plans for the modifications TVA has made at each site made. If there is not existing information that describes the structural changes in the original surface impoundment(s) or non-registered site(s), TVA shall discuss in the EIP how it will collect the information needed to document structural changes over time. This information is needed in determining the structural and seismic stability of each TVA site

5. Stipulate whether there are any as-built designs for the interface between the originally disposed CCR material and any disposal structures constructed above the original disposal area.

6. TVA shall discuss any existing stability calculations for final permitted design elevation for all landfills. Unless TDEC specifies otherwise, TVA shall conduct new stability calculations for all landfills, surface impoundments and/or non-registered disposal sites. The EIP shall describe the method TVA will use to determine structural stability. TVA shall provide stability calculations for each disposal area based upon (1) the permitted final elevation or planned final elevation for each landfill, (2) the current elevation for all surface impoundments and/or (3) the current elevation for all non-registered disposal location.

7. TVA shall specify how it will determine the construction methods and properties of the drainage layers between each “stacked layer” for permitted CCR landfills; including where the drainage layer discharges.

8. TVA shall review Section VI.D.5 (page 21373) of the section of the Federal CCR Preamble that describes areas of concern regarding overfill at landfills. TVA shall explain how it will determine if there are potential overfill situations for each surface impoundment/landfill at the TVA site.

9. Discuss current information/data that is available to estimate the shear strength of the CCR materials in the landfill(s), surface impoundment(s) and/or nonregistered sites. If there is not sufficient data available to determine shear strength, describe the methods TVA shall use to collect this data. If there is existing data collected during installation of soil/rock borings or

construction of ground water monitoring wells, provide a brief description of this data and how it will be presented for use in the EIP.

10. TVA shall provide **static, seismic and liquefaction analysis in accordance with 257.63 and 257.73 of the Federal CCR regulations** for final permitted design elevations for Landfills that are defined by the Federal Regulations as overfills. If the **analyses** have not been completed, then TVA shall provide **analyse**s for each landfill based upon either the permitted final elevation for each or for the planned final elevation for each; should TVA decide it does not need to use the entire permitted capacity of any permitted CCR landfill. **TVA shall identify and analyze the critical cross section(s) and document that the modeling represents the actual field conditions at the cross section location(s). TVA shall also address foundation settlement of these Landfills.**

11. TVA shall discuss any current dam safety analysis performed at the TVA site for all landfills, surface impoundments and/or non-registered disposal areas. If dam safety analysis has not been performed for each disposal area or if TDEC determines the dam safety analysis is inadequate, then TVA shall describe the method(s) it will use to determine the "dam safety factor" for all disposal areas at the TVA site.

12. TVA shall discuss any current information or assessments regarding seismic stability for the TVA site, including existing seismic analysis for each surface impoundment(s), landfill(s) and/or non-registered site(s) s at the TVA site. TVA shall describe in the EIP the method it will use to determine the size of the seismic event that would cause structural failure for entire area of the surface impoundments, landfills and/or non-registered disposal sites at the TVA site. The seismic analysis method proposed by TVA shall provide seismic data comparable to the requirements for seismic analysis in the federal CCR regulations at CFR 257.63. The seismic analysis plan shall determine the seismic stability of the entire TVA site and any improvements need to ensure seismic stability for the site, as it exists today and for closure in place. Soils below the surface impoundments and landfill shall be evaluated for liquefaction potential. If these soils are found to be susceptible to liquefaction, stability calculations shall be performed which account for liquefaction.

13. TVA shall discuss how the structural integrity of the entire area of CCR disposal (surface impoundment(s), landfill(s) and non-registered sites) shall be determined. TVA shall include in the EIP the methods and models it will use to evaluate structural integrity as discussed in CFR 257.73(d) and (e).

14. Discuss any current information available that may be used to determine the ability of the local geology to provide sufficient structural stability for the existing surface impoundments, landfills and/or non-registered disposal areas at the TVA site as well as any disposal area considered for closure in place. TDEC anticipates there will not be sufficient existing structural stability information for this analysis. Describe the methods TVA shall employ to collect data that may be used to determine the capability of the geologic formation at the TVA site to provide structurally

sound/load bearing strength for existing CCR disposal areas as well as for those disposal areas should TVA consider closure in place of those areas.

E. Surface Water Impacts

Because of the long operating history of the TVA Fossil Plants, there have been potential opportunities for CCR materials to move into surface water and for dissolved CCR constituents to migrate via ground water flow into surface water. As a part of the EIP, TVA shall describe how it will determine if CCR material and/or dissolved CCR constituents have entered surface water at or adjacent to TVA sites. TVA shall also describe in the EIP how it will assess any impact CCR material and/or dissolved CCR constituents may have on water quality and/or the impact on fish and aquatic life.

1. TVA shall discuss any current information it has for the TVA site that identifies CCR deposition on the streambed for surface water on the TVA site or surface water adjacent to the TVA site.

2. TVA shall describe in the EIP the methods it will use to determine if CCR material has moved from the TVA site into surface water on the TVA site or adjacent to the TVA site. TVA shall propose a procedure for sampling the streambed for CCR material. TVA shall describe sample collection methods, sample preservation and sample analysis methods for CCR materials. All samples shall be analyzed for the CCR constituents listed in Appendices 3 and 4 of the federal CCR regulations. Further, TVA shall propose how it will test sediment and CCR samples taken from riverbeds to determine if CCR constituents dissolve into surface water.

3. TVA shall describe how streambed sample results will be used to develop a map identifying the location of CCR material on the streambed and the depth of the CCR material on the streambed.

4. TVA shall discuss any current information it has for the TVA site that identifies the movement of ground water with dissolved CCR constituents into surface streams on or adjacent to the TVA site. This includes any surface water analyses TVA has performed for samples taken from the seeps and surface stream(s).

5. TVA shall propose a plan to collect and analyze water samples from seeps and surface stream(s) on the TVA site and/or adjacent to the TVA site. This plan shall include sampling locations, sample collection methods, sample preservation and transport and methods for sample analysis. All samples shall be analyzed for the CCR constituents listed in Appendices 3 and 4 of the federal CCR regulations.

6. TVA shall describe how seep and stream sample results will be used to develop a map identifying the location of seep and stream sampling points and the results of the analyses. This map shall also include the location of any public water intakes within 1 mile of the downstream side of the TVA site.

7. TVA shall provide a brief discussion of any studies conducted by TVA or any other agency to determine if CCR materials or dissolved CCR constituents have impacted fish and/or aquatic life.

8. Upon a determination by TDEC of the need to assess the impact of CCR material in surface streams or migration of ground water containing dissolved CCR constituents, TVA shall provide a plan to study the impact of CCR materials and/or constituents on fish and/or aquatic life in surface streams on the TVA site or adjacent to the TVA site.

Chuck Head, Senior Advisor
Bureau of Environment
TN Department of Environment & Conservation
William R. Snodgrass - TN Tower
312 Rosa L. Parks Ave., 2nd Floor
Nashville, TN 37243
615 532-0998
chuck.head@tn.gov

Robert J. Martineau, Jr.
Commissioner

Bill Haslam
Governor

September 12, 2016

Mr. Samuel Hixson	and	Mr. Paul Pearman
Tennessee Valley Authority		Tennessee Valley Authority
1101 Market Street MR 4G		1101 Market Street MR 4G
Chattanooga, TN 37402		Chattanooga, TN 37402

Dear Mr. Hixson and Mr. Pearman:

The Tennessee Valley Authority (TVA) operates eight coal-fired electricity-generating facilities (TVA Fossil Sites) in Tennessee. The Tennessee Department of Environment and Conservation (TDEC) is requiring TVA to assess the environmental impact of coal combustion residual (CCR) material on and around these sites as part of its regulatory authority. TDEC recognizes that TVA is working to meet the April 2015 U.S. Environmental Protection Agency (EPA) Coal Combustion Residual regulations (EPA CCR Regulations) for coal-fired power plants operating to produce electricity for off-site use to power businesses, industries, public utilities and homes. However, TVA is also obligated to comply with the statutes, rules, and regulations of the State of Tennessee.

As part of the effort to ensure compliance with both federal and state requirements at TVA Fossil Sites, TDEC and TVA are currently parties in a court action involving the TVA Gallatin facility.as Also, TDEC Commissioner's Order No. OGC 015-0177 (the Order) to TVA, for the other TVA Fossil Sites in the state. With respect to the TVA Gallatin facility, the parties are under the jurisdiction of the Davidson County Chancery Court. An environmental investigation is required at the TVA Gallatin site as part of an entered Agreed Temporary Injunction. For the other seven TVA Fossil Sites, subject to the Order, TVA is required to perform similar environmental investigations. The seven TVA Fossil Sites covered under the terms of the Order are:

1. the Allen site facility in Memphis;
2. the Bull Run facility near Oak Ridge;
3. the Cumberland facility in Cumberland City;
4. the John Sevier facility near Rogersville;
5. the Johnsonville facility in New Johnsonville;
6. the Kingston facility in Kingston; and
7. the Watts Bar facility near Spring City.

At all eight sites, TVA is required to perform a complete environmental investigation at each TVA Fossil Site. This investigation includes existing surface impoundments, on-site landfills permitted by TDEC, and any other CCR disposal sites at each TVA Fossil Site. TVA is to conduct environmental investigations at each site which includes determining:

- the location and quantity of all CCR material.
- the nature and extent of CCR contamination in groundwater;
- the location of discharges of CCR material and/or CCR contaminated groundwater to surface streams;
- the geologic and structural stability of each site and disposal area; and
- the impact of CCR materials on public health and the environment.

Finally, for the TVA Fossil Sites covered under the Order and the TVA Gallatin site which is subject to the Agreed Temporary Injunction from the Davidson County Chancery Court, TVA is to develop a corrective action plan for TDEC's approval that provides the best corrective action strategy to eliminate current and potential future CCR environmental contamination.[1]

Recently TVA published draft and final Environmental Impact Statements (EISs) for meeting the EPA CCR regulations at its Allen, Bull Run, John Sevier and Kingston TVA Fossil plant sites. The National Environmental Policy Act (NEPA) requires the EISs. For these TVA Fossil Sites, which are included in the Order, TVA has recommended closure in place as its corrective action of choice. The response from EPA Region 4 for these EISs has been that it "Lacks Objections" to TVA's proposals. However, TVA is also subject to the Order, the Agreed Temporary Injunction and the laws and regulations of the State of Tennessee. TDEC has advised TVA that it may initially choose closure in place as a corrective action remedy for the CCR disposal areas at the TVA Fossil plant sites in an attempt to comply with the federal CCR regulations. However, under the Order and the Agreed Temporary Injunction, TVA is required to:

- Investigate and determine the amount and location of CCR material at each TVA Fossil Site;
- Determine the extent of environmental impact of CCR constituents on public health and the environment; and
- Conduct corrective action that properly protects public health and the environment.

If information or data generated by the environmental investigations at any of these sites demonstrates that closure in place is not the most effective corrective action option due to the impact of CCR material on public health, the environment; site seismic and structural stability; and/or impacts to surface or groundwater, TDEC expressly reserved its right to order TVA to take additional corrective action. Such action may include, but not be limited to, removing a portion of or all CCR material from a surface impoundment, landfill, or non-registered CCR disposal site that TVA may be in the process of closing in place or has closed in place. TDEC may also require TVA to prevent migration of CCR constituents into groundwater and/or surface water and provide alternative water sources to local citizens, businesses, and industries impacted by the migration of CCR constituents off-site.

TVA has stated it plans to close surface impoundments in place at four of the eight TVA Fossil Plant sites in Tennessee. The Tennessee Solid Waste Disposal Act (the Act), Tennessee Code

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[1] The TVA Gallatin Fossil Site is involved in on-going litigation and ultimately the Court will make a determination as to appropriate corrective action at that location.

Annotated §§ 68-211-101 et. seq. provides TDEC with the statutory responsibility to *review and approve* the management of CCR material at each TVA Fossil Site. Specifically, Tenn. Code Ann. § 68-211-106(j) states:

> *The commissioner shall not issue a permit under this section for the disposal of coal ash or for the expansion of an existing coal ash disposal facility unless the plans for the disposal facility include a liner and a final cap;*
>
> *however, this subsection (j) shall not apply to the use of coal ash for fill, to any agricultural use, to any engineered uses as a feedstock for the production of a product, to wastewater treatment units or to the disposal of coal ash in connection with any of these uses, as authorized by the department pursuant to this part.*

Under this section, although a permit is not required for the certain specified uses of coal ash, these uses must still be "*authorized by the department pursuant to this part*." In other words, TVA shall not excavate, dredge, or otherwise move CCR material at its Fossil Sites until TDEC has approved the planned use.[2] As of receipt of this letter, TVA must submit for TDEC's review a plan for CCR material management for any activity that affects CCR material at TVA Fossil Sites other than the disposal of CCR material into properly permitted solid waste landfills in Tennessee or other states. TVA shall not implement a plan for CCR material management, other than disposal at a properly permitted landfill, at any TVA Fossil Plant site until the plan is approved by TDEC.

If you have any questions, please contact me.

Sincerely,

Chuck Head

Chuck Head.

CC:
Robert J. Martineau, Jr.
Shari Meghreblian
Jenny Howard
Joseph Sanders
Tisha Calabrese Benton
Pat Flood
David Owenby
Greg Signer
Kelly Love
Susan Smelley

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[2] Although this letter primarily focuses on the seven TVA Fossil Sites covered by the Order, § 68-211-106(j) is also applicable to the TVA Gallatin Fossil Site.

Charles L. Head, Senior Advisor
2nd Floor TN Tower, W.R. Snodgrass Building
312 Rosa L. Parks Avenue
Nashville, TN 37243615 532-0998
e-mail: chuck.head@state.tn.us

June 22, 2017

Paul J. Pearman
Tennessee Valley Authority
1101 Market Street, MR 4K
Chattanooga, TN 37402

RE: TDEC Commissioner's Order OGC 15-1077
TVA Coal Fired Fossil Fuel Plants
Environmental Investigation Plans
Conference Dates and EIP Due Dates

Dear Mr. Pearman:

The Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order OGC 15-0177 (the Order") to the Tennessee Valley Authority (TVA) that required TVA action at seven TVA Coal Fired Fossil Power Plants (active and inactive) located in Tennessee. The Order was signed on August 6, 2015 and included information about TVA's right to appeal the Order. TVA did not appeal the Order and it is now final.

The Order required TVA to perform environmental investigations and to take appropriate corrective action at seven TVA Coal Fossil Power Plants (CCR sites) in Tennessee. The Order is specific to Coal Combustion Residual (CCR) material. Paragraph VII. of the Order provides the sequence of events for environmental investigation at a TVA CCR site as presented below.

1. TVA and TDEC are required to schedule and conduct an initial meeting to discuss each CCR site. At each CCR site meeting, TVA provides the operational history of the CCR site, all geological and hydrogeological information currently available, results of environmental investigations and sampling, etc. This is basically a summary of TVA's current understanding of each CCR site.

2. TDEC reviews the information provided by TVA (historical information, geophysical properties of the site, operational history, etc.) at the on-site meeting and historical CCR site information provided by TVA. After review of the information provided by TVA, TDEC sends a letter to TVA that sets the date for submission of the draft CCR site Environmental Investigation Plan (EIP) and informs TVA of any additional environmental activities it believes are necessary to complete the CCR site environmental investigation.

3. TVA submits a draft Environmental Investigation Plan for the CCR site. TDEC reviews the draft CCR site EIP and provides TVA with comments that identify opportunities to improve the environmental investigation of the CCR site EIP. This letter also sets a due date for submission of the revised CCR site EIP.

4. TVA submits a revised EIP for the CCR site to TDEC, with a schedule of onsite activities such as installation of ground water monitoring wells, installing soil/rock borings to determine subsurface geological features, methods that will be used to determine the location and amount of disposed CCR material, surface water and ground water monitoring, etc.

5. TDEC provides TVA with its response to the revised EIP. When TDEC finds the CCR site EIP to be complete, TDEC notifies TVA via letter.

6. TVA is required to issue a public notice for the CCR site EIP before it is implemented. The public has 30 days to submit its EIP comments to TDEC. If EIP comments are submitted to TDEC, then TDEC has 30 days to respond to the comments.

7. Once the public comment period has ended, TDEC may provide TVA with CCR site EIP comments as a result of the review of the public comments submitted to TDEC. TVA submits and TDEC approves/disapproves the schedule of activities for environmental investigation at the CCR site. Unless TDEC disapproves the CCR site EIP schedule of activities, TVA proceeds with the environmental investigation, collects and generates data, then prepares an Environmental Assessment Report (EAR).

8. The EAR is submitted to TDEC. TDEC evaluates the EAR and decides if TVA has generated enough environmental investigation data to:

   a. Determine the impact of CCR materials to public health and the environment.
   b. Provide a comprehensive picture of the areas where CCR material disposed.
   c. Assess the structural and seismic stability of the CCR disposal areas.
   d. Determine the extent of CCR constituents in ground water and discharges to surface water.
   e. Determine if CCR material is disposed below the ground water table.

TDEC also determines if there is enough information generated to prepare a comprehensive corrective action plan. If TDEC determines the EAR is incomplete or deficient, then TDEC informs TVA of its concerns. TVA is then required to further investigate the CCR site, beginning with item 4. above.

Environmental Investigation Plan Submittals

TDEC and TVA have discussed the format of the Environmental Investigation Plans for the seven TVA Coal Fired Power Plants included in the Commissioner's Order. The sites included in the Commissioner's Order are:

- the TVA Allen Fossil Plant (TVA ALF);
- the TVA Bull Run Fossil Plant (TVA BRF);
- the TVA Cumberland Fossil plant (TVA CUF);
- the TVA Johnsonville Fossil Plant (TVA JoF);
- the TVA John Sevier Fossil Plant (TVA JSF);
- the TVA Kingston Fossil Plant (TVA KIF); and
- the TVA Watts bar Fossil Plant (TVA WBF).

TVA and TDEC met to discuss the format for the Environmental Investigation Plans (EIPs) after the first submission of the TVA CUF EIP. During this discussion, TDEC and TVA determined that the best approach to the investigation of the seven sites was to develop a comprehensive EIP. The EIP should include all activities planned for the initial investigation of each site, maps with historical and current information, identification of soil, ground water and surface water sampling; the methods to be employed to determine ground water elevations, flow rate and velocity, etc. We also discussed including the Standard Operating Procedures, Quality Assurance Project Plans, Sample Collection and Analysis Methods, Procedures for installation of Soil Borings and Monitoring Wells, etc. in the Appendices of the EIP for each site. The primary purpose of the EIP is to provide TDEC and the public with a complete description of the CCR site investigation activities and a schedule for those activates.

TDEC's goal is to work with TVA to ensure the environmental investigation of each TVA site is complete, accurate and timely. We believe working with TVA, following the protocol above, will help TDEC and TVA reach these goals. TVA is required to post each EIP for public notice and comment, once it is approved by TDEC as complete. The greater the detail of the EIP, the better the public will understand how each TVA site will be investigated.

TVA has submitted Revision 1 of the TVA CUF and TVA ALF EIPs to TDEC for review, following the structure described above. TDEC has found this EIP format to be comprehensive and practical. TDEC and TVA plan to meet on June 29, 2017 to discuss the status of the TVA JoF EIP, which has a due date of July 24, 2017. The pre-EIP Submittal meetings have been very helpful in exchange of thoughts, ideas and questions for each site.

Per our conversations, TDEC and TVA have agreed to a schedule for submission of the Revision 1 EIPS for TVA BRF, TVA JSF, TVA KIF and TVA WBF sites. This letter formalizes that schedule. The table below includes the dates for submittal of Revision 1 EIPs.

TVA CCR Environmental Investigation Plan Due Dates

TVA Coal Fired Power Plant	EIP Due Date
TVA Kingston	9/8/2017
TVA Bull Run	10/27/2017
TVA John Sevier	12/15/2017
TVA Watts Bar	2/09/2018

Attached to this letter are environmental investigation comments for the TVA BRF and KIF sites. We will provide comments for the TVA JSF and TVA WBF by July 15, 2017. We look forward to working with TVA in the investigation and remediation of each TVA CCR site. If you have questions or concerns about this letter, please give me a call.

Sincerely,

Chuck Head

Chuck Head

CC:	Susan Smelley	Britton Dotson	James Clark
	Pat Flood	Scotty Sorrells	Rob Burnette
	Tisha Calabrese Benton	Abigail Bowen	Joseph E. Sanders

Bull Run (BRF) Environmental Investigation Comments and Questions

General

- Bedding Planes dip 30-40 degrees to the southeast. Groundwater will typically flow in the direction of dip. Was the bedding planes considered when TVA selected locations for groundwater monitoring wells? TVA should demonstrate how the underlying strata near the Bull Run property influence the direction of groundwater flow. TVA's monitoring well locations at all ash disposal areas should be selected based on these findings.

- Two fault lines were identified on crossing the TVA Bull Run property. Were the faults considered when TVA selected locations for groundwater monitoring wells? TVA should demonstrate how the direction of groundwater flow is or could be influenced by the underlying faults at the Bull Run property and show how the well locations were selected. If groundwater is flowing along these fault lines, TVA should place monitoring wells at adequate locations to properly monitor it.

- The off-site water use survey needs to be updated and all potential supply sources verified whether used for human consumption or otherwise.

- The Groundwater Use Survey identifies multiple residential wells and municipal water intakes within one mile of the landfill. The water supply points within the one-mile range must be evaluated and sampled to determine if the water is impacted from CCR waste.

- Settlement analysis reference on page 84 of the multisite order presentation appears to have been misinterpreted from a previous TDEC questions. Please provide available documents relating to foundation settlement that may have or is calculated to occur as a result of the CCR loading on the natural foundation.

- Provide seismic stability calculations for Phase I of the Dry Fly Ash Stack, the Bottom Ash Disposal Area and the Gypsum Disposal Area 2A.

Dry Ash Stack – IDL 01 000 0080

- Residuum and upper bedrock hydrogeology and geotechnical properties appear to be adequately characterized. However, water-bearing zones in deeper bedrock are not characterized. The potential for downward vertical migration of CCR ash-derived contaminants, the potential for their migration along deeper structural and stratigraphic interfaces, and any bedrock migration fate and transport considerations have not been evaluated. To fully understand potential contaminant migration and risks to potential receptors, the vertical gradients and flow patterns need to be established.

- 8 monitoring wells were installed from 1983 to 1990, and 6 observation wells were installed from 2005 to 2006. Where are these wells and are they still being used? Reference page 90 of the multisite order presentation.

- The DSWM SW Rules requires that all permitted facilities that go into assessment submit a Ground Water Quality Assessment Plan. TVA should submit this plan and incorporate all comments/concerns addressed in this review.

- Please provide the current permitted version for drawing 10W299-11 as indicated on page 162 of the multisite order presentation. Please clarify if TVA plans to submit a vertical expansion overlaying phases I & II as indicated in the May 11, 2012 letter to Rick Brown. This expansion is also noted in Volume II of III of the Phase III Expansion permit document for IDL01-0080. This will direct the landfill's regulation under the Federal CCR rule and will also provide guidance on future closure plan submittals. Please confirm volumes and projected landfill life calculations presented in the approved permit documents and that site operations have the final approved plans.

- The document provided to TDEC identified as BRF47_102-229 Slope Stability Analyses Revised 082911 is not the final permitted stability calculations for the Dry Fly Ash Stack. The permitted stability calculations were submitted as on April 4, 2012. Please verify the current landfill geometry with the permitted documents and provide stability calculations for Phase I of the Dry Fly Ash Stack.

- Justify using a peak ground acceleration of 0.21g in the seismic stability analysis for the Dry Fly Ash Stack.

- Provide documentation and drawing illustrating the limits of closure for Phase I for the Dry Fly Ash Stack

Rail Loop

- No hydrogeologic, geotechnical, or structural stability assessments have been conducted at the Rail Loop site. Full subsurface characterization needs to be conducted to understand any potential groundwater or surface water impacts, contaminant fate/transport considerations and structural instability issues there may be.

- The Draft EIS for TVA Bull Run Fossil Plant Landfill Environmental Review, Project Number 2012-33, makes reference to a spring at The Rail Loop site. Please locate this feature on a map in relationship to the CCR limits.

Bottom Ash/Gypsum Ponds - IDL 01 000 0280

- When the Ash Ponds were originally constructed and the initial wastes placed, the pond bottoms were natural soil (elevation approx. 788 MSL) above the reservoir water level elevation (approx. 768 MSL). The current reservoir level is approximately 795 MSL. Despite claims that natural soils and dykes are composed of low permeability clays that affect "separation" of waste from the reservoir, the reservoir elevation and groundwater elevations in monitoring wells at the site indicate waste is likely to be submerged in groundwater at the lower levels of the fill.

- The Uppermost Aquifer cannot be adequately defined if water level data reflect saturated zones influenced by the ponds, sluice channels, saturated ash, and river elevations.

- The nature of groundwater flow and hydraulic interconnection between the waste, dykes, natural soils, and the ultimate discharge to the reservoir or deeper geologic formations are unknown. Vertical gradients between saturated waste, groundwater in unconsolidated deposits, and groundwater in bedrock have not been characterized. The dynamics of groundwater flow through the waste, dykes, pond floor and underlying soils, and bedrock need to be characterized to determine if potential contaminants from the waste fill migrate (or have the potential to migrate) from the unit and not be monitored by the existing shallow groundwater monitoring network.

- Historical groundwater data from sampled monitoring wells around the ponds complex indicates numerous statistically significant exceedances of monitored constituents above background. Likewise, there have been periodic MCL exceedances. These have typically been attributed to “naturally occurring” elements, excessive turbidity in groundwater samples, and/or laboratory/analysis-related interferences. Stated advantages of the Closure Plan include “improved groundwater quality”. It is unclear to the reviewer to what extent the waste ponds have affected groundwater quality, to what extent offsite resources are impacted, and what basis the Owner has for stating that Closure will result in improved groundwater quality. If the facility has caused groundwater degradation that Closure is purported to alleviate, the Owner needs to state to what the extent groundwater has been degraded, how the Closure will improve the degradation, and to what extent.

- TVA must install monitoring wells screened in bedrock and located in appropriate locations to adequately define the potentiometric surface and monitor groundwater.

- The DSWM SW Rules requires that all permitted facilities that go into assessment submit a Ground Water Quality Assessment Plan. TVA should submit this plan and incorporate all comments/concerns addressed in this review.

- Please provide locations and inverts for the French drains installed in the Gypsum Disposal Area 2A.

- Please clarify the Gypsum Stack volume on page 160 of the multisite order presentation. The CCR volume and size provided indicate an average depth of 10 to 11 feet. Section I-I’ on page 78 of the multisite order presentation does not identify gypsum in the disposal units stratigraphy. TVA shall provide details of the stratigraphy of the Gypsum Disposal Area 2A, from the final grade to bedrock. TVA shall provide stability calculations that include the Gypsum’s material properties and account for the Gypsum in the analysis.

- Clarify the ratio of sluiced fly ash to bottom ash for material; contained in the Bottom Ash Disposal Area. Section D-D’ on page 76 of the multisite order presentation indicates a majority of the CCR depth is sluiced fly ash. Would the CCR closure elevations indicated on page 155 of the multisite order intersect (excavate into) the sluiced fly ash? Please provide a detail of the stratigraphy of the Bottom Ash Disposal Area from the final grade to bedrock.

- Please provide a schedule for determining the Stilling Pond CCR volume and the test methods that will be used to determine the types and amounts of CCR materials in the Stilling Pond.

- Identify the test methods to be used (in situ or remolded) to determine the permeability of clay below the CCR disposal areas. Explain why permeability tests were not performed below the Gypsum Disposal Area 2.

- Clarify if the ash disposal line presented on page 19 of the multisite order presentation has been abandoned. TDEC requests that TVA verify the location of seep investigations that have been conducted, the repairs made to the seeps and whether any seeps continue to flow including TVA repaired seeps.

- The stability calculations should evaluate the south corner of Gypsum Disposal Area 2A. This area is of interest due to its proximity to the original flow path of Bull Run Creek and because it is not known if clay foundation soils are present in this area.

TVA Kingston (KIF Environmental Investigation Comments and Questions

TDEC requests that TVA provide responses to the points presented below in the revised EIP for the TVA Kingston site. TDEC has followed the format TVA used with the submittal of the TVA Cumberland Rev. 1 Environmental Investigation Plan.

1. Site Specific Information

- Existing or additional site characterization shall include a discussion of fluctuations in ground water elevations that may be connected to Watts Bar Lake levels, seasonal variations or other factors.
- Existing or additional site characterization shall estimate the amount of CCR material that is below the upper most aquifer for the Stilling Pond, historic Sluice Channel and the "ball field" temporary storage area. The upper most aquifer must be identified to accurately make this determination.
- TVA shall provide a schedule for the placement of any additional borings/monitoring wells proposed at the Kingston site as well as a map identifying the location all borings and monitoring wells that TVA plans to use as a part of its Environmental Investigation (existing and proposed). TVA shall present the reasons for selecting the location of additional boings/monitoring wells at the site. Further, TVA shall install/identify two ground water monitoring wells to serve as background ground water monitoring wells for the site. TVA shall have a TN Licensed Professional Geologist on site to log the installation borings and/or ground water monitoring to install borings and ground water monitoring wells as well as the method of construction for ground water monitoring wells. TVA shall propose a sampling plan to analyze soil, overburden and CCR material generated during on-site drilling for Appendix III and IV CCR constituents.
- TVA shall characterize the site's hydrogeology to better understand the cause of the Red-Water seeps at the East Dike/Engineered Red-Water Wetlands. The investigation should determine if the source might be either infiltration through the Interim Ash Staging Area (ballfield) or groundwater flow from offsite.
- TVA shall gather sufficient information to provide a three dimensional picture of the CCR material disposed in the Stilling Pond, Sluice Trench and "Ballfield" area. TVA shall gather enough information to determine the volume of CCR material disposed in each area.

2. Hydrogeologic Report

- TVA shall collect sufficient data from existing and proposed ground water monitoring wells and from existing and proposed soil borings to allow TVA to determine the following results that will be included in the Environmental Assessment Report:

  i. A ground water map for the site presenting the ground water elevation

  ii. Ground water flow rate and direction; and

iii. Location of ground water monitoring wells where the level of CCR constituents exceed the EPA CCR levels provided in Appendices III and IV of the rule;

3. Water Use Survey

- TVA shall conduct a water use survey as required by TDEC for the environmental investigation at other TVA Coal fired power plants. The survey shall include water wells and springs used by for either domestic or business purposes.

4. Ground Water Monitoring

- Due to the 2008 CCR release, there is extensive data for this site including ground water monitoring data. TVA should include a catalog of existing ground water monitoring wells that will be used in determining ground water flow rates, current ground water elevation and direction of ground water flow. TVA shall propose additional ground water monitoring wells, as needed, to accurately identify ground water quality, flow direction, velocity, quality and influence due to release of CCR constituents. TVA shall provide a ground water monitoring schedule that identifies the ground water monitoring wells that will be sampled, sampling methodology, sample collection and transportation, analytical methods used for analyses and the qualifications of the laboratory performing the analyses. All samples shall be analyzed for Appendix III and IV CCR constituents. Disposal units regulated by a landfill permit will need to incorporate the additional constituents through the end of post closure care period.

5. Ground Water - Chemical and Physical Properties

- Ground Water samples analyzed from Monitoring Well KIF-22 exceeded the Drinking Water MCL for Arsenic. TVA suggested the AS levels were higher than TVA Kingston Fossil Plant Environmental Investigation Plan expected due to the influenced of Total Suspended Solids in the ground water samples taken. TVA shall provide a science based explanation of this statement. TVA should explain its position that the Stilling Pond is contributing to the AS levels in Monitoring Well KIF-22.

- TVA shall determine if the level of the ground water at the TVA KIF site is controlled by the level of the Emory River. If the Emory River affects the ground water level, then TVA shall collect data to determine the extent of the impact of the Emory River on the ground water table below the TVA KIF site.

6. Structural and Seismic Stability

- Given the site stabilization work completed as a part of the CERCLA closure of the industrial landfill, additional analyses of the structural and seismic stability of the Stilling Pond is needed for the Stilling Pond once it is dewatered to determine if the Stilling Pond may be closed in place. TDEC has reviewed EPA’s comments about the seismic stability of the Stilling Pond. TDEC concurs with EPA’s statement “the underlying potential for liquefaction-induced failure of these units remains a concern”. The Stilling Pond at KIF is one of the units referenced.

- TVA shall provide a description of the methods it will employ to conduct seismic stability analyses, specifically, embankment liquefaction potential analysis for the Stilling Pond. TVA shall provide a schedule for conducting this analysis.

- It is our understanding that TVA has conducted seismic analyses for the Stilling Pond area and that if the Stilling Pond were closed in place there would be movement of Stilling Pond during a seismic event. TDEC cannot approve closure of the Stilling Pond in place, if the seismic and structural stability of the Stilling Pond does not meet the criteria established in the U.S. Environmental Protection Agency Coal Combustion Residual Rule, even if the Stilling Pond may not be “specifically” subject to those rules.

7. Site Geology

- Due to the 2008 CCR release, there is extensive data for this site including subsurface geology. TVA should include a catalog of existing ground water monitoring wells and soil borings subsurface geological conditions and stability and characteristics of local hydrogeology. TVA shall propose the location and construction of additional ground water monitoring wells and soil borings that will provide data to fully characterize the geology of this site.

- TVA shall collect sufficient data to prepare a three dimensional picture of the subsurface environment from ground surface to bedrock. This shall include the depth of CCR material and native soil, sand and rock, the physical characteristics of these materials and any geologic anomalies discovered during investigation.

Robert Wilkinson, P.G., CHMM CCR Technical Manager
2nd Floor TN Tower, W.R. Snodgrass Building
312 Rosa L. Parks Avenue
Nashville, TN 37243
Office: (615) 253-0689
e-mail: Robert.S.Wilkinson@tn.gov

Shari Meghreblian, Ph.D.
Commissioner

Bill Haslam
Governor

May 16, 2018

M. Susan Smelley
Director
Environmental Compliance and Operations
Tennessee Valley Authority
1101 Market Street, BR 4A-C
Chattanooga, TN 37402

RE: TDEC Commissioner's Order OGC 15-1077
TVA Watts Bar Coal Fired Fossil Fuel Plant
Environmental Investigation Plan Revision 2 Comments

Dear Ms. Smelley:

The Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order OGC 15-0177 (the Order) to the Tennessee Valley Authority (TVA) that required TVA action at seven TVA Coal Fired Fossil Power Plants (active and inactive) located in Tennessee. The Order was signed on August 6, 2015 and included information about TVA's right to appeal the Order. TVA did not appeal the Order and it is now final.

TVA submitted the Environmental Investigation Plan (EIP) Revision 1 (EIP Rev 1) for TVA Watts Bar Coal Fired Fossil Power Plant (TVA WBF) on February 9, 2018. TDEC has completed its review of EIP Rev 1 and is providing comments listed in the attached **Table 1 TVA Watts Bar EIP Rev 1 Summary of TDEC Comments**.

Please address the attached comments and submit a revised plan (EIP Rev 2) with a cover letter summarizing TVA's response to each comment and subsequent modifications to TDEC by **July 6, 2018**.

TDEC's goal is to work with TVA to ensure the environmental investigation of the TVA WBF site is complete, accurate and timely. Should you have any questions, please do not hesitate to contact me via email at Robert.S.Wilkinson@tn.gov or phone at (615) 253-0689.

Sincerely,

Robert Wilkinson, P.G., CHMM

CC:
Chuck Head
Pat Flood
Jennifer Dodd
Peter Lemiszki
Britton Dotson
Caleb Nelson
Angela Adams
Shawn Rudder
James Clark
Rob Burnette
Joseph E. Sanders
Bryan Wells

TVA Watts Bar EIP Rev 1
Summary of Comments

Section Number	Section Title	Page	Paragraph	Line	Comment
Water vs. Benthic sampling	Objectives	2	N/A	ca. 8	The surface water SAP says that most sample locations will require water and sediment sampling whereas the benthic SAP says that benthic and water samples will coincide. Will the same sites consistently be sampled for the different media?
General	N/A	N/A	N/A	N/A	With the exception of selenium and mercury, the CCR contaminants being analyzed don’t readily bioaccumulate. Are there meaningful data on other sites to determine whether tissue concentrations are especially elevated for CCR constituents or will the data on upstream sites be the sole data used for these purposes? What effects endpoints (e.g., toxicity, fecundity, growth inhibition) are available in the literature by which to determine whether effects are likely occurring?
General	Archaeological Sites	N/A	N/A	N/A	Just a reminder, an ARAP will be required for the shoreline slag stabilization project.
1	Introduction	1	1	2	Add reference "*Commissioner’s Order No. OGC15-0177* (TDEC Order)"
2.1	EIP Development and Structure	8	4 and 5		These two paragraphs appear to be formatted with an extra tab and are not a continuation of bullet #5.
2.3	Quality Assurance/ Quality Control	9	3	3	"*Requirements associated with various analyses; data generation,* data *reduction,* and data *management; and results reporting are stipulated therein.*"
3.1.1	TDEC Site Information Request No. 1	12	3	2	The TN professional geologist will provide field supervision and logging.

TVA Watts Bar EIP Rev 1
Summary of Comments

Section Number	Section Title	Page	Paragraph	Line	Comment
4.1.1	A.2 TDEC Site Information Request No. 1	20	4	1	The twelve sampling locations will need to be located/verified using a GPS.
4.1.1	A.2 TDEC Site Information Request No. 1	20	6	3	TVA will develop background levels of CCR constituents by totaling analytical results from soil samples from the same soil horizon (alluvium, colluvium, residuum, etc.). There should always be a minimum of 10 soil samples from the same soil horizon used to calculate the background levels of constituents. This may lead to multiple different background levels for a CCR constituent within the profile of one boring.
4.1.2	A.2 TDEC Site Information Request No. 2	21	2	All	The data provided in Appendix K is from John Sevier, please replace with Watts Bar data.
4.1.2	A.2 TDEC Site Information Request No. 2	21	2	All	TVA shall propose a leachability characterization study that includes an evaluation of CCR parameters (totals and leachable concentrations) from pore water and solid material samples from locations that would characterize the vertical and lateral distribution of leachability characteristics within all units at WBF.
4.1.4	A.2 TDEC Site Information Request No. 4	22	2	3	Please provide information regarding the mitigation of the pre-construction stream channel indicated on the 1935 topographic map beneath the Slag Disposal Area.
4.1.4	A.2 TDEC Site Information Request No. 4	22	2	3	TVA will investigate and determine the potential for preferential seepage pathways through the foundation soils via pre-construction stream channels that were present prior to development of the Slag Disposal Area.

TVA Watts Bar EIP Rev 1
Summary of Comments

Section Number	Section Title	Page	Paragraph	Line	Comment
4.1.5	A.5 TDEC Site Information Request No. 5	25	2	1	The drawings produced from the 3-D models will need to also show the final elevations of the Slag Disposal Area and Ash Pond Area.
4.3.1	C.1 TDEC Groundwater Monitoring and Mapping Request No. 1	30	5	3	Please provide boring logs, well installation and well abandonment records for wells depicted on Figure 4. Appendix H only included well logs for MW-1 through MW-3.
Appendix D - Exhibits	Exhibit No. 8	220/661	NA	NA	Please review map for intent. Contours are not present.
Appendix K	Leachability Data	All	All	All	The data provided is from John Sevier, please replace with Watts Bar data.
Appendix O, Stability SAP	All	All	All	All	Provide rational for determining the acceptable (tolerable) displacement performance criteria. Provide documentation that justify the stated correlation of 3 feet to a factor of safety of 1.0.
Appendix O - Stability SAP	All	All	All	All	TVA should verify through this investigation that inactive CCR landfill and/or surface Impoundments on site are no longer impounding water.
Appendix O - Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	507/661	NA	NA	Provide rational for determining the acceptable (tolerable) displacement performance criteria. Provide documentation that justify the stated correlation of 3 feet to a factor of safety of 1.0. Deformation tolerance shall be demonstrated to be appropriate for all components of the CCR storage unit's design.

Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix O - Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	507/661	Phase 1	NA	Explain the use of Newmark's analysis if FSpseudo > 1.0.
Appendix O - Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	508/661	Phase 2	NA	Explain the use of Newmark's analysis if FSpseudo > 1.0.
Appendix O - Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	509/661	Phase 4	NA	Work with TDEC to define acceptable performance will need to be established as part of the of Phase 1 Assessment.
Appendix O - Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	510/661	Table 2	NA	Work with TDEC to define acceptable criteria in Phase 1 of the Assessment. Reference comment above.
Appendix O - Stability SAP	5.1.3 Basis for Load Cases and Acceptance Criteria	511/661	NA	NA	TVA embankment dam design guidance (TVA 2016) should be removed from the list of documents used to determine acceptable criteria.
Appendix O - Stability SAP	5.1.3.1 Static Loading	512/661	NA	NA	Flood loading should be considered for CCR units located in the flood plain.

Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix P, Benthic SAP	All	All	All	NA	Are mayflies an appropriate choice for metals tissue analysis and what is the rationale for their use? In addition to being short-lived, they are not sediment-ingesting organisms. Would a crustacean or Corbicula be a better choice to assess metals uptake in benthos?
Appendix P, Benthic SAP	5.2.1.3	All	All	NA	What species will be targeted if sufficient mayflies are not available at a site, and will mayfly sampling and other species sampling be conducted? If so, is it meaningful to compare bioaccumulation data across species?
Appendix P, Benthic SAP	5.2.1.3	All	All	NA	You should also consider use of a collector-gatherer mayfly species since they would have the most exposure to sediments in their diet, burrowing mayflies would be best.
Appendix P, Benthic SAP	5.2.1.3	All	All	NA	By what means will mayfly tissue concentrations be normalized for comparison between sites?
Appendix P, Benthic SAP	5.2.1.3	All	All	NA	What is the purpose and use of developing depurated vs. non-depurated mayfly data?
Appendix P, Benthic SAP	5.2.1.3	All	All	NA	Would transport of mayflies on ice prior to depuration be a source of stress and thermal shock that would result in their death? What will be the depuration period and is it standard for such assessments?
Appendix P, Benthic SAP	5.2.5	All	All	NA	For sediment analysis, will acid volatile sulfide (AVS) analyses be conducted to compare to molar concentrations of metals known to be strongly bound by AVS?
Appendix P, Benthic SAP	All	All	All	NA	Will sediment contaminant concentrations be expressed on a dry weight basis?
Appendix P, Benthic SAP	All	All	All	NA	What is the basis of the 20 percent ash content as the value that triggers additional sampling and analysis?
Appendix P, Benthic SAP	All	All	All	NA	The sampling is often referred to as quantitative. A ponar sampler will penetrate to different depths based on substrate composition. How will identical sample sizes be ensured for appropriate site-to-site comparison?

Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix P, Benthic SAP	All	All	All	NA	How will you ensure that benthic community samples are collected from similar habitats/substrates so that any differences observed are due to contaminant concentrations and not habitat or substrate composition? Would sediment particle size analysis, photographs and notes related to habitat and substrate composition at each site assist in interpretation of benthic community composition data?
Appendix P, Benthic SAP	All	All	All	NA	The bioavailability and toxicity of chemicals cannot be accurately predicted based on chemical data alone. Would toxicity testing be a better approach or a good supplement to the proposed approach to assess contaminant effects between sites? If so, the concentrations of natural toxicants such as ammonia and dissolved sulfide should also be determined to support data interpretation.
Appendix P, Benthic SAP	Table 5	All	All	NA	It may also be useful to include ammonia and dissolved sulfide analysis in the proposed plan to support interpretation of benthic community data.
Appendix S, Surface Water SAP	All	NA	NA	NA	Will there be a comparison of chemical concentrations to conditions indicating possible environmental harm, for example water quality standards for receiving stream designated uses?
Appendix S, Surface Water SAP	All	12	Table 2	NA	TSS should be measured, it is needed for conversion of total metals concentrations to dissolved standards where applicable. Additionally, Mg should be measured and used with the Ca data to calculate protective conditions for metals whose standards are hardness-dependent.
Appendix S, Surface Water SAP	All	All	All	NA	In what seasons or months are the sampling events going to be conducted and why?
Appendix S, Surface Water SAP	5.2.4	All	All	NA	Some detail is needed with respect to the transects being conducted at different sampling sites to identify the channel thalwag. For example, how many depth assessments will be made at each site and at what distance (or percent of stream width) along the transect?

Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix S, Surface Water SAP	5.2.4	All	All	NA	Sampling will be conducted during seasonal mean flows and during flows of less than the 75th percentile. The mean would be below the 75th percentile, but you could be below the 75th percentile and be above the mean flow. Which condition will be the determining factor as to when sampling is conducted? Would a better approach be to conduct sampling when flows are between approximately the 25th and 75th percentile? You may want to consider sampling based on the median flow and some range around it.
Appendix T, Fish SAP	Fish SAP	All	All	NA	It would be beneficial to do the tissue processing in the laboratory instead of the field. Removal of liver and ovary might be easier in the lab and/or better ensure lack of contamination during processing.
Appendix T, Fish SAP	Fish SAP	All	All	NA	It is recommended to analyze individually any larger fish to supplement data obtained from the composite samples.
Appendix T, Fish SAP	Fish SAP	All	All	NA	A single composite tissue sample will be collected in most cases. How will data analysis be conducted when sample size is n = 1? The stated goal of assessing variability (pg. 10) can not be achieved once you composite the samples from a site.
Appendix T, Fish SAP	5.2.1	All	All	NA	Will dead/degraded/damaged fish pulled from gill nets left overnight be used in tissue analyses?
Appendix T, Fish SAP	5.2.4	All	All	NA	How will you determine whether you have “unexpected” results and that the retained split sample should be analyzed given that only one (composite) sample will be collected from each site? As a trigger, it is recommended that you use TDEC fish tissue criteria as applicable for additional analysis. If fillet composite exceeds criteria, then individual fillets should be analyzed from retained sample.
Appendix T, Fish SAP	5.2.4	All	All	NA	If the target species isn't available at a given site, what will be done?
Appendix T, Fish SAP	5.2.4	All	All	NA	I don't think there are legal size requirements for most if not all of your target species, you may want to remove the second bullet at the top of pg. 9

Section Number	**Section Title**	**Page**	**Paragraph**	**Line**	**Comment**
Appendix T, Fish SAP	5.2.5	All	All	NA	Is “gel ice” a potential source of contamination?
Appendix T, Fish SAP	6.2	18	5	1	The bolded sub-heading should be Laboratory Duplicate, not Field Duplicate Samples

Appendix B – Table 1

Summary of TDEC Comments & TVA Responses

July 6, 2018

Comment Number	Section Number	Section Title	Page	Para-graph	Line	WBF EIP Rev. 1 TDEC Comments	TVA Response to WBF EIP Rev. 1 TDEC Comments
1	Water vs. Benthic Sampling	Objectives	2	N/A	ca. 8	The surface water SAP says that most sample locations will require water and sediment sampling whereas the benthic SAP says that benthic and water samples will coincide. Will the same sites consistently be sampled for the different media?	The matching proposed sediment and surface stream transect locations included in the Surface Water and Benthic SAPs will be sampled for the different media. As part of the TDEC Order, surface stream samples have generally been co-located with sediment samples; for WBF, these transects match. Where sediment samples are located in close proximity to each other, one representative surface stream sample transect will be collected. Clarification has been added to the Benthic, Surface Stream, and Fish Tissue SAP's to identify co-located samples.
2	General	N/A	N/A	N/A	N/A	With the exception of selenium and mercury, the CCR contaminants being analyzed don't readily bioaccumulate. Are there meaningful data on other sites to determine whether tissue concentrations are especially elevated for CCR constituents or will the data on upstream sites be the sole data used for these purposes? What effects endpoints (e.g., toxicity, fecundity, growth inhibition) are available in the literature by which to determine whether effects are likely occurring?	The CCR constituents in surface water, sediments, benthic macroinvertebrates, and fish tissue occur naturally in the environment and can be variable across locations. Analytical results for samples collected during the environmental investigation for WBF will be interpreted in the context of: location relative to CCR units on the plant-downstream, adjacent, and upstream; publicly available surface water quality data (USGS/EPA); organism tissue concentrations reported during follow-up studies at Kingston; and other publicly available studies of CCR constituents (metals) in fish tissues.
3	General	Archaeological Sites	N/A	N/A	N/A	Just a reminder, an ARAP will be required for the shoreline slag stabilization project.	Comment is acknowledged.
4	1	Introduction	1	1	2	Add reference "Commissioner's Order No. OGC15-0177 (TDEC Order)"	Comment is acknowledged, and the corresponding change has been made in the document.
5	2.1	EIP Development and Structure	8	4 & 5	N/A	These two paragraphs appear to be formatted with an extra tab and are not a continuation of bullet #5.	Comment is acknowledged, and the corresponding change has been made in the document.
6	2.3	Quality Assurance/ Quality Control	9	3	3	"Requirements associated with various analyses; data generation, data reduction, and data management; and results reporting are stipulated therein."	Comment is acknowledged, and the corresponding change has been made in the document.
7	3.1.1	TDEC Site Information Request No. 1	12	3	2	The TN professional geologist will provide field supervision and logging.	Comment is acknowledged, and this information has been added to the EIP and Hydrogeological Investigation SAP.
8	4.1.1	A.2 TDEC Site Information Request No. 1	20	4	1	The twelve sampling locations will need to be located/verified using a GPS.	Comment is acknowledged, and the requested clarification can be found in the SAP.

Appendix B – Table 1

Summary of TDEC Comments & TVA Responses

July 6, 2018

Comment Number	Section Number	Section Title	Page	Para-graph	Line	WBF EIP Rev. 1 TDEC Comments	TVA Response to WBF EIP Rev. 1 TDEC Comments
9	4.1.1	A.2 TDEC Site Information Request No. 1	20	6	3	TVA will develop background levels of CCR constituents by totaling analytical results from soil samples from the same soil horizon (alluvium, colluvium, residuum, etc.). There should always be a minimum of 10 soil samples from the same soil horizon used to calculate the background levels of constituents. This may lead to multiple different background levels for a CCR constituent within the profile of one boring.	Comment is acknowledged, and the corresponding change has been made in the EIP. If a particular horizon or geologic unit is under represented in the statistical population, borings in addition to the those already proposed will be installed.
10	4.1.2	A.2 TDEC Site Information Request No. 2	21	2	All	The data provided in Appendix K is from John Sevier, please replace with Watts Bar data.	Data for other plants have been removed from the EIP. While no existing leachability data has been found for WBF, a CCR Material Characteristics SAP has been added to the EIP. See Response to Comment No. 11.
11	4.1.2	A.2 TDEC Site Information Request No. 2	21	2	All	TVA shall propose a leachability characterization study that includes an evaluation of CCR parameters (totals and leachable concentrations) from pore water and solid material samples from locations that would characterize the vertical and lateral distribution of leachability characteristics within all units at WBF.	The Exploratory Drilling SAP has been updated to add several temporary wells in the Ash Pond (consolidated and capped portion) and in the Slag Disposal Area. The borings for the temporary wells allow for collection of CCR samples and the temporary wells allow for pore water sampling. TVA has added a CCR Material Characteristics SAP to evaluate pore water samples and CCR material samples for leachability of the CCR parameters in the Ash Pond Area and the Slag Disposal Area (closed CCR units).
12	4.1.4	A.2 TDEC Site Information Request No. 4	22	2	3	Please provide information regarding the mitigation of the pre-construction stream channel indicated on the 1935 topographic map beneath the Slag Disposal Area.	TVA historical drawing 10W243 (R0, 1973) notes that soft surficial soils are to be removed in areas under new fill (i.e., new perimeter dikes) to a depth that will support heavy earthmoving equipment without rutting or heaving. Text has been added to the EIP discussing the mitigation efforts taken at the pre-construction stream channel locations. The geotechnical exploration outlined in the Exploratory Drilling SAP includes cone penetration tests at selected pre-construction stream channel locations (where they cross the unit perimeter) to evaluate soils in these areas.
13	4.1.4	A.2 TDEC Site Information Request No. 4	22	2	3	TVA will investigate and determine the potential for preferential seepage pathways through the foundation soils via pre-construction stream channels that were present prior to development of the Slag Disposal Area.	The Exploratory Drilling SAP has been updated to add groups of closely spaced CPT soundings where the pre-construction stream channels cross the perimeters of the Slag Disposal Area and the Drainage Improvements Area. This approach is consistent with the accepted approach to be taken at other plants to evaluate the same topic. In addition, two proposed CPTs within the unit interior have been moved slightly to align with the 1935 historical creek channel (see Exhibit 4).
14	4.1.5	A.5 TDEC Site Information Request No. 5	25	2	1	The drawings produced from the 3-D models will need to also show the final elevations of the Slag Disposal Area and Ash Pond Area.	Comment is acknowledged, and the final elevations of the Slag Disposal Area and Ash Pond Area are included on the list of drawing items to be provided in the EAR.

Appendix B – Table 1

Summary of TDEC Comments & TVA Responses

July 6, 2018

Comment Number	Section Number	Section Title	Page	Para-graph	Line	WBF EIP Rev. 1 TDEC Comments	TVA Response to WBF EIP Rev. 1 TDEC Comments
15	4.3.1	C.1 TDEC Groundwater Monitoring and Mapping Request No. 1	30	5	3	Please provide boring logs, well installation and well abandonment records for wells depicted on Figure 4. Appendix H only included well logs for MW-1 through MW-3.	Comment is noted. Available boring logs, well installation details and abandonment rationale for the wells shown on Figure 4 are provided in Appendix I.
16	Appendix D, Exhibits	Exhibit No. 8	220/ 661	N/A	N/A	Please review map for intent. Contours are not present.	The actual 1935 USGS map referenced in Exhibit 8 does not have contour mapping but does show original blueline stream locations prior to plant construction. An additional exhibit (Exhibit 9) has been developed from the 1942 USGS topographic mapping that presents contours and stream locations after plant construction and is provided in the EIP in Appendix E.
17	Appendix K	Leachability Data	All	All	All	The data provided is from John Sevier, please replace with Watts Bar data.	See Response to Comment No. 10
18	Appendix O, Stability SAP	All	All	All	All	Provide rational for determining the acceptable (tolerable) displacement performance criteria. Provide documentation that justify the stated correlation of 3 feet to a factor of safety of 1.0.	Text has been added in Section 5.1.3.2.1 of the Stability SAP to explain the technical basis for this correlation.
19	Appendix O, Stability SAP	All	All	All	All	TVA should verify through this investigation that inactive CCR landfill and/or surface Impoundments on site are no longer impounding water.	There is no impounded surface water within the boundaries of the closed units at Watts Bar. As part of a post-closure visual inspection, TVA will confirm that there is no impounded surface water within the boundaries of the closed units. The observations will be documented in inspection reports, which will be included in the EAR.
20	Appendix O, Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	507/ 661	N/A	N/A	Provide rational for determining the acceptable (tolerable) displacement performance criteria. Provide documentation that justify the stated correlation of 3 feet to a factor of safety of 1.0. Deformation tolerance shall be demonstrated to be appropriate for all components of the CCR storage unit's design.	Text has been added in Section 5.1.3.2.1 of the Stability SAP to explain the technical basis for this correlation.
21	Appendix O, Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	507/ 661	Phase 1	N/A	Explain the use of Newmark's analysis if FSpseudo > 1.0.	As noted in Section 5.1.3.2.1 of the Stability SAP, TVA has developed a method whereby the pseudostatic coefficient is correlated to a plant-specific tolerable displacement. This correlation is developed by performing a series of Newmark displacement analyses. This methodology is consistent with that used in TVA's CCR Rule demonstrations for seismic slope stability.
22	Appendix O, Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	508/ 661	Phase 2	N/A	Explain the use of Newmark's analysis if FSpseudo > 1.0.	As noted in Section 5.1.3.2.1 of the Stability SAP, TVA has developed a method whereby the pseudostatic coefficient is correlated to a plant-specific tolerable displacement. This correlation is developed by performing a series of Newmark displacement analyses.

Comment Number	Section Number	Section Title	Page	Para-graph	Line	WBF EIP Rev. 1 TDEC Comments	TVA Response to WBF EIP Rev. 1 TDEC Comments
							This methodology is consistent with that used in TVA's CCR Rule demonstrations for seismic slope stability.
23	Appendix O, Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	509/ 661	Phase 4	N/A	Work with TDEC to define acceptable performance will need to be established as part of the of Phase 1 Assessment.	During the Phase 1 stability assessment, TVA will work with TDEC to define criteria for acceptable performance that will be utilized during a potential Phase 4 (the final phase) of the proposed phased stability assessment. The factors that contribute to defining acceptable performance will be plant-specific and related to the consequences of the predicted deformations. As more plant-specific information becomes available after Phase 1, TVA and TDEC may need to revisit the acceptable performance criteria in light of the additional information. The corresponding change has been made in the EIP.
24	Appendix O, Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	510/ 661	Table 2	N/A	Work with TDEC to define acceptable criteria in Phase 1 of the Assessment. Reference comment above.	See Response to Comment No. 23
25	Appendix O, Stability SAP	5.1.3 Basis for Load Cases and Acceptance Criteria	511/ 661	N/A	N/A	TVA embankment dam design guidance (TVA 2016) should be removed from the list of documents used to determine acceptable criteria.	TVA has a significant portfolio of embankment dams, and its design guidance is one of several relevant industry standards that were considered to help inform the proposed load cases and acceptance criteria. The proposed criteria in the Stability SAP do not rely solely on the TVA guidance document. Further, the TVA analysis load cases and acceptance criteria are based upon and generally consistent with other industry standards, such as the dam safety criteria of the U.S. Army Corps of Engineers and the Federal Energy Regulatory Commission. Clarification has been provided in the SAP.
26	Appendix O, Stability SAP	5.1.3.1 Static Loading	512/ 661	N/A	N/A	Flood loading should be considered for CCR units located in the flood plain.	For existing landfills or surface impoundments that no longer impound water, a flood event would only influence units with outboard slopes along the adjacent river/reservoir. For WBF, this would include the Ash Pond (consolidated and capped portion) and Slag Disposal Area. However, the temporarily elevated river levels during a flood only provide additional stabilizing (i.e., resisting) force with respect to slope stability. Such a load case would have a higher factor of safety than the static, long-term case that is already being considered. Therefore, separate consideration of a flood load case would not provide useful analysis.

Comment Number	Section Number	Section Title	Page	Para-graph	Line	WBF EIP Rev. 1 TDEC Comments	TVA Response to WBF EIP Rev. 1 TDEC Comments
27	Appendix P, Benthic SAP	All	All	All	N/A	Are mayflies an appropriate choice for metals tissue analysis and what is the rationale for their use? In addition to being short-lived, they are not sediment-ingesting organisms. Would a crustacean or Corbicula be a better choice to assess metals uptake in benthos?	*Hexagenia* mayflies are relatively long-lived, widely distributed burrowing mayflies that are an important prey resource for higher trophic levels. Mayfly nymphs mature in the sediments and incidentally ingest sediments during feeding, making them susceptible to uptake and accumulation of pollutants present in sediments including metals. Mayfly nymphs are a widely-used organism in sediment bioaccumulation studies. TVA has conducted mayfly sampling for bioaccumulation evaluations at Kingston and Gallatin. Mayfly nymphs are prey items for bottom feeding fish and larger benthic macroinvertebrates. Mayfly adults are prey for insectivorous fish and birds. Thus, mayfly nymphs and adults represent the lowest levels of the aquatic/terrestrial foodchain.
28	Appendix P, Benthic SAP	5.2.1.3	All	All	N/A	What species will be targeted if sufficient mayflies are not available at a site, and will mayfly sampling and other species sampling be conducted? If so, is it meaningful to compare bioaccumulation data across species?	Mayflies of the genus *Hexagenia* will be used as long as they are recoverable. Other locations may be added if insufficient *Hexagenia* are encountered within the designated areas. If sufficient *Hexagenia* are still not encountered, other organisms such as *Pleurocera* or *Corbicula* will be evaluated as a replacement based on their availability. Bioaccumulation data will not be compared directly across species.
29	Appendix P, Benthic SAP	5.2.1.3	All	All	N/A	You should also consider use of a collector-gatherer mayfly species since they would have the most exposure to sediments in their diet, burrowing mayflies would be best.	*Hexagenia* are burrowing mayflies (nymphs dig into the sediment and filter feed on organic materials from within that burrow using a current created with their gills). Hexagenia nymphs (Ephemeroptera in general) are classified as collector-gatherer feeders.
30	Appendix P, Benthic SAP	5.2.1.3	All	All	N/A	By what means will mayfly tissue concentrations be normalized for comparison between sites?	On a plant by plant basis, mayfly tissues will be normalized based on drying specimens, grinding them together, and using a standard amount of dry weight in a mass spectrometer to analyze their chemical makeup.
31	Appendix P, Benthic SAP	5.2.1.3	All	All	N/A	What is the purpose and use of developing depurated vs. non-depurated mayfly data?	Mayfly nymphs of the genus *Hexagenia* ingest sediment while feeding. Predators that feed on mayfly nymphs also ingest the sediment contained in the gut of the nymphs. During the transition from nymph to adult, the gut contents are purged and the gut fills with air to increase the buoyancy of the adult insect. Adult mayflies do not feed during their short lives on the wing and do not have functional mouth parts or guts. Fish, birds, and other predators that consume adult mayflies would also ingest any CCR constituents that bioaccumulated in tissues (not gut contents) during the nymphal stage. Gut contents are short-term consumed substances which may or may not be absorbed into the organism upon digestion. Purging the gut contents (depuration) prior to laboratory analysis informs evaluation of potential bioaccumulation of CCR constituents in mayfly nymph tissues in the absence of CCR constituents in the gut contents.

Comment Number	Section Number	Section Title	Page	Para-graph	Line	WBF EIP Rev. 1 TDEC Comments	TVA Response to WBF EIP Rev. 1 TDEC Comments
32	Appendix P, Benthic SAP	5.2.1.3	All	All	N/A	Would transport of mayflies on ice prior to depuration be a source of stress and thermal shock that would result in their death? What will be the depuration period and is it standard for such assessments?	The TVA Kingston *Standard Operating Procedure for Mayfly Sampling* (TVA-KIF-SOP-29) referenced in Section 5.2.1.3 of the Benthic SAP outlines specific detailed procedures to minimize cold stress. The depuration period will be 48 hours. This is the standard period implemented at Kingston and Gallatin.
33	Appendix P, Benthic SAP	5.2.5	All	All	N/A	For sediment analysis, will acid volatile sulfide (AVS) analyses be conducted to compare to molar concentrations of metals known to be strongly bound by AVS?	Sediment analysis will be consistent with TVA SOPs, SAPs, and historical studies. Studies at Kingston showed AVS levels in the Vibecore samples were at or below detection limits, and Sequentially Extractable Metals concentrations were also low. With that limitation, assuming actual values were at the detection limits or as reported, AVS/SEM ratios were 0.90, 0.67, 0.63, and 1.10. Based on the results of the proposed sediment sampling, TVA will discuss the need for additional sampling, including AVS/SEM, with TDEC.
34	Appendix P, Benthic SAP	All	All	All	N/A	Will sediment contaminant concentrations be expressed on a dry weight basis?	Sediment contaminant concentrations will be expressed on a dry weight basis.
35	Appendix P, Benthic SAP	All	All	All	N/A	What is the basis of the 20 percent ash content as the value that triggers additional sampling and analysis?	Based on previously conducted studies at Kingston, a threshold of 40% ash resulted in benthic impacts. TVA has therefore established 20% ash as a conservative Phase 1 sediment sample result to trigger subsequent Phase 2 sediment sampling.
36	Appendix P, Benthic SAP	All	All	All	N/A	The sampling is often referred to as quantitative. A ponar sampler will penetrate to different depths based on substrate composition. How will identical sample sizes be ensured for appropriate site-to-site comparison?	Identical sample size is not required for comparison of the seven Reservoir Benthic Index (RBI) metrics listed below traditionally used by TVA to evaluate benthic macroinvertebrate populations: • Average number of taxa • Proportion of samples with long-lived organisms • Average number of *Ephemeroptera*, *Plecoptera*, and *Trichoptera* (EPT) taxa • Average proportion of oligochaete individuals • Average proportion of total abundance comprised by the two most abundant taxa • Average density excluding chironomids and oligochaete • Proportion of samples containing no organisms
37	Appendix P, Benthic SAP	All	All	All	N/A	How will you ensure that benthic community samples are collected from similar habitats/substrates so that any differences observed are due to contaminant concentrations and not habitat or substrate composition? Would sediment particle size analysis, photographs and notes related to habitat and substrate composition at each site assist in interpretation of benthic community composition data?	Habitats/substrates will be documented in the field; however, it is impossible to ensure that all benthic community samples will be collected from similar habitats/substrates while ensuring sample collection from representative areas of potential contamination, background areas, etc. Reservoir Benthic Index (RBI) metrics will result in a benthic index score or very poor, poor, fair, good, or excellent independent of habitat/substrate, and qualitative assumptions regarding RBI scores can be inferred if habitats/substrates differ dramatically. In addition, benthic community samples are being collected from two historical sample transects which will allow evaluation of temporal trends. Sediment particle size analysis is not proposed as the current procedures, analyses, and RBI metrics will adequately document habitat and community composition both temporally and spatially.

Comment Number	Section Number	Section Title	Page	Para-graph	Line	WBF EIP Rev. 1 TDEC Comments	TVA Response to WBF EIP Rev. 1 TDEC Comments
38	Appendix P, Benthic SAP	All	All	All	N/A	The bioavailability and toxicity of chemicals cannot be accurately predicted based on chemical data alone. Would toxicity testing be a better approach or a good supplement to the proposed approach to assess contaminant effects between sites? If so, the concentrations of natural toxicants such as ammonia and dissolved sulfide should also be determined to support data interpretation.	Toxicity testing could be a good supplement to the proposed approach if there is evidence of adverse effects on aquatic ecology in plant-adjacent water bodies. The proposed approach of evaluating bioaccumulation of CCR in fish and mayflies, and evaluating fish and benthic community structure for evidence of CCR impacts, should be the first phase since it focuses on whether there are any observable adverse ecological effects that may be associated with exposure to concentrations of CCR in sediments or surface water that approach or exceed published toxicity thresholds. Based on the results of the proposed benthic sampling, TVA will discuss the need for additional sampling, including toxicity testing and ammonia/dissolved sulfide analysis, with TDEC.
39	Appendix P, Benthic SAP	Table 5	All	All	N/A	It may also be useful to include ammonia and dissolved sulfide analysis in the proposed plan to support interpretation of benthic community data.	See Response to Comment No. 38.
40	Appendix S, Surface Water SAP	All	N/A	N/A	N/A	Will there be a comparison of chemical concentrations to conditions indicating possible environmental harm, for example water quality standards for receiving stream designated uses?	CCR constituents occur naturally in surface water and can be variable across locations and time. Surface water analytical results will be interpreted in the context of: location-downstream, adjacent, and upstream of the plant; publicly available water quality monitoring data (USGS/EPA); and State/Federal ambient water quality criteria for protection of aquatic life.
41	Appendix S, Surface Water SAP	All	12	Table 2	N/A	TSS should be measured, it is needed for conversion of total metals concentrations to dissolved standards where applicable. Additionally, Mg should be measured and used with the Ca data to calculate protective conditions for metals whose standards are hardness-dependent.	The Surface Stream SAP currently specifies that TSS has been added as a constituent. Mg and Ca have been added to calculate hardness.
42	Appendix S, Surface Water SAP	All	All	All	N/A	In what seasons or months are the sampling events going to be conducted and why?	Sampling events will be conducted during summer pool and winter pool to achieve representative results during both flow conditions. The corresponding change has been made to the EIP.
43	Appendix S, Surface Water SAP	5.2.4	All	All	N//A	Some detail is needed with respect to the transects being conducted at different sampling sites to identify the channel thalwag. For example, how many depth assessments will be made at each site and at what distance (or percent of stream width) along the transect?	It is intended that the thalweg will be identified by passing across the transect with boat mounted depth finding equipment for the larger rivers. For sampling conducted on smaller streams, the thalweg will be identified by measuring depth at intervals as appropriate for the width of the stream.
44	Appendix S, Surface Water SAP	5.2.4	All	All	N/A	Sampling will be conducted during seasonal mean flows and during flows of less than the 75th percentile. The mean would be below the 75th percentile, but you could be below the 75th percentile and be above the mean flow. Which condition will be the determining factor as to when sampling is conducted? Would a better approach be to conduct sampling when flows are between approximately the 25th and 75th	The SAP language has been revised to reflect flow between the 25th and 75th percentiles on the Tennessee River.

Comment Number	Section Number	Section Title	Page	Para-graph	Line	WBF EIP Rev. 1 TDEC Comments	TVA Response to WBF EIP Rev. 1 TDEC Comments
						percentile? You may want to consider sampling based on the median flow and some range around it.	
45	Appendix T, Fish SAP	Fish SAP	All	All	N/A	It would be beneficial to do the tissue processing in the laboratory instead of the field. Removal of liver and ovary might be easier in the lab and/or better ensure lack of contamination during processing.	Comment is acknowledged, and the corresponding changes have been made in the documents. The appropriate quality assurance/quality control procedures will be in place to avoid potential contamination during process are as outlined in the Fish Tissue SAP and WBF QAPP.
46	Appendix T, Fish SAP	Fish SAP	All	All	N/A	It is recommended to analyze individually any larger fish to supplement data obtained from the composite samples.	Section 5.2.1.2 of the Fish Tissue SAP specifies that the smallest fish in a composite be no less than 75% of the total length of the largest fish in the composite which is standard protocol. The size of the fish is generally correlated with age and with length of potential exposure to chemicals in the environment. Thus, the body burden of CCR in an individual fish that is larger than the size range of the composite may not be comparable.
47	Appendix T, Fish SAP	Fish SAP	All	All	N/A	A single composite tissue sample will be collected in most cases. How will data analysis be conducted when sample size is n = 1? The stated goal of assessing variability (pg. 10) can not be achieved once you composite the samples from a site.	As described in the SAP, multiple composite samples will be collected from areas upstream, adjacent to, and downstream of the plant. Tissue composites of each representative trophic level species will be collected for analysis of CCR constituents in whole body (shad), muscle tissue, liver, and ovaries. The approach for comparing analytical results between locations will be determined upon examination of the data.
48	Appendix T, Fish SAP	5.2.1	All	All	N/A	Will dead/degraded/damaged fish pulled from gill nets left overnight be used in tissue analyses?	Section 5.2.1, paragraph 4 states that "Fish visually observed to be decomposing will not be collected for sample analysis."
49	Appendix T, Fish SAP	5.2.4	All	All	N/A	How will you determine whether you have "unexpected" results and that the retained split sample should be analyzed given that only one (composite) sample will be collected from each site? As a trigger, it is recommended that you use TDEC fish tissue criteria as applicable for additional analysis. If fillet composite exceeds criteria, then individual fillets should be analyzed from retained sample.	For the purpose of the Fish Tissue SAP, unexpected results could refer to any of the following: 1) elevated laboratory method detection limits in one or more samples; 2) elevated detection limits for one or more CCR analytes; 3) other issues identified by the analytical laboratory; and 4) results for one or more CCR analytes in a sample that are notably higher or lower than the range of results for the same analyte detected in all other composites from the same sampling reach, or the range of results from composites of the same trophic level fish across all sampling reaches from the same sampling event.
50	Appendix T, Fish SAP	5.2.4	All	All	N/A	If the target species isn't available at a given site, what will be done?	It is anticipated that the target species will be available at the plant based on prior fish surveys regularly conducted by TVA. However, in the unlikely case that a target species is not available, there will not be any sample data for that target species.
51	Appendix T, Fish SAP	5.2.4	All	All	N/A	I don't think there are legal size requirements for most if not all of your target species, you may want to remove the second bullet at the top of pg. 9.	Comment acknowledged; however, TVA opts not to change the document due to potential size limit requirements.
52	Appendix T, Fish SAP	5.2.5	All	All	N/A	Is "gel ice" a potential source of contamination?	Gel ice will not be used. Gel ice has been replaced with wet ice in the Fish SAP.

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53	Appendix T, Fish SAP	6.2	18	5	1	The bolded sub-heading should be Laboratory Duplicate, not Field Duplicate Samples	This section of the SAP refers to field duplicate samples not laboratory duplicate samples (see the QAPP for laboratory duplicate sample discussions). The comment is acknowledged and the language has been revised in Section 6.2 to remove the reference to "laboratory" duplicate and correctly reflect field duplicate samples.

WBF Boring Location Revision Justification

Location ID	Issue Identified	Technical Objective	Changes
CPT25, CPT26, CPT27	Planned locations are on a steep slope that is inaccessible to CPT rig without extensive cribbing and safety planning. However, original technical objective is no longer applicable because an alternate location for the permanent monitoring well was identified.	Original purpose of these CPTs was to locate a buried/former railroad embankment, which would have thinner CCR deposits and might be an acceptable location for a permanent monitoring well.	Delete CPT25, CPT26, and CPT27 from scope of the EIP. An acceptable alternate location for the permanent monitoring well has already been identified, so the original technical objective of the CPTs is no longer necessary. There is no need to risk the CPT rig setup on the steep slope.
BG-01	Original proposed location is located in a hay field that had not been cut at the time the locations were staked; additionally, the only access route to the field is a rough path through the a wooded area which will be difficult to access with all of the support vehicles.	To meet a spatial distribution of BGS locations	Relocated boring (BG-01Alt) to an area of known accessibility approximately 570 feet to the north of the original location adjacent to the access route which is the closest accessible point that meets the Studies objectives.
BG-02	During the field staking activities, inspection of this revealed that there is not a suitable location to advance the soil boring because it appears that a significant amount of fill material has been added to the area as part of the construction of the boat ramp facilities	To meet a spatial distribution of BGS locations	Relocated boring (BG-02Alt) to an area of known accessibility approximately 730 feet to the northeast of the original location which is the closest accessible point that meets the Studies objectives.
BG-08	During the field staking activities a few areas of what appeared to be shallow bedrock were observed. This location is not currently proposed to be relocated; however, a potential alternate location was staked for utility clearance in the event that the original location cannot be advanced.	To meet a spatial distribution of BGS locations	Location BG-08Alt, approximately 70 feet southeast, was added during the field staking activities in the event that the original proposed location turns out to be unusable due to potential shallow bedrock.
BG-10	During field staking activities the proposed location for BG-10 was observed to be directly beneath overhead power lines and there was no adjacent room to move from under the lines.	To meet a spatial distribution of BGS locations	The location was subsequently staked directly across the road (~20 feet south) in an area that is not under power lines.

Figure No.
1

DRAFT

Title
Proposed Borings

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2018-10-30
Technical Review by KB on 2018-10-30

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

Legend

△	Proposed Cone Penetration Test
✕	Removed Proposed Cone Penetration Test
△	Proposed Cone Penetration Test (Renumbered)
▣	Proposed Boring with Piezometer Vibrating Wire *(Saturation Level in CCR, Pore Water Sampling, Geotechnical Data) (Screened Interval)*
○	Proposed Boring
⬠	Proposed Boring with Temporary Well
●	Existing Boring
〰	Historical Stream Alignment (Approximate)
━	Watts Bar Nuclear Facility 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 ESRI Imagery
3. Additional boring in Chemical Pond may be utilized if Cone Penetration Test is inconclusive.
4. CPT borings on 5 feet spacing at historical stream alignment.

Stantec

TVA

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Map Unit	Map Unit Name
AsF	Apison-Sunlight-Salacoa complex, 25 to 65 percent slopes
Bm	Bloomingdale silty clay loam, frequently flooded
CaB	Capshaw silt loam, 2 to 5 percent slopes
DAM	Dams, large
Eg	Egam silty clay loam, 0 to 3 percent slopes
EsC2	Etowah silt loam, 5 to 12 percent slopes, eroded
Ha	Hamblen-Tupelo complex, 0 to 3 percent slopes, occasionally flooded
HoB	Holston loam, 2 to 5 percent slopes
HoC	Holston loam, 5 to 12 percent slopes
Lh	Lee-hamblen complex, frequently flooded
PaC	Pailo gravelly silt loam, 5 to 12 percent slopes
PaD	Pailo gravelly silt loam, 12 to 25 percent slopes
PaF	Pailo gravelly silt loam, 25 to 60 percent slopes
SaB	Shady-altavista complex, 1 to 5 percent slopes
St	Staser loam, 0 to 3 percent slopes
TsD	Townley-Sunlight complex, 12 to 25 percent slopes
UDC	Udorthents-Urban land complex, 2 to 12 percent slopes
UUC	Urban land-Udorthents complex, 2 to 12 percent slopes
W	Water
WaB2	Waynesboro clay loam, 2 to 6 percent slopes, eroded
WaC	Waynesboro loam, 6 to 15 percent slopes
WaC2	Waynesboro clay loam, 6 to 15 percent slopes, eroded
WaD	Waynesboro loam, 15 to 25 percent slopes
WaD2	Waynesboro clay loam, 12 to 25 percent slopes, eroded
WbB2	Waynesboro loam, 2 to 6 percent slopes, eroded
WbD2	Waynesboro loam, 15 to 25 percent slopes, eroded
WvB	Wolftever silt loam, 1 to 5 percent slopes, rarely flooded
WwC2	Wolftever silty clay loam, 5 to 12 percent slopes, eroded

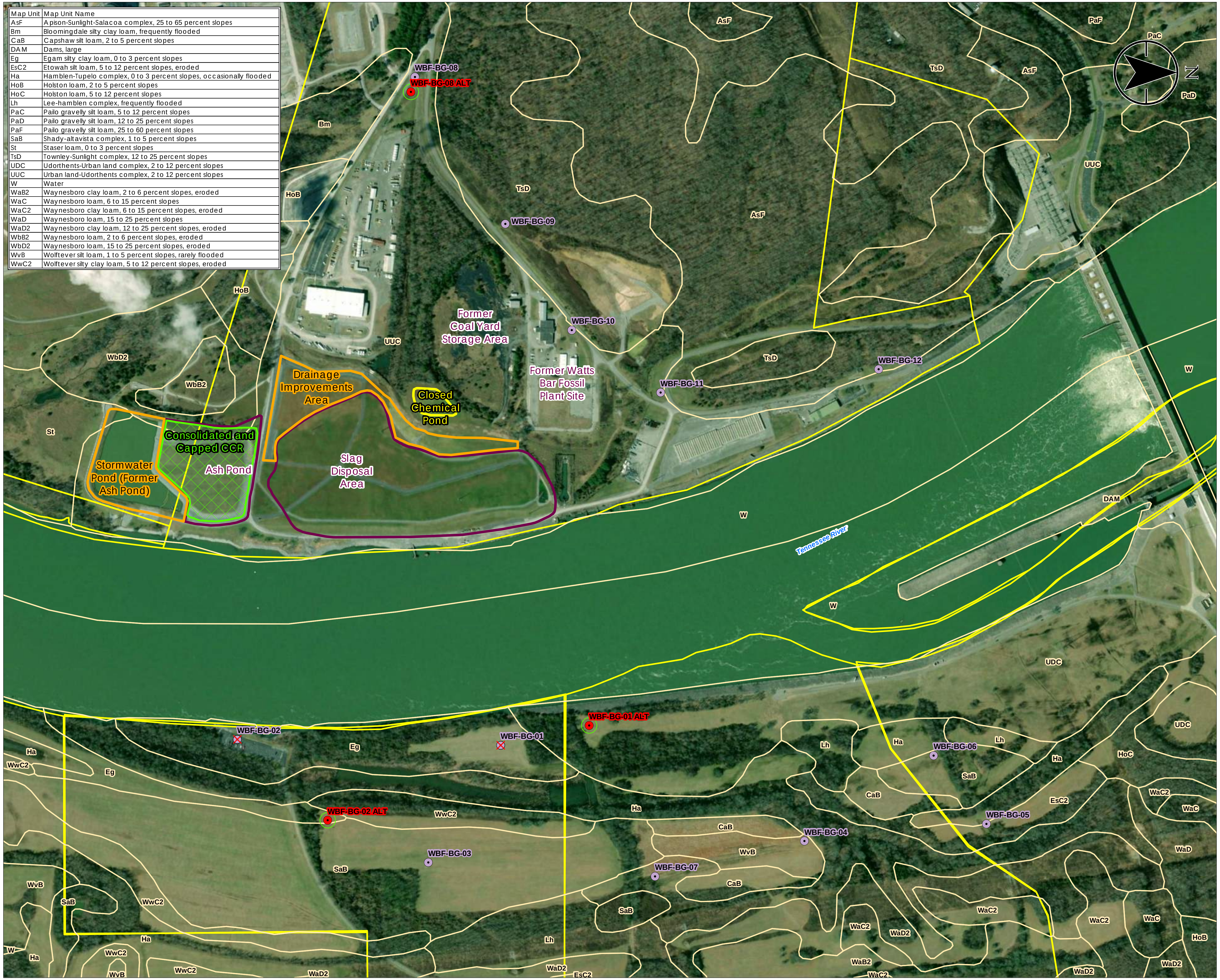

Figure No.
1

DRAFT

Title

Proposed Soil Sampling Locations

Client/Project

Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2018-11-14
Technical Review by TG on 2018-11-14

0 300 600 900 1,200
Feet
1:3,600 (At original document size of 22x34)

Legend

🟩	50 Ft Buffer
●	Alternate Proposed Background Soil Sample Location
☒	Revised Proposed Background Soil Sample Location
●	Proposed Background Soil Sample Location
▢	CCR Unit Area (Approximate)
🟨	Closed Chemical Pond (Approximate)
▨	Consolidated and Capped CCR Area (Approximate)
🟧	Drainage Improvements Area; Stormwater Pond (Former Ash Pond)
▢	Soil Map Unit
🟨	TVA Property

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Bing Imagery
3. Soils Data provided by US Department of Agriculture

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Summary of Proposed Updates to WBF EIP Rev 3 Final
General Documents

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response/SAP Edit	Proposed Update to WBF EIP Rev 3 Final
1	WBF	November 8, 2018	NA	NA	NA	NA	NA	NA	NA	NA	Programmatic revisions including updating timeline dates in Section 1.

Summary of Proposed Updates to WBF EIP Rev 3 Final
Exploratory Drilling SAP

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response/SAP Edit	Proposed Update to WBF EIP Rev 3 Final
1	CUF	September 13, 2018	NA	5.2.7	Equipment Decontamination Procedures	14	First (new)	NA	NA	NA	Add new first paragraph to Section 5.2.7: The decontamination procedures below apply to drilling and sampling in borings for temporary wells. For drilling and sampling in all other borings, as well as for all cone penetration testing, decontamination (per procedures listed in TVA TI ENV-05.80.05, Field Sampling Equipment Cleaning and Decontamination) will only occur before the first boring/CPT and after the last boring/CPT.
2	KIF	October 3, 2018	Email from Luisa to TVA re. Hydrogeological Investigation SAP and Exploratory Drilling SAP Deviation regarding placement of bentonite pellets and filter packs during well installation.	5.4.2.1	Materials and Installation	20	2	NA	NA	NA	Replace 2nd paragraph on page 20 with the following: It should be noted that the grout-will be placed by tremie method through one-inch (minimum) diameter PVC pipe. The grout will be placed using pumps gauged to allow the installation crew to monitor pressures during the grouting process. In open (uncased) boreholes, the sand filter zones and bentonite pellets will be placed by tremie method through one-inch (minimum) diameter PVC. In cased boreholes (i.e., through hollow-stem augers or temporary casing), the sand filter zones and bentonite pellets may be placed by tremie method or may be poured slowly into the annular space of the drill tooling to prevent bridging.
3	WBF	November 8, 2018	Plant-specific CPT Location change	4 and Figure 1 (Attachment A)	Plant Specific Exploration Plan		Table 1 and Table 2	NA	NA	NA	Remove CPT25-CPT27 from the tables of borings and Figure 1 in Attachment A, and re-number the CPTs that follow.
4	WBF	November 8, 2018	Plant-specific CPT Location change	4	Plant Specific Exploration Plan	7 8	5 1	all all	NA	NA	Update multiple paragraphs to delete CPT25, CPT26, and CPT27. Incorporate CPT24, CPT28-CPT32 into the technical objectives of the remaining paragraphs. Renumber the subsequent CPTs accordingly.

Summary of Proposed Updates to WBF EIP Rev 3 Final
Hydrogeological Investigation SAP

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response/SAP Edit	Proposed Update to WBF EIP Rev 3 Final
1	KIF	October 3, 2018	Email from Luisa to TVA re. Hydrogeological Investigation SAP and Exploratory Drilling SAP Deviation regarding placement of bentonite pellets and filter packs during well installation.	5.3.1	Materials and Installation	12	5	all lines	NA	NA	Replace 5th paragraph with this text: It should be noted that the grout will be placed by tremie method through one-inch (minimum) diameter PVC pipe. The grout will be placed using pumps gauged to allow the installation crew to monitor pressures during the grouting process. In open (uncased) boreholes, the sand filter zones and bentonite pellets will be placed by tremie method through one-inch (minimum) diameter PVC. In cased boreholes (i.e., through hollow-stem augers or temporary casing), the sand filter zones and bentonite pellets may be placed by tremie method or may be poured slowly into the annular space of the drill tooling to prevent bridging.

Summary of Proposed Updates to WBF EIP Rev 3 Final
Groundwater Investigation SAP

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response/SAP Edit	Proposed Update to WBF EIP Rev 3 Final
1	WBF	November 14, 2018	NA	5.2.2	NA				NA	NA	Added text to clarify acronyms used for Specific Conductivity, Dissolved Oxygen and Turbidity

Summary of Proposed Updates to WBF EIP Rev 3 Final
Background Soil SAP

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response/SAP Edit	Proposed Update to WBF EIP Rev 3 Final
1	All	NA	NA	SAP 5.1	Preparation For Field Activities	5	5th Bullet	Last	NA	NA	Add the following language to Section 5.1 of Background Soil SAP: "If a proposed boring location is discovered to have accessibility restrictions related to agricultural, cultural, biological, or other such limiting factors, then a replacement boring will be proposed at a location that will meet the study's goals with approval from TDEC"
2	All	NA	NA	SAP 5.0	Sample Collection and Field Activity Procedures	4	2nd	Last	NA	NA	Correct typo in reference to ENV-TI-0.5.80.01 Planning Sampling Events. Currently referenced TI-08.80.01, should be TI-05.80.01
3	All	NA	NA	SAP 5.0	Sample Collection and Field Activity Procedures	4	2nd	Last	NA	NA	Correct typo in reference to ENV-TI-0.5.80.50 Soil and Sediment Sampling. Currently referenced TI-08.80.50, should be TI-05.80.50
4	All	NA	NA	SAP 5.2	Sampling Methods and Protocol	6	1st	Last	NA	NA	Correct typo in reference to ENV-TI-0.5.80.50 Soil and Sediment Sampling. Currently referenced TI-08.80.50, should be TI-05.80.50
5	All	NA	NA	EIP 4.1.1	A.1 TDEC Site Information Request No. 1	35	Last	Last	NA	NA	Add the following language: "If a proposed boring location is discovered to have accessibility restrictions related to agricultural, cultural, biological, or other such limiting factors, then a replacement boring will be proposed at a location that will meet the study's goals with approval from TDEC"
6	WBF	November 8, 2018	Plant-specific Sampling Location change	NA	Plant Specific Exploration Plan	NA	NA	NA	NA	NA	Relocate WBF-BG-01, WBF-BG-02, and provide alternate locations for WBF-BG-08 and WBF-BG-10 in the tables of borings and Figure 1 in Attachment A.

Summary of Proposed Updates to WBF EIP Rev 3 Final
CCR Material Characteristics SAP

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response/SAP Edit	Proposed Update to WBF EIP Rev 3 Final
1	All	NA	NA	NA	NA				NA	NA	Add “ENV-TI-.05.80.01 Planning Sampling Events” to bullet list in Section 5.2
2	All	NA	NA	NA	NA				NA	NA	Clarify language on analyzing CCR material for totals, as well as leachability, in Sections 5.2.1 and 5.2.6
3	All	NA	NA	NA	NA				NA	NA	Add"μS/cm" units to specific conductivity in Section 5.2.1.2
4	All	NA	NA	NA	NA				NA	NA	Change “groundwater” to “pore water” for clarification in Table 6 footnote.
5	All	NA	NA	NA	NA				NA	NA	Add language to Section 5.2.4.2 that "during construction and installation of the temporary wells (i.e., sampling locations), a CCR material grab sample will be taken from each 5-foot core boring, from the top of the unit to its base."
6	All	NA	NA	6.2	NA				NA	NA	Clarify that rinsate blanks are to be collected for every 20 samples or once per sampling event.
7	KIF	November 6, 2018	NA	NA	NA				NA	NA	Remove arsenic speciation for all media from text and Table 6. Analytical Methods, Preservatives, Containers, and Holding Times in Section 5.

Summary of Proposed Updates to WBF EIP Rev 3 Final
Material Quantity SAP

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response/SAP Edit	Proposed Update to WBF EIP Rev 3 Final
1	WBF	November 14, 2018	NA	4.1.1	NA				NA	NA	Update the text and tables to reflect changes in the Exlporatory Drilling SAP based on the CPT boring removal and renumbering.

Summary of Proposed Updates to WBF EIP Rev 3 Final
Benthic SAP

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response/SAP Edit	Proposed Update to WBF EIP Rev 3 Final
1	NA	NA	TVA Comment	NA	Benthic SAP				NA	NA	Per TVA September 2018 email request, designating left and right banks as looking downstream. Reference added in Section 4.1.
2	NA	NA	TVA Comment	NA	Benthic SAP				NA	NA	Per TVA September 2018 email request, adding reference to potential collection of shallow sediment samples using self-closing mechanical benthic sampling device if Vibecore sampling not practical based on conditions encountered in the field. Reference added to Section 5.2.1.1.
3	NA	NA	TVA Comment	NA	EIP Section 4.5.7				NA	NA	Received additional biological monitoring reports from TVA. Will change reference to historical documentation from one document to multiple documents.

Summary of Proposed Updates to WBF EIP Rev 3 Final
Seepage Investigation SAP

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response/SAP Edit	Proposed Update to WBF EIP Rev 3 Final
1	All	November 1, 2018	NA	NA	NA				NA	NA	Add TVA TI ENV-TI-05.80.01 to Section 5.3 and References list, and remove duplicate TVA TI ENV-TI-05.80.02 entry.
2	WBF	November 16, 2018	NA	NA	NA				NA	NA	Amend the container cell in Table 5 for radium 226 and 228 by replacing "8-oz glass (soil)" with "One 16-oz widemouth glass (soil) for both samples."

Summary of Proposed Updates to WBF EIP Rev 3 Final
Surface Stream SAP

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response/SAP Edit	Proposed Update to WBF EIP Rev 3 Final
1	ALF	October 3, 2017	87	Appendix J, Section 5.2.2	Groundwater Investigation SAP, Well Purging	7	2	2	Indicate if specific conductance is measured in mS/cm or µS/cm.	Specific conductance will be measured and recorded in µS/cm in accordance with ENV-TI-05.80.42 (Rev 0001, effective date 3/31/2017).	Will update units in section 5.2.1 Field Analyses.
2	JOF	October 19, 2017	143	Surface Stream SAP	All	All	All	All	TDEC recommends conducting sampling away from and upstream of the boat and motor.	Comment is acknowledged, and the corresponding change has been made in the document.	Will add language to Section 5.2.4 Collection of Samples.
3	JOF	October 19, 2017	145	Surface Stream SAP	All	All	All	All	Please confirm that sampling teams will change tubes on peristaltic pumps between sample sites.	Tubing will be changed between sampling sites.	Will add language to Section 5.2.4 Collection of Samples.
4	JOF	October 19, 2017	146	Surface Stream SAP	All	All	All	All	TDEC recommends a metals grade nitric acid cleaning of sampling equipment between sample collection sites.	New, certified clean, single-use sampling equipment will be used at each location.	Will add nitric acid cleaning to Section 5.2.7 Equipment Decontamination Procedures. Assume that Hydrolab and non-disposable equipment will be cleaned with metals grade nitric acid between sites
5	BRF	January 29, 2018	89	Appendix Q	Stream SAP	All	All	All	Total hardness (as CaCO3) and Total Suspended Solids should be added to the analyte list to allow determination of water quality standards for hardness-dependent metals. TSS is needed for conversion of total metals concentrations since the criteria are expressed as dissolved.	The Surface Stream SAP currently specifies that TSS will be added to the list of constituents for this program. Total hardness will be calculated based on sample analyses and constituent results and presented in the EAR.	Will clarify that Total Hardness will be calculated based on constituent results
6	CUF	February 15, 2018	NA	5.2	Surface Stream SAP	9-11	NA	NA	NA	NA	Remove velocity measurements from surface stream SAPs as loading values were not necessary to achieve the objective. Comparison of concentration values is the preferred method for determining if CCR materials are having an effect on surface streams.
7	CUF	September 12, 2018	NA	5.2	Surface Stream SAP	NA	NA	NA	NA	NA	Add procedure for determining whether or not a thermocline exists.
8	BRF	June 5, 2018	TVA Comment	Table 7	Surface Stream SAP	NA	NA	NA	NA	NA	Add TDS & TSS to Table 7
9	JSF	October 11, 2018	NA	4.0	Sampling Locations	4	2	18	NA	NA	Will change "hardness" to total hardness in reference to previous comment to add total hardness to constituents (Item #6)
10	JSF	October 11, 2018	NA	5.2.4	Collection of Samples	12	3	12-14	NA	NA	Will add naming convention and clarifying language for right bank, left bank, thalweg.
11	WBF	November 8, 2018	NA	5.2.4	Collection of Samples	10	1	1-5	NA	NA	Add text to specify that if the sediment and surface water sampling is conducted concurrently/during the same event, upon arrival at a sample location where both sediment and surface water are being collected, the surface stream sample will be collected before the associated sediment sample.
12	WBF	November 8, 2018	NA	5.2.4	Collection of Samples	NA	NA	NA	NA	NA	Will clarify that filters will be treated as single-use.

Summary of Proposed Updates to WBF EIP Rev 3 Final
Fish Tissue SAP

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response/SAP Edit	Proposed Update to WBF EIP Rev 3 Final
1	CUF	April 1, 2018	TVA Comment	5.2.3.3	Chain of Custody Forms	10	1	4	NA	TVA/Stantec SAP change	Delete the sentence "The Investigation Project Manager will staff the project with a field sample manager during sample collection activities." due to change of sampling to be completed by TVA biologists instead of a consultant.
2	CUF	April 1, 2018	TVA Comment	5.2.4	Collection of Samples	12	10	5	NA	TVA/Stantec SAP change	Delete "but no more than one week apart," at the request of TVA biolgists to allow a wider sampling window due to their past sampling experience and past methods used in similar sampling projects by TVA.
3	NA	NA	TVA Comment	EIP Section 4.5.7	TDEC Surface Water Impacts Request No. 7	52	3	1	NA	TVA/Stantec SAP change	Received additional biological monitoring reports from TVA. Will change reference to historical documentation from one 2016 document to multiple documents dated 2001 to 2018.

Summary of Proposed Updates to WBF EIP Rev 3 Final
Quality Assurance Project Plan

Item No.	Plant	Date	TDEC Comment No.	Section No.	Section Title	Page	Paragraph	Line	TDEC Comment	TVA Response	Proposed Update to WBF EIP Rev 3 Final
1	WBF	NA	NA	2.2.4	Analytical Laboratories	6	Table 2-1	NA	NA	NA	Change PM for both TestAmerica Facilities to Gail Lage
2	WBF	NA	NA	2.2.4	Analytical Laboratories	6	Table 2-1	NA	NA	NA	Update primary TestAmerica facility to Nashville, TN and identify Pittsburgh and St. Louis as support facilities
3	WBF	NA	NA	2.2.4	Analytical Laboratories	6	Table 2-1	NA	NA	NA	Remove reference to arsenic speciation analyses and remove reference to TestAmerica Denver facility.
4	WBF	NA	NA	11.2	Field and Laboratory Quality Control Samples	28	Table 11-1	NA	NA	NA	Clarify field blank frequency to "1 per day of sampling activity per sampling team"
5	WBF	NA	NA	11.2	Field and Laboratory Quality Control Samples	28	Table 11-1	NA	NA	NA	Clarify filter blank collection frequency to "1 per sampling event per lot of filters used (when dissolved parameters are collected)"
6	WBF	NA	NA	19.1	Precision	49	3	NA	NA	NA	Add language defining RER equation
7	WBF	NA	NA	Attachment D	Table A: TVA - TDEC Order Sample Naming Conventions - Watts Bar Fossil Plant	D-2	NA	NA	NA	NA	Update nomenclature coding for background soil and surface stream investigations.
8	WBF	NA	NA	Attachment E	Investigation-Specific Quality Control Requirements – Background Soil Sampling	E-2	Table E-1	NA	NA	NA	Update container type to 16-oz glass for radiological parameters
9	WBF	NA	NA	Attachment E	Investigation-Specific Quality Control Requirements – Background Soil Sampling	E-2	Table E-1	NA	NA	NA	Remove thermal preservation required for radiological parameters
10	WBF	NA	NA	Attachment E	Investigation-Specific Quality Control Requirements – Background Soil Sampling	E-3	Table E-2	NA	NA	NA	Update RLs to match current laboratory reporting limits
11	WBF	NA	NA	Attachment F	Investigation-Specific Quality Control Requirements – Surface Stream	F-2	Table F-1	NA	NA	NA	Remove thermal preservation required for radiological parameters
12	WBF	NA	NA	Attachment F	Investigation-Specific Quality Control Requirements – Surface Stream	F-3	Table F-2	NA	NA	NA	Update RLs to match current laboratory reporting limits
13	WBF	NA	NA	Attachment G	Investigation-Specific Quality Control Requirements – Fish Tissue Sampling	G-3	Table G-2	NA	NA	NA	Removed note that biological samples will be reported on a dry-weight basis; tissue samples will be reported wet-weight.
14	WBF	NA	NA	Attachment G	Investigation-Specific Quality Control Requirements – Fish Tissue Sampling	G-3	Table G-2	NA	NA	NA	Update RLs to match current laboratory reporting limits
15	WBF	NA	NA	Attachment H	Investigation-Specific Quality Control Requirements – Benthic Sampling	H-3	Table H-2	NA	NA	NA	Update RLs to match current laboratory reporting limits
16	WBF	NA	NA	Attachment H	Investigation-Specific Quality Control Requirements – Benthic Sampling	H-3	Table H-2	NA	NA	NA	Removed note that biological samples will be reported on a dry-weight basis; tissue samples will be reported wet-weight.
17	WBF	NA	NA	Attachment H	Investigation-Specific Quality Control Requirements – Benthic Sampling	Various	Various	NA	NA	NA	Added sediment sampling requirements into Attachment H for consistency with SAP.
18	WBF	NA	NA	Attachment I	Investigation-Specific Quality Control Requirements – Seep Sampling	I-2	Table I-1	NA	NA	NA	Update container type to 16-oz glass for radiological parameters for seep soil
19	WBF	NA	NA	Attachment I	Investigation-Specific Quality Control Requirements – Seep Sampling	I-2	Table I-1	NA	NA	NA	Remove thermal preservation required for radiological parameters
20	WBF	NA	NA	Attachment I	Investigation-Specific Quality Control Requirements – Seep Sampling	I-3	Table I-2	NA	NA	NA	Update RLs to match current laboratory reporting limits
21	WBF	NA	NA	Attachment I	Investigation-Specific Quality Control Requirements – Seep Sampling	I-5	Table I-3	NA	NA	NA	Update RLs to match current laboratory reporting limits
22	WBF	NA	NA	Attachment J	Investigation-Specific Quality Control Requirements – Groundwater	J-2	Table J-1	NA	NA	NA	Remove thermal preservation required for radiological parameters
23	WBF	NA	NA	Attachment K	Investigation-Specific Quality Control Requirements – CCR Material	K-2	Table K-1	NA	NA	NA	Update container type to 16-oz glass for radiological parameters for CCR Material.
24	WBF	NA	NA	Attachment K	Investigation-Specific Quality Control Requirements – CCR Material	K-2	Table K-1	NA	NA	NA	Remove thermal preservation required for radiological parameters
25	WBF	NA	NA	Attachment I	Investigation-Specific Quality Control Requirements – CCR Material Characteristics	Various	Various	NA	NA	NA	Remove references to arsenic speciation for CCR Material Characteristics Investigation

Summary of Proposed Updates to WBF EIP Rev 3 Final
Quality Assurance Project Plan

26	WBF	NA	NA	Attachment K	Investigation-Specific Quality Control Requirements – CCR Material	K-2	Table K-1	NA	NA	NA	Update sample mass requirements for SPLP analyses.
27	WBF	NA	NA	Attachment K	Investigation-Specific Quality Control Requirements – CCR Material	K-7	Table K-4	NA	NA	NA	Remove surrogate requirement for radiological parameters in solid matrices.
28	WBF	NA	NA	Attachment K	Investigation-Specific Quality Control Requirements – CCR Material	K-2	Table K-1	NA	NA	NA	Add equipment blank requirements for CCR material
29	WBF	NA	NA	Attachment K	Investigation-Specific Quality Control Requirements – CCR Material	K-3	Table K-2	NA	NA	NA	Update RLs to match current laboratory reporting limits

APPENDIX C
QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN
FOR THE TENNESSEE VALLEY AUTHORITY
WATTS BAR FOSSIL PLANT
ENVIRONMENTAL INVESTIGATION

Revision 2

November 2018

Prepared by:

ENVIRONMENTAL STANDARDS, INC.
1140 Valley Forge Road
P.O. Box 810
Valley Forge, PA 19482-0810

Prepared for:

TENNESSEE VALLEY AUTHORITY
1101 Market Street
Chattanooga, TN 34702-2801

1.0 TABLE OF CONTENTS

Figures

Tables

Attachments

2.0 QUALITY ASSURANCE PROJECT PLAN DESCRIPTION

2.1 Background

The primary goal of this Tennessee Valley Authority (TVA) Watts Bar Fossil Plant (WBF) Environmental Investigation Quality Assurance Project Plan (WBF QAPP) is to confirm that the WBF environmental investigation objectives are met by TVA consultants and contractors generating documented, high-quality, reliable investigative/analytical data. This document describes the quality assurance (QA) requirements for work performed under the *TVA Watts Bar Fossil Plant Environmental Investigation Plan*, *Revision 2* (WBF EIP; June 2018) and provides QA procedures and quality control (QC) measures to be applied to associated sampling and monitoring activities. This WBF QAPP will govern the quality aspects of the investigation-specific Sampling and Analysis Plans (SAPs).

This WBF QAPP describes the QA implementation for the WBF EIP and identifies the obligations of the various entities responsible for generating environmental data. Specific details on the various sampling programs and project-specific quality objectives are presented in this WBF QAPP and/or the associated SAPs, with TVA Technical Instructions (TIs) or standard operating procedures (SOPs) guiding the specific activities performed under these plans. The WBF QAPP describes the generation and use of environmental data associated with the WBF EIP and is applicable to current sampling and monitoring programs associated with the project. Data generated under the WBF EIP will be managed in accordance with the Data Management Plan for the TVA Multi-Site Order.

2.2 Quality Assurance Program Organization, Management, and Responsibilities

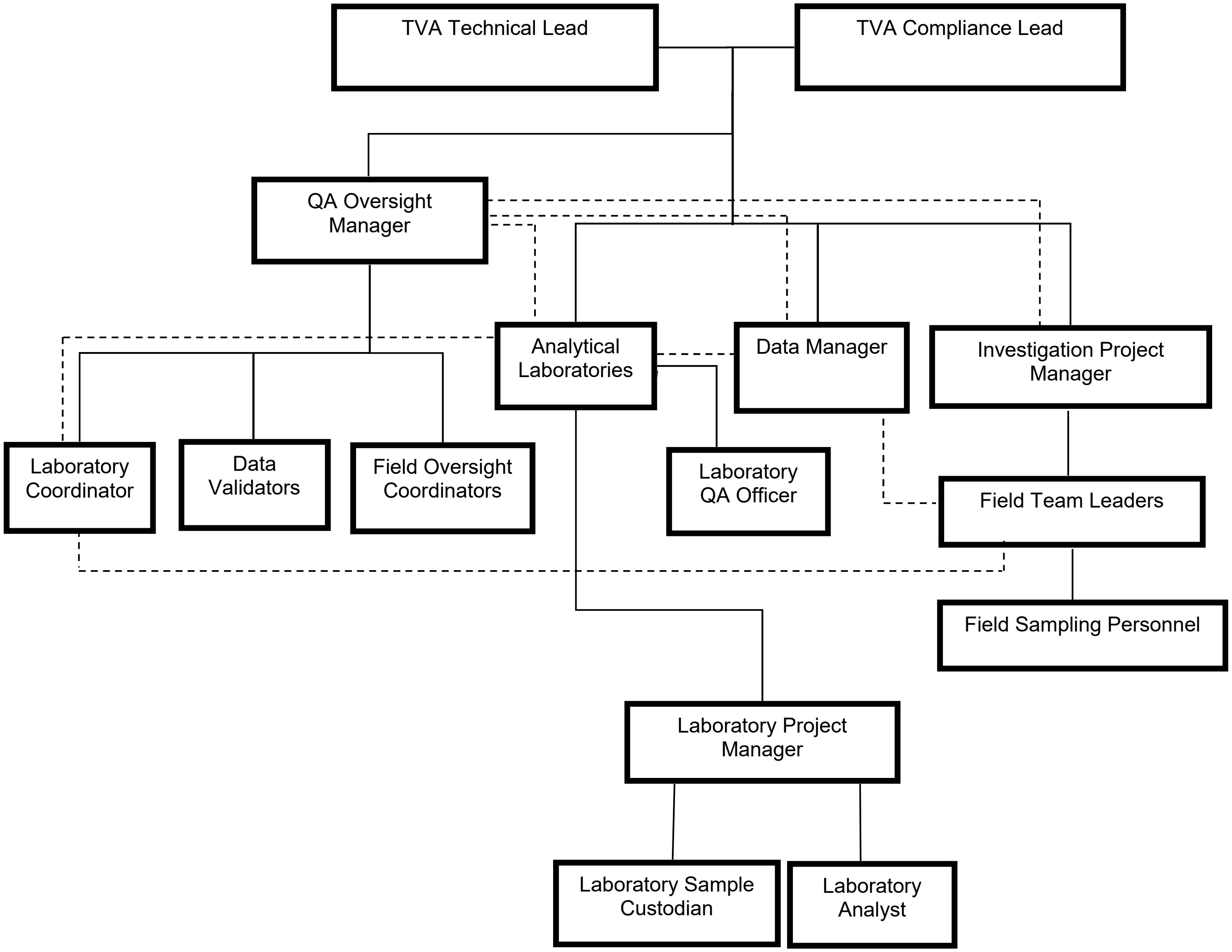
Successful implementation of a QA Program requires clear lines of reporting and authority, along with defined responsibilities for key individuals implementing and administrating the QA Program. This section describes the organizational structure, lines of authority, and responsibilities of key individuals accountable for the implementation and administration of the WBF EIP requirements. Project activities are performed within the framework of the organization and functions described in this section.

The organizational structure showing relationships of individuals with key responsibilities is presented in Figure 2-1. The organizational structure in Figure 2-1 represents a subsection of the overall organizational structure for the project as directly related to implementation of the WBF QAPP. The QA oversight consultant provides independent QA support to TVA including QA oversight of field and laboratory personnel. The organizational structure is designed to provide clear lines of responsibility and authority, regardless of the individuals filling particular roles. This organizational structure encompasses the following activities:

- Identifying lines of communication and coordination.
- Monitoring project schedules and performance.
- Managing technical resources.
- Providing periodic progress reports.
- Coordinating support functions such as laboratory analysis and data management.
- Rectifying deficiencies and issues that could impact data quality.

Field and laboratory personnel providing services in support of project efforts must perform work in compliance with the appropriate technical specifications for the activity.

Figure 2-1. Organization Chart and Lines of Communication for the WBF EIP



The sections below detail the roles and responsibilities for the positions involved in the WBF EIP.

2.2.1 TVA Compliance Lead

The TVA Compliance Lead is responsible for the coordination and direction of the WBF EIP. The TVA Compliance Lead is ultimately responsible for design and implementation of the WBF EIP. The TVA Compliance Lead interfaces with TVA Legal Counsel as necessary and provides reports to TVA Senior Management.

TVA Compliance Lead's responsibilities and duties include:

- Identifying lines of communication and coordination.
- Managing key technical resources.
- Providing periodic progress reports to TVA Senior Management.
- Reviewing and approving the WBF EIP strategy.
- Reviewing and approving WBF EIP quality objectives.
- Reviewing and approving SAPs.
- Rectifying deficiencies and issues.
- Participating in meetings with Tennessee Department of Environment and Conservation (TDEC).
- Providing compliance support to TVA Technical Lead.

2.2.2 TVA Technical Lead

The TVA Technical Lead is responsible for providing technical guidance for the WBF EIP. The TVA Technical Lead directs the Investigation Project Manager and independent QA Oversight Manager and is ultimately responsible for design and implementation of the WBF EIP. The TVA Technical Lead interfaces with TVA Legal Counsel as necessary and provides reports to TVA Senior Management.

TVA Technical Lead's responsibilities and duties include:

- Developing and reviewing the WBF EIP strategy.
- Developing and reviewing WBF EIP quality objectives.
- Reviewing and approving SAPs.
- Reviewing and analyzing overall task performance relative to planned QA requirements.
- Managing support functions such as laboratory analysis and data management.
- Rectifying deficiencies and issues.
- Providing technical support to the TVA Compliance Lead.
- Overseeing the budget.
- Monitoring project schedules and performance.

2.2.3 Investigation Project Manager

The Investigation Project Manager plans, coordinates, and oversees the performance of all investigation and sample collection activities. Investigation Project Manager's responsibilities include:

- Developing SAPs.
- Planning and coordinating Field Sampling Personnel for investigation and sampling events.
- Reviewing field logbooks for completeness, consistency, and accuracy.
- Managing and reviewing field sample Chain-of-Custody (COC) Records and associated documentation.
- Obtaining the appropriate field gear and supplies.
- Notifying management of situations requiring corrective action.
- Responding to, and implementing corrective action, as described in Section 16.0.

2.2.3.1 Field Team Leaders

The Field Team Leaders are the primary contacts in the field and are responsible for field activities, as listed below.

- Provide coordination and management of Field Sampling Personnel and subcontractors involved in field investigation, sampling, or calibration activities.
- Submit analytical requests to the Laboratory Coordinator.
- Ensure Field Sampling Personnel are familiar with field procedures and that these procedures are followed to achieve the data objectives.
- Review field logbooks and field data sheets for completeness, consistency, and accuracy.
- Conduct QA review of field data and coordinate submittal of field data to the Data Manager.

2.2.3.2 Field Sampling Personnel

Field Sampling Personnel are responsible for the performance of field activities as required by the program-specific SAPs and associated field TIs. Field Sampling Personnel document compliance with project requirements by recording field activities and observations in a field logbook at the time of the activity or observation. In addition, Field Sampling Personnel are responsible for collecting samples, submitting them to laboratories, and maintaining COC Records.

Field Sampling Personnel are responsible for field activities, including:

- Plan investigation and sample events and interface with the Laboratory Coordinator.
- Collect, label, and package samples.
- Ensure field procedures are followed to achieve the data objectives.
- Review field notebooks/logbooks for completeness, consistency, and accuracy.

- Provide coordination of sample delivery to project laboratories for analysis.

If there are problems encountered during any field activities, Field Sampling Personnel will inform the appropriate Field Team Leader and/or the Investigation Project Manager.

2.2.4 Analytical Laboratories

The functional roles for project analytical laboratories are described in this subsection. From the Project perspective, the structure is designed to facilitate information exchange about planning, technical requirements, schedules, and QA measures among the laboratories, Investigation personnel, QA Oversight personnel, and TVA personnel. Project information exchange specifically includes sample identification; preservation procedures; sample container requirements; sample collection procedures; decontamination protocols; and sample labeling, packing, holding times, and shipping.

Although internal laboratory structures may differ depending on the specific contractor, key functional roles include division management, technical direction, subcontracting coordination, data review, and data management.

The responsibilities of the analytical laboratories include, but are not limited to:

- Preparing and analyzing samples in a manner consistent with the analytical request, the WBF QAPP, and any applicable TVA TIs or other work instructions.
- Communicating with the QA Oversight team.
- Adhering to the laboratory QA Program.
- Implementing QC procedures for each test parameter.
- Reviewing analytical results, including raw data, calculations, and laboratory logbooks.
- Monitoring proper documentation and maintenance records.
- Identifying and implementing training requirements for the laboratory analytical personnel.
- Identifying QA problems and recommending appropriate corrective action.
- Preparing status reports (progress, problems, and recommended solutions).
- Preparing reports documenting completion of corrective actions.
- Providing electronic data deliverables (EDDs) in a format consistent with project requirements.

Laboratories will be selected based on a number of factors including capability, capacity, and ability to generate quality data that meet project objectives. The primary contracted laboratories may subcontract samples for special studies or non-routine analyte lists. In the event that samples are subcontracted, the primary laboratory is responsible for ensuring that analyses conform to the WBF QAPP requirements and the associated investigation-specific SAP. Data for subcontracted analyses will be reported through the primary contracted laboratory, which remains responsible for data quality.

The primary analytical laboratories expected to analyze samples associated with the WBF EIP are presented on Table 2-1.

Table 2-1. Analytical Laboratories for WBF EIP

Parameter/ Sample Type	Laboratory	Facility Address	Laboratory Contact
Metals, General Chemistry Parameters	TestAmerica Laboratories, Inc.	2960 Foster Creighton Drive Nashville, TN 37204[1]	Ms. Gail Lage (gail.lage@testamericainc.com)
		301 Alpha Drive Pittsburgh, PA 15237[2]	
Radiological Parameters		13715 Rider Trail North Earth City, MO 63045[2]	
Percent Ash	R.J. Lee Group	50 Hochberg Road, Monroeville, PA 15146	Ms. Monica Carse (MCarse@rjleegroup.com)
Biota Analyses	Pace Analytical Services, LLC	1241 Bellevue Street Suite 9 Green Bay, WI 54302	Mr. Tod Noltemeyer (tod.noltemeyer@pacelabs.com)
Geotechnical Characteristics	Stantec Consulting Services, Inc.	3052 Beaumont Centre Circle Lexington, KY 40513-1703	Ms. Ryan Jones (ryan.jones@stantec.com)
Benthic Invertebrate Community Assessment	Pennington & Associates, Inc.	161 McGee Lane Cookeville, TN 38501	Mr. Wendell Pennington (pai1@twlakes.net)

NOTES:

1 Primary analytical laboratory.
2 Support analytical laboratory.

2.2.4.1 Laboratory QA Officer

The Laboratory QA Officer ensures conformance with authorized policies, procedures, and sound laboratory practices as necessary. The Laboratory QA Officer will inform the Laboratory Project Manager of any non-conformances, introduce control samples into the sample train, and establish testing lots. In addition, the Laboratory QA Officer approves laboratory data before reporting or transmitting to permanent storage and is responsible for retention of supporting information such as control charts and other performance indicators to demonstrate that the systems that produced the data were in control. The Laboratory QA Officer also reviews results of internal QA audits and recommends corrective actions and schedules for their implementation.

The responsibilities of the Laboratory QA Officer include, but are not limited to:

- Administering the laboratory QA Program.
- Implementing QC procedures for each test parameter.
- Reviewing analytical results, including raw data, calculations, and laboratory log books.
- Monitoring proper documentation and maintenance of the records.

- Identifying and implementing training requirements for the laboratory analytical personnel.
- Overseeing QA implementation at the laboratory on a daily basis.
- Identifying QA problems and recommending appropriate corrective action.
- Preparing status reports (progress, problems, and recommended solutions).
- Preparing reports documenting completion of corrective actions.

2.2.4.2 Laboratory Project Manager

The Laboratory Project Manager is the primary contact for the Project Team at the analytical laboratory. A primary responsibility of the Laboratory Project Manager is to schedule analytical work within the laboratory, ensure that project-specific analytical requirements are communicated to staff, monitor analytical status/deadlines, approve laboratory reports, coordinate data revisions/corrections and re-submittal of data packages as necessary, and communicate sample preparation and analysis issues to the QA Oversight Manager and TVA Technical Lead on a real-time basis. The Laboratory Project Manager provides direction and support for laboratory administrative and technical project staff, interfaces with laboratory project staff on technical issues, and performs QA oversight of analytical data. The Laboratory Project Manager contacts the QA Oversight Manager and TVA Technical Lead if, at any point, there is a need to deviate from the WBF QAPP or other cited published materials. Any problems or inconsistencies identified at any time after laboratory sample receipt will be documented on a nonconformance report initiated by the Laboratory Project Manager and forwarded to the TVA Technical Lead and the Laboratory Coordinator.

The Laboratory Project Manager will provide sample receipt confirmations to the Laboratory Coordinator and Investigation Project Manager within one business day of sample login.

2.2.4.3 Laboratory Sample Custodian

The Laboratory Sample Custodian receives samples from TVA or its contractors, signs and dates COC Records, records the date and time of receipt, and records the condition of shipping containers and sample containers.

The Sample Custodian will verify and record agreement or non-agreement of information on sample custody documents. If there is non-agreement, the Sample Custodian will record the problems/inconsistencies for the case file and will inform the Laboratory Project Manager.

The Sample Custodian will also label sample containers with laboratory sample numbers, place sample containers and spent sample containers into the appropriate storage and/or secure areas, and monitor storage conditions.

2.2.4.4 Laboratory Analyst

The Laboratory Analyst is responsible for preparing and/or analyzing samples in accordance with this document and/or the applicable analytical methods. If there are problems encountered during sample preparation or analysis, the Laboratory Analyst will inform the Laboratory QA Officer and Laboratory Project Manager.

2.2.5 QA Functions

QA oversight activities will be performed by a third-party, independent contractor. The QA oversight consultant is an independent third-party QA organization and reports directly to the TVA Technical Lead.

2.2.5.1 QA Oversight Manager

The QA Oversight Manager develops, implements, and administers the overall QA Program for the WBF EIP. The QA Oversight Manager holds overall authority for the project QA and maintains that authority independently from the operational/production aspects of the project. The QA Oversight Manager also holds the authority to communicate at any level of the project organization in order to be effective.

The QA Oversight Manager's responsibilities and duties include:

- Establish a documented quality system for the project.
- Identify QA problems through periodic auditing and validation procedures.
- Initiate, recommend, or provide solutions to QA problems through designated channels.
- Ensure that project activities, including processing of information, delivery of products, and installation or use of equipment, are reviewed in accordance with QA objectives.
- Ensure that deficiencies or non-conformances are corrected.
- Ensure that further processing, delivery, or use of deficient or non-conforming data is controlled until correction of the non-conformance, deficiency, or unsatisfactory condition has occurred.
- Review and analyze overall task performance with respect to planned requirements.
- Perform general oversight of corrective action processes.
- Initiate and direct internal audits, inspections, surveillances, and observation of quality-related activities.
- Serve as point of contact for audits, inspections, surveillances, data management, and observation activities.
- Ensure deficiencies and non-conformances are corrected.
- Maintain QA documentation and records, including this WBF QAPP.

2.2.5.2 Laboratory Coordinator

The Laboratory Coordinator serves as a liaison between Field Team Leaders and the analytical laboratories for all work conducted under the WBF EIP. The Laboratory Coordinator's responsibilities include:

- Review analytical requests to verify consistency with project SAPs.
- Submit analytical requests to the Laboratory Project Manager.
- Schedule sample submission and transportation (as needed).
- Review and approve laboratory bottleware orders.
- Review COC Records submitted to the laboratories and sample receipt documentation provided by the laboratories.
- Serve as the point of contact for questions and issues arising during laboratory analysis.

2.2.5.3 Data Validators

Data Validators are responsible for performing review and validation of project data generated by the laboratories in accordance with the WBF QAPP and data specifications, producing data validation reports, and notifying the QA Oversight Manager of any specific issues or concerns.

2.2.5.4 Field Oversight Coordinators

Field Oversight Coordinators are independent from field sampling activities and work with the Field Team Leaders to ensure compliance with the WBF QAPP, program-specific sampling plans, and the associated project TIs. The Field Oversight Coordinators are responsible for training personnel involved in field sampling activities (if training is required), sample handling procedures, and sample custody as detailed in project TIs and the investigation-specific SAPs, and for periodically overseeing their performance of these functions. The Field Oversight Coordinators perform quality oversight of the Field Teams during sample collection and assess the procedures and performance of the Field Teams relative to the requirements in the WBF QAPP, TIs, and investigation-specific SAPs. As part of the quality oversight, the Field Oversight Coordinators will review COCs prior to submission of samples to the analytical laboratories.

2.2.6 Data Manager

The Data Manager is responsible for managing the project EQuIS^{TM} database, which includes analytical data from the project laboratories, field data from the Field Team Leaders, and historical data of known quality used as part of the WBF EIP. The Data Manager is the main point-of-contact for data-related issues. The Data Manager is responsible for ensuring compliance with the WBF QAPP and the Data Management Plan for the TVA Multi-Site Order (Data Management Plan). The Data Manager or designee receives EDDs directly from the project laboratories after sample analysis and formats the deliverables such that they can be used during the validation/verification process. Field data is collected and submitted to the Data Manager from the Field Team Leader utilizing field EDDs and is loaded and managed in the project database. A complete description of the Data Manager's responsibilities and responsibilities of Data Management support staff is provided in the Data Management Plan.

3.0 PROJECT DESCRIPTION AND APPLICABILITY

On August 6, 2015, TDEC issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA, setting forth a process for the investigation, assessment, and remediation of unacceptable risks at TVA's coal ash disposal sites in Tennessee. The TDEC Order is limited to the purposes and processes set forth in the Order. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at the Watts Bar Fossil Plant (WBF) on April 27, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management activities at WBF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On June 14, 2016, TDEC issued a follow-up letter, which provided specific questions and tasks for TVA to address as part of the EIP. On June 22, 2017, TDEC issued a second follow-up letter to TVA regarding the TDEC Order and EIP submittal dates. On November 15, 2016, TVA submitted WBF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

The purpose of the WBF EIP is to characterize the hydrology and geology of the WBF, identify the extent of soil, sediment, surface water, groundwater, and ecological impact by CCR, and assess the quantities and characteristics of CCR materials currently onsite. At the conclusion of the investigation, an Environmental Assessment Report (EAR) analyzing results of these investigations will be prepared and submitted to TDEC. The EAR will support the development of an appropriate corrective action plan, if necessary, for WBF.

To support the WBF EIP objectives, a QA program has been implemented to ensure the environmental data generated for use in decision making is of high-quality and is legally defensible. The project's environmental data have been and continue to be used for purposes such as, but not limited to, operational decisions; delineation of the extent of contamination and transport of ash by river flows; and demonstration of achievement of project objectives.

On behalf of TVA, Environmental Standards, Inc., an independent QA firm, has prepared this WBF QAPP. The requirements of the WBF QAPP are applicable to project environmental personnel, support staff, consultants, and subcontractors.

3.1 Purpose and Scope

The WBF QAPP is intended to establish an overall environmental QA framework for the WBF EIP and to provide quantitative quality objectives for analytical data generated under the WBF EIP. Requirements associated with various analyses; data generation, reduction, and management; and results reporting are stipulated herein. Additional specific requirements are described in the investigation-specific SAPs.

The scope of this document is to describe the QA requirements developed for the WBF EIP and provide the appropriate QA procedures and QC measures to be applied to the associated sampling and monitoring activities. The WBF QAPP addresses the following items:

- Project organizational structure, roles, and responsibilities.
- QA objectives.
- Training requirements.
- Field and laboratory documentation requirements.
- Sample collection, handling, and preservation.
- COC procedures.
- Field and laboratory instrumentation and equipment calibration and maintenance.
- Preventive maintenance procedures and schedules.
- Laboratory procedures.
- Analytical methods requirements.
- Sample analysis, data reduction, validation, and reporting.
- QC sample types and frequency.
- QA performance and system audits.
- Data assessment procedures, including processing, interpretation, and presentation.
- Corrective actions.
- QA reports to management.

Investigation-specific SAPs have been developed to address program-specific sampling requirements to provide data sufficient to address the objectives of the particular investigation. QC requirements and quantitative objectives for analytical data are presented in Attachments E through K of this WBF QAPP.

3.2 Schedule

Investigation-specific sampling schedules are addressed in each associated SAP.

In general, the anticipated schedule of activities related to analytical data generated from chemical analyses is presented below.

- The laboratory will provide analytical results and EDDs to TVA within its standard turn-around time (TAT); approximately 10 business days for chemical analyses and approximately 40 days for radiological analyses) from sample receipt (or sooner when expedited TAT is requested).
- The QA Oversight Consultant will screen the EDD for acceptability to the database and complete the initial verification within 2 business days of EDD receipt and successful EDD loading. Verified data will be available to TVA and Investigation personnel for internal use and reporting.
- The laboratory will provide full data deliverable packages to TVA and the QA Oversight Consultant within its standard TAT (approximately 20 business days for chemical analyses and approximately 45 days for radiological analyses) from sample receipt.
- The QA Oversight Consultant will complete data validation as requested by TVA, generate reports following receipt of the complete data package, and add data validation qualifiers to the database as appropriate.

The overall schedule for the WBF EIP is presented in the EIP. Schedules for the various sampling activities associated with each environmental investigation (EI) are addressed in the investigation-specific SAPs.

3.3 WBF QAPP Distribution and Revision

The WBF QAPP will be distributed to each consultant and contractor responsible for the collection, generation, and interpretation of field and analytical data. The TVA Technical Lead, QA Oversight Manager, or designee will be responsible for ensuring that necessary revisions are made so that the WBF QAPP is up-to-date with actual practices and will ensure that revisions and updates are distributed to necessary users. The document control format used in the WBF QAPP will identify the WBF QAPP revision number and revision date. A revision history that identifies each revision and a summary of the revision will be maintained.

4.0 DATA QUALITY OBJECTIVES PROCESS

The Data Quality Objectives (DQO) process is a series of planning steps based on a scientific method to ensure that the type, quantity, and quality of environmental data used in decision-making are appropriate for the intended application. In general, DQOs provide a qualitative and quantitative framework around which data collection programs can be designed. The qualitative aspect of DQOs seeks to encourage good planning for field investigations. The quantitative aspect of DQOs involves designing an efficient field investigation that reduces the possibility of incorrect decision-making.

The DQO process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA, its QA oversight consultant, and investigation personnel considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts at the WBF EIP.

5.0 SPECIAL TRAINING/CERTIFICATIONS

Field Sampling Personnel performing sample collection activities will be properly trained in equipment use and procedures necessary for each task prior to entering the field. Training will be conducted by TVA, the QA Oversight Consultant, the Investigation Project Manager, and/or other subcontractors. Any proposed training not provided by the QA Oversight Consultant will be reviewed and approved by the Field Oversight Coordinator before training is conducted. Field Sampling Personnel training will be fully documented and the documentation will be maintained as part of the Project Record.

Individuals who plan to participate in field activities must have current health and safety training prior to commencement of sample collection activities. The Field Team Leader will verify that participants who arrive on site have provided evidence of health and safety training. It will be the responsibility of the Field Team Leader to ensure that Field Sampling Personnel understand and comply with the applicable requirements for their individual tasks.

Field Sampling Personnel will be trained on applicable field QC measures associated with a particular sampling program during investigation-specific training. Training received by Field Sampling Personnel will be documented. In addition, Field Sampling Personnel will receive training based on field oversight activities and additional training sessions on applicable project TIs.

Personnel who are responsible for performing laboratory analyses will be properly trained by the QA Officer or her/his designee to conduct the various laboratory analyses described in the WBF QAPP. Each laboratory shall assure sufficient personnel with the necessary education, training, technical knowledge, and experience for their assigned functions. Laboratory personnel training will be documented in accordance with the laboratory’s Quality Program requirements.

Data verification and validation will be conducted under the direction of the QA Oversight Manager, who will be experienced with the production, reporting, verification, and validation of analytical data.

Additional QA training will be conducted at the discretion of the TVA Technical Lead and the QA Oversight Manager. Generally, the need for QA training for project personnel will be identified through systems and performance audits and training will be conducted as part of the corrective action process. Any QA training provided to project personnel will be documented.

6.0 DOCUMENTATION AND RECORDS

Appropriate records will be maintained in a secure project file to provide adequate documentation of the entire data generation process, including field sampling and laboratory analysis. Field records will include maintaining field logs, field data sheets, and sample COC documentation. Field QC samples will be documented in both the field logbook and sample COC Records.

The Project File will be the central repository for documents relevant to sampling and analysis activities as described in the WBF QAPP and in the investigation-specific Work Plans and/or SAPs. The TVA Technical Lead will hold overall responsibility for maintenance of documentation associated with the project, including relevant records, correspondence, reports, logs, data, field records, pictures, subcontractor reports, analytical data, and data reviews. The file will include the following information, if generated:

- Field records.
- Field data and data deliverables.
- Photographs.
- Drawings.
- Sample logs.
- Laboratory data deliverables.
- Data validation reports.
- Field and laboratory audit reports.
- Reports (*e.g.,* progress reports, QA reports).
- Custody documentation.

Electronic and hardcopy data will be archived for a minimum of 10 years from the date of report. TVA will maintain a complete project file and will archive hardcopy and electronic data in accordance with TVA records retention rules as delineated by TVA's records management documents. Electronic or hardcopy data associated with the WBF EIP will not be discarded, deleted, or destroyed by any party without the written consent of TVA Legal Counsel.

6.1 Field Data Documentation

Field data collected during the EI will be evaluated for usability by conducting a QA review, which will consist of checking the procedures used by field staff and comparing the data to previous measurements. Field QC samples will be used to verify that field measurements and sampling protocols have been observed and followed. The field data will be reviewed by the Field QA Oversight Coordinator or designee for the following:

- Compliance with TIs.
- Compliance with SAPs.
- Field equipment calibration method and frequency.
- Field calibration standard lot numbers and expiration dates.
- Date and time sampled.
- Preservation.
- Sampler collection procedures.
- COC Records.

- Date sample shipped.

Any deviations from applicable TIs or the investigation-specific SAPs will be approved and documented in the field logbook during sampling and data collection operations. The Field Team leader or designee will be notified of deviations.

The original COC Records will accompany samples to the analytical laboratories. Upon receipt and login of the samples at the laboratory, the remaining sections of the COC Record (such as description of the sample condition at the time of receipt, assigned laboratory identification number, and any special conditions) will be completed. The complete original COC Record will be archived at the analytical laboratory in accordance with the laboratory's document retention requirements and the requirements herein.

6.2 Laboratory Data Documentation

Analytical laboratories performing work on this project will retain records of the analytical data for a minimum of 10 years after project completion. Analytical data will not be disposed of without TVA's consent. In addition, laboratory data will be provided to TVA in hardcopy or approved electronic form. TVA will retain data in accordance with TVA records management requirements. Laboratory data will not be disposed without specific approval from the TVA Legal Counsel and the TVA Technical Lead.

6.2.1 Laboratory Data Reporting/Deliverable Package

Chemical analytical laboratories will report data at their standard TAT; generally, 10 business days from sample receipt at the laboratory for all chemical parameters. In some cases, expedited TATs are required. Results of sample chemical analyses are completed and results reported as a Level II report and EDD within 10 business days (refer to Attachment A for data deliverables requirements). Level IV data packages (refer to Attachment A for data deliverables requirements), in a hardcopy and/or electronic Adobe® Acrobat® portable document format (.pdf), will be submitted to TVA and the QA Oversight Consultant within approximately 20 business days from sample receipt at the laboratory. Radiological analysis results are completed and reported to TVA and the QA Oversight Consultant as a Level IV report and EDD within 45 business days.

Laboratories performing chemical analyses will be responsible for providing an EDD consistent with the Data Management Plan, as well as a Level II report and/or Level IV data package (see Attachment A). The deliverable package will contain final results (uncorrected for blanks and recoveries except where required by the referenced method), analytical method reference, sample results and detection limits, and results of field and laboratory QC samples. In addition, special analytical problems and/or any modifications of referenced methods will be noted in the Case Narrative of the laboratory report/data package. The number of significant figures reported will be consistent with the limits of uncertainty inherent in the analytical method.

As a general statement, chemical analytical data will typically be reported as follows:

- Concentrations for aqueous samples are expressed in terms of weight per unit volume (such as milligrams per liter [mg/L] or micrograms per liter [µg/L]).

- Concentrations for chemical analyses of solid samples (including biological samples) are expressed in terms of weight per unit weight of sample (such as milligrams per kilogram [mg/kg] or micrograms per kilogram [µg/kg]). Unless specifically directed otherwise, solid sample chemical analysis results will be reported on a dry-weight basis. Biological samples will be reported on a wet-weight basis. The reporting basis for solid samples will be clearly indicated in the laboratory data package.
- Radiological activities are expressed in terms of picocuries per unit volume or weight (such as pCi/L or pCi/g). For solid samples, radiological activities are not corrected for sample moisture content.

Chemical analytical data will be reported in the units specified in the Method Analyte Groups (MAGs) to ensure consistent reporting among the contracted laboratories.

Chemical analytical laboratory data will be provided in the Level II report and Level IV data package formats presented in Attachment A. In general, the Level IV data package will include summary forms and raw data for calibrations, QC, and sample analyses. QC results reported will include a method blank, matrix spike/matrix spike duplicate (MS/MSD) samples, field QC samples, and laboratory control samples (LCSs). Sample chemical analyses data (both field and laboratory QC sample results) will also be provided in EDDs. The laboratory is responsible for reviewing the electronic data to ensure that these data are consistent with those presented in the laboratory report/data package. Data discrepancies between the EDD submission and laboratory report/data package, if any, will be reconciled at validation; the data validators will notify the contract laboratory and TVA so that the laboratory deliverables may be revised by the contract laboratory. In the event that revisions to Level II or Level IV data packages are required based on data validation, complete revised deliverables clearly stamped with revision number and date will be provided by the contract laboratory so that a final complete data package is archived for each sample submittal.

6.3 Record Keeping

Written and/or electronic records generated under the WBF EIP, including but not limited to notes, logbooks, reports, draft and final documents, and forms, are maintained by the originator for inclusion in the project file as appropriate. In addition, electronic files, including but not limited to draft and final documents, and laboratory analytical reports are maintained as part of the electronic project file.

Chemical analytical data for this project will be reported in both an EDD and an analytical data package. An EarthSoft EQuIS database will be used for processing, storage, and reporting of all analytical data (historical and investigatory) to be used as part of the WBF EIP. To maintain uniformity and consistency among analytical laboratories, the EDD format for the transfer of data associated with the WBF EIP will be a complex EDD specification compatible with EQuIS. A simple EDD specification may be substituted for laboratories that do not possess the capabilities to generate a complex EDD or for analyses for which automated data review is not applicable (*e.g.*, percent ash analyses by polarized light microscopy). The EQuIS data transfer parameters are discussed further in the Data Management Plan. The EDD will be generated by the laboratories and will be used to facilitate loading the analytical data into the EQuIS Project Database.

Field data generated during the WBF EIP will also be stored in the EQuIS Project Database. A simple EDD specification will be utilized by the Field Team Leader (or designee) to submit field data to the EQuIS Project Database.

Analytical data packages will be prepared by the laboratory for sample analyses performed. A Limited data deliverable (Attachment A) in Adobe Acrobat .pdf and EQuIS EDD will be provided by the contract laboratory within the laboratory's standard TAT for limited deliverables (approximately 10 business days from sample receipt for chemical analyses and approximately 40 business days from sample receipt for radiological analyses). Full deliverables (Attachment A) will be provided by the laboratory in an Adobe Acrobat .pdf electronic format for all analyses within the laboratory's standard TAT for Full data deliverables (approximately 20 business days from sample receipt for chemical analyses and approximately 45 business days from sample receipt for radiological analyses).

6.4 Data Archival

Applicable electronic field and laboratory data collected during sampling will be archived electronically. Backup tapes containing databases and programs or software utilities will be maintained in a secure location. Hardcopy data, including but not limited to field logbooks, laboratory data deliverables, and data validation reports, will be archived in accordance with TVA's Document Control protocols. Formal records custody procedures will be maintained in accordance with TVA's Records Custody procedures.

7.0 SAMPLING PROCESS DESIGN

This section briefly outlines field investigation procedures for the WBF EIP. Detailed discussions of field protocol are provided in the various TIs developed for the project. In addition, detailed descriptions of field activities are provided in the investigation-specific SAPs.

Aqueous, solid, and biological samples may be collected in association with the WBF EIP. These samples will be subject to a variety of chemical, radiological, and physical analyses to support the objectives outlined in the WBF EIP and associated investigation-specific SAPs.

Field investigation and sampling procedures will be conducted such that samples are representative of the media sampled and the resultant data can be compared to other data sets. Sampling schemes (as described in the associated investigation-specific SAPs) are designed to provide a statistically meaningful number of field sampling points and the rationale for the collection of these samples. A sufficient number of samples will be collected for each sampling program to adequately characterize the area and provide a sufficiently large data set such that statistical analyses can be performed. Field investigation and sampling methods will be conducted in accordance with the investigation-specific SAPs and associated TVA TIs, which include equipment requirements and decontamination procedures to meet the objectives of the project.

The investigative rationale for a specific sampling and analytical program is addressed in the investigation-specific SAPs. Sampling and monitoring activities are subject to the requirements set forth in the TVA TIs and this WBF QAPP. Investigation-specific SAPs will describe specific sampling and monitoring activities when QA requirements, more stringent than those presented herein, are required to support the sampling and monitoring projects.

The sampling design and execution for monitoring activities associated with the WBF EIP are described in the various investigation-specific SAPs. For some investigations it is anticipated that the sampling and monitoring activities will evolve in a phased approach as data are gathered under the planned investigations. As the sampling and monitoring programs are developed, additional SAPs and program-specific TIs may be prepared.

As the project progresses, the data generated will be used to evaluate sampling and analytical needs. Subject to regulatory approval, adjustments may be made to sampling schedules, analyte lists, and requested methods when supported by the results of field investigations.

Investigation-specific SAPs will present Site maps, including sampling locations (when applicable), for the various sampling and monitoring programs performed at the Site. Detailed descriptions of sampling process design and field sampling activities are provided in the investigation-specific SAPs. Field investigations will be addressed in investigation-specific SAPs.

8.0 SAMPLING METHODS REQUIREMENTS

Descriptions of the procedures for the sampling, identification, packaging, and handling of project samples; the decontamination of sampling equipment; and the calibration and maintenance of sampling equipment are presented in the associated TIs and the investigation-specific SAPs. An overview of sample identification, documentation, and custody as related to data collection activities is presented in Section 9.0.

8.1 Sample Containers, Preservation, and Holding Times

Sample container/media, preservation, and holding time requirements will be presented in the investigation-specific SAPs. Samples will be stored in accordance with the requirements set forth in the referenced analytical method and/or laboratory TIs.

Field samples will be contained and preserved in accordance with appropriate United States Environmental Protection Agency (US EPA) analytical method specifications which are cited in each SAP. Sampling containers and preservatives will be provided by the laboratory. In most cases, the supplied sampling containers will be pre-preserved by the laboratory prior to shipment. On an investigation-specific basis, samples may be filtered and/or preserved at the analytical laboratory. For chemical analyses, sample containers provided will be new pre-cleaned I-Chem® Series 300 (or equivalent). Samples will be placed in individual pre-cleaned containers for shipment to the laboratory.

Sample container orders, when shipped by the laboratory, will include a packing list that details the number and type of bottles shipped, the bottle lot numbers, chemical preservatives, and the packer’s signature. The COC Records will be completed by Field Sampling Personnel and returned to the laboratory with the samples. Sample containers will be individually custody-sealed and placed inside the sample cooler. After the cooler is sealed, Field Sampling Personnel will attach signed/dated custody seals to the outside of the cooler as described in TVA *Sample Labeling and Custody* TI (ENV-TI-05.80.02).

Samples will be stored according to the applicable storage criteria from the time of collection until the time of analysis by the laboratory. Field Sampling Personnel will keep samples cold by placing ice in the coolers in which samples will be stored until delivery to the analytical laboratory personnel. After receipt of the samples, it is the laboratory's responsibility to store the applicable samples according to the applicable preservation conditions until preparation and analysis has been initiated.

Samples have a finite holding time (the time between sample collection, sample digestion, and sample analysis) to limit the potential for degradation of the analytes. The holding times for required analyses are measured from the verified time of sample collection. When possible, samples will be shipped by overnight carrier or delivered by same-day courier to minimize the time between collection and laboratory receipt.

8.2 Decontamination

Tools and equipment decontamination procedures are implemented to prevent cross-contamination of samples and to control potential inadvertent transport of hazardous constituents. Disposable sampling equipment will be utilized to the extent possible in an effort to limit the potential for cross-contamination. The non-disposable equipment will be decontaminated using the procedures described in the TVA *Field Sampling Equipment Cleaning and Decontamination* TI (ENV-TI-05.80.05) and/or the investigation-specific SAP.

9.0 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Field Sampling Personnel are responsible for the collection, description, documentation, labeling, packaging, storage, handling, and shipping of samples obtained in the field. These practices are necessary to ensure sample integrity from collection through laboratory analysis and data reporting. To demonstrate and document sample integrity aspects, information relative to the collected project samples will be described and thoroughly documented. Samples will be labeled, packaged, preserved, and shipped to the laboratories for analysis in appropriate sample containers, under the recommended temperature conditions with a COC Record documenting the time and day of sample collection.

Laboratory-supplied sample kits with custody seals, packing materials, sample containers, and preservatives will be used for project samples during sample collection and transport to the TVA-contracted laboratories. The sample containers and preservation requirements for samples collected under each investigation will be presented in Attachments E through K to this WBF QAPP.

COC Records will be assigned standardized identification numbers and task codes describing the intended purpose of the sampling event. Attachment D provides specific requirements for sample nomenclature for the WBF EIP.

Samples will be assigned identifications using the sample nomenclature scheme identified in Attachment D of this document. As additional site sampling and monitoring plans are developed, nomenclature will be developed in accordance with the sample locations and naming codes (when necessary) will be generated.

9.1 Sample Documentation

Field activity evidentiary files will be maintained by the Investigation personnel and will include information that defines the Project in its entirety, including but not limited to, the information below.

- Field logbooks.
- Field data sheets.
- Raw data.
- QC information.
- COC Records.
- Airbills (when used) for sample shipments.
- Photographs.

Field documentation procedures are described in the *Field Record Keeping* TI (ENV-TI-05.80.03) and in the investigation-specific SAPs.

9.1.1 Chain-of-Custody Record

A primary consideration for environmental data is the ability to demonstrate that samples have been obtained from specific locations and have reached the laboratory without alteration. Evidence of collection, shipment, laboratory receipt, and laboratory custody while samples are in the laboratory's possession will be documented by maintaining a COC that records each sample and the individuals responsible for sample collection, shipment, and receipt at the project laboratory. Samples that are collected will be accompanied by a COC Record. An example COC Record is included in Attachment C. The following information will be recorded on the COC Record:

- Project name and number.
- Name of sampler.
- Sample identifier/name, location, date and time collected, and sample type.
- Analyses requested.
- Special instructions and/or sample hazards, if applicable.
- Signature of sampler in the designated blocks, including date, time, and company.
- Sample condition (including temperature) upon receipt as reported by the analytical laboratory.
- Signature of the laboratory receipt personnel in the designated blocks, including date, time, and company affiliation.

Original COC Records are transferred to the analytical laboratories such that sample custody is maintained through analysis and reporting. Copies of COC Records are maintained on site by the Field Team Leaders. Duplicates of COC Records are retained by the TVA Technical Lead and .pdf versions of COC Records are maintained by the Data Management Team as part of the Project File.

COC Records will reference defined MAGs to communicate sample analysis requirements to the analytical laboratories. MAGs identify the required analytical methods, parameter lists, and reporting units to ensure consistent reporting of data among multiple laboratories. In addition, MAGs enable automated data completeness evaluation and data verification upon receipt of electronic data. An overview of the data management process is provided in Section 15.0.

For samples collected for chemical, optical, or radiological analyses, field COCs are provided to the QA Oversight Consultant's Data Manager by the Field Sampling Personnel performing the sample collection. EQuIS field sample EDDs are subsequently created to facilitate completeness review upon laboratory submittal of the associated analytical data.

9.1.2 Sample Custody in the Field

The purpose of sample custody procedures is to document the history of samples (and sample extracts or digestates) from the time of sample collection through shipment and sample receipt, analysis, and disposal. A sample is considered to be in one's custody if one of the following conditions applies:

- The sample is in an individual's actual possession.
- The sample is in view after being in an individual's physical possession.
- It was in the physical possession of an investigator and then they secured it to prevent tampering; and/or
- It is placed in a designated secure area.

Each individual field sampler is responsible for the care and custody of the samples he/she collects until the samples are properly transferred to temporary storage or are shipped to the laboratory. The following COC procedures will be followed for samples submitted to the laboratory for analyses:

- Each individual field sampler is responsible for the care and custody of samples he/she collects until the samples are properly transferred (relinquished on the COC by Field Sampling Personnel) to another person ("acceptor" of the samples) or are shipped to the laboratory.
- A COC Record will be completed at the time of sample collection by the Field Sampling Personnel for each batch of samples submitted to the laboratory in accordance with the Sample Labeling and Custody Technical Instruction (ENV-TI-05.80.02). Field sampling logs may be used in the place of formal COCs in the field.
- If multiple coolers are needed, one COC Record will accompany each cooler that contains the samples identified on the COC.
- Sample coolers will be packed and sealed with custody seals for transport from field and shipment to laboratory in accordance with the Handling and Shipping of Samples Technical Instruction (ENV-TI-05.80.06).
- Each time a sample batch is transferred (Field Sampling Personnel relinquish custody to the laboratory or other sampling team personnel), signatures of the individuals relinquishing and receiving the sample batch, as well as the date and time of transfer, will be documented on the COC or courier documentation form. Note that commercial courier custody is tracked by commercial courier records and not by COC.
- A copy of the carrier air bill will be retained as part of the permanent COC documentation record.
- The laboratory will record the condition of the sample containers, and cooler temperature upon receipt, and record this information on a combination of sample receipt documentation including a sample receipt confirmation checklist and the COC.

Documentation of sample preservation checks (where applicable) will be recorded in the sample preparation documentation.

Changes or corrections to the information documented by the COC Record (including, but not limited to, field sample ID or requested analyses) must be changed by marking through the incorrect information with a single strike through line and, dating, and initialing the change in accordance with the *Field Record Keeping* Technical Instruction (ENV-TI-05.80.03). If the request for a change or correction comes from the Field Sampling Personnel after the COC Records have been relinquished to the laboratory, a copy of the COC Record will be revised, initialed, and forwarded to the laboratory, where the revised version will supersede the original COC Record. This record will be used to document sample custody transfer from the sampler to the laboratory and will become a permanent part of the Project File.

Sample coolers with appropriate custody seals will be shipped to the contract laboratory in a timely fashion to ensure proper thermal preservation and meet analytical method holding times.

9.2 Sample Packaging and Shipment

Samples will be packed and shipped to the laboratory in accordance with applicable U.S. Department of Transportation (US DOT) regulations, consulting corporate guidelines, and International Air Transport Association (IATA) standards (as detailed in the most current edition of *IATA Dangerous Goods Regulations* for hazardous materials shipments), as applicable.

Samples that are to be stored at a temperature < 6 degrees Celsius (°C) (not frozen) will be placed on wet ice within 15 minutes of sample collection and packaged with additional wet ice for shipment to the analytical laboratory. Samples requiring temperature preservation at < -10°C are packaged with dry ice for shipment to the analytical laboratory.

9.3 Sample Custody in the Laboratory

The following subsections describe the COC procedures associated with sample receipt, storage, tracking, and documentation by the laboratory.

9.3.1 Sample Receipt

A designated Laboratory Sample Custodian will be responsible for samples received at the laboratory. The Laboratory Sample Custodian will be familiar with custody requirements and the potential hazards associated with environmental samples. In addition to receiving samples, the Laboratory Sample Custodian will also be responsible for documenting sample receipt, maintaining samples at < 6 °C (or < -10°C for frozen samples) during the sample log-in process, storage at < 6 °C (or < -10 °C) for frozen samples before and after sample analysis, and the proper disposal of samples. Upon sample receipt, the Sample Custodian will:

- Inspect the sample containers for integrity and ensure that custody seals are intact on the shipping coolers. The temperature of the samples upon receipt and the presence of leaking or broken containers will be noted on the COC Record/sample receipt forms.

- Sign (with date and time of receipt) the COC/sample analysis request forms, thereby assuming custody of the samples and assign the laboratory sample identification numbers.
- Compare the information of the COC Record/sample receipt with the sample labels to verify sample identity. Any inconsistencies will be resolved through the Laboratory Coordinator before sample analysis proceeds.
- Store samples in accordance with Section 9.3.2.

The QA Oversight Manager and Laboratory Coordinator must be notified immediately via e-mail or documented telephone call when samples are received broken or improperly preserved. Samples received in a condition that may potentially impact results will be placed on hold pending direction from the QA Oversight Manager or Laboratory Coordinator. In the event that aqueous samples for metals analyses are received at pH > 2, acid preservative will be added in the originally received sample bottleware by the laboratory and the pH of the samples will be allowed to equilibrate in the originally received bottleware for a minimum of 24 hours prior to digestion. Sample preservation and equilibration will be fully documented via laboratory logbooks.

9.3.2 Sample Storage

Analytical samples will be stored in a locked facility and maintained within the appropriate temperature range as specified in US EPA SW-846 Chapter 3, or Table II of 40 CFR 136.3 sample storage requirements. The temperature will be monitored and recorded daily by laboratory personnel.

Required sample storage conditions are presented in Attachments E through K of this WBF QAPP.

9.3.3 Sample Tracking

Each sample will receive a unique laboratory sample identification number at the laboratory when the sample is logged into the laboratory information management system (LIMS).

Sample preparation/digestion records will be generated to fully document sample handling prior to analysis. Laboratory data will be entered on the sample digestion form and permanently recorded in a laboratory logbook.

The laboratory will maintain a sample tracking system that documents the following:

- Organization/individual who performed sample analyses.
- Date of sample receipt, extraction or digestion, and analysis.
- Names of Analysts.
- Sample preparation procedures.
- Analytical methods used to analyze the samples.
- Calibration and maintenance of instruments.
- Deviations from established analytical procedures, if applicable.
- QC procedures used to ensure that analyses were in control during data generation (instrument calibration, precision checks, method standards, method blanks, *etc*.).

- Procedures used for the calculation of precision and accuracy for the reported data.
- Statement of quality of analytical results.

9.4 Sample Archive

Upon request, unused portions of samples may be requested by TVA from the laboratory for archival. Archived samples will be shipped under COC and relinquished to the TVA Technical Lead or designee. The sample archive will be equipped to properly maintain thermal preservation of the samples and will be locked or in an access controlled locations such that sample custody is maintained.

Unused portions of samples collected in association with the WBF EIP may be returned to TVA for archive or disposal or may be disposed of by the contract laboratories. Archived samples will be cataloged and stored in an organized manner. In the event that project objectives are not met for a sample, any remaining portion with preparation/analytical holding time remaining may be retrieved and submitted to a TVA contracted laboratory for additional analysis.

10.0 ANALYTICAL METHODS REQUIREMENTS

Analytical methods cited in this WBF QAPP reference US EPA's *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846); US EPA Clean Water Act Test Methods; and *Standard Methods for the Examination of Water and Wastewater*. These and potentially other methods, constituents, and reporting limits for samples collected under this EI are presented in Attachments E through K of this WBF QAPP. Analytical methods will be selected based on the ability to detect constituents of concern at reporting limits sufficient to meet project requirements and quality objectives for precision, accuracy, and sensitivity.

10.1 Field Analysis

Field analyses will be conducted in accordance with the associated field sampling TIs and/or published field method as applicable. The results from field analysis are reviewed and stored electronically.

Detailed descriptions of field monitoring activities, the field analytical equipment, and the sampling equipment utilized to perform the field activities are provided in the investigation-specific SAPs and/or in the associated TVA TIs.

10.2 Laboratory Analysis

To support the objectives of the WBF EIP, the collected samples will be tested for the methods, constituents, and reporting limits presented in Attachments E through K of this WBF QAPP. Individual sample reporting limits may vary from the laboratory's routinely reported limits; this variance may be a result of dilution requirements, sample weight or volume used to perform the analysis, dry-weight adjustment for solid samples, the presence of analytical background contaminants, or other sample-related or analysis-related conditions. Additional analytical needs may be identified based on future project needs, and as such, the WBF QAPP and SAPs will be modified to document the QC requirements associated with these additional analyses.

Dissolved metals analysis of aqueous samples shall be performed on field-filtered (0.45-µm filter) select water samples. Alternatively, dissolved metals analysis of aqueous samples may be performed on a sample that has been filtered in the laboratory. In the event that laboratory filtration is required, sample aliquots collected for dissolved metals analyses will be preserved after filtration and these preserved aqueous samples will be allowed to equilibrate a minimum of 24 hours between sample preservation and digestion.

For some investigations, a filtered and nonfiltered sample aliquot may be submitted for all requested analytical parameters. In the event that the filtered and nonfiltered aliquots are not assigned distinct sample identifications (IDs), each parameter will be identified as either “total” (*i.e.*, nonfiltered) or “dissolved” (*i.e.*, filtered) in the project database.

The reporting limits indicated in Attachments E through K of this WBF QAPP shall represent the maximum reporting limits (not adjusted for sample weight/volume, dilution factors, and percent moisture for non-aqueous samples).

All analytical methods performed by the TVA-contracted laboratory must have valid method detection limit (MDL) studies and MDL verifications by matrix type, by preparation method, and by analytical method. MDL studies must include all preparatory and analytical processes used for the preparation and analysis of investigative samples. Formal MDL evaluations must be performed at the frequency dictated by the current US EPA-promulgated procedures or the current The NELAC Institute (TNI) laboratory accreditation standard or the frequency dictated below, whichever is more frequent. TVA’s contracted laboratories will conduct MDL studies in accordance with the current TNI laboratory accreditation standard as described below.

The initial MDL study will include a minimum of seven spiked replicates prepared and analyzed in a minimum of three separate batches, spaced over the course of three separate calendar days. If an MDL is to be determined over more than one instrument, each instrument must have at least two analyses on two different calendar days. For an analyte to be considered detected during an MDL study it must meet the analytical method’s qualitative identification criteria without any manual searching routines. Only analyses associated with acceptable initial calibration, continuing calibration, and batch QC can be used. The MDL based on spiked replicates will be calculated as follows:

$$MDL_s = t_{(n-1,1-\alpha=0.99)}S$$

Where: MDL_s = MDL based on analysis of replicate spikes,
t = Students 99th percentile single-tailed t-value and
S = the sample standard deviation of the replicate analyses.

If the calculated MDL_s for any analyte is less than 10% the concentration of the spiked concentration, repeat the study for that analyte at a lower spike concentration. If the calculated MDL_s is higher than the spiked concentration, the study must be repeated at a higher spike concentration from the original study.

In addition to the spiked samples, an MDL will be determined using method blank results (MDL_b). The initial MDL_b determined using the method blanks will be a minimum of seven method blanks prepared and analyzed in at least three separate batches, spaced over the course of three separate calendar days. If an MDL_b is to be determined over more than one instrument, each instrument must have at least two analyses on two different calendar days. For an analyte to be considered detected during an MDL study it must meet the analytical method qualitative identification criteria without any manual searching routines. Only analyses associated with acceptable initial calibration, continuing calibration, and batch QC can be used.

If the analytical system for which the MDL_b is being determined gives numeric results for every analysis, the MDL_b will be calculated as follows:

$$MDL_b = \overline{X} + t_{(n-1,1-\alpha=0.99)} S$$

Where: $\overline{X}$ = the mean of the method blank results,
t = Students 99th percentile single-tailed t-value and
S = the sample standard deviation of the replicate analyses.

If the analytical system for which the MDL_b is being determined gives censored results or otherwise gives numeric results for some, but not all method blanks:

- If fewer than 101 numeric method blank results are available, set the MDL_b to the highest method blank result.

- If more than 100 numeric method blank results are available, set the MDL_b to the level that is no less than the 99th percentile of the method blank results.

MDL_s and MDL_b must be compared and the higher value utilized for MDL reporting.

The MDL is to be verified annually through the quarterly analysis of standards spiked at the same concentration used to determine MDL_s. For verification analyses for a pooled MDL for more than one instrument, each instrument must have at least two analyses, prepared in different batches and analyzed on separate days. MDL verification analyses must meet the analytical method qualitative identification criteria, again without any manual searching routines. Only analyses associated with acceptable initial calibration, continuing calibration, and batch QC can be used.

On an annual basis, the MDL calculation is to be repeated using the results from the quarterly spiked samples and method blanks. The resulting MDL is to be compared to the initially derived MDL. If the repeated MDL is within a factor of 0.5 to 2.0 of the existing MDL, and fewer than 3% of the method blank results have numerical results above the existing MDL, then the initially derived MDL may be left unchanged. Otherwise, adjust the MDL to the new repeated MDL.

To add a new instrument, the new instrument must have at least two spike analyses and at least two method blanks. The new spike results would be combined with the existing results and a new MDL_s would be calculated. If the new MDL_s is within a factor of 0.5 to 2.0 of the existing MDL, then the initially derived MDL_s may be left unchanged. If all method blank analyses are below the existing MDL and the MDL_s meets the criteria described above, the MDL may be left unchanged. Otherwise, adjust the MDL to the new MDL. Once 6-months of blank data have been generated on a new instrument, MDLs will be evaluated to assess the need for adjustment.

The laboratory will perform a percent moisture analysis on solid and biological samples where possible. Chemical analysis results for solid samples will be reported on a dry-weight basis unless specifically requested otherwise. Biological samples will be reported on a wet-weight basis. Radiological activities and physical/optical analysis results will not be corrected for sample moisture. The reporting basis (wet-weight, dry-weight, *etc*.) will be maintained as an attribute of the result in the database.

11.0 QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

This section describes the data objectives and associated data quality indicators used for the project. QA procedures are designed to ensure high quality for all environmental data associated with this project.

The subsections below are intended to provide an introduction to site-wide QA objectives and protocols and set forth minimum requirements for the WBF EIP. Specific quantitative QA objectives for each investigation are presented in Attachments E through K of this WBF QAPP.

11.1 General

There are four levels of data quality that have been developed for this project. The data quality levels defined below provide general indications of measurement defensibility. The data quality level of a particular measurement is used to determine whether that measurement is sufficient to meet the program-specific DQOs.

Field Screening – This level is characterized by the use of portable analytical instruments (such as temperature probe) which can provide real-time data to assist in the optimization of sampling locations and health and safety support. Data can be generated regarding the presence or absence of certain contaminants at sampling locations.

Field Analyses – This level is characterized by the use of portable analytical instruments, which can be used on site (such as Hydrolab® instrument) or in a mobile laboratory stationed near a site. Depending on the types of contaminants, sample matrix, and personnel skills, qualitative and quantitative data can be obtained.

Screening Data with Definitive Confirmation – These data are generated by rapid, less precise methods of analysis with less rigorous sample preparation. Sample preparation steps may be restricted to simple procedures such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup. Screening data provides analyte identification and quantitation, although the quantitation may be relatively imprecise. At least 10% of the screening data will be confirmed using appropriate analytical methods and QA/QC procedures and criteria associated with definitive data. Screening data without associated confirmation data is not considered to be data of known quality.

Definitive Data – These data are generated using rigorous analytical methods, such as approved US EPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. These methods produce tangible raw data (such as chromatograms, spectra, or digital values) in the form of paper printouts or computer-generated electronic files. Data may be generated by an on-site or off-site laboratory, as long as the QA/QC requirements are satisfied. To be definitive, either the analytical or total measurement error must be determined.

Field Screening data will be obtained with portable instruments, such as conductivity meters, temperature probes, and may be used for health and safety and field operational monitoring. In addition, these instruments and field test kits may be used to produce Field Analysis data to determine where to collect a sample to assess impacts and identify which samples are to be designated for laboratory confirmation analyses.

Field pH measurements for aqueous samples will be performed in accordance with TVA TI *Field Measurement Using a Multi-Parameter Sonde* (ENV-TI-05.80.46), and U.S. EPA SW-846 Method 9040C, and the associated investigation-specific SAP. Field pH meters used for collecting aqueous sample data will also meet the calibration requirements of these procedures including calibration adjustment to account for buffer temperature during calibration. Field-collected pH measurements for aqueous samples will be considered field analysis data and are appropriate for quantitative use. Field pH measurements for soil samples will be conducted using pH kits or equivalent with confirmation samples submitted to the fixed-base analytical laboratory for definitive analysis.

Attainment of qualitative data indicators is assessed by monitoring QA measures, such as precision, accuracy, representativeness, comparability, and completeness, as discussed in Section 19.0. Specific qualitative criteria for the chemical analyses to be performed in association with the WBF EIP are presented in Attachments E through K of this WBF QAPP. The objectives associated with accuracy and precision of laboratory results are assessed through an evaluation of the results of QC samples. The accuracy of field measurements will be assessed by calibration, as described in the associated field TIs.

11.2 Field and Laboratory Quality Control Samples

The quality of data collected in the field will be controlled, monitored, and verified by maintaining site logs, by documenting field activities, and by collecting and analyzing of QC samples concurrently with investigative samples. Field and laboratory QC samples will be used to assess accuracy and precision for chemical analyses to gauge both field and laboratory activities. Further discussion and equations for determining accuracy and precision may be found in Section 19.0 of the WBF QAPP. In addition, specific requirements for comparability, completeness and representativeness of field and laboratory QC samples may be found in Section 19.0 of the WBF QAPP. QC samples will be used to assess laboratory performance and gauge the likelihood of cross-contamination associated with both field and laboratory activities.

The subsections below apply to chemical analyses performed on aqueous, solid, and biological samples associated with the WBF EIP.

QC samples will be collected and analyzed in conjunction with samples designated for laboratory analysis. The QC checks that may be instituted by field and laboratory personnel may include, but not be limited to, the following:

- Equipment Rinsate Blanks.
- Field Blanks
- Filter Blank Samples
- Field Duplicate Samples.
- MS/MSD Samples.
- Laboratory Method Blanks.
- LCSs/Laboratory Control Sample Duplicates (LCSDs).
- Laboratory Duplicate Samples.

These types of QC samples are discussed in the following subsections. Field QC samples will be submitted to the laboratory using the same information as the associated investigative samples.

Field QC samples will be collected at the frequency specified on Table 11-1. Laboratory QC samples will be analyzed at the frequency specified in the associated laboratory SOPs and referenced analytical methods. The analysis frequencies specified below are considered the minimum required frequencies; investigation-specific Work Plans and/or SAPs and/or TIs may require more frequent collection of field QC samples.

Table 11-1. Field Quality Control Sample Minimum Frequency

Field QC Sample	Aqueous Sampling Frequency	Solids Sampling Frequency	Biological Sampling Frequency
Equipment Rinsate Blank	1 per sampling event	1 per 20 field samples; minimum of 1 per sampling event	Prior to use for decontaminated equipment
Field Blank	1 per day of sampling activity per sampling team	N/A	N/A
Filter Blank[c]	1 per sampling event per lot of filters used (when dissolved parameters are collected)	N/A	N/A
Field Duplicate[a]	1 per 20 field samples; minimum of 1 per sampling event	1 per 20 field samples; minimum of 1 per sampling event	1 per 20 field sample aliquots or 1 per species (when possible)
MS/MSD or Laboratory Duplicate[b]	1 per 20 field samples; minimum of 1 per sampling event	1 per 20 field samples; minimum of 1 per sampling event	1 per 20 field sample aliquots or 1 per species[d] (when possible)

N/A Not Applicable

[a] True field duplicate samples are not feasible for whole ash/sediment cores (depending on volume recovered), or biological specimens; consequently, co-located samples will be collected when possible.

[b] Laboratory duplicate analyses will be performed in lieu of MS/MSD for parameters not amenable to spiking (*e.g.*, pH, total dissolved solids [TDS]).

[c] Filter lot check is to be performed one per lot of filters used and scheduled in a manner to allow for laboratory to report data prior to investigative sample collection.

[d] Sufficient biological sample mass is not always available to perform an MS/MSD pair; when sufficient mass does not exist, the laboratory will perform LCS/LCSD.

11.2.1 Equipment Rinsate Blanks

Collection and analysis of equipment rinsate blanks are performed to assess the efficiency of field equipment decontamination procedures in preventing cross-contamination between samples. Laboratory-supplied analyte-free reagent water will be poured into/through/over clean (decontaminated) sampling equipment used in the collection of investigative samples and subsequently collected into prepared sample bottles. For biological specimens, equipment rinsate blanks will be used to monitor decontamination of holding tanks, processing equipment or similar laboratory equipment; equipment blanks associated with biological specimens will be collected prior to specimen introduction. For Vibecore® sampling and other sediment/soil core sampling, analyte-free reagent water will be poured through Lexan® tubing. The rinsate blank will be analyzed for the same parameters as the investigative samples.

11.2.2 Field Blanks

Field blanks are used to assess the potential for cross-contamination of aqueous samples during the sampling process due to ambient conditions and to validate the cleanliness of sample containers. The collection of field blanks is recommended if known or suspected sources of contamination are located within close proximity to the sampling activities. Field blank samples will be generated using laboratory-supplied deionized water.

11.2.3 Filter Blank Samples

Filter blanks are samples of laboratory-supplied deionized water passed through in-line filters used in the collection of dissolved metals (and other analytes requested on a filtered basis).

11.2.4 Field Duplicate Samples

Field duplicate samples are used to check for sampling and analytical error, reproducibility, and homogeneity. For soil or sediment samples, the duplicate will be obtained by collecting a sample from an area adjacent to the routine sample (that is, co-located sample), or by collecting a separate aliquot of homogenized soil or sediment from within the same core, whichever is more appropriate for the type of sample/sampling technique (surface or subsurface sediment sample). For biological specimens, the duplicate will be obtained by collecting additional specimen(s) from a particular area. Duplicates will be analyzed for the same parameters as the associated investigative samples.

11.2.5 Matrix Spike/Matrix Spike Duplicate

MS/MSD samples are investigative samples to which known amounts of compounds are added in the laboratory before extraction/digestion and analysis. The recoveries for spiked analytes can be used to assess how well the method used for analysis recovers target analytes in the site-specific sample matrix, a measure of accuracy. Additionally, the relative percent difference (RPD) between the results of the MS and MSD provide a measure of precision. In the event that sufficient sample volume to perform MS/MSD analyses is not provided, the laboratory may substitute LCS/LCSD analyses (see Section 11.2.7).

For parameters that are not amenable to spiking (*e.g.*, pH, total dissolved solids [TDS]), a laboratory duplicate (see Section 11.2.8) will be used to demonstrate matrix-specific precision.

11.2.6 Laboratory Method Blanks

Method blanks consist of analyte-free materials (such as reagent water) and reagents (such as sodium sulfate) that are prepared in the same manner as the associated samples (digested, extracted, *etc*.) and that are analyzed and reported in the same manner as the associated investigative samples. Laboratory method blanks will be performed as indicated in the analytical method and in the associated laboratory SOPs.

11.2.7 Laboratory Control Samples/Laboratory Control Sample Duplicates

An LCS is a sample of laboratory certified material that is fortified (spiked) with the analytes of interest or a certified reference material that is prepared and analyzed in the same manner as investigative samples. The LCS must be from a source that is different from the source of the initial calibration standards (that is, second-source). LCS data are used to monitor analytical accuracy and laboratory performance. LCSs are prepared and analyzed with each preparation batch of 20 (or less) field samples. In the event that insufficient sample volume to perform MS/MSD analyses (Section 11.2.5) is received, an LCSD will be prepared to assess laboratory precision. LCS will be performed at a minimum frequency of 1 per batch of 20 (or fewer) field samples or as required by the referenced analytical method and as specified in the associated laboratory SOPs.

11.2.8 Laboratory Duplicate Samples

A laboratory duplicate (LD) sample is obtained by splitting a field sample into two separate aliquots and performing separate preparation and analysis on the respective aliquots if a field collected sample is not designated as a LD sample. The analysis of laboratory duplicate samples monitors precision; however, precision may be affected by sample homogeneity, particularly in the case of solid samples. Laboratory duplicates will be analyzed and reported with every batch of 20 (or fewer) field samples. MSDs (see Section 11.2.5) may be substituted for laboratory duplicates for inorganic analyses. The laboratory will utilize a project sample for the laboratory duplicate in every batch that includes project samples.

12.0 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

12.1 Field Equipment

Equipment failure will be minimized by routinely inspecting field equipment to ensure that it is operational and by performing preventive maintenance procedures. Field sampling equipment will be inspected prior to sample collection activities by the Field Sampling Personnel and necessary repairs will be made prior to use of the sampling equipment. Routine preventive maintenance procedures, at a minimum, will include removal of foreign debris from exposed surfaces of the sampling equipment, storage of equipment in a cool dry place protected from the elements, inspections of the equipment each day prior to use, and verification of instrument calibrations as described in Section 13.0.

Field equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be obtained from a contracted equipment supplier. All equipment will be serviced in accordance with the manufacturer’s specified recommendations or written procedure based on the manufacturer’s instructions or recommendations. Maintenance will be performed in accordance with the schedule specified by the manufacturer to minimize the downtime of the measurement system. Maintenance work will be performed by qualified personnel.

Field equipment will be maintained in good working order to minimize downtime while fieldwork is in progress. Field equipment will be maintained under service contract for rapid instrument repair or provision of backup instruments in the case of instrument failure.

Non-routine maintenance procedures require field equipment be inspected prior to initiation of fieldwork to determine whether or not the equipment is operational. If not operational, the equipment will be serviced or replaced by a contracted equipment provider. Batteries will be fully charged or new, as applicable.

The ability to collect valid samples requires that field equipment be appropriately cleaned and maintained. The elements of an effective maintenance program are identified below.

- Pre-cleaned or certified-clean equipment.
- Spare parts or service contract for equipment repair or replacement.
- Contingency plan.
- Maintenance and repair of non-dedicated equipment.

12.2 Supplies and Consumables

Field supplies and consumable items (including, but not limited to, pre-cleaned containers, preserved containers, tubing, and filters) will be inspected upon receipt. Certificates of cleanliness for consumables provided by the laboratory will be retained on file at the laboratory. Chemical preservatives provided in pre-preserved containers will be certified by the laboratory prior to use. Certificates of cleanliness for supplies and lot numbers of supplies obtained by the field team will be retained by Investigation personnel as part of the project records. All supplies and consumable materials will be certified clean to levels sufficient to meet data objectives for the associated investigation.

12.3 Laboratory Equipment

The ability to generate valid analytical data requires that analytical instrumentation be properly maintained. The laboratory will be responsible for appropriate maintenance for major instruments. The elements of an effective maintenance program are identified below and discussed in the following subsection:

- Instrument maintenance logbooks.
- Instrument maintenance and repair.
- Available spare parts.
- Contingency plans.

Periodic preventive maintenance is required for sensitive equipment. Instrument manuals will be kept on file for reference when equipment needs repair. The troubleshooting sections of factory manuals may be used to assist personnel in performing maintenance tasks.

Major instruments in the laboratory are covered by annual service contracts with manufacturers or other qualified personnel (internal or external). Under these agreements, regular preventive maintenance visits are made by trained service personnel. Maintenance is documented and maintained in permanent records by the individual responsible for each instrument.

The calibration and maintenance sections of the laboratories’ SOPs will establish the schedule for servicing critical items to minimize the downtime of the measurement system. The laboratory will adhere to the maintenance schedule and will promptly arrange any necessary service. Qualified personnel will perform the required service.

12.3.1 Instrument Maintenance Logbooks

In the laboratory, each analytical instrument will be assigned an instrument logbook. Maintenance activities will be recorded in the instrument logbook and the information entered will include:

- Date of service.
- Person performing the service.
- Type of service performed and reason for service.
- Replacement parts installed (if applicable).
- Miscellaneous information.

If service is performed by the manufacturer or its representative, a copy of the service record will be inserted into the page immediately following the logbook page where the above-cited information has been entered.

12.3.2 Instrument Calibration and Maintenance

An overview of the routine calibration procedures used for analytical instrumentation is presented in Section 13.0. Preventive maintenance and calibration by manufacturer service representatives will be provided on a routine basis.

In addition to maintenance by manufacturer service representatives, procedures for routine maintenance in accordance with manufacturer specifications for each analytical instrument will be followed by the laboratory. These procedures will include maintaining inventories of spare parts used routinely (such as spare torches for inductively coupled plasma/mass spectrometry [ICP/MS] instruments). Instrument operators have the responsibility to ensure that an acceptable inventory of spare parts is maintained.

Instrument calibration and maintenance procedures will be conducted in accordance with the laboratory’s QA Program and the specific calibrations sections of the laboratory’s analytical SOPs.

13.0 INSTRUMENT CALIBRATION AND FREQUENCY

This section provides the requirements for calibration of measuring and test equipment/instruments used in field sampling and laboratory analysis. The calibration procedures stipulated in the WBF QAPP are designed to ensure that field equipment and instrumentation are calibrated to operate within manufacturer specifications and that the required traceability, sensitivity, and precision of the equipment/instruments are maintained. Measurements that affect the quality of an item or activity will be taken only with instruments, tools, gauges, or other measuring devices that are accurate, controlled, calibrated, adjusted, and maintained at predetermined intervals to ensure the specified level of precision and accuracy.

In general, instrument calibration will be conducted in accordance with manufacturer's recommendations, method requirements, and field TIs or laboratory SOPs.

13.1 Field Equipment Calibration and Procedures

Field instruments that may be used include, but are not limited to, the following:

- Multi-parameter Sonde Water Quality Meter.
- Oxidation Reduction Potential Meter.
- Dissolved Oxygen Meter.
- Water Flow Meter.
- Depth-to-Water Level Meter.
- Turbidimeter.

All field analytical equipment used to conduct monitoring will be calibrated/standardized daily prior to use. The calibration/standardization procedures for field instrumentation are described in the calibration section of the applicable field TIs. The calibration/standardization acceptance criteria for field instruments are provided in the applicable TVA TIs.

Personnel performing instrument calibrations/standardizations shall be trained in its proper operation and calibration. Records of instrument calibration/standardization will be maintained by the Field Team Leader and will be subject to audit by the Field Oversight Coordinator or designee. The Field Team Leader will maintain copies of the instrument manuals on site.

The calibration records will include documentation of the following information:

- Instrument name and identification number.
- Name of person performing the calibration.
- Date of calibration.
- Calibration points.
- Results of the calibration.
- Manufacturer lot number of the calibration standards.
- Expiration dates for the calibration standards, when applicable.

Field equipment will be properly inspected, charged, and in good working condition prior to the beginning of each working day. Prior to the start of each working day, the Field Team Leader will inspect equipment to ensure its proper working condition. If equipment is not in the proper working condition, the Field Team Leader must repair or replace the equipment prior to the start of field activities. Field equipment and instruments will be properly protected against inclement weather conditions during the field work. At the end of each working day, field equipment and instruments will be properly decontaminated, taken out of the field, and appropriately placed for overnight storage and/or charging.

Field-collected pH measurements for aqueous samples will be considered field analysis data and are appropriate for quantitative use. Field-collected pH measurements for solid samples will be considered field screening data. Field pH measurements for aqueous samples will be conducted using calibrated instrumentation sufficient to meet the requirements of SW-846 Method 9040C. In addition to the TVA and method requirements, post-calibration checks will be performed on pH 4.0 and pH 10.0 buffer solutions. All post-calibration checks (pH 4.0, 7.0, and

10.0) will be subject to an acceptance criterion of ±0.05 pH units. Aqueous sample pH measurements will not be conducted until the pH meter is calibrated within these acceptance criteria. Field pH measurements for solid samples will be conducted using pH test kits or equivalent; samples will be subsequently submitted to a fixed-base laboratory for definitive pH analysis.

Dissolved oxygen meter calibration will be conducted using a single-point water-saturated air method in accordance with the instrument manufacturer's recommendations.

Calibration checks may suggest the need for maintenance or calibration by the manufacturer. Field instruments that do not meet the calibration requirements will be taken out-of-service until acceptable performance can be verified. Maintenance will be performed when the instrument will not adequately calibrate. Maintenance of field equipment will be noted in an instrument logbook or field notebook.

Field equipment calibration is addressed in greater detail in the TIs associated with each field investigation or monitoring activity.

13.2 Laboratory Equipment Calibration

Instruments and equipment used in the laboratory will be controlled by a formal calibration program as described in the laboratory's Quality Assurance Manual. The program will verify that the equipment has the proper calibration range, accuracy, and precision to generate data comparable with specific requirements. Calibration will be performed by laboratory personnel experienced in the referenced methods for the analysis of project samples for the constituents of concern.

Instrument calibration procedures and corrective actions are described in the calibration section of the associated laboratory SOP. At a minimum, laboratory instrument calibration will be performed in accordance with the associated technical and quality control requirements specified in the method applicable to the associated SAPs.

The laboratory will provide all data and information to demonstrate that the analytical system was properly calibrated at the time of analysis, including calibration method, required frequency, source of standards, response factors, linear range, check standards, and applicable control limits, as part of the data deliverables.

Before any instrument is used as a measuring device, the instrument's response to reference materials must be determined. The manner in which various instruments are calibrated is dependent on the particular type of instrument and its intended use. Preparation of reference materials used for calibration will be documented in a laboratory notebook.

The two types of laboratory instrument calibration are initial calibration and continuing calibration verification. Initial calibration procedures establish the calibration range of the instrument. Typically, multiple analyte concentrations are used to establish the calibration range and calibration data. The laboratory evaluates the resulting calibration data as detailed in the calibration section of the associated SOP.

Continuing calibration verification usually measures the instrument's response to fewer calibration standards and requires instrument response to fall within certain limits of the initial measured instrument response. Continuing calibration verification may be used within an analytical sequence to verify stable calibration throughout the sequence and/or to demonstrate that instrument response did not drift during a period of non-use of the instrument.

The QA measures in the calibration section of the associated laboratory SOP will be used for calibration, calibration verification, and subsequent sample analyses. In addition, the following procedures will be used for the calibration of balances and thermometers.

Laboratory balances will be calibrated and serviced annually by a certified contractor. Balances will undergo a calibration check prior to use each day using multiple S-Class or equivalent class weights that bracket the usage range. A record of calibrations and daily checks will be documented.

Oven and refrigerator thermometers will be calibrated annually against a National Institute of Standards and Technology- (NIST-) certified thermometer in the range of interest. Annual calibrations will be documented. Daily oven and refrigerator readings will be recorded. Thermometers must be tagged with any applicable correction factors.

Records will be maintained as evidence of required calibration frequencies, and equipment will be marked suitably to indicate calibration status. If marking on the equipment is not possible, records traceable to the equipment will be readily available for reference.

14.0 DATA ACQUISITION REQUIREMENTS FOR NON-DIRECT MEASUREMENTS

Historical and legacy data will be gathered and evaluated for acceptability prior to use in the WBF EIP and inclusion in the EAR. Historical and legacy data may be procured from several sources, including TVA and TDEC records or TVA-led investigations performed outside the scope of the WBF EIP. Historical and legacy chemical data of known quality/defensibility may be used quantitatively as supplemental information to design specific investigation or for human health and ecological risk assessments. Chemical data are considered of known quality/defensibility if sample collection information and data deliverables are available to substantiate the reported analytical results. Historical and legacy data of unknown quality may be used for qualitative purposes.

Historical and legacy geotechnical data of known quality/defensibility may be used quantitatively as supplemental information to planned investigations under the WBF EIP. The quality/defensibility of geotechnical data will be determined by qualified personnel (*i.e.*, Professional Engineer or Professional Geologist) depending on the type of data requiring evaluation. Generally, these data will be compared against changes in site conditions, changes in the state of practice (*e.g.,* revisions/updates to standard methods), and changes in governing standards (*e.g.*, technical standards or professional guidelines) since the data were generated and also will be compared to more recently collected data for consistency of results.

Historical and legacy data will be transmitted in its original format whenever possible. In addition, raw data and other supporting documentation is acquired and may be validated if appropriate or feasible.

Historical and legacy data that are determined to be intended for quantitative use will be subjected to a formal critical review process. Historical data will minimally be subjected to a reasonability review to identify potentially suspect data, apparent anomalies, or data that are not representative of current site conditions. Additional evaluation and/or validation may be conducted following the reasonability review; the level of review and validation conducted will be dependent on the data type, availability of supporting documentation, and criticality of the dataset for completing project objectives. In the event that historical or legacy data cited in the WBF EIP cannot be substantiated, the data may not be suitable to support certain aspects of the investigation, and new data may be collected to supplement the historical/legacy data.

TVA, QA oversight, and investigation subject-matter experts will cooperatively develop formal criteria for evaluating historical data sets for potential quantitative use in the EAR.

15.0 DATA MANAGEMENT

A comprehensive Data Management Plan has been developed for all data generated and used under the TVA Multi-Site Order. Consolidated management of data related to the Order will ensure that environmental data associated with the project are appropriately maintained and accessible to data end users. The Data Management Plan will provide a basis for supporting a full technical data management business cycle from pre-planning of sampling events to reporting and analysis with a particular emphasis on ensuring completeness, data usability, and most importantly defensibility of the data.

Historical data and data generated from EI collection events at each facility addressed in the Order will be consolidated in the single EQuIS database. The EQuIS database will implement QA procedures at each step in the data transfer process to ensure that a complete, correct data set is maintained. A detailed description of the various elements of the data management program is presented in the Data Management Plan. In addition, the Data Management Plan describes sample planning and tracking process and details the flow of field and laboratory data into the project database. Finally, the Data Management Plan describes the process by which errors in data already reported in the project database are rectified and how those changes are managed and documented.

16.0 ASSESSMENTS AND RESPONSE ACTIONS

The primary goal of the WBF QAPP is to ensure that project data objectives are met and that defensible, high-quality, analytical data are generated for use decision-making processes. The WBF QAPP includes systems and performance audits to ensure that established QA procedures are properly implemented.

The WBF QAPP will be distributed to each consultant and contractor responsible for the collection, generation, and interpretation of field and analytical data. The QA Oversight Manager or designee will be responsible for ensuring that necessary revisions are made so that the WBF QAPP is up-to-date with actual practices and will ensure that revisions and updates are provided to everyone on the distribution list. The document control format used in the WBF QAPP will identify the WBF QAPP revision number and revision date. A revision history that identifies each revision and a summary of the revision will be maintained.

16.1 Field Activities

Field QA will include (but not be limited to) the following:

- Instrument calibration.
- Documentation of sample collection and field conditions.
- Adherence to COC procedures.
- Adherence to the WBF QAPP, the investigation-specific SAPs, and the associated field TIs.
- Collection of field QC samples.

The QA review for usability of objective field data will be performed at two levels. For the first level, data will be reviewed at the time of collection by following SAPs and TVA TIs. For the second level, after data reduction to table format or arrays, the data will be reviewed for inconsistent values.

Any inconsistencies identified during data review will be investigated by the Field Team Leader. When possible, the Field Team Leader will seek clarification from the Field Sampling Personnel responsible for collecting the data. Resolution of discrepancies will be documented using the corrective action process detailed in Section 16.4.

Field data will be reviewed for reasonableness and completeness. In addition, random checks of sampling and field conditions will be made to check recorded data at that time to confirm the recorded observations. Whenever possible, peer review will also be incorporated into the QA review process in order to maximize consistency among Field Sampling Personnel.

Any observed discrepancies between the COC Record and the samples received will be documented by the laboratory, and the TVA Technical Lead, QA Oversight Manager, and the Field Team Leader will be contacted for resolution.

The field COC Record information will be initially keyed into and maintained in the laboratory's database. A copy of the laboratory's COC Record, referred to as sample receipt confirmation, will be sent to the QA Oversight Manager and Data Manager following sample login for verification of properly entered and COC Record requests and information such as sample identification numbers, analyses requested, and the quantity of samples. In case of discrepancies between the COC Record and the sample receipt confirmation, the appropriate revisions will be communicated to the laboratory for the appropriate COC Record corrections. Corrected information on the COC Record will be recorded into the project data management system.

16.2 Laboratory Analysis

Internal laboratory QA will consist of the following:

- Instrument performance checks.
- Instrument calibration and calibration verification.
- Retrieval of documentation pertaining to instrument standards, samples, and data.
- Adherence to the WBF QAPP and the associated laboratory SOPs.
- Documentation of sample preservation, transport, and analytical methodology.
- Adherence to the analytical methodology (at a minimum).
- Analysis of QC samples (discussed in Section 11.2).

The samples received by the laboratory will be handled in accordance with internal laboratory QC procedures. The laboratory's deliverables, on submission to Data Validators, will be verified and/or validated with guidance from the National Functional Guidelines. Data package completeness will be assessed and missing or incomplete information will be obtained from the laboratory. Any incorrect data will be corrected. Data usability will be evaluated and appropriate qualifiers will be added to the database. Any data deemed unreliable by data validation efforts due to imprecision, holding time exceedances, and failure of relevant QC measures will be qualified appropriate and/or not utilized for the project.

16.2.1 Data Reduction

Data reduction is performed by the individual Analysts and consists of calculating concentrations in samples from the raw data obtained from the measuring instruments. Data reduction complexity is dependent upon the specific method and the number of discrete operations (extractions/digestion, dilutions, and levels/concentrations) involved in obtaining a sample that can be measured.

For analytical methods, sample response will be applied to the average response factor or the regression line to obtain an initial raw result, which will then be factored into equations to obtain the estimate of the concentration in the original sample. Rounding will not be performed until after the final result has been obtained to minimize rounding errors; results will not normally be expressed in more than three significant figures.

Copies of raw data and calculations used to generate the final results will be retained on file to allow reconstruction of the data reduction process at a later date.

The laboratory data reduction process is described in detail in the associated laboratory SOPs.

16.2.2 Laboratory Data Review

System reviews are performed at all levels. The individual analyst continuously reviews the quality of data through calibration checks, QC sample results, and performance evaluation (PE) samples. These reviews will be performed prior to submission to the Laboratory Project Manager or designee.

Criteria for analytical data review/verification include checks for internal consistency, transmittal errors, laboratory protocol, and laboratory QC. QC sample results and information documented in field notes will be used to interpret and evaluate laboratory data. The Laboratory QA Officer will independently conduct a complete review of selected reports to confirm analytical results.

The laboratory will complete data verification procedures, including:

- Verifying analyses requested were analyses performed.
- Preliminary data proofing for inconsistencies; investigation and corrections, where possible.
- Reviewing laboratory data sheets for reporting/detection limits, holding times, surrogate recovery performance, and spike recovery performance.
- Double-checking computerized data entry, if applicable.

The Laboratory Project Manager or designee will review data for consistency and reasonableness with other generated data and determine whether project requirements have been satisfied. Selected hardcopy output of data will be reviewed to ensure that results have been interpreted correctly. Unusual or unexpected results will be reviewed, and a determination will be made as to whether the analyses will be repeated. In addition, the Laboratory Project Manager or designee may recalculate selected results to verify the calculation procedure.

The Laboratory QA Officer will independently conduct a review of the Project data to determine project requirements have been met. Discrepancies will be reported to the Laboratory Project Manager or designee for resolution.

Prior to final review/signoff by the Laboratory Project Manager or designee, the laboratory personnel will verify that the report deliverable is complete and in proper format, screen the report for compliance to laboratory and WBF QAPP requirements, and ensure that the Case Narrative addresses any noted deficiencies. The Laboratory Project Manager or designee will perform the final laboratory review prior to reporting the results to the QA Oversight Consultant and TVA. Any discrepancy noted during laboratory review that results in sample reanalysis or data correction must be documented using the corrective action procedure addressed in Section 16.4.

16.3 Performance and System Audits

Internal audits will be initiated by the QA Oversight Manager at the discretion of the TVA Technical Lead. Internal audits may be conducted based upon issues identified during various other assessment activities. The internal systems and performance audits will be planned and conducted by the QA Oversight Manager or designee or other appropriate QA Program personnel with the experience and competency to perform the audits/assessments. As part of the planning process for conducting internal audits, internal audits or assessments will first be scheduled. Next, the Audit Team will be identified, and the pertinent documentation and procedures relevant to the audit will be obtained and reviewed by the Audit Team. Internal audits may be announced or unannounced. The Audit Team members will hold a minimum of a Bachelor’s degree in a scientific discipline and have 5 or more years of QA and on-site laboratory auditing experience. As indicated in Section 2.0, the QA Oversight Manager holds overall authority for the project QA Program and maintains that authority independently from the operational/production aspects of the project.

Documentation of systems and performance audits and any resulting corrective actions will be maintained as part of the Project File. Audit documentation will be reported to the TVA Technical Lead.

16.3.1 Performance Audits

Performance audits are quantitative evaluations of data quality produced by a particular activity or function. Performance audits of the participating laboratories performing chemical analyses of project samples may be conducted through the submission and analysis of performance evaluation samples.

The QA Oversight Manager or designee will coordinate the manufacture and submission of performance audit samples to the laboratory. A TNI-approved performance testing sample provider will be used to obtain the performance evaluation samples. PE sample studies will be conducted at the discretion of the TVA Technical Lead for TVA contract laboratories analyzing aqueous, solid, and biological samples associated with the WBF EIP. The performance evaluation sample matrices and requested analytes will be determined based on the nature of the work performed by that laboratory for the project.

Upon receipt of results from the performance evaluation study analyses, the QA Oversight Manager or designee will evaluate the data relative to the certified “true values” and will prepare a comprehensive report (including a discussion of non-analytical issues, such as data package preparation and presentation). If multiple laboratories are included in the performance evaluation study, a statistical evaluation of the results will be performed and a simple fencepost test will be conducted for each analyte to determine outliers; a set of warning limits and acceptance limits (based on the set of data excluding outliers) will be generated for the analytes. The performance evaluation study report will contain a detailed account of any results that are outside of the established acceptance limits. Laboratories will be contacted to explain discrepancies between the reported concentrations and the “known” (true) concentrations of the analytes in the performance evaluation samples and to provide corrective actions in accordance with the corrective action process described in Section 16.4. Performance evaluation sample documentation, inclusive of corrective action responses, will be maintained as part of the Project File.

16.3.2 System Audits

System audits entail on-site observation and evaluation of participating laboratories and field sampling activities for compliance with the WBF QAPP, TIs, and/or investigation-specific Work Plans and/or SAPs. Prior to conducting an on-site audit, the Auditor will conduct a thorough examination of procedures and records. These on-site audits will also include verification of effectiveness of implemented corrective actions.

The system audits will address both field and laboratory activities, including a review of personnel qualifications, equipment, documentation, sampling techniques, analytical methods, and adherence to QA procedures. Each laboratory has its own QA Plan; therefore, the laboratory audit activities under the WBF QAPP will entail a general review of laboratory QA practices.

Systems audits of laboratories conducting chemical analyses of project samples will be performed by the QA Oversight Manager or designee. Field audits will be conducted by the Field Oversight Coordinator or designee.

On-site audits of laboratories analyzing samples associated with the WBF EIP will be conducted at the discretion of the TVA Technical Lead. Each laboratory will be audited on an annual basis or more frequently as directed by the TVA Technical Lead. Field activities will be subjected to assessments and/or surveillances on a regular basis as new Field Sampling Personnel, new procedures, or new sampling activities are performed. In addition, the Field Oversight Coordinator may observe sampling events as appropriate given the sensitivity of the samples collected.

16.4 Feedback and Corrective Action

In general, feedback and corrective action processes for the WBF EIP will be conducted in accordance with TVA's *Corrective Action Program*. TVA's Corrective Action Program includes various pathways depending on the nature and severity of the issue identified. Issues will be resolved using the lowest-level pathway that adequately identifies and addresses the cause of the non-conformance or deficiency and prevents recurrence.

16.4.1 Feedback Mechanism

There are mechanisms within the project structure that allow for the identification, feedback, and control of any non-conformances or deficiencies. In general, the technical personnel involved with the project are responsible for reporting suspected technical non-conformances through standard communication channels established by the organizational structure. In the same manner, project personnel are responsible for reporting suspected QA non-conformances.

Feedback will be provided to laboratory personnel and the Field Sampling Personnel by the TVA Technical Lead, QA Oversight Manager, and/or Investigation Project Manager. Laboratories may receive feedback based on systems and performance audits and ongoing data validation. In addition, laboratories may provide feedback to the QA Oversight Manager. Documentation of feedback will be maintained in the Project File.

16.4.2 Corrective Action for Field Activities

Field Sampling Personnel have the initial responsibility to monitor the quality of field measurements and observations. The Field Team Leader is responsible for verifying that QC procedures are followed. This responsibility requires the Field Team Leader to assess the correctness of field methods and the ability to meet QA objectives. If a problem occurs that might jeopardize the integrity of the project or that might cause a specific QA objective not to be met, the Field Team Leader will notify the TVA Technical Lead and QA Oversight Manager. An appropriate corrective action will then be determined and implemented. The Field Team Leader will document the problem, the corrective action, and the results. A copy of the documentation form will be provided to the TVA Technical Lead.

Field auditing is a recognized technique for evaluating the performance of Field Sampling Personnel and assessing how team performance may affect data quality. Field audits will be conducted by the Field Oversight Coordinator to ensure that sampling, handling, and transportation to project laboratories provide assurance that such procedures meet QA protocols and that field documentation is sufficient to produce data of satisfactory quality, and to provide a "defense" in the event that field procedures are called into question. Field audits will be conducted at a minimum of once (for one-time field collection activity) or semi-annually (for reoccurring field activities), or as directed by the TVA Technical Lead or designee to verify that corrective actions have been implemented if deficiencies were identified in prior field audits or as requested by the TVA Technical Lead.

16.4.3 Laboratory Corrective Action

Corrective action within the laboratory will be performed in accordance with the laboratory's formal QA Program.

The laboratory has the responsibility to monitor the quality of the analytical system and to provide a corrective action process adequate to address problems encountered in laboratory analysis of samples. The laboratory will verify that QC procedures are followed and that the analytical results of QC samples are within the acceptance criteria. The verification requires that the laboratory assess the correctness of the following items, as appropriate:

- Sample preparation procedure.
- Initial calibration.
- Calibration verification.
- Method blank result.
- Laboratory control sample.
- Laboratory duplicate analysis.
- Fortified sample result.
- Internal standard performance.

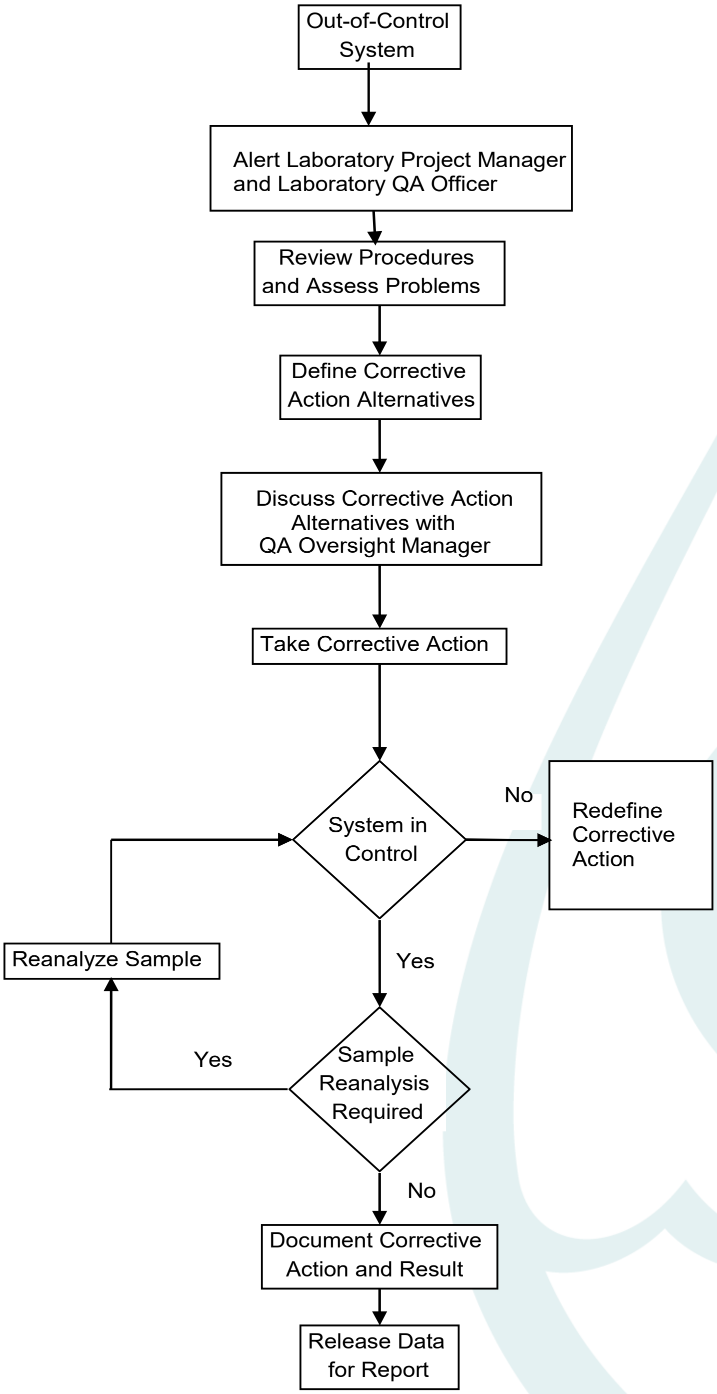
If the assessment reveals that the QC acceptance criteria are not met, the laboratory must immediately evaluate the analytical system and correct the problem. The Laboratory Analyst will notify the Laboratory Project Manager and Laboratory QA Officer of the problem and, if possible, will identify potential causes and suggest correct action.

When the appropriate corrective action measures have been implemented and the analytical system is determined to be "in control," the Laboratory Analyst will document the problem, the corrective action taken, and resultant data demonstrating that the analytical system is in control. Copies of the documentation will be provided to the Laboratory Project Manager and the Laboratory QA Officer.

Data generated concurrently with an out-of-control system will be evaluated for usability relative to the nature of the deficiency. If the deficiency does not adversely impact the usability of the results, data will be reported and the deficiency will be addressed in the Case Narrative. If sample results are adversely impacted, the Laboratory Project Manager will be notified and appropriate corrective action (such as reanalysis) will be taken.

Figure 16-1 presents the critical pathway for laboratory corrective actions.

Figure 16-1. Critical Path for Laboratory Corrective Action



17.0 REPORTS TO MANAGEMENT

The QA activities performed by laboratories conducting analyses of WBF EIP samples will be monitored by the TVA Technical Lead and the QA Oversight Manager.

Communication among TVA, QA personnel, the Field Team Leader, and laboratory personnel is important to ensure that problems are remedied and that solutions are documented in an informed and timely manner.

After the completion of a performance and systems audit, the QA Oversight Manager will submit an audit report to the TVA Technical Lead. This audit report will include a list of observed field activities, a list of reviewed documents, and any observed deficiencies. The TVA Technical Lead and QA Oversight Manager or designee will meet with the Laboratory Project Managers of any area with observed deficiencies to review the audit findings, confirm the observations, and resolve misunderstandings. In the event that inadequacies are identified, corrective actions will be undertaken as outlined in Section 16.4.

17.1 Field QA Reports

The Field Team Leader and Investigation Project Manager will provide the TVA Technical Lead with routine field progress reports. Compiled field data sets will be provided to the Data Manager for inclusion in the project EQuIS database. The TVA Technical Lead and QA Oversight Manager or designee will be immediately notified about field QA situations that require corrective action. Corrective action will be performed and documented in accordance with the protocol set forth in Section 16.4.

17.2 Laboratory QA Reports

The Laboratory QA Officer may provide periodic summary reports specific to the project to the QA Oversight Manager. These reports may summarize QA activities for the reporting period, including results of performance audits (external and internal), results of system audits (external and internal), summaries of corrective action to remedy out-of-control situations, and recommendations for revisions of laboratory procedures to improve the analytical systems. The Laboratory Project Manager will notify the QA Oversight Manager and Laboratory Coordinator about laboratory QA situations that appear to systematically impact data quality.

The Laboratory QA Officer will immediately notify the QA Oversight Manager and the Laboratory Coordinator of any laboratory QA situations that require corrective action and ascertain if such measures meet the DQOs of the project. Corrective action will be performed and documented in accordance with the protocol set forth in Section 16.4 or internal laboratory corrective action tracking system, as appropriate.

17.3 Internal Performance and System Audit/Assessment Reports

Documentation of systems and performance audits and any resulting corrective actions will be maintained as part of the Project File. Audit documentation will be reported to the TVA Technical Lead.

18.0 DATA REVIEW, VERIFICATION, AND VALIDATION

The Data Validators will verify or validate data generated by the laboratories for chemical analyses of project samples. Any issues observed during data validation will be brought to the attention of the QA Oversight Manager and TVA Technical Lead; the Laboratory Project Manager will be contacted to determine and implement an appropriate corrective action.

The purpose of analytical data verification and validation is to ensure data completeness, correctness, and method compliance/conformance, and identify data quality, including unusable data that would not be sufficient to support environmental decisions. In addition to the laboratory QA review, the data presented in Level IV data packages will be verified and validated by the Data Validators for the following:

- Compliance with requested testing requirements.
- Completeness.
- Reporting accuracy (including hardcopy to EDD).
- Confirmation of receipt of requested items.
- Traceability, sensibility, and usability of the data.

In addition to the above criteria, data will be validated with guidance from the following documents:

- US EPA CLP National Functional Guidelines (NFG) for Inorganic Data Review (October 2004);
- US EPA Region 4 Data Validation SOPs for CLP Inorganic Data by Inductively Coupled Plasma – Atomic Emission Spectroscopy (September 2011);
- US EPA Region 4 Data Validation SOPs for CLP Mercury Data by Cold Vapor Atomic Absorption (September 2011);
- US EPA Region 4 Environmental Investigations SOPs and Quality Assurance Manual (November 2001).

It should be noted that data validation guidelines specified above were developed for work conducted under the US EPA Contract Laboratory Program; therefore, these guidelines are not completely applicable to the Clean Water Act (CWA), Standard Methods, and SW-846 methods referenced for the WBF EIP. Professional judgment will be used as necessary to adapt the guidelines for use in evaluating usability of data generated in accordance with CWA, Standard Methods, and SW-846 methodology.

Analytical data from off-site, commercial laboratories will be qualified with guidance from the National Functional Guidelines previously referenced. The data validation qualifiers listed below will be used for project samples:

- Organic Data Validation Qualifiers

U*	This result should be considered "not detected" because it was detected in an associated field or laboratory blank at a similar level.
R	Unreliable positive result; compound may or may not be present in sample.
UR	Unreliable reporting or detection limit; compound may or may not be present in sample.
J	Quantitation is approximate due to limitations identified during data validation.
UJ	This compound was not detected, but the reporting or detection limit should be considered estimated due to a bias identified during data validation.

- Inorganic Data Validation Qualifiers

U*	This result should be considered "not detected" because it was detected in a rinsate blank or laboratory blank at a similar level.
R	Unreliable positive result; analyte may or may not be present in sample.
UR	Unreliable reporting or detection limit; analyte may or may not be present in sample.
J	Quantitation is approximate due to limitations identified during data validation.
UJ	This analyte was not detected, but the reporting or detection limit may or may not be higher due to a bias identified during data validation.

The EDD and Full data packages for data generated from the chemical analysis of project samples will summarize the deviations from approved protocols and significant data findings in the Case Narratives. Analytical reports will be submitted to TVA and the QA Oversight Consultant as separate documents and will be transmitted in an electronic (.pdf and EDD) and/or hardcopy formats. The QA Oversight Consultant will maintain a database of TVA data for data validation and/or verification. The Data Validators will complete data validation and generate reports for TVA. Data validation and project reports will be submitted to the TVA Technical Lead. Electronic validated data will be submitted upon approval from the TVA Technical Lead. The Data Management Plan details the process for appending data qualifiers in the EQuIS database and submitting verified and validated data to data users.

In addition to the validation qualifiers, qualifier reason codes will be maintained in the database. The reason codes below will be used to describe the usability issue(s) associated with results qualified during data review. Additional reason codes may be added as needed to address recurring usability issues.

Reason Code	Explanation
BE	Equipment blank contamination. The result should be considered "not-detected."
BF	Field blank contamination. The result should be considered "not-detected."
BL	Laboratory blank contamination. The result should be considered "not-detected."
BN	Negative laboratory blank contamination.
C	Initial and/or continuing calibration issue, indeterminate bias.
C+	Initial and/or continuing calibration issue. The result may be biased high.

Reason Code	Explanation
C-	Initial and/or continuing calibration issue. The result may be biased low.
FD	Field duplicate imprecision.
FG	Total versus Dissolved Imprecision.
H	Holding time exceeded.
I	Internal standard recovery outside of acceptance limits.
L	LCS and LCSD recoveries outside of acceptance limits, indeterminate bias.
L+	LCS and/or LCSD recoveries outside of acceptance limits. The result may be biased high.
L-	LCS and/or LCSD recoveries outside of acceptance limits. The result may be biased low.
LD	Laboratory duplicate imprecision.
LP	LCS/LCSD imprecision.
M	MS and MSD recoveries outside of acceptance limits, indeterminate bias.
M+	MS and/or MSD recoveries outside of acceptance limits. The result may be biased high.
M-	MS and/or MSD recoveries outside of acceptance limits. The result may be biased low.
MP	MS/MSD imprecision.
P	Post-digestion spike recoveries outside of acceptance limits, indeterminate bias.
P+	Post-digestion spike recovery outside of acceptance limits. The result may be biased high.
P-	Post-digestion spike recovery outside of acceptance limits. The result may be biased low.
Q	Chemical preservation issue.
R	RL standards outside of acceptance limits, indeterminate bias.
R+	RL standard(s) outside of acceptance limits. The result may be biased high.
R-	RL standard(s) outside of acceptance limits. The result may be biased low.
RL	Positive result reported between the MDL and QL.
S	Radium-226+228 flagged due to reporting protocol for combined results.
SD	Serial dilution imprecision.
T	Temperature preservation issue.
X	Percent solids < 50%.
Y+	Chemical yield outside of acceptance limits. The result may be biased high.
Y-	Chemical yield outside of acceptance limits. The result may be biased low.
Z	ICP/MS interference.

Reason Code	Explanation
ZZ	Other.

19.0 VERIFICATION AND VALIDATION METHODS

The overall QA objective for field activities, laboratory analyses, and data assessment is to produce data of sufficient and known quality to support the investigation-specific objectives and to produce high-quality, legally defensible data.

This data assessment activity is an ongoing coordinated process with data production and is intended to ensure that data produced during the project are acceptable for use in subsequent evaluations. Both statistical and qualitative evaluations will be used to assess the quality of the data. The primary evaluation of the data will be based upon the control samples. The blank samples will be used to evaluate whether or not the laboratory and/or field sample handling represent a possible source of sample contamination. Duplicate sample results will be used to evaluate data precision.

All data submitted to the project EQuIS database will undergo data verification. Analytical data will be available for preliminary internal use after verification. Initially, 100% of the all chemical and physical analysis data will be reported in fully documented (Level IV) data packages for independent data validation. If after the percentage of full data validation has decreased, a trend in frequency of reporting issues, method non-compliances, or data usability issues is identified, data validation will be conducted for specific data points or the percentage of full data validation percentage may be increased until the issues have been minimized to their initial frequency.

Data verification includes the review of laboratory deliverables for completeness, correctness, and compliance with applicable methods. The validation of data presented in a Level IV data package includes the review of commercially-available raw data and associated QC summary forms for compliance with the applicable methods and for data usability with respect to the appropriate guidance documents. The nature and extent of the data package available for review is dependent on the analytical method used (such as US EPA methods, SW-846, *etc*.) and the reporting and deliverables requirements defined in the WBF QAPP and investigation-specific SAPs. After completion of either full or limited data validation, a QA report will be prepared. The QA report will address WBF QAPP and method non-compliance issues, reporting errors, data usability issues, and include summary tables with qualified sample results. The QA report will also address laboratory calculation errors (*i.e.*, the reported value is more than 10% different than the value calculated from the raw data by the data validator). The summary tables will include reported sample results and the associated data qualifiers. The QA report will be fully supported by photocopied pages of the laboratory data showing deficiencies identified in the review, as an attachment to the report.

The data produced during the sampling tasks included in the field investigation will be compared with the defined QA objectives and criteria for precision, accuracy, representativeness, completeness, and comparability (PARCC) and sensitivity. The primary goal of these procedures is to ensure that the data reported are representative of actual conditions at the Site.

Standard procedures are used so that known and acceptable levels of PARCC are maintained for each data set. Descriptions of these criteria are presented in the following subsections.

Specific quantitative QA objectives for chemical analyses associated with the WBF EIP are presented in Attachments E through K of this WBF QAPP.

19.1 Precision

The degree of agreement between the numerical values of a set of duplicate samples performed in an identical fashion constitutes the precision of the measurement.

During the collection of data using field methods and/or instruments, precision is checked by reporting measurements at one location and comparing results. For example, soil measurements are taken in pairs at a certain point and depth and the values compared. The measurements are considered sufficiently precise only if the values are within a specified percentage of each other.

Analytical precision for non-radiological parameters is calculated by expressing, as a percentage, the RPD between results of analyses of duplicate samples for a given analyte. Precision is expressed as an RPD when both results are greater than 5× the reporting limit as calculated by the following formula:

$$RPD = abs\left[\frac{\mathrm{A} - \mathrm{B}}{\left(\frac{A+B}{2}\right)}\right] \times 100$$

Where: A = Value of original sample
B = Value of duplicate sample

When at least one result is less than 5× the reporting limit, the difference between the results is used to evaluate precision.

Analytical precision for radiological analyses is calculated as the relative error ratio (RER) using the following formula:

$$RER = abs\left[\frac{ACT_s - ACT_d}{\sqrt{(TPU_s)^2 + (TPU_d)^2}}\right]$$

Where: Abs = Absolute Value
ACT_s = Sample Activity
ACT_d = Duplicate Activity
TPU_s = Total Propagated Uncertainty of Sample
TPU_d = Total Propagated Uncertainty of Duplicate

Specific precision and difference objectives for field duplicate samples and laboratory duplicate samples (including MSDs) are presented in Attachments E through K of this WBF QAPP.

19.2 Accuracy

Accuracy is the degree of agreement of a measurement, X, with an accepted reference or true value, T. Accuracy is usually expressed as the difference between the two values, X-T, or the difference as a percentage of the reference or true value, 100(X-T)/T; accuracy is also sometimes expressed as a ratio X/T. Accuracy, which is a measure of the bias in a system, is assessed by means of reference samples and percent recoveries. Error may arise due to personal, instrumental, or method factors.

The two types of analytical check samples used are LCSs and MSs. Analytical accuracy is expressed as the percent recovery (%R) of an analyte that has been added to the control sample or a standard matrix (such as blank soil) at a known concentration prior to analysis.

The formula used to calculate accuracy for the LCS is:

$$\% R = \left(\frac{A_T}{A_F}\right) \times 100$$

Where: A_T = Total concentration of the analyte measured or recovered
A_F = Concentration of the analyte spiked

When calculating accuracy for the MS analysis, a correction for background concentration found in the unspiked sample must be made. MS recovery is calculated using the following formula:

$$\% R = \left(\frac{A_T - A_O}{A_F}\right) \times 100$$

Where: A_T = Concentration of the analyte measured or recovered
A_0 = Unspiked concentration of the analyte
A_F = Concentration of the analyte spiked

In general, the accuracy objectives are based on the requirements set forth in the referenced analytical method and in Attachments E through K of this WBF QAPP.

19.3 Representativeness

Representativeness expresses the degree to which sample data are accurate and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter associated with the proper design of the sampling program. The representativeness criterion can, therefore, be met through the proper selection of sampling locations, the collection of a sufficient number of samples and the use of standardized sampling procedures (*viz*., TVA TIs) to describe sampling techniques and the rationale used to select sampling locations to ensure representativeness of the sample data.

Representativeness will also be measured by the collection of field duplicates or co-located samples, as appropriate given the sample matrix. Comparison of the analytical results of field duplicates will provide a direct measure of individual sample representativeness.

19.4 Completeness

Completeness is a measure of the degree to which the amount of sample data collected meets the needs of the sampling program and is quantified as the relative number of analytical data points that meet the acceptance criteria (including accuracy, precision, and any other criteria required by the specific analytical method used). Completeness is defined as a comparison between actual numbers of usable data points expressed as a percentage of expected number of points.

Difficulties encountered while handling samples in the laboratory, as well as unforeseen complications regarding analytical methods, may affect completeness during sample analysis. The minimum goal for completeness is 90%; the ability to exceed this goal is dependent on the applicability of the analytical methods to the sample matrix analyzed. If data cannot be reported without qualifications, project completion goals may still be met if the qualified data (data of known quality, even if not perfect) are suitable for specified project goals. Percent completeness will be expressed as the ratio of the total number of usable results relative to the total number of analytical results. The total number of usable analytical results will be total number of results minus any results deemed unusable (or rejected) at validation.

19.5 Comparability

Comparability is a qualitative parameter used to express the confidence with which one data set can be compared with another. The comparability of the data, a relative measure, is influenced by sampling and analytical procedures. By providing specific protocols for obtaining and analyzing samples, data sets will be comparable regardless of who collects the sample or who performs the sample analysis.

The laboratory will be responsible providing the following controls to allow assessment of comparability:

- Adherence to current, standard US EPA-approved methodology for sample preservation.
- Compliance with holding times and analysis consistent with WBF QAPP.
- Consistent reporting units for each parameter of similar matrices.
- US EPA-traceable or NIST-traceable standards, when applicable.

20.0 RECONCILIATION OF DATA TO PROJECT OBJECTIVES

The QA Oversight Manager, in conjunction with the TVA Technical Lead, will determine whether field and validated analytical data or data sets meet the requirements necessary for decision-making. The results of measurements will be compared to the objectives set forth in the program-specific SAPs.

Generally, data assessment begins with verification and validation of project data to ensure that the sampling and analysis protocols specified in the associated TVA TIs and SAPs were followed, and that the measurement systems were performed in accordance with the criteria specified in these documents and this WBF QAPP. Data limitations identified during data verification and validation are communicated to the project team via reports and qualification in the project database.

Following data assessment, statistical analysis is performed to determine if the investigation and project objectives were achieved. As data are evaluated, anomalies in the data or data gaps may become apparent to the data users. Data that do not meet the data users’ needs will be identified and appropriately noted so that decision-makers are aware of data limitations.

Data that are determined not to meet the investigation and project objectives may be used qualitatively or may be rejected depending on the program-specific requirements and the intended use of the data. The TVA Technical Lead, with the support of the QA Oversight Manager or designee and Data Validators, will assist data end users in evaluating data limitations identified and determining whether data are acceptable for their intended use.

21.0 REFERENCES

American Public Health Association, American Water Works Association, Water Environmental Federation. *Standard Methods for the Examination of Water and Wastewater,* 21st Edition, September 2005.

ASTM. Various procedures for analytical methods.

TVA. *Field Sampling Equipment Cleaning and Decontamination,* ENV-TI-05.80.05. March 2017

TVA. *Field Sampling Quality Control,* ENV-TI-05.80.04. March 2017.

TVA. *Sample Labeling and Custody,* ENV-TI-05.80.02, March 2017.

TVA. *Field Record Keeping,* ENV-TI-05.80.03. March 2017

TVA. *Handling and Shipping of Samples,* ENV-TI-05.80.06. March 2017.

TVA. *Field Measurement Using a Multi-Parameter Sonde,* ENV-TI-05.80.46. March 2017.

US EPA. *Data Quality Objectives Process for Superfund, Interim Final Guidance,* EPA540-R-93-071, September 1993.

US EPA Region 4. *Data Validation Standard Operating Procedures for Contract Laboratory Program Inorganic Data by Inductively Coupled Plasma – Atomic Emission Spectroscopy and Inductively Coupled Plasma – Mass Spectroscopy*. SOP No: QAS-SOP-12; September 2011.

US EPA Region 4. *Data Validation Standard Operating Procedures for Contract Laboratory Program Mercury Data by Cold Vapor Atomic Absorption.* SOP No: QAS-SOP-13; September 2011.

US EPA Region 4. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual,* November 2001.

US EPA Region 4. *Field pH Measurement,* SESDRPOC-100-R3, January 2013.

US EPA. *National Functional Guidelines for Inorganic Data Review,* October 2004.

US EPA. *QA Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations – Chemical Evaluations,* 1995.

US EPA. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, 3rd Edition including Final Update IV, November 2000.

US EPA. 40 CFR Part 136, *Final Methods Update Rule*, March 2008.

ATTACHMENT A

DATA PACKAGE DELIVERABLE REQUIREMENTS

Required Data Deliverables Elements

All Sample Data Packages will include data for analyses of all samples in one sample delivery group (SDG), including field samples, reanalyses, secondary dilutions, blanks, laboratory control samples (LCS), laboratory control sample duplicates (LCSD), matrix spikes (MS), matrix spike duplicates (MSD), and/or laboratory duplicates. A fraction-specific unit is not a required deliverable if the analysis of that fraction was not required for samples in the SDG. The Sample Data Package must be complete before submission and must be consecutively paginated. The Sample Data Package will be arranged in the following order:

- Cover Letter/Letter of Transmittal signed by Technical Project Manager or designee

- Title Page

- Table of Contents

- SDG Narrative

The SDG Narrative will be clearly labeled "SDG Narrative" and will contain laboratory name; SDG number; TVA sample identifications; laboratory sample numbers; and detailed documentation of any QC, sample, shipment, and/or analytical problems encountered in processing (preparing and analyzing) the samples reported in the data package. A glossary of qualifier codes used in the SDG must also be provided.

The laboratory must also include reference to preparation and analytical methods performed and applicable project documents (*e.g.,* approved work plans), any problems encountered, both technical and administrative, corrective actions taken and resolution, and an explanation of all flagged edits (*i.e.*, exhibit edits) on quantitation reports (including results flagged due to storage blank contamination).

The SDG Narrative must be signed and dated by the Laboratory Manager or designee. The SDG Narrative must include a statement or statements relative to compliance with this document and any applicable project documents and description of any deviations from these documents:

- Field and Internal (Laboratory) Chain-of-Custody Records
- Sample Receipt Documentation Log, and all Project Correspondence

Copies of both the external and internal Chain-of-Custody Records for all samples within the SDG must be included in the deliverables. The Chain-of-Custody Records will list all temperature and pH measurements for all samples requiring pH adjustment for preservation.

A.1 Inorganic and General Chemistry Deliverables Requirements

The following subsections provide detailed requirements for the information presented on each of the deliverables elements referenced in Table A-1. In the event that certain required information is not included on a particular form, the laboratory will provide additional documentation (e.g., preparation logs or analytical runlogs) to ensure that the minimum required level of documentation is supplied.

A.1.1 Target Analyte Results Summaries

Target analyte results summaries are required for all MS/MSD samples, laboratory duplicate samples, LCS/LCSDs, and preparation blanks and will be arranged in increasing alphanumeric order by laboratory sample number.

The target analyte results summary must include:

- SDG Number
- TVA sample number
- laboratory sample identifier
- matrix of the TVA sample
- date of sample collection
- sample percent solids (if applicable)
- name and CAS number for each target analyte
- concentration or project-required detection limit (PRDL) for each target analyte
- any applicable flags for target analyte results (e.g., “U” to designate a “not-detected” result)
- concentration units

A.1.2 Initial and Continuing Calibration Verification Summary

The initial and continuing calibration verification summaries will be arranged in chronological order, by instrument and must include:

- SDG number
- names for all target analytes
- instrument identifier

- start and end dates and times of the analytical sequence
- true concentrations for all target analytes for the ICV and CCV standards
- observed concentrations for all target analytes for each ICV and CCV analyses
- calculated percent recoveries for all target analytes for each ICV and CCV analyses
- control limits for ICV and CCV
- percent recoveries
- concentration units

A.1.3 PRDL Standard Summary

The PRDL standard summaries will be arranged in chronological order, by instrument and must include the following:

- SDG number
- names for all target analytes
- instrument identifier
- dates and times for the PRDL standard analyses
- true concentrations for all target analytes
- observed concentrations for all target analytes for each PRDL standard analysis
- calculated percent recoveries for all target analytes for each PRDL
- standard analysis
- control limits for PRDL standard recoveries
- concentration units

A.1.4 Initial and Continuing Calibration Blank Summary

The initial and continuing calibration blank summaries will be arranged in chronological order, by instrument and must include the following:

- SDG number

- names for all target analytes
- instrument identifier
- start and end dates and times of the analytical sequence
- observed concentration or PRDL for each target analyte for each initial calibration blank (ICB) or continuing calibration blank (CCB) analysis
- acceptance limits for ICB and CCB analyses
- concentration units

A.1.5 Preparation Blank Analytical Summary

The preparation blank analytical summaries will be arranged in chronological order, by instrument and must include:

- SDG number
- preparation blank sample identifier
- names for all target analytes
- instrument identifier
- observed concentration or PRDL for each target analyte
- acceptance limits
- concentration units

A.1.6 ICP and/or ICP/MS Interference Check Sample Summary

The ICP and/or ICP/MS interference check sample summaries will be arranged in chronological order, by instrument and must include:

- SDG number
- names for all target analytes
- instrument identifier
- dates and times for the ICP interference check standard analyses
- true concentrations for all target analytes
- observed concentrations for all target analytes observed in each ICP

interference check standard analysis

- calculated percent recoveries for all target analytes for each ICP interference check standard analysis
- control limits for ICP interference check standard recoveries
- concentration units

A.1.7 Matrix Spike /Matrix Spike Duplicate Summary

The MS/MSD summaries will be arranged in alphanumeric order by laboratory sample number and must include:

- SDG number
- TVA sample number for the spiked sample
- percent solids for the TVA sample (if applicable)
- names for all target analytes
- analyte concentration observed in the non-spiked sample aliquot
- true concentrations for all target analytes in the spike solutions
- observed concentrations for all target analytes in the spike sample/spike sample duplicate analyses
- calculated percent recoveries for all target analytes
- control limits for spike sample/spike sample duplicate recoveries
- calculated RPD between spike sample/spike sample duplicate results
- RPD limit for each analyte
- concentration units

A.1.8 Post-Digestion Spike Sample Recovery Summary (if applicable)

The post-digestion spike sample recovery summaries will be arranged in alphanumeric order by laboratory sample number and must include:

- SDG number

- TVA sample number for the post-digestion spike parent sample
- percent solids for the TVA sample (if applicable)
- names for all target analytes
- analyte concentration observed in the non-spiked sample aliquot
- true concentrations for all target analytes in the post-spike solution
- observed concentrations for all target analytes in the post-spike sample analysis
- calculated percent recoveries for all target analytes
- control limits for post-spike sample recoveries
- concentration units

A.1.9 Duplicates Precision Summary

The duplicate precision summaries will be arranged in alphanumerical order by TVA sample number and must include:

- SDG number
- TVA sample number for the duplicate sample
- percent solids for the TVA sample (if applicable)
- names for all target analytes
- analyte concentration observed in the original sample aliquot
- observed concentrations for all target analytes in the duplicate sample analysis
- calculated RPD for all target analytes
- control limits for RPD
- concentration units

A.1.10 LCS/LCSD Recovery Summary

The LCS/LCSD recovery summaries will be arranged in chronological order, by instrument and must include:

- SDG number
- LCS/LCSD identification number
- names for all target analytes
- true concentrations for all target analytes in the LCS/LCSD solution
- observed concentrations for all target analytes in the LCS/LCSD analysis
- calculated percent recoveries for all target analytes
- control limits for LCS/LCSD recoveries
- concentration units
- RPD between LCS/LCSD results
- RPD limit for each analyte

A.1.11 Standard Addition Results Summary (where applicable) must include:

- SDG number
- TVA sample number for the sample that underwent the standard additions procedure
- names for all target analytes
- analyte concentration or absorbance observed in the non-spiked sample aliquot
- true concentrations for all target analytes for each standard addition analysis
- observed concentration or absorbance for each standard addition analysis
- calculated concentration for each target analyte
- calculated correlation coefficient for each target analyte
- concentration units

A.1.12 ICP and/or ICP/MS Serial Dilution Summary

The ICP and/or ICP/MS serial dilution summaries will be arranged in alphanumeric order by laboratory sample number and must include:

- SDG number
- TVA sample number for the ICP serial dilution sample
- names for all target analytes
- analyte concentration observed in the original sample aliquot
- observed concentrations for all target analytes in the ICP serial dilution analysis
- calculated RPD for all target analytes
- control limits for RPD
- concentration units

A.1.13 PRDL and MDL Summary

The PRDL and MDL summaries will be arranged in chronological order, by instrument and must include:

- SDG number
- instrument identifier
- date the MDL determination was performed
- names for all target analytes
- determined MDL for all target analytes
- PRDL for all target analytes
- concentration units

A.1.14 ICP Interelement Correction Factors Summary

The ICP interelement correction factors summaries will be arranged in chronological order, by instrument and must include:

- SDG number
- instrument identifier
- date the ICP interelement correction factors determination was performed
- names for all target analytes

- determined ICP interelement correction factors concentrations for all target analytes
- concentration units

A.1.15 ICP and/or ICP/MS Linear Range Summary

The ICP and/or ICP/MS linear range summaries will be arranged in chronological order, by instrument and must include:

- SDG number
- instrument identifier
- date the ICP linear range determination was performed
- names for all target analytes
- determined ICP linear range concentrations for all target analytes
- concentration units

A.1.16 Preparation Logs

- TCLP or SPLP Preparation Logs (if TCLP or SPLP extraction was performed)
- TVA sample and QC sample digestion logs

A.1.17 Analytical Sequence Form

The analytical sequence forms will be arranged in chronological order, by analyte, by instrument and must include:

- SDG number
- instrument identifier
- TVA sample numbers associated with the sequence
- QC sample identifiers associated with the sequence
- analysis date and time for each TVA sample and QC sample associated with the sequence
- identification of all target analytes reported from each TVA sample and QC sample analysis

- dilution factor for each TVA sample and QC sample analysis
- start and end dates and times for the sequence

A.1.18 ICP/MS Additional Forms

ICP/MS Data Packages will include the following forms in addition to the requirements listed above.

- ICP/MS Tune Summary
- ICP/MS Internal Standards Relative Intensity Summary

A.1.19 Raw Data for Metals/Mercury

- For each reported value, the laboratory will provide all raw data used to obtain that value. This requirement applies to all required QA/QC measurements and instrument standardization as well as all sample analysis results. This statement does not apply to the Quarterly Verifications Parameters submitted as part of each data package. Raw data must contain all instrument readouts used for the sample results. Each exposure or instrumental reading must be provided, including those readouts that may fall below the PRDL. All ICP, ICP/MS, and AA instruments must provide a legible hardcopy of the direct real-time instrument readout (e.g., strip-charts, printer tapes, etc.). A photocopy of the instrument’s direct sequential readout must be included. A hardcopy of the instrument’s direct instrument readout for cyanide must be included if the instrumentation has the capability.
- Raw data must include instrument calibration and calibration curves/equations.

A.1.20 Raw Data for General Chemistry Parameters

- For each reported value, the laboratory will provide all raw data (instrument printouts or logbook pages) used to obtain that value. This requirement applies to all required QA/QC measurements and instrument standardization, as well as all sample analysis results. Raw data must contain all instrument readouts/logbooks pages used for the sample results. Each exposure or instrumental reading must be provided, including those readouts/logbook pages that may fall below the quantitation limit. A photocopy of the instrument’s direct sequential readout must be included if the instrumentation has the capability.

- Raw data must include instrument calibration and calibration curves/equations as applicable.

- Wet Chemistry Preparation Logs (by parameter)

Table A-1: Required Deliverables for Inorganic and General Chemistry Analyses

	Section	ICP/MS Metals	Mercury	General Chemistry Parameters
Cover Letter/Letter of Transmittal	n/a	X	X	X
Case Narrative	n/a	X	X	X
Field and Internal (Laboratory) COC Records	n/a	X	X	X
Sample Receipt Documentation Log	n/a	X	X	X
Project Correspondence	n/a	X	X	X
Target Analyte Results Summary	A.1.1	X	X	X
ICP/MS Tune Summary	A.1.18	F		
Initial Calibration Summary	A.1.19 A.1.20	F	F	F
Initial and Continuing Calibration Verification (ICV/CCV) Summary	A.1.2	F	F	F
PRDL Standard Summary	A.1.3	F	F	
Initial and Continuing Calibration Blank Summary	A.1.4	F	F	F^{A}
Preparation Blank Summary	A.1.5	X	X	X
Interference Check Sample Summary	A.1.6	F		
MS/MSD Duplicate Summary	A.1.7	X	X	X^{A}
Post-Digestion Spike Sample Recovery Summary	A.1.8	F	F	
Duplicates Precision Summary	A.1.9	X	X	X
LCS/LCSD Recovery Summary	A.1.10	X	X	X
ICP and/or ICP/MS Serial Dilution Summary	A.1.12	F		
PRDL and MDL Summary	A.1.13	F	F	F^{A}
Standard Additions Results Summary	A.1.11	F^{A}	F^{A}	
ICP Interelement Correction Factors Summary	A.1.14	F		
ICP and/or ICP/MS Linear Range Summary	A.1.15	F		
ICP/MS Tune Internal Standards Relative Intensity Summary	A.1.18	F		
TCLP or SPLP Preparation Logs	A.1.16	F^{A}	F^{A}	
Digestion Logs	A.1.16	F	F	
General Chemistry Preparation Logs	A.1.20			F
Analytical Sequence Form	A.1.17	F	F	F
Raw Data	A.1.19	F	F	F

Notes:

X	Required element for all deliverables Levels
F	Required additional element for full deliverables (in addition to elements required for all deliverables levels)
^{A}	Required element for associated deliverable level when applicable to the analyses performed

A.2 Radiological Deliverables Requirements

The following subsections provide detailed requirements for the information presented on each of the deliverables elements referenced in Table A-2. In the event that certain required information is not included on a particular form, the laboratory will provide additional documentation (e.g., preparation logs or analytical runlogs) to ensure that the minimum required level of documentation is supplied.

The radiological data will be arranged in the following order by individual parameter requested for the samples in the SDG.

A.2.1 Target Analyte Results Summary: Target analyte results summaries are required for all samples and will be arranged in increasing alphanumeric order by TVA sample number. The target analyte results summary must include the following:

- SDG Number
- TVA sample number
- laboratory sample identifier
- matrix of the TVA sample
- date of sample collection
- date of sample analysis
- sample activity, uncertainty, and the sample-specific minimum detectable concentration (MDC). The sample-specific MDC will be based on the background of the detector that the sample was counted on. The sample activity (positive or negative), uncertainty, and sample-specific MDC will be reported for positive and “not-detected” results
- any applicable flags for target analyte results (e.g., “U” to designate a “not-detected” result)
- concentration units

A.2.2 Chemical Yield (Tracer/Carrier) Recovery Summary that must include the following:

- SDG number
- TVA sample number
- Method blank sample number
- Laboratory Duplicate sample number

- LCS identification number
- LCSD identification number (if performed)
- percent recovery for all tracers/carriers
- applicable recovery limits for each tracer/carrier

A.2.3 Method Blank Summary: The method blank summaries will be arranged in chronological order, by instrument and method and must include the following:

- SDG number
- names for all target analytes
- observed activity, uncertainty, and MDC for each target analyte for each method blank analysis
- concentration units

A.2.4 Duplicates Precision Summary: The duplicate precision summaries will be arranged by instrument and method and must include the following:

- SDG number
- TVA sample number for the duplicate sample
- names for all target analytes
- analyte activity, uncertainty, and MDC observed in the original sample aliquot
- observed activity, uncertainty, and MDC for all target analytes in the duplicate sample analysis
- calculated RPD/Replicate Error Ratio (RER) for all target analytes
- control limits for RPD/RER
- concentration units

A.2.5 LCS Recovery Summary: The LCS recovery summaries will be arranged by instrument and method and must include the following:

- SDG number
- LCS identifier
- names for all target analytes

- true concentrations for all target analytes in the LCS solution
- observed concentrations for all target analytes in the LCS analysis
- calculated percent recoveries for all target analytes
- control limits for LCS recoveries
- concentration units

A.2.6 Calibration Verification Summary: The calibration verification summaries will be arranged by instrument and method and must include the following:

- SDG number
- names for all target analytes
- instrument identifier
- date the calibration verification was performed. For each method and analyte, the Contracted Laboratories will provide Calibration Verification summaries that include or bracket the analysis dates of the field and QC samples.
- acceptance limits for the calibration verification
- the following calibration verification summaries will be provided for Gas Flow Proportional Counter data
    a. Efficiency Checks
    b. Background Checks
- the following calibration verification summaries will be provided for Alpha Spectroscopy data
    a. Energy Calibration Checks
        b. Efficiency Checks
        c. Background Checks
        d. Resolution (FWHM) Checks
- the following calibration verification summaries will be provided for Alpha Scintillation data
    a. Daily Instrument Performance Checks
    b. Background Checks

A.2.7 Raw Data

For each reported value, the Contracted Laboratories will provide all raw data (instrument printouts) used to obtain that value. This applies to all required QA/QC measurements (including tracer/carrier recoveries) as well as all sample analysis results. Raw data must contain all instrument readouts and worksheets used for the sample results. An exhibit work sheet per method (including example calculations showing how sample activity, total propagated uncertainty [TPU] and minimum detectable activity [MDA] are calculated) will be provided.

A.2.8 Preparation Logs (by method)

A.2.9 Traceability Documents (by method)

Table A-2: Required Deliverables for Radiological Analyses

	Section	Radiological Parameters
Cover Letter/Letter of Transmittal	n/a	X
Case Narrative	n/a	X
Field and Internal (Laboratory) COC Records	n/a	X
Sample Receipt Documentation Log	n/a	X
Project Correspondence	n/a	X
Target Analyte Results Summary	A.2.1	X
Chemical Yield (Tracer/Carrier) Recovery Summary	A.2.2	X
Method Blank Summary	A.2.3	X
Duplicates Precision Summary	A.2.4	X
LCS Recovery Summary	A.2.5	X
Calibration Verification Summary	A.2.6	X
Raw Data	A.2.7	F
Preparation Logs	A.2.8	X
Traceability Documents	A.2.9	X

Notes:

X	Required element for all deliverables levels
F	Required additional element for full deliverables (in addition to elements required for all deliverables levels)

ATTACHMENT B

SAMPLING PROCEDURES LIST

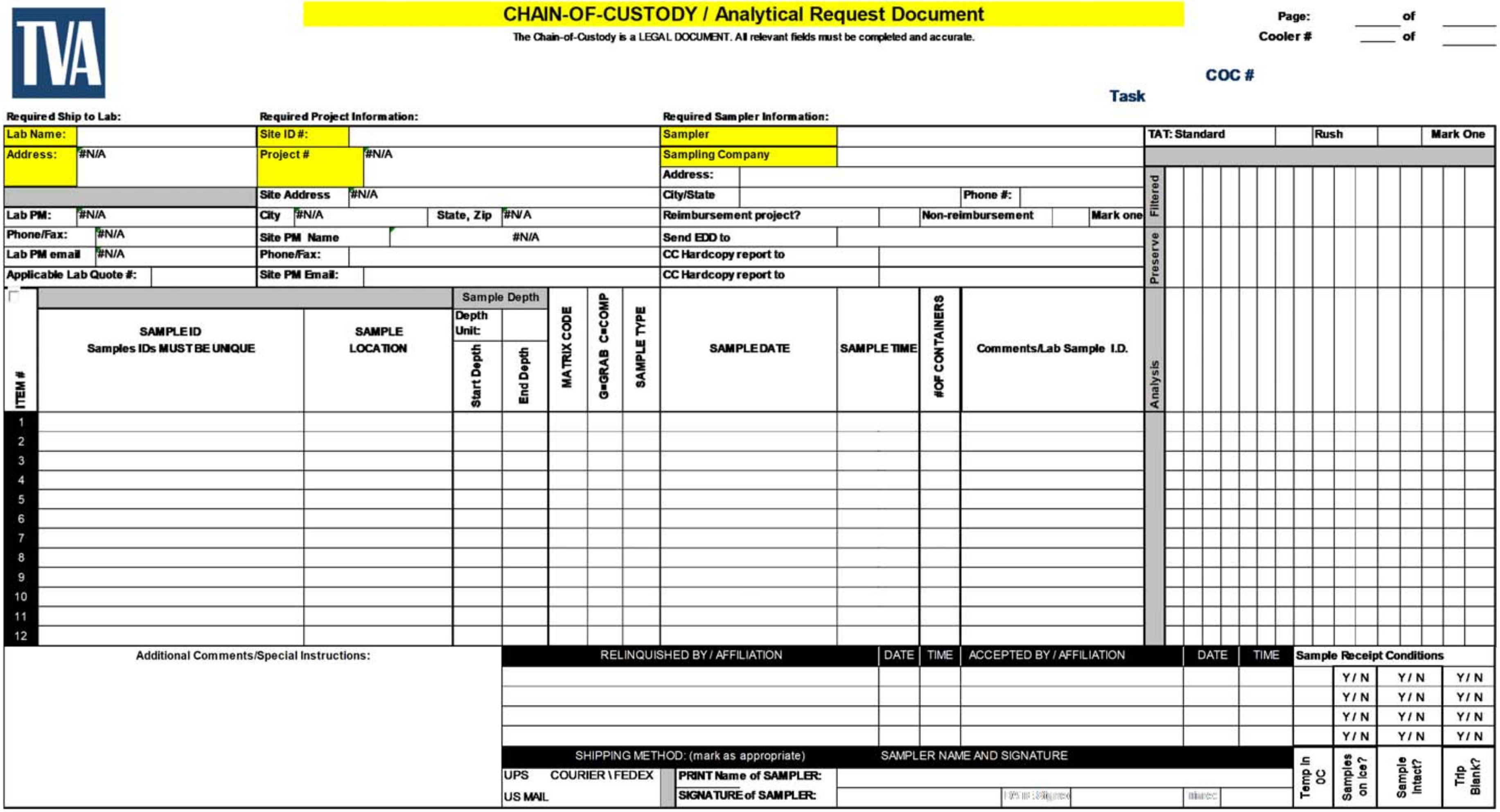
The TVA Technical Instructions (TIs) and/or standard operating procedures (SOPs) associated with the WBF EIP are identified on Table B-1. Current versions of these documents are maintained on TVA's Accellion Workspace.

Table B-1: Applicable TIs and SOPs

Document Number	**Document Title**
EMA-TI-05.80.40	*Surface Water Sampling*
ENV-TI-05.80.02	*Sample Labeling and Custody*
ENV-TI-05.80.03	*Field Record Keeping*
ENV-TI-05.80.04	*Field Sampling Quality Control*
ENV-TI-05.80.05	*Field Sampling Equipment Cleaning and Decontamination*
ENV-TI-05.80.06	*Handling and Shipping of Samples*
ENV-TI-05.80.42	*Groundwater Sampling*
ENV-TI-05.80.44	*Groundwater Level and Well Depth Measurement*
ENV-TI-05.80.46	*Field Measurements Using a Multi-Parameter Sonde*
TVA-KIF-SOP-29	*Mayfly Water Sampling*
TVA-KIF-SOP-31	*Standard Operating Procedure for: Fish sampling with Gill Nets*
TVA-KIF-SOP-33	*Fish Sampling Using Boat-mounted Electro-shocker*
TVA-KIF-SOP-35	*Reservoir Benthic Macroinvertebrate Sampling*
TVA-GAF-SOP-02	*Sediment Sampling*

ATTACHMENT C

EXAMPLE CHAIN OF CUSTODY RECORD



TVA

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed and accurate.

Page: ______ of ______
Cooler # ______ of ______

COC #

Task

Required Ship to Lab:

Lab Name:	
Address:	#N/A
Lab PM:	#N/A
Phone/Fax:	#N/A
Lab PM email	#N/A
Applicable Lab Quote #:	

Required Project Information:

Site ID #:			
Project #	#N/A		
Site Address	#N/A		
City	#N/A	State, Zip	#N/A
Site PM Name	#N/A		
Phone/Fax:			
Site PM Email:			

Required Sampler Information:

Sampler				
Sampling Company				
Address:				
City/State		Phone #:		
Reimbursement project?		Non-reimbursement		Mark one
Send EDD to				
CC Hardcopy report to				
CC Hardcopy report to				

TAT: Standard		Rush		Mark One

	Sample Depth									
ITEM #	SAMPLE ID Samples IDs MUST BE UNIQUE	SAMPLE LOCATION	Depth Unit: Start Depth	End Depth	MATRIX CODE	G=GRAB C=COMP	SAMPLE TYPE	SAMPLE DATE	SAMPLE TIME	#OF CONTAINERS	Comments/Lab Sample I.D.	Filtered / Preserve / Analysis
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												

Additional Comments/Special Instructions:

RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME

Sample Receipt Conditions

Temp In 0C	Samples on Ice?	Sample Intact?	Trip Blank?
	Y / N	Y / N	Y / N
	Y / N	Y / N	Y / N
	Y / N	Y / N	Y / N
	Y / N	Y / N	Y / N

SHIPPING METHOD: (mark as appropriate)
UPS COURIER \ FEDEX
US MAIL

SAMPLER NAME AND SIGNATURE
PRINT Name of SAMPLER:
SIGNATURE of SAMPLER:

ATTACHMENT D

TDEC ORDER SAMPLE NAMING CONVENTIONS

WATTS BAR FOSSIL PLANT

Table A: TVA - TDEC Order Sample Naming Conventions - Watts Bar Fossil Plant

Site (Plant) Name	**Site Acronym**	**Sample Type (Matrix)**	**Matrix Sample Type Acronym**	**Location**	**Location ID**	**Depth Interval (If Applicable)**	**Quality Assurance/Quality Control Sample Type**	**QA/QC Sample Type Acronym**	**Date of Sample**	**Example**
Watts Bar Fossil Plant	WBF	Background Soil	BS	Soil Boring or Monitoring Well Number	BGXX WBFXXX	Feet/Feet	Equipment Rinsate Blank	EBXX	Year/Month/Day	WBF-BS-BGXX-6.0/8.0-20181114 WBF-BS-WBFXXX-6.0/8.0-20181114 WBF-BS-EBXX-20181114 WBF-BS-FBXX-20181114 WBF-BS-LBXX-20181114 WBF-BS-DUPXX-20181114
		Coal Combustion Residuals	CCR	Temporary Well Number	TWXX	Feet/Feet	Field Blank	FBXX	Year/Month/Day	WBF-CCR-TWXX-6.0/8.0-20181114 WBF-CCR-EBXX-20181114 WBF-CCR-FBXX-20181114 WBF-CCR-DUPXX-20181114
		Groundwater	GW	Monitoring Well Number	WBFXXX or Existing Name	Feet Below Top of Casing	Filter Blank Tubing Blank Liner Blank	FLBXX TBXX LBXX	Year/Month/Day	WBF-GW-WBFXXX-30-20181114 WBF-GW-WBF201-30-20181114 WBF-GW-EBXX-20181114 WBF-GW-FBXX-20181114 WBF-GW-FLBXX-20181114 WBF-GW-TBXX-20181114 WBF-GW-DUPXX-20181114
		Pore Water	PW	Temporary Well Number	TWXX	Feet Below Top of Casing	Field Duplicate	DUPXX	Year/Month/Day	WBF-PW-TWXX-30-20181114 WBF-PW-EBXX-20181114 WBF-PW-FBXX-20181114 WBF-PW-FLBXX-20181114 WBF-PW-TBXX-20181114 WBF-PW-DUPXX-20181114
		Seep Soil	SeS	Seep Number	XX	NA	Matrix Spike/Matrix Spike Duplicate *Note applicable sample on COC	MS/MSD	Year/Month/Day	WBF-SeS-XX-20181114 WBF-SeS-EBXX-20181114 WBF-SeS-FBXX-20181114 WBF-SeS-DUPXX-20181114
		Seep Water	SeW	Seep Number	XX	NA			Year/Month/Day	WBF-SeW-XX-20181114 WBF-SeW-EBXX-20181114 WBF-SeW-FBXX-20181114 WBF-SeW-FLBXX-20181114 WBF-GW-TBXX-20181114 WBF-SeW-DUPXX-20181114

Surface Stream **Not Stratified:**	STR		Water Body Acronym Spatial Location Number	TR = Tennessee River		SUR = Water Surface MID = Mid Column BOT = Epibenthic		Year/Month/Day		WBF-STR-TRXX-SUR-20181114 WBF-STR-TRXX-Mid-20181114 WBF-STR-TRXX-BOT-20181114 WBF-STR-EBXX-20181114 WBF-STR-FBXX-20181114 WBF-STR-FLBXX-20181114 WBF-STR-TBXX-20181114 WBF-STR-DUPXX-20181114
Surface Stream **Stratified:**	STR		Water Body Acronym Spatial Location Number	TR = Tennessee River		SUR = Near Surface ME = Mid-Epillimnion MH = Mid-Hypolimnion BOT = Near Bottom		Year/Month/Day		WBF-STR-TRXX-SUR-20181114 WBF-STR-TRXX-ME-20181114 WBF-STR-TRXX-MH-20181114 WBF-STR-TRXX-BOT-20181114 WBF-STR-EBXX-20181114 WBF-STR-FBXX-20181114 WBF-STR-FLBXX-20181114 WBF-STR-TBXX-20181114 WBF-STR-DUPXX-20181114
Fish	FH		See Table B							
Macro-invertebrate	MAC		See Table C							
Adult Mayflies	MFA		See Table B							
Purated Mayfly Nymphs	MFP		See Table B							
Non-Purated Mayfly Nymphs	MFN		See Table B							
Sediment	SED		See Table C							

Table B: TVA - TDEC Order Fish & Mayfly Sample Naming Conventions – Watts Bar Fossil Plant

Site (Plant) Name	Site Acronym	Sample Type (Matrix)	Biota Matrix Code	Species Identifier	Species Identifier Acronym	River & River Mile Collection Location	Environmental Medium Identifier	Quality Control/Quality Assurance Sample Type	Sample Type Acronym	Date of Sample	Example
Watts Bar Fossil Plant	WBF	Adult Mayflies	MFA	NA	NA	TRD: Tennessee River Downstream Reach (Approximately TRRM 525.5 – 523.6)	NA	Field Duplicate	DUPXX	Year/Month/Day	WBF-MFA-TRD-20181114 WBF-MFA-DUPXX-20181114 WBF-MFA-EBXX-20181114
		Purated Mayfly Nymphs	MFP	NA	NA	TRU: Tennessee River Upstream Reach (Approximately TRRM 529.4 - 527.5)	NA	Equipment Rinsate Blank	EBXX	Year/Month/Day	WBF-MFP-TRU-20181114 WBF-MFP-DUPXX-20181114 WBF-MFP-EBXX-20181114
		Non-Purated Mayfly Nymphs	MFN	NA	NA	TRA: Tennessee River Adjacent Reach (Approximately KLRM 534.0 – 531.9)	NA			Year/Month/Day	WBF-MFN-TRA-20181114 WBF-MFN-DUPXX-20181114 WBF-MFN-EBXX-20181114
		Fish	FH	Blue Gill	BG		F = Fillet tissue sample O = Ovary tissue sample L = Liver tissue sample			Year/Month/Day	WBF-FH-BG-BH-F-20181114 WBF-FH-BG-BH-O-20181114 WBF-FH-BG-BH-L-20181114 WBF-FH-BG-F-DUPXX-20181114 WBF-FH-BG-F-EBXX-20181114
				Channel Catfish	CC		F = Fillet tissue sample O = Ovary tissue sample L = Liver tissue sample			Year/Month/Day	WBF-FH-CC-IC-F-20181114 WBF-FH-CC-IC-O-20181114 WBF-FH-CC-IC-L-20181114 WBF-FH-CC-O-DUPXX-20181114 WBF-FH-CC-O-EBXX-20181114
				Largemouth Bass	LB		F = Fillet tissue sample O = Ovary tissue sample L = Liver tissue sample			Year/Month/Day	WBF-FH-LB-TRD-F-20181114 WBF-FH-LB-TRD-O-20181114 WBF-FH-LB-TRD-L-20181114 WBF-FH-LB-L-DUPXX-20181114 WBF-FH-LB-L-EBXX-20181114
				Redear Sunfish	RS		F = Fillet tissue sample O = Ovary tissue sample L = Liver tissue sample			Year/Month/Day	WBF-FH-RS-TRU-F-20181114 WBF-FH-RS-TRU-O-20181114 WBF-FH-RS-TRU-L-20181114 WBF-FH-RS-F-DUPXX-20181114 WBF-FH-RS-F-EBXX-20181114
				Shad	SH		WF = Whole Fish			Year/Month/Day	WBF-FH-SH-TRA-WF-20181114 WBF-FH-SH-WF-DUPXX-20181114 WBF-FH-SH-WF-EBXX-20181114

Table C: TVA - TDEC Order Sediment and Benthic Sample Naming Conventions - Watts Bar Fossil Plant

Site (Plant) Name	**Site Acronym**	**Sample Type (Matrix)**	**Matrix Code**	**Location**	**Location ID**	**Transect Number**	**Sample Number**	**Depth Interval (If Applicable)**	**Quality Control/Quality Assurance Sample Type**	**QA/QC Sample Type Acronym**	**Date of Sample**	**Example**
Watts Bar Fossil Plant	WBF	Macroinvertebrate	MAC	Water Body Acronym	TR = Tennessee River	TRXX	BENXX	Feet/Feet	NA	NA	Year/Month/Day	WBF-MAC-TRXX-BENXX-0.0/0.5-20181114
		Sediment	SED	Water Body Acronym	TR = Tennessee River	TRXX	Right Bank = RB Center = CTR Left Bank = LB	Feet/Feet	Equipment Rinsate Blank	EBXX	Year/Month/Day	WBF-SED-TRXX-RB-0.0/0.5-20181114 WBF-SED-TRXX-CTR-0.0/0.5-20181114 WBF-SED-TRXX-LB-0.0/0.5-20181114 WBF-SED-TRXX-EBXX-20181114 WBF-SED-TRXX-DUPXX-20181114
									Field Duplicate	DUPXX		
									Matrix Spike/Matrix Spike Duplicate *MS/MSD only applicable on sediment samples, note on COC	MS/MSD		

ATTACHMENT E

INVESTIGATION-SPECIFIC QUALITY CONTROL REQUIREMENTS

BACKGROUND SOIL SAMPLING

Table E-1. Sample Containers, Mass, Preservation, and Holding Time Requirements

Matrix	**Parameter(s)**	**Container Type**	**Recommended Sample Mass/Volume**	**Preservation**	**Holding Time**
Solid	Metals	4-oz glass	5 g	Cool to < 6°C	180 days
	Mercury				28 days
	Radiological Parameters	16-oz glass	20 g	NA	180 days
	Anions (Chloride, Fluoride, and Sulfate)	4-oz glass	5 g	Cool to < 6°C	28 days
	pH				NA*
	Percent Ash	4-oz glass	5 g	NA	NA
Aqueous Blanks	Metals	250-mL HDPE	250 mL	HNO_3 to pH < 2 Cool to < 6°C	180 days
	Mercury				28 days
	Anions (Chloride, Fluoride, and Sulfate)	250-mL HDPE	250 mL	Cool to < 6°C	28 days
	Radiological Parameters	3× 1-L HDPE	3000 mL	HNO_3 to pH < 2	180 days

*Holding time for soil pH samples is 15 minutes following creation of soil paste. Soil samples will be tested in the field using field pH test kits, 10% of the sample locations will have confirmation samples submitted for laboratory analysis of pH and will have paste prepared in the laboratory so that analysis can be completed within the holding time.

Notes:

oz - ounce
g - grams
mL - milliliter
L - liter
HDPE - High Density Polyethylene
NA - Not applicable

Table E-2: Analytes, Methods, and Reporting Limits – Solid Matrices

Parameter	CAS No.	Method	Reporting Limit[1]	Units
Antimony	7440-36-0	SW-846 6020A	0.200	mg/kg
Arsenic	7440-38-2	SW-846 6020A	0.100	mg/kg
Barium	7440-39-3	SW-846 6020A	1.00	mg/kg
Beryllium	7440-41-7	SW-846 6020A	0.100	mg/kg
Boron	7440-42-8	SW-846 6020A	8.0	mg/kg
Cadmium	7440-43-9	SW-846 6020A	0.100	mg/kg
Calcium	7440-70-2	SW-846 6020A	50.0	mg/kg
Chromium	7440-47-3	SW-846 6020A	0.200	mg/kg
Cobalt	7440-48-4	SW-846 6020A	0.0500	mg/kg
Copper	7440-50-8	SW-846 6020A	0.200	mg/kg
Lead	7439-92-1	SW-846 6020A	0.100	mg/kg
Lithium	7439-93-2	SW-846 6020A	0.500	mg/kg
Mercury	7487-94-7	SW-846 7471B	0.0330	mg/kg
Molybdenum	7439-98-7	SW-846 6020A	0.500	mg/kg
Nickel	7440-02-0	SW-846 6020A	0.100	mg/kg
Selenium	7782-49-2	SW-846 6020A	0.500	mg/kg
Silver	7440-22-4	SW-846 6020A	0.100	mg/kg
Thallium	7440-28-0	SW-846 6020A	0.100	mg/kg
Vanadium	7440-62-2	SW-846 6020A	0.100	mg/kg
Zinc	7440-66-6	SW-846 6020A	0.500	mg/kg
Radium-226	13982-63-3	EPA 901.1	1.00	pCi/g
Radium-228	15262-20-1	EPA 901.1	1.00	pCi/g
Radium-226+228	RA226/228	CALC	1.00	pCi/g
Percent Ash	%ASH	R.J. Lee SOP OPT23.02	1	%
Chloride	16887-00-6	SW-846 9056A Modified	10.0	mg/kg
Fluoride	16984-48-8	SW-846 9056A Modified	1.0	mg/kg
Sulfate	14808-79-8	SW-846 9056A Modified	10.0	mg/kg
pH[2]	PH	SW-846 9045D Modified (laboratory-based definitive analysis)	0.1	pH units

Notes:

CAS No. - Chemical Abstracts Service registry number
mg/kg - milligrams per kilogram
pCi/g - picoCuries per gram
CALC - Parameter determined by calculation.

[1] Samples will be reported on a dry-weight basis; sample-specific reporting limits will vary based on sample mass, dilution factors, and percent moisture.

[2] Soil samples will be tested in the field using field pH test kits, 10% of the sample locations will have confirmation samples submitted for laboratory analysis of pH and will have paste prepared in the laboratory so that analysis can be completed within the holding time (15 minutes following creation of soil paste).

Table E-3: Quantitative QA Objectives – Soil Samples

Analyte/ Parameter Group	**Method**	**Equipment Rinsate Blank, Field Blank, Method Blank**	**LCS Accuracy (% R)**	**MS/MSD Accuracy (% R)**	**LCS/LCSD Precision (RPD)**	**MS/MSD Precision (RPD)**	**Laboratory Duplicate Precision (RPD)**	**Field Duplicate Precision[1]**
Metals	SW-846 6020A	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Mercury	SW-846 7471B	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Radium-226	EPA 901.1	< RL	75-125	NA	RER < 2	NA	RER < 2	RER < 2
Radium-228	EPA 901.1	< RL	75-125	NA	RER < 2	NA	RER < 2	RER < 2
Anions	SW-846 9056A Modified	< RL	80-120	75-125	35	35	20	RPD < 35% difference < 2× the RL
Percent Ash	R.J. Lee SOP OPT23.02	< RL	NA	NA	NA	NA	±10%	RPD < 35% difference < 2× the RL
pH	SW-846 9045D Modified (laboratory-based definitive analysis)	pH 6-8 for laboratory-supplied deionized water	NA	NA	NA	NA	±0.2 pH units	±0.5 pH units

Notes:
[1] When both field duplicate results are > 5× the RL, the RPD must be < 20%. When at least one result is < 5× the RL, the difference must be < the RL

LCS	-	Laboratory Control Sample
LCSD	-	Laboratory Control Sample Duplicate
MS/MSD	-	Matrix Spike/Matrix Spike Duplicate
NA	-	Not Applicable
RPD	-	Relative Percent Difference
RER	-	Relative Error
RL	-	Reporting Limit
%R	-	Percent Recovery

ATTACHMENT F

INVESTIGATION-SPECIFIC QUALITY CONTROL REQUIREMENTS

SURFACE STREAM SAMPLING

Table F-1. Sample Containers, Mass, Preservation, and Holding Time Requirements

Matrix	Parameter(s)	Container Type	Recommended Sample Mass/Volume	Preservation	Holding Time
Surface Water	Metals (Total)	250-mL HDPE	250 mL	HNO_3 to pH < 2 Cool to < 6°C	180 days
	Mercury (Total)				28 days
	Metals (Dissolved)	250-mL HDPE	250 mL	HNO_3 to pH < 2 after field filtration Cool to < 6°C	180 days
	Mercury (Dissolved)				28 days
	Anions (Chloride, Fluoride, and Sulfate)	250-mL HDPE	250 mL	Cool to <6°C	28 days
	Radiological Parameters	3× 1-L HDPE	3000 mL	HNO_3 to pH < 2	180 days
	pH (field measurement)	NA	NA	NA	15 minutes
	Total Dissolved Solids (TDS)	250-mL HDPE	100 mL	Cool to < 6°C	7 days
	Total Suspended Solids (TSS)	1 L HDPE	1 L (unfiltered)	Cool to < 6°C	7 days

Notes:

oz - ounce
g - grams
mL - milliliter
L - liter
HDPE - High Density Polyethylene
NA - Not applicable

Table F-2: Analytes, Methods, and Reporting Limits – Surface Water Samples

Parameter	CAS No.	Method	Reporting Limit	Units
Chloride	7647-14-5	EPA 300.0/ SW-846 9056	1.00	mg/L
Fluoride	16984-48-8	EPA 300.0/ SW-846 9056	0.10	mg/L
Sulfate	7757-82-6	EPA 300.0/ SW-846 9056	1.00	mg/L
Total Dissolved Solids	TDS	SM2540C	10.0	mg/L
Total Suspended Solids	TSS	SM2540D	10.0	mg/L
pH	pH	SW-846 Method 9040C	0.100	pH units
Antimony (total and dissolved)	7440-36-0	SW-846 6020A	2.00	μg/L
Arsenic (total and dissolved)	7440-38-2	SW-846 6020A	1.00	μg/L
Barium (total and dissolved)	7440-39-3	SW-846 6020A	10.0	μg/L
Beryllium (total and dissolved)	7440-41-7	SW-846 6020A	1.00	μg/L
Boron (total and dissolved)	7440-42-8	SW-846 6020A	80.0	μg/L
Cadmium (total and dissolved)	7440-43-9	SW-846 6020A	1.00	μg/L
Calcium (total and dissolved)	7440-70-2	SW-846 6020A	500	μg/L
Chromium (total and dissolved)	7440-47-3	SW-846 6020A	2.00	μg/L
Cobalt (total and dissolved)	7440-48-4	SW-846 6020A	0.5	μg/L
Copper (total and dissolved)	7440-50-8	SW-846 6020A	2.00	μg/L
Iron (total and dissolved)	7439-89-6	SW-846 6020A	5.00	μg/L

Parameter	CAS No.	Method	Reporting Limit	Units
Lead (total and dissolved)	7439-92-1	SW-846 6020A	1.00	µg/L
Lithium (total and dissolved)	7439-93-2	SW-846 6020A	5.00	µg/L
Magnesium (total and dissolved)	7439-95-4	SW-846 6020A	500	µg/L
Manganese (total and dissolved)	7439-96-5	SW-846 6020A	5.00	µg/L
Mercury (total and dissolved)	7487-94-7	SW-846 7470A	0.200	µg/L
Molybdenum (total and dissolved)	7439-98-7	SW-846 6020A	5.00	µg/L
Nickel (total and dissolved)	7440-02-0	SW-846 6020A	1.0	µg/L
Selenium (total and dissolved)	7782-49-2	SW-846 6020A	5.00	µg/L
Silver (total and dissolved)	7440-22-4	SW-846 6020A	1.00	µg/L
Thallium (total and dissolved)	7440-28-0	SW-846 6020A	1.00	µg/L
Vanadium (total and dissolved)	7440-62-2	SW-846 6020A	1.00	µg/L
Zinc (total and dissolved)	7440-66-6	SW-846 6020A	5.00	µg/L
Radium-226	13982-63-3	EPA 903.0	1	pCi/L
Radium-228	15262-20-1	EPA 904.0	1	pCi/L
Radium-226+228	RA226/228	CALC	1	pCi/L
Total Hardness	HARD	CALC	500	µg/L

Notes:

CAS No.	-	Chemical Abstracts Service registry number
mg/L	-	milligrams per liter
µg/L	-	micrograms per liter
pCi/L	-	picoCuries per liter
CALC	-	Parameter determined by calculation.

Table F-3: Quantitative QA Objectives – Surface Water

Analyte/ Parameter Group	**Method**	**Surrogate Compound Recoveries/ Chemical Yield (%)**	**Equipment Rinsate Blank, Field Blank, Method Blank**	**LCS Accuracy (% R)**	**MS/MSD Accuracy (% R)**	**LCS/LCSD Precision (RPD)**	**MS/MSD Precision (RPD)**	**Laboratory Duplicate Precision (RPD)**	**Field Duplicate Precision[1]**
Metals (total and dissolved)	SW-846 6020A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Mercury (total and dissolved)	SW-846 7470A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Total Dissolved Solids	SM 2540C	NA	< RL	80-120	NA	20	NA	20	RPD < 20% difference < the RL
Total Suspended Solids	SM 2540D	NA	< RL	80-120	NA	20	NA	20	RPD < 20% difference < the RL
Anions (Chloride, Fluoride, Sulfate)	SW-846 9056A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
pH	SW-846 Method 9040C	NA	NA	NA	NA	NA	NA	NA	±0.5 pH units
Radium-226	EPA 903.0	30-110	< RL	80-120	NA	RER < 2	NA	RER < 2	RER < 2
Radium-228	EPA 904.0	30-110	< RL	80-120	NA	RER < 2	NA	RER < 2	RER < 2

Notes:

[1] When both field duplicate results are > 5× the RL, the RPD must be < 20%. When at least one result is < 5× the RL, the difference must be < the RL

LCS	-	Laboratory Control Sample
LCSD	-	Laboratory Control Sample Duplicate
MS/MSD	-	Matrix Spike/Matrix Spike Duplicate
NA	-	Not Applicable
RPD	-	Relative Percent Difference
RER	-	Relative Error
RL	-	Reporting Limit
%R	-	Percent Recovery

ATTACHMENT G

INVESTIGATION-SPECIFIC QUALITY CONTROL REQUIREMENTS

FISH TISSUE SAMPLING

Table G-1. Sample Containers, Mass, Preservation, and Holding Time Requirements

Matrix	Parameter(s)	Container Type	Recommended Sample Mass/Volume	Preservation	Holding Time
Fish Tissue	Metals	Resealable plastic bag or 8-oz WM jar for filets Resealable plastic bag or small WM jar (1 to 4-oz) for liver/ovary tissue	5 g	During sample collection and transportation to the laboratory, cool to < 6°C After receipt at the laboratory, freeze at < -10°C	1 year
	Mercury		1 g		
	Percent Moisture		2 g[1]		
Aqueous Blanks	Metals	250-mL HDPE	250 mL	HNO_3 to pH < 2 Cool to < 6°C	180 days
	Mercury				28 days

Notes:

oz - ounce
WM - wide-mouth
g - grams
HDPE - High Density Polyethylene
NA - Not applicable.

[1] A minimum of 2 grams is required for moisture analysis when sufficient sample mass is available. For samples with limited mass (*e.g.*, liver or ovary tissue), moisture analysis will be performed on a minimum 1-gram mass.

Table G-2: Analytes, Methods, and Reporting Limits – Fish Tissue Samples

Parameter	CAS No.	Method	Reporting Limit[1]	Units
Antimony	7440-36-0	SW-846 6020A	0.5	mg/kg
Arsenic	7440-38-2	SW-846 6020A	0.5	mg/kg
Barium	7440-39-3	SW-846 6020A	1.0	mg/kg
Beryllium	7440-41-7	SW-846 6020A	0.5	mg/kg
Boron	7440-42-8	SW-846 6020A	0.5	mg/kg
Cadmium	7440-43-9	SW-846 6020A	0.5	mg/kg
Calcium	7440-70-2	SW-846 6020A	84	mg/kg
Chromium	7440-47-3	SW-846 6020A	0.5	mg/kg
Cobalt	7440-48-4	SW-846 6020A	0.5	mg/kg
Copper	7440-50-8	SW-846 6020A	0.5	mg/kg
Lead	7439-92-1	SW-846 6020A	0.5	mg/kg
Lithium	7439-93-2	SW-846 6020A	0.5	mg/kg
Mercury	7487-94-7	SW-846 7473	0.02	mg/kg
Molybdenum	7439-98-7	SW-846 6020A	0.5	mg/kg
Nickel	7440-02-0	SW-846 6020A	0.5	mg/kg
Selenium	7782-49-2	SW-846 6020A	0.5	mg/kg
Silver	7440-22-4	SW-846 6020A	0.5	mg/kg
Strontium	7440-24-6	SW-846 6020A	0.5	mg/kg
Thallium	7440-28-0	SW-846 6020A	0.5	mg/kg
Vanadium	7440-62-2	SW-846 6020A	0.5	mg/kg
Zinc	7440-66-6	SW-846 6020A	5.8	mg/kg
Percent Moisture	MOISTURE	ASTM D2974-87	0.1	%

Notes:

CAS No. - Chemical Abstracts Service registry number
mg/kg - milligrams per kilogram

[1] Samples will be reported on a wet-weight basis; sample-specific reporting limits will vary based on sample mass and dilution factors.

Table G-3: Quantitative QA Objectives – Fish Tissue Samples

Analyte/ Parameter Group	**Method**	**Equipment Rinsate Blank, Method Blank**	**LCS Accuracy (% R)**	**MS/MSD Accuracy (% R)**	**LCS/LCSD Precision (RPD)**	**MS/MSD Precision (RPD)**	**Laboratory Duplicate Precision (RPD)**	**Field Duplicate Precision[1]**
Metals	SW-846 6020A	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Mercury	SW-846 7473	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Percent Moisture	ASTM D2974-87	< RL	NA	NA	NA	NA	10	RPD < 35% difference < 2× the RL

Notes:

[1] When both field duplicate results are > 5× the RL, the RPD must be < 20%. When at least one result is < 5× the RL, the difference must be < the RL

LCS	-	Laboratory Control Sample
LCSD	-	Laboratory Control Sample Duplicate
MS/MSD	-	Matrix Spike/Matrix Spike Duplicate
NA	-	Not Applicable
RPD	-	Relative Percent Difference
RL	-	Reporting Limit
%R	-	Percent Recovery

ATTACHMENT H

INVESTIGATION-SPECIFIC QUALITY CONTROL REQUIREMENTS

BENTHIC SAMPLING

Table H-1. Sample Containers, Mass, Preservation, and Holding Time Requirements

Matrix	**Parameter(s)**	**Container Type**	**Recommended Sample Mass/Volume**	**Preservation**	**Holding Time**
Sediment	Metals	4-oz glass	5 g	Cool to < 6°C	180 days
	Mercury				28 days
	Radiological Parameters	16-oz glass	20 g	NA	180 days
	Anions (Chloride, Fluoride, and Sulfate)	4-oz glass	5 g	Cool to < 6°C	28 days
	pH				NA
	Percent Ash	4-oz glass	5 g	NA	NA
Mayflies (nymphs and adults)	Metals	4-oz glass	5 g	Frozen < -10°C	1 year
	Mercury		1 g		
	Percent Moisture		5 g (2 g minimum)		
Aqueous Blanks	Metals	250-mL HDPE	250 mL	HNO_3 to pH < 2 Cool to < 6°C	180 days
	Mercury				28 days
	Anions (Chloride, Fluoride, and Sulfate)	250-mL HDPE	250 mL	Cool to < 6°C	28 days
	pH				24 hours
	Radiological Parameters	3× 1-L HDPE	3000 mL	HNO_3 to pH < 2	180 days

Notes:

oz - ounce
g - grams
HDPE - High Density Polyethylene
mL - milliliters
L - liters
NA - Not applicable.

Table H-2: Analytes, Methods, and Reporting Limits – Sediment Samples

Parameter	CAS No.	Method	Reporting Limit[1]	Units
Antimony	7440-36-0	SW-846 6020A	0.200	mg/kg
Arsenic	7440-38-2	SW-846 6020A	0.100	mg/kg
Barium	7440-39-3	SW-846 6020A	1.00	mg/kg
Beryllium	7440-41-7	SW-846 6020A	0.100	mg/kg
Boron	7440-42-8	SW-846 6020A	8.0	mg/kg
Cadmium	7440-43-9	SW-846 6020A	0.100	mg/kg
Calcium	7440-70-2	SW-846 6020A	50.0	mg/kg
Chromium	7440-47-3	SW-846 6020A	0.200	mg/kg
Cobalt	7440-48-4	SW-846 6020A	0.0500	mg/kg
Copper	7440-50-8	SW-846 6020A	0.200	mg/kg
Lead	7439-92-1	SW-846 6020A	0.100	mg/kg
Lithium	7439-93-2	SW-846 6020A	0.500	mg/kg
Mercury	7487-94-7	SW-846 7471B	0.0330	mg/kg
Molybdenum	7439-98-7	SW-846 6020A	0.500	mg/kg
Nickel	7440-02-0	SW-846 6020A	0.100	mg/kg
Selenium	7782-49-2	SW-846 6020A	0.500	mg/kg
Silver	7440-22-4	SW-846 6020A	0.100	mg/kg
Thallium	7440-28-0	SW-846 6020A	0.100	mg/kg
Vanadium	7440-62-2	SW-846 6020A	0.100	mg/kg
Zinc	7440-66-6	SW-846 6020A	0.500	mg/kg
Radium-226	13982-63-3	EPA 901.1	1.00	pCi/g
Radium-228	15262-20-1	EPA 901.1	1.00	pCi/g
Radium-226+228	RA226/228	CALC	1.00	pCi/g
Percent Ash	%ASH	R.J. Lee SOP OPT23.02	1	%
Chloride	16887-00-6	SW-846 9056A Modified	10.0	mg/kg
Fluoride	16984-48-8	SW-846 9056A Modified	1.0	mg/kg
Sulfate	14808-79-8	SW-846 9056A Modified	10.0	mg/kg
pH	PH	SW-846 9045D Modified	0.100	pH units

Notes:

CAS No.	-	Chemical Abstracts Service registry number
mg/kg	-	milligrams per kilogram
pCi/g	-	picoCuries per gram
CALC	-	Parameter determined by calculation

[1] Samples will be reported on a dry-weight basis; sample-specific reporting limits will vary based on sample mass, dilution factors, and percent moisture.

Table H-3: Analytes, Methods, and Reporting Limits – Mayfly Samples

Parameter	CAS No.	Method	Reporting Limit[1]	Units
Antimony	7440-36-0	SW-846 6020A	0.5	mg/kg
Arsenic	7440-38-2	SW-846 6020A	0.5	mg/kg
Barium	7440-39-3	SW-846 6020A	0.5	mg/kg
Beryllium	7440-41-7	SW-846 6020A	0.5	mg/kg
Boron	7440-42-8	SW-846 6020A	0.5	mg/kg
Cadmium	7440-43-9	SW-846 6020A	0.5	mg/kg
Calcium	7440-70-2	SW-846 6020A	0.5	mg/kg
Chromium	16065-83-1	SW-846 6020A	0.5	mg/kg
Cobalt	7440-48-4	SW-846 6020A	0.5	mg/kg
Copper	7440-50-8	SW-846 6020A	0.5	mg/kg
Lead	7439-92-1	SW-846 6020A	0.5	mg/kg
Lithium	7439-93-2	SW-846 6020A	0.5	mg/kg
Mercury	7487-94-7	SW-846 7473	0.5	mg/kg
Molybdenum	7439-98-7	SW-846 6020A	0.5	mg/kg
Nickel	7440-02-0	SW-846 6020A	0.5	mg/kg
Selenium	7782-49-2	SW-846 6020A	0.5	mg/kg
Silver	7440-22-4	SW-846 6020A	0.5	mg/kg
Strontium	7440-24-6	SW-846 6020A	0.5	mg/kg
Thallium	7440-28-0	SW-846 6020A	0.5	mg/kg
Vanadium	7440-62-2	SW-846 6020A	0.5	mg/kg
Zinc	7440-66-6	SW-846 6020A	0.5	mg/kg
Percent Moisture	MOISTURE	ASTM D2974-87	0.1	%

Notes:

CAS No.	-	Chemical Abstracts Service registry number
mg/kg	-	milligrams per kilogram
pCi/g	-	picoCuries per gram
CALC	-	Parameter determined by calculation

1 Samples will be reported on a wet-weight basis; sample-specific reporting limits will vary based on sample mass, dilution factors, and percent moisture.

Table H-4: Quantitative QA Objectives – Sediment Samples

Analyte/ Parameter Group	**Method**	**Equipment Rinsate Blank, Field Blank, Method Blank**	**LCS Accuracy (% R)**	**MS/MSD Accuracy (% R)**	**LCS/LCSD Precision (RPD)**	**MS/MSD Precision (RPD)**	**Laboratory Duplicate Precision (RPD)**	**Field Duplicate Precision[1]**
Percent Ash	R.J. Lee SOP OPT23.02	< RL	NA	NA	NA	NA	±10%	RPD < 35% difference < 2× the RL
Metals	SW-846 6020A	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Mercury	SW-846 7471B	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Radium-226	EPA 901.1	< RL	75-125	NA	RER < 2	NA	RER < 2	RER < 2
Radium-228	EPA 901.1	< RL	75-125	NA	RER < 2	NA	RER < 2	RER < 2
Anions	SW-846 9056A Modified	< RL	80-120	75-125	35	35	20	RPD < 35% difference < 2× the RL
pH	SW-846 9045D Modified	pH 6-8 for laboratory-supplied DI water	NA	NA	NA	NA	±0.2 pH units	±0.5 pH units

Notes:

[1] When both field duplicate results are > 5× the RL, the RPD must be < 20%. When at least one result is < 5× the RL, the difference must be < the RL

LCS	-	Laboratory Control Sample
LCSD	-	Laboratory Control Sample Duplicate
MS/MSD	-	Matrix Spike/Matrix Spike Duplicate
NA	-	Not Applicable
RPD	-	Relative Percent Difference
RER	-	Relative Error
RL	-	Reporting Limit
%R	-	Percent Recovery

Table H-5: Quantitative QA Objectives – Mayfly Samples

Analyte/ Parameter Group	**Method**	**Equipment Rinsate Blank, Method Blank**	**LCS Accuracy (% R)**	**MS/MSD Accuracy (% R)**	**LCS/LCSD Precision (RPD)**	**MS/MSD Precision (RPD)**	**Laboratory Duplicate Precision (RPD)**	**Field Duplicate Precision[1]**
Metals	SW-846 6020A	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Mercury	SW-846 7473	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Percent Moisture	ASTM D2974-87	< RL	NA	NA	NA	NA	10	RPD < 35% difference < 2× the RL

Notes:

[1] When both field duplicate results are > 5× the RL, the RPD must be < 20%. When at least one result is < 5× the RL, the difference must be < the RL

LCS	-	Laboratory Control Sample
LCSD	-	Laboratory Control Sample Duplicate
MS/MSD	-	Matrix Spike/Matrix Spike Duplicate
NA	-	Not Applicable
RPD	-	Relative Percent Difference
RL	-	Reporting Limit
%R	-	Percent Recovery

ATTACHMENT I

INVESTIGATION-SPECIFIC QUALITY CONTROL REQUIREMENTS

SEEP SAMPLING

Table I-1. Sample Containers, Mass, Preservation, and Holding Time Requirements

Matrix	Parameter(s)	Container Type	Recommended Sample Mass/Volume	Preservation[1]	Holding Time
Seep Water	Metals (Total)	250-mL HDPE	250 mL	HNO_3 to pH < 2 Cool to < 6°C	180 days
	Mercury (Total)				28 days
	Metals (Dissolved)	250-mL HDPE	250 mL	HNO_3 to pH < 2 after filtration Cool to < 6°C	180 days
	Mercury (Dissolved)				28 days
	Anions (Chloride, Fluoride, and Sulfate)	250-mL HDPE	250 mL	Cool to < 6°C	28 days
	Radiological Parameters	3× 1-L HDPE	3000 mL	HNO_3 to pH < 2	180 days
	pH (field measurement)	NA	NA	NA	15 minutes
	Total Dissolved Solids (TDS)[2]	250-mL HDPE	100 mL (unfiltered)	Cool to < 6°C	7 days
	Total Suspended Solids (TSS)[2]	1 L HDPE	1000 mL (unfiltered)	Cool to < 6°C	7 days
Seep Soil	Metals	4-oz glass	5 g	Cool to < 6°C	180 days
	Mercury				28 days
	Radiological Parameters	16-oz glass	20 g	NA	180 days
	Anions (Chloride, Fluoride, and Sulfate)	4-oz glass	5 g	Cool to < 6°C	28 days
	pH				NA*

Notes:

HDPE	-	High Density Polyethylene.
g	-	grams
mL	-	milliliters
L	-	liters
NA	-	Not applicable.

[1] Filtered samples requiring chemical preservation will be preserved after field filtration.
[2] TDS and TSS will be performed using unfiltered sample volume.

*Holding time for soil pH samples is 15 minutes following creation of soil paste. Soil samples will be tested in the field using field pH test kits, 10% of the sample locations will have confirmation samples submitted for laboratory analysis of pH and will have paste prepared in the laboratory so that analysis can be completed within the holding time.

Table I-2: Analytes, Methods, and Reporting Limits – Seep Soil

Parameter	CAS No.	Method	Reporting Limit[1]	Units
Antimony	7440-36-0	SW-846 6020A	0.200	mg/kg
Arsenic	7440-38-2	SW-846 6020A	0.100	mg/kg
Barium	7440-39-3	SW-846 6020A	1.00	mg/kg
Beryllium	7440-41-7	SW-846 6020A	0.100	mg/kg
Boron	7440-42-8	SW-846 6020A	0.5	mg/kg
Cadmium	7440-43-9	SW-846 6020A	0.100	mg/kg
Calcium	7440-70-2	SW-846 6020A	50.0	mg/kg
Chromium	16065-83-1	SW-846 6020A	0.200	mg/kg
Cobalt	7440-48-4	SW-846 6020A	0.0500	mg/kg
Copper	7440-50-8	SW-846 6020A	0.200	mg/kg
Lead	7439-92-1	SW-846 6020A	0.100	mg/kg
Lithium	7439-93-2	SW-846 6020A	0.500	mg/kg
Mercury	7487-94-7	SW-846 7471B	0.0330	mg/kg
Molybdenum	7439-98-7	SW-846 6020A	0.500	mg/kg
Nickel	7440-02-0	SW-846 6020A	0.100	mg/kg
Selenium	7782-49-2	SW-846 6020A	0.500	mg/kg
Silver	7440-22-4	SW-846 6020A	0.100	mg/kg
Sodium	7440-23-5	SW-846 6020A	50.0	mg/kg
Thallium	7440-28-0	SW-846 6020A	0.100	mg/kg
Vanadium	7440-62-2	SW-846 6020A	0.100	mg/kg
Zinc	7440-66-6	SW-846 6020A	0.500	mg/kg
Radium-226	13982-63-3	EPA 901.1	1.00	pCi/g
Radium-228	15262-20-1	EPA 901.1	1.00	pCi/g
Radium-226+228	RA226/228	CALC	1.00	pCi/g
Chloride	16887-00-6	SW-846 9056A Modified	10.0	mg/kg
Fluoride	16984-48-8	SW-846 9056A Modified	1.0	mg/kg
Sulfate	14808-79-8	SW-846 9056A Modified	10.0	mg/kg
pH	PH	SW-846 9045D Modified (laboratory-based definitive analysis)	0.1	pH units

Notes:

CAS No. - Chemical Abstracts Service registry number
mg/kg - milligrams per kilogram
pCi/g - picoCuries per gram
CALC - Parameter determined by calculation

1 Samples will be reported on a dry-weight basis; sample-specific reporting limits will vary based on sample mass, dilution factors, and percent moisture.

Table I-3: Analytes, Methods, and Reporting Limits – Seep Water Samples

Parameter	CAS No.	Method	Reporting Limit	Units
Chloride	7647-14-5	EPA 300.0/ SW-846 9056	1.00	mg/L
Fluoride	16984-48-8	EPA 300.0/ SW-846 9056	0.10	mg/L
Sulfate	7757-82-6	EPA 300.0/ SW-846 9056	1.00	mg/L
Total Dissolved Solids	TDS	SM2540C	10.0	mg/L
Total Suspended Solids	TSS	SM2540D	10.0	mg/L
pH	pH	SW-846 9040C	0.05	pH units
Antimony (Total and Dissolved)	7440-36-0	SW-846 6020A	2.00	µg/L
Arsenic (Total and Dissolved)	7440-38-2	SW-846 6020A	1.00	µg/L
Barium (Total and Dissolved)	7440-39-3	SW-846 6020A	10	µg/L
Beryllium (Total and Dissolved)	7440-41-7	SW-846 6020A	1.00	µg/L
Boron (Total and Dissolved)	7440-42-8	SW-846 6020A	80	µg/L
Cadmium (Total and Dissolved)	7440-43-9	SW-846 6020A	1.00	µg/L
Calcium (Total and Dissolved)	7440-70-2	SW-846 6020A	500	µg/L
Chromium (Total and Dissolved)	16065-83-1	SW-846 6020A	2.00	µg/L
Cobalt (Total and Dissolved)	7440-48-4	SW-846 6020A	0.5	µg/L
Copper (Total and Dissolved)	7440-50-8	SW-846 6020A	2.00	µg/L
Lead (Total and Dissolved)	7439-92-1	SW-846 6020A	1.00	µg/L
Lithium (Total and Dissolved)	7439-93-2	SW-846 6020A	5.00	µg/L

Parameter	CAS No.	Method	Reporting Limit	Units
Mercury (Total and Dissolved)	7487-94-7	SW-846 7470A	0.200	µg/L
Molybdenum (Total and Dissolved)	7439-98-7	SW-846 6020A	5.00	µg/L
Nickel (Total and Dissolved)	7440-02-0	SW-846 6020A	10	µg/L
Selenium (Total and Dissolved)	7782-49-2	SW-846 6020A	5.00	µg/L
Silver (Total and Dissolved)	7440-22-4	SW-846 6020A	1.00	µg/L
Sodium (Total and Dissolved)	7440-23-5	SW-846 6020A	500	µg/L
Thallium (Total and Dissolved)	7440-28-0	SW-846 6020A	1.00	µg/L
Vanadium (Total and Dissolved)	7440-62-2	SW-846 6020A	1.00	µg/L
Zinc (Total and Dissolved)	7440-66-6	SW-846 6020A	5.00	µg/L
Radium-226	13982-63-3	EPA 903.0	1	pCi/L
Radium-228	15262-20-1	EPA 904.0	1	pCi/L
Radium-226+228	RA226/228	CALC	1	pCi/L

Notes:

CAS No. - Chemical Abstracts Service registry number
mg/L - milligrams per liter
pCi/L - picoCuries per liter
CALC - Parameter determined by calculation

Table I-4: Quantitative QA Objectives – Seep Soil Samples

Analyte/ Parameter Group	**Method**	**Equipment Rinsate Blank, Field Blank, Method Blank**	**LCS Accuracy (% R)**	**MS/MSD Accuracy (% R)**	**LCS/LCSD Precision (RPD)**	**MS/MSD Precision (RPD)**	**Laboratory Duplicate Precision (RPD)**	**Field Duplicate Precision[1]**
Metals	SW-846 6020A	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Mercury	SW-846 7471B	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Radium-226	EPA 901.1	< RL	75-125	NA	RER < 2	NA	RER < 2	RER < 2
Radium-228	EPA 901.1	< RL	75-125	NA	RER < 2	NA	RER < 2	RER < 2
Anions	SW-846 9056A Modified	< RL	80-120	75-125	35	35	20	RPD < 35% difference < 2× the RL
pH	SW-846 9045D Modified (laboratory-based definitive analysis)	pH 6-8 for laboratory-supplied deionized water	NA	NA	NA	NA	±0.2 pH units	±0.5 pH units

Notes:

[1] When both field duplicate results are > 5× the RL, the RPD must be < 20%. When at least one result is < 5× the RL, the difference must be < the RL

LCS	-	Laboratory Control Sample
LCSD	-	Laboratory Control Sample Duplicate
MS/MSD	-	Matrix Spike/Matrix Spike Duplicate
NA	-	Not Applicable
RPD	-	Relative Percent Difference
RER	-	Relative Error
RL	-	Reporting Limit
%R	-	Percent Recovery

Table I-5: Quantitative QA Objectives – Seep Water Samples

Analyte/ Parameter Group	Method	Surrogate Compound Recoveries/ Chemical Yield (%)	Equipment Rinsate Blank, Field Blank, Method Blank	LCS Accuracy (% R)	MS/MSD Accuracy (% R)	LCS/LCSD Precision (RPD)	MS/MSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Field Duplicate Precision[1]
Metals (Total and Dissolved)	SW-846 6020A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Mercury (Total and Dissolved)	SW-846 7470	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Total Dissolved Solids	SM 2540C	NA	< RL	80-120	NA	20	NA	20	RPD < 20% difference < the RL
Total Suspended Solids	SM 2540D	NA	< RL	80-120	NA	20	NA	20	RPD < 20% difference < the RL
Anions (Chloride, Fluoride, Sulfate)	SW-846 9056A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
pH	SW-846 9040C	NA	NA	NA	NA	NA	NA	NA	±0.5 pH units
Radium-226	EPA 903.0	30-110	< RL	80-120	NA	RER < 2	NA	RER < 2	RER < 2
Radium-228	EPA 904.0	30-110	< RL	80-120	NA	RER < 2	NA	RER < 2	RER < 2

Notes:

[1] When both field duplicate results are > 5× the RL, the RPD must be < 20%. When at least one result is < 5× the RL, the difference must be < the RL

LCS - Laboratory Control Sample
MS/MSD - Matrix Spike/Matrix Spike Duplicate
RPD - Relative Percent Difference
RER - Relative Error

ATTACHMENT J

INVESTIGATION-SPECIFIC QUALITY CONTROL REQUIREMENTS

GROUNDWATER INVESTIGATION SAMPLING

Table J-1. Sample Containers, Mass, Preservation, and Holding Time Requirements

Matrix	**Parameter(s)**	**Container Type**	**Recommended Sample Mass/Volume**	**Preservation[1]**	**Holding Time**
Groundwater	Metals (Total)	250-mL HDPE	250 mL	HNO_3 to pH < 2 Cool to < 6°C	180 days
	Mercury (Total)				28 days
	Metals (Dissolved)	250-mL HDPE	250 mL	HNO_3 to pH < 2 after filtration Cool to < 6°C	180 days
	Mercury (Dissolved)				28 days
	Anions (Chloride, Fluoride, and Sulfate)	250-mL HDPE	250 mL	Cool to < 6°C	28 days
	Radiological Parameters	3× 1-L HDPE	3000 mL	HNO_3 to pH < 2	180 days
	Total Dissolved Solids (TDS)	250-mL HDPE	100 mL	Cool to < 6°C	7 days
	Alkalinity (Total, Carbonate, and Bicarbonate)	250 mL HDPE	50-mL	Cool to < 6°C	14 days
	pH (field measurement)	NA	NA	NA	15 minutes

Notes:

HDPE - High Density Polyethylene
mL - milliliters
L - liters
NA - Not applicable.

[1] Filtered samples requiring chemical preservation will be preserved after field filtration.

Table J-2: Analytes, Methods, and Reporting Limits – Groundwater Samples

Parameter	CAS No.	Method	Reporting Limit	Units
Chloride	7647-14-5	EPA 300.0/ SW-846 9056	1.00	mg/L
Fluoride	16984-48-8	EPA 300.0/ SW-846 9056	0.10	mg/L
Sulfate	7757-82-6	EPA 300.0/ SW-846 9056	1.00	mg/L
Total Dissolved Solids	TDS	SM2540C	10.0	mg/L
pH	pH	SW-846 Method 9040C	0.100	pH units
Antimony (Total and Dissolved)	7440-36-0	SW-846 6020A	2.00	μg/L
Arsenic (Total and Dissolved)	7440-38-2	SW-846 6020A	1.00	μg/L
Barium (Total and Dissolved)	7440-39-3	SW-846 6020A	10.0	μg/L
Beryllium (Total and Dissolved)	7440-41-7	SW-846 6020A	1.00	μg/L
Boron (Total and Dissolved)	7440-42-8	SW-846 6020A	80	μg/L
Cadmium (Total and Dissolved)	7440-43-9	SW-846 6020A	1.00	μg/L
Calcium (Total and Dissolved)	7440-70-2	SW-846 6020A	500	μg/L
Chromium (Total and Dissolved)	16065-83-1	SW-846 6020A	2.00	μg/L
Cobalt (Total and Dissolved)	7440-48-4	SW-846 6020A	0.500	μg/L
Copper (Total and Dissolved)	7440-50-8	SW-846 6020A	2.00	μg/L
Lead (Total and Dissolved)	7439-92-1	SW-846 6020A	1.00	μg/L
Lithium (Total and Dissolved)	7439-93-2	SW-846 6020A	5.00	μg/L
Magnesium (Total and Dissolved)	7439-95-4	SW-846 6020A	500	μg/L
Mercury (Total and Dissolved)	7487-94-7	SW-846 7470A	0.200	μg/L
Molybdenum (Total and Dissolved)	7439-98-7	SW-846 6020A	5.00	μg/L
Nickel (Total and Dissolved)	7440-02-0	SW-846 6020A	1.00	μg/L
Potassium (Total and Dissolved)	7440-09-7	SW-846 6020A	500	μg/L
Selenium (Total and Dissolved)	7782-49-2	SW-846 6020A	5.00	μg/L

Parameter	CAS No.	Method	Reporting Limit	Units
Silver (Total and Dissolved)	7440-22-4	SW-846 6020A	1.00	µg/L
Sodium (Total and Dissolved)	7440-23-5	SW-846 6020A	500	µg/L
Thallium (Total and Dissolved)	7440-28-0	SW-846 6020A	1.00	µg/L
Vanadium (Total and Dissolved)	7440-62-2	SW-846 6020A	1.00	µg/L
Zinc (Total and Dissolved)	7440-66-6	SW-846 6020A	5.00	µg/L
Radium-226	13982-63-3	EPA 903.0	1	pCi/L
Radium-228	15262-20-1	EPA 904.0	1	pCi/L
Radium-226+228	RA226/228	CALC	1	pCi/L
Alkalinity, Total	ALK	SM2320B	5.0	mg/L
Alkalinity, Carbonate	CARB	SM2320B	5.0	mg/L
Alkalinity, Bicarbonate	BICARB	SM2320B	5.0	mg/L

Notes:

CAS No. - Chemical Abstracts Service registry number
mg/L - milligrams per liter
µg/L - micrograms per liter
pCi/L - picoCuries per liter
CALC - Parameter determined by calculation.

Table J-3: Quantitative QA Objectives – Groundwater

Analyte/ Parameter Group	Method	Surrogate Compound Recoveries/ Chemical Yield (%)	Equipment Rinsate Blank, Field Blank, Method Blank	LCS Accuracy (% R)	MS/MSD Accuracy (% R)	LCS/LCSD Precision (RPD)	MS/MSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Field Duplicate Precision[1]
Metals (Total and Dissolved)	SW-846 6020A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Mercury (Total and Dissolved)	SW-846 7470A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Total Dissolved Solids	SM 2540C	NA	< RL	80-120	NA	20	NA	20	RPD < 20% difference < the RL
Anions (Chloride, Fluoride, Sulfate)	SW-846 9056A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
pH	SW-846 9040C	NA	NA	NA	NA	NA	NA	NA	±0.5 pH units
Alkalinity (Total, Carbonate, and Bicarbonate)	SM2320B	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Radium-226	EPA 903.0	30-110	< RL	80-120	NA	RER < 2	NA	RER < 2	RER < 2
Radium-228	EPA 904.0	30-110	< RL	80-120	NA	RER < 2	NA	RER < 2	RER < 2

Notes:

[1] When both field duplicate results are > 5× the RL, the RPD must be < 20%. When at least one result is < 5× the RL, the difference must be < the RL

LCS/LCSD	-	Laboratory Control Sample/Laboratory Control Sample Duplicate
MS/MSD	-	Matrix Spike/Matrix Spike Duplicate
RPD	-	Relative Percent Difference
RER	-	Relative Error
RL	-	Reporting Limit
%R	-	Percent Recovery

ATTACHMENT K

INVESTIGATION-SPECIFIC QUALITY CONTROL REQUIREMENTS

CCR MATERIAL CHARACTERISTIC SAMPLING

Table K-1. Sample Containers, Mass, Preservation, and Holding Time Requirements

Matrix	Parameter(s)	Container Type	Recommended Sample Mass/Volume	Preservation[1]	Holding Time
CCR Material	Metals	4-oz glass	5 g	Cool to < 6°C	180 days
	Mercury				28 days
	Radiological Parameters	16-oz glass	20 g	NA	180 days
	Anions (Chloride, Fluoride, and Sulfate)	4-oz glass	5 g	Cool to < 6°C	28 days
	pH				NA*
	Total Organic Carbon	8-oz glass	10 g	Cool to <6°C	28 days
	SPLP	16-oz glass	100 g MINIMUM	Cool to <6°C	28 days
SPLP Leachates	Metals	NA	NA; generated in laboratory	Cool to < 6°C	180 days
	Mercury				28 days
	Radiological Parameters			NA	180 days
	Anions (Chloride, Fluoride, and Sulfate)			Cool to < 6°C	28 days
	pH				NA*
Pore Water	Metals (Total)	250-mL HDPE	250 mL	HNO_3 to pH < 2 Cool to < 6°C	180 days
	Mercury (Total)				28 days
	Metals (Dissolved)	250-mL HDPE	250 mL	HNO_3 to pH < 2 after filtration Cool to < 6°C	180 days
	Mercury (Dissolved)				28 days
	Anions (Chloride, Fluoride, and Sulfate)	250-mL HDPE	250 mL	Cool to < 6°C	28 days
	Radiological Parameters	3× 1-L HDPE	3000 mL	HNO_3 to pH < 2	180 days
	Total Dissolved Solids (TDS)[2]	250-mL HDPE	100 mL (unfiltered)	Cool to < 6°C	7 days
	Total Organic Carbon	250-mL amber glass or 2x 40-mL VOA Vial	250 mL or 80 mL	Cool to ≤ 6°C H2SO4 to pH < 2	28 days
	pH (field measurement)	NA	NA	NA	15 minutes

Matrix	Parameter(s)	Container Type	Recommended Sample Mass/Volume	Preservation[1]	Holding Time
Aqueous Equipment Blanks	Metals	250-mL HDPE	250 mL	HNO_3 to pH < 2 Cool to < 6°C	180 days
	Mercury				28 days
	Metals (Dissolved)	250-mL HDPE	250 mL	HNO_3 to pH < 2 after filtration Cool to < 6°C	180 days
	Mercury (Dissolved)				28 days
	Anions (Chloride, Fluoride, and Sulfate)	250-mL HDPE	250 mL	Cool to < 6°C	28 days
	Radiological Parameters	3× 1-L HDPE	3000 mL	HNO_3 to pH < 2	180 days
	Total Dissolved Solids (TDS)[2]	250-mL HDPE	100 mL (unfiltered)	Cool to < 6°C	7 days
	Total Organic Carbon	250-mL amber glass or 2x 40-mL VOA Vial	250 mL or 80 mL	Cool to ≤ 6°C H2SO4 to pH < 2	28 days

Notes:

mL	-	milliliters
L	-	Liters
HDPE	-	High Density Polyethylene
NA	-	Not applicable

[1] Filtered samples requiring chemical preservation will be preserved after field filtration.

[2] TDS will be performed for unfiltered sample volume only.

* Soil samples will be tested in the field using field pH test kits, 10% of the sample locations will have confirmation samples submitted for laboratory analysis of pH and will have paste prepared in the laboratory so that analysis can be completed within the holding time (15 minutes following creation of soil paste).

Table K-2: Analytes, Methods, and Reporting Limits – CCR Material

Parameter	CAS No.	Method	Reporting Limit [1]	Units
Antimony	7440-36-0	SW-846 6020A	0.200	mg/kg
Arsenic	7440-38-2	SW-846 6020A	0.100	mg/kg
Barium	7440-39-3	SW-846 6020A	1.00	mg/kg
Beryllium	7440-41-7	SW-846 6020A	0.100	mg/kg
Boron	7440-42-8	SW-846 6020A	8.0	mg/kg
Cadmium	7440-43-9	SW-846 6020A	0.100	mg/kg
Calcium	7440-70-2	SW-846 6020A	50.0	mg/kg
Chromium	7440-47-3	SW-846 6020A	0.200	mg/kg
Cobalt	7440-48-4	SW-846 6020A	0.0500	mg/kg
Copper	7440-50-8	SW-846 6020A	0.200	mg/kg
Iron	7439-89-6	SW-846 6020A	5.00	mg/kg
Lead	7439-92-1	SW-846 6020A	0.100	mg/kg
Lithium	7439-93-2	SW-846 6020A	0.500	mg/kg
Mercury	7487-94-7	SW-846 7471B	0.0330	mg/kg
Manganese	7439-96-5	SW-846 6020A	0.500	mg/kg
Molybdenum	7439-98-7	SW-846 6020A	0.500	mg/kg
Nickel	7440-02-0	SW-846 6020A	0.100	mg/kg
Selenium	7782-49-2	SW-846 6020A	0.500	mg/kg
Silver	7440-22-4	SW-846 6020A	0.100	mg/kg
Thallium	7440-28-0	SW-846 6020A	0.100	mg/kg
Vanadium	7440-62-2	SW-846 6020A	0.100	mg/kg
Zinc	7440-66-6	SW-846 6020A	0.500	mg/kg
Radium-226	13982-63-3	EPA 901.1	1.00	pCi/g
Radium-228	15262-20-1	EPA 901.1	1.00	pCi/g
Radium-226+228	RA226/228	CALC	1.00	pCi/g
Total Organic Carbon	7440-44-0	Lloyd Kahn or SW-846 9060A	1000	mg/kg
Chloride	16887-00-6	SW-846 9056A Modified	10.0	mg/kg
Fluoride	16984-48-8	SW-846 9056A Modified	1.0	mg/kg
Sulfate	14808-79-8	SW-846 9056A Modified	10.0	mg/kg

Parameter	CAS No.	Method	Reporting Limit [1]	Units
pH	PH	SW-846 9045D Modified (laboratory-based definitive analysis)	0.1	pH units

Notes:

CAS No. - Chemical Abstracts Service registry number
mg/kg - milligrams per kilogram
pCi/g - picoCuries per gram
CALC - Parameter determined by calculation

1 Samples will be reported on a dry-weight basis; sample-specific reporting limits will vary based on sample mass, dilution factors, and percent moisture.

Table K-3: Analytes, Methods, and Reporting Limits – SPLP Leachates

Parameter	CAS No.	Method	Reporting Limit	Units
Chloride	7647-14-5	EPA 300.0/ SW-846 9056	1.00	mg/L
Fluoride	16984-48-8	EPA 300.0/ SW-846 9056	0.10	mg/L
Sulfate	7757-82-6	EPA 300.0/ SW-846 9056	1.00	mg/L
Total Dissolved Solids	TDS	SM2540C	10.0	mg/L
pH	pH	SW-846 Method 9040C	0.0100	pH units
Antimony	7440-36-0	SW-846 6020A	2.00	µg/L
Arsenic	7440-38-2	SW-846 6020A	1.00	µg/L
Barium	7440-39-3	SW-846 6020A	10.0	µg/L
Beryllium	7440-41-7	SW-846 6020A	1.00	µg/L
Boron	7440-42-8	SW-846 6020A	80.0	µg/L
Cadmium	7440-43-9	SW-846 6020A	1.00	µg/L
Calcium	7440-70-2	SW-846 6020A	500	µg/L
Chromium	7440-47-3	SW-846 6020A	2.00	µg/L
Cobalt	7440-48-4	SW-846 6020A	0.500	µg/L
Copper	7440-50-8	SW-846 6020A	2.00	µg/L
Iron	7439-89-6	SW-846 6020A	50.0	µg/L
Lead	7439-92-1	SW-846 6020A	1.00	µg/L
Lithium	7439-93-2	SW-846 6020A	5.00	µg/L
Manganese	7439-96-5	SW-846 6020A	5.00	µg/L
Mercury	7487-94-7	SW-846 7470A	0.200	µg/L
Molybdenum	7439-98-7	SW-846 6020A	5.00	µg/L
Nickel	7440-02-0	SW-846 6020A	10.00	µg/L
Selenium	7782-49-2	SW-846 6020A	5.00	µg/L
Silver	7440-22-4	SW-846 6020A	1.00	µg/L

Parameter	CAS No.	Method	Reporting Limit	Units
Thallium	7440-28-0	SW-846 6020A	1.00	µg/L
Vanadium	7440-62-2	SW-846 6020A	1.00	µg/L
Zinc	7440-66-6	SW-846 6020A	5.00	µg/L
Radium-226	13982-63-3	EPA 903.0	1	pCi/L
Radium-228	15262-20-1	EPA 904.0	1	pCi/L
Radium-226+228	RA226/228	CALC	1	pCi/L
Total Organic Carbon	7440-44-0	SM 5310C	1.00	mg/L

Notes:

CAS No. - Chemical Abstracts Service registry number
mg/L - milligrams per liter
µg/L - micrograms per liter
pCi/L - picoCuries per liter
CALC - Parameter determined by calculation.

Table K-4: Analytes, Methods, and Reporting Limits – Pore Water Samples

Parameter	**CAS No.**	**Method**	**Reporting Limit**	**Units**
Chloride	7647-14-5	EPA 300.0/ SW-846 9056	1.00	mg/L
Fluoride	16984-48-8	EPA 300.0/ SW-846 9056	0.10	mg/L
Sulfate	7757-82-6	EPA 300.0/ SW-846 9056	1.00	mg/L
Total Dissolved Solids	TDS	SM2540C	10.0	mg/L
pH	pH	SW-846 Method 9040C	0.05	pH units
Antimony (Total and Dissolved)	7440-36-0	SW-846 6020A	2.00	µg/L
Arsenic (Total and Dissolved)	7440-38-2	SW-846 6020A	1.00	µg/L
Barium (Total and Dissolved)	7440-39-3	SW-846 6020A	10.0	µg/L
Beryllium (Total and Dissolved)	7440-41-7	SW-846 6020A	1.00	µg/L
Boron (Total and Dissolved)	7440-42-8	SW-846 6020A	80.0	µg/L
Cadmium (Total and Dissolved)	7440-43-9	SW-846 6020A	1.00	µg/L
Calcium (Total and Dissolved)	7440-70-2	SW-846 6020A	500	µg/L
Chromium (Total and Dissolved)	7440-47-3	SW-846 6020A	2.00	µg/L
Cobalt (Total and Dissolved)	7440-48-4	SW-846 6020A	0.500	µg/L
Copper (Total and Dissolved)	7440-50-8	SW-846 6020A	2.00	µg/L
Iron (Total and Dissolved)	7439-89-6	SW-846 6020A	50.0	µg/L

Parameter	CAS No.	Method	Reporting Limit	Units
Lead (Total and Dissolved)	7439-92-1	SW-846 6020A	1.00	µg/L
Lithium (Total and Dissolved)	7439-93-2	SW-846 6020A	5.00	µg/L
Manganese (Total and Dissolved)	7439-96-5	SW-846 6020A	5.00	µg/L
Mercury (Total and Dissolved)	7487-94-7	SW-846 7470A	0.200	µg/L
Molybdenum (Total and Dissolved)	7439-98-7	SW-846 6020A	5.00	µg/L
Nickel (Total and Dissolved)	7440-02-0	SW-846 6020A	10.00	µg/L
Selenium (Total and Dissolved)	7782-49-2	SW-846 6020A	5.00	µg/L
Silver (Total and Dissolved)	7440-22-4	SW-846 6020A	1.00	µg/L
Thallium (Total and Dissolved)	7440-28-0	SW-846 6020A	1.00	µg/L
Vanadium (Total and Dissolved)	7440-62-2	SW-846 6020A	1.00	µg/L
Zinc (Total and Dissolved)	7440-66-6	SW-846 6020A	5.00	µg/L
Radium-226	13982-63-3	EPA 903.0	1	pCi/L
Radium-228	15262-20-1	EPA 904.0	1	pCi/L
Radium-226+228	RA226/228	CALC	1	pCi/L
Total Organic Carbon	7440-44-0	SM 5310C	1.00	mg/L

Notes:

CAS No.	-	Chemical Abstracts Service registry number
mg/L	-	milligrams per liter
µg/L	-	micrograms per liter
pCi/L	-	picoCuries per liter
CALC	-	Parameter determined by calculation.

Table K-5: Quantitative QA Objectives – CCR Material

Analyte/ Parameter Group	**Method**	**Equipment Rinsate Blank, Field Blank, Method Blank**	**LCS Accuracy (% Recovery)**	**MS/MSD Accuracy (% Recovery)**	**LCS/LCSD Precision (RPD)**	**MS/MSD Precision (RPD)**	**Laboratory Duplicate Precision (RPD)**	**Field Duplicate Precision[1]**
Metals	SW-846 6020A	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Mercury	SW-846 7471B	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Radium-226	EPA 901.1	< RL	75-125	NA	RER<2	NA	RER<2	RER<2
Radium-228	EPA 901.1	< RL	75-125	NA	RER<2	NA	RER<2	RER<2
Total Organic Carbon	Lloyd Kahn or SW-846 9060A	< RL	80-120	75-125	35	35	20	RPD < 35% difference < 2× the RL
pH	SW-846 9045D Modified	pH 6-8 for laboratory-supplied deionized water	NA	NA	NA	NA	±0.2 pH units	±0.5 pH units

Notes:

[1] When both field duplicate results are > 5× the RL, the RPD must be < 20%. When at least one result is < 5× the RL, the difference must be < the RL

LCS - Laboratory Control Sample
MS/MSD - Matrix Spike/Matrix Spike Duplicate
RPD - Relative Percent Difference
RER - Relative Error

Table K-6: Quantitative QA Objectives – SPLP Leachates

Analyte/ Parameter Group	Method	Surrogate Compound Recoveries/ Chemical Yield (%)	Equipment Rinsate Blank, Field Blank, Method Blank	LCS Accuracy (% R)	MS/MSD Accuracy (% R)	LCS/LCSD Precision (RPD)	MS/MSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Field Duplicate Precision[1]
Metals	SW-846 6020A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Mercury	SW-846 7470A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Total Dissolved Solids	SM 2540C	NA	< RL	80-120	NA	20	NA	20	RPD < 20% difference < the RL
Anions (Chloride, Fluoride, Sulfate)	SW-846 9056A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Total Organic Carbon	SM 5310C	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
pH	SW-846 Method 9040C	NA	NA	NA	NA	NA	NA	NA	±0.5 pH units
Radium-226	EPA 903.0	30-110	< RL	80-120	NA	RER < 2	NA	RER < 2	RER < 2
Radium-228	EPA 904.0	30-110	< RL	80-120	NA	RER < 2	NA	RER < 2	RER < 2

Notes:

[1] When both field duplicate results are > 5× the RL, the RPD must be < 20%. When at least one result is < 5× the RL, the difference must be < the RL

LCS	-	Laboratory Control Sample
LCSD	-	Laboratory Control Sample Duplicate
MS/MSD	-	Matrix Spike/Matrix Spike Duplicate
NA	-	Not Applicable
RPD	-	Relative Percent Difference
RER	-	Relative Error
RL	-	Reporting Limit
%R	-	Percent Recovery

Table K-7: Quantitative QA Objectives – Pore Water

Analyte/ Parameter Group	Method	Surrogate Compound Recoveries/ Chemical Yield (%)	Equipment Rinsate Blank, Field Blank, Method Blank	LCS Accuracy (% R)	MS/MSD Accuracy (% R)	LCS/LCSD Precision (RPD)	MS/MSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Field Duplicate Precision[1]
Metals (Total and Dissolved)	SW-846 6020A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Mercury (Total and Dissolved)	SW-846 7470A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Total Dissolved Solids	SM 2540C	NA	< RL	80-120	NA	20	NA	20	RPD < 20% difference < the RL
Anions (Chloride, Fluoride, Sulfate)	SW-846 9056A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Total Organic Carbon	SM 5310C	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
pH	SW-846 Method 9040C	NA	NA	NA	NA	NA	NA	NA	±0.5 pH units
Radium-226	EPA 903.0	30-110	< RL	80-120	NA	RER < 2	NA	RER < 2	RER < 2
Radium-228	EPA 904.0	30-110	< RL	80-120	NA	RER < 2	NA	RER < 2	RER < 2

Notes:

[1] When both field duplicate results are > 5× the RL, the RPD must be < 20%. When at least one result is < 5× the RL, the difference must be < the RL

LCS	-	Laboratory Control Sample
LCSD	-	Laboratory Control Sample Duplicate
MS/MSD	-	Matrix Spike/Matrix Spike Duplicate
NA	-	Not Applicable
RPD	-	Relative Percent Difference
RER	-	Relative Error
RL	-	Reporting Limit
%R	-	Percent Recovery

APPENDIX D
DATA MANAGEMENT PLAN

TVA

Tennessee Valley Authority, 1101 Market Street, BR 4A, Chattanooga, Tennessee 37402-2801

March 8, 2018

Mr. Chuck Head
Assistant Commissioner
Tennessee Department of Environment
and Conservation (TDEC)
Tennessee Tower William R. Snodgrass Building
312 Rosa L Parks Avenue
Nashville, Tennessee 37243-1548

Dear Mr. Head:

TENNESSEE VALLEY AUTHORITY (TVA) – DATA MANAGEMENT PLAN (DMP) – COMMISSIONER'S ORDER NUMBER OGC15-0177

Enclosed is the DMP for the above mentioned order. This DMP Revision 1 responds to comments provided by TDEC in an email dated February 7, 2018.

If you have questions regarding this information, please contact Bryan Wells at (423) 751-7393 or by email at wbwells@tva.gov. You may also contact me at (423) 751-3304 or by email at sstidwell@tva.gov.

Sincerely,

M. Susan Smelley

M. Susan Smelley
Director
Environmental Compliance & Operations

Enclosure

cc (w/o Enclosure):

Ms. Angela Adams
CCR Environmental Consultant
TDEC Division of Water Resources
761 Emory Valley Road
Oak Ridge, Tennessee 37830

Mr. Robert Burnette, P.E.
Tennessee Department of Environment
and Conservation
1301 Riverfront Parkway, Suite 206
Chattanooga, Tennessee 37402

Mr. James Clark
Chief Geologist
TDEC Columbia Field Office
1421 Hampshire Road
Columbia, Tennessee 38401

Mr. Britton Dotson
Environmental Fellow
Tennessee Department of Environment
and Conservation
William R. Snodgrass TN Tower
312 Rosa L Parks Avenue, 11th Floor
Nashville, Tennessee 37243-1548

Ms. Jenny Howard
General Council
Tennessee Department of Environment
and Conservation
William R. Snodgrass TN Tower
312 Rosa L Parks Avenue, 2nd Floor
Nashville, Tennessee 37243-1548

Ms. Shari Meghreblian, Ph.D.
Deputy Commissioner, Bureau of Environment
Tennessee Department of Environment
and Conservation
William R. Snodgrass TN Tower
312 Rosa L Parks Avenue, 2nd Floor
Nashville, Tennessee 37243-1548

Mr. Robert S. Wilkinson
Coal Combustion Residual Technical Manager
Tennessee Department of Environment
and Conservation
William R. Snodgrass TN Tower
312 Rosa L Parks Avenue
Nashville, Tennessee 37243-1548

WBW:SMF
cc (Electronic Distribution):
J. A. Birdwell, WT 6A-K
B. E. Brickhouse, BR 4A-C
J. L. Brundige, SP 6B-C
T. E. Cheek, BR 4A-C
S. M. Connors, LP 3K-C
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B. S. Fowler, BR 4A-C
J. J. Hoagland, WT 9D-K
J. C. Kammeyer, LP 5D-C
T. E. Korth, BR 4A-C
K. A. Love, SP 6B-C
J. R. Quinn, III, LP 5G-C
T. S. Rudder, BR 4A-C
M. S. Turnbow, LP 5G-C
W. B. Wells, III, BR 4A-C
J. B. Woodward, BR4D-C
ECM, ENVrecords

Setting the Standards for Innovative Environmental Solutions

TENNESSEE VALLEY AUTHORITY

MULTI-SITE ORDER ENVIRONMENTAL INVESTIGATIONS

DATA MANAGEMENT PLAN

Revision 1

March 2018

Prepared by

ENVIRONMENTAL STANDARDS, INC.
1140 Valley Forge Road
P.O. Box 810
Valley Forge, PA 19482-0810

Prepared for

TENNESSEE VALLEY AUTHORITY
1101 Market Street
Chattanooga, TN 34702-2801

Revision Log

MULTI-SITE ORDER ENVIRONMENTAL INVESTIGATIONS DATA MANAGEMENT PLAN (TVA EI DMP)

Revision and Date	Section Reference	Revision Description
Revision 0, November 2017	n/a	Issued for TDEC Review
Revision 1, March 2018	2.1.2	Updated responsibilities to align with QA Program definitions.
Revision 1, March 2018	2.1.2.1	Updated responsibilities to align with QA Program definitions.

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APPENDICES

1.0 INTRODUCTION

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner’s Order No. OGC15-0177 (Multi-Site Order), to the Tennessee Valley Authority (TVA), setting forth a process for the investigation, assessment, and remediation of unacceptable risks at TVA’s coal ash disposal sites in Tennessee. In response to the Multi-Site Order, TVA is initiating Environmental Investigations (EIs) at each of the TVA facilities in Tennessee addressed in the Multi-Site Order. The primary goal of this TVA EI Data Management Plan (TVA EI DMP) is to address the logistics and technical challenges of managing analytical data generated by environmental laboratories and Field Sampling Personnel in support of activities intended to address the requirements set forth in the Multi-Site Order. This TVA EI DMP is intended to provide a basis for supporting a full technical data management business cycle from pre-planning of sampling events to reporting and analysis with a particular emphasis on completeness, data usability, and most importantly, defensibility of the analytical data.

Typical environmental Quality Assurance Project Plans (QAPPs), Sampling and Analysis Plans (SAPs), and Data Management Plans (DMPs) predominately focus on analytical chemistry data from the environmental investigations of various media (air/vapors, soil, sediment, surface water, and groundwater) and receptors (ecological and human). Due to the comprehensive nature of the Coal Combustion Residuals (CCR) Rule and the Multi-Site Order, the over-arching disciplines requiring data management are:

- Civil/Mapping;
- Environmental/Surface Water;
- Geotechnical; and
- Hydrogeology.

The work products of these disciplines will produce a wide-range of data and deliverables needing management. In addition, the Multi-Site Order requires a timely distribution of information to TDEC as well as public involvement.

TVA has decided that the best way to support the wide-array of data management needs related to the Multi-Site Order, is to build a SharePoint-based knowledge management portal (KMP) where data and deliverables will be housed and accessible. The KMP will integrate the EarthSoft® EQuIS™ (EQuIS) database for analytical chemistry and field parameter data, geographic information system (GIS) database for geospatial data, and various other databases for historical and current deliverables. The KMP will thus serve as the central access point for the Environmental Investigation Plans (EIPs), the EI data, and other data necessary for the Corrective Action/Risk Assessment (CARA).

To support the TVA Multi-Site Order response objectives, a Quality Assurance (QA) program has been implemented to verify that environmental data generated for use in decision-making is of high quality and is legally defensible. The QA program is documented in the QAPPs developed as part of each site-specific EIP. The sampling design and execution for monitoring activities associated with each EI are described in the site-specific EIP and investigation-specific SAPs.

Environmental data have been and will continue to be used for purposes such as, but not limited to, operational decisions, ecological and human health risk assessments; delineation of the extent of contamination and ash transport; and to demonstrate the achievement of project objectives. Accordingly, it is imperative that the data are subjected to a formal data management process.

On behalf of TVA, Environmental Standards, an independent QA firm, has prepared this TVA EI DMP. The requirements of the TVA EI DMP are applicable to TVA environmental personnel, TVA information technologies personnel, support staff, contractors, and analytical laboratories.

1.1 Historical and Recent Data

Environmental data associated with surface water, groundwater, sediment, biological, CCR, and soil samples have been collected by TVA during previous operational periods. For the purpose of this TVA EI DMP, “historical” data on this project is defined as analytical data collected by TVA or its contractors prior to the institution of this data management plan. Historical analytical data sets intended for use under the TVA Multi-Site Order response will be included in TVA's project database as requested by TVA. Historical data migration efforts will be detailed in one or more separate Data Migration Plans, at such time that the scope of the migration has been developed. TVA will conduct environmental sampling under the EIPs developed in response to the Multi-Site Order, resulting in the generation of a significant amount of environmental analytical and related field data; these data are referred to as “Recent” data in this TVA EI DMP.

1.2 Existing Project Database General Structure

TVA and its designated contractors will use an existing EQuIS database (TVA EI database) to store recent data, as well as any historical data requiring migration. The TVA EI database will be separated into distinct facilities to store data associated with each site-specific EIP. The database will use common valid values, data qualifier definitions, and management processes across all TVA facilities. Reference value files (RVF) containing lists of valid values used in the database will be provided to analytical laboratories, Field Team Leaders, and other appropriate parties, as needed.

1.3 Objectives

The major objectives for the TVA Multi-Site Order Data Management Program are to:

- Maintain data control, consistency, reliability, and reproducibility throughout the life of the EIs;
- Establish the framework for consistent documentation of the quality and validity of field and laboratory data compiled during investigations;
- Describe in detail the data management procedures for EI-related data;
- Include procedures and timelines for sharing data with stakeholders as well as procedures for providing both electronic and hardcopies to specified recipients of each type of data; and
- Enable the use of EI data in a consistent and easily shared format among appropriate parties.

2.0 DATA MANAGEMENT TEAM

This section describes the key roles and responsibilities associated with the Data Management Program and processes for managing data.

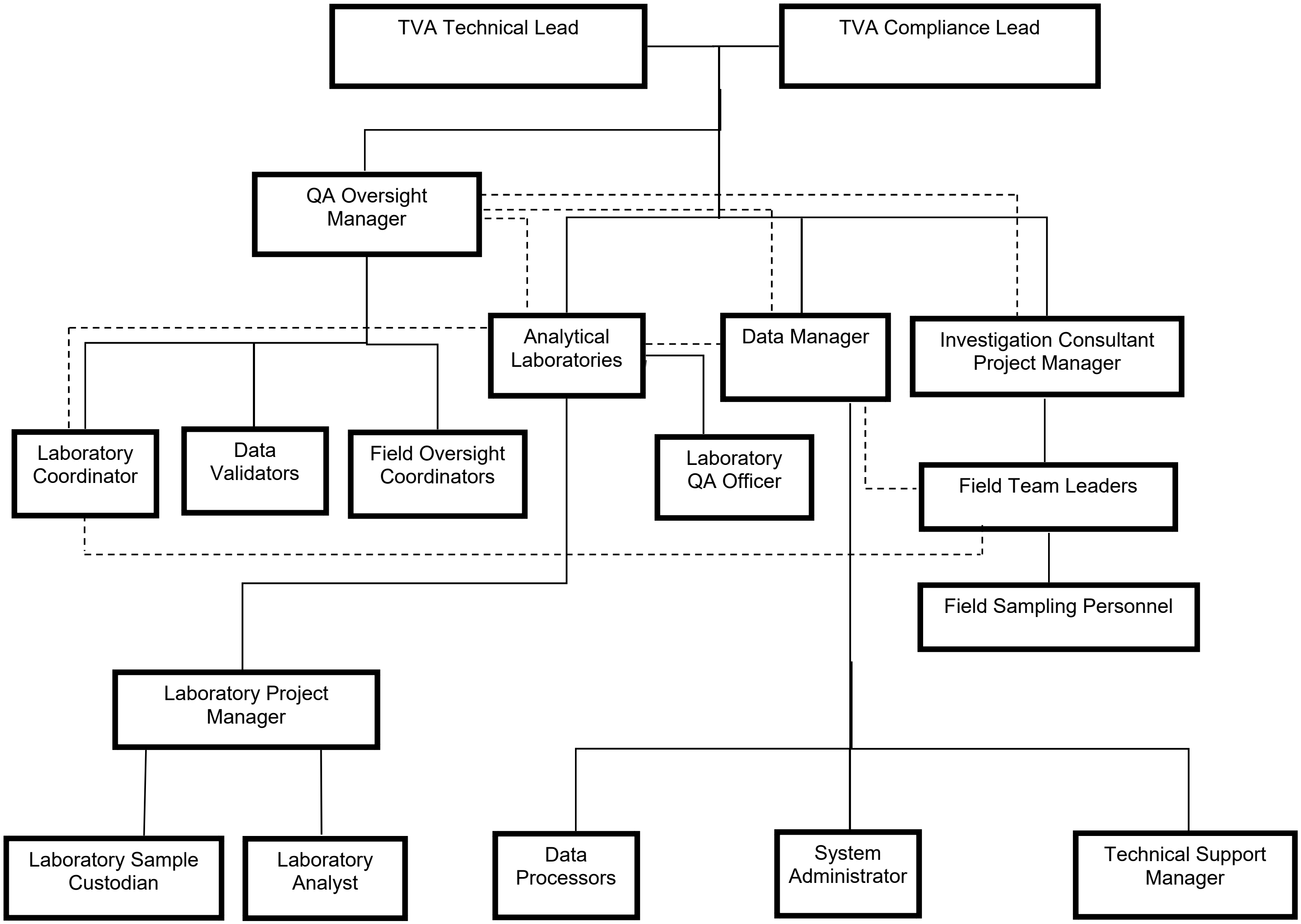
Users of the EQuIS Quality and Data Management System (EQDMS) primarily consist of technical and project staff that are assumed to have a general understanding of the environmental data and the EIs being conducted at each TVA facility. Some users are also required to have an advanced understanding of the EQDMS and relational database architecture.

The data management team consists of the following positions.

- Data Manager
- Data Processors
- Technical Support Manager
- System Administrator
- Data Analysts and Other Data Users
- Field Team Leaders
- Field Sampling Personnel
- Laboratory Coordinator

The organization chart for the TVA EI Data Management Program is presented in Figure 2-1. The Data Management Team is a component of the overall QA Program for each plant-specific EI. The roles and responsibilities for the TVA Technical Lead, TVA Compliance Lead, Investigation Consultant Project Manager and subordinate roles, Analytical Laboratory and subordinate roles, and QA Oversight Manager and subordinate roles are detailed in the QAPP developed for each of the plant-specific EIs. The relationship between the TVA Technical Lead and the TVA Compliance Lead is reflected in Part VII.F of the Multi-Site Order. Descriptions of data management personnel roles and responsibilities, and additional responsibilities of project personnel specific to the data management program, are provided in the sections below.

Figure 2-1. Organization Chart and Lines of Communication for TVA Multi-Site Order EI Data Management



2.1 Data Managers

Data Managers are responsible for managing the project EQuIS database, which includes analytical data from the project laboratories, field data from the investigation consultant, and historical data of known quality that is intended for use under the TVA Multi-Site Order. The Data Manager acts as the single point of contact for TVA for data management and for data-related issues. Data Managers are responsible for ensuring compliance with the plant-specific EI QAPP and the TVA EI DMP. Data Managers make certain that adequate Data Management Team members are available and properly trained, and that adequate software and hardware are available. Data Managers perform periodic audits on components of the data management system including access and security controls, system documentation, and data backup procedures. Data Managers have an intimate knowledge of the data management process, relational database concepts, and the architecture of the EQDMS.

Data Managers are typically the most knowledgeable and active user of the EQDMS and performs or directs the majority of the data updates or changes. A Data Manager or designee receives electronic data deliverables (EDDs) directly from the project laboratories after sample analysis and formats the deliverables such that they can be used during the validation/verification process. Field data is collected and submitted to a Data Manager from the Field Team Leaders utilizing field EDDs and is loaded and managed in the project database. Data Managers work directly with the Investigation Consultant Project Managers and field staff members to perform checks that the data are complete and accurate, as well as with data analysts, and other data users to provide queries, tables, graphs, and data exports. Data Managers are responsible for updating and implementing the TVA EI DMP and other quality documentation pertaining to data management.

2.1.1 Data Processors

Data Processors log in and load data delivered to the system. Data Processors are responsible for first-level activities and report any exceptions encountered in a standard process to the Data Manager for review and action. Data Processors are responsible for deliverable tracking, standard data loading, and providing standard EQDMS reports. Data Processors update or modify data in the database at the direction of the Data Manager in support of QA activities.

2.1.2 Technical Support Manager

The Technical Support Manager is responsible for any programming or database schema change required to support the operation of the EQDMS for this project. The Technical Support Manager is typically involved in the planning and implementation phases of the project and, once the system is operational, acts primarily as a technical advisor to the project team for any contemplated change in functionality. The Technical Support Manager sets user authentication and controls access to the data, maintains data tables necessary for the EQDMS to run, and generally manages EQDMS usage. The Technical Support Manager has a strong background in information systems and relational database hardware, software design and programming, detailed understanding of the EQDMS architecture, and familiarity with the data management business process.

2.1.3 System Administrator

The System Administrator will be responsible for the operation and maintenance of the EQDMS. The System Administrator will back up the data and confirm that the system is available for users. The System Administrator has a strong background in network support, information systems, and hardware and software maintenance.

2.2 Field Team Leaders

The Field Team Leaders are the primary contacts in the field and are responsible for field activities, as listed below.

- Provide coordination and management of field personnel and subcontractors.
- Provide coordination of field sampling and calibration activities.
- Submit analytical requests to the Laboratory Coordinator.
- Verify field-sampling personnel are familiar with field procedures and that these procedures are followed to achieve the data objectives.
- Review field logbooks and field data sheets for completeness, consistency, and accuracy.
- Conduct QA review of field data and coordinate submittal of field data to the Data Manager

Field Team Leaders are responsible for implementing the investigation-specific SAPs that describe data collection requirements and activities to be conducted. Field Team Leaders are responsible for overall coordination between field activities and the data management process. Field Team Leaders understand the data management process and interactions between field and data management staff.

2.2.1 Field Sampling Personnel

Field Sampling Personnel are responsible for the performance of field activities as required by the investigation-specific SAPs and associated field TIs. Field Sampling Personnel document compliance with project requirements by recording field activities and observations in a field logbook at the time of the activity or observation. In addition, Field Sampling Personnel are responsible for collecting samples, submitting them to laboratories, and maintaining COC Records.

2.3 Laboratory Coordinator

The Laboratory Coordinator serves as a liaison between Field Team Leaders and the analytical laboratories. The Laboratory Coordinator’s responsibilities include:

- Review analytical requests to verify consistency with project SAPs.
- Submit analytical requests to the Laboratory Project Manager.
- Schedule sample submission and transportation (as needed).
- Review and approve laboratory bottleware orders.

- Review Chain of Custody (COC) Records submitted to the laboratories and sample receipt documentation provided by the laboratories.
- Serve as the point of contact for questions and issues arising during laboratory analysis.

2.4 Data Analysts and Other Data Users

Data analysts and other data users may be any project team members who require access to analytical data for reporting, interpretation, or decision-making. Data analysts and other data users use the EQDMS to evaluate data that have completed the verification/validation process. Analysts and Users can run standard reports in EQDMS and do not update or modify data in the database.

3.0 DATA MANAGEMENT PROCESS

Optimal control of data is enforced by rigorous pre-planning of sampling activities. The EQDMS provides the functionality to support the creation of COC forms and bottle labels, auto loading of laboratory-generated analytical chemistry data, automated correctness checking, detailed completeness checking, data verification, support for data validation reporting and editing, and technical data reporting and presentation. This functionality exists so that the stages of data management are efficient and performed as accurately as possible. Appendix A presents workflow diagrams illustrating the overall data management process and the detailed data verification/validation process.

3.1 Planning

The data management process starts with preparation of the investigation-specific SAP. This planning phase gives consideration for appropriate levels of documentation specific to the individual data collection process and details any appropriate field measurements and/or other event-related data. Based on the field-planning document, the Data Manager configures the EQDMS for the investigation to support the data collected on the required COC forms. Configuration of the system may involve defining Method Analyte Groups (MAGs) in the database that include the methods used by laboratories to analyze samples and the analytes to be reported by those methods, as well as setting up standard forms and reports to meet the needs of the project team. The EQDMS supports storage of the information on the COC form, including the laboratory, shipping information, sample identifications (IDs), type and quantity of containers, preservatives, analytical tests, sample date, and sampler. At the time of sample collection, the Field Sampling Personnel fill out the remaining information including the sampler's initials, sample collection date, and time, shipping information and sample IDs. Some deviation from this approach may be acceptable if it is fully documented and approved in investigation-specific SAPs.

3.2 Field Measurements and Sample Collection

The process continues with Field Sampling Personnel collecting environmental samples and field measurements, and documenting field activities. Field documents must be recorded and stored electronically in accordance with project requirements. The EQDMS provides the functionality to create the electronic COCs (eCOCs), or COCs may be manually populated by the Field Sampling Personnel, at the discretion of TVA and its designated contractor(s). The COC form, whether generated as an eCOC or hand-written, will serve as the legal document of sample handling and transfer. The COC form is provided to the Data Project Manager to enter technical data into the EQDMS and could possibly include additional sampling event information, coordinate data and field measurements. The details for the specific data to be collected during sampling or other activities are contained in investigation-specific SAPs and related TIs.

3.3 Sample Tracking

Sample tracking begins when the COC is created. Events tracked in the EQDMS include: sample shipment, laboratory sample receipt, data package receipt, EDD receipt, and any rejection or resubmission dates, as needed.

Data Processors update the sample tracking records in EQDMS upon receiving a deliverable. The laboratory receives and evaluates the samples for proper COC procedures and sample handling. The laboratory assigns unique laboratory sample IDs and a Sample Delivery Group (SDG) number. To confirm that samples were received and that the correct analyses will be performed, the laboratory then provides the Data Processors with a sample receipt confirmation (SRC) that specifies the following.

- Sample receipt quantities and condition of containers (such as broken/leaking, temperature, hold time, custody maintained).
- Sample preparation (such as compositing and filtration) and analyses to be conducted.
- Date that analyses will be completed.
- Laboratory sample IDs and SDG number.

A copy of the SRC is provided to Data Processors who update the database with the sample receipt information and continue to track sample/data reporting progress until all data are delivered and review completed.

3.4 Laboratory Analysis and Reporting

The laboratory personnel analyze the samples as specified on the COC Record and according to the published method and project-specific requirements outlined in the associated plant-specific EI QAPP. Once the samples are analyzed, an electronic copy of the laboratory data package and an EDD are produced and forwarded to an electronic mailbox established specifically for the project. A Data Processor monitors the project mailbox for deliverables received and processes the data for testing against project specifications as described in the following sections.

3.5 Data Loading and Review

Data are assigned status values based on progression through the data loading and review process. There are currently three status levels for data that have been reviewed. These status levels are “VERIFIED”, “FINAL-VERIFIED”, and “VALIDATED”. Data are automatically unclassified and assigned no status upon initial load to the database. After an automated chemistry data verification and second-level review, data are manually assigned a state of “VERIFIED” by a Data Processor. If automated verification is the only level of review required, the Data Processor sets the data to a stage of “FINAL-VERIFIED”. Upon completion of data validation inclusive of senior reviews, data are assigned a status of “VALIDATED” by a Data Processor.

3.5.1 Initial Data Loading

EDDs are received in an electronic mailbox established specifically for the project. EDDs are loaded by a Data Processor and data are automatically unclassified. The first test of the EDD is for correctness against the project specifications. Correctness testing is a review of the EDD format against structural rules. Correctness determines if data are delivered using the correct file layout, data types, and adherence to project specific values. The full list of requirements can be found in the EDD specification in Appendix B. When an error is identified during testing for correctness, an e-mail containing a report of the deficiency is created and reviewed by a Data Manager and sent to the laboratory with the request for resubmission. Typical problems found in this review are missing or incorrect valid values, incorrectly formatted data, duplicate rows, and missing Parent/Child sample relationships.

After successfully passing the correctness testing and subsequent loading to the database, data completeness is checked by comparing the planned sampling data associated with the COC form to the actual sample, analytical method and analyte delivered by the laboratory. When an error is identified during testing for completeness, an e-mail containing a report of the deficiency is created and reviewed by the Data Manager and sent to the laboratory requesting resubmission, with a copy to the QA Oversight Manager.

Once data have passed correctness and completeness processing, the data are ready for automated data verification processing.

3.5.2 VERIFIED Status

Automated electronic data verification is only performed on data that has been deemed to be correct and complete. A verification report is produced for review by the Data Validator. Data verification activities are conducted according to the associated plant-specific QAPP. The criteria used to assess accuracy and precision of the data are detailed in the associated plant-specific QAPP. The data are reviewed from a usability perspective using screening software; the qualification assigned by the screening software are subsequently reviewed by a Data Validator. A Data Processor will make any needed edits identified by the Data Validator. All edits are reviewed by the initial Data Validator, as well as peer reviewed by the QA Oversight Manager. After review and approval of the data verification report and related results by the Data Validator, the data are assigned a status of “VERIFIED” by a Data Processor.

3.5.3 FINAL-VERIFIED Status

Data that are not going to be subjected to data validation are set to a status of “FINAL-VERIFIED” by a Data Processor once the verification process as detailed above is complete.

3.5.4 VALIDATED Status

Validation will occur after automated verification has been completed. The decision to perform data validation on any given data set will be determined based upon the data quality objectives for that data set. Data validation is supported by reporting and edit functionalities in the EQDMS. Data tables are provided to the Data Validator, who will manually annotate those tables with validation edits. A Data Processor will make any needed edits; edited data tables are returned to the initial Data Validator for review and approval. Once all edits have been confirmed, final validation tables will be prepared for inclusion in reports. All edits are reviewed by the initial Data Validator, as well as peer reviewed by the QA Oversight Manager. This stage also reveals and resolves any EDD to hardcopy data discrepancies. After review and approval of the final data validation tables by the QA Oversight Manager, the data are assigned a status of “VALIDATED” by a Data Processor.

The associated plant-specific QAPP and/or the investigation-specific SAPs detail the sample program specific goals for the timeline of activities such as validation.

3.6 EQuIS Reports

Reports are available to users through EQuIS Professional or EQuIS Enterprise. Standard EQuIS reports and a summary of their purposes are detailed in Appendix C.

3.7 Management of Historical Data

As indicated in Section 1.2, there have been prior sampling events at TVA facilities that generated historical data. Managing historical data from these investigations is complicated by the fact that the agencies and contractors performing the investigations used different methods for sampling and analysis. In addition, the historical data may not have complete laboratory reports that allow proper verification/validation of the data. To manage historical data in a manner that addresses the variety of types, sources, and formats, as well as concerns regarding data validation, the following procedures will be implemented.

Electronic data received from other consultants may be migrated to EQDMS. The migration steps include matching up the historical fields with the fields in EQDMS, appending the historical data into the previously determined EQDMS fields, and running error checks on the newly appended data. If questions arise, the previous consultants are contacted for data clarifications. The data migration steps, such as field matching and changes made, are documented for future reference.

If only hardcopy files exist for desired results, these files may be used to perform manual entry of data into EQDMS. Any data requiring manual entry are checked by a second person for correctness of the entry.

Depending on the source and reliability of the historical data, data will be marked reportable or non-reportable. Reportable data are data deemed appropriate for quantitative use. Non-reportable data are deemed to be of unknown quality and may be used for qualitative purposes only. Historical data will be reviewed and assessed for potential quantitative or qualitative use following the procedures described in Section 14.0 of the associated plant-specific QAPP. Data are loaded into the database with an unclassified status, and updated to a status of “FINAL-NOT QCd” or another relevant status based upon the data quality and review.

Historical and legacy data that are determined to be intended for quantitative use will be subjected to a formal critical review process. Historical data will minimally be subjected to a reasonability review to identify potentially suspect data, apparent anomalies, or data that are not representative of current site conditions. Additional evaluation and/or validation may be conducted following the reasonability review; the level of review and validation conducted will be dependent on the data type, availability of supporting documentation, and criticality of the dataset for completing project objectives. In the event that historical or legacy data cited in the EIP cannot be substantiated, the data may not be suitable to support certain aspects of the investigation, and new data may be collected to supplement the historical/legacy data. After undergoing the review process described in the plant-specific QAPP, the data are marked appropriately within the EQDMS (*i.e.*, data deemed appropriate for quantitative use are marked as reportable and data deemed of unknown quality and or appropriate for qualitative use only are marked as non-reportable. Non-reportable results remain in EQDMS and can be queried, but are not included in standard reports. Custom reports can be created for non-reportable historical data, but users are cautioned about the undetermined reliability of the data.

3.8 Documenting and Communicating Changes to Reported Data

3.8.1 Communication of Issue

Errors in reported data are typically found by the data user or an individual working as part of the data management team. It is the responsibility of the individual to correctly identify and report an error in data stored in the EQDMS. An individual on the project team (a stakeholder) who identifies a need to change data must send an e-mail to a Data Manager describing the requested data change and providing supporting documentation. Any individual requesting a changed to data in the EQDMS is referred to as the Data Change Requestor in the subsequent sections. The Data Change Request Workflow Diagram presented in Appendix D illustrates the process for managing changes to reported data.

3.8.2 Completion of the Data Change Request Form

A Data Manager is responsible for reviewing the request and initiating a Data Change Request Form. An example Data Change Request Form is presented in Appendix E. Completion of the Data Change Request Form is essential to ensuring that the appropriate procedures and approvals are in place prior to initiating any changes and/or updates to the data reported in the EQDMS. The form contains essential information pertaining to the request itself, the origin of the request, the solution applied, contact information and signatures upon the approval and completion of the task. The Data Change Request Form shall be completed by the Data Manager with information from the Data Change Requestor. Additionally, the Data Change Request Form requires signatures by the QA Oversight Manager, the Data Manager, and the Data Change Requestor.

The Data Manager shall complete the Data Change Request Form prior to the approval and initiation of any changes and/or updates to the data already loaded to the EQDMS. The following sections of the Data Change Request Form shall be completed in full:

- Date: Date of the request as initiated by the Data Change Requestor
- Proposed Completion Date: Tentative date of completion as identified by the Data Requestor

- Name: Data Change Requestor
- Company: Data Change Requestor’s company
- Phone/E-mail: Contact information of the Data Change Requestor
- Description of Request: A detailed summary outlining the request along with its origin and purpose
- Required Signatures: the printed name, signature and date signed of the:
    - Data Manager
    - QA Oversight Manager
    - Data Change Requestor

3.8.3 Communication and Approval Process for Data Change Request Form

The following steps are performed when communicating and approving the Data Change Request Form.

- The Data Manager complete the Data Change Request Form in its entirety as detailed above. A brief description of the resolution shall be provided in the section for use by the Data Project Manager.
- The Data Manager shall then request the review and confirmation of the Data Change Request Form by the Data Change Requestor.
- Upon approval of the Data Change Request Form, the Data Requestor will sign and date the form.
- The Data Manager will submit the Data Change Request Form to the QA Oversight Manager for review and signature.
- The Data Manager shall coordinate or perform the data change or update as requested. Upon resolution, the Data Manager shall sign and date the form.
- Once the Data Change Request Form is signed by all necessary parties, the Data Manager shall e-mail the approved Data Change Request Form, along with a report or query to confirm appropriate changes, to all stakeholders.
- Completed Data Change Request Forms will be posted on the KMP.

4.0 EQDMS DATA MANAGEMENT SYSTEM

This section provides an overview of the EQDMS and its components. This section also describes the specification for laboratory data submission and valid values.

4.1 EQDMS Overview

The EQDMS is composed of a commercially available environmental data management software suite, EQuIS, and can be supplemented and expanded using purpose-built QA Modules to work with the EQuIS software. The EQDMS has been configured to support project-specific requirements. The EQuIS software suite, which has been in use and continuously improved since 1994, is used on many environmental projects by industrial clients, consultants, and regulatory agencies at the state and federal levels. Functionality is provided on the internet for casual users and on the desktop for power users.

Software modules used on this project are described below.

4.1.1 EQuIS Enterprise Database

Analytical data, field data, and water level measurements are stored and hosted in a Microsoft® SQL database using the EQuIS Enterprise SQL server data schema. EQuIS connects to and accesses data using industry standard methodology. Security of the data is maintained using SQL server roles and assigning users appropriately.

4.1.2 COC Forms

COC forms for this project may be hand-written or generated utilizing an eCOC generator, if desired. The eCOC generator creates a unique COC ID and enables the Field Sampling Personnel to print COC forms. The eCOC is provided to the Data Project Manager to enter technical data into the EQDMS and could possibly include additional sampling event information, coordinate data and field measurements. The data generated from the eCOC are used to test analytical laboratory data for completeness and support status reports. The details for the specific data to be collected during sampling or other activities are detailed in investigation-specific SAPs, and related TIs.

4.1.3 EQuIS Enterprise Electronic Data Processor

The Enterprise electronic data processor (EDP) functionally enables loading of EDDs, testing against project specifications, and reporting the results of the testing to users. The rules and criteria built into the selected EDP Format are used to verify the correctness of EDDs.

4.1.4 Completeness Processor

The Completeness Processor assesses laboratory data within an SDG for the existence of project-specified data such as target analyte lists. Each SDG should represent a set of samples based on a COC form, each sample represents a set of analytical methods, and each analytical method represents a particular list of target analytes. MAGs are used to define required methods, analytes, fractions, and units. Completeness checks performed on data loaded into the EQDMS include:

- Confirming that all samples, analytical methods, and analytes requested on the COC/MAG are provided by the laboratory
- Confirming that no additional samples, analytical methods, or analytes are provided by the laboratory that were not planned
- Confirming that the following fields match identically between the planned and laboratory data:
  - Sample Names
  - Sample Matrix
  - Analytical Method
  - Fraction
  - Chemical Abstract Service (CAS) Registry Number
  - Result Units

4.1.5 Data Verification Module

The Environmental Standards Data Verification Module assesses loaded, correct, and complete data against project-specific QC limits for field and lab blank contamination, holding times, accuracy, precision, and surrogates. This functionality supports the project goals by automating a significant amount of manual effort in the quantitative assessment of analytical data.

4.1.6 EQuIS Enterprise

Enterprise is a web-based portal for visualization and generating pre-defined reports on demand. This function is ideally suited for casual users with a need to access project data in a simplified way and build simple reports. Users may run reports with defined parameters selected and save those settings for future uses as a “Pick Report.” Pick Reports can be scheduled for automated processing based on pre-defined triggers, the arrival of an EDD, or on a schedule such as a day of the week. Output from this reporting function can be a spreadsheet, a PDF, or a complex formatted deliverable such as an Excel® file that auto-formats based on selections.

4.1.7 EQuIS Professional

EQuIS Professional is a desktop application that is designed for more technical users. It has the capability to perform the same reporting functions as seen in Enterprise, but can additionally design, build, and publish Enterprise reports. This application enhances decision support by enabling links to analysis and visualization functions that can create crosstab tables, graphs, and statistical output. EQuIS Professional can also interface with third-party tools such as gINT®, Rockworks®, EVS®, Visual Modflow®, and Excel.

4.2 Electronic Data Deliverable Specification

The EQDMS can import EDDs in a wide variety of formats. The standard EQuIS EQEDD is used for submittal of all recent data by analytical laboratories. Laboratories are required to submit EDDs in accordance with the EQEDD Format provided in Appendix B.

5.0 SYSTEMS MANAGEMENT AND ADMINISTRATION

This section describes how the EQDMS is managed and administrated. Database Administration includes:

- Adding, altering, and deleting users, roles, and privileges; and
- Providing for routine backup of the database.

5.1 Access and Security

The EQDMS uses application-level and database-level security to limit access to system functionality. Users are required to log onto the system in order to gain entry into the application. The Data Management team has defined privileges based on roles while other users, such as data analysts and other data users have read-only privileges to the project data and read/write privileges to their personal reports. User accounts and privileges are maintained by the Technical Support Manager and approved by a Data Manager.

5.2 Data Backup

Automated full backups of the EQDMS are performed daily, and automated incremental backups of transactions are performed every 15 minutes to safeguard that any potential data loss is limited. An incremental daily backup is archived every night and retained for 30 days. A full weekly backup is archived and retained for 2 months. Monthly full backups are archived and retained for 40 years. Backups are written to digital tapes and are stored the next business day in an off-site environmentally controlled storage facility.

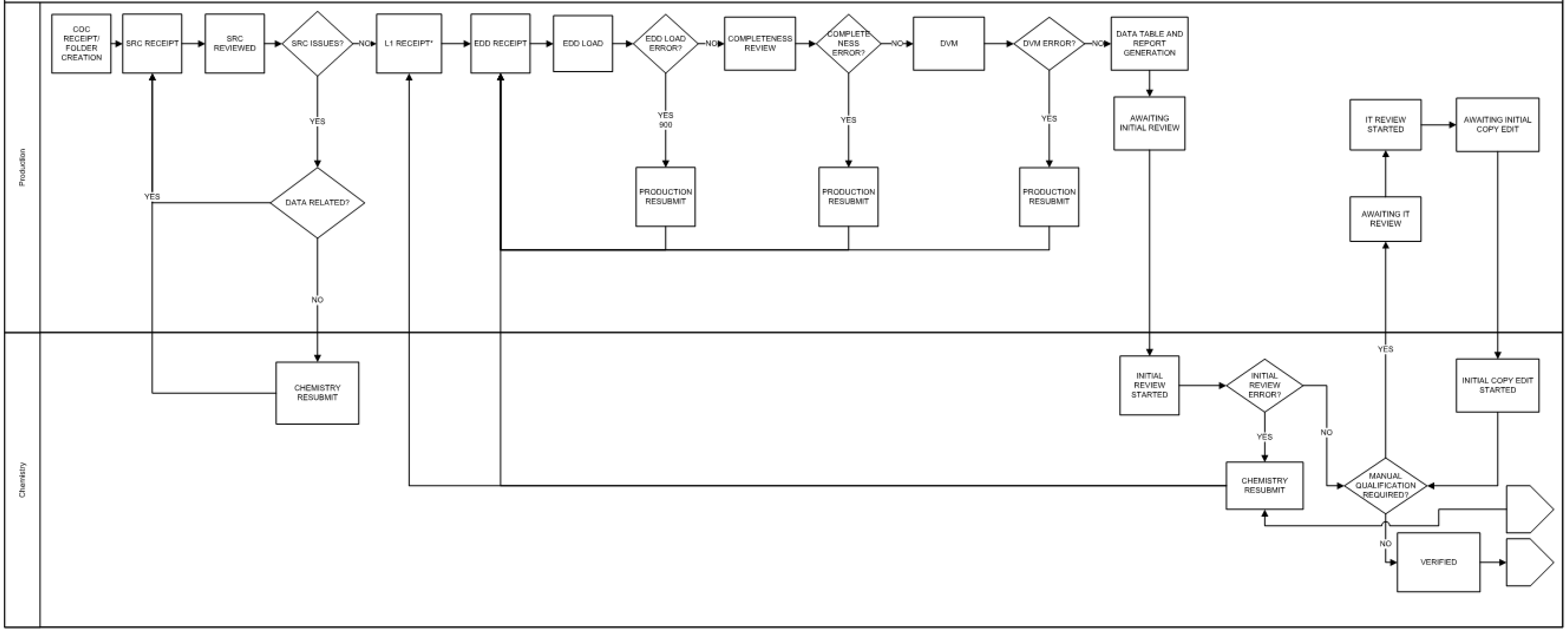
6.0 REFERENCES

- ENV-TI 05.80.02 Sample Labeling and Custody
- ENV-TI 05.80.03 Field Record Keeping
- ENV-TI 05.80.04 Field Sampling Quality Control
- ENV-TI 05.80.06 Handling and Shipping of Samples

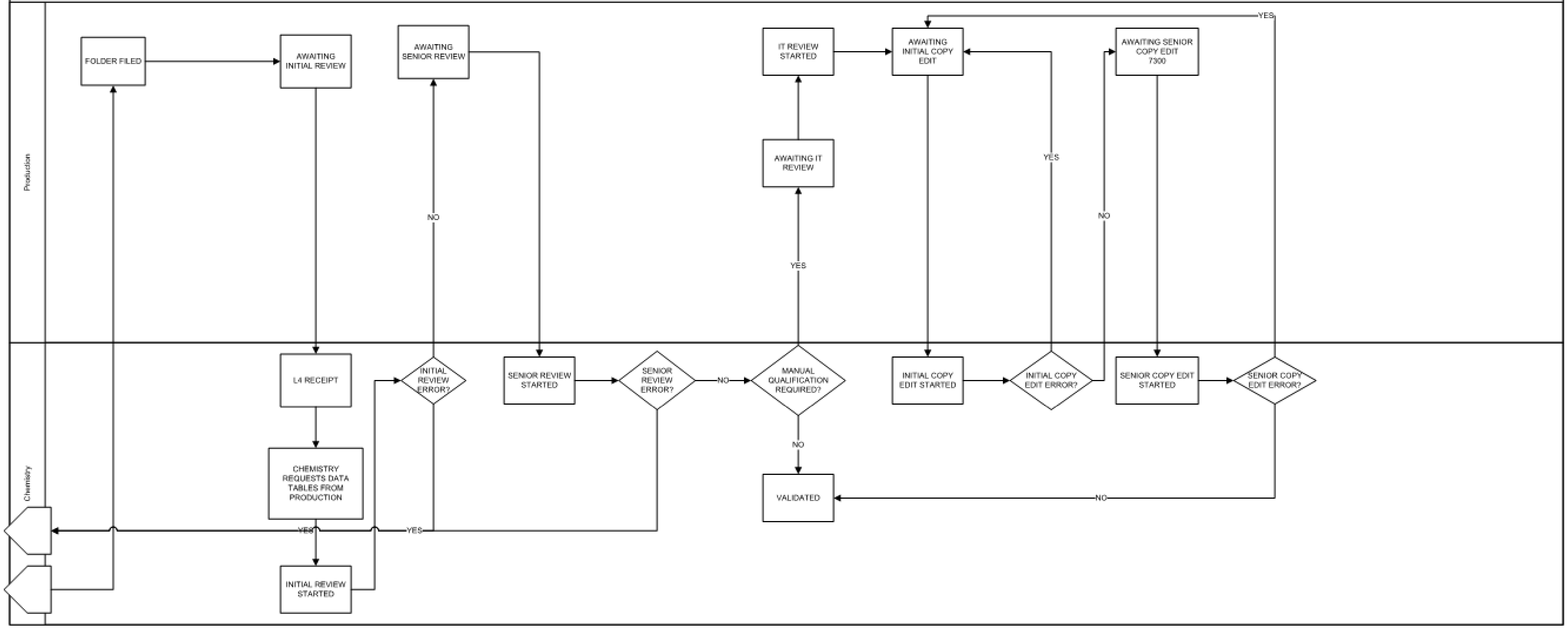
APPENDIX A

DATA MANAGEMENT WORKFLOW DIAGRAMS

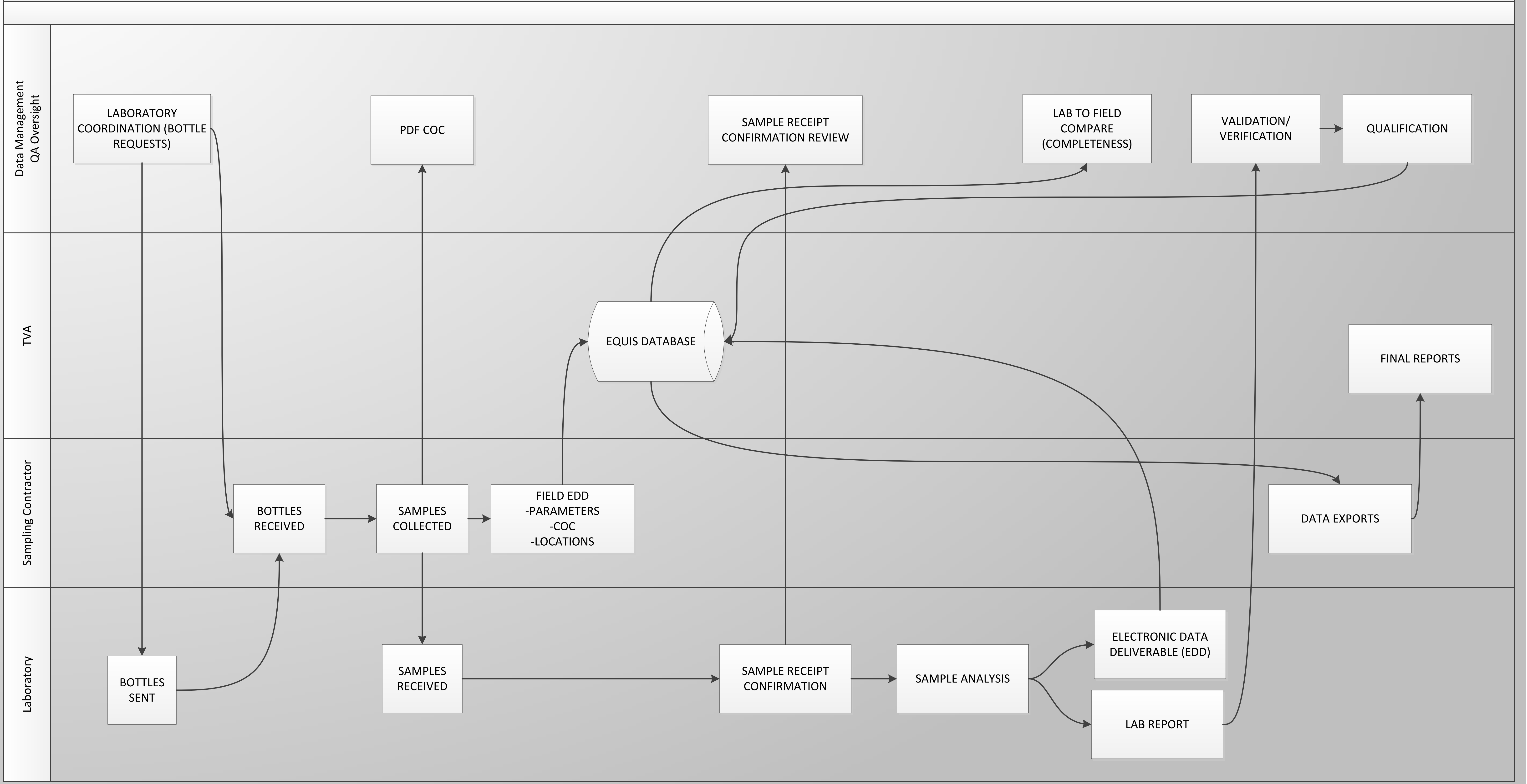
TVA DATA MANAGEMENT PROCESS/VERIFICATION AND VALIDATION



TVA DATA MANAGEMENT PROCESS/VERIFICATION AND VALIDATION (CONT)



Lab Coordination/Data Management Process



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APPENDIX B

EQUIS EDD SPECIFICATIONS

EQuIS EQEDD Laboratory EDD Specifications

November 2017

INTRODUCTION

The purpose of this document is to describe the processing of the laboratory data and provides the required specifications of the electronic data deliverable (EDD).

FILE FORMAT

All data from the field must be stored in an ASCII file using a tab-delimited standard format. Maximum length of text fields is indicated in the parentheses. If the information is less than the maximum length, do not pad the record with spaces.

Each record must be terminated with a carriage return/line feed (*i.e.,* standard DOS text file). The file can be produced using any software with the capability to create ASCII files. Date is reported as MM/DD/YYYY (month/day/year) and time as HH:MM (hour: minute). Time uses a 24-hour clock, thus 3:30 p.m. will be reported as 15:30.

Each record in an import file must have one or more fields with values that make the row unique. These fields are indicated in the “PRIMARY KEY?” column. Required fields are indicated in the “REQUIRED?” column.

NULL FORMAT

Some fields in the EDD are optional or only required “when applicable.” When a field is <u>not</u> listed as required, this means that a null or blank may be appropriate. However, the blank value must still be surrounded by tabs. In other words, the number of fields is always the same, whether or not the fields include data.

NAMING CONVENTION

The filename extensions are used to indicate the file type as follows:

Type of Rows	File Name
Lab Sample	LabSample._v1.txt
Test & Results	TestResultsQC_v1.txt
Test Batch	TestBatch_v1.txt

FILE DELIVERY

All EDD deliverables must be sent in a zip file containing the EDD files listed above. The zipped file must be named using the following naming convention:

- *SDG*.FACILITYCODE.EQEDD.zip

EDD SPECIFICATION

LabSample_v1

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
	sys_sample_code	Text(40)	Y	PK		Unique sample identifier.
	sample_name	Text(50)				Additional sample identification information as necessary.
	sample_matrix_code	Text(10)	Y		RVF	Code which distinguishes between different of sample matrix types.
	sample_type_code	Text(20)	Y		RVF	Code which distinguishes between different types of samples.
	sample_source	Text(10)	Y		ENUM	This field identifies where the sample came from, either field or laboratory.
	parent_sample_code	Text(40)				The value of "sys_sample_code" that uniquely identifies the sample that was the source of this sample.
	sample_delivery_group	Text(20)				The sampling event with which the sample is associated.
	sample_date	DateTime	Y			Date and time sample was collected (in MM/DD/YYYY HH:MM format for EDD).
	sys_loc_code	Text(20)				Soil boring or well installation location.
	start_depth	Numeric				Beginning depth (top) of sample in feet below ground surface.

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
	end_depth	Numeric				Ending depth (top) of sample in feet below ground surface.
	depth_unit	Text(15)			RVF	Unit of measurement for the sample begin and end depths.
	chain_of_custody	Text(40)				Chain-of-Custody identifier. A single sample may be assigned to only one Chain-of-Custody.
	sent_to_lab_date	DateTime				Date sample was sent to laboratory (in MM/DD/YYYY format for EDD).
	sample_receipt_date	DateTime				Date that sample was received at laboratory (in MM/DD/YYYY format for EDD).
	sampler	Text(50)				Name or initials of sampler.
	sampling_company_code	Text(40)	Y		RVF	Name or initials of sampling company (not controlled vocabulary).
	sampling_reason	Text(30)				
	sampling_method	Text(40)				Sampling method.
	task_code	Text(40)				Code used to identify the task under which the field sample was retrieved.
	collection_quarter	Text(5)				Format: YYQ# where YY is year and # is 1, 2, 3, or 4 representing the quarter.

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
	composite_yn	Text(1)	Y		ENUM	Is sample a composite sample? 'Y' for yes or 'N' for no.
	composite_desc	Text(255)				Description of composite sample (if composite_yn is 'Yes').
	sample_class	Text(10)				Report as null.
	custom_field_1	Text(255)				Report as null.
	custom_field_2	Text(255)				Report as null.
	custom_field_3	Text(255)				Report as null.
	comment	Text(2000)				Comment.

TestResultsQC_v1

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
	sys_sample_code	Text(40)	Y	PK		Unique sample identifier.
	lab_anl_method_name	Text(20)	Y	PK	RVF	Laboratory analytical method name or description.
	analysis_date	DateTime	Y	PK		Date and time of sample analysis in 'MM/DD/YYYY HH:MM' format.
	total_or_dissolved	Text(10)	Y	PK	RVF	Must be either 'D' for dissolved or filtered [metal] concentration, 'T' for total or undissolved, or "N" for everything else.
	column_number	Text(2)				Values include either '1C' for first-column analyses, '2C' for second-column analyses, or 'NA' for tests for which this distinction is not applicable.
	test_type	Text(10)	Y	PK	RVF	Type of test.
	lab_matrix_code	Text(10)			RVF	Code which distinguishes the type of sample matrix.
	analysis_location	Text(2)	Y		ENUM	Must be either 'FI' for field instrument or probe, 'FL' for mobile field laboratory analysis, or 'LB' for fixed based laboratory analysis.
	basis	Text(10)	Y		ENUM	Must be either 'Wet' for wet-weight basis reporting, 'Dry' for

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
						dry-weight basis reporting, or 'NA' for tests for which this distinction is not applicable.
	container_id	Text(30)				Report as null.
	dilution_factor	Numeric				Effective test dilution factor.
	prep_method	Text(20)			RVF	Laboratory sample preparation method name or description.
	prep_date	DateTime				Beginning date and time of sample preparation in 'MM/DD/YYYY HH:MM' format.
	leachate_method	Text(15)				Laboratory leachate generation method name or description.
	leachate_date	DateTime				Beginning date and time of leachate preparation in 'MM/DD/YYYY HH:MM' format.
	lab_name_code	Text(20)			RVF	Unique identifier of the laboratory.
	qc_level	Text(10)			ENUM	May be either 'screen' or 'quant'.
	lab_sample_id	Text(20)				Laboratory LIMS sample identifier.
	percent_moisture	Text(5)				Percent moisture of the sample portion used in this test.
	subsample_amount	Text(14)				Amount of sample used for test.
	subsample_amount_unit	Text(15)			RVF	Unit of measurement for

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
						subsample amount.
	analyst_name	Text(50)				
	instrument_id	Text(60)				Instrument identifier.
	comment	Text(2000)				Comments about the test.
	preservative	Text(20)			RVF	Sample preservative used.
	final_volume	Numeric				The final volume of the sample after sample preparation. Include all dilution factors.
	final_volume_unit	Text(15)			RVF	The unit of measure that corresponds to the final volume.
	cas_rn	Text(15)	Y	PK	RVF	Use values in analyte valid value table.
	chemical_name	Text(255)	Y			Use the name in the analyte valid value table.
	result_value	Numeric				Analytical result reported at an appropriate number of significant digits. May be blank for non-detects.
	result_error_delta	Text(20)				Error range applicable to the result value; typically used only for radiochemistry results.
	result_type_code	Text(10)	Y		RVF	Must be either 'TRG' for a target or regular result, 'TIC' for tentatively identified compounds, 'SUR' for surrogates, 'IS' for internal standards, or

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
						'SC' for spiked compounds.
	reportable_result	Text(10)	Y		ENUM	Must be either 'Yes' for results which are considered to be reportable, or 'No' for other results.
	detect_flag	Text(2)	Y		ENUM	May be either 'Y' for detected analytes, 'N' for non-detects or 'TR' for trace.
	lab_qualifiers	Text(20)				Qualifier flags assigned by the laboratory.
	validator_qualifiers	Text(20)				Qualifier flags assigned by the validation firm.
	interpreted_qualifiers	Text(20)			RVF	Qualifier flags assigned by the validation firm.
	organic_yn	Text(1)	Y		ENUM	Must be either 'Y' for organic constituents, or 'N' for inorganic constituents.
	method_detection_limit	Text(20)				Method detection limit.
	reporting_detection_limit	Numeric				Concentration level above which results can be quantified with confidence.
	quantitation_limit	Text(20)				Concentration level above which results can be quantified with confidence.
	result_unit	Text(15)			RVF	Unit of measurement for the result.
	detection_limit_unit	Text(15)			RVF	Unit of measurement for the detection limit(s).

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
	tic_retention_time	Text(8)				Retention time in seconds for tentatively identified compounds.
	result_comment	Text(2000)				Result-specific comments.
	lab_sdg	Text(20)				Sample Delivery Group (SDG) identifier.
	qc_original_conc	Numeric				The concentration of the analyte in the original (un-spiked) sample.
	qc_spike_added	Numeric				The concentration of the analyte added to the original sample.
	qc_spike_measured	Numeric				The measured concentration of the analyte.
	qc_spike_recovery	Numeric				The percent recovery calculated as specified by the laboratory QC program.
	qc_dup_original_conc	Numeric				The concentration of the analyte in the original (un-spiked) sample.
	qc_dup_spike_added	Numeric				The concentration of the analyte added to the original sample.
	qc_dup_spike_measured	Numeric				The measured concentration of the analyte in the duplicate.
	qc_dup_spike_recovery	Numeric				The duplicate percent recovery calculated.
	qc_rpd	Text(8)				The relative percent difference calculated.

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
	qc_spike_lcl	Text(8)				Lower control limit for spike recovery.
	qc_spike_ucl	Text(8)				Upper control limit for spike recovery.
	qc_rpd_cl	Text(8)				Relative percent difference control limit.
	qc_spike_status	Text(10)			ENUM	Used to indicate whether the spike recovery was within control limits.
	qc_dup_spike_status	Text(10)			ENUM	Used to indicate whether the duplicate spike recovery was within control limits.
	qc_rpd_status	Text(10)			ENUM	Used to indicate whether the relative percent difference was within control limits.

TestBatch_v1

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
	sys_sample_code	Text(40)		PK		Unique sample identifier.
	lab_anl_method_name	Text(20)		PK	RVF	Laboratory analytical method name or description.
	analysis_date	DateTime		PK		Date and time of sample analysis in 'MM/DD/YYYY HH:MM' format.
	total_or_dissolved	Text(10)		PK	RVF	Must be either 'D' for dissolved or filtered [metal] concentration, 'T' for total or undissolved, or "N" for everything else.
	column_number	Text(2)				Values include either '1C' for first-column analyses, '2C' for second-column analyses, or 'NA' for tests for which this distinction is not applicable.
	test_type	Text(10)		PK	RVF	Type of test.
	test_batch_type	Text(10)	Y	PK	RVF	Laboratory batch type. Valid values include 'Prep', 'Analysis', and 'Leach'. This is a required field for all batches.
	test_batch_id	Text(20)	Y			Unique identifier for all laboratory batches.

“REQUIRED WHEN APPLICABLE” FIELDS

Some “Required When Applicable” fields are data driven and are, therefore, not listed below.

SAMPLE LEVEL

	BD	BS	EB	FB	FD	LB	LD	LR	MB	MS	N	RB	SD	TB
PARENT_SAMPLE_CODE	X				X		X	X		X			X	
SAMPLE_DATE			X	X	X					X	X	X	X	X
SAMPLE_TIME			X	X	X					X	X	X	X	X
SAMPLE_RECEIPT_DATE			X	X	X					X	X	X	X	X
SAMPLE_RECEIPT_TIME			X	X	X					X	X	X	X	X

RESULT LEVEL-TARGET & SPIKED RESULTS (TRG & SC)

	BD	BS	EB	FB	FD	LB	LD	LR	MB	MS	N	RB	SD	TB
QC_ORIGINAL_CONC		X			X			X		X				
QC_SPIKE_ADDED		X								X				
QC_SPIKE_MEASURED		X								X				
QC_SPIKE_RECOVERY		X								X				
QC_DUP_ORIGINAL_CONC													X	
QC_DUP_SPIKE_ADDED													X	
QC_DUP_SPIKE_MEASURED	X												X	
QC_DUP_SPIKE_RECOVERY	X												X	
QC_RPD	X							X					X	

RESULT LEVEL-SURROGATE RESULTS (SUR)

	BD	BS	EB	FB	FD	LB	LD	LR	MB	MS	N	RB	SD	TB
QC_SPIKE_ADDED		X	X	X		X		X	X	X	X	X		X
QC_SPIKE_MEASURED		X	X	X		X		X	X	X	X	X		X
QC_SPIKE_RECOVERY		X	X	X		X		X	X	X	X	X		X
QC_DUP_SPIKE_ADDED	X												X	
QC_DUP_SPIKE_MEASURED	X												X	
QC_DUP_SPIKE_RECOVERY	X												X	

APPENDIX C

EQUIS STANDARD REPORTS

EQuIS Standard Reports

Novemberr 2017

Introduction

The purpose of this document is to describe the standard reports provided with EQuIS version 6.6.

Action Level Reports

Action Level Exceedance

The Action Level Exceedance Report compares values from a saved Analytical Results Report against one or more action levels (*e.g.*, regulatory limits).

Action Level Exceedance (by EDD)

This version of the Action Level Exceedance Report is used for checking exceedances within an EDD (instead of within a saved report), and is commonly used as an Environmental Information Agent (EIA), or trigger, within EQuIS Enterprise

Analyte Exceedance (Over Time)

The Analyte Exceedance Report provides a simple way to find results for a chemical that exceeds a specified value.

Action Level Exceedance II by EDD

This version of the Action Level Exceedance II Report is used for checking exceedances within an EDD (instead of within a saved report), and is commonly used as an Environmental Information Agent (EIA), or trigger, within EQuIS Enterprise

Action Level Exceedance II by User Report

This report allows you to run an Action Level Exceedance Report by selecting a saved user report as well as the additional action level parameters.

Action Level Exceedance II - Percent Variance

The Action Level Exceedance II - Percent Variance Report is designed to flag analytical results within a given EDD that vary by more than the listed percentage from the historical average for each chemical and location

Action Level Exceedance II with Parameters

The Action Level Exceedance II with Parameters Report displays all of the parameters from the Analytical Results II Report, thus allowing you to create the Analytical Results Report and the Action Level Exceedance Report together (displayed once in the Action Level Exceedance format).

Action Level Exceedance Format I

The Action Level Exceedance Format I Report generates a report with or without action level exceedances. Its row headers are Constituent, action levels and units. Its column headers are

Location ID, Sample Date, Sample Time, Sampled Interval, Sample ID, Laboratory and Lab. Number. It can report up to a maximum of three action level codes. The units of action levels can be used as final units of the report. Checking results against summed action levels can be done in the report. It is a class report based on the Analytical Results II Report.

Action Level Exceedance Format III

The Action Level Exceedance Format III Report generates cross-tabbed analytic results with or without action level exceedances. The row headers are Analyte, Units, Limits, and action levels, if selected. Its column headers are Station ID, Sample ID, Matrix, and Sample Date. This allows you to add lab qualifiers after results and export RT_QUALIFIER.REMARK as a footnote. Two types of action level comparisons are possible.

ALE II Crosstab - Row-based

The report generates cross-tabbed analytic results with or without action level exceedances.

ALE II Crosstab - Column-based

The report generates cross-tabbed analytic results with or without action level exceedances

Analytical Results Reports

Analytical and Water Results

Analytical and Water Results runs the Analytical Results II* and Water Level (Extra Fields) reports, and combines the output rows so the water level data are reported as CAS_RN results. This enables direct comparison in crosstab reports.

Analytical Results by EDDs

The Analytical Results by EDDs Report is an advanced version of the Analytical Results II* Report. This report includes a new group of input parameters, "EDD." If the "Use EDD Date Range" input parameter is checked, the date range specified in the EDD input parameter group will override the date range specified in the Sample input parameter group. The EDD date range will query Analytical Results on the dates the results were loaded to EQuIS.

Analytical Results Crosstab (Chemicals by Location)

This report creates a Crosstab Report in Microsoft Excel that displays location, sample date and sample type as column headers, and chemicals as row headers.

Analytical Results (Extra Fields)

It provides "additional fields" for users to select extra fields, except for all the fields of the Analytical Results.

Analytical Results (QC)

This report is identical to the Analytical Results Report, except it also includes all of the DT_RESULT_QC fields in the output. The report is designed for users that need to report QC information.

Analytical Results with Sample Parameter (Table)

The Analytical Results with Sample Parameter (Table) Report combines the Analytical Results Report and the Sample Parameter Report

Analytical Results II

The core function for reporting analytical data in EQuIS Professional. You can execute this function standalone and also use it within several other reports.

Analytical Results II - No Sample Taken

The sample must still satisfy the defined parameters (date range, sample type, *etc*.). All of the other parameters are related to samples/test/results (date range, sample type, *etc*.). This report also includes sample data, even if that sample does not have any tests/results

Basic Results Profile

The Basic Results Profile is a result of cross tabbing the Basic Results Report so that the measured results of chemicals vs. their sampling dates and depths can easily be read. The results of each location are placed in their own Excel worksheet.

Basic Results II

In addition to reporting the content of DT_BASIC_RESULT, the Basic Results II Report also provides measured results with unit conversion, if users provide a unit over the user interface.

Gauging and Analytical Report

This report creates a Crosstab Report in Microsoft Excel. The columns include water level (i.e. gauging data) information, followed by the selected analytes.

Database Tables Tools

Client Metrics Report

The Client Metrics Report summarizes how many records are available in several main tables, and how many total records in DT_/AT_/RT_ tables of each facility listed in DT_FACILITY are in the EQuIS database, and the number of records in the tables without the FACILITY_ID field in DT_/AT_/RT_ tables

Database Diagnostics

Database Diagnostics Report provides information on the owner, type and CREATED_DATETIME of a selected object or the name, owner, and type of all objects in the database if you do not select a specific object.

EQuIS Data Audit

The report reports the questionable (location, sample, test, result and reference *etc.*) data information under the facilities and/or the locations that are involved in checking items.

EQuIS Enterprise Report Usage

The EQuIS Enterprise Report Usage Report generates a report on the information of users and the report names used during a range of date

Reference Values

A report that lists all the reference values with a status flag of "R" in all reference tables. This report exports all the reference tables to individual worksheets in Microsoft Excel. The worksheets are named for each reference table. You may select to export records with all or any specific individual status flags.

Table Row Counts

The Table Row Counts Report generates the total number of rows per table in the database (TOTAL_ROWS), the number of these rows in the current FACILITY_ID or facility group (IN_FACILITY), the number of reference values per reference table with STATUS_FLAG="A" and "R" (STATUS_FLAG_A and STATUS_FLAG_R, respectively).

EnviroInsite Reports

EnviroInsite Boring Log

This report creates a boring log in EnviroInsite according to the selected template file. The report queries the data in EQuIS, opens EnviroInsite and compiles the log

EnviroInsite Site Diagram

Site diagram report is an alternative report for the EnviroInsite Data Export. It is a simplified report that lets you automate steps in EnviroInsite to create tables, contours, etc.

EnviroInsite Spider Diagram

The EnviroInsite Spider Diagram Report allows you to create spider diagrams using EnviroInsite for data within EQuIS. Water Level and Analytical Results can be outputted as spider diagrams

Google Earth Reports

Google Earth 3D Action Levels

This report lets the user select a saved Analytical Results Report and an action level. The output of the report shows concentrations of each chemical represented as a vertical cylinder at each location. The height of the cylinder represents the amount of concentration (taller cylinders show greater amount of chemical).

Google Earth 3D Action Level Sample Parameters

This report lets you select a saved Sample Parameter Report, and an action level. The output of the report shows concentrations of each parameter represented as a vertical cylinder at each location. The height of the cylinder represents the parameter value (taller cylinders show greater value).

Google Earth 3D Analyte Aggregates

This report prompts you to select a saved Analytical Results Report. You then select whether you want to aggregate values by group or individual. You may also select the aggregate function you want to use (default is maximum). The report displays vertical cylinders representing the aggregate value at each location, along with a label showing the numeric value

Google Earth 3D Analytical Results (3D Cylinders)

This report prompts you to select a saved Analytical Results Report. The output of the report shows concentrations of each chemical represented as a vertical cylinder at each location. The height of the cylinder represents the amount of concentration (taller cylinders show greater amount of chemical). Each chemical is displayed in a different color. You can select which chemical to view by clicking in the circle next to the desired chemical name. This report includes data over the selected date range. You can drag the time slider, or press the Play button, to watch the values change over time

Google Earth 3D Basic Results (XYZ Plot)

This report is computationally intensive, and interpolates a unique grid for each parameter and date. For example, a site may have only 100 different records, but 25 different dates. In this case the report would interpolate 25 different grids, and potentially consume vast system resources. Please also note that there are limitations to the size and complexity of KML/KMZ files supported in Google Earth.

Google Earth Analytical Results (Aggregate) Pie Charts

The output of this report shows pie charts illustrating the sum of each of the chemicals. If you choose to aggregate by group, then the pie charts will show the sum of each group.

Google Earth Analytical Results (XYZ Plot)

This Google Earth Report uses a saved Analytical Results Pick Report as the primary input parameter. The Analytical Results output is exported into to a *.kmz, and separated by chemical with each sampling date. Multiple sampling dates can be displayed in animation using Google Earth's time animation bar.

Google Earth Location Parameter (XYZ Plot and Contour)

This report prompts you to select a date range and one (or more) location parameters. The output of this report shows values of each parameter represented as a three dimensional contour. The Places tree lists each parameter. Underneath each parameter there are folders for each of the days where values exist for that parameter. Values from each day are interpolated using a Nearest Neighbor algorithm. The interpolated values are then displayed using a color palette ranging from blue (low) to red (high). Each color in the palette is shown as a folder, so the user can check/uncheck that folder to show/hide values in that range.

Google Earth Locations

The purpose of this report is to show locations from an EQuIS facility in Google Earth. Each location is labeled with the DT_LOCATION.SYS_LOC_CODE. The Places tree in Google Earth groups each location by type (*i.e*. DT_LOCATION.LOC_TYPE). The report output can also include DT_LOCATION.LOC_DESC in the 'callout box' when a location is clicked

Google Earth Sample Parameters (3D Cylinders)

This report prompts you to select a saved Sample Parameter Report. The output of the report shows values of each parameter represented as a vertical cylinder at each sampling location. The height of the cylinder represents the parameter value (taller cylinders show greater values). Each parameter is displayed in a different color. You can select which parameter to view by clicking in the circle next to the desired parameter name.

This report includes data over the selected date range. You can drag the time slider or press the Play button to watch the values change over time.

Google Earth Water Levels (3D Cylinders)

This report prompts you to select a saved Water Level Report.

The output of the report shows the water level as a vertical cylinder at each location. The height of the cylinder represents the water level (taller cylinders show greater water elevation).

This report includes data over the selected date range. You can drag the time slider or press the Play button to watch the values change over time.

Google Earth Water Levels (XYZ Plot)

The output of this report shows the water level represented as a three dimensional contour. The Places tree contains folders for each of the days on which water level measurements exist. Values from each day are interpolated using a Nearest Neighbor algorithm. The interpolated values are then displayed using a color palette ranging from blue (low) to red (high). Each color in the palette is shown as a folder, so the user can check/uncheck that folder to show/hide values in that range.

In addition to the color palette, the elevation of each point (distance from the ground) represents the relative value to other points. For example, the lower valued points are close to the ground; whereas the higher valued points are farther above the ground. This relative distance from the ground makes it possible to view a 2D contour (by reducing the tilt in Google Earth to look straight down from above) or to view a 3D surface (by increasing the tilt in Google Earth to look from the side).

This report includes data over the selected date range. You can drag the time slider, or press the Play button, to watch the values change over time. The report provides the option to create Contours, Color grids, Dot Plots or Surface Plots.

Google Earth Weather - Wind Speed and Direction

This report creates an animated "wind sock" at each location. The sock (*i.e*. red line) points in the direction the wind is blowing and the length of the sock indicates the relative wind speed. This report includes data over the selected date range. You can drag the time slider, or press the Play button, to watch the values change over time.

Location Parameter Reports

Location Information

The Location Information Report is the class report based off of the database procedure Location Information Report. It provides metadata about sample locations (wells, boreholes, *etc.*), including the matrices by which locations have been sampled as well as the screened interval.

Location Parameter “Real Time” Ticker Charts

This report creates ticker charts based on location parameter data.
This report is deployed as a web page and requires EQuIS Enterprise.

Location Parameter Exceedance

The report compares PARAM_VALUE of DT_LOCATION_PARAMETER with a value provided over the user interface and generates an exceedance report. It calls the Location Parameters report

Location Parameters

Location Parameter Standard Report has been improved to fill non-numeric results as PARAM_TEXT in their respective outputs.

Location Parameters (Action Level Exceedance)

This report checks PARAM_VALUE of the Location Parameters report against the action levels of the Action Levels Report and then generates an Action Level Exceedance Report.

Location Parameters (Extra Fields)

The Location Parameters (Extra Fields) Report generates the location parameter information from DT_LOCATION_PARAMETER and other selectable fields from DT_FACILITY, DT_LOCATION_PARAMETER, DT_PRECIPITATION, VW_LOCATION and VW_WELL

Location Parameters (Most Recent)

The Location Parameters (Most Recent) Report compiles the PARAM_VALUES along with other parameters in DT_LOCATION_PARAMETER that are obtained most recently. It uses the Location Parameters Report

Location Parameters (Rollup)

The Location Parameters (Rollup) Report compiles the hourly, daily, weekly or monthly average values of PARAM_VALUES in DT_LOCATION_PARAMETER based on selected parameters. It uses the Location Parameters Report

Sample Parameter Reports

Analytical Results with Sample Parameter (Tables)

The Analytical Results with Sample Parameter (Table) Report combines the Analytical Results Report and the Sample Parameter Report.

Sample Parameters

This report queries data from the DT_SAMPLE_PARAMETER table. The Sample Parameter standard report has been improved to fill non-numeric results as PARAM_TEXT in their respective outputs

Sample Parameters (Action Level Exceedance)

The Sample Parameters (Action Level Exceedance) Report is similar to the Sample Parameters (Exceedance) Report with the exception that it uses a saved Sample Parameters Report, action levels from DT_ACTION_LEVEL and DT_ACTION_LEVEL_PARAMETER rather than a user-entered action level value over the user interface, and more output fields.

Sample Parameters (Exceedance)

The Sample Parameters (Exceedance) Report examines PARAM_VALUES of DT_SAMPLE_PARAMETER a user-entered action level value over the user interface and generates a report with exceedances.

Sample Parameters (Extra Fields)

This report adds the functionality of reporting more selective fields.

Sample Parameters (Most Recent)

Sample Parameters (Most Recent) II Report compiles the PARAM_VALUE along with other parameters in DT_SAMPLE_PARAMETER that are obtained most recently.
Sample Parameters (Most Recent) II

It compiles the PARAM_VALUE along with other parameters in DT_SAMPLE_PARAMETER that are obtained the most recently. It uses the Sample Parameters (Extra Fields) Report to get raw data.

Statistics Reports

Analytical Results – Statistics

The Analytical Results (Statistics) Report is a new report based from the standard Analytical Results (Aggregate) Report. It computes various statistical functions not found in the aggregate report, namely: minimum, maximum, mean, median, sum, standard deviation, variance, skewness, Mann-Kendall S, Sen slope, confidence (90%, 95%, 99%, and 95%) and 95% Student's-t UCL (UCL = mean + student_t *sd/n).

Analytical Results with Sample Calculations

The Analytical Results with Sample Calculations (Table) Report generates the results of the Analytical Results, and the results from the calculations of balance and summation of the results of the Analytical Results.

Analytical Statistics

This report allows you to compare results to historical data from the specified statistical date range. It includes the option to highlight exceedances and results that fall outside the range of the historical values as well as display the information in graphical form.

ChemStat Report

The ChemStat Report generates a table that presents a statistical analysis for the selected analytes. The report summarizes the entire dataset into a single table with the rows representing each analyte in the dataset, and the columns representing the summary statistics. It allows you to focus in on those analytes and use the spatial and temporal querying tools provided, to understand what is going on. It does not show the report by location or by sample, but allows you to easily identify what analytes exceed the LOD and Action Levels, and the statistics associated with these exceedances. It uses Analytical Results report to get source data

Facility Results II

Facility Results II provides a broad overview of the analytical result information for the selected locations, along with the sample depth and screened interval

Facility Samples (Summary by EDD Date)

For all facilities which the user is subscribed to, this report will return the date of the most recent sample entered, the number of samples within the date range, and the number of samples that have been loaded year-to-date

Flow Rate

The Flow Rate Report calculates the volumes and rates of instant flow and cumulative flow per selected time interval based on the data from DT_FLOW. It also compares flow rate (for Flow-Inst) or flow volume (for Flow-Daily etc.) to action levels, if action level data are provided.

Lithology Summary

The Lithology Summary Report generates a table that summarizes maximum depths, minimum depths, maximum thicknesses and minimum thicknesses of each GEO_UNIT_CODE1 of location groups

Location Analyte Review

This report creates a Crosstab Report in Microsoft Excel that displays summary information about which locations have been sampled for specific chemicals during the specified date range. The report also indicates whether the chemical was detected or not.

Relative Percent Difference

The Relative Percent Difference Report (RDP) determines the difference between analytical results reported in primary, duplicate, and triplicate samples

Relative Percent Difference II

Relative Percent Difference II Report (RDP) determines the difference between analytical results reported in primary, duplicate, and triplicate samples.

Relative Percent Difference III

The Relative Percent Difference III Report determines the difference between analytical results reported in primary, duplicate, and triplicate samples (SYS_SAMPLE_CODE) as defined by user selection.

Sample Summary by Analyte Group

The Sample Summary by Analyte Group Report generates analysis information of collected samples included in various groups of analytes. The analysis information is represented by a combination of x/X, e/E, s/S, t/T, a/A, z/Z, which marks a sample as detected/non-detected regular results as well as if the results use special leachate methods

Sanitas

The Sanitas Report generates necessary data used by the Sanitas statistics software

Statistics: Analytical Statistics (by Location)

The report generates the statistics information of Mean, UCL, Median, Standard Deviation, Coefficient of Variation, Skewness, Minimum, Maximum, Count (n), Mann-Kendall S, Trend analysis (at 80% confidence, 90% confidence, 95% confidence, 99% confidence) and Sen Slope based on a saved Analytical Results Report.

Statistics: Analyte by Sample (Lithology)

This report creates a Crosstab Report in Microsoft Excel that displays lithology samples down the side, and analytes across the top. Below the crosstab are summary statistics for each analyte. The report can also report action level violations if the Action Level input is selected.

Statistics: Samples, Statistics and Exceedances

This report creates a Crosstab Report in Microsoft Excel that displays samples down the side, and analytes across the top. Below the crosstab are summary statistics for each analyte. This report is similar to “Statistics: Analyte by Sample (Lithology)” with the exception that it does not have the information on the depths of lithology.

Statistics: Samples, Statistics and Exceedances of Each Location

The report lists sample values and calculates the statistics, such as the Number of Samples, the Number of Detects, Maximum, Mean, 95% UCL, and Minimum and Standard Deviation based on a saved Analytical Results Report. The report can also report action level exceedances, if the Action Level input is selected.

Water Level Reports

Water Level Report Basics

The Water Level Reports return the field measured water level elevations as stored directly in EQuIS or as calculated or estimated water level elevation based on user inputs if LNAPL thickness and density are stored in the database

Non-Detect Trend Report

The Non-Detect Trend Report produces an Excel spreadsheet that includes non-detects and detects as trend lines for multiple compounds

LNAPL Column Report

The LNAPL Column Report creates a visual display of daily LNAPL thickness and water levels in the selected wells. A series of wells are presented on a single MS Excel Column chart that displays the depth of air (white), LNAPL (brown), and water (blue). The vertical extent of each column represents the total depth of the well. The locations are organized in both alphanumeric and chronological order

Water Level Aggregate vs Location Plot (2d, 3d, or Bubble)

Water Level Aggregate vs. Location Plot (2d, 3d, or Bubble) generates surface 2d contours, surface 3d contours, and bubble charts of an aggregation (max, min, avg, or sum) of the water level vs locations.

Water Level Elevation Trend Plot

Water level Trend Plot Report generates charts of water level elevations. In addition, an analyte can be added to water level charts. It uses Water Levels report and Analytical Results report to retrieve source data

Water Level Information

The Water Level Info Report generates water level (DT_WATER_LEVEL.EXACT_ELEV) data of selected locations in the form of graphs, plus other location information such as well diameter, installation date, top of casing, depth, purpose and owner.

Water Levels

The Water Levels Report conveys information about water levels, LNAPLs, and DNAPLs stored in the DT_WATER_LEVEL table. This report uses specific logic for computing the corrected water level elevation based on input parameters selected by the user

Water Levels (Extra Fields)

The Water Levels (Extra Fields) Report generates water level information. It is an improved Class Report version of the Water Levels (EQuIS func) Report. The Water Levels Report conveys information about water levels, LNAPLs, and DNAPLs stored in the DT_WATER_LEVEL table. This report uses specific logic for computing the corrected water level elevation based on input parameters selected by the user.

Water Levels (Most Recent)

The Water Levels (Most Recent) Report uses the Water Levels report to show the most recent water level elevation for each location

Contact List Export

Export EQuIS st_user, dt_person, and rt_company information as a contact list suitable for import to eMail or Client Resource Management (CrM) system.

Downhole Point Parameters

This report converts the downwhole point parameter values into numeric values and allows you to plot the parameters in an x-y chart, and save a template

Execute Scheduled Report

The "Execute Scheduled Report" report allows you to run a scheduled EIA Report. You choose which scheduled EIA to run, then click the Go button. There is no output for the report, it simply tells workflow to start the scheduled report now instead of waiting for the scheduled time. The report will continue to run on the originally designated schedule.

Facility Detects by Chemical

This report uses Analytical Results as input and performs a crosstab that counts the number of detects for each chemical across the entire facility.

Facility Parameters

The Facility Parameters Report generates the facility parameter information from DT_FACILITY_PARAMETER and other selectable fields

License Use

The report allows users to investigate license uses in details or in a summary.

ProUCL_data

The EQuIS ProUCL Report export allows EQuIS users to export analytical data in a format that can be used in ProUCL (a third party statistical application developed by the US EPA)

Risk Assessment - SADA

Description: This is a report that will automatically interface with the University of Tennessee Knoxville's Spatial Analysis and Decision Assistance (SADA) Software

Sample Holding Time II

The Sample Holding Time II Report displays time spent from sampling to analyzing the samples plus other items, which can also be obtained in the Analytical Results II** Report

Service Provider Licensing - Usage Report

The Service Provider Licensing Usage Report reports on product usage and billing rate information for EarthSoft Resellers

Tag Cloud - Chemical Concentrations

This report creates a tag cloud, based on overall chemical concentrations for the current facility
Unsubscribed User Report

This report can be used to notify managers and admins of users not subscribed to facilities
VLA - PPU Usage and Billing Statement

Generate usage information for invoicing purposes. This report is only required for usage-based Viewer License Agreements.

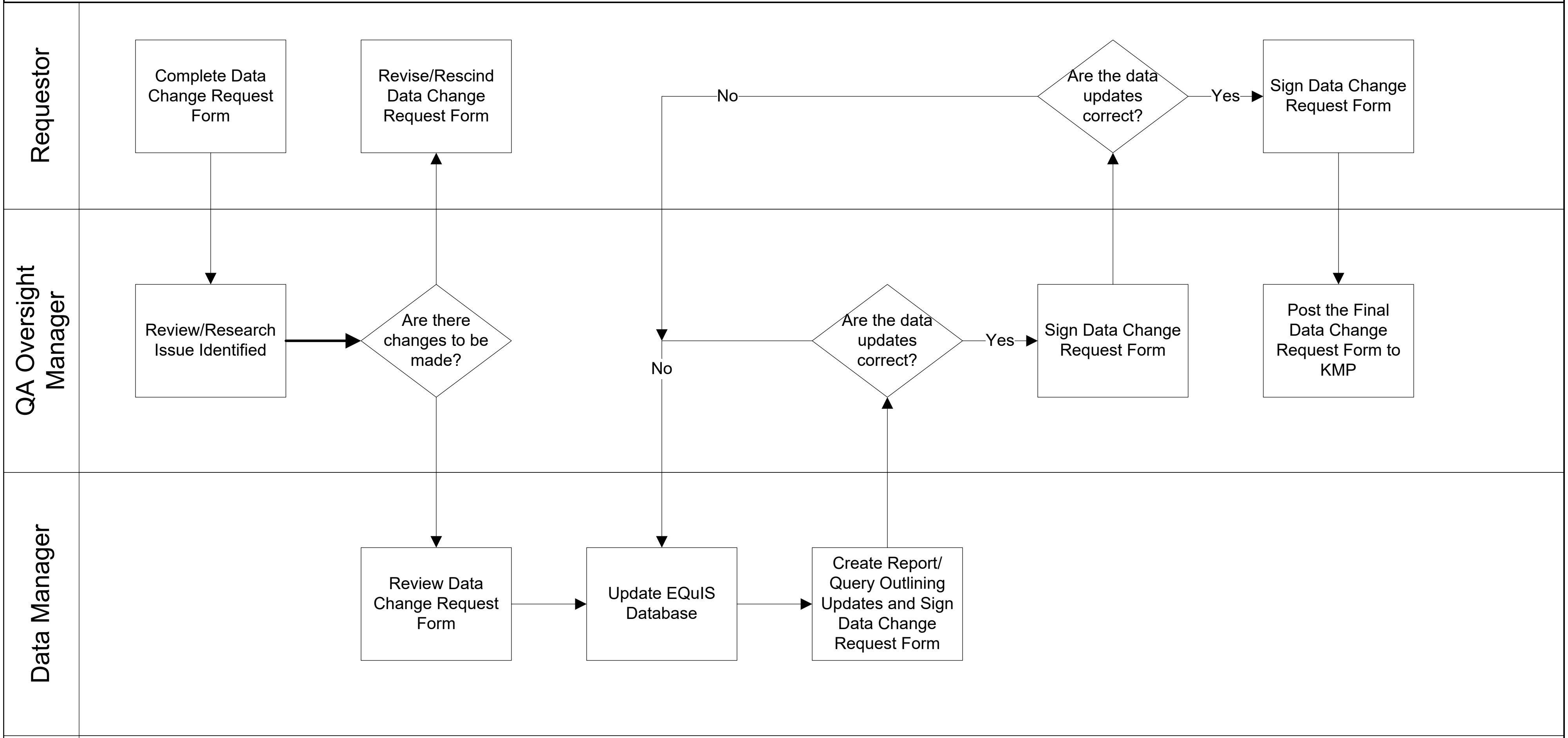
Well Construction

Well Construction Report is a class and Igrid Report that outputs well construction information from DT_WELL, DT_LOCATION, DT_COORDINATE, and DT_WELL_SEGMENT with default SEGMENT_TYPE='SCREEN'.

APPENDIX D

DATA CHANGE REQUEST WORKFLOW DIAGRAM

Data Change Request Process



ENVIRONMENTAL® STANDARDS 30 YEARS 1987 - 2017

APPENDIX E

TVA DATA CHANGE REQUEST FORM

Tennessee Valley Authority
Data Change Request Form

The Data Change Request Form will serve to document the data request and time-table for delivery.

Steps:

- Fill out Data Change Request Form and associated files to further explain the request.
- Attach the form and associated files in an e-mail to the Data Manager
- The subject of the e-mail should be- "**Data Change Request [Date].**"
- The Data Manager will be in contact to confirm information and delivery date.

Requestor Information		Data Manager use:
Date:		
Proposed Completion Date:		
Name:		
Company:	Phone:	
E-mail:		
Description of Request: (Below)	File Attached? Y N	
Summary: Proposed Solution:		Date Completed:

Data Manager/QA Oversight Manager

Signature ____________________________________ **Date:** _______________

Signature ____________________________________ **Date:** _______________

Data Change Requestor

Signature ____________________________________ **Date:** ______________

Stakeholders to Notify:

APPENDIX E
EXHIBITS

U:\TVA-EIP\175566336\gis\mxds\WBF_StudyArea.mxd Revised: 2018-02-07 By: mbough

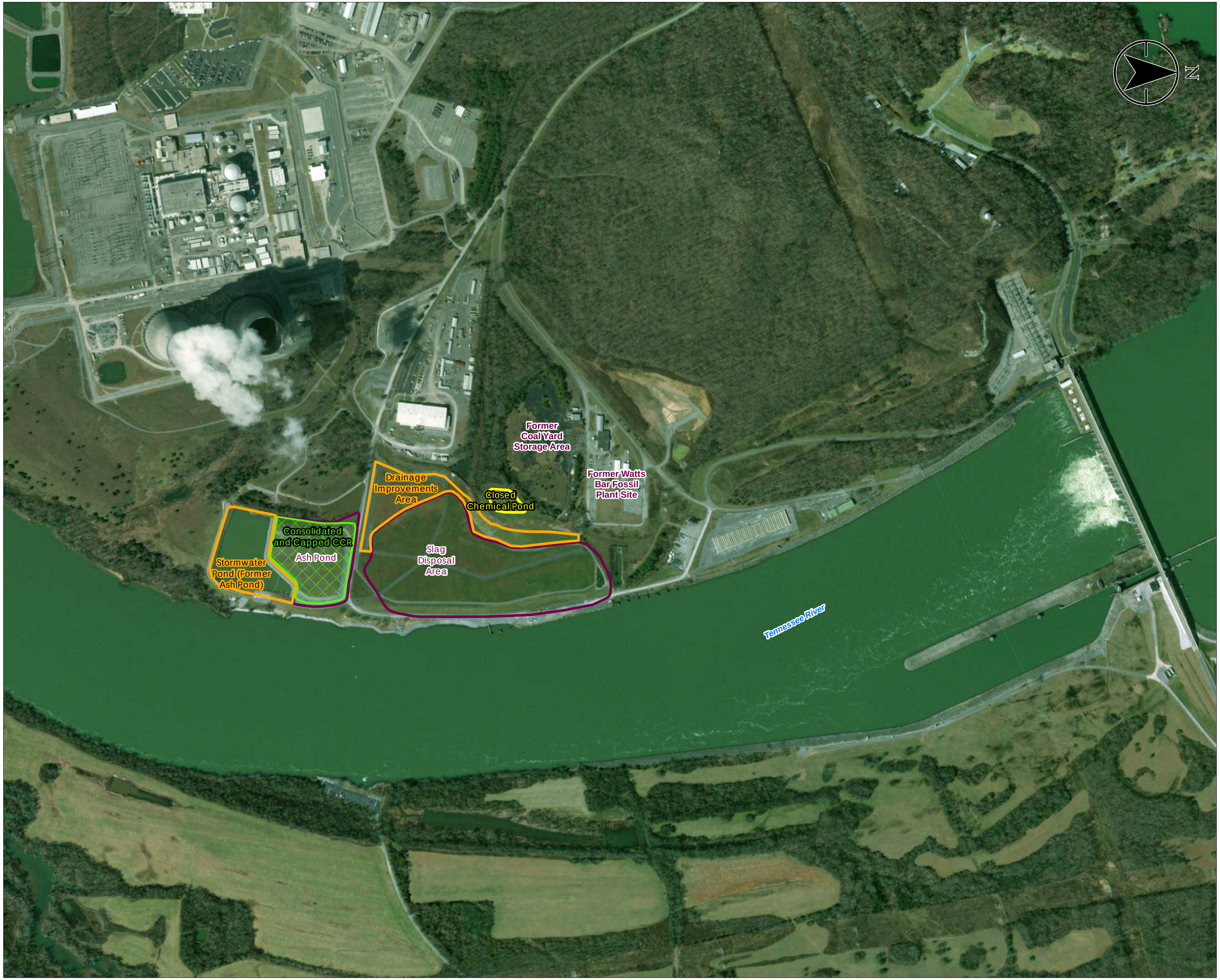


Exhibit No.
1

Title

Study Area

Client/Project

Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LMB on 2018-02-07
Technical Review by TG on 2018-02-07

0 350 700 1,050 1,400 Feet
1:4,200 (At original document size of 22x34)

Legend

▭	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 ESRI Imagery

Stantec TVA

Exhibit No.
2

Title
Watts Bar Fossil Plant
Existing Groundwater Well Locations

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LMB on 2018-02-06
Technical Review by SB on 2018-02-06

0 300 600 900 1,200 Feet
1:3,600 (At original document size of 22x34)

Legend

✚ River Gauge

■ Existing Groundwater Monitoring Well

▢ 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 ESRI Imagery

U:\TVA-EIP\175566336\gis\mxds\WBF_Existing_Well_Locations.mxd Revised: 2018-02-06 By: mbough

Exhibit No.
3

Title
Watts Bar Fossil Plant
Proposed Groundwater Well Locations

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LMB on 2018-02-06
Technical Review by SB on 2018-02-06

0 300 600 900 1,200 Feet
1:3,600 (At original document size of 22x34)

Legend

✚	River Gauge
▣	Existing Groundwater Monitoring Well
●	Proposed Groundwater Monitoring Well
☐	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 ESRI Imagery

U:\TVA-EIP\175566336\gis\mxds\WBF_Proposed_GW.mxd Revised: 2018-02-06 By: mbough

Exhibit No.
4

Title
Watts Bar Fossil Plant
Existing and Closed Well Locations

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LMB on 2018-02-06
Technical Review by SB on 2018-02-06

0 300 600 900 1,200 Feet
1:3,600 (At original document size of 22x34)

Legend

⊕	Closed Well
▣	Existing Groundwater Monitoring Wells
☐	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 ESRI Imagery

U:\TVA-EIP\175566336\gis\mxds\WBF_Existing_Closed_Wells.mxd Revised: 2018-02-06 By: mbough

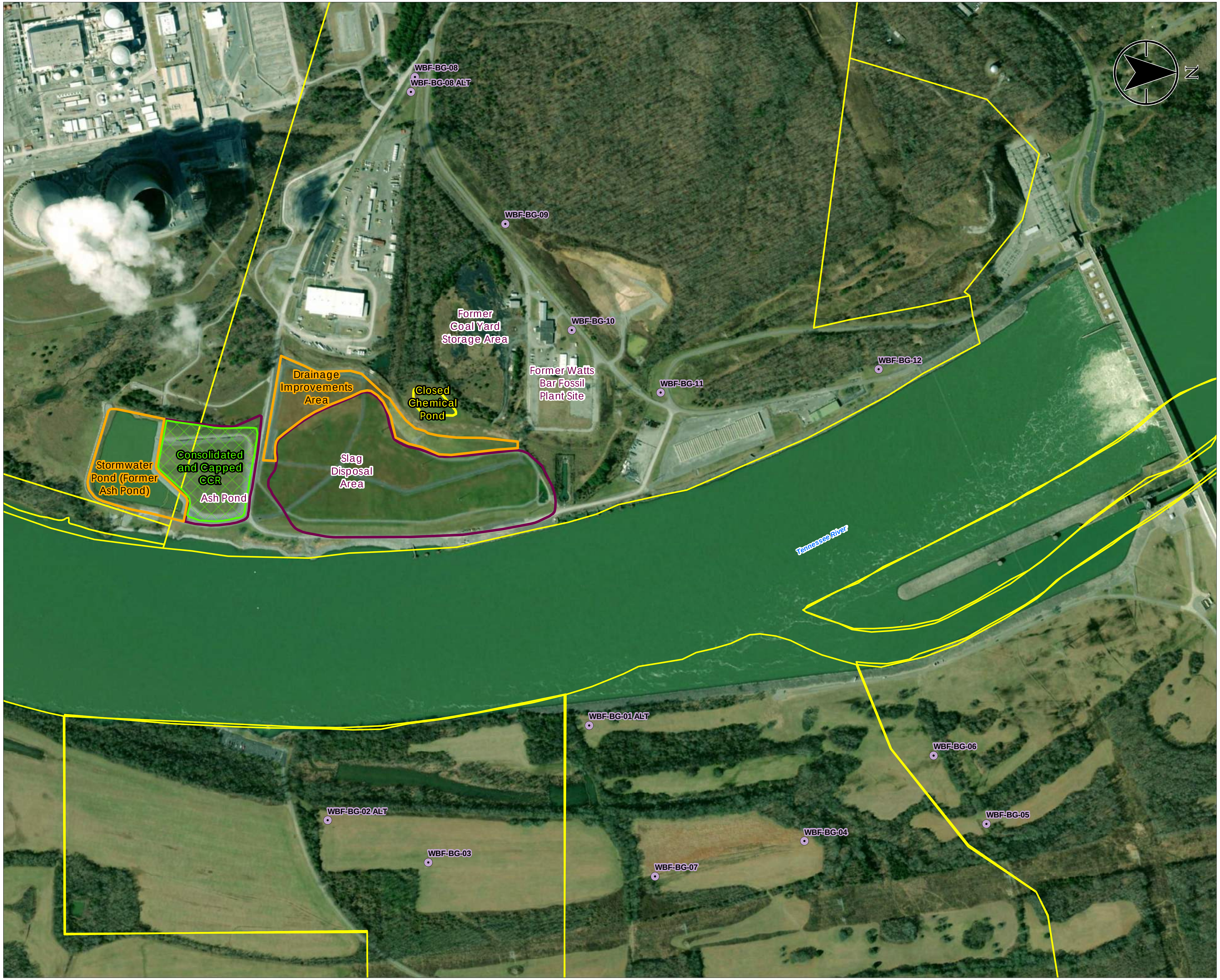


Exhibit No.
5

Title
Proposed Soil Sampling Locations

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2018-11-14
Technical Review by TG on 2018-11-14

0 300 600 900 1,200 Feet
1:3,600 (At original document size of 22x34)

Legend

- ● Proposed Background Soil Sample Location
- 🟪 CCR Unit Area (Approximate)
- 🟨 Closed Chemical Pond (Approximate)
- 🟩 Consolidated and Capped CCR Area (Approximate)
- 🟧 Drainage Improvements Area; Stormwater Pond (Former Ash Pond)
- 🟨 TVA Property

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by ESRI Imagery

U:\TVA-EIP\175566336\gis\mxds\WBF_Proposed_Soil_Sampling.mxd Revised: 2018-11-14 By: mbough

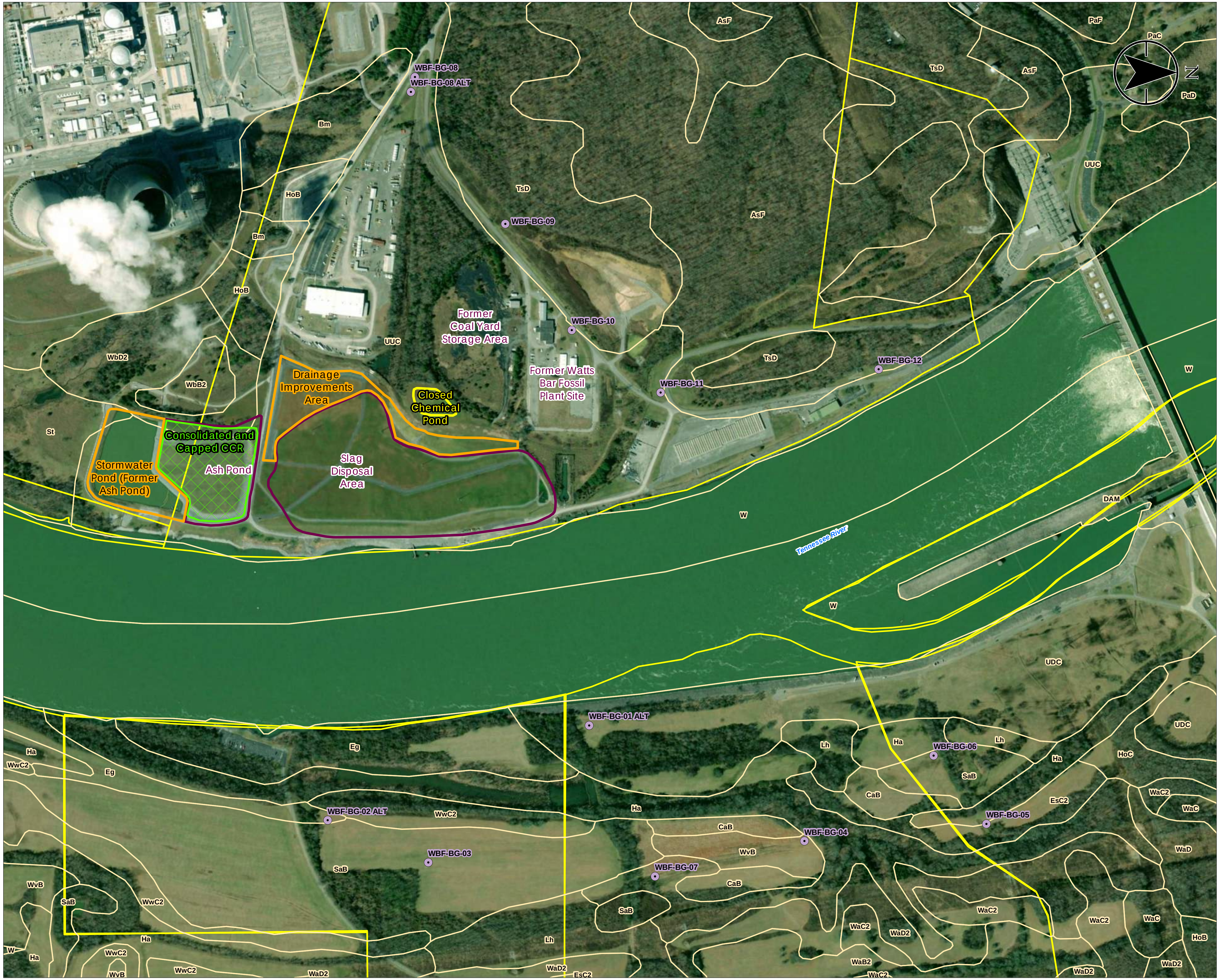


Exhibit No.
6

Title
Proposed Soil Sampling Locations

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2018-11-14
Technical Review by TG on 2018-11-14

0 300 600 900 1,200 Feet
1:3,600 (At original document size of 22x34)

Legend

- ● Proposed Background Soil Sample Location
- ☐ Soil Map Unit
- ☐ CCR Unit Area (Approximate)
- ☐ Closed Chemical Pond (Approximate)
- ☒ Consolidated and Capped CCR Area (Approximate)
- ☐ Drainage Improvements Area; Stormwater Pond (Former Ash Pond)
- ☐ TVA Property

Map Unit	Map Unit Name
AsF	Apison-Sunlight-Salacoa complex, 25 to 65 percent slopes
Bm	Bloomingdale silty clay loam, frequently flooded
CaB	Capshaw silt loam, 2 to 5 percent slopes
DAM	Dams, large
Eg	Egam silty clay loam, 0 to 3 percent slopes
EsC2	Etowah silt loam, 5 to 12 percent slopes, eroded
Ha	Hamblen-Tupelo complex, 0 to 3 percent slopes, occasionally flooded
HoB	Holston loam, 2 to 5 percent slopes
HoC	Holston loam, 5 to 12 percent slopes
Lh	Lee-hamblen complex, frequently flooded
PaC	Pailo gravelly silt loam, 5 to 12 percent slopes
PaD	Pailo gravelly silt loam, 12 to 25 percent slopes
PaF	Pailo gravelly silt loam, 25 to 60 percent slopes
SaB	Shady-altavista complex, 1 to 5 percent slopes
St	Staser loam, 0 to 3 percent slopes
TsD	Townley-Sunlight complex, 12 to 25 percent slopes
UDC	Udorthents-Urban land complex, 2 to 12 percent slopes
UUC	Urban land-Udorthents complex, 2 to 12 percent slopes
W	Water
WaB2	Waynesboro clay loam, 2 to 6 percent slopes, eroded
WaC	Waynesboro loam, 6 to 15 percent slopes
WaC2	Waynesboro clay loam, 6 to 15 percent slopes, eroded
WaD	Waynesboro loam, 15 to 25 percent slopes
WaD2	Waynesboro clay loam, 12 to 25 percent slopes, eroded
WbB2	Waynesboro loam, 2 to 6 percent slopes, eroded
WbD2	Waynesboro loam, 15 to 25 percent slopes, eroded
WvB	Wolftever silt loam, 1 to 5 percent slopes, rarely flooded
WwC2	Wolftever silty clay loam, 5 to 12 percent slopes, eroded

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Bing Imagery
3. Soils Data provided by US Department of Agriculture

Stantec

TVA

U:\TVA-EIP\175566336\gis\mxds\WBF_Proposed_Soil_Sampling_wSoilsOverlay.mxd Revised: 2018-11-14 By: mbough

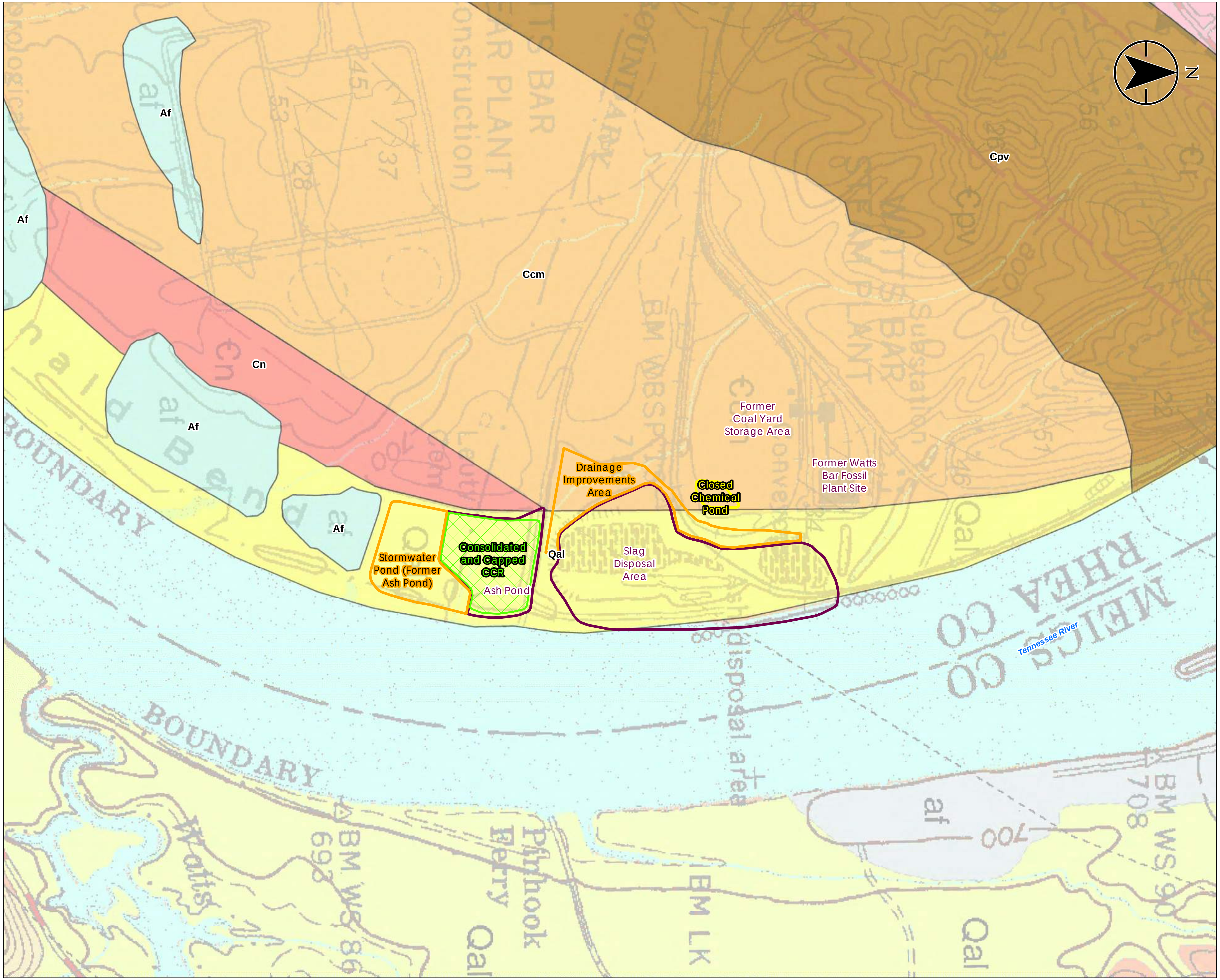


Exhibit No.
7

Title
Watts Bar Fossil Plant Geologic Map

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LMB on 2018-02-07
Technical Review by TG on 2018-02-07

0 300 600 900 1,200 Feet
1:3,600 (At original document size of 22x34)

Legend

- CCR Unit Area (Approximate)
- Closed Chemical Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)
- Af - Artificial Fill
- Qal - Surficial Deposits
- Cpv - Pumpkin Valley Shale
- Ccm - Conasauga Middle Group
- Cn - Nolichucky Shale

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Geologic Map: USGS TVA, Decatur Quadrangle, 1973
   Topographic Map: USGS TVA, Decatur Quadrangle, 1935

U:\TVA-EIP\175566336\gis\mxds\WBF_GeologicMap.mxd Revised: 2018-02-07 By: mbough

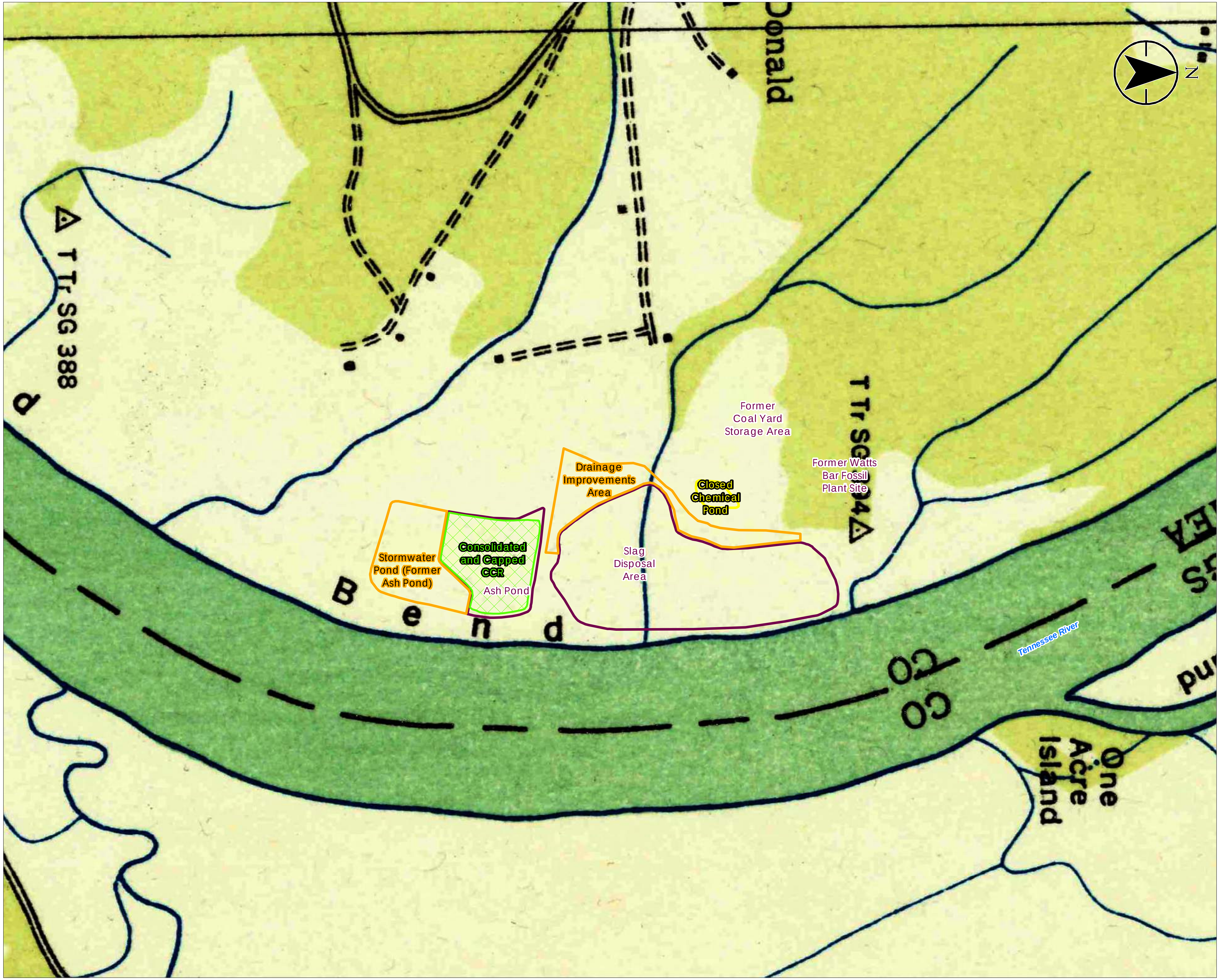


Exhibit No.
8

Title
Watts Bar Fossil Plant
1935 Topographic Map

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LMB on 2018-06-12
Technical Review by TG on 2018-06-12

0 300 600 900 1,200 Feet
1:3,600 (At original document size of 22x34)

Legend

🟪	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. Topographic Map: USGS TVA, Decatur Quadrangle, 1935

Stantec

TVA

U:\TVA-EIP\175566336\gis\mxds\WBF_TopographicMap_1935.mxd Revised: 2018-06-12 By: mbough

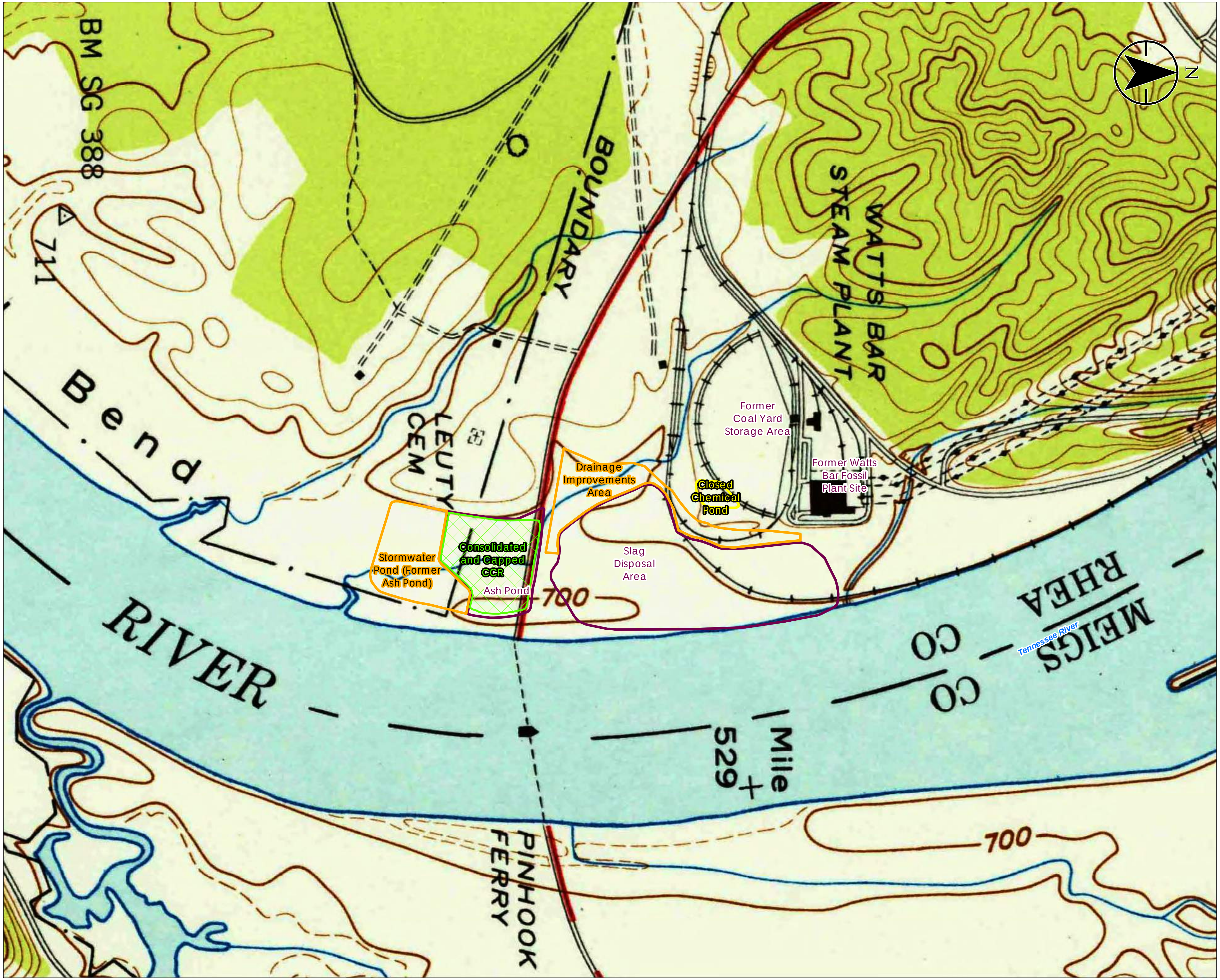


Exhibit No.
9

Title
Watts Bar Fossil Plant
1942 Topographic Map

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LMB on 2018-06-12
Technical Review by TG on 2018-06-12

0 300 600 900 1,200 Feet
1:3,600 (At original document size of 22x34)

Legend

▢	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. Topographic Map: USGS TVA, Decatur Quadrangle, 1942

U:\TVA-EIP\175566336\gis\mxds\WBF_TopographicMap_1942.mxd Revised: 2018-06-12 By: mbough

Exhibit No.
10

Title
Existing Borings

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LT on 2018-02-07
Technical Review by TG on 2018-02-07

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

Legend

●	Existing Boring
┅	Watts Bar Nuclear Facility 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 ESRI Imagery

Stantec
TVA

U:\TVA-EIP\175566336\gis\mxds\WBF_Existing_Borings.mxd Revised: 2018-02-07 By: mbough

Exhibit No.
11

Title
Proposed Borings

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2018-11-13
Technical Review by KB on 2018-11-13

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

Legend

△	Proposed Cone Penetration Test
▣	Proposed Boring with Piezometer Vibrating Wire
○	Proposed Boring
✿	Proposed Boring with Temporary Well *(Screened Material)*
●	Existing Boring
〰	Historical Stream Alignment (Approximate)
┅	Watts Bar Nuclear Facility 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 ESRI Imagery
3. Additional boring in Chemical Pond may be utilized if Cone Penetration Test is inconclusive.
4. CPT borings on 5 feet spacing at historical stream alignment.

U:\TVA-EIP\175566336\gis\mxds\WBF_Proposed_Borings.mxd Revised: 2018-11-13 By: TRink

Exhibit No.
12

Title
Existing CCR Thickness Boring Data

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LMB on 2018-02-07
Technical Review by TG on 2018-02-07

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

Legend

●	Boring with CCR Thickness Data
▬	Watts Bar Nuclear Facility 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 ESRI Imagery

U:\TVA-EIP\175566336\gis\mxds\WBF_CCR_Data.mxd Revised: 2018-02-07 By: mbough

Exhibit No.
13

Title
Uppermost Foundation Soil Data

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LMB on 2018-02-07
Technical Review by TG on 2018-02-07

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

Legend

- ● Clay
- ● Clayey Sand
- ⬢ Silt
- ---- Watts Bar Nuclear Facility 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 ESRI Imagery

Stantec

TVA

U:\TVA-EIP\175566336\gis\mxds\WBF_Foundation_Soils.mxd Revised: 2018-02-07 By: mbough

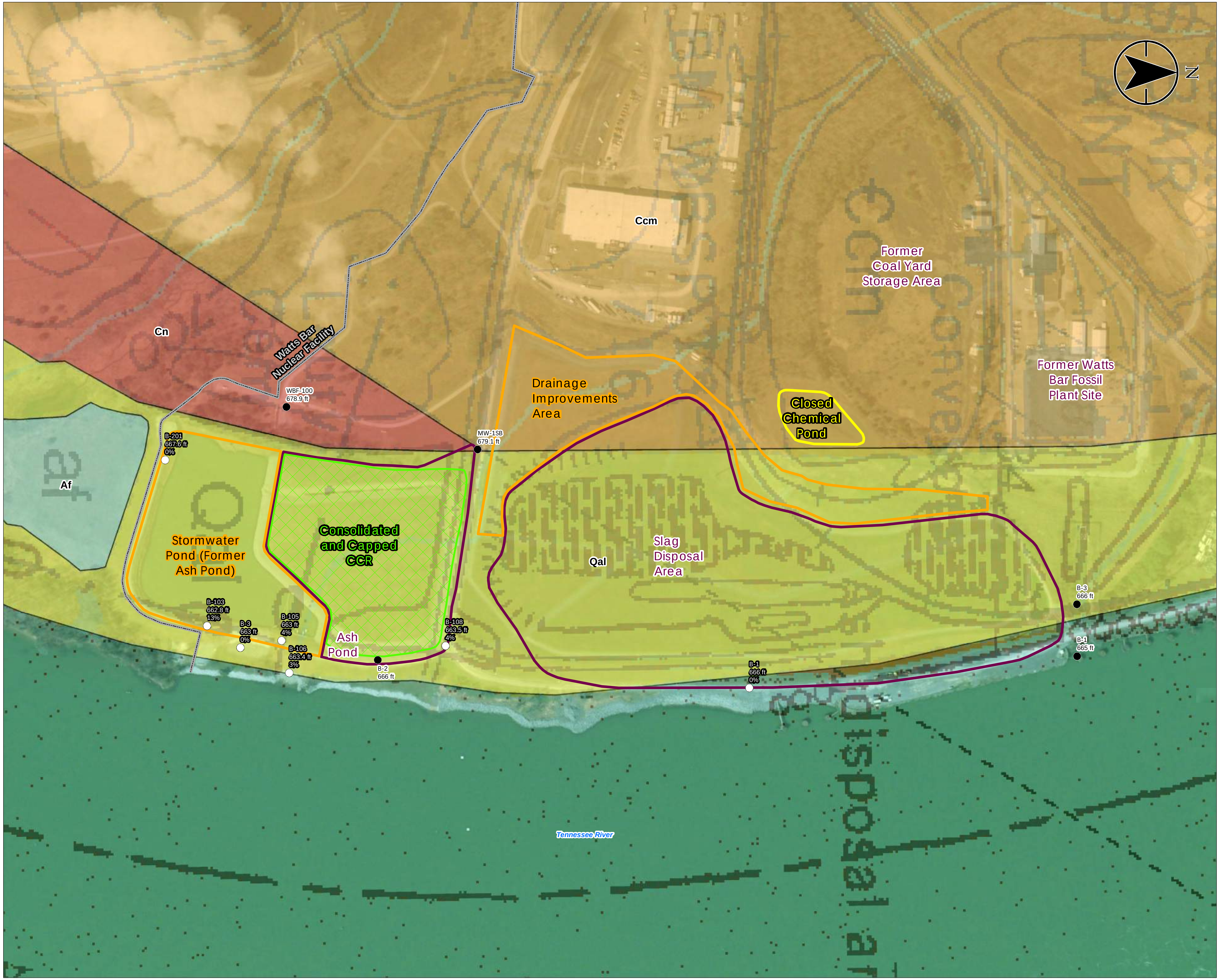


Exhibit No.
14

Title

Existing Top of Rock Elevation Boring Data

Client/Project

Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LMB on 2018-02-07
Technical Review by TG on 2018-02-07

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

Legend

- ● Borings without Rock Core Data [ID & TOR Elevation]
- ○ Borings with Rock Core Data [ID, TOR Elevation, RQD]
- Watts Bar Nuclear Facility Boundary
- ☐ CCR Unit Area (Approximate)
- ☐ Closed Chemical Pond (Approximate)
- ▨ Consolidated and Capped CCR Area (Approximate)
- ☐ Drainage Improvements Area; Stormwater Pond (Former Ash Pond)
- ☐ Af - Artificial Fill
- ☐ Qal - Surficial Deposits
- ☐ Ccm - Conasauga Middle Group
- ☐ Cn - Nolichucky Shale

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by ESRI Imagery
3. Geologic Map: USGS TVA, Decatur Quaddrangle, 1973

U:\TVA-EIP\175566336\gis\mxds\WBF_TOR_Elevation.mxd Revised: 2018-02-07 By: mbough

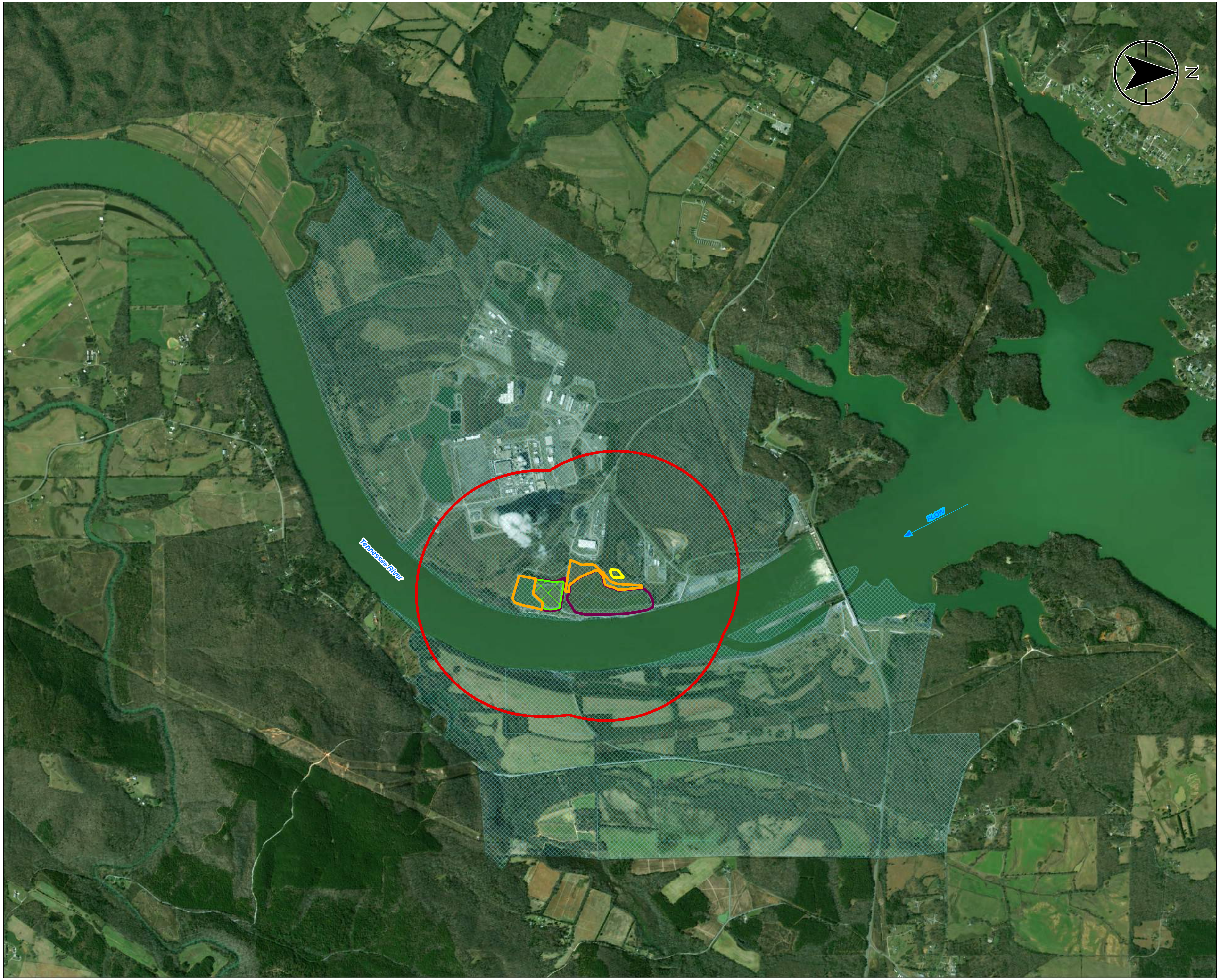


Exhibit No.
15

Title

Watts Bar 1/2 Mile Radius Map

Client/Project

Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LT on 2018-02-06
Technical Review by SB on 2018-02-06

0 1,000 2,000 3,000 4,000 Feet
1:12,000 (At original document size of 22x34)

Legend

- 🟥 CCR Unit Area 1/2 mile radius
- ▨ TVA Property
- ☐ 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 ESRI Imagery

Stantec

TVA

U:\TVA-EIP\175566336\gis\mxds\WBF-half_mile_radius.mxd Revised: 2018-02-06 By: mbough

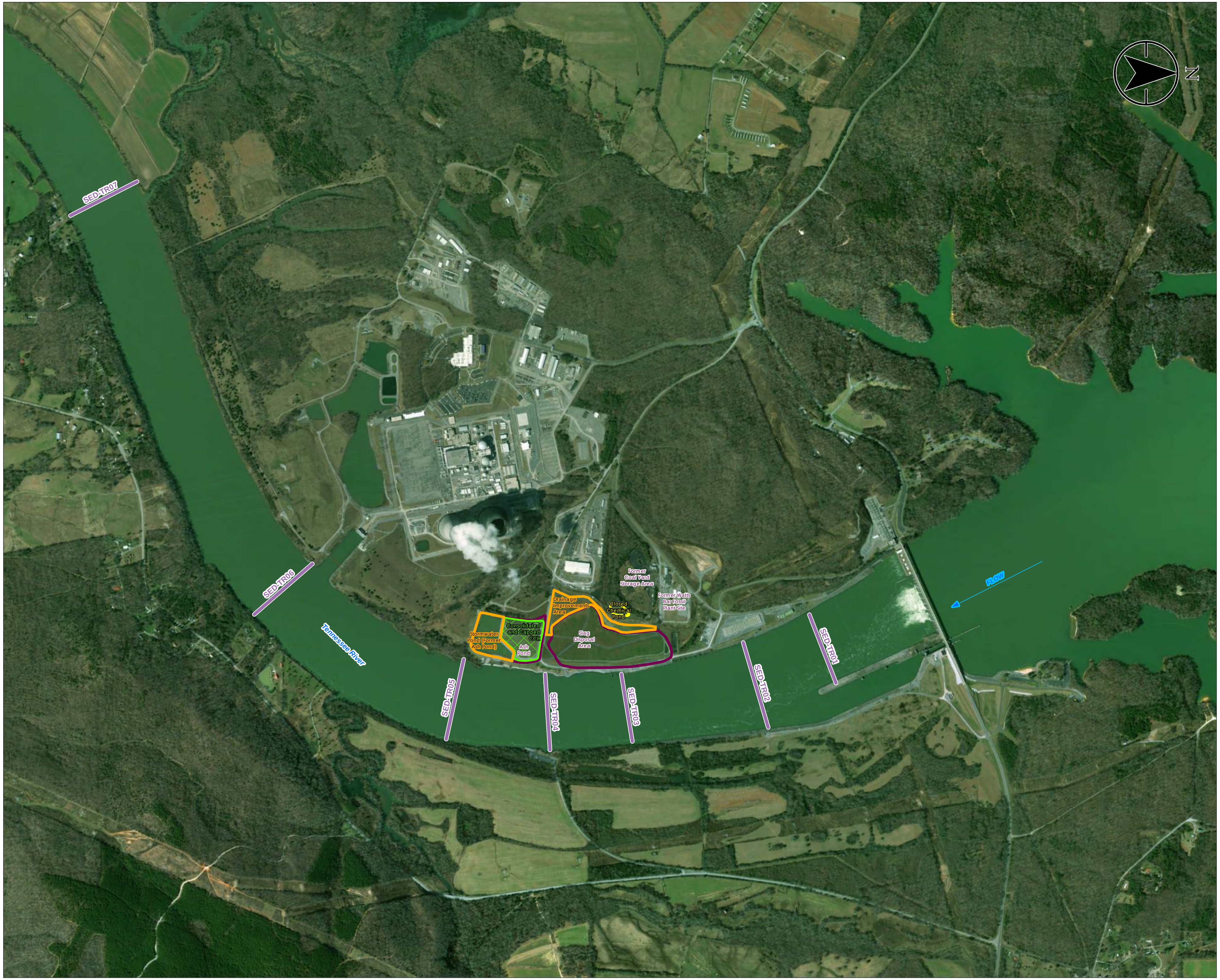


Exhibit No.
16

Title
Sediment Sampling

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2018-02-06
Technical Review by TG on 2018-02-06

0 700 1,400 2,100 2,800 Feet
1:8,400 (At original document size of 22x34)

Legend

▬	Sediment Transect
▢	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 ESRI Imagery

Stantec
TVA

U:\TVA-EIP\175566336\gis\mxds\WBF_Sediment_Sampling.mxd Revised: 2018-02-06 By: mbough

Exhibit No.
17

Title
Benthic Macroinvertebrates Sampling

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2018-02-06
Technical Review by TG on 2018-02-06

0 1,250 2,500 3,750 5,000 Feet
1:15,000 (At original document size of 22x34)

Legend

▬	Benthic Transect
▭	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 ESRI Imagery

Stantec TVA

U:\TVA-EIP\175566336\gis\mxds\WBF_Benthic_Transects.mxd Revised: 2018-02-06 By: mbough

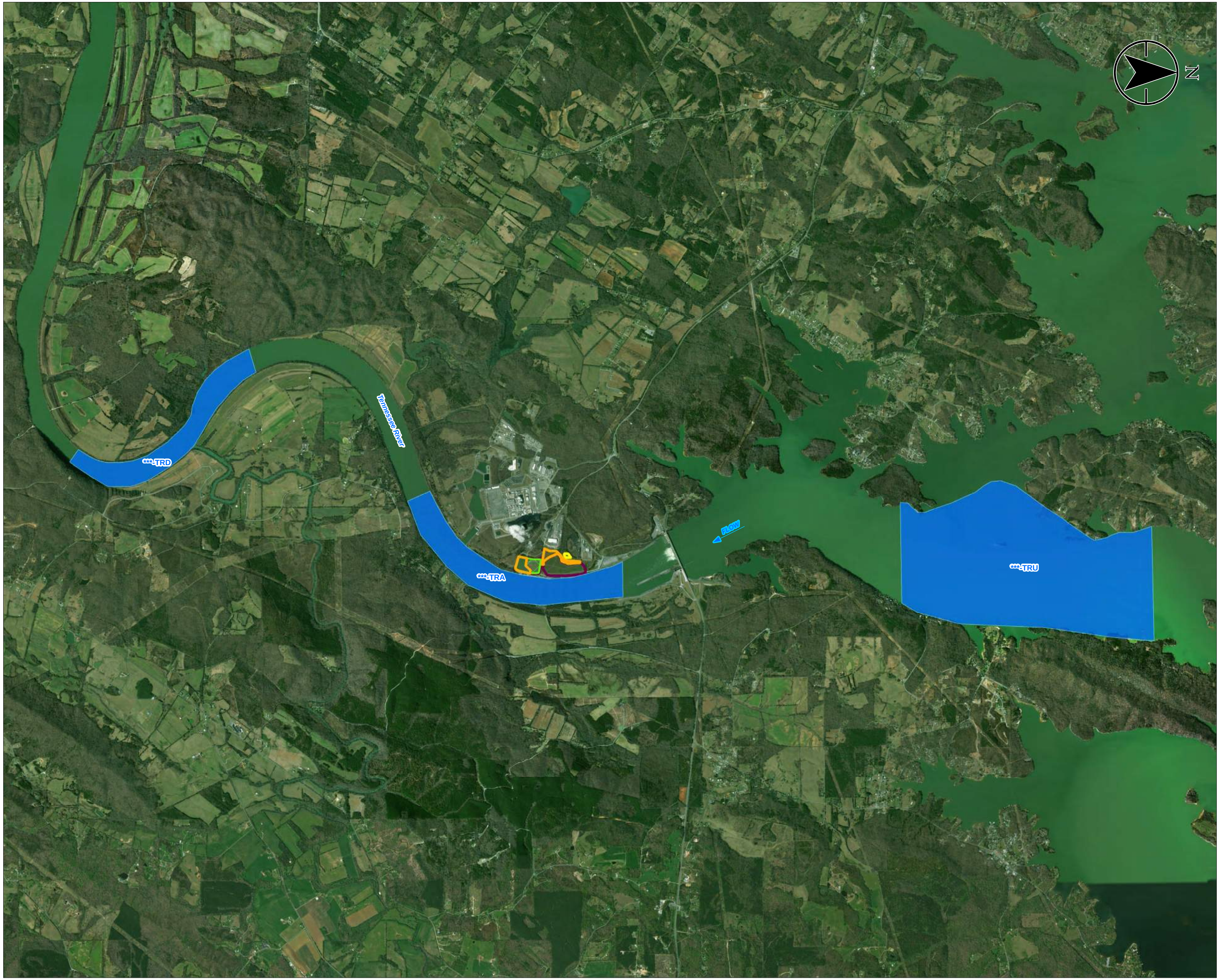


Exhibit No.
18

Title
Mayfly Sampling
Adult Mayflies, Purated Mayfly Nymphs, & Non-Purated Mayfly Nymphs

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2018-02-06
Technical Review by TG on 2018-02-06

0 2,000 4,000 6,000 8,000 Feet
1:24,000 (At original document size of 22x34)

Legend

🟦	Mayfly Sample Location
🟪	CCR Unit Area (Approximate)
🟨	Closed Chemical Pond (Approximate)
🟩	Consolidated and Capped CCR Area (Approximate)
🟧	Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

Notes
1. *** Adult Mayflies, Purated Mayfly Numphs, and Non-Purated Mayfly Nymphs; sampled at each location, samples at each location will have a unique ID sample Biota Matrix Code (MFA, MFP, MFN respectively).
2. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
3. Imagery Provided by ESRI Imagery

U:\TVA-EIP\175566336\gis\mxds\WBF_Mayfly_Sampling.mxd Revised: 2018-02-06 By: mbough

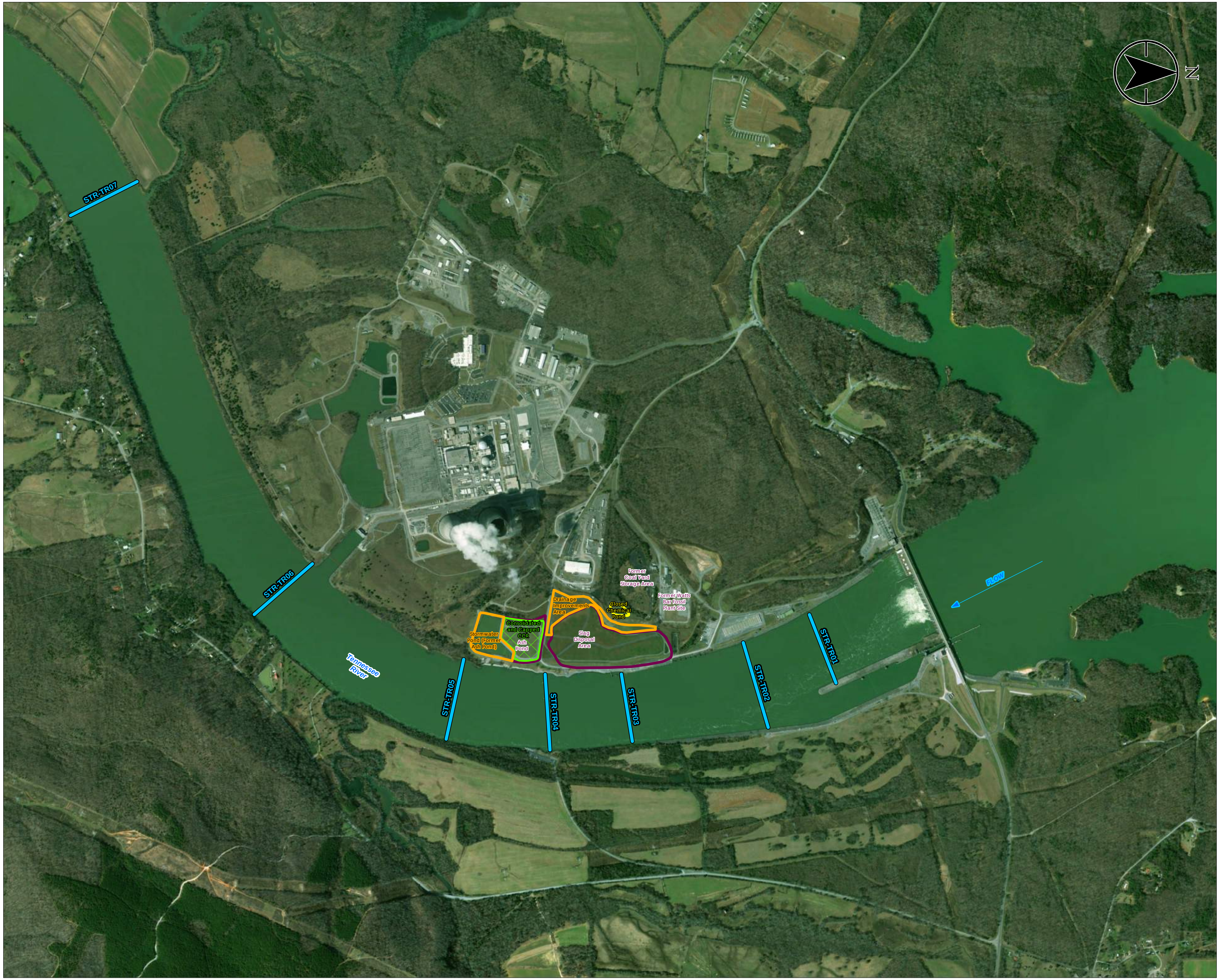


Exhibit No.
19

Title
Surface Stream Sampling

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2018-02-06
Technical Review by TG on 2018-02-06

0 700 1,400 2,100 2,800 Feet
1:8,400 (At original document size of 22x34)

Legend

▬	Stream Sample Transect
☐	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 ESRI Imagery

Stantec

TVA

U:\TVA-EIP\175566336\gis\mxds\WBF_Surface_Stream.mxd Revised: 2018-02-06 By: mbough

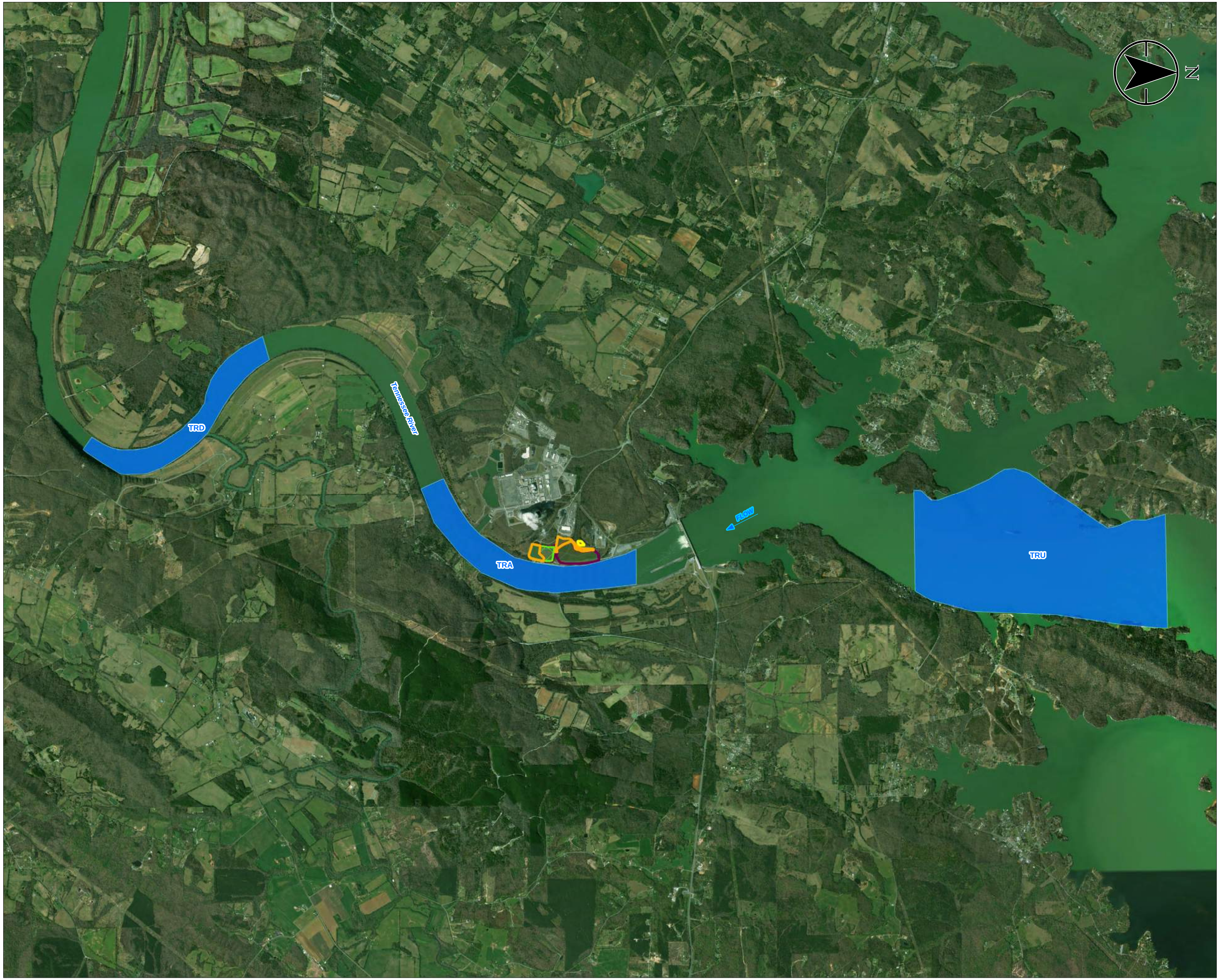


Exhibit No.
20

Title
Fish Sampling

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2018-02-06
Technical Review by TG on 2018-02-06

0 2,000 4,000 6,000 8,000 Feet
1:24,000 (At original document size of 22x34)

Legend

- 🟦 Fish Sample Location
- ☐ 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 ESRI Imagery

Stantec TVA

U:\TVA-EIP\175566336\gis\mxds\WBF_Fish_Sampling.mxd Revised: 2018-02-06 By: mbough

APPENDIX F
EXPLORATORY DRILLING SAP

Exploratory Drilling Sampling and Analysis Plan Watts Bar Fossil Plant

Revision 3

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

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

November 19, 2018

EXPLORATORY DRILLING
SAMPLING AND ANALYSIS PLAN
WATTS BAR FOSSIL PLANT

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	February 9, 2018
2	Addresses May 16, 2018 TDEC Review Comments and Issued for TDEC Review	July 6, 2018
3	Addresses Applicable Programmatic Revisions and Issued for TDEC Approval	November 19, 2018

EXPLORATORY DRILLING
SAMPLING AND ANALYSIS PLAN
WATTS BAR FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Exploratory Drilling
Sampling and Analysis Plan
Watts Bar Fossil Plant
Tennessee Valley Authority
Spring City, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: November 19, 2018 Revision 3

All parties executing work as part of this Sampling and Analysis Plan sign below acknowledging they have reviewed, understand, and will abide by the requirements set forth herein.

TVA Investigation Project Manager — 11/19/18 Date

TVA Investigation Field Lead — 11/19/18 Date

Health, Safety, and Environmental (HSE) Manager — 11-18-18 Date

Investigation Project Manager — 2018-11-13 Date

Rock J. Vitale Digitally signed by Rock J. Vitale DN: cn=Rock J. Vitale, o, ou, email=rvitale@envstd.com, c=US Date: 2018.11.14 12:27:36 -05'00'

QA Oversight Manager — Date

K. Ryan R. Jones

Laboratory Project Manager — 2018-11-13 Date

Charles L. Head
TDEC Senior Advisor — Date

Robert Wilkinson
TDEC CCR Technical Manager — Date

Stantec

Table of Contents

LIST OF TABLES

LIST OF ATTACHMENTS

ATTACHMENT A	**FIGURE**
ATTACHMENT B	**FIELD EQUIPMENT LIST**

1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at Watts Bar Fossil Plant (WBF) on April 27, 2016, at which time TVA briefed TDEC on its Coal Combustion Residual (CCR) management plans at WBF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On June 14, 2016, TDEC issued a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 22, 2017, TDEC issued a second follow-up letter to TVA regarding the TDEC Order and EIP submittal dates. On November 15, 2016, TVA submitted WBF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

Through the various information requests, as well as TDEC comments, a need for several exploratory borings at WBF (the Plant) has been identified. This Exploratory Drilling Sampling and Analysis Plan (SAP) has been prepared to outline the proposed borings and the methods to be employed during the Investigation.

2.0 OBJECTIVES

The objective of this Exploratory Drilling SAP is to outline the methods that will be used to execute the following activities:

- Where applicable, perform additional soil and rock borings, piezometer installation, and laboratory testing to refine subsurface characterization and material quantity estimates,
- Where applicable, install temporary wells to allow for pore water sampling and measuring piezometric (i.e., water) levels within CCR units.

Pore water sampling and water level readings are not within the scope of this SAP, but are addressed in other SAPs within the EIP.

Additional, future borings performed under other programs, such as EPA Final CCR Rule compliance and closure design, may be used to supplement the data necessary to respond to information requests in the EIP. However, performance of those borings is governed by other programs and is not covered herein.

3.0 HEALTH AND SAFETY

This work will be conducted under an approved Plant-specific Health and Safety Plan (HASP). This HASP will be in accordance with TVA Safety policies and procedures. Each worker will be responsible for reviewing and following the HASP. Personnel conducting field activities will have completed required training, understand safety procedures, and be qualified to conduct the field work described in this SAP. The HASP will include a job safety analysis (JSA) for each task described in this SAP and provide control methods to protect personnel. Personal protective equipment (PPE) requirements and safety, security, health, and environmental procedures are defined in the HASP. In addition, authorized field personnel will attend TVA required safety training and Plant orientation.

The Field Team Leader will conduct safety briefings each day prior to beginning work and at mid-shift or after lunch breaks and will document these meetings to include the names of those in attendance and items discussed. TVA-specific protocols will be followed, including the completion of 2-Minute Rule cards. The JSAs will be updated if conditions change.

4.0 PLANT-SPECIFIC EXPLORATION PLAN

The proposed soil and rock boring locations were selected to aid in addressing data gaps and supplementing existing data, as necessary to address information requests of the TDEC Multi-site Order for WBF. Rationale for individual cone penetration test (CPT), borings, temporary wells, and/or piezometers are discussed below. Refer to Figure 1 in Attachment A for a layout of proposed locations.

In order to address TDEC's information requests regarding CCR material quantity, water levels, CCR material characteristics, and subsurface materials, subsurface characterization will be supplemented by performing CPTs and installing multi-purpose borings at locations shown on Figure 1 in Attachment A. These additional borings will provide supplemental data relative to CCR thickness, water levels, foundation soil type and thickness, and top of bedrock elevations for the interior of the CCR units. A total of 13 borings with both vibrating wire piezometers and temporary well installations and 41 CPTs are proposed. Table 1 provides a summary of CPTs and borings proposed in each CCR unit. Table 2 lists individual CPTs and borings along with more detail about the purpose of each. If the boring for a temporary well demonstrates that the CCR is unsaturated and above the expected phreatic surface, the temporary well will not be installed, and the boring will be backfilled.

Table 1. Summary of Exploratory Drilling Proposed in each CCR Unit

CCR Unit	Total No. of Proposed CPTs	Total No. of Proposed Borings	No. of Borings with Temporary Wells	No. of Borings with Vibrating Wire Piezometers	No. of Borings with Rock Coring
Slag Disposal Area	30	11	3	4	8
Chemical Pond*	1	0*	0	0	0
Drainage Improvement Area**	10	0**	0	0	0
Ash Pond	0	2	2	0	0
Total	**41**	**13**	**5**	**4**	**8**

*The Chemical Pond is not a CCR unit, but drilling is planned to confirm that the Chemical Pond does not contain CCR backfill. A supplemental boring may be added should the CPT data be inconclusive.
**The Drainage Improvement Area is not a CCR unit, but drilling is planned to determine if the Drainage Improvement Area contains CCR material. Supplemental borings may be added should the CPT data be inconclusive.

Table 2. Detailed Boring and CPT Descriptions

Boring No.	CCR Unit	Deepest Material Encountered	Temporary Well Screen Location	VWPZ Tip Location(s)[1]	Boring Purpose[2]
B01	Slag Disposal Area	Bedrock	--	--	Geo
B02	Slag Disposal Area	Bedrock	--	CCR, Foundation Soils, Bedrock	PZ, Geo
B03	Slag Disposal Area	Bedrock	--	CCR, Foundation Soils, Bedrock	PZ, Geo
B04	Slag Disposal Area	Bedrock	--	CCR, Foundation Soils, Bedrock	PZ, Geo
B05	Slag Disposal Area	Bedrock	--	CCR, Foundation Soils, Bedrock	PZ, Geo
B06	Slag Disposal Area	Bedrock	--	--	Geo
B07	Slag Disposal Area	Bedrock	--	--	Geo
B08	Slag Disposal Area	Bedrock	--	--	Geo
TW01	Ash Pond	Foundation Soil	Sluiced Ash	--	PZ, PW, Geo
TW02	Ash Pond	Foundation Soil	Sluiced Ash	--	PZ, PW, Geo
TW03	Slag Disposal Area	Foundation Soil	CCR	--	PZ, PW, Geo
TW04	Slag Disposal Area	Foundation Soil	CCR	--	PZ, PW, Geo
TW05	Slag Disposal Area	Foundation Soil	CCR	--	PZ, PW, Geo
CPT01	Slag Disposal Area	Bedrock	--	--	Geo
CPT02	Slag Disposal Area	Bedrock	--	--	Geo
CPT03	Slag Disposal Area	Bedrock	--	--	Geo
CPT04	Slag Disposal Area	Bedrock	--	--	Geo
CPT05	Slag Disposal Area	Bedrock	--	--	Geo
CPT06	Slag Disposal Area	Bedrock	--	--	Geo
CPT07	Slag Disposal Area	Bedrock	--	--	Geo
CPT08	Slag Disposal Area	Bedrock	--	--	Geo
CPT09	Slag Disposal Area	Bedrock	--	--	Geo
CPT10	Slag Disposal Area	Bedrock	--	--	Geo
CPT11	Slag Disposal Area	Bedrock	--	--	Geo
CPT12	Slag Disposal Area	Bedrock	--	--	Geo
CPT13	Slag Disposal Area	Bedrock	--	--	Geo
CPT14	Slag Disposal Area	Bedrock	--	--	Geo
CPT15	Slag Disposal Area	Bedrock	--	--	Geo
CPT16	Slag Disposal Area	Bedrock	--	--	Geo
CPT17	Slag Disposal Area	Bedrock	--	--	Geo
CPT18	Slag Disposal Area	Bedrock	--	--	Geo
CPT19	Slag Disposal Area	Bedrock	--	--	Geo
CPT20	Slag Disposal Area	Bedrock	--	--	Geo
CPT21	Slag Disposal Area	Bedrock	--	--	Geo
CPT22	Slag Disposal Area	Bedrock	--	--	Geo
CPT23	Slag Disposal Area	Bedrock	--	--	Geo

Table 2. Detailed Boring and CPT Descriptions

Boring No.	CCR Unit	Deepest Material Encountered	Temporary Well Screen Location	VWPZ Tip Location(s)[1]	Boring Purpose[2]
CPT24	Slag Disposal Area	Bedrock	--	--	Geo
CPT25	Slag Disposal Area	Bedrock	--	--	Geo
CPT26	Slag Disposal Area	Bedrock	--	--	Geo
CPT27	Slag Disposal Area	Bedrock	--	--	Geo
CPT28	Slag Disposal Area	Bedrock	--	--	Geo
CPT29	Slag Disposal Area	Bedrock	--	--	Geo
CPT30	Slag Disposal Area	Bedrock	--	--	Geo
CPT31	Drainage Improvement Area	Bedrock	--	--	Geo
CPT32	Drainage Improvement Area	Bedrock	--	--	Geo
CPT33	Drainage Improvement Area	Bedrock	--	--	Geo
CPT34	Drainage Improvement Area	Bedrock	--	--	Geo
CPT35	Drainage Improvement Area	Bedrock	--	--	Geo
CPT36	Drainage Improvement Area	Bedrock	--	--	Geo
CPT37	Drainage Improvement Area	Bedrock	--	--	Geo
CPT38	Drainage Improvement Area	Bedrock	--	--	Geo
CPT39	Drainage Improvement Area	Bedrock	--	--	Geo
CPT40	Drainage Improvement Area	Bedrock	--	--	Geo
CPT41	Chemical Pond	Bedrock	--	--	Geo

[1] VWPZ = Vibrating Wire Piezometer (grouted in place); No temporary well installed.

[2] PZ = Piezometric (Water) Levels in CCR; PW = Pore Water Sampling; Geo = Geotechnical Data

As shown in Figure 1, eight (8) proposed borings (B01 through B08) and 12 proposed CPT soundings (CPT01 through CPT05, CPT12 through CPT15, CPT21, CPT23, and CPT24) are located within or near the Slag Disposal Area unit footprint. The purpose of these borings is to improve spatial coverage for CCR thickness, water levels, foundation type and thickness, top of bedrock elevations, and shallow bedrock characterization (via rock coring).

In select borings, vibrating wire piezometers will be grouted in place in the major material zones encountered in the boring (e.g., CCR, foundation soil(s), bedrock). These vibrating wire piezometers will allow water level (i.e., pore water pressure) readings in the various materials and improve subsurface characterization of the CCR in this vicinity. The in-situ penetration resistance measured by the CPT will be used to differentiate CCR from foundation soil and to support material quantity estimating. Pore pressure dissipation tests may be performed in select CPT soundings and in select depth intervals. Note that the exploratory drilling program at WBF does not necessitate downhole testing in rock.

A total of five (5) borings with temporary wells are proposed. Two (2) temporary wells (TW01 and TW02) are proposed within the Consolidated and Capped CCR portion of the Ash Pond and three (3) temporary wells (TW03 through TW05) are proposed within the Slag Disposal Area unit footprint. The temporary wells will be screened near the bottom of the CCR in the units, after the portion of the borehole is sealed that penetrated the foundation soils. The temporary wells are located in accessible areas of the unit interiors to improve spatial coverage for CCR thickness and water levels, and to facilitate CCR material characterization. Each of the borings will also allow undisturbed tube sampling of CCR and/or foundation soils, if needed.

As shown in Figure 1, 13 CPT soundings (CPT06 through CPT11 and CPT34 through CPT40) are proposed along the perimeters of the Slag Disposal Area and Drainage Improvement Area. These CPTs are proposed to better characterize the uppermost foundation soils in the immediate vicinity of the mapped, pre-construction stream channel. At both stream crossing locations along the perimeter, a series of closely spaced Cone Penetration Test (CPT) soundings is proposed. The CPT data, correlated to existing nearby boring logs, can be used to differentiate relatively sandy (i.e., more pervious) foundation soils, if present. Pore pressure dissipation tests will be performed in select soundings and in select depth intervals. Additional CPT soundings may be added while in the field, if further delineation becomes necessary.

During maintenance repairs to the sheet pile dock area performed in 2018, review of historic drawings indicated beneficial reuse CCR material used as backfill in the construction of the sheet pile walls. Observations during the repairs confirmed the presence of the beneficial reuse backfill. Along the sheet pile dock area to the east of the Slag Disposal Area, twelve (12) CPT soundings are proposed (CPT16 through CPT20, CPT22, and CPT25 through CPT30). The purpose of these CPTs is to quantify the volume of beneficial reuse CCR material used as backfill in the construction of the sheet pile dock area. Additionally, these CPTs will improve spatial coverage for CCR thickness, water levels, foundation type and thickness, and top of bedrock elevations. Additional CPT soundings may be added while in the field, if further delineation becomes necessary.

In the Drainage Improvement Area, three (3) CPT soundings (CPT31 through CPT33) are proposed. The purpose of the CPTs is to determine if CCR material is present within this footprint. The in-situ penetration resistance measured by the CPT will be used to differentiate CCR from foundation soil, and to support material quantity estimating. Additionally, one (1) CPT sounding (CPT41) is proposed in the interior of the closed Chemical Pond. The purpose of this CPT is to confirm that the pond footprint does not contain CCR (historical TVA documents are unclear if soil or CCR was used as fill during closure). If CPT results are inconclusive, supplemental borings may be added to sample the subsurface material.

Borings will be advanced using a conventional rotary drill rig with standard penetration test (SPT) and undisturbed (Shelby) tube sampling, then rock coring will be performed in select borings for shallow bedrock characterization. SPT samples will be collected for general soil and CCR characterization. Undisturbed tube samples will be collected for laboratory testing. Rock coring in select borings will be performed to obtain approximately 10 feet of rock core to characterize the bedrock beneath the CCR units.

5.0 SAMPLE COLLECTION AND FIELD ACTIVITY PROCEDURES

This section provides details of procedures that will be used to advance borings, collect soil and rock samples, install instruments, backfill borings, document field activities, and assist in providing scientifically defensible results.

Exploratory Drilling activities will adhere to applicable ASTM standards and TVA Environmental Technical Instruction (TI) documents. The field geologist/engineer will maintain a project field book and field forms (hard copy or electronic) to record field measurements and observations. Field activities will be documented in accordance with Section 5.2.3.

5.1 PREPARATION FOR FIELD ACTIVITIES

Truck or track-mounted CPT rigs and/or drill rigs are proposed to advance borings for this exploration phase of the Investigation. The boring locations will be located and field utility cleared by TVA and/or Contractor personnel (using a field surveyor and the Excavation Permit process) prior to mobilizing the drill crews.

As part of field mobilization activities, the field sampling team will:

- Designate a Safety Officer and a Tennessee licensed professional engineer or professional geologist.

- Complete required health and safety paperwork and confirm field team members have completed required training.

- Coordinate activities with the drill crew(s).

- Clear Access – Proposed boring locations will be marked using a wooden stake or survey flag with the position surveyed using the global positioning system (GPS). Suitability of each location will be evaluated for logistical issues including access, grubbing needs, overhead utility clearance, and proximity to Plant features. Access improvements, including clearing and grubbing or road building, will be completed prior to the investigation start date.

- If a boring will penetrate an engineered final cap component (e.g., low hydraulic conductivity soil layer, geosynthetic cap system, or vegetative soil layer), a temporary penetration will be prepared to allow drilling access. When applicable, field work plans will include detailed procedures for creating this temporary penetration.

- Perform Environmental Review - As required by the National Environmental Policy Act (NEPA), an environmental review must be completed to document and mitigate any potential impact of the work described herein. The level of review required for this work is anticipated to be a categorical exclusion, which would be documented by TVA with a categorical exclusion checklist (CEC). A CEC has a number of signatories from TVA. It is understood that the environmental review is to be completed before implementation of the field work. Additionally, plant staff will not issue an excavation permit ahead of the completed environmental review.

- Complete Utility Locate(s) / Excavation Permit(s) - Prior to initiating subsurface activities, subsurface utility clearance will be sought via the plant engineering department and/or the TN 811 service. At locations within the Plant, engineering will provide primary utility clearance assurance in addition to TN 811 being notified. At all other drilling locations, TVA or 3rd party underground locators will be engaged to clear boring locations. An excavation permit is required prior to initiating any digging or boring at the Plant. A key component to the completion of the excavation permit is consensus on the drilling locations with pertinent TVA staff.

- Identify Water Source – During implementation of the EIP, a source of potable water will be required to complete several investigation tasks, including certain drilling methods and decontamination procedures.

- Obtain required functional and calibrated field instruments, including health and safety equipment.

5.2 SAMPLING METHODS AND PROTOCOLS

TVA proposes to perform disturbed soil sampling (i.e., split-spoon sampling) and rock coring (only where specified) for the Investigation. Undisturbed soil sampling (Shelby tube) may be performed in selected borings if observed subsurface conditions and testing needs warrant. The sampling will allow TVA to develop a better understanding of the subsurface profile within the CCR and foundation materials and provide samples for subsequent laboratory testing to characterize materials. For geotechnical investigation borings and piezometer installations, a Tennessee licensed professional geologist (PG) or professional engineer (PE) will be present and will log the borings. The PG or PE will have suitable experience in geotechnical or geological engineering projects to support the work. This approach has been used at current investigations at other TVA Plants in Tennessee.

5.2.1 Drilling, Logging, and Surveying

5.2.1.1 Exploratory Borings

CPTs will be advanced using truck- or track-mounted rigs and data collected per ASTM D5778. Borings will be advanced using truck- or track-mounted rotary drill rigs. The borings are proposed to be advanced utilizing hollow-stem augering techniques (ASTM D6151) until boring termination depth or auger refusal, whichever is shallower. In some situations, drilling with a casing advancer may be a suitable alternative to augering.

If needed due to high water levels or underlying soils in the field, drilling will be performed using mud rotary techniques. Temporary casing will be set for mud circulation purposes and an upward discharge drag bit connected to drill rods will advance the boring through the soil materials.

The upward discharge bits are designed to direct the drilling fluid and cuttings upward and out of the boring. The drilling fluids are conveyed to the surface and into a recirculation tub where the suspended drill cuttings can settle out.

The recirculation tub employs a series of baffles to promote settling of the suspended particles allowing recirculation (recycling) of the drilling mud. The drilling fluid density and viscosity will be monitored at approximate 15-foot depth intervals using a mud balance and Marsh funnel, respectively.

If borings are to be advanced into rock, upon completion of drilling in overburden, temporary casing will be installed and seated into competent rock. The purpose of the casing is to separate the bedrock from the overburden (including saturated zones of CCR) while rock coring is performed and drilling fluid (water) is circulated. Appropriate drilling methods will be selected to seat the casing and achieve the objective of separating saturated CCR from bedrock. Rock coring tools will be inserted through the casing and coring will be performed in bedrock to the bottom of the hole. The diameters of drill tooling will be as necessary to facilitate soil sampling, rock coring, and/or temporary well installation.

5.2.1.2 Borehole Logging

The field geologist/engineer will prepare a written or electronic field log for each boring. In addition to describing each recovered soil or rock sample, the log will document boring location, drilling personnel, tooling/equipment used, drilling performance, depth to water, sample number, sample recovery, SPT blow counts, Rock Quality Designation (RQD), and other relevant observations. Soil color will be logged per the appropriate Munsell soil color chart.

Similarly, the field geologist/engineer will prepare a written or electronic installation log for each vibrating wire piezometer or temporary well. The log will document location, materials, depth, depth interval for each backfill material, and surface completion details (protective casing, concrete pad, bollards, etc.).

Field documentation will also be prepared for development and slug testing of each temporary well.

5.2.1.3 Surveying

Once completed, borings will be surveyed for horizontal and vertical control by survey grade GPS. The final survey of each location will be conducted following completion and abandonment of each individual sampling location. The survey data will be added to the final boring logs once available.

5.2.2 Field Equipment Description, Testing/Inspection, Calibration, and Maintenance

A list of anticipated equipment for the field activities described herein is provided as Attachment B. A final list of equipment will be prepared by the Field Team Leader, and approved by TVA, prior to mobilization. Field equipment will be inspected, tested, and calibrated (as applicable) prior to initiation of fieldwork by Field Sampling Personnel and, if necessary, repairs will be made prior to equipment use. If equipment is not in the proper working condition, that piece of equipment will be repaired or taken out of service and replaced prior to use. Additional information regarding field equipment inspection and testing is included in the QAPP.

5.2.3 Field Documentation

Field documentation will be maintained in accordance with TVA TI ENV-05.80.03*, Field Record Keeping* and the QAPP. Field documentation associated with investigation activities will primarily be recorded in Plant-specific field forms, logbooks and/or on digital media (e.g., geographic information system (GIS)/GPS documentation). Additional information regarding field documentation is provided below and included in the QAPP and TVAs TIs.

5.2.3.1 Daily Field Activities

Field observations and measurements will be recorded and maintained daily to chronologically document field activities, including sample collection and management. Field observations and measurements will be recorded in bound, waterproof, sequentially paginated field logbooks and/or on digital media and field forms.

Deviations from applicable work plans will be documented in the field logbook during sampling and data collection operations. The TVA Technical Lead and the QA Oversight Manager or designee will approve deviations before they occur.

5.2.3.2 Field Forms

Plant-specific field forms will be used to record field measurements and observations for specific tasks. Boring log forms (hard copy or electronic) will be used to document lithologic conditions and field observations at each boring location.

5.2.3.3 Photographs

In addition to documentation of field activities as previously described, photographs of field activities will also be used to document the field investigation. A photo log will be developed, and each photo in the log will include the location, date taken, and a brief description of the photo content, including direction facing for orientation purposes.

5.2.4 Collection of Samples

5.2.4.1 Standard Penetration Test Sampling

The Standard Penetration Test (SPT) samples will provide information for developing the field boring logs/soil profiles, and soil specimens for laboratory natural moisture content and index testing. The SPT sampling will be conducted in accordance with ASTM D 1586 *Standard Method for Penetration Testing and Sampling for Soils*, and consists 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.

In certain cases, larger diameter sampling devices (e.g., 3-inch diameter split-spoon samplers) may be utilized to obtain disturbed samples. Applications of larger samplers may include obtaining larger quantity of material per depth interval or collecting material with larger particles (e.g., gravel too large for SPT sampling). Although similar to an SPT sample, the in-situ penetration resistance is not equivalent to a SPT blowcount (i.e., SPT N-value).

5.2.4.2 Shelby Tube (ST) Sampling

The guidelines for performing ST sampling for geotechnical investigations are found in ASTM D 1587 and United States Army Corps of Engineers (USACE) Engineer Manual EM 1110-1-1804 *Geotechnical Investigations,* Appendix F. The USACE manual is intended as a guide of commonly accepted soil sampling practices and procedures used by geotechnical personnel performing field sampling operations for earthen dams.

5.2.4.3 Rock Core Sampling

Rock coring (only where specified) will be performed in select borings to provide samples that can be visually examined to characterize the rock strata type and structure. Rock coring will be performed in accordance with ASTM D 2113.

5.2.5 Preservation and Handling

5.2.5.1 SPT Samples

SPT samples will be logged and placed in glass jars. Once each jar is filled, the rim and threads will be cleaned, the jar capped, and a label (Section 5.2.5.4) will be applied to the jar. Each sample container will be checked to ensure that it is sealed, labeled legibly, and externally clean before placing the sample container in a box for transport.

5.2.5.2 Shelby Tube Samples

Upon extraction of a ST sample from the boring, the tube will be carefully handled to prevent disturbance. After logging the sample recovery and describing the soil that is visible at the end of the tube, the ends will be labeled (top and bottom), sealed and capped. The top and bottom of each tube will be sealed with molten microcrystalline petroleum wax. Expandable O-ring packers may be used in lieu of wax seals. Plastic caps will be placed at each end of the tube and will be sealed with electrician tape. Each tube will be labeled (Section 5.2.5.4) and stored upright in a rack (Section 5.2.5.5).

5.2.5.3 Rock Core Samples

The recovered rock core specimens will be placed in labeled, wooden core boxes. The core boxes will be protected from the weather and transported to an appropriate on-site or off-site storage facility.

5.2.5.4 Sample Labels and Identification System

Each SPT jar and ST will have a sample label affixed. Sample labels will contain the following information recorded in waterproof, non-erasable ink. Rock core boxes will have similar information written directly on the wooden core box in waterproof, non-erasable ink:

- Project number
- Sample location
- Boring ID number
- Depth of sampling interval

- Date of sample collection
- Sampler's initials

5.2.5.5 Packaging and Shipping

At appropriate intervals, assigned personnel will transport the samples to the testing laboratory or designated storage facility. SPT and other disturbed bulk samples (if any) will be treated as Group B samples as discussed in ASTM D4220.

The Shelby tubes will be stored vertically in padded racks constructed in accordance with ASTM D4220. Based on anticipated weather conditions during sampling operations, care will be taken in the storage of the samples to guard against the samples being exposed to extreme heat or cold. Prior to transport, the tubes will be transferred to a custom box built in accordance with ASTM D4220 guidelines for transporting Group D type soil samples.
Core boxes will be stacked for stable, secure transport to the laboratory, on-site, or off-site storage facility.

5.2.6 Sample Analyses

Select soil samples obtained during the geotechnical investigation will be subjected to geotechnical laboratory testing. Testing will be assigned to characterize the predominant CCR and soil materials recovered in each boring. The laboratory tests will be performed in accordance with applicable ASTM standard testing procedures.

The laboratory analyses are expected to include natural moisture content determinations (D2216), sieve and hydrometer analyses (D422), specific gravity (D854), and Atterberg Limits (D4318). The results of the testing will be used to assist in subsurface characterization and correlation with existing data. If other tests are found to be necessary, they will also be performed in accordance with applicable ASTM standard testing procedures. The Plant-specific laboratory testing program will be developed based on the recovery and spatial distribution of samples from the drilling and sampling program.

5.2.7 Equipment Decontamination Procedures

The decontamination procedures below apply to drilling and sampling in borings for temporary wells. For drilling and sampling in all other borings, as well as for all cone penetration testing, decontamination (per procedures listed in TVA TI ENV-05.80.05, Field Sampling Equipment Cleaning and Decontamination) will only occur before the first boring/CPT and after the last boring/CPT.

Documented decontamination will be performed for drilling equipment, tooling, and instruments in contact with subsurface materials in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination* to prevent cross-contamination. Decontamination pads will be constructed for decontamination of large downhole tooling (augers, drill rods, etc.) using a high-pressure washer/steam cleaner.

Decontamination pads will be constructed at locations designated by TVA personnel using poly sheeting with sufficient berms to contain decontamination fluids and prevent potential runoff to uncontrolled areas. Following decontamination, fluids will be disposed of in accordance with Section 5.2.8. Decontamination activities will be performed away from surface water bodies and areas of potential impacts.

Decontamination of non-disposable sampling equipment or instruments can be performed using potable water and Liquinox® or other appropriate non-phosphatic detergent in 5-gallon buckets.

Decontamination of sampling equipment and instrument (e.g., split spoons, water level meters, pumps for well development, etc.) will be performed prior to use and between sampling locations. Decontamination activities will be documented in the logbook field notes. Additional information regarding equipment decontamination procedures is located in the QAPP.

5.2.8 Waste Management

Investigation derived waste (IDW) generated during implementation of this Sampling and Analysis Plan may include, but is not limited to:

- Soil cuttings
- Rock cuttings
- Drilling mud
- Well development water
- Personal Protective Equipment
- Decontamination fluids
- General trash

IDW will be handled in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination,* the Plant-specific waste management plan, and local, state, and federal regulations. Transportation and disposal of IDW will be coordinated with TVA Plant personnel.

5.3 DOWNHOLE TESTING IN ROCK

5.3.1 Downhole Geophysics

In proposed borings with rock coring, the following suite of geophysical analyses will be performed (only where specified) to investigate groundwater conditions deeper in the bedrock.

Acoustic Televiewer: This tool generates an image of the borehole wall by transmitting acoustic pulses from a rotating sensor and records the subsequent amplitudes and travel times reflected at the borehole wall giving an unwrapped and continuous image of the borehole and allows for the mapping and evaluation of fractures. The acoustic televiewer requires a fluid filled borehole as the fluid transmits the acoustic signal and data can only be collected in open borehole sections.

Heat Pulse Flow Meter: This instrument will measure the vertical direction and flow rate of fluids in a borehole. The instrument is lowered to a desired depth, typically above and below a known fracture, at which point a heat grid is released from the instrument into the water.

The travel time of the heat grid to either the sensor above or below is measured and used to calculate a flow rate.

Gamma: Natural gamma (or gamma) logging uses the scintillation properties of certain crystals to detect the presence of gamma radiation from unstable isotopes in the formations adjacent to the well or borehole. In aquifers that are not contaminated by artificial radioisotopes, the most significant naturally-derived radioisotopes that emit gamma radiation are potassium-40 (K40) and daughter products of the uranium and thorium series. It can be used in fluid filled or dry boreholes and is used for lithologic and stratigraphic correlation.

Fluid Resistivity log: Records the electric resistivity of water in the borehole. Changes in fluid resistivity reflect differences in dissolved-solids concentration of water. Fluid-resistivity logs are useful for delineating water-bearing zones and identifying vertical flow in the borehole.

Caliper Log: The caliper arms expand or contract to measure the diameter of the borehole as the probe is pulled up through the borehole. Surface equipment records the measurements transmitted up to the ground surface through the cable attached to the probe. Changes in diameter of the borehole indicate the size and location of fractures or irregularities caused by drilling or lithology. Often the caliper tools are not sensitive enough to detect small but hydraulically important fractures and it may not detect vertical fractures intersected by the borehole, unless one of the caliper arms happens to align with the vertical fracture.

In addition, pH, dissolved oxygen, temperature, and groundwater conductivity will be measured in the pilot holes. The purpose of these measurements is to provide a qualitative profile of changes in these parameters that might indicate the presents of different waters. Logs of these parameters are useful for delineating water-bearing zones and identifying vertical flow in the borehole between zones of differing hydraulic head penetrated by wells. Borehole flow between zones is indicated by changes in values of the parameters as instruments are lowered into and raised from the pilot holes.

5.3.2 Pressure Testing

Upon completion of rock coring and downhole geophysical testing (only where specified), targeted pressure testing (packer tests) will be conducted to provide a measure of hydraulic conductivity of bedrock. The intervals to be tested will be selected based on results of the geophysical tests. TVA proposes that downhole water pressure tests (or field hydraulic conductivity tests) be performed in each rock core boring. These tests work by isolating an identified interval (generally a ten-foot interval) of the borehole with inflatable rubber packers.

Potable water is then pumped into the interval at constant pressure for typically five minutes with volume of water lost being measured using a flow meter. The hydraulic conductivity values are then calculated from the field data using an appropriate formula that may be based on the rate of flow into the formation at each location.

5.4 WELL INSTALLATION AND BACKFILLING

After a boring is advanced to its intended bottom depth, one of the following actions may be taken:

- Backfill the borehole without installing a well or a vibrating wire piezometer.
- Install a vibrating wire piezometer and backfill the borehole around the instrument.
- Install a temporary well and backfill the annular space around the well materials,

In some cases, the lower portion of a borehole may be backfilled, followed by installing a vibrating wire piezometer or temporary well in the upper portion.

If a boring penetrates an engineered component (e.g., low hydraulic conductivity soil layer, geosynthetic cap system, or vegetative soil layer), these interval(s) will be backfilled such that equivalent or better performance is maintained. When applicable, field work plans will include procedures for repair of geosynthetics, protection around well riser pipes, and quality control monitoring and testing of such repairs.

5.4.1 Backfilling Boring without Instrumentation

Borings that do not include instrumentation (i.e., temporary well or vibrating wire piezometer) will generally be backfilled with a bentonite-cement grout. A tremie pipe will be lowered to the bottom of borehole and grout will be injected as the drilling tools are removed, to displace water and cuttings to appropriately seal the boring. Stage grouting is not anticipated due to the modest depths. Backfill grout will use the following mix:

- 30 gallons of water
- 94 lbs. of Portland Cement
- 25 lbs. of Bentonite
- This will produce a mix with a Water: Cement: Bentonite (W: C: B) ratio (by weight) of 2.5: 1.0: 0.3

If highly permeable zones are encountered (e.g., fractured rock), the grout mixture may be thickened. Bentonite pellets may be used to seal a permeable zone before resuming grouting above such a zone.

5.4.2 Temporary Wells

Within the context of the EIP, a temporary well may be used for measuring water levels, as well as obtaining pore water samples for analytical testing. Although constructed in the same way as a monitoring well, a temporary well serves a unique purpose for a limited duration and is thus differentiated in name.

Temporary wells will be installed by qualified drill crews using rotary or sonic drill units working under the direction of a licensed Tennessee driller. Additionally, field supervision will be provided by a Tennessee licensed PG or PE. The PG or PE will have suitable experience in geotechnical or geological engineering projects to support the work. This approach has been used at current investigations at other TVA Plants in Tennessee.

Temporary wells will be installed in accordance with TVA TI ENV-TI-05.80.25, *Monitoring Well and Piezometer Installation and Development*. Exact depth/location of each screen will be determined based on as-drilled conditions. A temporary well installation record will be drafted for each well and will include notes and details of the installation procedures.

5.4.2.1 Materials and Installation

The temporary wells will be installed using current industry and regulatory protocols to reduce potential for introducing contaminants during the drilling and installation process. Decontamination processes will be in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*. These procedures include, in part, decontamination of the drilling equipment and tools before and after each well by washing with hot, potable water delivered under high pressure, using new well screen and riser that have been cleaned and sealed in plastic at the factory, and placing washed filter pack sand that is certified by NSF International. Other steps employed during the installations include the workers donning clean, nitrile gloves during the handling of downhole equipment and well materials, and using potable water for grouting purposes.

A temporary well will consist of a four-inch diameter Schedule 40 PVC well screen (0.010-inch slots) and riser. The screen and riser will consist of flush-joint, threaded PVC pipe. The screen length will be selected based on the results of the boring and the target stratum, but will not be longer than 10 feet. A pre-packed well screen may be used. A four-inch diameter Schedule 40 PVC bottom well plug measuring approximately six inches in length will be threaded onto the bottom of the screen. The PVC riser will extend above (2.5 feet minimum) the ground surface and will be capped with a temporary plug or slip cap. The annular space will be backfilled with a sand filter pack (20/40 mesh) extending a minimum of two feet above and six inches below the screen.

A minimum two-foot thick bentonite pellet seal will be placed on top of the sand filter pack. After the bentonite pellet seal has sufficiently hydrated, (minimum of 8 hours of hydration time when using cement grouts above the seal), the remaining annular space will be backfilled with a non-shrink, bentonite-cement grout.

It should be noted that the grout will be placed by tremie method through one-inch (minimum) diameter PVC pipe. The grout will be placed using pumps gauged to allow the installation crew to monitor pressures during the grouting process. In open (uncased) boreholes, the sand filter zones and bentonite pellets will be placed by tremie method through one-inch (minimum) diameter PVC. In cased boreholes (i.e., through hollow-stem augers or temporary casing), the sand filter zones and bentonite pellets may be placed by tremie method or may be poured slowly into the annular space of the drill tooling to prevent bridging.

If vibrating wire piezometers became necessary, one or more transducers (at multiple depths, if needed) can be installed in a boring and grouted in-place. These grouted in-place piezometers (GIPPs) will be attached to a sacrificial one-inch (minimum) diameter PVC pipe. The boring will be backfilled using the bentonite-cement grout described previously, placed by the tremie method.

If the well is not to be installed at the bottom of the borehole, the lower portion of the hole will be backfilled with bentonite-cement grout or bentonite pellets. After the grout cures enough to support the weight of the overlying well materials and backfill, the well can be installed above the grouted zone.

Subsequent wellhead construction will consist of an above-grade, steel locking protective cover anchored to a concrete surface pad. The protective cover will extend above the concrete pad and the annular space will be filled with sand or pea gravel to about six-inches below the top of PVC casing. Steel protective bollards filled with concrete will be installed near each corner of the concrete pad. If the installation is only expected to be used for a relatively short duration and it is located in an area of little vehicular activity (i.e., low risk of damage), the surface protection may be modified to allow for easier removal when the instrument is no longer needed. The top of each well casing will be surveyed and correlated to the vertical datum used by the Plant.

An example installation log is shown in Figure 2. A drawing of the wellhead construction is shown in Figure 3.

5.4.2.2 Well Development

Each new well will be developed by a combination of bailing, surging, and pumping after a minimum of 24 hours following completion. Equipment will be decontaminated per TVA TI ENV-TI-05.80.05. First, a bailer will be lowered and raised within the screened intervals to create a slight surging action to dislodge particles within the wells and sand filter packs. A baseline reading of turbidity, pH, temperature, and specific conductance will be measured using properly calibrated Oakton® turbidity and PCSTestr 35 water testing meters (or equivalents). If the well contains heavy sediment, further bailing will be performed before continuation of development with surge blocks and submersible pumps.

A surge block will be used within the screened interval to move water and particles through the screen and sand filter packs. This process may be repeated several times to decrease the water turbidity within the wells.

Lastly, a submersible pump will be employed to further develop the wells until an acceptable level of turbidity is achieved. Target turbidity value of less than or equal to ten (10) Nephelometric turbidity units (NTUs) will be utilized for temporary wells per TVA TI ENV-TI-05.80.42. If the target turbidity value cannot practically be achieved, well development will be conducted according to the requirements listed in TVA TI ENV-TI-05.80.25, *Monitoring Well and Piezometer Installation and Development*.

5.4.2.3 Slug Testing

After development, TVA will perform a slug test in each temporary well to measure hydraulic conductivity. Equipment will be decontaminated per TVA TI ENV-TI-05.80.05. The slug tests will be performed in accordance with ASTM D 4044, *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 will be used to collect water level information from the wells.

As part of the slug testing, each well will be 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 has been installed and the water level stabilizes, a solid slug (e.g., PVC pipe filled with sand) will be introduced into the well to cause a nearly instantaneous change in the water level. The water levels will then be recorded at regular intervals until reaching near static levels. After reaching static levels, the test will be terminated and a second slug test will be conducted by instantaneously removing the slug and monitoring water levels until static levels are reached again. The results will be recorded electronically and downloaded into a data collector. Raw data will be checked in the field for discrepancies prior to demobilizing from the Plant.

The field data, once collected and returned to the office, will be reduced using a software program to estimate the hydraulic conductivity of the in-situ soils.

5.4.3 Monitoring and Sampling

Monitoring and/or sampling of temporary wells is not addressed in this SAP. Refer to the CCR Material Characteristics SAP.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

The QAPP describes quality assurance (QA)/quality control (QC) requirements for the overall Investigation. The following sections provide details regarding QA/QC requirements specific to Exploratory Drilling.

6.1 OBJECTIVES

The Data Quality Objectives (DQOs) process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA and the Investigation Project Manager considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts for the Investigation.

Specific quantitative acceptance criteria for analytical precision and accuracy for the matrices included in this investigation are presented in the QAPP.

6.2 QUALITY CONTROL CHECKS

The accuracy of the drilling, temporary well installation and slug testing processes must be maintained throughout the investigation. In addition, planned drilling and installation methods must be confirmed during field activities to provide confidence that porewater samples and water level measurements collected as part of other SAPs provide representative analytical results and data.

Field personnel will be responsible for performing checks to confirm that the SAP has been followed. This consists of the completion of applicable field forms and documentation of field activities.

6.3 DATA VALIDATION AND MANAGEMENT

As stated in the EIP, a QAPP has been developed such that environmental data are appropriately maintained and accessible to data end users. The field investigation will be performed in accordance with the QAPP. Laboratory analytical data will be subjected to data validation in accordance with the QAPP. The data validation levels and process will also be described in the QAPP.

7.0 SCHEDULE

Anticipated schedule activities and durations for the implementation of this SAP are summarized below. This schedule is preliminary and subject to change based on approval, field conditions, and weather conditions. For the overall EIP Implementation schedule, including anticipated dates, see the schedule provided in the EIP.

Table 3. Preliminary Schedule for Exploratory Drilling SAP Activities

Project Schedule		
Task	**Duration**	**Notes**
Exploratory Drilling SAP Submittal		Completed
Prepare for Field Activities	20 Days	Following EIP Approval
Conduct Field Activities	100 Days	Following Field Preparation
Laboratory Analysis (if any)	40 Days	Following Field Activities
Data Validation	30 Days	Following Lab Analysis

8.0 ASSUMPTIONS AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- Assessment of suitability of areas and access to borings, including clearing and grubbing, will be completed prior to the exploration start date.

- Sampling methods and field locations may be adjusted based on actual field conditions. Changes made in the field will be reported in the Environmental Assessment Report (EAR) as appropriate.

- Well screen and riser pipe dimensions may be adjusted based on actual field conditions and sampling needs. Changes made in the field will be reported in the EAR as appropriate.

9.0 REFERENCES

Tennessee Valley Authority (TVA). 2017a. "Field Record Keeping." Technical Instruction ENV-TI-05.80.03. March.

Tennessee Valley Authority (TVA). 2017b. "Field Sampling Equipment Cleaning and Decontamination." Technical Instruction ENV-TI-05.80.05. March.

Tennessee Valley Authority (TVA). 2017c. "Monitoring Well and Piezometer Installation and Development." Technical Instruction ENV-TI-05.80.25. May.

United States Army Corps of Engineers (USACE). 2001. "Geotechnical Investigations." EM 1110-1-1804. January.

ATTACHMENT A
FIGURE

Figure No.
1

Title
Proposed Borings

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2018-11-13
Technical Review by KB on 2018-11-13

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

Legend

△	Proposed Cone Penetration Test
▣	Proposed Boring with Piezometer Vibrating Wire
○	Proposed Boring
⬠	Proposed Boring with Temporary Well *(Screened Material)*
●	Existing Boring
〰	Historical Stream Alignment (Approximate)
┅	Watts Bar Nuclear Facility 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 ESRI Imagery
3. Additional boring in Chemical Pond may be utilized if Cone Penetration Test is inconclusive.
4. CPT borings on 5 feet spacing at historical stream alignment.

Stantec TVA

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ATTACHMENT B
FIELD EQUIPMENT LIST

Field Equipment List
Exploratory Drilling

Item Description
***Health and Safety Equipment (e.g. PPE, PFD, first aid kit)**
***Field Supplies/Consumables (e.g. data forms, labels, nitrile gloves)**
***Decontamination Equipment (e.g. non-phosphate detergent)**
***Sampling/Shipping Equipment (e.g. cooler, ice, jars, forms)**
Field Equipment
GPS (sub-meter accuracy preferred)
Digital camera
Batteries
Cone penetrometer testing assembly
Hollow stem augers
Split-spoon sampler and associated rods
Shelby tube sampler
[1]Drilling Rig and associated equipment
Water pump and water tank
Core barrel
Tremie pipe
Cement
Bentonite
Piezometer screen
Sand
Piezometer standpipe
Water level indicator meter
Well pump (purging well) and tubing
Acoustic Televiewer
Rubber packers
Hand tools (e.g. wrench, hammer, etc.)
***These items are detailed in associated planning documents to avoid redundancy.**
[1]Drilling rig equipment will be selected based on site conditions, selected by the Drilling Contractor, and approved by TVA.

APPENDIX G
HYDROGEOLOGICAL INVESTIGATION SAP

Hydrogeological Investigation Sampling and Analysis Plan Watts Bar Fossil Plant

Revision 3

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

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

November 19, 2018

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	February 9, 2018
2	Addresses May 16, 2018 TDEC Review Comments and Issued for TDEC review	July 6, 2018
3	Addresses Applicable Programmatic Revisions and Issued for TDEC Approval	November 19, 2018

HYDROGEOLOGICAL INVESTIGATION
SAMPLING AND ANALYSIS PLAN
WATTS BAR FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Hydrogeological Investigation
Sampling and Analysis Plan
Watts Bar Fossil Plant
Tennessee Valley Authority
Spring City, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: November 19, 2018 Revision 3

All parties executing work as part of this Sampling and Analysis Plan sign below acknowledging they have reviewed, understand, and will abide by the requirements set forth herein.

TVA Investigation Project Manager — 11/19/18 Date

TVA Investigation Field Lead — 11/19/18 Date

Health, Safety, and Environmental (HSE) Manager — 11-19-18 Date

Clay S Pennington
Investigation Project Manager — 2018-11-13 Date

Rock J. Vitale Digitally signed by Rock J. Vitale
DN: cn=Rock J. Vitale, o, ou, email=rvitale@envstd.com, c=US
Date: 2018.11.14 12:28:01 -05'00'
QA Oversight Manager — Date

K. Ryan R. Jones
Laboratory Project Manager — 2018-11-13 Date

Charles L. Head
TDEC Senior Advisor — Date

Robert Wilkinson
TDEC CCR Technical Manager — Date

Stantec

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LIST OF TABLES

LIST OF ATTACHMENTS

1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at Watts Bar Fossil Plant (WBF) on April 27, 2016, at which time TVA briefed TDEC on its Coal Combustion Residual (CCR) management plans at WBF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On June 14, 2016, TDEC issued a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 22, 2017, TDEC issued a second follow-up letter to TVA regarding the TDEC Order and EIP submittal dates. On November 15, 2016, TVA submitted WBF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

In response to TDEC's comments, TVA has developed this Hydrogeological Investigation Sampling and Analysis Plan (SAP) to install monitoring wells to provide locations to measure groundwater levels and collect groundwater samples. The plan provides procedures and methods necessary to conduct investigation activities at the WBF Plant (Plant).

2.0 OBJECTIVES

The objectives of this Hydrogeological Investigation SAP are to further characterize groundwater flow direction at the Plant and install monitoring wells to provide locations to collect groundwater samples for analysis of CCR constituents. A Plant-specific Quality Assurance Project Plan (QAPP) will provide the procedures necessary to conduct investigation activities associated with the hydrogeological investigation.

3.0 HEALTH AND SAFETY

This work will be conducted under an approved Plant-specific Health and Safety Plan (HASP). This HASP will be in accordance with TVA Safety policies and procedures. Each worker will be responsible for reviewing and following the HASP. Personnel conducting field activities will have completed required training, understand safety procedures, and be qualified to conduct the field work described in this SAP. The HASP will include a job safety analysis (JSA) for each task described in this SAP and provide control methods to protect personnel. Personal protective equipment (PPE) requirements, safety, security, health, and environmental procedures are defined in the HASP. In addition, authorized field personnel will attend TVA required safety training and Plant orientation.

The Field Team Leader will conduct safety briefings each day prior to beginning work and at mid-shift or after lunch breaks and document these meetings to include the names of those in attendance and items discussed. TVA-specific protocols will be followed, including the completion of 2-Minute Rule cards. The JSAs will be updated if conditions change.

4.0 MONITORING WELL LOCATIONS

Monitoring wells installed as part of this investigation will be used to collect groundwater samples and levels. Sampling frequency and procedures are provided in the Groundwater Investigation SAP.

TVA plans to install six monitoring wells at preliminarily identified locations in the saturated sand and gravel layer above bedrock, if found, as part of this investigation. One background well (WBF-102) and one downgradient well (WBF-101) are proposed near the Ash Pond, and one background well (WBF-103) and three downgradient wells (WBF-104, WBF-105 and WBF-106) are proposed near the Slag Disposal Area.

At WBF, the overburden generally consists of alluvial deposits of silt and clay underlain by a layer of sand and gravel. The unconsolidated deposits are underlain by weathered bedrock. Based on previous investigation activities conducted at WBF for the Ash Pond (TVA 2013, Stantec 2017), groundwater may be present in the sand and gravel layer above bedrock. However, the sand and gravel layer may be thin or absent west of the Ash Pond. Similar subsurface conditions were observed near the Slag Disposal Area during previous investigations (TVA 1949, Law Environmental 1989, Law Engineering 1991, TVA 2013). The sand and gravel layer was present east/northeast of the Slag Disposal Area near the river and generally absent west of the Slag Disposal Area near the Plant buildings. As a result, groundwater may not be present in the overburden west of the Ash Pond and Slag Disposal Area and installation of useful monitoring wells in the overburden may not be possible. Additionally, the Slag Disposal Area may contain beneficially used CCR material that extends east near the western Chickamauga Lake/Tennessee River shoreline. If the CCR material extends near the shoreline, then useful monitoring wells in the overburden may not be possible. As discussed in Section 4.4.6 of the Environmental Investigation Plan (EIP) and the Exploratory Drilling SAP, additional soil borings are proposed to investigate subsurface conditions on the eastern edge of the Slag Disposal Area. Data collected from that investigation will be used to evaluate appropriate and accessible downgradient well locations. If alternative well locations are required, then the data collected as part of the initial investigation phase proposed in this SAP will be reviewed to propose appropriate locations or well screen interval depths. The proposed well locations and rationale for construction details will be provided to TDEC for review and comment prior to installation. Figure 1 shows the locations of the proposed wells and Table 1 shows the proposed well construction details.

TVA will evaluate the data collected and assess the suitability of the proposed background well locations during this investigation. Based on the information gathered at the locations described above, additional monitoring wells may be needed to fully characterize groundwater flow direction. If additional wells are needed, TVA, in communication with TDEC, will install those wells to obtain additional groundwater information. Results of investigations to characterize the hydrogeology will be included and described in the EAR.

The target depths and estimated screened intervals of the proposed wells are presented in Table 1.

Table 1. Proposed Well Construction Details

Well ID	Estimated Total Depth (Feet below Ground Surface)	Estimated Screen Interval (Feet below Ground Surface)	Target Screen Lithology
WBF-101	33	23 - 33	Overburden - Alluvium
WBF-102	60	48 - 58	Overburden - Alluvium
WBF-103	60	48 – 58	Overburden - Alluvium
WBF-104	45	35 – 45	Overburden - Alluvium
WBF-105	45	35 – 45	Overburden - Alluvium
WBF-106	45	35 – 45	Overburden - Alluvium

*All total depths and screen intervals are dependent on specific conditions at each proposed well location

5.0 SAMPLE COLLECTION AND FIELD ACTIVITY PROCEDURES

This section provides details of procedures that will be used to prepare for field activities, install groundwater monitoring wells, and assist in providing scientifically defensible results.

Monitoring well installation will adhere to applicable American Society for Testing and Materials (ASTM) and TVA Environmental Technical Instruction (TI) documents. A project field book and field forms will be maintained by the Investigation Field Team Leader to record field measurements, analyses, and observations. Field activities will be documented according to TVA TI ENV-TI-05.80.03, *Field Record Keeping*.

5.1 PREPARATION FOR FIELD ACTIVITIES

As part of field mobilization activities, the field sampling team will:

- Designate a Safety Officer and a Tennessee-licensed Professional Geologist

- Complete required health and safety paperwork and confirm field team members have completed required training.

- Coordinate activities with the drilling subcontractor.

- Clear Access – Proposed monitoring well locations will be marked using a wooden stake or survey flag with the position surveyed using the global positioning system (GPS). Suitability of each location will be evaluated for logistical issues including access, grubbing needs, overhead and underground utility clearance, and proximity to Plant features. Access improvements, including clearing and grubbing or road building, will be completed prior to the investigation start date.

- Perform Environmental Review – As required by the National Environmental Policy Act (NEPA), an environmental review must be completed to document and mitigate any potential impact of the work described herein. The level of review required for this work is anticipated to be a categorical exclusion, which would be documented by TVA with a categorical exclusion checklist (CEC). A CEC will require a number of signatories from TVA. It is understood that the environmental review is to be completed before implementation of the field work. Additionally, plant staff will not issue an excavation permit ahead of the completed environmental review.

- Complete Utility Locate(s) / Excavation Permit(s) - Prior to initiating subsurface activities, subsurface utility clearance will be sought via the plant engineering department and/or the TN 811 service. At locations within the Plant, engineering will provide primary utility clearance assurance in addition to TN 811 being notified. At all other drilling locations where, underground obstructions or utilities are expected nearby, TVA or 3rd party underground locators will be engaged to clear boring locations. For drilling locations outside the plant (e.g., along public roads and rights-of-way), utility avoidance assurance will be supplemented by the TN 811 service and the TVA or 3rd party underground locators. An excavation permit is required prior to initiating any digging or boring at the Plant. A key component to the completion of the excavation permit is consensus on the drilling locations with pertinent TVA staff.

- Identify Water Source – During implementation of the EIP, a source of potable water will be required to complete several investigation tasks, including certain drilling methods and decontamination procedures.

- Obtain required calibrated field instruments, including health and safety equipment.

- Discuss project objectives and potential hazards with project personnel.

5.2 DRILLING AND SAMPLING METHODS AND PROTOCOL

Drilling activities performed at the Plant during implementation of this SAP will include advancing subsurface boreholes using auger techniques or other compatible technology based on field conditions and rig availability. If drilling methods that require the use of water are used for the installation of monitoring wells, then only potable water will be used.

The following sections present drilling and soil sampling procedures required to complete the tasks presented. Once completed, borings will be surveyed for horizontal and vertical control by survey grade GPS.

5.2.1 Drilling, Logging, and Survey

The monitoring well borings are proposed to be advanced utilizing hollow-stem augering techniques (ASTM D6151-08) until designed boring termination depth or auger refusal, whichever is shallower. In some situations, drilling with a casing advancer may be a suitable alternative to augering.

TVA proposes to perform continuous soil sampling during drilling to allow for visual logging of the materials encountered at each location. The soil boring logs will provide additional understanding of the subsurface profile including the saturated soils. Drilling, logging and sampling activities will be performed under the direction of a Professional Geologist, licensed in the State of Tennessee, who has sufficient experience to execute the work.

The field geologist will prepare a written field log for each boring. In addition to describing each recovered soil sample, the log will document boring location, drilling personnel, tooling/equipment used, drilling performance, depth to water, sample number, sample recovery, Standard Penetration Test (SPT) blow counts, and other relevant observations. Soil color will be logged per the appropriate Munsell soil color chart.

Similarly, the field geologist will prepare a written installation log for each well. The log will document well location, well materials, well depth, depth interval for each backfill material, and surface completion details (protective casing, concrete pad, bollards, etc.).

In addition to the soil log, the field geologist will collect soil samples through the well screen interval of background monitoring wells as described in Section 5.2.1.2 of the Background Soil SAP provided as an appendix to the EIP.

Once the boring is completed and the well is installed it will be surveyed for horizontal and vertical control by survey grade GPS to the vertical datum used by the Plant. The survey data will be added to the final boring logs once available and a crosswalk will be provided to indicate what the Plant datum's equivalency is to mean sea level (MSL).

5.2.2 Field Equipment Description, Testing/Inspection, Calibration, and Maintenance

A list of anticipated equipment for the field activities described herein is provided as Attachment B. A final list of equipment will be prepared by the Field Team Leader, and approved by TVA, prior to mobilization. Field equipment will be inspected, tested, and calibrated (as applicable) prior to initiation of fieldwork by Field Sampling Personnel and, if necessary, repairs will be made prior to equipment use. If equipment is not in the proper working condition, that piece of equipment will be repaired or taken out of service and replaced prior to use. Additional information regarding field equipment inspection and testing is included in the QAPP.

5.2.3 Field Documentation

Field documentation will be maintained in accordance with TVA TI ENV-05.80.03, *Field Record Keeping* and the QAPP. Field documentation associated with investigation activities will primarily be recorded in Plant-specific field forms, logbooks and/or on digital media (e.g., geographic information systems (GIS) or global positioning systems (GPS) documentation). Additional information regarding field documentation is provided below and included in the QAPP and TVAs TIs.

5.2.3.1 Daily Field Activities

Field observations and measurements will be recorded and maintained daily to chronologically document field activities, including sample collection and management. Field observations and measurements will be recorded in bound, waterproof, sequentially paginated field logbooks and/or on digital media and field forms.

Deviations from applicable work plans will be documented in the field logbook during sampling and data collection operations. The TVA Technical Lead and the QA Oversight Manager or designee will approve deviations before they occur.

5.2.3.2 Field Forms

Plant-specific field forms will be used to record field measurements and observations for specific tasks. Boring log forms will be used to document lithologic conditions and field observations at each boring location. Monitoring well diagrams will be prepared for each well.

Field documentation will also be prepared for development of each monitoring well.

5.2.3.3 Chain-of-Custody Forms

Chain-of-custody (COC) forms are not applicable to this SAP. Refer to the Groundwater Investigation SAP for groundwater sampling and monitoring procedures.

5.2.3.4 Photographs

In addition to documentation of field activities as previously described, photographs of field activities will also be used to document the field investigation. A photo log will be developed, and each photo in the log will include the location, date taken, and a brief description of the photo content, including direction facing for orientation purposes.

5.2.4 Collection of Samples

5.2.4.1 Standard Penetration Test Sampling

The SPT samples will provide information for developing continuous boring logs/soil profiles. The SPT sampling will be conducted in accordance with ASTM D 1586 *Standard Method for Penetration Testing and Sampling for Soils* and consists 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.

5.2.4.2 Monitoring and Sampling

Monitoring or sampling of wells is not addressed in this SAP. Refer to the Groundwater Investigation SAP for groundwater sampling and monitoring procedures. Preservation and Handling

5.2.4.3 SPT Samples

SPT samples will be logged and placed in glass jars. Once each jar is filled, the rim and threads will be cleaned, the jar capped, and a label (Section 5.2.5.2) will be applied to the jar. Each sample container will be checked to ensure that it is sealed, labeled legibly, and externally clean before placing the sample container in a box for transport.

5.2.4.4 Sample Labels and Identification System

Each SPT jar will have a sample label affixed. Sample labels will contain the following information recorded in waterproof, non-erasable ink. Rock core boxes will have similar information written directly on the wooden core box in waterproof, non-erasable ink:

- Project number
- Sample location
- Boring ID number
- Depth of sampling interval
- Date of sample collection
- Sampler's initials

5.2.4.5 Packaging and Shipping

At appropriate intervals, assigned personnel will transport the samples to the testing laboratory or designated storage facility. SPT and other disturbed bulk samples (if any) will be treated as Group B samples as discussed in ASTM D4220.

5.2.5 Sample Analyses

Select soil samples obtained during the investigation will be subjected to geotechnical laboratory testing. Testing will be assigned to characterize the predominant soil materials recovered in each boring. The laboratory tests will be performed in accordance with applicable ASTM standard testing procedures.

The laboratory analyses are expected to include natural moisture content determinations (D2216), sieve and hydrometer analyses (D422), specific gravity (D854), and Atterberg Limits (D4318). The results of the testing will be used to assist in subsurface characterization and correlation with existing data. If other tests are found to be necessary, they will also be performed in accordance with applicable ASTM standard testing procedures. The Plant-specific laboratory testing program will be developed based on the recovery and spatial distribution of samples from the drilling and sampling program.

5.2.6 Equipment Decontamination Procedures

Documented decontamination will be performed for drilling equipment, tooling, and instruments in contact with subsurface materials in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination* to prevent cross-contamination. Decontamination pads will be constructed for decontamination of large downhole tooling (augers, drill rods, etc.) using a high-pressure washer/steam cleaner.

Decontamination pads will be constructed at locations designated by TVA personnel using poly sheeting with sufficient berms to contain decontamination fluids and prevent potential runoff to uncontrolled areas. Following decontamination, fluids will be disposed of in accordance with Section 5.2.8. Decontamination activities will be performed away from surface water bodies and areas of potential impacts. Decontamination of non-disposable sampling equipment or instruments can be performed using potable water and Liquinox® or other appropriate non-phosphatic detergent in 5-gallon buckets.

Decontamination of sampling equipment and instrument (e.g., split spoons, water level meters, pumps for well development, etc.) will be performed prior to use and between sampling locations. Decontamination activities will be documented in the logbook field notes. Additional information regarding equipment decontamination procedures is located in the QAPP.

5.2.7 Waste Management

Investigation derived waste (IDW) generated during implementation of this Sampling and Analysis Plan may include, but is not limited to:

- Soil cuttings
- Well development water
- Purge water
- Personal Protective Equipment

- Decontamination fluids
- General trash

IDW will be handled in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*, the Plant-specific waste management plan, and local, state, and federal regulations. Transportation and disposal of IDW will be coordinated with TVA Plant personnel.

5.3 MONITORING WELL INSTALLATION

Monitoring wells will be installed at the boring locations by qualified drill crews under the direction of a licensed Tennessee driller. TVA and contractor personnel will assist by providing excavation (drill) permitting, utility clearances, and access to locations along with other coordination.

Monitoring wells will be installed in accordance with TVA TI ENV-TI-05.80.25, *Monitoring Well and Piezometer Installation and Development*.

5.3.1 Materials and Installation

The monitoring wells will be installed using current industry and regulatory protocols to reduce potential for introducing contaminants during the drilling and installation process. Decontamination processes will be in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*. These procedures include, in part, decontamination of the drilling equipment and tools before and after each well by washing with hot, potable water delivered under high pressure, using new well screen and riser that have been cleaned and sealed in plastic at the factory, and placing washed filter pack sand that is certified by NSF International.

Other steps employed during the installations include the workers donning clean, nitrile gloves during the handling of downhole equipment and well materials, and using potable water for grouting purposes.

Monitoring wells will consist of a four-inch diameter Schedule 40 PVC pre-packed well screen (0.010-inch slots) and riser. The screen and riser will consist of flush-joint, threaded PVC pipe. The screen length will be selected based on the results of the boring and the target stratum, but will not be longer than 10 feet. A four-inch diameter Schedule 40 PVC bottom well plug measuring approximately six inches in length will be threaded onto the bottom of the screen. The PVC riser will extend above (2.5 feet minimum) the ground surface and will be capped with a temporary plug or slip cap. The annular space will be backfilled with a sand filter pack (20/40 mesh) extending a minimum of two feet above and six inches below the screen. A minimum two-foot thick bentonite pellet seal will be placed on top of the sand filter pack.

After the bentonite pellet seal has sufficiently hydrated, (minimum of eight hours of hydration time when using cement grouts above the seal), the remaining annular space will be backfilled with a non-shrink, bentonite-cement grout.

It should be noted that the grout will be placed by tremie method through one-inch (minimum) diameter PVC pipe. The grout will be placed using pumps gauged to allow the installation crew to monitor pressures during the grouting process. In open (uncased) boreholes, the sand filter zones and bentonite pellets will be placed by tremie method through one-inch (minimum) diameter PVC. In cased boreholes (i.e., through hollow-stem augers or temporary casing), the sand filter zones and bentonite pellets may be placed by tremie method or may be poured slowly into the annular space of the drill tooling to prevent bridging. Subsequent wellhead construction will consist of an above-grade, steel locking protective cover anchored to a concrete surface pad. The protective cover will extend above the concrete pad and the annular space will be filled with sand or pea gravel to about six-inches below the top of casing. Steel protective bollards filled with concrete will be installed near each corner of the concrete pad. The top of each well casing will be surveyed and correlated to the vertical datum used by the Plant. A crosswalk will be provided that indicates what the Plant datum's equivalency is to MSL.

An example installation log is shown on Figure 2. A drawing of the wellhead construction is shown on Figure 3.

5.3.2 Well Development

Each new monitoring well will be developed by a combination of bailing, surging, and pumping after a minimum of 24 hours following completion. Equipment will be decontaminated per TVA TI ENV-TI-05.80.05. First, a bailer will be lowered and raised within the screened intervals to create a slight surging action to dislodge particles within the wells and sand filter packs. A baseline reading of turbidity, pH, temperature, and specific conductance will be measured using a properly calibrated Oakton® turbidity and PCSTestr 35 water testing meters (or equivalents). If the well contains heavy sediment, further bailing will be performed before continuation of development with surge blocks and submersible pumps. A surge block will be used within the screened interval to move water and particles through the screen and sand filter packs. This process may be repeated several times to decrease the water turbidity within the wells.

Lastly, a submersible pump will be employed to further develop the wells until an acceptable level of turbidity is achieved. Target turbidity value of less than or equal to ten (10) Nephelometric turbidity units (NTUs) will be utilized for the wells per TVA-ENV-TI-05.80.42. If the target turbidity value cannot practically be achieved, well development will be conducted according to the requirements listed in TVA-ENV-TI-05.80.25, *Monitoring Well and Piezometer Installation and Development*.

5.3.3 Slug Testing

After development, TVA will perform slug testing in each monitoring well to measure hydraulic conductivity. Equipment will be decontaminated per TVA TI ENV-TI-05.80.05. The slug tests will be performed in accordance with ASTM D 4044, *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 will be used to collect water level information from the wells.

As part of the slug testing, each well will be 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 has been installed, a solid slug (e.g., PVC pipe filled with sand) will be introduced into the well to cause a nearly instantaneous change in the water level. The water levels will then be recorded at regular intervals until reaching near static levels. After reaching static levels, the test will be terminated and a second slug test will be conducted by instantaneously removing the slug and monitoring water levels until static levels are reached again. The results will be recorded electronically and downloaded into a data collector. Raw data will be checked in the field for discrepancies prior to demobilizing from the Plant.

The field data, once collected and returned to the office, will be evaluated using a software program to estimate the hydraulic conductivity of the in-situ soils.

5.4 INSTALLATION OF DEDICATED SAMPLING PUMPS

New dedicated sampling pumps will be installed in the new groundwater monitoring wells after well development and slug testing are completed. The well depths and static groundwater levels will be measured during well development to place the pumps at the proper intake depths for future well sampling. The pump intake depth will be located at approximately the mid-point of the well screen or the mid-point of the saturated portion of the well screen. Well pump placement depths and additional pump installation calculations and details will be recorded on field forms in the field.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

The QAPP describes quality assurance (QA)/quality control (QC) requirements for the investigation. The following sections provide details regarding QA/QC requirements specific to the installation of groundwater monitoring wells.

6.1 OBJECTIVES

The Data Quality Objectives (DQOs) process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA and the Investigation Project Manager considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts for the investigation.

Specific quantitative acceptance criteria for analytical precision and accuracy for the matrices included in this investigation are presented in the QAPP.

6.2 QUALITY CONTROL CHECKS

The accuracy of the drilling, monitoring well installation and slug testing processes must be maintained throughout the investigation. In addition, planned drilling and installation methods must be confirmed during field activities to provide confidence that groundwater samples and water level measurements collected as part of other SAPs provide representative analytical results and data.

Field personnel will be responsible for performing checks to confirm that the SAP has been followed. This consists of the completion of applicable field forms and documentation of field activities.

6.3 DATA VALIDATION AND MANAGEMENT

As stated in the EIP, a QAPP has been developed such that environmental data are appropriately maintained and accessible to data end users. The field investigation will be performed in accordance with the QAPP. Laboratory analytical data will be subjected to data validation in accordance with the QAPP. The data validation levels and process will also be described in the QAPP.

7.0 SCHEDULE

Anticipated schedule activities and durations for the implementation of this SAP are summarized below. This schedule is preliminary and subject to change based on approval, site conditions, and weather conditions. For the overall EIP implementation schedule, including anticipated dates, see the schedule provided in the EIP.

Table 2. Preliminary Schedule for Hydrogeological Investigation SAP Activities

Project Schedule		
Task	**Duration**	**Notes**
Hydrogeological Investigation SAP Submittal		Completed
Prepare for Field Activities	30 Days	Following EIP Approval
Conduct Field Activities	30 Days	Following Field Preparation

8.0 ASSUMPTIONS AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- Field locations may be adjusted based on actual field conditions;
- Proposed monitoring well locations can be safely accessed; and
- Saturated unconsolidated materials exist at each proposed location.

9.0 REFERENCES

Law Engineering, Incorporated. (1991). "Watts Bar Fossil Plant, Report of Environmental Services". January.

Law Environmental, Inc. (1989). "Tennessee Valley Authority, Watts Bar Fossil Plant, Report for Preliminary Detection Assessment". December.

Stantec (2017). "Groundwater Optimization - Phase 3, Watts Bar Fossil Plant". Prepared for Tennessee Valley Authority. March 2017.

Tennessee Valley Authority (1949). "The Watts Bar Steam Plant, A Comprehensive Report on the Planning, Design, Construction, and Initial Operation of the Watts Bar Steam Plant." Technical Report No. 8.

Tennessee Valley Authority (2013). "Tennessee Valley Authority, Watts Bar Fossil Facility, NPDES Permit No. TN0005461, Ash Pond Closure Plan". November.

Tennessee Valley Authority (2017a). "Field Record Keeping." Technical Instruction ENV-TI-05.80.03. March.

Tennessee Valley Authority (2017b). "Field Sampling Equipment Cleaning and Decontamination." Technical Instruction ENV-TI-05.80.05. March.

Tennessee Valley Authority (2017c). "Monitoring Well and Piezometer Installation and Development." Technical Instruction ENV-TI-05.80.25. April.

ATTACHMENT A
FIGURES

Figure No.
1

Title

Watts Bar Fossil Plant
Proposed Groundwater Well Locations

Client/Project

Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LMB on 2018-02-06
Technical Review by SB on 2018-02-06

0 300 600 900 1,200 Feet
1:3,600 (At original document size of 22x34)

Legend

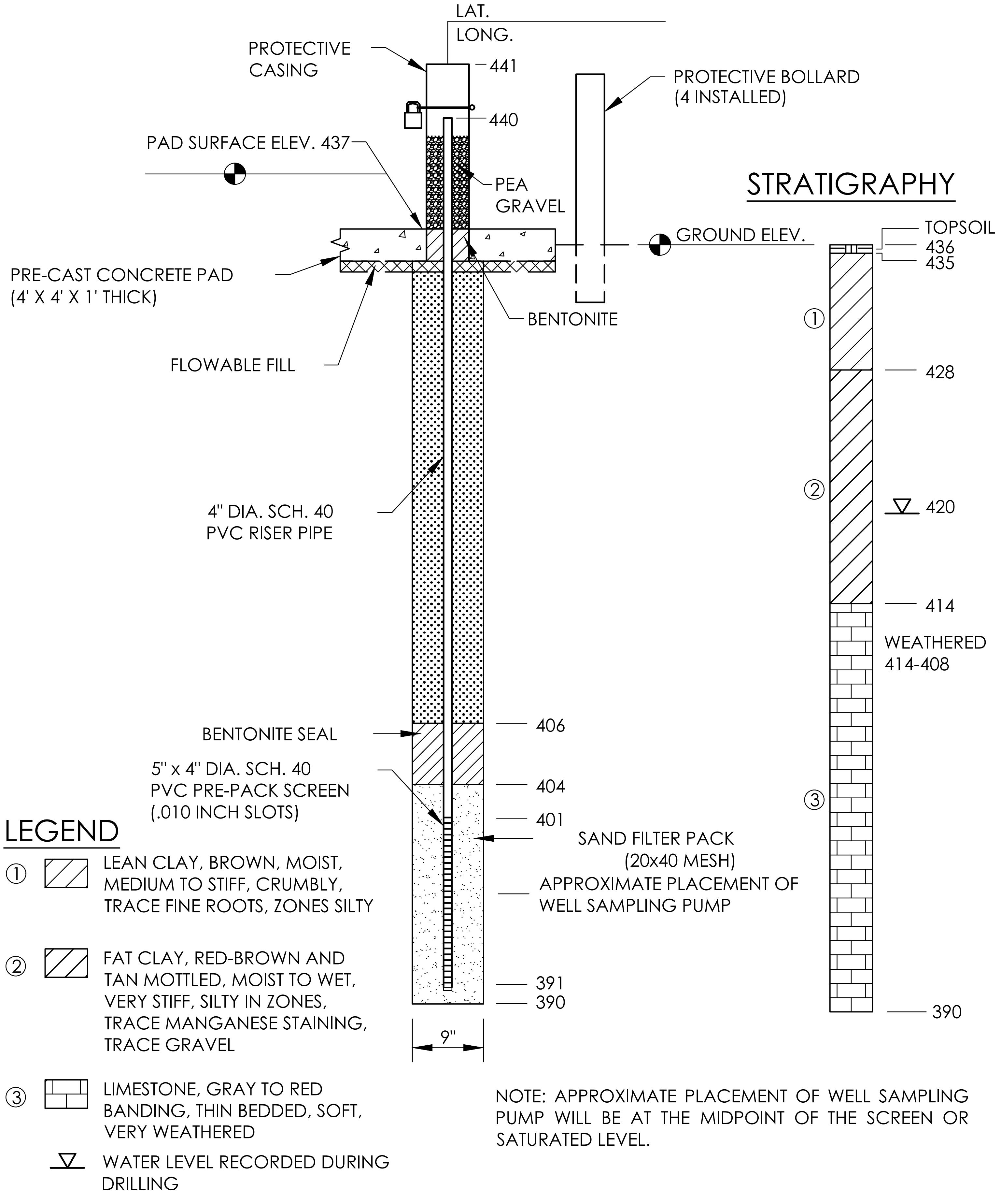
✚	River Gauge
▣	Existing Groundwater Monitoring Well
●	Proposed Groundwater Monitoring Well
☐	CCR Unit Area (Approximate)
☐	Closed Chemical Pond (Approximate)
▨	Consolidated and Capped CCR Area (Approximate)
☐	Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by ESRI Imagery

Stantec

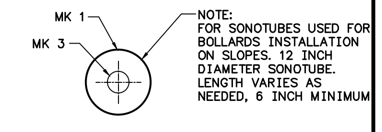
TVA



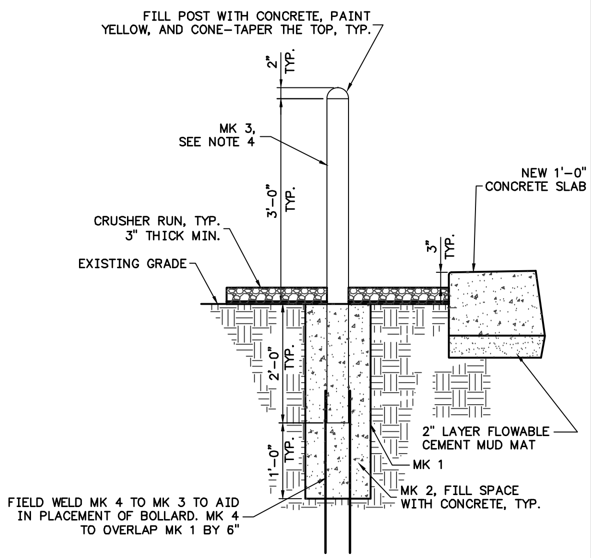
NOTE: THIS FIGURE IS AN EXAMPLE MONITORING WELL LOG PROVIDED FOR REFERENCE PURPOSES AND DOES NOT REPRESENT CURRENT SITE CONDITIONS.

FIGURE 2. EXAMPLE MONTORING WELL INSTALLATION LOG

BOLLARD DETAIL

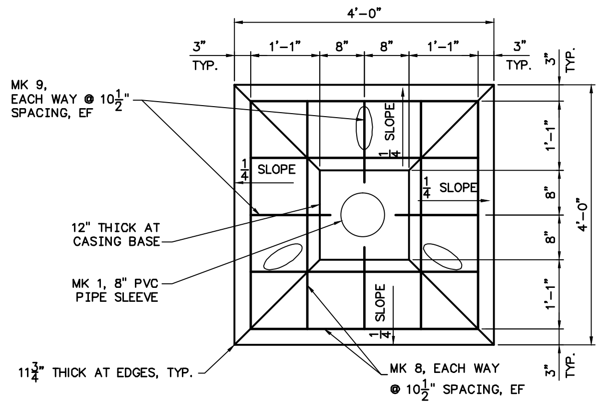


PLAN – BOLLARD

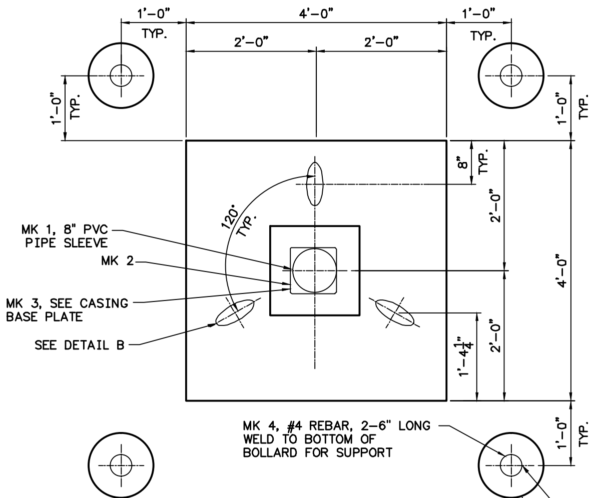


ELEVATION – BOLLARD

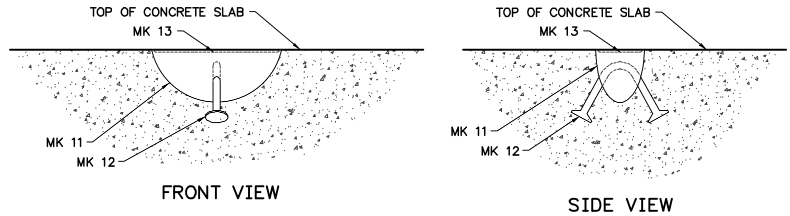
BOLLARD DETAIL			
		MARK NUMBERS AND MATERIAL LIST	
MARK NO.	QUANTITY	DESCRIPITION	PROCURE
1	1 EA	12" SONOTUBE CONCRETE FORM	CONT
2	AS-REQ	CONCRETE, 3000PSI	CONT
3	1 EA	TS 3/16"TX4"DIA.X5'L, CARBON STEEL	CONT
4	2 EA	#4 REBAR, 2-6" LONG	CONT



CONCRETE PAD PLAN & DETAILS



PLAN

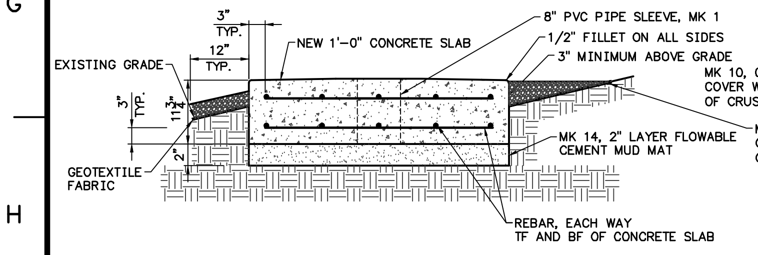


FRONT VIEW

SIDE VIEW

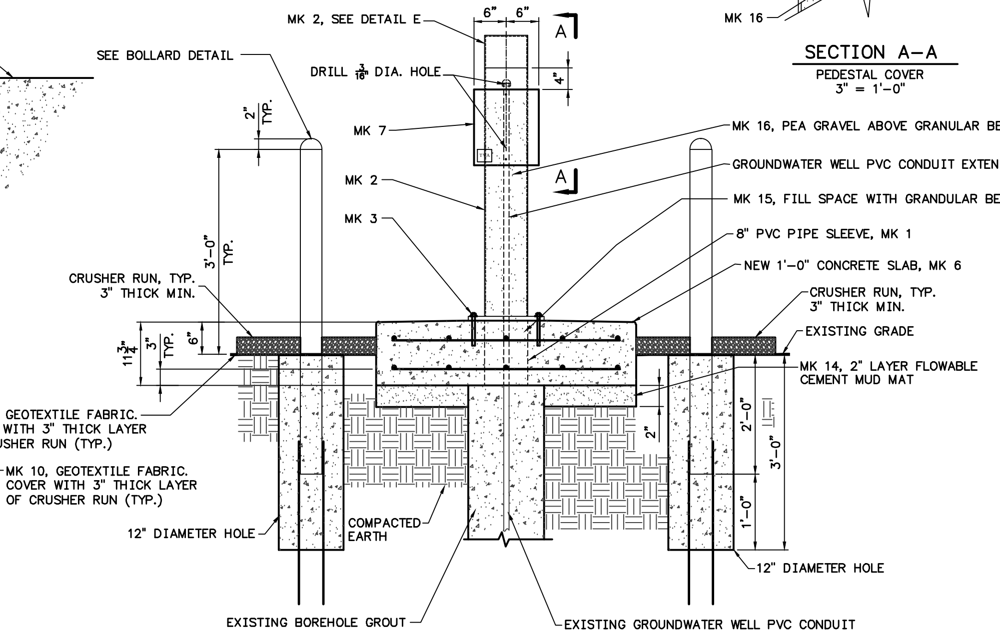
DETAIL B – LIFTING ANCHOR

3" = 1'-0"

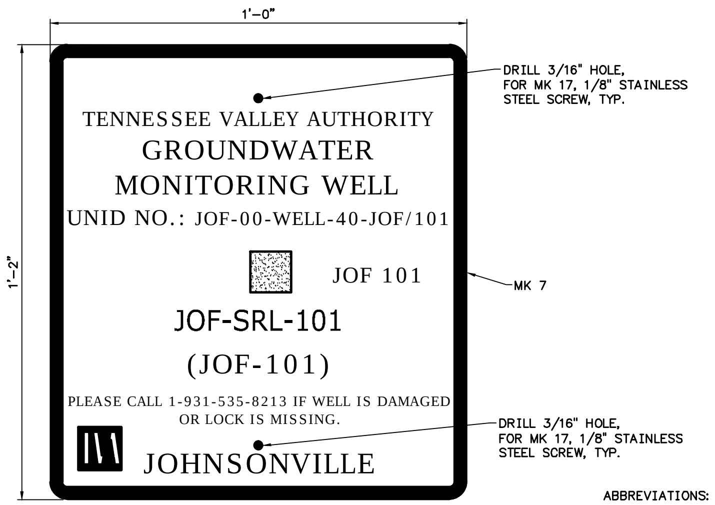


4'-0"X4'-0" CONCRETE PAD FOUNDATION

ON SLOPE AREA

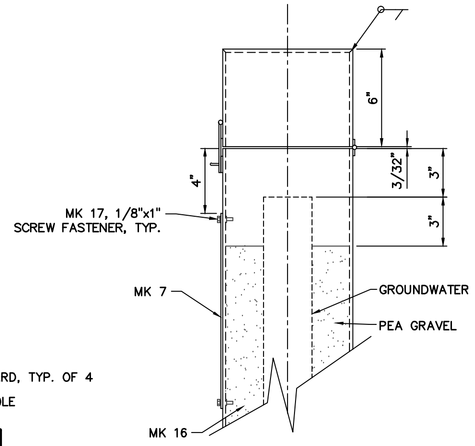


ELEVATION – GROUNDWATER WELL



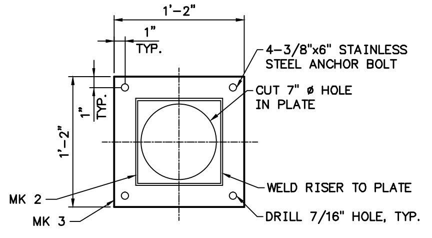
GROUNDWATER MONITORING WELL SIGN

NTS



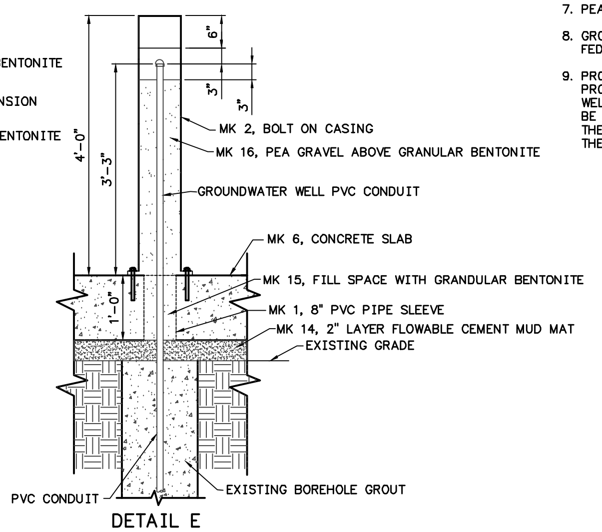
SECTION A–A

PEDESTAL COVER
3" = 1'-0"



MK 3 – CASING BASE PLATE

NTS



DETAIL E

MARK NUMBERS AND MATERIAL LIST			
MARK NO.	QUANTITY	DESCRIPITION	PROCURE
1	1 EA	8"DIA.X1'-0"L. PVC PIPE SLEEVE	CONT
2	1 EA	TS 3/16"T8"X8"X5'L, GALVANIZED A500, SEE SECT A-A.	CONT
3	1 EA	14"X14"X3/4" STEEL PLATE WITH 4-3/8"x6" STAINLESS STEEL ANCHOR BOLTS	CONT
4	8 EA	#4 REBAR, 2-6" LONG	CONT
5	4 EA	TS 3/16"TX4"DIA.X5'L, CARBON STEEL	CONT
6	AS-REQ	CONCRETE, 3000PSI	CONT
7	1 EA	3/16"X14"HX12"L WITH 1/2" RADIUS CORNERS INSTRUMENT SIGN	TVA
8	16 EA	#5 REBAR, 3'-6" LONG	CONT
9	8 EA	#5 REBAR, 1'-3" LONG	CONT
10	AS-REQ	GEOTEXTILE, EASY GARDNER CONTRACTOR GRADE LANDSCAPE FABRIC, MODEL 30109 OR EASY GARDNER COMMERCIAL LANDSCAPE FABRIC, MODEL 2508R OR AN APPROVED EQUAL	CONT
11	3 EA	E LIFT FORM, PEIKKO, PRODUCT #E-670F, OR APPROVED EQUAL	CONT
12	3 EA	E LIFT ANCHOR, PEIKKO, PRODUCT #E-670-375G, OR APPROVED EQUAL	CONT
13	3 EA	FILL WITH SAND THEN ADD 1/2" LAYER OF EXTERIOR SILICONE CAULK	CONT
14	AS-REQ	FLOWABLE CEMENT MUD MAT	CONT
15	AS-REQ	GRANDULAR BENTONITE	CONT
16	AS-REQ	3/8" SIZE WASHED PEA GRAVEL	CONT
17	AS-REQ	2-1/8"x1" STAINLESS STEEL SCREW	CONT

ABBREVIATIONS:

CONT – CONTRACTOR

TVA – PROJECT

NOTES:

1. ALL STAINLESS STEEL TO BE GRADE 303 UNLESS NOTED OTHERWISE.
2. IMPLEMENT BEST MANAGEMENT PRACTICES PRIOR TO STARTING WORK.
3. PROVIDE TEMPORARY SPILL CONTAINMENT DEVICES IF CONTRACTOR WILL REFUEL EQUIPMENT ONSITE.
4. BOLLARDS PAINTING REQUIREMENTS:
   A. SURFACE PREPARATION:

      CLEAN SURFACES PRIOR TO APPLYING THE PAINT IN ACCORDANCE WITH THE STEEL STRUCTURES PAINTING COUNCIL (SSPC) SP-2 & -3 STANDARDS, "HAND AND POWER TOOL CLEANING". ALL LOSE RUST, LOOSE PAINT, AND OTHER LOOSE DETRIMENTAL FOREIGN MATTER SHALL BE REMOVED. FEATHER THE EDGES OF ANY REMAINING OLD PAINT SO THAT THE REPAINTED SURFACES CAN HAVE A REASONABLY SMOOTH APPEARANCE.

   B. PAINT AND PRIMER – SHERWIN WILLIAMS COATINGS SYSTEM OR AN APPROVED EQUEAL:

      PRIMER

      SHERWIN WILLIAMS DURA PLATE 235 @ 3-5 MILS DFT FOR BARE STEEL OR RUST.

      SHERWIN WILLIAMS POLYSILOXANE 1K @ 1.5-2.5 MILS DFT PER COAT FOR THE PREVIOUSLY PRIMED OR PAINTED SURFACES.

      FINISH COLOR

      SHERWIN WILLIAMS SUNSPOT YELLOW (SW) 1672.

   C. BOLLARDS SHALL RECEIVE ONE COAT OF PRIMER AND TWO COATS OF PAINT.
5. CONCRETE PAD TO HAVE A BROOM FINISH.
6. BENTONITE SHALL BE CETCO C/S OR AN APPROVED EQUAL.
7. PEA GRAVEL SHALL BE WASHED 3/8" SIZE OR AN APPROVED EQUAL.
8. GROUNDWATER MONITORING WELL SIGN SHALL BE PAINTED BLUE, FEDERAL STANDARD NO. 15187.
9. PROVIDE A MASTER LOCK ON THE GROUND WATER MONITORING WELL PROTECTIVE COVER THAT WILL ACCEPT TVA GROUND WATER MONITORING WELL KEY NUMBER 0896 ONLY. LOCKS NOT ACCEPTING KEY 0896 WILL NOT BE ALLOWED UNLESS PRIOR APPROVAL IS OBTAINED FROM TVA. CONTACT THE PLANT'S ENVIRONMENTAL SCIENTIST FOR ASSISTANCE IN OBTAINING THE PROPER LOCK.

R												
R 0	05-05-2016	JLG	CWH	JLG			SEB	MST			D	DISCIPLINE INTERFACE
INITAL ISSUE												
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD	1 2 3 4

SCALE: 1" = 1'-0" EXCEPT AS NOTED

YARD
GROUNDWATER INSTRUMENTATION

TYPICAL GROUNDWATER MONITORING
WELL CONCRETE PAD & BOLLARDS PLAN
ELEVATION & CONSTRUCTION DETAILS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.L. GRAY	C.W. HENSLEY	J.L. GRAY			S.E. BENNETT	M.S. TURNBOW

JOHNSONVILLE FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2008	DATE	30	C	10W858-08	R 0

TASK COMPLETED BY: REV NO.

PLOT FACTOR:
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

Figure 3. Typical Groundwater Monitoring Well Construction Details

ATTACHMENT B
FIELD EQUIPMENT LIST

Field Equipment List
Hydrogeological Investigation

Item Description
***Health and Safety Equipment (e.g. PPE, PFD, first aid kit)**
***Field Supplies/Consumables (e.g. data forms, labels, nitrile gloves)**
***Decontamination Equipment (e.g. non-phosphate detergent)**
***Sampling/Shipping Equipment (e.g. cooler, ice, jars, forms)**
Field Equipment[1]
GPS (sub-meter accuracy preferred)
Digital camera
Batteries
Pressure transducer and data recorder
Data collector
Dedicated well sampling pumps, fittings, and tubing
Stainless steel clamps
Pump controller and power supply
Generator (if needed)
Acoustic Televiewer
Heat Pulse Flow Meter
Multi-parameter sonde
Rubber packers
Solid Slug (e.g. PVC filled with sand)
Well pump (purging well) and tubing
Water level indicator meter
Oil/water interface meter
***These items are detailed in associated planning documents to avoid redundancy.**
[1] Refer to the Exploratory Drilling SAP for other drilling-specific field equipment

APPENDIX H
GROUNDWATER INVESTIGATION SAP

Groundwater Investigation Sampling and Analysis Plan Watts Bar Fossil Plant

Revision 3

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

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

November 19, 2018

GROUNDWATER INVESTIGATION
SAMPLING AND ANALYSIS PLAN
WATTS BAR FOSSIL PLANT

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	February 9, 2018
2	Addresses May 16, 2018 TDEC Review Comments and Issued for TDEC Review	July 6, 2018
3	Issued for TDEC Approval	November 19, 2018

GROUNDWATER INVESTIGATION
SAMPLING AND ANALYSIS PLAN
WATTS BAR FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Groundwater Investigation
Sampling and Analysis Plan
Watts Bar Fossil Plant
Tennessee Valley Authority
Spring City, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: November 19, 2018 Revision 3

All parties executing work as part of this Sampling and Analysis Plan sign below acknowledging they have reviewed, understand, and will abide by the requirements set forth herein.

TVA Investigation Project Manager — 11/19/18 Date

TVA Investigation Field Lead — 11/19/18 Date

Health, Safety, and Environmental (HSE) Manager — 11-19-18 Date

Investigation Project Manager — 2018-11-13 Date

Rock J. Vitale Digitally signed by Rock J. Vitale
DN: cn=Rock J. Vitale, o, ou,
email=rvitale@envstd.com, c=US
Date: 2018.11.14 12:28:23 -05'00'

QA Oversight Manager — Date

Laboratory Project Manager — 11-15-18 Date

Charles L. Head
TDEC Senior Advisor — Date

Robert Wilkinson
TDEC CCR Technical Manager — Date

Stantec

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LIST OF TABLES

LIST OF ATTACHMENTS

1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at Watts Bar Fossil Plant (WBF) on April 27, 2016, at which time TVA briefed TDEC on its Coal Combustion Residual (CCR) management plans at WBF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On June 14, 2016, TDEC issued a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 22, 2017, TDEC issued a second follow-up letter to TVA regarding the TDEC Order and EIP submittal dates. On November 15, 2016, TVA submitted WBF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

In response to TDEC's comments, TVA has developed this Groundwater Investigation Sampling and Analysis Plan (SAP) to investigate groundwater conditions at the WBF Plant (Plant). The Groundwater Investigation SAP provides the procedures necessary to conduct investigation activities associated with the sampling and analysis of groundwater.

2.0 OBJECTIVES

The objective of the Groundwater Investigation SAP is to provide the procedures necessary to characterize existing groundwater quality and evaluate groundwater flow conditions on the TVA Plant, in response to the TDEC Commissioner's Multi Site Order. The approach in characterizing the groundwater conditions is to collect groundwater samples for chemical analyses and measure groundwater and surface water elevations to evaluate the potential presence of CCR related constituents in groundwater and direction of groundwater flow to respond to TDEC's request.

3.0 HEALTH AND SAFETY

This work will be conducted under an approved Plant-specific Health and Safety Plan (HASP). This HASP will be in accordance with TVA Safety policies and procedures. Each worker will be responsible for reviewing and following the HASP. Personnel conducting field activities will have completed required training, understand safety procedures, and be qualified to conduct the field work described in this SAP. The HASP will include a job safety analysis (JSA) for each task described in this SAP and provide control methods to protect personnel. Personal protective equipment (PPE) requirements and safety, security, health, and environmental procedures are defined in the HASP. In addition, authorized field personnel will attend TVA required safety training and Plant orientation.

The Field Team Leader will conduct safety briefings each day prior to beginning work and at mid-shift or after lunch breaks and document these meetings to include the names of those in attendance and items discussed. TVA-specific protocols will be followed, including the completion of 2-Minute Rule cards. The JSAs will be updated if conditions change.

4.0 SAMPLING LOCATIONS

TVA is currently sampling groundwater at WBF for National Pollutant Discharge Elimination System (NPDES) permit closure requirements. Monitoring wells that are being sampled as part of the closure requirements will not be sampled as part of this SAP. However, groundwater levels will be measured in each well within this existing monitoring network as part of this SAP. This information, in conjunction with groundwater levels measured in newly installed wells and piezometers will provide information to prepare groundwater contour maps for the plant.

Sampling Scope

TVA will measure groundwater levels at the following monitoring well locations across the site:

- Existing monitoring wells MW-1, MW-2, MW-3 and WB-100.
- Six monitoring wells (WB-101, WB-102, WB-103, WBF-104, WB-105 and WB-106) to be installed as part of the environmental investigation.
- Piezometers installed in the CCR units as part of the Environmental Investigation (EI).

Piezometers will only be gauged to collect groundwater elevations because they were not designed to collect representative groundwater analytical samples. Groundwater flow direction and rate will be calculated for each sampling event.

The Hydrogeological Investigation SAP provides the rationale, locations, contingencies, and installation methods for proposed new monitoring wells.

Surface water elevations will be measured at an automated surface water gauging station in Tennessee River/Chickamauga Lake. Figure 1 (Attachment A) shows the location of the Tennessee River/Chickamauga Lake monitoring point.

Groundwater samples will be collected from the six new monitoring well locations and submitted for laboratory analysis of CCR constituents and major cations/anions (magnesium, potassium, sodium, carbonate and bicarbonate) (see Section 5.2.7 for the parameter list).

The results of groundwater samples collected from monitoring wells from other programs will be used as applicable to the TDEC Order. However, monitoring wells that are part of other programs will not be sampled as part of the EI. The data utilized from other programs will be provided in the Environmental Assessment Report (EAR).

Figure 1 shows the monitoring well locations (existing and proposed) that will be sampled or from which groundwater elevation measurements will be collected as part of this SAP. This figure will be updated to show the actual locations for wells after execution of the Hydrogeological Investigation SAP. If additional wells are needed to fully characterize groundwater at the Plant, then those additional wells will be monitored according to the Groundwater Investigation SAP.

Sampling Frequency

TVA plans to conduct six sampling events, conducted at a frequency of one event every two months for one year as part of the environmental investigation to characterize seasonal groundwater flow direction, rates, and quality. According to United States Environmental Protection Agency (US EPA) Project Summary document "Sampling Frequency for Ground-Water Quality Monitoring" dated September 1989 , quarterly and bimonthly groundwater sampling frequencies are appropriate for major, non-reactive chemical constituents. However, more frequent sampling intervals are not recommended due to potential statistical autocorrelation issues.

Data from these six sampling events will be provided in the EAR.

TVA will continue to collect groundwater samples from the existing monitoring wells at the frequency required under the NPDES closure permit and review the analytical results as part of other activities that are being conducted concurrently with this investigation.

5.0 SAMPLE COLLECTION AND FIELD ACTIVITY PROCEDURES

This section provides details of procedures that will be used to prepare for field activities, collect groundwater samples, take groundwater and surface water elevation measurements, and assist in providing scientifically defensible results.

Groundwater sampling will adhere to applicable EPA and TVA Environmental Technical Instruction (TI) documents. A project field book and field forms will be maintained by the Field Team Leader to record field measurements, analyses, and observations. Field activities will be documented according to TVA TI ENV-TI-05.80.03, *Field Record Keeping*.

5.1 PREPARATION FOR FIELD ACTIVITIES

As part of field mobilization activities, the field sampling team will conduct the following:

- Designate a Safety Officer
- Complete required health and safety documentation and confirm field team members have completed required training
- Coordinate field activities with the Laboratory Coordinator, including ordering sample bottles and preservatives, obtaining coolers and distilled water, if needed, and notifying the laboratory of sampling dates
- Obtain required calibrated field instruments, including health and safety equipment, water level meters, and equipment needed for measuring parameters that define stability during well purging
- Discuss project objectives and potential hazards with project personnel
- Obtain a control box for dedicated pumps
- Complete sample paperwork to the extent possible, prior to deploying into the field, including chain-of-custody forms and sample labels

Obtain ice prior to sample collection for sample preservation.

5.2 SAMPLING METHODS AND PROTOCOL

5.2.1 Groundwater and Surface Water Level Measurements

Prior to sampling, each monitoring well and staff gauge will be inspected for damage or indications that the well integrity has been compromised. If field observations indicate the need for well or staff gauge maintenance or repairs, the Field Team Leader will notify TVA.

After the monitoring well and staff gauge integrity inspection is completed, the water level in each well and at each staff gauge will be measured in relation to a surveyed reference point (e.g., top of well casing) using an electronic water level indicator. Groundwater elevation data will be measured and recorded in accordance with TVA TI ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*. The elevation will be recorded to the nearest 0.01 foot. To the extent possible, the field team will minimize the length of time between collection of the first and last water level measurement for the monitoring well network and staff gauges. At a minimum, measurements will be made within the same day. In addition, barometric pressure readings will be recorded daily. TVA plans to use a multi-parameter sensor equipped with a National Institute of Science & Technology (NIST) certified temperature sensor.

The water level indicator will be decontaminated between each well by following the decontamination procedures provided below in Section 5.2.8.

5.2.2 Well Purging

Following the measurement of groundwater levels, monitoring wells will be purged using pumps dedicated to each well. Purging will continue until field measurements of water quality parameters stabilize during three consecutive readings at 3 to 5-minute intervals per the criteria listed in TVA TI ENV-TI-05.80.42, *Groundwater Sampling*. The stabilization criteria follow:

- pH - ±0.1
- Specific conductivity - ±5% micro Siemens per centimeter (µS/cm)
- Dissolved oxygen (DO) - ±10% for > 0.5 milligrams per Liter (mg/L) or <0.5 mg/L
- Turbidity - below 10 (Nephelometric Turbidity Unit) NTUs or ±10% for values above 10 NTUs

Field measurements, including pH, specific conductivity, turbidity, oxidation/reduction potential, and temperature, will be collected during purging using a flow-through cell. Once the field parameters have stabilized, samples will be collected. For low yield wells, field parameters will be measured at the time of sample collection in an open sample container using a multi-parameter probe. A final turbidity measurement will be made after each sample is collected.

If after two hours of purging field parameters have not stabilized, then groundwater samples will be collected and the efforts to stabilize parameters will be recorded in the field log book and field data sheet. A final turbidity measurement will be made after each sample is collected.

Purging beginning and end times, pumping rates, water quality parameter readings, and groundwater levels will be recorded throughout the purging operation on field sampling forms. The total volume purged at each well may vary based on recharge rates and stabilization of water quality parameters.

Low-flow purging techniques will be used to collect a representative sample from the water bearing unit unless the wells do not yield sufficient water. If the well has been sampled historically using low-flow sampling methods, then the well will be purged at the rate known to induce minimal drawdown. If pump settings are unknown, purging will begin at a minimum pumping rate of 0.1 liter per minute (L/min) and will be slowly increased to a setting that induces little or no drawdown, if possible. Pumping rates will not exceed 0.5 L/min. If drawdown exceeds 0.3 feet, but reaches stability, purging of the well will continue and the current flow rate, drawdown, and time will be recorded on the field data sheet by the sampler.

Low yield wells will be purged until standing water is removed. Groundwater samples will be collected with a low-flow pump, as soon as water levels return to 80% within the well bore to obtain the necessary sample volume, but no later than 24 hours after the well purge.

5.2.3 Field Equipment Description, Testing/Inspection, Calibration, and Maintenance

A list of anticipated equipment for the field activities described herein is provided as Attachment B. A final list of equipment will be prepared by the Field Team Leader, and approved by TVA, prior to mobilization. Field equipment will be inspected, tested, and calibrated (as applicable) prior to initiation of fieldwork by Field Sampling Personnel and, if necessary, repairs will be made prior to equipment use. If equipment is not in the proper working condition, that piece of equipment will be repaired or taken out of service and replaced prior to use. Additional information regarding field equipment inspection and testing is included in the Quality Assurance Project Plan (QAPP).

5.2.4 Field Documentation

Field documentation will be maintained in accordance with TVA TI ENV-05.80.03, *Field Record Keeping* and the QAPP. Field documentation associated with investigation activities will primarily be recorded in Plant-specific field forms, logbooks and/or on digital media (e.g., geographic information system (GIS) or global positioning system (GPS) documentation). Additional information regarding field documentation is provided below and included in the QAPP and TVAs TIs.

5.2.4.1 Daily Field Activities

Field observations and measurements will be recorded and maintained daily to chronologically document field activities, including sample collection and management. Field observations and measurements will be recorded in bound, waterproof, sequentially paginated field logbooks and/or on digital media and field forms.

Deviations from applicable work plans will be documented in the field logbook during sampling and data collection operations. The TVA Technical Lead and the QA Oversight Manager or designee will approve deviations before they occur.

5.2.4.2 Field Forms

Plant-specific field forms will be used to record field measurements and observations for specific tasks. TVA groundwater sampling forms will be used to document groundwater level measurements, stabilization parameters and field observations at each monitoring well location.

5.2.4.3 Chain-of-Custody Forms

For the environmental samples to be collected, chain-of-custody (COC) forms, shipping documents, and sample logs will be prepared and retained. Field Quality Control samples will be documented in both the field notes (logbooks and field forms) and on sample COC records. COC forms will be reviewed daily by the Field Team Leader and Field Oversight Coordinator for completeness and a quality control (QC) check of samples in each cooler compared to sample IDs on the corresponding COC form. The Investigation Project Manager will staff the project with a field sample manager during sample collection activities. Additional information regarding COC forms is included in Section 6.2.2 of this SAP, the QAPP, and TVA TIs.

5.2.4.4 Photographs

In addition to documentation of field activities as previously described, photographs of field activities will also be used to document the field investigation. A photo log will be developed, and each photo in the log will include the location, date taken, and a brief description of the photo content, including direction facing for orientation purposes.

5.2.5 Collection of Samples

5.2.5.1 Groundwater Sampling

A final reading of water quality parameters will be conducted and documented on field sampling forms at the time of sample collection, but these measurements will not be from the sample itself. Unfiltered groundwater samples will be collected in appropriate, laboratory provided, pre-preserved sample containers. Samples will be collected directly from the pump discharge line.

The sampler will wear clean latex (or equivalent) gloves when handling sample containers and will not touch the interior of containers or container caps. New gloves will be used when handling each sample. When filling sample bottles, care will be taken to minimize sample aeration (i.e., water will be directed down the inner walls of the sample bottle) and avoid overfilling and diluting preservatives. Each sample bottle will be capped before filling the next bottle.

It will be necessary to collect filtered (dissolved) inorganic constituent samples, in addition to unfiltered (total) inorganic constituent samples, if the final turbidity value prior to sampling exceeds 10 NTUs. Dissolved sample collection will be accomplished in accordance with TVA TI ENV-TI-05.80.42.

Issues that could affect the quality of samples will be recorded on the field data sheet or in the log book along with the action(s) taken to resolve the issue. These could include observations such as clogged sampling tubes, highly turbid samples or defective materials or equipment.

5.2.6 Preservation and Handling

Sample containers will be labeled in accordance with TVA TI ENV-TI-05.80.02, *Sample Labeling and Custody*. Once each sample container is filled, the rim and threads will be cleaned by wiping with a clean paper towel and capped, and a signed and dated custody seal will be applied. Each sample container will be checked to ensure that it is sealed, labeled legibly, and externally clean. Sample containers will be packaged in a manner to prevent breakage during shipment.

Coolers will be prepared for shipment in accordance with TVA TI ENV-TI-05.80.06, *Handling and Shipping of Samples* by taping the cooler drain shut and lining the bottom of the cooler with packing material or bubble wrap. Sample containers will be placed in the cooler in an upright position. Small uniformly sized containers will be stacked in an upright configuration and packing material will be placed between layers. Plastic containers will be placed between glass containers when possible. A temperature blank will be placed inside each cooler to measure sample temperature upon arrival at the laboratory. Loose ice will be placed around and among the sample containers to cool the samples to less than 6 degrees Celsius (°C) during shipment. The cooler will be filled with additional packing material to secure the containers.

The original COC form will be placed in a re-sealable plastic bag taped to the inside lid of the cooler. A copy of the COC form will be retained with the field notes in the project files. A unique cooler ID number will be written on the COC form and the shipping label placed on the outside of the cooler. The total number of coolers required to ship the samples will be recorded on the COC form. If multiple coolers are required to ship samples contained on a single COC form, then the original copy will be placed in cooler 1 of X with copies (marked as such) placed in the additional coolers. Two signed and dated custody seals will be placed on alternate sides of the cooler lid. Packaging tape (i.e., strapping tape) will be wrapped around the cooler to secure the sample shipment.

Upon receipt of the samples, the analytical laboratory will open the cooler and will sign "received by laboratory" on each COC form. The laboratory will verify that the custody seals have not been previously broken and that the seal number corresponds with the number on the COC form. The laboratory will note the condition and temperature of the samples upon receipt and will identify discrepancies between the contents of the cooler and COC form. If there are discrepancies the Laboratory Project Manager will immediately call the Laboratory Coordinator and Field Team Leader to resolve the issue and note the resolution on the laboratory check-in sheet. The analytical laboratory will then forward the back copy of the COC form to the QA Oversight Manager and Investigation Project Manager.

5.2.7 Sample Analyses

Groundwater samples will be submitted to the TVA-approved laboratory for analysis. Samples will be analyzed for the CCR related constituents listed in Title 40 of the Code of Federal Regulations Part 257 (40 CFR 257), Appendices III and IV. In addition, five inorganic constituents listed in Appendix I of TN Rule 0400-11-01-.04 (i.e., TDEC regulations), and not included in the 40 CFR 257 Appendices III and IV, will be analyzed to maintain continuity with TDEC environmental programs. The additional constituents listed in TDEC Appendix 1 include the following metals: 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 are included in the analyses for this SAP. The additional geochemical parameters include bicarbonate, carbonate, magnesium, potassium and sodium.

Tables 1 through 4 summarize the constituents requiring analysis. Analytical methods, preservation requirements, container size, and holding times for each chemical analysis are presented in Table 5. Additional sampling and laboratory-specific information is covered in more detail in the QAPP.

Table 1. 40 CFR Part 257 Appendix III Constituents

Appendix III Constituents
Boron
Calcium
Chloride
Fluoride
pH
Sulfate
Total Dissolved Solids

Table 2. 40 CFR Part 257 Appendix IV Constituents

Appendix IV Constituents
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226 and 228 Combined

Table 3. TN Rule 0400-11-01-.04, Appendix I Inorganic Constituents

TDEC Appendix I Constituents*
Copper
Nickel
Silver
Vanadium
Zinc

* Constituents not listed in CCR Appendices III and IV

Table 4. Additional Geochemical Parameters

Major Cations/Anions
Bicarbonate
Carbonate
Magnesium
Potassium
Sodium

Table 5. Analytical Methods, Preservatives, Containers, and Holding Times

Parameter	Analytical Methods	Preservative(s)	Container(s)	Holding Times
Metals, dissolved	SW-846 6020A	HNO3 to pH < 2 Cool to <6°C	250-mL HDPE	180 days
Metals, total	SW-846 6020A	HNO3 to pH < 2 Cool to <6°C	250-mL HDPE	180 days
Mercury, dissolved	SW-846 7470A	HNO3 to pH < 2 Cool to <6°C	250-mL HDPE	28 days
Mercury, total	SW-846 7470A	HNO3 to pH < 2 Cool to <6°C	250-mL HDPE	28 days
Radium 226	SW-846 903.0	HNO3 to pH < 2 Cool to <6°C	1 L glass or Plastic	180 days
Radium 228	SW-846 904.0	HNO3 to pH < 2 Cool to <6°C	2 L glass or plastic	180 days
Chloride	SW-846 9056A	Cool to <6°C	250-mL HDPE	28 days
Fluoride	SW-846 9056A	Cool to <6°C	250-mL HDPE	28 days
Sulfate	SW-846 9056A	Cool to <6°C	125-mL HDPE	28 days
pH	SW-846 9040C (field measurement)	NA	NA	15 minutes
Total Dissolved Solids	SM2540C	Cool to <6°C	250-mL HDPE	7 days
Alkalinity (Total, Carbonate, and Bicarbonate)	SM2320B	Cool to <6°C	250-mL HDPE	14 days

The pH of groundwater samples will be measured in the field.

5.2.8 Equipment Decontamination Procedures

Documented decontamination will be performed for non-dedicated groundwater sampling equipment in contact with groundwater or surface water in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination* to prevent cross-contamination. Pumps are dedicated to each well and do not need to be decontaminated.

Decontamination activities will be performed away from surface water bodies and areas of potential impacts. Decontamination of non-disposable sampling equipment or instruments can be performed using water and Liquinox ® or other appropriate non-phosphatic detergent in 5-gallon buckets. Following decontamination, fluids will be disposed in accordance with Section 5.2.9.

Decontamination of sampling equipment and instruments (i.e., water level meters, etc.) will be performed prior to use and between sampling locations. Decontamination activities will be documented in the logbook field notes. Additional information regarding equipment decontamination procedures is located in the QAPP.

5.2.9 Waste Management

Investigation derived waste (IDW) generated during implementation of this Sampling and Analysis Plan may include, but is not limited to:

- Purge water
- Personal Protective Equipment
- Decontamination fluids
- General trash

IDW will be handled in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination,* the plant's site-specific waste management plan, and local, state, and federal regulations. Transportation and disposal of IDW will be coordinated with TVA Plant personnel.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

The QAPP describes quality assurance (QA)/quality control (QC) requirements for the overall Investigation. The following sections provide details regarding QA/QC requirements specific to groundwater sampling and analysis.

6.1 OBJECTIVES

The Data Quality Objectives (DQOs) process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA and the Investigation Project Manager considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts for the Investigation.

Specific quantitative acceptance criteria for analytical precision and accuracy for the matrices included in this investigation are presented in the QAPP.

6.2 QUALITY CONTROL CHECKS

Five types of field QA/QC samples will be collected during sampling activities: field duplicate samples, matrix spike/matrix spike duplicate (MS/MSD) samples, equipment blanks, field blanks, and filter blanks. QA/QC samples will be collected in accordance with TVA TI ENV-TI-05.80.04, *Field Sampling Quality Control*. Criteria for the number and type of QA/QC samples to be collected for each analytical parameter are specified below.

Field Duplicate Samples – One duplicate sample will be collected for every 20 samples or once per sampling event. Duplicate samples will be prepared as blind duplicates and will be collected in two sets of identical, laboratory-prepared sample bottles. The primary and duplicate samples will be labeled according to procedure in Section 6.2.1. Sample identifier information will not be used to identify the duplicated samples. Actual sample identifiers for duplicate samples will be noted in the field logbook. The duplicate sample will be analyzed for the same parameters as the primary sample.

MS/MSD Samples – A sufficient volume of sample will be collected for use as the MS/MSD. MS/MSD samples will be collected to allow matrix spike samples to be run to assess the effects of matrix on the accuracy and precision of the analyses. One MS/MSD sample will be analyzed for every 20 groundwater samples collected or once per sampling event. Additional sample volume intended for use as the MS/MSD must be identified in the comments field on the COC records and sample labels. The location of sample collection will be noted in the log book. The MS/MSD sample will be analyzed for the same analytes as the primary sample, with the exception of parameters that are not amenable to MS/MSD.

For parameters such as Total Suspended Solids and radium that are not amenable to the MS/MSD procedure, additional sample volume will be collected for laboratory duplicate analysis per the QAPP.

Equipment Blanks (Rinsate Blanks) – One equipment (rinsate) blank will be collected for each sampling event. The equipment blank will be collected at a groundwater sampling location by pouring laboratory-provided deionized water into or over the decontaminated sampling equipment (e.g., a decontaminated water level meter), then into the appropriate sample containers. The time and location of collecting the equipment blank will be noted in the log book. The sample will be analyzed for the same analytes as the sample collected from the monitoring well location where the equipment blank is prepared. If the tubing used to collect the filter blank is not certified clean tubing, then a tubing blank will be collected at a frequency of one blank per lot.

Field Blanks: One field blank sample will be prepared per day using laboratory-supplied deionized water. The sample will be analyzed for the same analytes, with the exception of pH.

Filter Blanks – One filter blank will be collected during each day of the sampling activities when dissolved parameters are collected for analysis. The filter blank will be collected at a groundwater sampling location by passing laboratory-supplied deionized water through in-line filters used in the collection of dissolved metals (or other analytes), then into the appropriate sample containers. The time and location of collecting the filter blank will be noted in the log book. The sample will be analyzed for the same analytes as the sample collected from the location where the filter blank is prepared. In addition, one filter blank will be collected per lot of filters used. The filter lot check is to be performed one per lot of filters used and scheduled in a manner to allow for laboratory to report data prior to investigative sample collection.

6.2.1 Sample Labels and Identification System

Sample IDs will be recorded on all sample container labels, custody records, and field sheets in accordance with TVA TIs ENV-TI-05.80.02, Sample Labeling and Custody and ENV-TI-05.80.03, Field Record Keeping. Each sample container will have a sample label affixed and secured with clear package tape as necessary to ensure the label is not removed. Information on sample labels will be recorded in waterproof, non-erasable ink. Specific information regarding sampling labeling and identification is included in the QAPP.

6.2.2 Chain-of-Custody

The possession and handling of individual samples must be traceable from the time of sample collection until the time the analytical laboratory reports the results of sample analyses to the appropriate parties. Field staff will be responsible for sample security and record keeping in the field.

The COC form documents the sample transfer from the field to the laboratory, identifies the contents of a shipment, provides requested analysis from the laboratory, and tracks custody transfers. Additional information regarding COC procedures is located in the QAPP.

6.3 DATA VALIDATION AND MANAGEMENT

As stated in the EIP, a QAPP has been developed such that environmental data are appropriately maintained and accessible to data end users. The field investigation will be performed in accordance with the QAPP. Laboratory analytical data will be subjected to data validation in accordance with the QAPP. The data validation levels and process will also be described in the QAPP.

7.0 SCHEDULE

Anticipated schedule activities and durations for the implementation of this SAP are summarized below. This schedule is preliminary and subject to change based on approval, field conditions, and weather conditions. For the overall EIP Implementation schedule, including anticipated dates, see the schedule provided in the EIP

Table 6. Preliminary Schedule for Groundwater Investigation SAP Activities

Project Schedule		
Task	**Duration**	**Notes**
Groundwater Investigation SAP Submittal		Completed
Prepare for Field Activities for the first bimonthly sampling event	10 Days	Following Completion of Monitoring Well Development
Conduct Field Activities	10 Days	Following Field Preparation
Laboratory Analysis	50 Days	Following Field Activities
Data Validation	30 Days	Following Lab Analysis

Note: Monitoring well installation and development schedules are provided in the Hydrogeological Investigation SAP.

Six bimonthly groundwater sampling events for one year are proposed for this EI. The first bimonthly sampling event will occur 10 days after completion of development of the proposed monitoring wells. The next five sampling events will occur on a bimonthly basis.

8.0 ASSUMPTIONS AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- Access to well locations will be provided prior to the field preparation start date for each round of sampling.

9.0 REFERENCES

Tennessee Valley Authority (TVA). 2017a. "Sample Labeling and Custody." Technical Instruction ENV-TI-05.80.02, Revision 0001 March 31.

Tennessee Valley Authority (TVA). 2017b. "Field Record Keeping." Technical Instruction ENV-TI-05.80.03, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017c. "Field Sampling Quality Control." Technical Instruction ENV-TI-05.80.04, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017d. "Field Sampling Equipment Cleaning and Decontamination." Technical Instruction ENV-TI-05.80.05, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017e. Handling and Shipping of Samples. Technical Instruction ENV-TI-05.80.06, Revision 0000 March 31.

Tennessee Valley Authority (TVA). 2017f. "Groundwater Sampling." Technical Instruction ENV-TI-05.80.42, Revision 0001. March 31.

Tennessee Valley Authority (TVA). 2017g. "Groundwater Level and Well Depth Measurement." Technical Instruction ENV-TI-05.80.44, Revision 0000. March 31

Tennessee Valley Authority (TVA). 2017h. "Field Measurement Using a Multi-Parameter Sonde." Technical Instruction ENV-TI-05.80.46, Revision 0000. March 31.

United States Environmental Protection Agency (U.S. EPA). 1989. "Sampling Frequency for Ground-Water Quality Monitoring Project Summary Document." September.

ATTACHMENT A
FIGURE

Figure No.
1

Title
Watts Bar Fossil Plant
Proposed Groundwater Well Locations

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LMB on 2018-02-06
Technical Review by SB on 2018-02-06

0 300 600 900 1,200
Feet
1:3,600 (At original document size of 22x34)

Legend

✚	River Gauge
▣	Existing Groundwater Monitoring Well
●	Proposed Groundwater Monitoring Well
▭	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 ESRI Imagery

U:\TVA-EIP\175566336\gis\mxds\WBF_Proposed_GW.mxd Revised: 2018-02-06 By: mbough

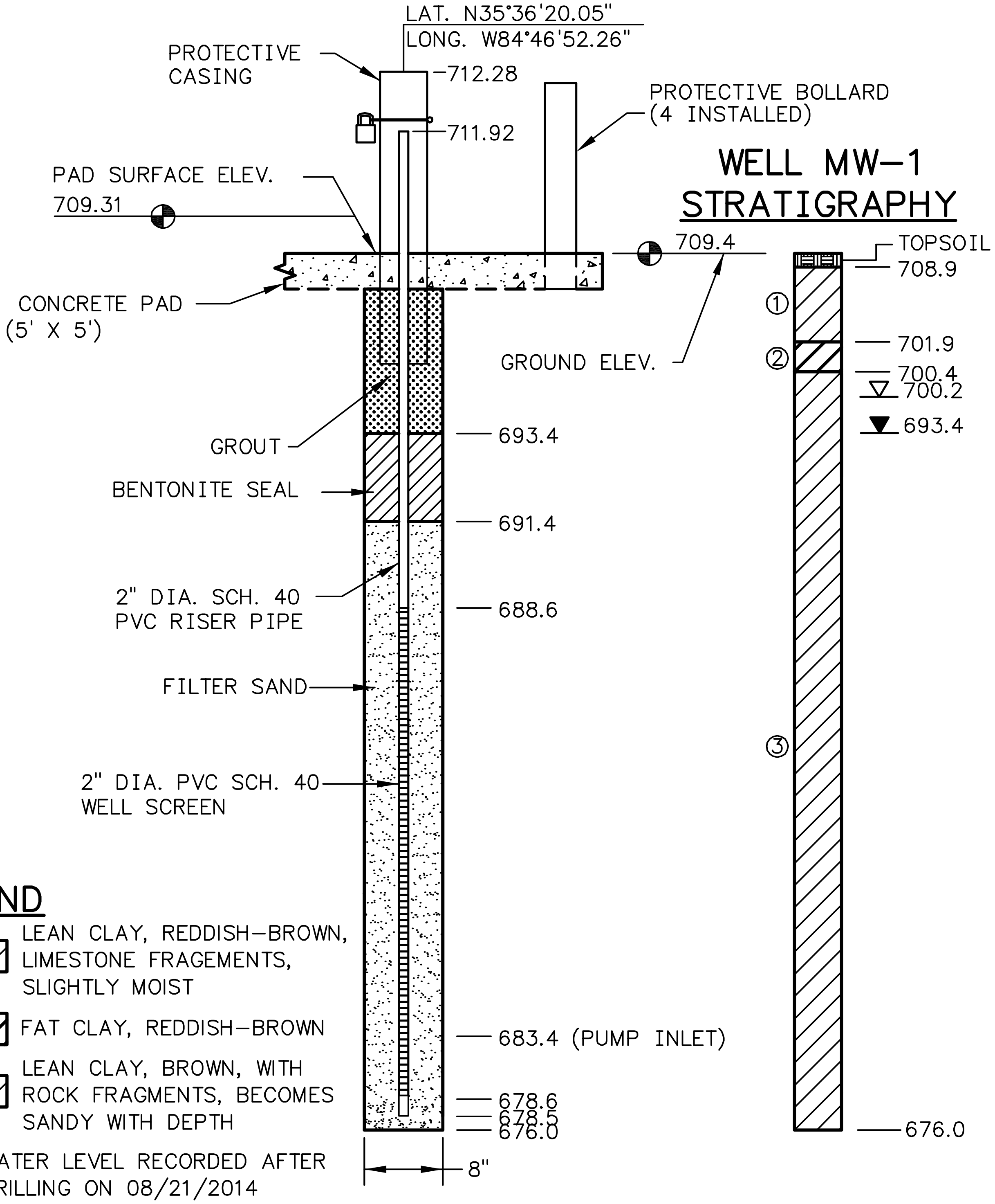
ATTACHMENT B
FIELD EQUIPMENT LIST

Field Equipment List
Groundwater Investigation

Item Description
***Health and Safety Equipment (e.g. PPE, PFD, first aid kit)**
***Field Supplies/Consumables (e.g. data forms, labels, nitrile gloves)**
***Decontamination Equipment (e.g. non-phosphate detergent)**
***Sampling/Shipping Equipment (e.g. cooler, ice, jars, forms)**
Field Equipment
GPS (sub-meter accuracy preferred)
Digital camera
Batteries
Flow measurement supplies (e.g. graduated cylinder, stop watch)
Water level indicator meter
Oil/water interface meter
Photoionization detector (PID)
Sample filtration device and filters
Dedicated well sampling pumps, fittings, and tubing
Stainless steel clamps
Pump controller and power supply
Air compressor, air line heads, and end fittings
Generator (if needed)
Multi-parameter Sonde with flow-through cell
Multi-parameter sensor equipped with a National Institute of Science & Technology (NIST) certified temperature sensor
Turbidity meter
***These items are detailed in associated planning documents to avoid redundancy.**

APPENDIX I

GROUNDWATER WELL CONSTRUCTION DETAILS



LEGEND

① ▨ LEAN CLAY, REDDISH-BROWN, LIMESTONE FRAGEMENTS, SLIGHTLY MOIST

② ▨ FAT CLAY, REDDISH-BROWN

③ ▨ LEAN CLAY, BROWN, WITH ROCK FRAGMENTS, BECOMES SANDY WITH DEPTH

▽ WATER LEVEL RECORDED AFTER DRILLING ON 08/21/2014

▼ WATER LEVEL RECORDED DURING DRILLING ON 07/25/2014

NOTES:

1. SUBSURACE STRATIGRAPHY BASED ON BORING LOG MW-1 BY TERRACON (07/25/2014).
2. SURVEY INFORMATION PROVIDED BY STANTEC (NAD83/NGVD29 SHOWN).
3. WELL INSTALLED ON 07/25/2014 BY TERRACON.
4. SCREEN INTERVAL AND WELL DEPTH BASED ON VIDEO LOGGING (STANTEC, 11/10/2016).

PLOT DATE: 03/02/2017 USER: JENNINGS, MATTHEW
U:\1755\TVA GW MONITORING WELLS - CADD\WBF\175565303 - INSTALL\WELL LOGS\65303-MWELL-MW-1.DWG

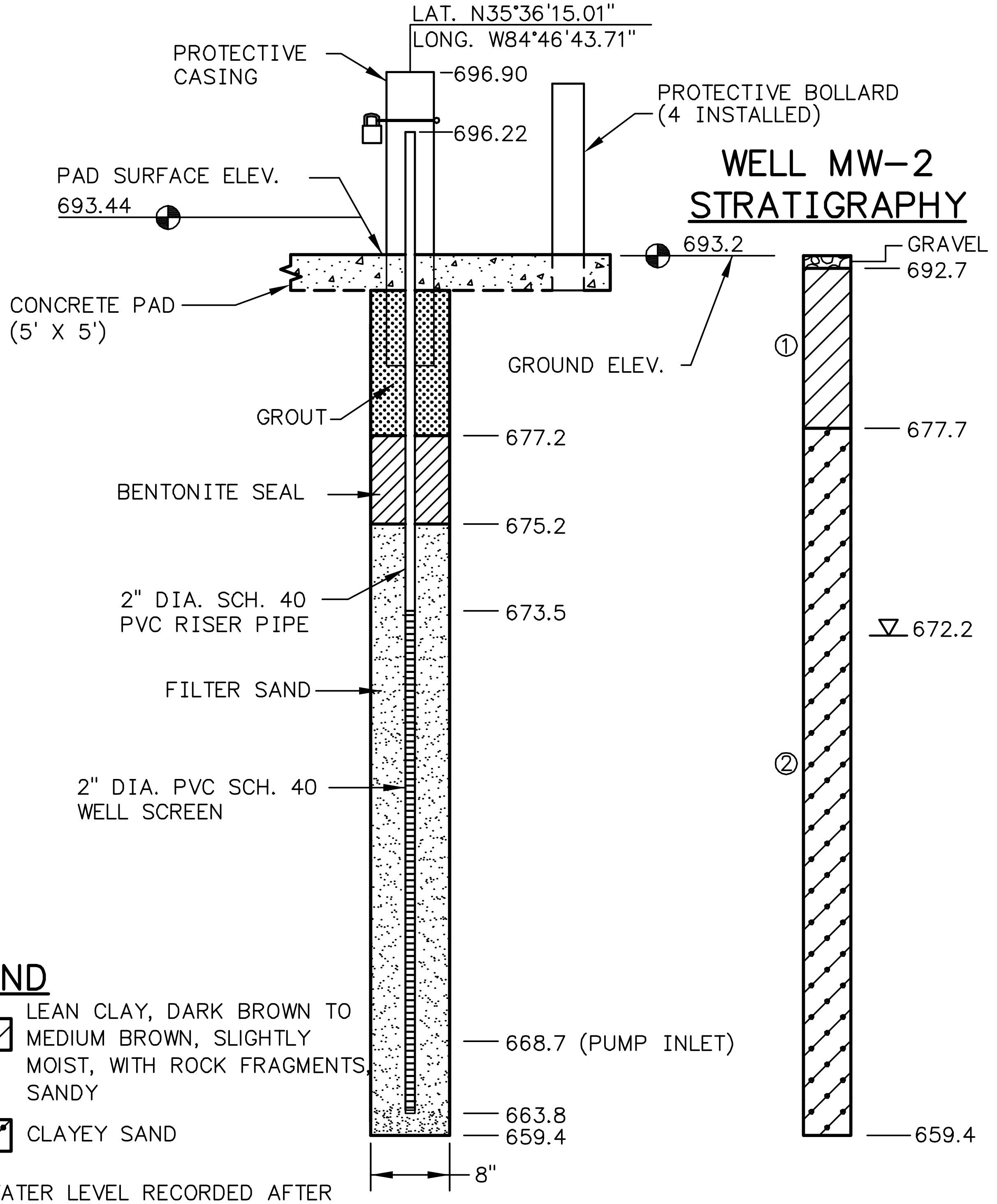
MW-1 MONITORING WELL INSTALLATION DETAIL
TVA WATTS BAR FOSSIL PLANT
SPRING CITY, RHEA COUNTY, TN

Stantec

Stantec Consulting Services Inc.
3052 Beaumont Centre Circle
Lexington, Kentucky
40513

www.stantec.com

DRAWN BY	MSJ	DATE MARCH, 2017		REVISED		SHEET
CHECKED BY	DRP	PROJ. NO.175565303	1.		3.	1 of 1
CHECKED BY	BLB	SCALE NTS	2.		4.	



LEGEND

① ▨ LEAN CLAY, DARK BROWN TO MEDIUM BROWN, SLIGHTLY MOIST, WITH ROCK FRAGMENTS, SANDY

② ⧄ CLAYEY SAND

▽ WATER LEVEL RECORDED AFTER DRILLING ON 08/21/2014

NOTES:

1. SUBSURACE STRATIGRAPHY BASED ON BORING LOG MW-2 BY TERRACON (07/25/2014).
2. SURVEY INFORMATION PROVIDED BY STANTEC (NAD83/NGVD29 SHOWN).
3. WELL INSTALLED ON 07/25/2014 BY TERRACON.
4. SCREEN INTERVAL AND WELL DEPTH BASED ON VIDEO LOGGING (STANTEC, 11/10/2016).

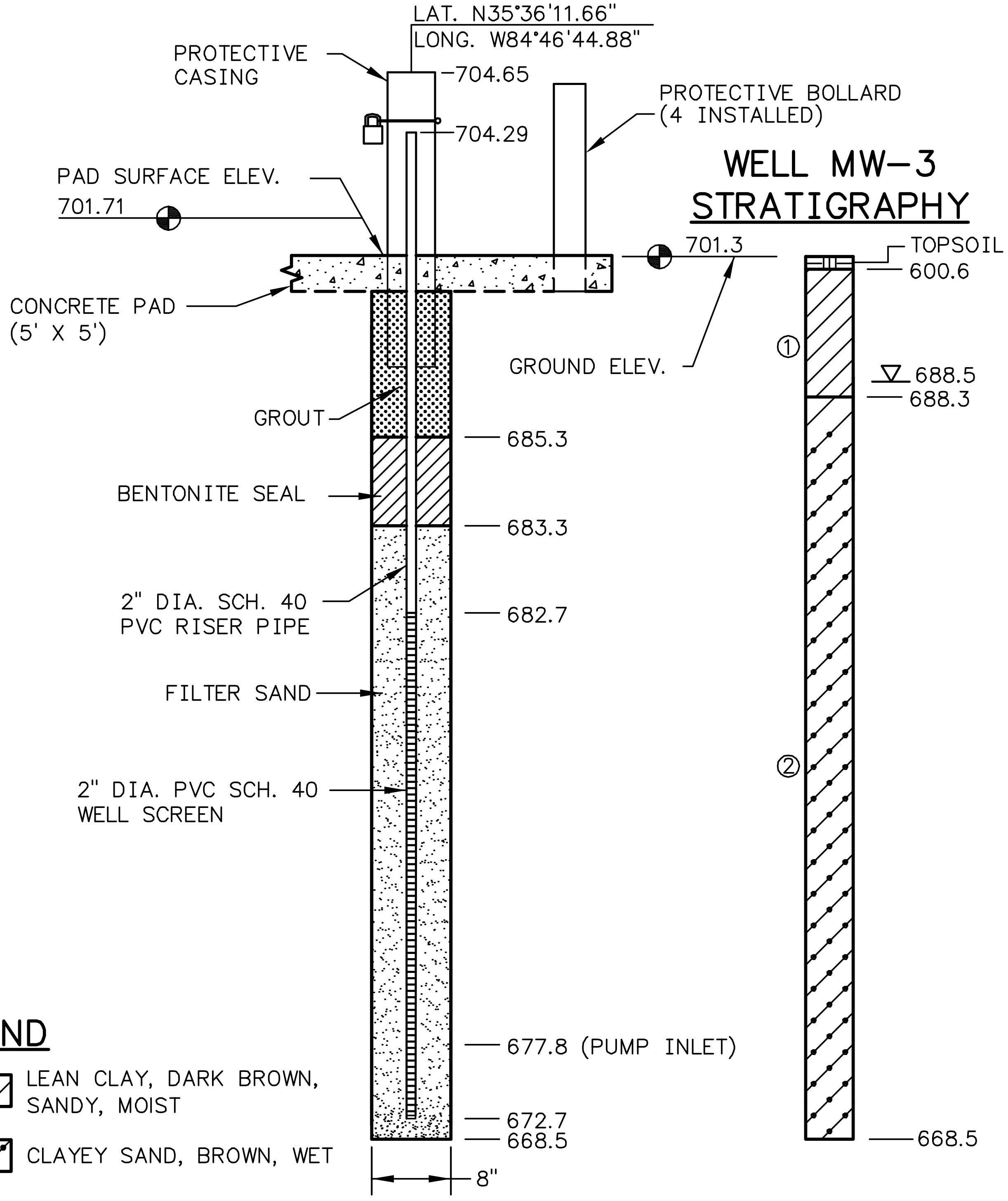
PLOT DATE: 03/01/2017 USER: JENNINGS, MATTHEW
U:\1755\TVA GW MONITORING WELLS - CADD\WBF\175565303 - INSTALL\WELL LOGS\65303-MWELL-MW-2.DWG

MW-2 MONITORING WELL INSTALLATION DETAIL
TVA WATTS BAR FOSSIL PLANT
SPRING CITY, RHEA COUNTY, TN

Stantec

Stantec Consulting Services Inc.
3052 Beaumont Centre Circle
Lexington, Kentucky
40513
www.stantec.com

DRAWN BY MSJ	DATE MARCH, 2017	REVISED			SHEET
CHECKED BY DRP	PROJ. NO. 175565303	1.	3.		1 of 1
CHECKED BY BLB	SCALE NTS	2.	4.		



LEGEND

① ▨ LEAN CLAY, DARK BROWN, SANDY, MOIST

② ▨ CLAYEY SAND, BROWN, WET

▽ WATER LEVEL RECORDED AFTER DRILLING ON 08/21/2014

NOTES:

1. SUBSURACE STRATIGRAPHY BASED ON BORING LOG MW–3 BY TERRACON (07/25/2014).
2. SURVEY INFORMATION PROVIDED BY STANTEC (NAD83/NGVD29 SHOWN).
3. WELL INSTALLED ON 07/25/2014 BY TERRACON.
4. SCREEN INTERVAL AND WELL DEPTH BASED ON VIDEO LOGGING (STANTEC, 11/09/2016).

PLOT DATE: 03/01/2017 USER: JENNINGS, MATTHEW
U:\1755\TVA GW MONITORING WELLS – CADD\WBF\175565303 – INSTALL\WELL LOGS\65303-MWELL-MW-3.DWG

MW-3 MONITORING WELL INSTALLATION DETAIL
TVA WATTS BAR FOSSIL PLANT
SPRING CITY, RHEA COUNTY, TN

Stantec

Stantec Consulting Services Inc.
3052 Beaumont Centre Circle
Lexington, Kentucky
40513

www.stantec.com

DRAWN BY	MSJ	DATE MARCH, 2017	REVISED		SHEET
CHECKED BY	DRP	PROJ. NO. 175565303	1.	3.	1 of 1
CHECKED BY	BLB	SCALE NTS	2.	4.	

TYPE II MONITORING WELL INSTALLATION RECORD

JOB NAME WATTS BAR STEAM PLANT

JOB NUMBER K-88195

WELL NUMBER WB-1

INSTALLATION DATE 10-7-88

LOCATION PROVIDED BY TVA

GROUND SURFACE ELEVATION PROVIDED BY TVA

REFERENCE POINT ELEVATION PROVIDED BY TV

GRANULAR BACKFILL MATERIAL QUARTZ SAND, COARSE

SLOT SIZE 0.010 INCH

SCREEN MATERIAL PVC

SCREEN DIAMETER 2 INCHES

RISER MATERIAL PVC

RISER DIAMETER 2 INCHES

DRILLING TECHNIQUE POWER AUGER

DRILLING CONTRACTOR LAW ENGINEERING

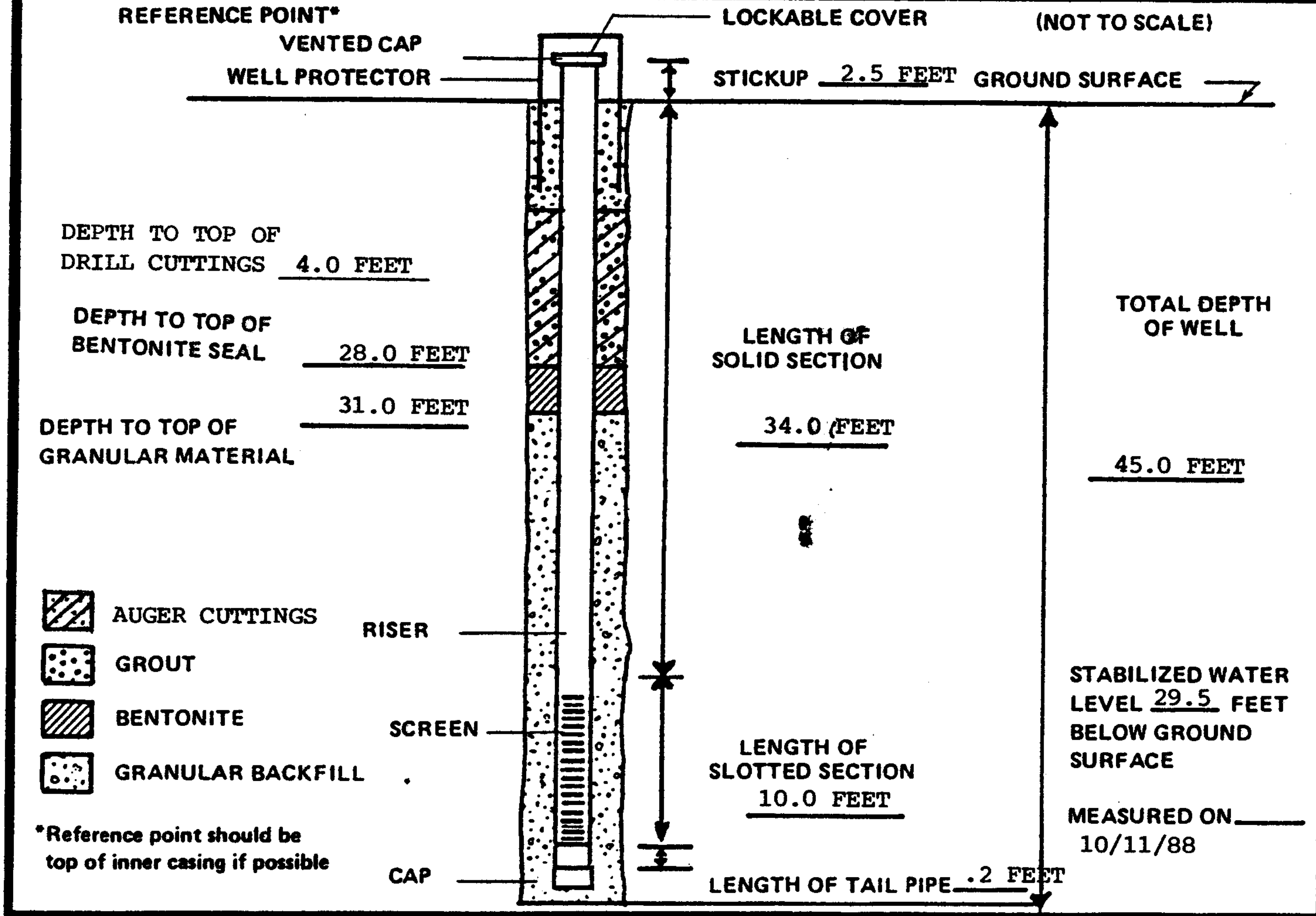
BOREHOLE DIAMETER APPROXIMATELY 11 INCHES

LAW ENGINEERING FIELD REPRESENTATIVE H. W. ROBINSON

LOCK BRAND MASTER

SIZE/MODEL NO. 1

KEY CODE/COMBINATION 2041



STICKUP 2.5 FEET

DEPTH TO TOP OF DRILL CUTTINGS 4.0 FEET

DEPTH TO TOP OF BENTONITE SEAL 28.0 FEET

DEPTH TO TOP OF GRANULAR MATERIAL 31.0 FEET

LENGTH OF SOLID SECTION 34.0 FEET

TOTAL DEPTH OF WELL 45.0 FEET

LENGTH OF SLOTTED SECTION 10.0 FEET

LENGTH OF TAIL PIPE .2 FEET

STABILIZED WATER LEVEL 29.5 FEET BELOW GROUND SURFACE

MEASURED ON 10/11/88

*Reference point should be top of inner casing if possible

LAW ENGINEERING TESTING COMPANY

TYPE II MONITORING WELL INSTALLATION RECORD

JOB NAME WATTS BAR STEAM PLANT

JOB NUMBER K-88195

WELL NUMBER WB-2

INSTALLATION DATE 10-4-88

LOCATION PROVIDED BY TVA

GROUND SURFACE ELEVATION PROVIDED BY TVA

REFERENCE POINT ELEVATION PROVIDED BY TVA

GRANULAR BACKFILL MATERIAL QUARTZ SAND, COARSE

SLOT SIZE .010 INCH

SCREEN MATERIAL PVC

SCREEN DIAMETER 2 INCHES

RISER MATERIAL PVC

RISER DIAMETER 2 INCHES

DRILLING TECHNIQUE POWER AUGER AND AIR ROTARY

DRILLING CONTRACTOR HIGHLAND DRILLING

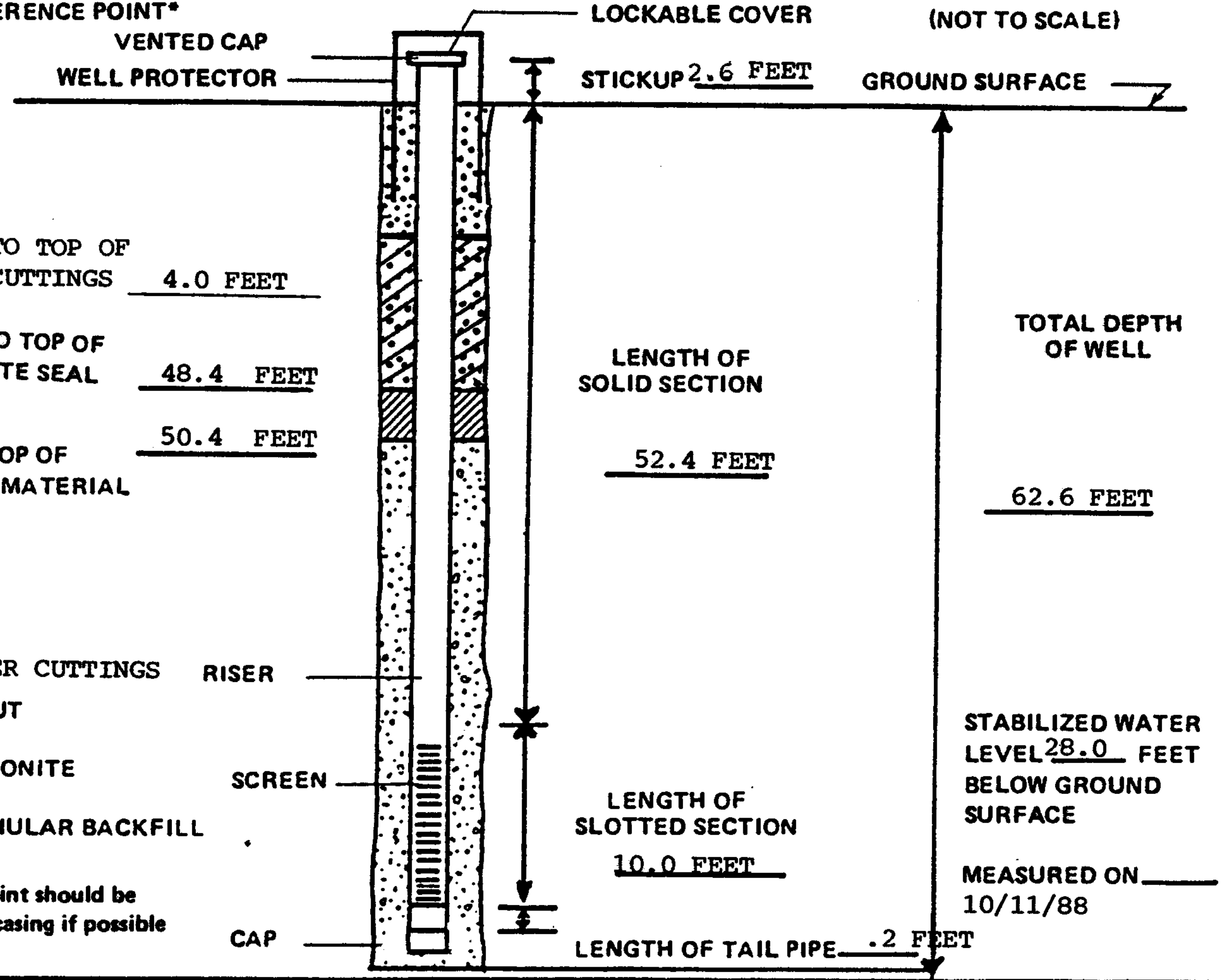
BOREHOLE DIAMETER 8" (AUGER), 5 7/8 (AIR ROTARY)

LAW ENGINEERING FIELD REPRESENTATIVE H. W. ROBINSON

LOCK BRAND MASTER

SIZE/MODEL NO. 1

KEY CODE/COMBINATION 2043



STICKUP 2.6 FEET

DEPTH TO TOP OF DRILL CUTTINGS 4.0 FEET

DEPTH TO TOP OF BENTONITE SEAL 48.4 FEET

DEPTH TO TOP OF GRANULAR MATERIAL 50.4 FEET

LENGTH OF SOLID SECTION 52.4 FEET

TOTAL DEPTH OF WELL 62.6 FEET

LENGTH OF SLOTTED SECTION 10.0 FEET

LENGTH OF TAIL PIPE .2 FEET

STABILIZED WATER LEVEL 28.0 FEET BELOW GROUND SURFACE

MEASURED ON 10/11/88

▨ AUGER CUTTINGS

⁘ GROUT

▨ BENTONITE

⁘ GRANULAR BACKFILL

*Reference point should be top of inner casing if possible

LAW ENGINEERING TESTING COMPANY

TYPE II MONITORING WELL INSTALLATION RECORD

JOB NAME WATTS BAR STEAM PLANT

JOB NUMBER K-88195

WELL NUMBER WB-3

INSTALLATION DATE 10-10-88

LOCATION PROVIDED BY TVA

GROUND SURFACE ELEVATION PROVIDED BY TVA

REFERENCE POINT ELEVATION PROVIDED BY TVA

GRANULAR BACKFILL MATERIAL QUARTZ SAND, COARSE

SLOT SIZE .010 INCH

SCREEN MATERIAL PVC

SCREEN DIAMETER 2 INCHES

RISER MATERIAL PVC

RISER DIAMETER 2 INCHES

DRILLING TECHNIQUE POWER AUGER

DRILLING CONTRACTOR LAW ENGINEERING

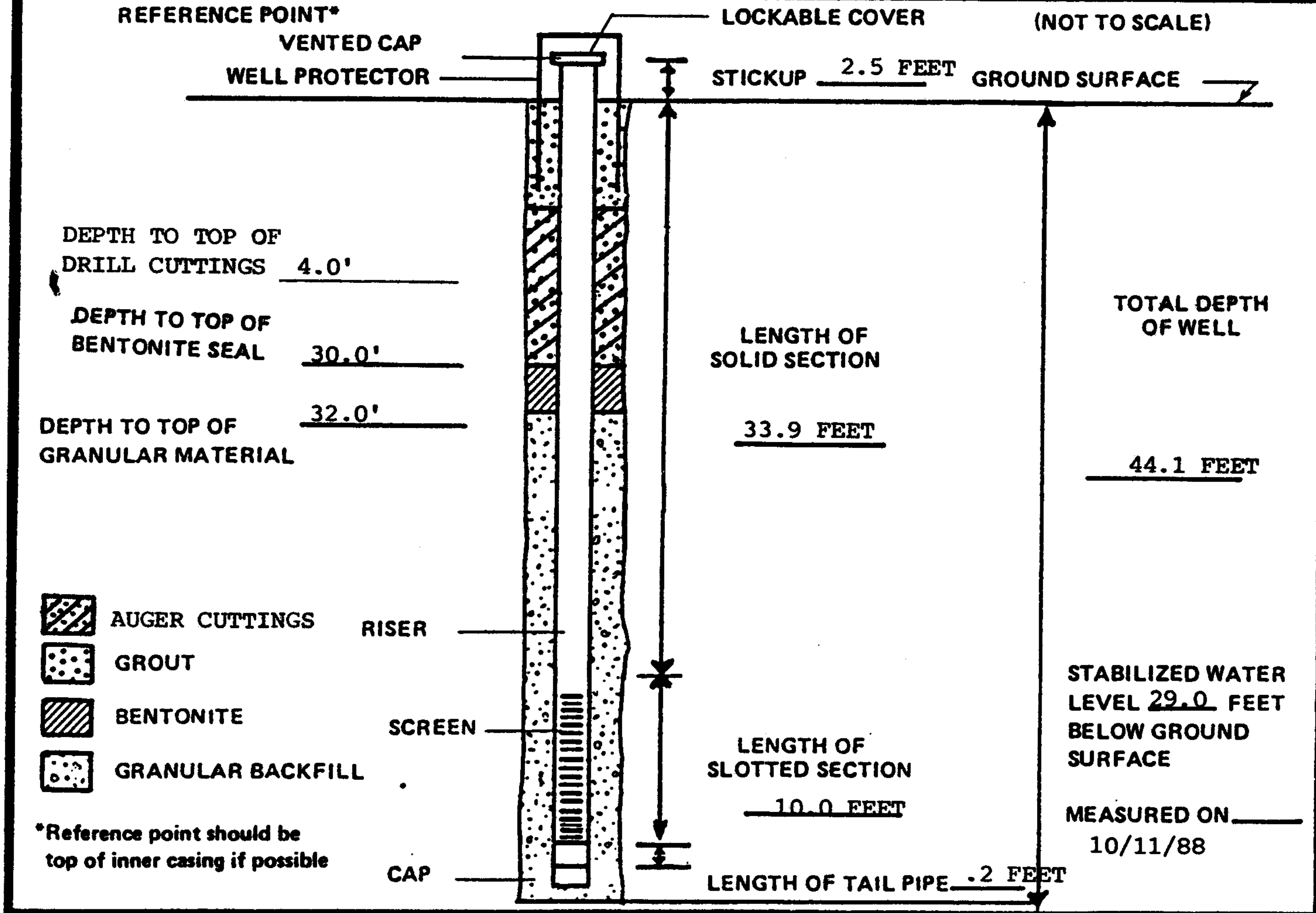
BOREHOLE DIAMETER APPROXIMATELY 11 INCHES

LAW ENGINEERING FIELD REPRESENTATIVE H.W. ROBINSON

LOCK BRAND MASTER

SIZE/MODEL NO. 1

KEY CODE/COMBINATION 2043



STICKUP 2.5 FEET

DEPTH TO TOP OF DRILL CUTTINGS 4.0'

DEPTH TO TOP OF BENTONITE SEAL 30.0'

DEPTH TO TOP OF GRANULAR MATERIAL 32.0'

LENGTH OF SOLID SECTION 33.9 FEET

TOTAL DEPTH OF WELL 44.1 FEET

LENGTH OF SLOTTED SECTION 10.0 FEET

LENGTH OF TAIL PIPE .2 FEET

STABILIZED WATER LEVEL 29.0 FEET BELOW GROUND SURFACE

MEASURED ON 10/11/88

*Reference point should be top of inner casing if possible

LAW ENGINEERING TESTING COMPANY

APPENDIX J
GROUNDWATER MONITORING DATA

Figure No.
1

Title
Watts Bar Fossil Plant
Existing and Closed Well Locations

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LMB on 2018-02-06
Technical Review by SB on 2018-02-06

0 300 600 900 1,200 Feet
1:3,600 (At original document size of 22x34)

Legend

- ⊕ Closed Well
- ▣ Existing Groundwater Monitoring Wells
- ▭ 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 ESRI Imagery

U:\TVA-EIP\175566336\gis\mxds\WBF_Existing_Closed_Wells.mxd Revised: 2018-02-06 By: mbough

Table 1A
Groundwater Chemical Data

Well ID	Historical Well ID Ref.	Date	Inorganics																																Anions		
			Aluminum, total (ug/L)	Antimony, total (ug/L)	Arsenic, total (ug/L)	Barium, total (ug/L)	Beryllium, total (ug/L)	Boron, total (ug/L)	Cadmium, total (ug/L)	Calcium, total (mg/L)	Chromium, total (ug/L)	Cobalt, total (ug/L)	Copper, total (ug/L)	Iron, total (ug/L)	Lead, total (ug/L)	Lithium, total (ug/L)	Magnesium, total (mg/L)	Manganese, total (ug/L)	Mercury, total (ug/L)	Molybdenum, total (ug/L)	Nickel, total (ug/L)	Nitrite + Nitrate (mg/L)	Potassium, total (mg/L)	Selenium, total (ug/L)	Silicon, total (ug/L)	Silver, total (ug/L)	Strontium, total (ug/L)	Sodium, total (mg/L)	Thallium, total (ug/L)	Tin, total (ug/L)	Titanium, total (ug/L)	Vanadium, total (ug/L)	Zinc, total (ug/L)	Chloride, total (mg/L)	Fluoride, total (mg/L)	Sulfate, total (mg/L)
	MCLs	**TDEC**	**-**	**6**	**10**	**2000**	**4**	**-**	**5**	**-**	**100**	**-**	**-**	**-**	**15~**	**-**	**-**	**-**	**2**	**-**	**100**	**10^**	**-**	**50**	**-**	**100**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**4**	**-**
		EPA	**-**	**6**	**10**	**2000**	**4**	**-**	**5**	**-**	**100**	**-**	**1300~**	**-**	**15~**	**-**	**-**	**-**	**2**	**-**	**-**	**1^^**	**-**	**50**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**4**	**-**
WBF-1	WB1	12/12/88	36000	<1	2	330	--	980	0.6	54	35	--	30	40000	**17**	220	14	1400	--	<20	22	--	2.3	5	34000	--	170	7.1	--	--	--	60	40	9	--	180
		03/09/89	530	<1	2	50	--	1000	<0.1	54	<1	--	<10	1600	<1	<10	9.2	560	--	<20	<1	--	0.65	<1	8800	--	120	6.8	--	--	--	10	<10	8	--	140
		06/21/89	4900	<1	2	90	--	1100	0.3	56	9	--	<10	7200	6	<10	11	730	--	<20	12	--	1.2	<1	14000	--	200	7.1	--	--	--	<10	30	6	--	59
		08/16/89	8000	<1	3	70	--	790	0.6	50	13	--	10	9700	**42**	<10	9.8	650	--	<20	12	--	1	<1	15000	--	150	6.9	--	--	--	<10	20	9	--	62
		08/28/89	--	--	--	--	--	860	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.2	--	--	--	--	--	--	--	--
		12/13/89	4300	2	<1	80	--	1000	3	52	4	--	<10	4200	2	<10	7.7	430	--	<20	5	--	0.79	<1	15000	--	190	7.7	--	--	--	<10	<10	10	--	140
		03/21/90	540	<1	1	90	--	1200	<0.1	52	<1	--	<10	1000	<1	<10	9.1	510	--	<20	5	--	0.7	<1	7600	--	140	7	--	--	--	<10	<10	8	--	140
		06/26/90	1400	<1	<1	60	--	850	<0.1	50	1	--	<10	1800	6	<10	8	510	--	<20	4	--	0.65	<1	8100	--	170	7	--	--	--	<10	<10	7	--	120
		09/25/90	1400	<1	<1	40	--	770	0.1	51	<1	--	<10	1900	<1	<10	8.8	530	--	<20	3	--	0.6	<1	7600	--	130	6.5	--	--	--	<10	10	7	--	100
		12/11/90	400	<1	2	50	--	860	<0.1	48	1	--	<10	1300	<1	<10	8.4	460	--	<20	3	--	0.58	<1	7300	--	170	6.8	--	--	--	<10	<10	7	--	120
		03/04/91	1000	1	<1	90	--	640	0.2	50	2	--	10	1700	2	<10	7.1	640	--	90	5	--	1.2	<1	6200	--	210	7.1	--	--	--	<10	20	7	--	110
		06/05/91	2900	<1	7	80	--	800	0.3	62	<1	--	<10	3800	2	<10	9.1	860	--	60	3	--	1	<1	9700	--	240	6.9	--	--	--	<10	10	6	--	150
		09/04/91	42000	3	**39**	300	--	960	3	63	45	--	10	43000	**20**	40	16	960	--	50	38	--	6.7	2	44000	--	300	6.8	--	--	--	70	140	6	--	26
		12/16/91	2600	3	7	50	--	850	0.2	57	6	--	<10	4600	3	<10	9.8	680	--	<20	2	--	0.75	<1	5500	--	280	7	--	--	--	<10	10	7	--	170
		03/17/92	110	1	<1	50	--	830	0.1	52	<1	--	<10	3600	1	<10	1.5	610	--	40	4	--	0.6	<1	6400	--	190	6.1	--	--	--	<10	<10	6	--	160
		06/22/92	580	<1	1	42	--	880	0.4	52	6	--	<10	900	1	<10	8.1	510	--	25	2	--	0.6	<1	6900	--	140	7.4	--	--	--	<10	<10	6	--	100
		06/22/92	460	<1	1	37	--	850	0.3	52	2	--	<10	990	<1	<10	8.2	520	--	30	<1	--	0.7	<1	7300	--	160	7.8	--	--	--	<10	<10	6	--	120
		09/03/92	840	2	1	40	--	620	0.1	48	<1	--	40	1100	1	<10	7.8	500	--	<20	6	--	0.68	<1	7000	--	130	7	--	--	--	30	<10	6	--	120
		12/17/92	580	--	<1	30	<1	800	0.4	50	<1	--	<10	1200	<1	<10	7.2	450	--	<20	<1	--	0.6	<1	--	--	120	6.5	--	--	--	<10	<10	7	--	120
		06/02/93	1100	--	<1	50	<1	<500	--	53	--	--	<10	1100	1	--	7	670	--	50	1	--	0.8	--	--	--	200	6.4	--	--	--	--	<10	7	--	83
		12/13/93	140	--	<1	<10	<1	<500	--	44	--	--	<10	620	<1	--	7.6	460	--	30	3	--	0.7	--	--	--	150	6.2	--	--	--	--	<10	6	--	83
		06/15/94	<50	--	<1	60	<1	600	--	58	--	--	<10	1300	2	--	8.7	890	--	50	4	--	1	--	--	--	270	6.9	--	--	--	--	<10	8	--	51
		06/29/95	210	<1	<1	30	<1	800	--	52	--	--	<10	2400	<1	--	7.4	880	--	--	--	--	0.9	<1	--	--	70	6	--	--	--	--	<10	6	--	66
		07/18/96	110	--	<1	50	<1	500	--	62	--	--	<10	5000	1	--	9.4	1100	--	--	--	--	0.9	--	--	--	270	7.1	--	--	--	--	<10	7	--	87
		05/12/97	<50	--	<1	70	<1	800	--	55	--	--	<10	3500	<1	--	8.3	1200	--	--	--	--	1.1	--		--	270	6.7	--	--	--	--	<10	7	--	65
		05/13/98	120	--	<1	90	<1	1100	--	66	--	--	<10	2100	<1	--	9.3	1400	--	--	--	--	1.3	--	--	--	320	7.8	--	--	--	--	<10	7	--	96
		02/03/00	80	--	<1	80	<1	600	--	61	--	--	<10	720	1.5	--	8.1	1400	--	90	--	--	1.5	--	9200	<10	330	6.4	--	<50	<5	<10	<10	6	--	80
WBF-100	N/A	01/18/17	--	<2	<1	108	<1	1670	<1	146	<2	<0.5	<2	--	<1	<5	--	--	<0.2	<5	1.03	--	--	<5	--	<1	--	--	<1	--	--	<1	<5	6.63	<0.1	194
		04/05/17	--	<2	<1	96.7	<1	2650	<1	172	<2	<0.5	<2	--	<1	<5	--	--	<0.2	<5	<1	--	--	<5	--	<1	--	--	<1	--	--	<1	24.1	7.56	<0.1	213
		04/05/17	--	<2	<1	97.9	<1	2450	<1	172	<2	<0.5	<2	--	<1	<5	--	--	<0.2	<5	<1	--	--	<5	--	<1	--	--	<1	--	--	<1	<5	7.5	<0.1	226
		07/18/17	--	--	--	--	--	1560	--	150	--	--	--	--	--	<5	--	--	--	<5	--	--	--	--	--	--	--	--	--	--	--	--	--	6.94	--	210
		10/16/17	--	<2	<1	68.5	<1	1790	<1	149	<2	<0.5	<2	--	<1	<5	--	--	<0.2	<5	<1	--	--	<5	--	<1	--	--	<1	--	--	<1	<5	7.54	<0.1	226
WBF-2	WB2	12/12/88	1000	<1	<1	80	--	<500	0.2	10	1	--	<10	1300	4	280	2.2	140	--	<20	<1	--	1.6	1	5800	--	280	78	--	--	--	<10	370	2	--	10
		03/09/89	830	<1	1	180	--	<500	<0.1	12	<1	--	<10	1300	4	24	2.9	84	--	50	<1	--	1.6	1	6900	--	370	61	--	--	--	<10	<10	1	--	2
		06/21/89	100	<1	<1	70	--	<500	0.1	7.9	<1	--	<10	1000	13	24	1.7	39	--	<20	11	--	1.3	<1	4900	--	260	73	--	--	--	<10	280	2	--	1
		08/16/89	900	<1	<1	160	--	<500	0.6	12	2	--	<10	1400	5	30	2.7	69	--	<20	25	--	1.8	<1	6600	--	320	67	--	--	--	<10	10	2	--	3
		08/28/89	--	--	--	--	--	<500	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	67	--	--	--	--	--	--	--	--
		12/13/89	2800	1	1	140	--	<500	2	11	4	--	<10	2000	6	30	4.5	48	--	<20	77	--	1.9	<1	10000	--	300	67	--	--	--	<10	90	3	--	3
		03/21/90	920	<1	<1	290	--	<500	<0.1	16	3	--	<10	1400	<1	30	4	100	--	<20	2	--	1.6	<1	7600	--	360	67	--	--	--	<10	<10	2	--	17
		06/26/90	2200	<1	<1	260	--	<500	<0.1	10	1	--	<10	2700	6	20	2.5	42	--	<20	1	--	1.5	<1	8300	--	340	65	--	--	--	<10	<10	2	--	4
		09/25/90	2500	<1	<1	270	--	<500	0.1	12	<1	--	10	3700	5	30	3.1	94	--	<20	19	--	1.3	<1	9400	--	270	62	--	--	--	<10	20	2	--	3
		12/11/90	22000	<1	<1	820	--	<500	0.3	13	25	--	10	28000	15	50	6.8	420	--	<20	23	--	2.5	<1	28000	--	480	64	--	--	--	40	70	3	--	5
		03/04/91	36000	2	<1	1500	--	<500	0.5	14	27	--	60	57000	**30**	70	10	870	--	30	29	--	3.4	<1	39000	--	560	77	--	--	--	80	170	2	--	4
		06/05/91	37000	<1	6	1500	--	<500	0.4	7.1	28	--	10	46000	**26**	60	9.2	370	--	30	28	--	2	<1	40000	--	530	66	--	--	--	130	60	3	--	5

Table 1A
Groundwater Chemical Data

Well ID	Historical Well ID Ref.	Date	Inorganics																															Anions		
			Aluminum, total (ug/L)	Antimony, total (ug/L)	Arsenic, total (ug/L)	Barium, total (ug/L)	Beryllium, total (ug/L)	Boron, total (ug/L)	Cadmium, total (ug/L)	Calcium, total (mg/L)	Chromium, total (ug/L)	Cobalt, total (ug/L)	Copper, total (ug/L)	Iron, total (ug/L)	Lead, total (ug/L)	Lithium, total (ug/L)	Magnesium, total (mg/L)	Manganese, total (ug/L)	Mercury, total (ug/L)	Molybdenum, total (ug/L)	Nickel, total (ug/L)	Nitrite + Nitrate (mg/L)	Potassium, total (mg/L)	Selenium, total (ug/L)	Silicon, total (ug/L)	Silver, total (ug/L)	Strontium, total (ug/L)	Sodium, total (mg/L)	Thallium, total (ug/L)	Tin, total (ug/L)	Titanium, total (ug/L)	Vanadium, total (ug/L)	Zinc, total (ug/L)	Chloride, total (mg/L)	Fluoride, total (mg/L)	Sulfate, total (mg/L)
	MCLs	**TDEC**	**-**	**6**	**10**	**2000**	**4**	**-**	**5**	**-**	**100**	**-**	**-**	**-**	**15~**	**-**	**-**	**-**	**2**	**-**	**100**	**10^**	**-**	**50**	**-**	**100**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**4**	**-**
		EPA	**-**	**6**	**10**	**2000**	**4**	**-**	**5**	**-**	**100**	**-**	**1300~**	**-**	**15~**	**-**	**-**	**-**	**2**	**-**	**-**	**1^^**	**-**	**50**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**4**	**-**
WBF-2 (cont.)	WB2	09/04/91	430	2	**24**	240	--	<500	0.2	12	2	--	<10	570	4	30	2.7	<5	--	<20	3	--	1.3	<1	7000	--	330	56	--	--	--	<10	<10	2	--	5
		12/16/91	2400	**11**	5	290	--	<500	0.1	13	4	--	<10	2600	5	30	3	48	--	<20	5	--	1.5	<1	4800	--	390	59	--	--	--	<10	20	2	--	14
		03/17/92	740	1	<1	200	--	<500	0.1	10	<1	--	<10	1700	3	37	0.4	130	--	<20	5	--	1.2	<1	7000	--	310	67	--	--	--	<10	<10	1	--	4
		06/22/92	1000	<1	2	150	--	<500	0.2	8.6	5	--	<10	1900	2	45	2	58	--	<20	4	--	1.8	<1	7200	--	240	69	--	--	--	<10	30	1	--	13
		09/03/92	3700	<1	2	260	--	<500	0.4	16	<1	--	20	3200	6	40	3.2	110	--	<20	7	--	1.8	<1	13000	--	320	70	--	--	--	<10	20	2	--	12
		12/17/92	8	--	3	350	<1	<500	<0.1	15	3	--	<10	5700	**16**	30	3.4	100	--	<20	4	--	1.7	<1	--	--	290	51	--	--	--	<10	20	2	--	12
		06/02/93	27000	--	4	710	<1	<500	--	33	--	--	10	22000	**41**	--	9.1	530	--	<20	22	--	2	--	--	--	670	73	--	--	--	--	120	4	--	14
		12/13/93	1800	--	5	720	<1	<500	--	23	--	--	<10	4100	**40**	--	5.3	260	--	<20	18	--	1.9	--	--	--	810	66	--	--	--	--	20	14	--	29
		06/15/94	68000	--	**16**	2000	**8**	<500	--	66	--	--	50	65000	**130**	--	21	1400	--	<20	48	--	3.3	--	--	--	1600	76	--	--	--	--	250	4	--	15
		06/29/95	360	<1	<1	440	<1	<500	--	44	--	--	<10	4800	3	--	7.1	840	--	--	--	--	1.2	1	--	--	460	25	--	--	--	--	<10	6	--	18
		07/18/96	2800	--	<1	400	<1	<500	--	34	--	--	<10	5200	4	--	6.4	740	--	--	--	--	1.2	--	--	--	530	33	--	--	--	--	10	5	--	18
		05/12/97	3100	--	<1	400	<1	<500	--	35	--	--	<10	2500	5	--	6.7	660	--	--	--	--	1.5	--	--	--	470	30	--	--	--	--	10	6	--	18
		05/13/98	36000	--	4	1100	3	<200	--	25	--	--	10	31000	**49**	--	9.3	430	--	--	--	--	2.6	--	--	--	850	53	--	--	--	--	100	8	--	56
		02/03/00	3200	--	1.2	320	<1	160	--	12	--	--	10	2100	4.8	--	3	60	--	<20	--	--	2.3	--	14000	<10	400	62	--	<50	35	<10	20	3	--	5
WBF-3	WB3	12/12/88	1700	<1	3	170	--	<500	<0.1	28	2	--	<10	14000	1	260	4.5	770	--	<20	<1	--	0.67	2	12000	--	170	5.8	--	--	--	<10	30	2	--	<1
		03/09/89	440	<1	3	160	--	<500	<0.1	32	<1	--	<10	9500	<1	<10	6.4	2200	--	<20	<1	--	0.69	1	12000	--	130	5.5	--	--	--	<10	10	3	--	28
		03/09/89	580	<1	2	160	--	<500	<0.1	30	<1	--	<10	8700	1	<10	6.4	2200	--	<20	<1	--	0.69	<1	11000	--	140	5.7	--	--	--	10	<10	3	--	35
		06/21/89	720	<1	3	160	--	<500	0.1	26	2	--	<10	13000	3	<10	4.1	680	--	<20	4	--	0.61	<1	13000	--	150	5.4	--	--	--	<10	<10	3	--	2
		08/16/89	460	<1	3	150	--	<500	0.3	28	<1	--	<10	12000	<1	<10	4.5	720	--	30	3	--	0.68	<1	11000	--	180	5.8	--	--	--	10	<10	2	--	5
		08/28/89	--	--	--	--	--	<500	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--
		12/13/89	2400	<1	2	160	--	<500	0.3	25	3	--	<10	10000	2	<10	6.1	560	--	<20	5	--	0.6	<1	16000	--	180	6.4	--	--	--	20	80	3	--	<1
		03/21/90	530	<1	2	160	--	<500	<0.1	26	1	--	<10	11000	<1	<10	4.6	770	--	<20	3	--	0.62	<1	11000	--	150	5.4	--	--	--	<10	<10	2	--	<1
		06/26/90	1000	1	2	170	--	<500	<0.1	30	<1	--	<10	14000	5	<10	3.9	740	--	<20	<1	--	0.64	<1	12000	--	180	5.3	--	--	--	<10	<10	3	--	<1
		09/25/90	1600	<1	2	170	--	<500	0.2	27	<1	--	<10	14000	1	<10	4.7	830	--	<20	3	--	0.6	<1	13000	--	130	52	--	--	--	<10	10	3	--	<1
		12/11/90	600	<1	2	160	--	<500	<0.1	26	1	--	<10	13000	1	<10	4.2	770	--	<20	2	--	0.55	<1	11000	--	180	5.2	--	--	--	10	30	3	--	4
		03/04/91	1500	3	3	210	--	<500	0.6	26	3	--	30	13000	1	<10	4.4	760	--	20	2	--	0.89	<1	12000	--	170	5.2	--	--	--	<10	20	2	--	3
		06/05/91	2200	<1	6	210	--	<500	0.2	29	<1	--	<10	15000	2	<10	4.5	870	--	<20	2	--	0.6	<1	14000	--	150	5.2	--	--	--	<10	20	4	--	<1
		09/04/91	1500	4	**19**	160	--	<500	0.2	27	4	--	<10	14000	2	<10	4.4	770	--	<20	4	--	0.8	<1	14000	--	170	4.8	--	--	--	<10	<10	3	--	3
		12/16/91	1300	4	6	200	--	<500	<0.1	32	4	--	<10	16000	2	<10	5.6	1600	--	<20	4	--	0.62	<1	6400	--	350	5.2	--	--	--	<10	<10	4	--	30
		03/17/92	250	<1	2	150	--	<500	0.1	24	<1	--	<10	11000	<1	<10	0.7	640	--	<20	<1	--	0.5	<1	10000	--	170	4.5	--	--	--	<10	<10	2	--	<1
		06/22/92	100	<1	3	130	--	<500	0.1	24	4	--	<10	11000	<1	<10	3.5	690	--	<20	<1	--	0.5	<1	11000	--	110	5.8	--	--	--	<10	<10	2	--	9
		09/03/92	340	1	3	140	--	<500	<0.1	26	<1	--	10	13000	<1	<10	3.9	780	--	<20	3	--	0.56	<1	12000	--	110	5.9	--	--	--	<10	<10	2	--	1
		09/03/92	260	<1	3	140	--	<500	<0.1	26	<1	--	<10	13000	2	<10	3.8	760	--	<20	5	--	0.58	<1	12000	--	110	5.8	--	--	--	<10	<10	2	--	1
		12/17/92	450	--	3	150	<1	<500	<0.1	30	<1	--	<10	11000	<1	<10	3.8	760	--	<20	2	--	0.7	<1	--	--	170	5.1	--	--	--	<10	<10	3	--	1
		06/02/93	250	--	4	160	<1	<500	--	29	--	--	<10	15000	<1	--	3.8	820	--	<20	<1	--	0.5	--	--	--	190	5.4	--	--	--	--	<10	3	--	3
		12/13/93	280	--	4	180	<1	<500	--	28	--	--	<10	14000	1	--	4.3	810	--	<20	6	--	0.7	--	--	--	180	5.1	--	--	--	--	<10	3	--	<2
		06/15/94	160	--	3	180	<1	<500	--	28	--	--	<10	16000	<1	--	4.3	840	--	<20	1	--	0.6	--	--	--	200	5	--	--	--	--	<10	3	--	2
		06/29/95	150	<1	4	150	<1	<500	--	29	--	--	<10	19000	<1	--	4.1	860	--	--	--	--	0.6	2	--	--	60	5	--	--	--	--	<10	3	--	2
		07/18/96	110	--	3	140	<1	<500	--	29	--	--	<10	15000	8	--	4.5	870	--	--	--	--	0.5	--	--	--	160	5	--	--	--	--	<10	6	--	8
		05/12/97	110	--	2	170	<1	<500	--	28	--	--	<10	14000	<1	--	4.4	880	--	--	--	--	0.6	--	--	--	160	5.2	--	--	--	--	20	3	--	<2
		05/13/98	270	--	2	180	<1	<200	--	29	--	--	<10	15000	2	--	4.3	820	--	--	--	--	0.6	--	--	--	150	5.3	--	--	--	--	<10	4	--	7
		02/03/00	320	--	2.3	190	<1	<200	--	29	--	--	<10	13000	<1	--	4.5	920	--	<20	--	--	0.76	--	16000	<10	200	5.3	--	<50	11	<10	<10	5	--	11
WBF-MW-1	MW-1	10/20/14	--	<2	<2	47.7	<2	--	<1	--	<5	10.7	<10	--	<2	--	--	--	<0.2	--	<10	--	--	<10	--	<5	--	--	<2	--	--	<2	<50	--	<0.1	--
		01/13/15	--	<2	<2	47.4	<2	--	<1	--	<2	14.1	<2	--	<2	--	--	--	<0.2	--	10.5	--	--	<2	--	<2	--	--	<2	--	--	<2	<25	--	<0.1	--
		01/13/15	--	<2	<2	46.3	<2	--	<1	--	<2	13.4	<2	--	<2	--	--	--	<0.2	--	10	--	--	<2	--	<2	--	--	<2	--	--	<2	<25	--	<0.1	--

Table 1A
Groundwater Chemical Data

Well ID	Historical Well ID Ref.	Date	Inorganics																														Anions		
			Aluminum, total (ug/L)	Antimony, total (ug/L)	Arsenic, total (ug/L)	Barium, total (ug/L)	Beryllium, total (ug/L)	Boron, total (ug/L)	Cadmium, total (ug/L)	Calcium, total (mg/L)	Chromium, total (ug/L)	Cobalt, total (ug/L)	Copper, total (ug/L)	Iron, total (ug/L)	Lead, total (ug/L)	Lithium, total (ug/L)	Magnesium, total (mg/L)	Manganese, total (ug/L)	Mercury, total (ug/L)	Molybdenum, total (ug/L)	Nickel, total (ug/L)	Nitrite + Nitrate (mg/L)	Potassium, total (mg/L)	Selenium, total (ug/L)	Silicon, total (ug/L)	Silver, total (ug/L)	Strontium, total (ug/L)	Sodium, total (mg/L)	Thallium, total (ug/L)	Tin, total (ug/L)	Titanium, total (ug/L)	Vanadium, total (ug/L)	Zinc, total (ug/L)	Chloride, total (mg/L)	Fluoride, total (mg/L)	Sulfate, total (mg/L)
	MCLs	**TDEC**	**-**	**6**	**10**	**2000**	**4**	**-**	**5**	**-**	**100**	**-**	**-**	**-**	**15~**	**-**	**-**	**-**	**2**	**-**	**100**	**10^**	**-**	**50**	**-**	**100**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**4**	**-**
		EPA	**-**	**6**	**10**	**2000**	**4**	**-**	**5**	**-**	**100**	**-**	**1300~**	**-**	**15~**	**-**	**-**	**-**	**2**	**-**	**-**	**1^^**	**-**	**50**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**4**	**-**
WBF-MW-1 (cont.)	MW-1	04/21/15	--	<2	<2	44.7	<2	--	<1	--	<2	15.5	<2	--	<2	--	--	--	<0.2	--	11.6	--	--	<2	--	<2	--	--	<2	--	--	2.17	<25	--	<0.1	--
		07/22/15	--	<2	<2	44	<2	--	<1	--	<2	9.8	<2	--	<2	--	--	--	<0.2	--	6.57	--	--	<2	--	<2	--	--	<2	--	--	3.62	<25	--	<0.1	--
		10/06/15	--	<2	<2	42.6	<2	--	<1	--	<2	10.5	69.1	--	<2	--	--	--	<0.2	--	7.57	--	--	<2	--	<2	--	--	<2	--	--	2.93	75.8	--	<0.1	--
		10/06/15	--	<2	<2	41.8	<2	--	<1	--	<2	10.4	<2	--	<2	--	--	--	<0.2	--	8.56	--	--	<2	--	<2	--	--	<2	--	--	2.97	<25	--	<0.1	--
		01/25/16	--	<2	<2	48.8	<2	--	<1	--	<2	10	<2	--	<2	--	--	--	<0.2	--	8.53	--	--	<2	--	<2	--	--	<2	--	--	5.71	<25	--	<0.1	--
		04/13/16	--	<2	<2	53	<2	--	<1	--	<2	11.2	<2	--	<2	--	--	--	<0.2	--	7.38	--	--	<2	--	<2	--	--	<2	--	--	<4	<25	--	<0.1	--
		07/06/16	--	<2	<2	43.1	<2	--	<1	--	<2	8.52	<2	--	<2	--	--	--	<0.2	--	5.45	--	--	<2	--	<2	--	--	<2	--	--	<2	<25	--	<0.1	--
		07/06/16	--	<2	<2	43.4	<2	--	<1	--	<2	8.34	<2	--	<2	--	--	--	<0.2	--	5.36	--	--	<2	--	<2	--	--	<2	--	--	2.08	<25	--	<0.1	--
		10/04/16	--	<2	<2	46.7	<2	949	<1	72.3	<2	7.44	<2	--	<2	11.2	--	--	<0.2	<2	6.02	--	--	<2	--	<2	--	--	<2	--	--	<2	<25	6.79	<0.1	95.3
		10/04/16	--	<2	<2	43.9	<2	940	<1	73.8	<2	7.77	<2	--	<2	10.6	--	--	<0.2	<2	5.5	--	--	<2	--	<2	--	--	<2	--	--	<2	<25	6.8	<0.1	72.5
		01/18/17	--	--	--	--	--	989	--	69.8	--	--	--	--	--	12.1	--	--	--	<5	--	--	--	--	--	--	--	--	--	--	--	--	--	8.52	--	91.8
		04/04/17	--	<2	<1	37.7	<1	1320	<1	61.7	<2	12.3	<2	--	<1	7.32	--	--	<0.2	<5	7.73	--	--	<5	--	<1	--	--	<1	--	--	<1	10.8	7.62	<0.1	85
		07/18/17	--	--	--	--	--	818	--	70.4	--	--	--	--	--	9.33	--	--	--	<5	--	--	--	--	--	--	--	--	--	--	--	--	--	7.66	--	84.7
		07/18/17	--	--	--	--	--	817	--	72.2	--	--	--	--	--	9.22	--	--	--	<5	--	--	--	--	--	--	--	--	--	--	--	--	--	9.14	--	82.4
		10/16/17	--	<2	<1	37.8	<1	923	<1	68.5	<2	9.39	<2	--	<1	10	--	--	<0.2	<5	5.78	--	--	<5	--	<1	--	--	<1	--	--	<1	<5	7.35	<0.1	80.3
WBF-MW-2	MW-2	10/20/14	--	<2	<2	78.2	<2	--	<1	--	<5	<2	<10	--	<2	--	--	--	<0.2	--	<10	--	--	<10	--	<5	--	--	<2	--	--	2.04	<50	--	<0.1	--
		01/13/15	--	<2	<2	74.4	<2	--	<1	--	<2	<2	<2	--	<2	--	--	--	<0.2	--	<2	--	--	<2	--	<2	--	--	<2	--	--	<2	<25	--	<0.1	--
		04/21/15	--	<2	<2	75.3	<2	--	<1	--	<2	<2	<2	--	<2	--	--	--	<0.2	--	<2	--	--	<2	--	<2	--	--	<2	--	--	2.24	<25	--	<0.1	--
		04/21/15	--	<2	<2	76	<2	--	<1	--	<2	<2	<2	--	<2	--	--	--	<0.2	--	<2	--	--	<2	--	<2	--	--	<2	--	--	2.47	<25	--	<0.1	--
		07/22/15	--	<2	<2	54.1	<2	--	<1	--	<2	<2	<2	--	<2	--	--	--	<0.2	--	<2	--	--	<2	--	<2	--	--	<2	--	--	3.44	<25	--	<0.1	--
		10/06/15	--	<2	<2	56.3	<2	--	<1	--	2.97	<2	<2	--	<2	--	--	--	<0.2	--	2.15	--	--	<2	--	<2	--	--	<2	--	--	5.66	<25	--	<0.1	--
		01/25/16	--	<2	<2	51.8	<2	--	<1	--	<2	<2	<2	--	<2	--	--	--	<0.2	--	<2	--	--	<2	--	<2	--	--	<2	--	--	5.61	<25	--	<0.1	--
		01/25/16	--	<2	<2	51.8	<2	--	<1	--	10.7	<2	<2	--	<2	--	--	--	<0.2	--	<2	--	--	<2	--	<2	--	--	<2	--	--	5.55	<25	--	<0.1	--
		04/13/16	--	<2	<2	48.1	<2	--	<1	--	<2	<2	<2	--	<2	--	--	--	<0.2	--	<2	--	--	<2	--	<2	--	--	<2	--	--	<4	<25	--	<0.1	--
		07/06/16	--	<2	<2	48.4	<2	--	<1	--	<2	<2	<2	--	<2	--	--	--	<0.2	--	<2	--	--	<2	--	<2	--	--	<2	--	--	2.23	<25	--	<0.1	--
		10/04/16	--	<2	<2	43.6	<2	230	<1	33.5	<2	<2	<2	--	<2	<50	--	--	<0.2	<2	<2	--	--	<2	--	<2	--	--	<2	--	--	<2	<25	2.52	<0.1	39.6
		01/18/17	--	--	--	--	--	1610	--	69.7	--	--	--	--	--	<5	--	--	--	<5	--	--	--	--	--	--	--	--	--	--	--	--	--	5.56	--	73
		04/04/17	--	<2	<1	58.4	<1	1740	<1	70.4	<2	0.65	<2	--	<1	<5	--	--	<0.2	<5	<1	--	--	<5	--	<1	--	--	<1	--	--	<1	<5	6.22	<0.1	54.2
		07/17/17	--	--	--	--	--	174	--	35.1	--	--	--	--	--	<5	--	--	--	<5	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	37.8
		10/16/17	--	<2	<1	83.1	<1	824	<1	51.4	<2	<0.5	<2	--	<1	<5	--	--	<0.2	<5	<1	--	--	<5	--	<1	--	--	<1	--	--	<1	<5	7.25	<0.1	37.6
		10/16/17	--	<2	<1	85.1	<1	849	<1	52	<2	<0.5	<2	--	<1	<5	--	--	<0.2	<5	<1	--	--	<5	--	<1	--	--	<1	--	--	1.08	<5	6.81	<0.1	36.2
WBF-MW-3	MW-3	10/21/14	--	<2	<2	132	<2	--	<1	--	<5	<2	<10	--	<2	--	--	--	<0.2	--	<10	--	--	<10	--	<5	--	--	<2	--	--	3.82	<50	--	<0.1	--
		10/21/14	--	<2	<2	133	<2	--	<1	--	<5	<2	<10	--	<2	--	--	--	<0.2	--	<10	--	--	<10	--	<5	--	--	<2	--	--	3.87	<50	--	<0.1	--
		01/13/15	--	<2	<2	94.3	<2	--	<1	--	<2	<2	<2	--	<2	--	--	--	<0.2	--	<2	--	--	<2	--	<2	--	--	<2	--	--	<2	<25	--	<0.1	--
		04/21/15	--	<2	<2	101	<2	--	<1	--	<2	<2	<2	--	<2	--	--	--	<0.2	--	<2	--	--	<2	--	<2	--	--	<2	--	--	2.12	<25	--	<0.1	--
		07/22/15	--	<2	<2	118	<2	--	<1	--	<2	<2	<2	--	<2	--	--	--	<0.2	--	<2	--	--	<2	--	<2	--	--	<2	--	--	4.29	<25	--	<0.1	--
		07/22/15	--	<2	<2	125	<2	--	<1	--	<2	<2	2.7	--	<2	--	--	--	<0.2	--	<2	--	--	<2	--	<2	--	--	<2	--	--	2.3	<25	--	<0.1	--
		10/06/15	--	<2	<2	120	<2	--	<1	--	<2	<2	<2	--	<2	--	--	--	<0.2	--	<2	--	--	<2	--	<2	--	--	<2	--	--	3.57	<25	--	<0.1	--
		01/25/16	--	<2	<2	108	<2	--	<1	--	<2	<2	<2	--	<2	--	--	--	<0.2	--	<2	--	--	<2	--	<2	--	--	<2	--	--	5.7	<25	--	<0.1	--
		04/13/16	--	<2	<2	113	<2	--	<1	--	<2	<2	<2	--	<2	--	--	--	<0.2	--	<2	--	--	<2	--	<2	--	--	<2	--	--	<4	<25	--	<0.1	--
		04/13/16	--	<2	<2	104	<2	--	<1	--	<2	<2	<2	--	<2	--	--	--	<0.2	--	<2	--	--	<2	--	<2	--	--	<2	--	--	<4	<25	--	<0.1	--

Table 1A
Groundwater Chemical Data

Well ID	Historical Well ID Ref.	Date	Inorganics																																	Anions		
			Aluminum, total (ug/L)	Antimony, total (ug/L)	Arsenic, total (ug/L)	Barium, total (ug/L)	Beryllium, total (ug/L)	Boron, total (ug/L)	Cadmium, total (ug/L)	Calcium, total (mg/L)	Chromium, total (ug/L)	Cobalt, total (ug/L)	Copper, total (ug/L)	Iron, total (ug/L)	Lead, total (ug/L)	Lithium, total (ug/L)	Magnesium, total (mg/L)	Manganese, total (ug/L)	Mercury, total (ug/L)	Molybdenum, total (ug/L)	Nickel, total (ug/L)	Nitrite + Nitrate (mg/L)	Potassium, total (mg/L)	Selenium, total (ug/L)	Silicon, total (ug/L)	Silver, total (ug/L)	Strontium, total (ug/L)	Sodium, total (mg/L)	Thallium, total (ug/L)	Tin, total (ug/L)	Titanium, total (ug/L)	Vanadium, total (ug/L)	Zinc, total (ug/L)	Chloride, total (mg/L)	Fluoride, total (mg/L)	Sulfate, total (mg/L)
	MCLs	**TDEC**	**-**	**6**	**10**	**2000**	**4**	**-**	**5**	**-**	**100**	**-**	**-**	**-**	**15~**	**-**	**-**	**-**	**2**	**-**	**100**	**10^**	**-**	**50**	**-**	**100**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**4**	**-**
		EPA	**-**	**6**	**10**	**2000**	**4**	**-**	**5**	**-**	**100**	**-**	**1300~**	**-**	**15~**	**-**	**-**	**-**	**2**	**-**	**-**	**1^^**	**-**	**50**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**4**	**-**
WBF-MW-3 (cont.)	MW-3	07/06/16	--	<2	<2	107	<2	--	<1	--	<2	<2	<2	--	<2	--	--	--	<0.2	--	<2	--	--	<2	--	<2	--	--	<2	--	--	2.42	<25	--	<0.1	--
		10/04/16	--	<2	<2	118	<2	1190	<1	62.4	<2	<2	<2	--	<2	<50	--	--	<0.2	<2	<2	--	--	<2	--	<2	--	--	<2	--	--	<2	<25	5.56	<0.1	43.4
		04/04/17	--	<2	<1	39.6	<1	299	<1	37.6	<2	<0.5	<2	--	<1	<5	--	--	<0.2	<5	<1	--	--	<5	--	<1	--	--	<1	--	--	<1	<5	2.77	<0.1	35
		07/17/17	--	--	--	--	--	941	--	55.6	--	--	--	--	--	<5	--	--	--	<5	--	--	--	--	--	--	--	--	--	--	--	--	--	7.04	--	46.8
		10/16/17	--	<2	<1	34.7	<1	147	<1	29.8	<2	<0.5	<2	--	<1	<5	--	--	<0.2	<5	<1	--	--	<5	--	<1	--	--	<1	--	--	<1	<5	1.89	<0.1	32.6

~ Action Level
^ nitrate MCL (MCL has not been established for nitrite)
^^ nitrite MCL (more conservative MCL of nitrate and nitrite)
-- no data
Bold numbers indicate that measured values exceed TDEC MCLs
cont. - continued
EPA - Environmental Protection Agency; MCLs established in 40 CFR Part 141 Appendix I
Grey cells indicate that measured values exceed EPA MCLs
MCL - Maximum Contaminant Level
mg/L - milligrams per liter
N/A - not applicable
Ref. - reference
TDEC - Tennessee Department of Environment and Conservation; MCLs established in Rules of TDEC Solid Waste Management Appendix III
ug/L - microgram per liter
Well ID - well identification

Well ID	Historical Well ID Ref.	Date	General Chemistry										
			Alkalinity, Carbonate (mg/L)	Alkalinity, total (mg/L CaCO3)	Alkalinity, Bicarbonate (mg/L)	Oxygen-Reduction Potential (mV)	Oxygen, Dissolved (mg/L)	pH	Specific Conductivity (micromhos/cm)	Temperature (°C)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTU)
WBF-1	WB1	12/12/88	--	86	--	290	0.3	6.20	360	16.3	250	--	--
		03/09/89	--	93	--	NM	0.2	5.80	99	16.5	210	--	--
		06/21/89	--	46	--	280	0.7	5.90	340	20.2	610	--	--
		08/16/89	--	31	--	300	0.2	5.90	320	19.2	220	--	--
		08/28/89	--	34	--	100	0.1	5.90	340	20.2	--	--	--
		12/13/89	--	33	--	NM	0.2	6.10	370	16.4	260	--	--
		03/21/90	--	35	--	110	0.3	6.00	340	18.3	240	--	--
		06/26/90	--	32	--	225	0.4	6.16	338	18.7	230	--	--
		09/25/90	--	37	--	190	0.5	6.10	325	17.4	210	--	--
		12/11/90	--	40	--	290	0.6	6.10	350	17.9	200	--	--
		03/04/91	--	55	--	225	0.4	6.20	350	17.7	260	--	--
		06/05/91	--	47	--	177	0.9	6.30	384	18.5	290	--	--
		09/04/91	--	35	--	379	0.5	6.10	329	18.1	230	--	--
		12/16/91	--	49	--	150	0.4	6.00	421	17.4	290	47	--
		03/17/92	--	42	--	243	0.5	6.00	386	19.4	250	4	--
		06/22/92	--	--	--	158	0.4	6.20	333	18.8	230	19	--
		06/22/92	--	--	--	--	--	--	--	--	240	30	--
		09/03/92	--	45	--	236	0.1	6.10	349	18.3	210	27	--
		12/17/92	--	49	--	12	0.4	6.00	358	17.5	230	14	--
		06/02/93	--	70	--	153	0.2	6.20	339	20.1	220	59	--
		12/13/93	--	52	--	84	0.4	6.10	311	18.3	190	4	--
		06/15/94	--	90	--	234	0.1	6.30	372	20.8	200	<1	--
		06/29/95	--	88	--	136	0.1	6.10	337	19.2	220	17	--
		07/18/96	--	114	--	172	0.1	6.30	446	19.4	280	5	--
		05/12/97	--	109	--	149	0.2	6.10	384	20.4	230	3	--
		05/13/98	--	124	--	50	0.2	6.20	465	20.0	260	7	--
		02/03/00	--	102	--	82	0.5	6.40	401	18.4	290	5	--
WBF-100	N/A	01/18/17	--	--	--	299	1.8	6.50	811	16.4	578	0.8	1.1
		04/05/17	--	--	--	256	0.55	6.01	788	16.1	551	1	1
		04/05/17	--	--	--	--	--	--	--	--	555	1	--
		07/18/17	--	--	--	353	0.14	6.44	795	18.1	556	--	1.7
		10/16/17	--	--	--	329	0.64	6.17	834	17.4	572	<0.5	2.7
WBF-2	WB2	12/12/88	--	210	--	170	0.4	7.70	363	15.2	220	--	--
		03/09/89	--	177	--	NM	0.4	7.80	330	17.6	180	--	--
		06/21/89	--	178	--	230	4.1	7.80	300	22.7	220	--	--
		08/16/89	--	168	--	190	0.6	7.80	310	19.3	190	--	--
		08/28/89	--	176	--	NM	0.3	7.80	330	19.8	--	--	--
		12/13/89	--	164	--	NM	0.3	7.90	320	15.3	200	--	--
		03/21/90	--	171	--	NM	0.3	7.80	310	17.0	210	--	--
		06/26/90	--	174	--	25	2.7	7.97	319	18.3	210	--	--
		09/25/90	--	173	--	180	4.1	7.90	312	17.7	180	--	--
		12/11/90	--	176	--	-160	0.5	8.20	320	16.9	230	--	--
		03/04/91	--	170	--	230	0.8	7.90	316	15.7	280	--	--
		06/05/91	--	175	--	58	1.4	8.10	307	17.1	320	--	--
		09/04/91	--	152	--	37	1.4	8.10	299	17.9	150	--	--
		12/16/91	--	170	--	216	5.6	7.80	340	16.0	200	110	--
		03/17/92	--	169	--	247	0.6	8.0	335	18.0	200	33	--

Well ID	Historical Well ID Ref.	Date	General Chemistry										
			Alkalinity, Carbonate (mg/L)	Alkalinity, total (mg/L CaCO3)	Alkalinity, Bicarbonate (mg/L)	Oxygen-Reduction Potential (mV)	Oxygen, Dissolved (mg/L)	pH	Specific Conductivity (micromhos/cm)	Temperature (°C)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTU)
WBF-2 (cont.)	WB2	06/22/92	--	175	--	54	0.5	7.90	298	17.6	190	80	--
		09/03/92	--	183	--	66	0.1	7.70	348	17.3	150	48	--
		12/17/92	--	108	--	104	1.6	8.20	202	16.3	300	360	--
		06/02/93	--	185	--	50	0.3	7.80	348	20.3	240	1400	--
		12/13/93	--	174	--	-80	0.5	8.00	314	18.9	340	1600	--
		06/15/94	--	190	--	297	0.4	7.30	349	23.7	890	5800	--
		06/29/95	--	167	--	139	2.4	6.60	382	20.3	200	1200	--
		07/18/96	--	167	--	150	0.1	6.90	384	19.4	390	1100	--
		05/12/97	--	158	--	257	1.6	6.40	376	20.6	360	6800	--
		05/13/98	--	168	--	308	2.6	8.10	315	20.4	330	880	--
		02/03/00	--	174	--	4.4	7.6	8.40	305	16.0	70	120	--
WBF-3	WB3	12/12/88	--	118	--	18	0.8	6.80	221	14.9	130	--	--
		03/09/89	--	32	--	71	0.3	5.90	360	18.5	140	--	--
		03/09/89	--	32	--	71	0.3	5.90	360	18.5	110	--	--
		06/21/89	--	110	--	70	1.2	6.60	210	20.4	120	--	--
		08/16/89	--	104	--	20	0.3	6.80	210	18.6	100	--	--
		08/28/89	--	109	--	NM	0.3	6.80	220	18.3	--	--	--
		12/13/89	--	105	--	NM	0.1	6.90	220	15.00	120	--	--
		03/21/90	--	106	--	NM	0.3	6.70	200	17.5	100	--	--
		06/26/90	--	105	--	NM	0.2	6.82	221	17.5	120	--	--
		09/25/90	--	109	--	89	0.4	6.80	218	16.7	100	--	--
		12/11/90	--	107	--	-60	0.5	6.80	220	16.3	140	--	--
		03/04/91	--	105	--	-60	0.5	6.80	220	15.0	140	--	--
		06/05/91	--	102	--	-76	0.5	6.90	213	17.4	120	--	--
		09/04/91	--	108	--	-72	0.6	6.80	217	17.8	80	--	--
		12/16/91	--	108	--	-20	0.4	6.50	289	15.4	170	48	--
		03/17/92	--	107	--	-69	0.5	6.90	227	16.9	100	27	--
		06/22/92	--	110	--	-46	0.4	6.90	207	17.1	50	29	--
		09/03/92	--	110	--	-48	0.1	6.80	231	17.2	100	29	--
		09/03/92	--	--	--	--	--	--	--	--	80	25	--
		12/17/92	--	114	--	30	0.7	6.70	233	15.6	130	22	--
		06/02/93	--	115	--	-90	0.2	6.80	230	19.0	100	36	--
		12/13/93	--	115	--	-118	0.3	6.80	225	16.2	100	24	--
		06/15/94	--	117	--	89	0.1	6.90	225	20.2	80	28	--
		06/29/95	--	118	--	70	0.2	6.60	238	18.5	120	22	--
		07/18/96	--	121	--	103	0.5	6.80	248	18.9	100	32	--
		05/12/97	--	121	--	84	0.1	6.40	254	19.1	100	26	--
		05/13/98	--	126	--	76	0.2	6.60	253	18.9	120	31	--
		02/03/00	--	111	--	65	0.5	6.80	239	16.4	170	20	--
WBF-MW-1	MW-1	10/20/14	--	130	--	312	0.1	5.60	453	16.6	--	15.1	18.4
		01/13/15	--	104	--	337	0.1	5.60	419	15.6	--	21.9	26.4
		01/13/15	--	--	--	--	--	--	--	--	--	22.3	--
		04/21/15	--	80	--	353	0.1	5.70	399	16.8	--	36.4	38
		07/22/15	--	105	--	330	0.1	5.80	456	18.1	--	5.3	8.4
		10/06/15	--	126	--	345	0.1	6.10	439	18.5	--	13.5	14
		10/06/15	--	--	--	--	--	--	--	--	--	4.3	--
		01/25/16	--	116	--	164	0.1	6.00	442	16.3	--	22.4	22

Table 1B
Groundwater Physical Data

Well ID	Historical Well ID Ref.	Date	General Chemistry											
			Alkalinity, Carbonate (mg/L)	Alkalinity, total (mg/L CaCO3)	Alkalinity, Bicarbonate (mg/L)	Oxygen-Reduction Potential (mV)	Oxygen, Dissolved (mg/L)	pH	Specific Conductivity (micromhos/cm)	Temperature (°C)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTU)
WBF-MW-1 (cont.)	MW-1	04/13/16	--	131	--	351	0.1	5.70	462	16.2	--	28.4	29
		07/06/16	--	136	--	345	0.1	5.70	407	19.6	--	13.1	17
		07/06/16	--	135	--	--	--	--	--	--	--	13.5	--
		10/04/16	--	--	--	350	0.1	5.80	482	20.5	317	9	23
		10/04/16	--	--	--	--	--	--	--	--	304	10.3	--
		01/18/17	--	--	--	331	1.2	6.00	455	17.5	300	--	10
		04/04/17	--	--	--	370	1.87	5.18	375	18.5	234	1.6	3.7
		07/18/17	--	--	--	319	0.39	5.97	456	19.4	294	--	2.8
		07/18/17	--	--	--	--	--	--	--	--	308	--	--
		10/16/17	--	--	--	327	0.16	5.62	450	18.5	288	<2	3.9
WBF-MW-2	MW-2	10/20/14	--	148	--	358	0.1	5.80	357	18.9	--	11.3	16.9
		01/13/15	--	120	--	342	0.1	6.00	345	17.5	--	10	12.3
		04/21/15	--	121	--	412	0.1	5.80	378	17.2	--	18.3	16.9
		04/21/15	--	--	--	--	--	--	--	--	--	18.4	--
		07/22/15	--	67	--	425	0.1	5.60	278	19.0	--	2.7	4.8
		10/06/15	--	62	--	412	0.1	6.40	238	19.8	--	12.8	4.9
		01/25/16	--	68	--	196	0.1	6.40	163	17.9	--	3	4.8
		01/25/16	--	--	--	--	--	--	--	--	--	5	--
		04/13/16	--	70.7	--	442	0.1	6.00	260	18.7	--	5.7	4.8
		07/06/16	--	74.9	--	447	0.1	6.10	261	21.0	--	7.3	11
		10/04/16	--	--	--	460	0.1	6.10	236	22.9	148	3.9	20
		01/18/17	--	--	--	--	--	--	--	--	297	--	--
		01/19/17	--	--	--	223	0.2	6.50	462	17.0	--	--	4.9
		04/04/17	--	--	--	281	2.06	5.87	373	17.5	221	3.9	6.3
		07/17/17	--	--	--	357	1.01	6.09	235	20.0	148	--	--
		10/16/17	--	--	--	497	1.39	5.83	321	18.2	191	<2	--
		10/16/17	--	--	--	--	--	--	--	--	199	<2	--
WBF-MW-3	MW-3	10/21/14	--	120.5	--	272	0.1	6.00	375	18.5	--	25.2	29
		10/21/14	--	--	--	--	--	--	--	--	--	26.3	--
		01/13/15	--	115	--	340	1.6	6.00	376	16.2	--	8.8	12.9
		04/21/15	--	133	--	330	0.1	6.30	419	16.8	--	9.8	12.7
		07/22/15	--	144	--	277	0.3	6.20	42	18.0	--	11.5	13
		07/22/15	--	--	--	--	--	--	--	--	--	11.4	--
		10/06/15	--	161	--	258	0.1	6.60	434	18.0	--	9.6	10
		01/25/16	--	151	--	157	0.1	6.40	411	16.9	--	7.4	13
		04/13/16	--	163	--	213	0.1	6.20	475	17.5	--	15.8	14
		04/13/16	--	163	--	--	--	--	--	--	--	18.2	--
		07/06/16	--	139	--	251	0.1	6.10	408	19.3	--	7.1	9
		10/04/16	--	--	--	332	1.2	6.00	393	19.6	231	15.4	18
		04/04/17	--	--	--	367	1.54	5.70	227	19.5	141	<0.5	4.3
		07/17/17	--	--	--	421	2.29	6.07	337	20.5	228	--	4.3
		10/16/17	--	--	--	363	0.68	5.89	203	19.0	129	<2	3.1

-- no data
°C - degrees Celsius
CaCO3 - calcium carbonate
cm - centimeters
cont. - continued
mg/L - milligrams per liter
mV - millivolts
N/A - not applicable
NM - not measured
NTU - nephelometric turbidity units
Ref. - reference
Well ID - well identification

Table 1C
Groundwater Elevation Data

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
WBF-1	WB1	03/09/89	714.11	--	0.30
		08/08/89	687.66	46.39	26.74
		08/16/89	687.01	46.39	27.40
		08/28/89	687.66	46.39	26.74
		12/13/89	685.40	--	29.00
		03/21/90	688.45	46.19	25.95
		06/26/90	686.71	--	27.69
		09/25/90	686.52	--	27.89
		12/11/90	684.61	46.19	29.79
		03/04/91	687.96	46.19	26.44
		06/05/91	686.88	46.19	27.53
		09/04/91	689.11	--	25.30
		12/16/91	687.53	46.29	26.87
		03/17/92	--	46.29	29.40
		06/22/92	--	30.61	27.10
		09/03/92	--	46.39	27.53
		12/17/92	--	46.39	29.27
		06/02/93	--	46.32	27.40
		12/13/93	--	46.36	28.84
		06/15/94	--	46.26	27.33
		06/29/95	--	46.42	27.89
		07/18/96	--	46.42	27.53
		05/12/97	--	46.42	27.59
		05/13/98	--	46.19	25.69
		02/03/00	--	46.26	31.17
WBF-2	WB2	03/09/89	664.70	--	50.00
		08/08/89	686.71	65.09	27.99
		08/16/89	686.48	65.09	28.22
		08/28/89	686.81	65.09	27.89
		12/13/89	668.01	--	46.69
		03/21/90	687.96	64.99	26.74
		06/26/90	684.51	--	30.18
		09/25/90	685.50	--	29.20
		12/11/90	681.79	64.99	32.91
		03/04/91	685.99	64.99	28.71
		06/05/91	685.07	64.99	29.63
		09/04/91	687.30	--	27.40
		12/16/91	680.02	65.09	34.68
		03/17/92	777.20	65.09	30.84
		06/22/92	779.89	65.19	28.15
		09/03/92	779.36	65.09	28.67
		12/17/92	777.85	65.09	30.18
		06/02/93	779.46	65.12	28.58
		12/13/93	777.95	65.12	30.09
		06/15/94	779.43	65.16	28.61
		06/29/95	--	65.12	29.07
		07/18/96	--	65.12	28.61

Table 1C
Groundwater Elevation Data

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
WBF-2 (cont.)	WB2	05/12/97	--	65.12	29.04
		05/13/98	--	64.96	27.00
		02/03/00	--	64.96	32.45
WBF-3	WB3	03/09/89	684.61	--	29.99
		08/08/89	693.08	46.59	21.52
		08/16/89	692.42	46.59	22.18
		08/28/89	694.23	46.59	20.37
		12/13/89	688.09	--	26.51
		03/21/90	694.75	46.49	19.85
		06/26/90	691.50	--	23.10
		09/25/90	691.60	--	23.00
		12/11/90	691.01	46.49	23.59
		03/04/91	694.00	46.49	20.60
		06/05/91	692.09	46.49	22.51
		09/04/91	695.80	--	18.80
		12/16/91	694.98	46.59	19.62
		03/17/92	--	65.09	23.03
		06/22/92	--	46.59	21.95
		09/03/92	--	46.59	22.47
		12/17/92	--	46.59	22.51
		06/02/93	--	46.59	22.38
		12/13/93	--	46.59	21.78
		06/15/94	--	46.49	22.93
		06/29/95	--	46.59	23.00
		07/18/96	--	46.59	22.60
		05/12/97	--	46.59	21.85
		05/13/98	--	46.32	20.24
		02/03/00	--	46.32	23.92
WBF-MW-1	MW-1	10/20/14	703.67	33.23	8.46
		01/13/15	705.12	33.23	7.02
		04/21/15	705.77	33.23	6.36
		07/22/15	704.49	33.23	7.64
		10/06/15	704.27	33.23	7.87
		01/25/16	704.69	33.23	7.45
		04/13/16	704.27	33.23	7.87
		07/06/16	702.40	33.23	9.74
		10/04/16	701.38	33.23	10.76
WBF-MW-2	MW-2	10/20/14	682.97	32.22	21.26
		01/13/15	682.87	32.22	21.36
		04/21/15	684.22	32.22	20.01
		07/22/15	685.53	32.22	18.70
		10/06/15	685.30	32.22	18.93
		01/25/16	683.23	32.22	21.00
		04/13/16	681.82	32.22	22.41
		07/06/16	683.89	32.22	20.34
		10/04/16	682.74	32.22	21.49

Table 1C
Groundwater Elevation Data

Well ID	Historical Well ID Ref.	Date	GW Elevation (ft amsl)	Well Depth (ft below TOC)	Water Level Depth (ft below TOC)
WBF-MW-3	MW-3	10/21/14	682.87	31.56	13.39
		01/13/15	682.38	31.56	13.88
		04/21/15	683.37	31.56	12.89
		07/22/15	683.60	31.56	12.66
		10/06/15	683.86	31.56	12.40
		01/25/16	682.91	31.56	13.35
		04/13/16	680.68	31.56	15.58
		07/06/16	682.91	31.56	13.35
		10/04/16	681.86	31.56	14.40

Note: Groundwater elevation data for WBF-100 will be included at a later date.
Historical well and groundwater data were obtained from a groundwater database. Inconsistencies at the same location could potentially be related to well repairs and re-surveying the location, obstructions in the well, conversion of units and/or human error. Well and groundwater data for existing wells will be confirmed during the investigation and other ongoing programs and provided in interim monthly reports and/or the Environmental Assessment Report.

-- no data
cont. - continued
ft - feet
ft amsl - feet above mean sea level
GW - groundwater
NA - not applicable
Ref. - reference
TOC - top of casing
Well ID - well identification

TVA Watts Bar Fossil Plant
Closed Monitoring Well Construction Details

Well ID	Historic ID	Well Type	Facility / Location	Installation Date	Well Closed	TN State Plane Northing NAD 27 (ft)	TN State Plane Easting NAD 27 (ft)	Top of Casing (ft-amsl)	Top of Ground (ft-amsl)	Well Depth (ft btoc)	Existing Stickup Height (ft ags)	Well Inside Diameter (in)	Screened Formation	Screened Interval (ft btoc)	Rationale
WBF-1	WB1	Monitoring Well	Ash Pond	10/7/1988	UNK	443476.04	2362927.14	UNK	UNK	45.0	2.5	2.0	Alluvium (brown and gray clayey sand)	35.0 - 45.0	Unknown
WBF-2	WB2	Monitoring Well	Ash Pond	10/4/1988	UNK	443659.74	2362963.77	UNK	UNK	62.6	2.6	2.0	Gray slate and limestone	52.6 - 62.6	Unknown
WBF-3	WB3	Monitoring Well	Ash Pond	10/10/1988	UNK	443846.93	2362958.20	UNK	UNK	44.1	2.5	2.0	Brown silty clay, fine to medium sand and silt	34.1 - 44.1	Unknown

Abbreviations:

ft-amsl	feet above mean sea level
ft	feet
ft btoc	feet below top of casing
ft ags	feet above ground surface
ID	Identification
in	inches
NA	No information available
NAD 27	North American Datum of 1927
UNK	Unknown

TVA Watts Bar Fossil Plant
Existing Monitoring Well Construction Details

Well ID	Historic ID	Program	Function	Well Installation Date	Facility / Location	Screened Formation	Current Status	Screened Interval (ft btoc)	TN State Plane Northing NAD 27 (ft)	TN State Plane Easting NAD 27 (ft)	TN State Plane Northing NAD 83 (ft)	TN State Plane Easting NAD 83 (ft)	Top of Casing Elevation (ft NGVD 29)	Ground Surface Elevation (ft NGVD 29)	Well Inside Diameter (in)	Well Depth (ft btoc)	Existing Stickup Height (ft ags)	Pump Intake Depth (ft btoc)	Pump Intake Elevation (ft NGVD29)
WBF-MW-1	MW-1	STA	WQS	7/25/2014	Ash Pond Complex	Alluvial Silts and Clays	Active Compliance Background	23.3 - 33.3	443979.56	2362294.34	465357.35	2330802.23	711.92	709.4	2.0	33.5	2.5	28.5	683.4
WBF-MW-2	MW-2	STA	WQS	7/25/2014	Ash Pond Complex	Alluvial Sand	Active Compliance	22.7 - 32.4	443478.34	2363006.76	464856.13	2331514.67	696.22	693.2	2.0	32.5	3.0	27.5	668.7
WBF-MW-3	MW-3	STA	WQS	7/25/2014	Ash Pond Complex	Alluvial Sand	Active Compliance	21.6 - 31.6	443138.93	2362914.36	464516.71	2331422.27	704.29	701.3	2.0	31.6	3.0	26.5	677.8
WBF-100	WBF-100	STA	WQS	11/10/2016	Ash Pond Complex	Alluvial Sand / Alluvial Silts and Clays	Proposed Background Well	47.7 - 57.8	443364.57	2362148.09	464742.34	2330655.98	741.49	737.4	4.0	58.3	4.1	53.5	688.0

Well construction depths based on video logging performed by Stantec.

Ground surface elevations are based on survey datum and/or well completion data.

Abbreviations:

ft	feet
ft btoc	feet below top of casing
ft ags	feet above ground surface
ft NGVD 29	Feet North American Vertical Datum 1929
ID	Identification
in	inches
NAD27	North American Datum of 1927
NAD83	North American Datum of 1983
STA	State compliance well
WQS	Water quality sample

APPENDIX K
BACKGROUND SOIL SAP

Background Soil Sampling and Analysis Plan Watts Bar Fossil Plant

Revision 3

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

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

November 19, 2018

BACKGROUND SOIL
SAMPLING AND ANALYSIS PLAN
WATTS BAR FOSSIL PLANT

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	February 9, 2018
2	Addresses May 16, 2018 TDEC Review Comments and Issued for TDEC Review	July 6, 2018
3	Addresses Applicable Programmatic Revisions and Issued for TDEC Approval	November 19, 2018

BACKGROUND SOIL
SAMPLING AND ANALYSIS PLAN
WATTS BAR FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Background Soil
Sampling and Analysis Plan
Watts Bar Fossil Plant
Tennessee Valley Authority
Spring City, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: November 19, 2018 Revision 3

All parties executing work as part of this Sampling and Analysis Plan sign below acknowledging they have reviewed, understand, and will abide by the requirements set forth herein.

TVA Investigation Project Manager	11/19/18 Date
TVA Investigation Field Lead	11/19/18 Date
Health, Safety, and Environmental (HSE) Manager	11-19-18 Date
Investigation Project Manager	2018-11-13 Date
Rock J. Vitale Digitally signed by Rock J. Vitale DN: cn=Rock J. Vitale, o, ou, email=rvitale@envstd.com, c=US Date: 2018.11.14 12:28:40 -05'00' QA Oversight Manager	Date
Laboratory Project Manager	11-15-18 Date
Charles L. Head TDEC Senior Advisor	Date
Robert Wilkinson TDEC CCR Technical Manager	Date

Stantec

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1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at Watts Bar Fossil Plant (WBF) on April 27, 2016, at which time TVA briefed TDEC on its Coal Combustion Residual (CCR) management plans at WBF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On June 14, 2016, TDEC issued a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 22, 2017, TDEC issued a second follow-up letter to TVA regarding the TDEC Order and EIP submittal dates. On November 15, 2016, TVA submitted WBF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

In response to TDEC's comments, this Background Soil Sampling, and Analysis Plan (SAP) has been developed to provide procedures and methods necessary to characterize background soils in the vicinity of the WBF Plant (Plant).

2.0 OBJECTIVES

The objective of this Background Soil SAP is to characterize background soils on TVA property in the vicinity of the Plant. The approach in characterizing the background soils is to identify locations where naturally occurring, in place, native soils are present, yet unaffected by CCR material. Samples will be analyzed for CCR Parameters listed in 40 CFR Part 257, Appendices III and IV along with additional parameters required by the state groundwater monitoring program (copper, nickel, silver, vanadium, and zinc). These constituents will be hereafter referred to as "CCR Parameters." Additionally, the surficial soil at each location will be collected and analyzed for percent ash, to determine the presence or absence of windblown CCR.

This Background Soil SAP and the Plant-specific Quality Assurance Project Plan (QAPP) will provide the procedures necessary to conduct investigation activities associated with the sampling and analysis of background soils. Proposed field activities will include the following tasks:

- Verify and document proposed sampling locations using global positioning system (GPS) surveying
- Collect background soil samples from proposed locations
- Package and ship soil samples to laboratory for analysis of CCR Parameters

3.0 HEALTH AND SAFETY

This work will be conducted under an approved Plant-specific Health and Safety Plan (HASP). This HASP will be in accordance with TVA Safety policies and procedures. Each worker will be responsible for reviewing and following the HASP. Personnel conducting field activities will have completed required training, understand safety procedures, and be qualified to conduct the field work described in this SAP. The HASP will include a job safety analysis (JSA) for each task described in this SAP and provide control methods to protect personnel. Personal protective equipment (PPE) requirements and safety, security, health, and environmental procedures are defined in the HASP. In addition, authorized field personnel will attend TVA required safety training and Plant orientation.

The Field Team Leader will conduct safety briefings each day prior to beginning work and at mid-shift or after lunch breaks and document these meetings to include the names of those in attendance and items discussed. TVA-specific protocols will be followed, including the completion of 2-Minute Rule cards. The JSAs will be updated if conditions change.

4.0 SAMPLING LOCATIONS

A map of twelve-proposed background soil sampling locations is provided as Figure 1 (Attachment A). The locations were selected based on access, current hydrogeologic knowledge, and the sample location criteria set forth by TDEC. In addition, areas where known or suspected beneficial reuse of CCR has occurred were excluded from consideration as sampling points. Additional considerations in selection of background soil boring locations included: relative elevation to the Plant, similar geologic units, and/or similar depositional environment (i.e., alluvial, or non-alluvial), and when feasible, proximity to existing background groundwater monitoring wells.

Boring advancement through unconsolidated soils to refusal will be conducted at locations shown on Figure 1, all of which are within a one-mile radius of the Plant. Soil borings will be advanced using a direct-push technology (DPT) drill rig (typically equipped with five-foot long probe rods or dual tube samplers) or an equivalent technology. The rods will be decontaminated between sampling locations in accordance with Section 5.2.7. In addition to the soil data that will be collected from the proposed sampling locations, TVA will collect soil samples through the well screen interval at locations of proposed background groundwater monitoring wells.

Grab samples will be collected in five-foot intervals during boring advancement from the ground surface to the top of bedrock/partially weathered rock/weathered rock (refusal.) Each boring will be logged by a Tennessee-licensed professional geologist.

In addition to collection of soil samples from the twelve-background soil boring locations, accessible rock and residuum outcrops in the vicinity of the Plant will be visually inspected in an attempt to determine if naturally occurring sources of metallic ore minerals are present in the area. This visual inspection is needed due to the presence of mineral deposits listed by the United States Geological Service in Rhea and Meigs Counties, Tennessee. The presence of metallic ore deposits, including iron and manganese, in the area could naturally increase the concentrations of these and other associated metallic elements in the background soils. If the visual inspections identify potential naturally occurring sources of metallic ore minerals, rock samples will be collected for further assessment.

5.0 SAMPLE COLLECTION AND FIELD ACTIVITY PROCEDURES

This section provides details of procedures that will be used to prepare for field activities, advance soil borings, collect background soil samples, and assist in providing scientifically defensible results.

Background soil sample collection will adhere to applicable United States Environmental Protection Agency (EPA), and TVA Environmental Technical Instruction (TI) documents. A project field book and field forms will be maintained by the Field Team Leader to record field measurements, analyses, and observations. Field activities will be planned in accordance with TVA TI ENV-TI-05.80.01 *Planning Sampling* Events, conducted according to TVA TI ENV-TI-05.80.50, *Soil and Sediment Sampling*, and documented according to TVA TI ENV-TI-05.80.03, *Field Record Keeping*.

5.1 PREPARATION FOR FIELD ACTIVITIES

As part of field mobilization activities, the field sampling team will:

- Designate a Safety Officer and a Tennessee-licensed professional geologist.
- Complete required health and safety paperwork and confirm field team members have completed required training.
- Coordinate field activities with the Laboratory Coordinator to ensure that sample bottles and preservatives are ordered, coolers and analyte-free deionized water are obtained, and sampling and sample arrival dates are communicated to the laboratories.
- Coordinate activities with the drilling subcontractor.
- Clear Access – Proposed boring locations will be marked using a wooden stake or survey flag with the position surveyed using GPS. Suitability of each location will be evaluated for logistical issues including access, grubbing needs, overhead utility clearance, and proximity to Plant features. Access improvements, including clearing and grubbing or road building, will be completed prior to the investigation start date. If a proposed boring location is discovered to have accessibility restrictions related to agricultural, cultural, biological, or other such limiting factors, then a replacement boring will be proposed at a location that will meet the study's goals with approval from TDEC.
- Perform Environmental Review – As required by the National Environmental Policy Act (NEPA), an environmental review must be completed to document and mitigate any potential impact of the work described herein. The level of review required for this work is anticipated to be a categorical exclusion, which would be documented by TVA with a categorical exclusion checklist (CEC). A CEC has a number of signatories from TVA.

It is understood that the environmental review is to be completed before implementation of the field work. Additionally, plant staff will not issue an excavation permit ahead of the completed environmental review.

- Complete Utility Locate(s) / Excavation Permit(s) - Prior to initiating subsurface activities, subsurface utility clearance will be sought via the plant engineering department and/or the TN 811 service. At locations within the Plant, engineering will provide primary utility clearance assurance in addition to TN 811 being notified. At all other drilling locations TVA or 3rd party underground locators will be engaged to clear boring locations. For drilling locations outside the plant (e.g., along public roads and rights-of-way), utility avoidance assurance will be supplemented by the TN 811 service and the TVA or 3rd party underground locators. An excavation permit is required prior to initiating any digging or boring at the Plant. A key component to the completion of the excavation permit is consensus on the drilling locations with pertinent TVA staff.

- Identify Water Source – During implementation of the EIP, a source of potable water will be required to complete several investigation tasks, including certain drilling methods and decontamination procedures.

- Obtain required functional and calibrated field instruments, including health and safety equipment.

- Complete sample paperwork to the extent possible, including chain-of-custody forms and sample labels in accordance with TVA TIs ENV-TI-05.80.02, *Sample Labeling and Custody* and ENV-TI-05.80.03, *Field Record Keeping.*

- Obtain ice daily prior to beginning work for sample preservation.

5.2 SAMPLING METHODS AND PROTOCOL

Drilling activities performed at the Plant during implementation of this SAP will include advancing subsurface boreholes using DPT or other compatible technology based on field conditions and rig availability. Sampling activities will be conducted according to TVA TI ENV-TI-05.80.50, *Soil and Sediment Sampling*.

The following sections present drilling and soil sampling procedures required to complete the tasks presented.

5.2.1 Drilling, Logging, and Surveying

5.2.1.1 Background Borings

Probe advancement will be initiated using the static weight of the rig until encountering refusal. Percussion will be used to advance the probe rods further following maximum penetration under the static load. A new two-inch inside diameter one- time use clear, polyvinyl chloride (PVC) sample liner will be placed inside the sample rod before each push to collect continuous soil samples. After the sample rod is pushed to the appropriate depth, it will be retracted, and the liner and sample removed and placed on clean plastic sheeting.

A new PVC liner will then be placed in the sampler and another rod will be added to the run. DPT sample rods will be driven and retracted in a continuous run until the desired soil boring depth is achieved.

A liner cutter will be used to open the liner for sample retrieval. Soils that are not considered part of the representative sample (e.g., slough as determined by visual inspection of the sample) will be managed in accordance with Section 5.2.8. The core length will be measured to calculate sample recovery. Soils obtained in each PVC liner will be logged by a Tennessee-licensed professional geologist. Samples will be collected in accordance with Section 5.2.4.

Once sample collection is complete at each boring, the boreholes will generally be filled with a bentonite-cement grout mixture using a tremie pipe to within approximately six inches of the surface. The top six inches will be restored to match the existing conditions.

5.2.1.2 Background Groundwater Monitoring Wells

During installation of proposed background monitoring wells, soil samples will be collected to provide additional background soil data. Soil samples collected during the installation of these monitoring wells will either be collected using the same method described in above in Section 5.2.1.1 or by using split spoon samplers driven through the hollow stem augers used to advance the monitoring well boring. Soil samples from these monitoring well locations will be collected through the well screen interval.

5.2.1.3 Borehole Logging

During boring advancement, each borehole will be logged by a Tennessee-licensed professional geologist. At a minimum, the following information will be recorded in accordance with TVA TI ENV-TI-05.80.03, *Field Record Keeping* and *American Society of Testing and Materials (ASTM) Standard D2488* and entered on boring logs for each borehole and each distinct stratum described:

- Name of person completing boring log;
- Boring identification and boring date;
- Soil color and classification, using Munsell soil color charts and Modified Unified Soil Classification System (USCS) for unconsolidated materials;
- Visual identification of CCR in soil cores, if present;
- Moisture content (e.g. dry, moist, or wet);
- Soil consistency or density, size, shape, and angularity of particles (for fine to coarse grained soils);
- Soil pH as determined in the field using field pH test kits;
- Depth interval represented by stratum observations;
- Additional observations deemed relevant (e.g. presence of groundwater, fractures, GPS survey data, etc.); and
- Field boring logs will be collected on field forms and then input to gINT for final production.

5.2.1.4 Surveying

Once completed, borings will be surveyed for horizontal and vertical control by survey grade GPS. The final survey of each location will be conducted following completion and abandonment of each individual sampling location. The survey data will be added to the final boring logs once available.

5.2.2 Field Equipment Description, Testing/Inspection, Calibration, and Maintenance

A list of anticipated equipment for the field activities described herein is provided as Attachment B. A final list of equipment will be prepared by the Field Team Leader, and approved by TVA, prior to mobilization. Field equipment will be inspected, tested, and calibrated (as applicable) prior to initiation of fieldwork by Field Sampling Personnel and, if necessary, repairs will be made prior to equipment use. If equipment is not in the proper working condition, that piece of equipment will be repaired or taken out of service and replaced prior to use. Additional information regarding field equipment inspection and testing is included in the QAPP.

5.2.3 Field Documentation

Field documentation will be maintained in accordance with TVA TI ENV-05.80.03, *Field Record Keeping* and the QAPP. Field documentation associated with investigation activities will primarily be recorded in Plant-specific field forms, logbooks and/or on digital media (e.g., geographic information system (GIS)/GPS documentation). Additional information regarding field documentation is provided below and included in the QAPP and TVAs TIs.

5.2.3.1 Daily Field Activities

Field observations and measurements will be recorded and maintained daily to chronologically document field activities, including sample collection and management. Field observations and measurements will be recorded in bound, waterproof, sequentially paginated field logbooks and/or on digital media and field forms.

Deviations from applicable work plans will be documented in the field logbook during sampling and data collection operations. The TVA Technical Lead and the QA Oversight Manager or designee will approve deviations before they occur.

5.2.3.2 Field Forms

Plant-specific field forms will be used to record field measurements and observations for specific tasks. Boring log forms will be used to document lithologic conditions and field observations at each boring location.

5.2.3.3 Chain-of-Custody Forms

For the environmental samples to be collected, chain-of-custody (COC) forms, shipping documents, and sample logs will be prepared and retained. Field Quality Control samples will be documented in both the field notes (logbooks and field forms) and on sample COC records. COC forms will be reviewed daily by the Field Team Leader and Field Oversight Coordinator for completeness and a quality control (QC) check of samples in each cooler compared to sample

IDs on the corresponding COC form. The Investigation Project Manager will staff the project with a field sample manager during sample collection activities. Additional information regarding COC forms is included in Section 6.2.2 of this SAP, the QAPP, and TVA TIs.

5.2.3.4 Photographs

In addition to documentation of field activities as previously described, photographs of field activities will also be used to document the field investigation. A photo log will be developed, and each photo in the log will include the location, date taken, and a brief description of the photo content, including direction facing for orientation purposes.

5.2.4 Collection of Samples

Sample collection for laboratory analysis at each location will be initiated at the ground surface. An initial grab sample representing the surficial soils (i.e., top 6 inches) will be collected by hand auger and submitted for laboratory analysis of percent ash by polarized light microscopy (PLM) in addition to CCR Parameters.

The additional analysis of percent ash by PLM on the surficial sample is to determine if there have been any windblown CCRs deposited at the boring location. Sampling will continue the length of the boring by collecting grab samples from the mid-point of each five-foot boring interval. The mid-point for grab samples will be the mid-point based on recovery. If soils are expected to be hard to recover during core retrieval core catchers will be used to prevent loss of sample material. No composite samples are proposed. If a change in lithology, such as a change in residuum, colluvium, alluvium, etc. occurs within a core interval separate grab samples will be collected from the mid-point of both lithologies in the core.

Each sample from the recovered core will be collected with a gloved hand, properly decontaminated sample scoop, or certified clean disposable sample scoop, field samplers will wear a new pair of disposable nitrile gloves while handling each sample. The samples will be placed in a new, re-sealable bag and will be homogenized using a gloved hand or decontaminated sample scoop, certified clean disposable sample scoop and/or by kneading the material through the outside of the bag until the physical appearance is consistent over the entire sample.

After homogenization, the sample will be collected from the bag and placed in the appropriate laboratory-supplied sample containers. Each sample will be submitted to the laboratory for CCR Parameters (refer to Section 5.2.6).

5.2.5 Preservation and Handling

Prior to placing each soil sample into the laboratory supplied containers, an aliquot of the homogenized soil sample will be tested using a field pH test kit with the results recorded in the daily field notes. Once each sample container is filled, the rim and threads will be cleaned by wiping with a clean paper towel and capped. Each sample container will be checked to ensure that it is sealed, labeled legibly, and externally clean. Sample containers will be packaged in a manner to prevent breakage during shipment.

Coolers will be prepared for shipment in accordance with TVA TI ENV-05.80.06, *Handling and Shipping of Samples* by taping the cooler drain shut and lining the bottom of the cooler with packing material or bubble wrap. Sample containers will be placed in the cooler in an upright position. Small uniformly sized containers (such as 4-ounce or 8-ounce soil jars) will be stacked in an upright configuration and packing material will be placed between layers. Plastic containers will be placed between glass containers when possible. A temperature blank will be placed inside each cooler to measure sample temperature upon arrival at the laboratory. Gel ice or loose ice will be placed around and among the sample containers to cool the samples to less than 6 degrees Celsius (°C) during shipment. The cooler will be filled with additional packing material to secure the containers.

The original COC form will be placed in a re-sealable plastic bag taped to the inside lid of the cooler. A copy of the COC form will be retained with the field notes in the project files. A unique cooler ID number will be written on the COC form and the shipping label placed on the outside of the cooler. The total number of coolers required to ship the samples will be recorded on the COC form. If multiple coolers are required to ship samples contained on a single COC form, then the original copy will be placed in cooler 1 of X with copies (marked as such) placed in the additional coolers. Two signed and dated custody seals will be placed on alternate sides of the cooler lid. Packaging tape (i.e., strapping tape) will be wrapped around the cooler to secure the sample shipment.

Upon receipt of the samples, the analytical laboratory will open the cooler and will sign "received by laboratory" on each COC form. The laboratory will verify that the custody seals have not been previously broken and that the seal number corresponds with the number on the COC form. The laboratory will note the condition and temperature of the samples upon receipt and will identify discrepancies between the contents of the cooler and COC form. If there are discrepancies the Laboratory Project Manager will immediately call the Laboratory Coordinator and Field Team Leader to resolve the issue and note the resolution on the laboratory check-in sheet. The analytical laboratory will then forward the back copy of the COC form to the QA Oversight Manager and Investigation Project Manager.

5.2.6 Sample Analyses

Samples will be submitted to the TVA-approved laboratory for analysis. These samples will be analyzed for concentrations of CCR Parameters in order to evaluate naturally occurring levels and establish a baseline in background soils. Tables 1-3 summarize the constituents requiring analysis. Analytical methods, preservation requirements, container size, and holding times for each chemical analysis is presented in Table 4. Additional sampling and laboratory-specific information is covered in more detail in the QAPP.

Table 1. 40 CFR Part 257 Appendix III Constituents

Appendix III Constituents
Boron
Calcium
Chloride
Fluoride
pH
Sulfate
Total Dissolved Solids – Not Applicable

Table 2. 40 CFR Part 257 Appendix IV Constituents

Appendix IV Constituents
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226 and 228 Combined

Table 3. TN Rule 0400-11-01-.04, Appendix 1 Inorganic Constituents

TDEC Appendix 1 Constituents*
Copper
Nickel
Silver
Vanadium
Zinc

* Constituents not listed in CCR Appendices III and IV

Table 4. Analytical Methods, Preservatives, Containers, and Holding Times

Parameter	Analytical Methods	Preservative(s)	Container(s)	Holding Times
Percent ash	PLM (RJ Lee SOP OPT23.02)	Not Applicable	4 oz. glass	Not Applicable
Metals	SW-846 6020A	Cool to <6° C	4 oz. glass	180 days
Mercury	SW-846 7471B	Cool to <6° C	4 oz. glass	28 days
Radium 226	SW-846 901.1	Cool to <6° C	One 16 oz. wide mouth glass jar to be used for both Ra 226 and 228 samples	180 days
Radium 228	SW-846 901.1	Cool to <6° C	See Ra 226 above.	180 days
Chloride	SW-846 9056A Modified	Cool to <6° C	4 oz. glass	28 days
Fluoride	SW-846 9056A Modified	Cool to <6° C	4 oz. glass	28 days
Sulfate	SW-846 9056A Modified	Cool to <6° C	4 oz. glass	28 days
pH	SW-846 9045D Modified	Cool to <6° C	4 oz. glass	Not Applicable*

*Holding time for soil pH samples is 15 minutes following creation of soil paste. Soil samples will be tested in the field using field pH test kits, 10% of the sample locations will have confirmation samples submitted for laboratory analysis of pH and will have paste prepared in the laboratory so that analysis can be completed within the holding time.

5.2.7 Equipment Decontamination Procedures

Documented decontamination will be performed for drilling equipment, tooling, and instruments in contact with subsurface materials in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination* to prevent cross-contamination. Decontamination pads will be constructed for decontamination of large downhole tooling (augers, drill rods, etc.) using a high-pressure washer/steam cleaner.

Decontamination pads will be constructed at locations designated by TVA personnel using poly sheeting with sufficient berms to contain decontamination fluids and prevent potential runoff to uncontrolled areas. Following decontamination, fluids will be pumped into a drum for storage, transportation, and ultimately disposal in accordance with Section 5.2.8. Decontamination activities will be performed away from surface water bodies and areas of potential impacts. Decontamination of non-disposable sampling equipment or instruments can be performed using water and Liquinox® or other appropriate non-phosphatic detergent in 5-gallon buckets.

Decontamination of sampling equipment and instruments (e.g., water level meters, etc.) will be performed prior to use and between sampling locations. Decontamination activities will be documented in the logbook field notes. Additional information regarding equipment decontamination procedures is in the QAPP.

5.2.8 Waste Management

Investigation derived waste (IDW) generated during implementation of this Sampling and Analysis Plan may include, but is not limited to:

- Soil Cuttings;
- Personal Protective Equipment;
- Decontamination fluids; and
- General trash.

IDW will be handled in accordance with TVA TI ENV-TI-05.80.05 *Field Sampling Equipment Cleaning and Decontamination,* the Plant-specific waste management plan, and local, state, and federal regulations. Transportation and disposal of IDW will be coordinated with TVA Plant personnel.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

The QAPP describes quality assurance (QA)/quality control (QC) requirements for the overall Investigation. The following sections provide details regarding QA/QC requirements specific to background soil sampling and analysis.

6.1 OBJECTIVES

The Data Quality Objectives (DQOs) process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA and the Investigation Project Manager considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts for the Investigation.

Specific quantitative acceptance criteria for analytical precision and accuracy for the matrices included in this investigation are presented in the QAPP.

6.2 QUALITY CONTROL CHECKS

Four types of field QA/QC samples will be collected during sampling activities: field duplicate samples, matrix spike/matrix spike duplicate (MS/MSD) samples, equipment blanks, and field blanks. QA/QC samples will be collected in accordance with TVA TI ENV-TI-05.80.04, *Field Sampling Quality Control*. Criteria for the number and type of QA/QC samples to be collected for each analytical parameter are specified below. A complete description of the QA requirements is provided in the QAPP.

Field Duplicate Samples – One field duplicate sample will be collected for every 20 soil samples or once per sampling event. Duplicates samples will be prepared as blind duplicates and will be collected by splitting the homogenized sample volume into two sets of identical, laboratory-prepared sample bottles. The primary and duplicate samples will be labeled according to procedure in Section 6.2.1. Sample identifier information will not be used to identify the duplicated samples. Actual sample identifiers for duplicate samples will be noted in the field logbook. The duplicate sample will be analyzed for the same parameters as the primary sample.

MS/MSD Samples – A sufficient volume of soil is already contained in the laboratory supplied soil sample jars for use as the MS/MSD. As such, MS/MSD samples will be collected by the laboratory from the sample containers submitted for standard analysis, allowing matrix spike samples to be run to assess the effects of matrix on the accuracy and precision of the analyses. One MS/MSD sample will be analyzed for every 20 soil samples collected. Additional sample volume intended for use as the MS/MSD must be identified in the comments field on the COC records and sample labels. The location of sample collection will be noted in the log book.

The MS/MSD sample will be analyzed for the same analytes as the primary sample, with the exception of parameters that are not amenable to MS/MSD.

Equipment Blanks (Rinsate Blanks) – One equipment (rinsate) blank will be collected for every 20 samples. The equipment blank will be collected at a soil boring location by pouring laboratory-provided deionized water into or over the decontaminated sampling equipment (e.g., decontaminated DPT cutting shoe, sample scoops, or other non-disposable decontaminated equipment), then into the appropriate sample containers. The time and location of collecting the equipment blank will be noted in the log book. The sample will be analyzed for the same analytes, with the exception of pH, as the sample collected from the soil boring location where the equipment blank is prepared.

Field Blanks: One field blank sample will be prepared per day using laboratory-supplied deionized water. The sample will be analyzed for the same analytes, with the exception of pH.

6.2.1 Sample Labels and Identification System

Sample IDs will be recorded on all sample container labels, custody records, and field sheets in accordance with TVA TIs ENV-TI-05.80.02, *Sample Labeling and Custody* and ENV-TI-05.80.03, *Field Record Keeping*. Each sample container will have a sample label affixed and secured with clear package tape as necessary to ensure the label is not removed. Information on sample labels will be recorded in waterproof, non-erasable ink. Specific information regarding sampling labeling and identification is included in the QAPP.

6.2.2 Chain-of-Custody

The possession and handling of individual samples must be traceable from the time of sample collection until the time the analytical laboratory reports the results of sample analyses to the appropriate parties. Field staff will be responsible for sample security and record keeping in the field.

The COC form documents the sample transfer from the field to the laboratory, identifies the contents of a shipment, provides requested analysis from the laboratory, and tracks custody transfers. Additional information regarding COC procedures is located in the QAPP.

6.3 DATA VALIDATION AND MANAGEMENT

As stated in the EIP, a QAPP has been developed such that environmental data are appropriately maintained and accessible to data end users. The field investigation will be performed in accordance with the QAPP. Laboratory analytical data will be subjected to data validation in accordance with the QAPP. The data validation levels and process will also be described in the QAPP.

PLM data will not be subjected to data validation due to the specialized training and equipment required to accurately visually quantitate ash. PLM data will be subjected to verification including a review of QC analyses and a reasonability assessment based on photomicrographs included in the data package.

7.0 SCHEDULE

Anticipated schedule activities and durations for the implementation of this SAP are summarized below. This schedule is preliminary and subject to change based on approval, field conditions, and weather conditions. For the overall EIP Implementation schedule, including anticipated dates, see the schedule provided in the EIP.

Table 5. Preliminary Schedule for Background Soil SAP Activities

Project Schedule		
Task	**Duration**	**Notes**
Background Soil SAP Submittal		Completed
Prepare for Field Activities	25 Days	Following EIP Approval
Conduct Field Activities	35 Days	Following Field Preparation
Laboratory Analysis	50 Days	Following Field Activities
Data Validation	30 Days	Following Lab Analysis

8.0 ASSUMPTIONS AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- Plant-specific safety requirements are anticipated to include TVA specified training and attendance at a safety briefing. Only Investigation Project Manager employees and subcontractors performing work activities will be required to meet the above requirements.
- A dedicated Safety Officer will be present for this work.
- Assessment of suitability of areas and access to borings, including clearing and grubbing, will be provided by TVA, and will be completed prior to the Investigation start date.

9.0 REFERENCES

Environmental Protection Agency (EPA). 1995. “Engineering Forum Issue; Determination of Background Concentrations of Inorganics in Soils and Sediments at Hazardous Waste Sites.” December.

Environmental Protection Agency (EPA). 2004. “National Functional Guidelines for Inorganic Data Review.” October.

Environmental Protection Agency (EPA) Region 4. 2001. “Environmental Investigations Standard Operating Procedures and Quality Assurance Manual.” November.

Tennessee Valley Authority (TVA). 2017a. “Planning Sampling Events.” Technical Instruction ENV-TI-05.80.01, Revision 0000 March 31.

Tennessee Valley Authority (TVA). 2017b. “Sample Labeling and Custody.” Technical Instruction ENV-TI-05.80.02, Revision 0001 March 31.

Tennessee Valley Authority (TVA). 2017c. “Field Record Keeping.” Technical Instruction ENV-TI-05.80.03, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017d. “Field Sampling Quality Control.” Technical Instruction ENV-TI-05.80.04, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017e. “Field Sampling Equipment Cleaning and Decontamination.” Technical Instruction ENV-TI-05.80.05, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017f. “Handling and Shipping of Samples.” Technical Instruction ENV-TI-05.80.06, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017g. “Soil and Sediment Sampling.” Technical Instruction ENV-TI-05.80.50, Revision 0000 September 29.

ATTACHMENT A
FIGURE

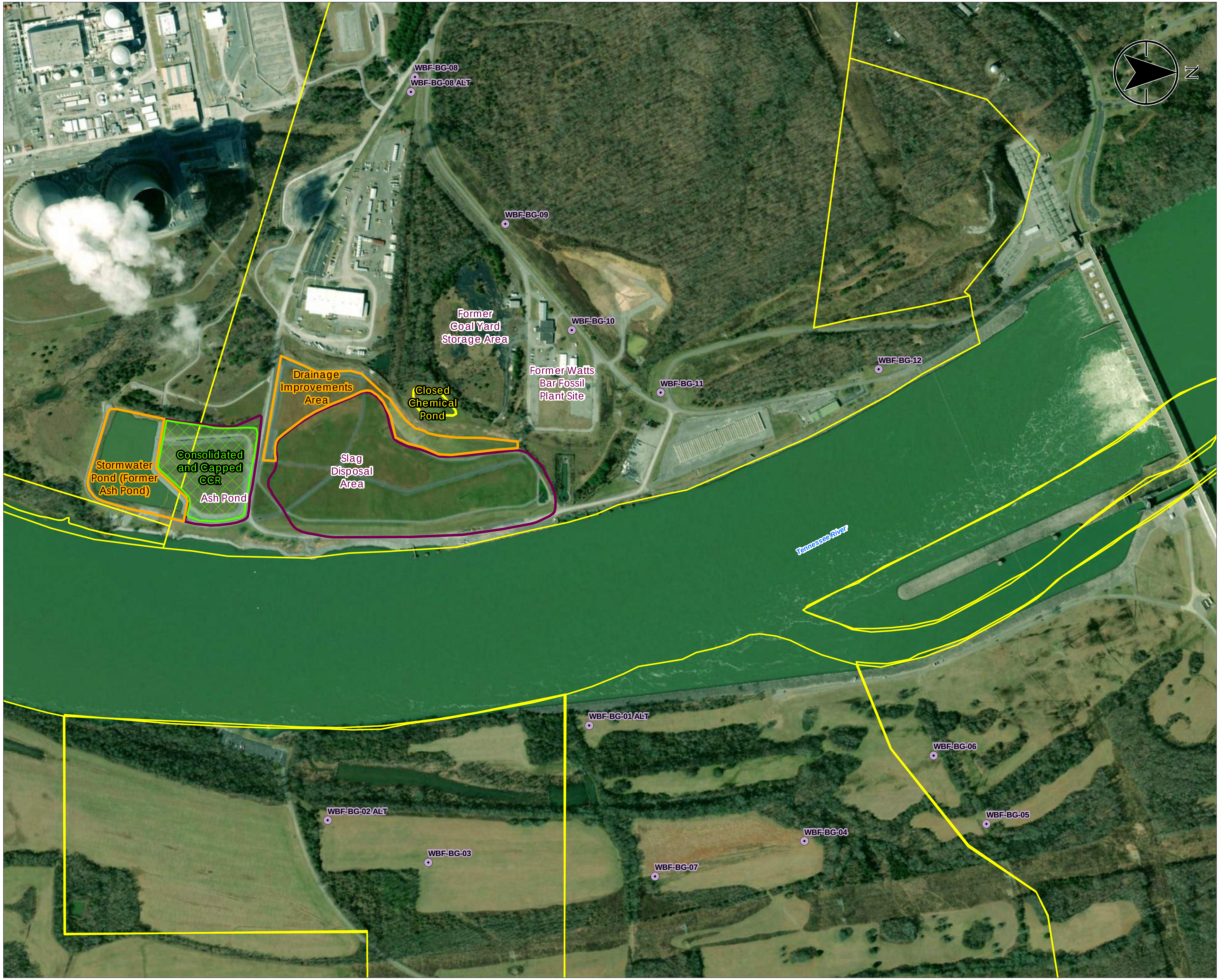


Figure No.
1

Title
Proposed Soil Sampling Locations

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2018-11-14
Technical Review by TG on 2018-11-14

0 300 600 900 1,200 Feet
1:3,600 (At original document size of 22x34)

Legend

- ● Proposed Background Soil Sample Location
- ▢ CCR Unit Area (Approximate)
- ▢ Closed Chemical Pond (Approximate)
- ▨ Consolidated and Capped CCR Area (Approximate)
- ▢ Drainage Improvements Area; Stormwater Pond (Former Ash Pond)
- ▢ TVA Property

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by ESRI Imagery

U:\TVA-EIP\175566336\gis\mxds\WBF_Proposed_Soil_Sampling.mxd Revised: 2018-11-14 By: mbough

ATTACHMENT B
FIELD EQUIPMENT LIST

Field Equipment List
Background Soil Investigation

Item Description
***Health and Safety Equipment (e.g. PPE, PFD, first aid kit)**
***Field Supplies/Consumables (e.g. data forms, labels, nitrile gloves)**
***Decontamination Equipment (e.g. non-phosphate detergent)**
***Sampling/Shipping Equipment (e.g. cooler, ice, jars, forms)**
Field Equipment[1]
GPS (sub-meter accuracy preferred)
Digital camera
Batteries
Photoionization detector (PID)
Water level indicator meter
Field pH Test Kits
***These items are detailed in associated planning documents to avoid redundancy.**
[1]Refer to the Exploratory Drilling SAP for drilling-specific field equipment

APPENDIX L
CCR MATERIAL CHARACTERISTICS SAP

CCR Material Characteristics Sampling and Analysis Plan Watts Bar Fossil Plant

Revision 3

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

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

November 19, 2018

CCR MATERIAL CHARACTERISTICS
SAMPLING AND ANALYSIS PLAN
WATTS BAR FOSSIL PLANT

REVISION LOG

Revision	Description	Date
2	Addresses May 16, 2018 TDEC Review Comments and Issued for TDEC Review	July 6, 2018
3	Addresses Applicable Programmatic Revisions and Issued for TDEC Approval	November 19, 2018

CCR MATERIAL CHARACTERISTICS
SAMPLING AND ANALYSIS PLAN
WATTS BAR FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: CCR Material Characteristics
Sampling and Analysis Plan
Watts Bar Fossil Plant
Tennessee Valley Authority
Spring City, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: November 19, 2018 Revision 3

All parties executing work as part of this Sampling and Analysis Plan sign below acknowledging they have reviewed, understand, and will abide by the requirements set forth herein.

TVA Investigation Project Manager — 11/19/18 Date

TVA Investigation Field Lead — 11/19/18 Date

Health, Safety, and Environmental (HSE) Manager — 11-19-18 Date

Investigation Project Manager — 2018-11-13 Date

Rock J. Vitale Digitally signed by Rock J. Vitale DN: cn=Rock J. Vitale, o, ou, email=rvitale@envstd.com, c=US Date: 2018.11.14 12:28:57 -05'00'

QA Oversight Manager — Date

Laboratory Project Manager — 11-15-18 Date

Charles L. Head
TDEC Senior Advisor — Date

Robert Wilkinson
TDEC CCR Technical Manager — Date

Stantec

Table of Contents

LIST OF TABLES

CCR MATERIAL CHARACTERISTICS
SAMPLING AND ANALYSIS PLAN
WATTS BAR FOSSIL PLANT

LIST OF ATTACHMENTS

1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at Watts Bar Fossil Plant (WBF) on April 27, 2016, at which time TVA briefed TDEC on its Coal Combustion Residual (CCR) management plans at WBF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On June 14, 2016, TDEC issued a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 22, 2017, TDEC issued a second follow-up letter to TVA regarding the TDEC Order and EIP submittal dates. On November 15, 2016, TVA submitted WBF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

TDEC's comments included a request for a leachability characterization study that includes an evaluation of CCR parameters (totals and leachable concentrations) from pore water and solid material samples from locations that would characterize the vertical and lateral distribution of leachability characteristics within all units at WBF. Therefore, this CCR Material Characteristics Sampling and Analysis Plan has been developed to determine the leachability of CCR constituents (listed in 40 CFR Part 257, Appendix III and IV of the CCR Rule) in CCR units at the WBF Plant (Plant).

2.0 OBJECTIVES

The objective of this CCR Material Characteristics SAP is to characterize the leachability of CCR constituents from material in a CCR unit, in response to the TDEC Order. The approach is to collect and analyze pore water and CCR material from the locations identified in Section 4.0.

This CCR Material Characteristics SAP will provide procedures necessary to conduct the sampling and analysis of pore water and CCR material in the CCR units, and to characterize them for the CCR Parameters list. Proposed activities will include the following major tasks:

- Verify proposed sampling locations using the global positioning system (GPS)
- Develop temporary wells in the ash disposal area (drilling and installation procedures of the temporary wells are outlined in the Exploratory Drilling SAP)
- Collect pore water and CCR material samples from the temporary well locations
- Conduct laboratory testing and analyses

3.0 HEALTH AND SAFETY

This work will be conducted under an approved Plant-specific Health and Safety Plan (HASP). This HASP will be in accordance with TVA Safety policies and procedures. Each worker will be responsible for reviewing and following the HASP. Personnel conducting field activities will have completed required training, understand safety procedures, and be qualified to conduct the field work described in this SAP. The HASP will include a job safety analysis (JSA) for each task described in this SAP and provide control methods to protect personnel. Personal protective equipment (PPE) requirements and safety, security, health, and environmental procedures are defined in the HASP. In addition, authorized field personnel will attend TVA required safety training and Plant orientation.

The Field Team Leader will conduct safety briefings each day prior to beginning work and at mid-shift or after lunch breaks and will document these meetings to include the names of those in attendance and items discussed. TVA-specific protocols will be followed, including the completion of 2-Minute Rule cards. The JSAs will be updated if conditions change.

4.0 SAMPLING LOCATIONS

The Study Area for this CCR Materials Characteristics SAP consists of the consolidated and capped area of the former Ash Pond and the Slag Disposal Area. Each proposed sampling location in the Study Area will accommodate sampling for pore water and CCR material. Pore water will be collected as filtered and unfiltered samples, while CCR material will be collected as unsaturated and saturated samples (as conditions allow). Five sample locations were selected, based on TDEC's request to characterize the leachability of constituents from the material in each CCR Unit. All samples will be taken from temporary wells placed in the CCR units, which will also be used to determine the water level in those units.

In temporary wells TW01 through TW05, pore water samples will be taken at the base of the unit in the original sluiced ash.

During construction and installation of the temporary wells (i.e., sampling locations), a CCR material grab sample will be taken from each 5-foot core boring, from the top of the unit to its base. This will result in the collection of CCR material samples from both the phreatic zone (for saturated samples) and non-phreatic zone (for unsaturated samples). Samples shall not be taken from active ponds; they shall only be taken from former ponds once they have been dewatered and stabilized. After the temporary wells have been installed, pore water samples will be taken at the base of the units in the ash.

A map showing all pore water/CCR material sampling locations is provided as Figure 1 in Attachment A. Installation and construction specifications for the temporary wells are provided in the WBF Exploratory Drilling SAP. The proposed temporary well locations are subject to change based on ongoing site operations and conditions. TDEC will be notified of any changes in well locations.

Table 1. Proposed Sample Locations

Sample Location ID	Description
TW01	Ash Pond - southern-most TW
TW02	Ash Pond - northeastern corner
TW03	Slag Disposal Area - southern TW
TW04	Slag Disposal Area – between TW03 and TW05
TW05	Slag Disposal Area – northern-most TW

TW = Temporary well

5.0 SAMPLE COLLECTION AND FIELD ACTIVITY PROCEDURES

This section provides details of procedures that will be used to collect samples, document field activities, and assist in providing scientifically defensible results.

Pore water and CCR material sampling will adhere to applicable EPA and TVA Environmental Technical Instruction (TI) documents. A project field book and field forms will be maintained by the Field Team Leader to record field measurements, analyses, and observations. Field activities will be planned in accordance with TVA TI ENV-TI-05.80.01 *Planning Sampling* Events, conducted according to TVA TI ENV-TI-05.80.50, *Soil and Sediment Sampling,* and documented according to TVA TI ENV-TI-05.80.03, *Field Record Keeping*.

5.1 PREPARATION FOR FIELD ACTIVITIES

As part of field mobilization activities, the field sampling team will conduct the following:

- Designate a Safety Officer
- Complete required health and safety paperwork and confirm field team members have completed required training
- Coordinate field activities with the Laboratory Coordinator to ensure that sample bottles and preservatives are ordered, coolers and analyte-free deionized (DI) water are obtained, and sampling and sample arrival dates are communicated to the laboratories
- Obtain required calibrated field instruments, including health and safety equipment, water level meters, and equipment needed for measuring parameters that define stability during well purging
- Discuss project objectives and potential hazards with project personnel
- Complete sample paperwork to the extent possible prior to deploying to the field, including chain-of-custody (COC) forms and sample labels
- Obtain ice prior to sample collection for sample preservation

5.2 SAMPLING METHODS AND PROTOCOL

Sampling and collection methods will be conducted in accordance with applicable TVA Technical Instructions (TIs), including:

- ENV-TI-05.80.01 *Planning Sampling Events*
- ENV-TI-05.80.02 *Sample Labeling and Custody*

- ENV-TI-05.80.03 *Field Record Keeping*
- ENV-TI-05.80.04 *Field Sampling Quality Control*
- ENV-TI-05.80.05 *Field Sampling Equipment Cleaning and Decontamination*
- ENV-TI-05.80.06 *Handling and Shipping of Samples*
- ENV-TI-05.80.42 *Groundwater Sampling*
- ENV-TI-05.80.44 *Groundwater Level and Well Depth Measurement*
- ENV-TI-05.80.46 *Field Measurement Using A Multiparameter Sonde*
- ENV-TI-05.80.50, *Soil and Sediment Sampling*

5.2.1 Pore Water and CCR Material Collection and Analysis

Pore water samples will be collected from the phreatic zone at the base of a unit, and above any applicable drainage layer, in order to obtain in-situ leaching information for the material. The analyses of actual pore water samples will provide real-time measurements of any constituents that may be leaching from the material.

Samples of CCR material will be collected from the borings advanced for the temporary wells, constructed specifically to obtain pore water samples, from both saturated and unsaturated zones in the CCR unit. These samples will be analyzed for the parameters described below both for totals, and leachability, after being subjected to the most applicable leaching method based on emerging science in the industry, which could include the Synthetic Precipitation Leaching Procedure (SPLP).

The pore water and CCR material samples will be analyzed for the constituents listed in 40 CFR Part 257, Appendices III and IV, and the five inorganic constituents listed in Appendix 1 of TN Rule 0400-11-01-.04 (i.e., TDEC regulations) which include copper, nickel, silver, vanadium, and zinc. The combined Appendices III and IV constituents, and TDEC Appendix 1 inorganic constituents, will hereafter be referred to collectively as the "CCR Parameters." Total organic carbon (TOC), iron, and manganese have been added to the CCR Parameters list as specific parameters of interest under this SAP.

5.2.1.1 Water Level Measurements

Prior to sampling, each temporary well and staff gauge will be inspected for damage or indications that the well integrity has been compromised. If field observations indicate the need for well or staff gauge maintenance or repairs, the Field Team Leader will notify TVA.

After the temporary well and staff gauge integrity inspection is completed, the water level in each well and at each staff gauge will be measured in relation to a surveyed reference point (e.g., top of well casing) using an electronic water level indicator. Pore water elevation data will be measured and recorded in accordance with TVA TI ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*. The elevation will be recorded to the nearest 0.01 foot. To the extent possible, the field team will minimize the length of time between collection of the first and last water level measurement for the monitoring well network and staff gauges. At a minimum, measurements will be made within the same day. In addition, barometric pressure readings will be recorded daily. TVA plans to use a multi-parameter sensor equipped with a National Institute of Science & Technology (NIST) certified temperature sensor.

The water level indicator will be decontaminated between each well by following the decontamination procedures provided below in Section 5.2.7.

5.2.1.2 Well Purging

Following the measurement of water levels, monitoring wells will be purged using a dedicated pump for pore water sampling. Purging will continue until field measurements of water quality parameters stabilize during three consecutive readings at 3 to 5 minute intervals per the criteria listed in TVA TI ENV-TI-05.80.42, *Groundwater Sampling*. The stabilization criteria follow:

- pH - ±0.1;
- Specific conductivity - ±5% microsiemens per centimeter (μS/cm):
- Dissolved oxygen (DO) - ±10% for > 0.5 mg/L or <0.5 mg/L; and
- Turbidity - below 10 NTUs or ±10% for values above 10 NTUs.

Field measurements, including pH, specific conductivity, turbidity, oxidation/reduction potential, and temperature, will be collected during purging using a flow-through cell. Once the field parameters have stabilized, samples will be collected. For low yield wells, field parameters will be measured at the time of sample collection in an open sample container using a multi-parameter probe. A final turbidity measurement will be made after each sample is collected.

If after 2 hours of purging field parameters have not stabilized, then groundwater samples will be collected and the efforts to stabilize parameters will be recorded in the field log book and field data sheet. A final turbidity measurement will be made after each sample is collected.

Purging beginning and end times, pumping rates, water quality parameter readings, and groundwater levels will be recorded throughout the purging operation on field sampling forms. The total volume purged at each well may vary based on recharge rates and stabilization of water quality parameters.

Low-flow purging techniques will be used to collect a representative sample from the water bearing unit unless the wells do not yield sufficient water. If pump settings are unknown, purging will begin at a minimum pumping rate of 0.1 liter per minute (L/min) and will be slowly increased to a setting that induces little or no drawdown, if possible. Pumping rates will not exceed 0.5 L/min. If drawdown exceeds 0.3 feet, but reaches stability, purging of the well will continue and the current flow rate, drawdown, and time will be recorded on the field data sheet by the sampler.

Low yield wells will be purged until standing water is removed. Groundwater samples will be collected with a low-flow pump, as soon as water levels return to 80% within the well bore, but no later than 24 hours after the well purge.

5.2.2 Field Equipment Description, Testing/Inspection, Calibration and Maintenance

A list of anticipated equipment for the field activities described herein is provided as Attachment B. A final list of equipment will be prepared by the Field Team Leader, and approved by TVA, prior to mobilization. Field equipment will be inspected, tested, and calibrated (as applicable) prior to initiation of fieldwork by Field Sampling Personnel and, if necessary, repairs will be made prior to equipment use. If equipment is not in the proper working condition, that piece of equipment will be repaired or taken out of service and replaced prior to use. Additional information regarding field equipment inspection and testing is included in the Quality Assurance Project Plan (QAPP).

5.2.3 Field Documentation

Field documentation will be maintained in accordance with TVA TI ENV-05.80.03, *Field Record Keeping* and the QAPP. Field documentation associated with investigation activities will primarily be recorded in Plant-specific field forms, logbooks and/or on digital media (e.g., geographic information system (GIS)/GPS documentation). Additional information regarding field documentation is provided below and included in the QAPP and TVAs TIs.

5.2.3.1 Daily Field Activities

Field observations and measurements will be recorded and maintained daily to chronologically document field activities, including sample collection and management. Field observations and measurements will be recorded in bound, waterproof, sequentially paginated field logbooks and/or on digital media and field forms.

Deviations from applicable work plans will be documented in the field logbook during sampling and data collection operations. The TVA Technical Lead and the QA Oversight Manager or designee will approve deviations before they occur.

5.2.3.2 Field Forms

Plant-specific field forms will be used to record field measurements and observations for specific tasks. Field logbooks will be used to record daily activities, including sample collection and tracking information.

5.2.3.3 Chain-of-Custody Forms

For the environmental samples to be collected, chain-of-custody (COC) forms, shipping documents, and sample logs will be prepared and retained. Field Quality Control samples will be documented in both the field notes (logbooks and field forms) and on sample COC records. COC forms will be reviewed daily by the Field Team Leader and Field Oversight Coordinator for completeness and a quality control (QC) check of samples in each cooler compared to sample IDs on the corresponding COC form. The Investigation Project Manager will staff the project with a field sample manager during sample collection activities. Additional information regarding COC forms is included in Section 6.2.2 of this SAP, the QAPP, and TVA TIs.

5.2.3.4 Photographs

In addition to documentation of field activities as previously described, photographs of field activities will also be used to document the field investigation. A photo log will be developed, and each photo in the log will include the location, date taken, and a brief description of the photo content, including direction facing for orientation purposes.

5.2.4 Collection of Samples

5.2.4.1 Pore Water Sampling

Pore water sample collection will adhere to TVA TI ENV-TI-05.80.42, *Groundwater Sampling*. The sampling team leader will maintain a project field book and field forms to record field measurements, analyses, and observations. Field activities will be documented according to TVA TI ENV-TI-05.80.03, *Field Record Keeping*.

Filtered and unfiltered pore water samples will be collected once from each of the temporary well locations, in appropriate, laboratory provided, pre-preserved sample containers. Samples will be collected directly from the pump discharge line.

A final reading of water quality parameters will be conducted and documented on field sampling forms at the time of sample collection, but these measurements will not be from the sample itself. Unfiltered pore water samples will be collected in appropriate, laboratory provided, pre-preserved sample containers.

The sampler will wear clean nitrile (or equivalent) gloves when handling sample containers and will not touch the interior of containers or container caps. New gloves will be used when handling each sample. When filling sample bottles, care will be taken to minimize sample aeration (i.e., water will be directed down the inner walls of the sample bottle) and avoid overfilling and diluting preservatives. Each sample bottle will be capped before filling the next bottle.

It will be necessary to collect filtered (dissolved) inorganic constituent samples, in addition to unfiltered (total) inorganic constituent samples. Dissolved sample collection will be accomplished in accordance with TVA TI ENV-TI- 05.80.42.

Issues that could affect the quality of samples will be recorded on the field data sheet or in the log book along with the action(s) taken to resolve the issue. These could include observations such as clogged sampling tubes, highly turbid samples or defective materials or equipment.

5.2.4.2 CCR Material Sampling

Boring advancement through the CCR material to the base of the unit will be in concurrence with the Plant Exploratory Drilling SAP, with CCR material collected using 3-inch diameter split-spoon samplers. Sample collection will be conducted in accordance with TVA TI ENV-TI-05.80.50, *Soil and Sediment Sampling*. Continuous sampling will be conducted until the base of the CCR unit has been reached. Split-spoons will be decontaminated between sampling locations in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*.

During construction and installation of the temporary wells (i.e., sampling locations), a CCR material grab sample will be taken from each 5-foot core boring, from the top of the unit to its base. No composite samples are proposed. Each sample will be collected with a gloved hand, properly decontaminated sample scoop, or certified clean disposable sample scoop. Field samplers will wear a new pair of disposable nitrile gloves (or equivalent) while handling each sample. The samples will be placed in a new, re-sealable bag and will be homogenized using a gloved hand or decontaminated sample scoop, certified clean disposable sample scoop and/or by kneading the material through the outside of the bag until the physical appearance is consistent over the entire sample. After homogenization, the sample will be collected from the bag and placed in the appropriate laboratory-supplied sample containers. Each sample will be submitted to the laboratory for analytical testing (refer to Section 5.2.6).

5.2.5 Preservation and Handling

Prior to placing each CCR material sample into the laboratory supplied containers, an aliquot of the homogenized sample will be tested using a field pH test kit with the results recorded in the daily field notes. Sample containers will be labeled in accordance with TVA TI ENV-05.80.02, *Sample Labeling and Custody*.

Once each sample container is filled, the rim and threads will be cleaned by wiping with a clean paper towel and capped, and a signed and dated custody seal will be applied.

Each sample container will be checked to ensure that it is sealed, labeled legibly, and externally clean. Sample containers will be packaged in a manner to prevent breakage during shipment.

Coolers will be prepared for shipment in accordance with TVA TI ENV-TI-05.80.06, *Handling and Shipping of Samples* by taping the cooler drain shut and lining the bottom of the cooler with packing material or bubble wrap. Sample containers will be placed in the cooler in an upright position. Small uniformly sized containers will be stacked in an upright configuration, and packing material will be placed between layers. Plastic containers will be placed between glass containers when possible. A temperature blank will be placed inside each cooler to measure sample temperature upon arrival at the laboratory. Loose ice will be placed around and among the sample containers to cool the samples to less than 6 degrees Celsius (°C) during shipment. The cooler will be filled with additional packing material to secure the containers.

The original COC form will be placed in a re-sealable plastic bag taped to the inside lid of the cooler. A copy of the COC form will be retained with the field notes in the project files. A unique cooler ID number will be written on the COC form and the shipping label placed on the outside of the cooler. The total number of coolers required to ship the samples will be recorded on the COC form. If multiple coolers are required to ship samples contained on a single COC form, then the original copy will be placed in cooler 1 of X with copies (marked as such) placed in the additional coolers. Two signed and dated custody seals will be placed on alternate sides of the cooler lid. Packaging tape (i.e., strapping tape) will be wrapped around the cooler to secure the sample shipment.

Upon receipt of the samples, the analytical laboratory will open the cooler and will sign "received by laboratory" on each COC form. The laboratory will verify that the custody seals have not been previously broken and that the seal number corresponds with the number on the COC form. The laboratory will note the condition and temperature of the samples upon receipt and will identify discrepancies between the contents of the cooler and COC form. If there are discrepancies the Laboratory Project Manager will immediately call the Laboratory Coordinator and Field Team Leader to resolve the issue and note the resolution on the laboratory check-in sheet. The analytical laboratory will then forward the back copy of the COC form to the QA Oversight Manager and Investigation Project Manager.

5.2.6 Sample Analyses

Pore water and CCR material samples will be submitted to the TVA-approved laboratory for analysis. Pore water samples will consist of filtered and unfiltered samples, and analyzed for the CCR Parameters and additional parameters of interest.

CCR material samples (both saturated and unsaturated) will be be analyzed for total CCR Parameters as well as leachability, after being subjected to the most applicable leaching method based on emerging science in the industry, which could include the SPLP, prior to an analysis for the CCR Parameters and additional parameters of interest.

All samples will be analyzed for the CCR related constituents listed in Title 40 of the Code of Federal Regulations Part 257 (40 CFR 257), Appendices III and IV. In addition, five inorganic constituents listed in Appendix 1 of TN Rule 0400-11-01-.04 (i.e., TDEC regulations), and not included in the 40 CFR 257 Appendices III and IV, will be analyzed to maintain continuity with TDEC environmental programs. The additional constituents listed in TDEC Appendix 1 include the following metals: copper, nickel, silver, vanadium, and zinc. The combined federal CCR Appendices III and IV constituents, and TDEC Appendix 1 inorganic constituents, are referred to collectively as "CCR Parameters." Total organic carbon (TOC), manganese, and iron will be analyzed as additional parameters of interest.

Tables 2 through 5 summarize the constituents requiring analysis. Analytical methods, preservation requirements, container size, and holding times for each chemical analysis are presented in Table 6. Additional sampling and laboratory-specific information is covered in more detail in the QAPP.

Table 2. 40 CFR Part 257 Appendix III Constituents

Appendix III Constituents
Boron
Calcium
Chloride
Fluoride
pH
Sulfate
Total Dissolved Solids

Table 3. 40 CFR Part 257 Appendix IV Constituents

Appendix IV Constituents
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226 and 228 Combined

Table 4. TN Rule 0400-11-01-.04, Appendix 1 Inorganic Constituents

TDEC Appendix 1 Constituents*
Copper
Nickel
Silver
Vanadium
Zinc

* Constituents not listed in CCR Appendices III and IV

Table 5. Additional Parameters of Interest

Parameters of Interest*
Total Organic Carbon (TOC)
Iron
Manganese

* Constituents not included in the CCR Parameters

Table 6. Analytical Methods, Preservatives, Containers, and Holding Times

Parameter	Analytical Methods	Preservative(s)	Container(s)	Holding Times
Metals, dissolved	SW-846 6020A	HNO3 to pH < 2 & Cool to <6°C	250-mL HDPE	180 days
Metals, total	Liquid & Solid - SW-846 6020A	HNO3 to pH < 2 & Cool to <6°C; Cool to <6°C	250-mL HDPE; 4-oz glass (CCR)	180 days
Mercury, dissolved	SW-846 7470A	HNO3 to pH < 2 & Cool to <6°C	250-mL HDPE	28 days
Mercury, total	Liquid - SW-846 7470A; Solid - SW-846 7471B	HNO3 to pH < 2 & Cool to <6°C; Cool to <6°C	250-mL HDPE; 4-oz glass (CCR)	28 days
Radium 226	Liquid - SW-846 903.0; Solid - SW-846 901.1	HNO3 to pH < 2 & Cool to <6°C; Cool to <6°C	1 L glass or Plastic; One 16-oz wide mouth glass jar (CCR) to be used for both Ra 226 and 228 samples	180 days
Radium 228	Liquid - SW-846 904.0; Solid - SW-846 901.1	HNO3 to pH < 2 & Cool to <6°C; Cool to <6°C	2 L glass or plastic; See Ra 226 above for CCR	180 days
CCR Parameters	SPLP Leachability Method	Cool to <6°C	2 16-oz glass (CCR)	28 days

Table 6. Analytical Methods, Preservatives, Containers, and Holding Times

Parameter	Analytical Methods	Preservative(s)	Container(s)	Holding Times
Chloride	Liquid - SW-846 9056A; Solid - SW-846 9056A Modified	Cool to <6°C; Cool to <6°C	250-mL HDPE; 4-oz glass (CCR)	28 days
Fluoride	Liquid - SW-846 9056A; Solid - SW-846 9056A Modified	Cool to <6°C; Cool to <6°C	250-mL HDPE; 4-oz glass (CCR)	28 days
Sulfate	Liquid - SW-846 9056A; Solid - SW-846 9056A Modified	Cool to <6°C; Cool to <6°C	125-mL HDPE; 4-oz glass (CCR)	28 days
pH	Liquid - SW-846 9040C (field measurement); Solid - SW-846 9045D	NA	NA (liquids); 4-oz glass (CCR)	NA*
Total Dissolved Solids (TDS)	SM2540C	Cool to <6°C	250-mL HDPE	7 days
Total Organic Carbon (TOC)	Liquid - SM5310C; Solid - SW-846 9060A	H_2SO_4 to pH<2 & Cool to <6°C; Cool to <6°C	250-mL amber glass; 4-oz glass (CCR)	28 days

*The pH of pore water samples will be measured in the field. Holding time for CCR material pH samples is 15 minutes following creation of sample paste. CCR material samples will be tested in the field using field pH test kits, 10% of the sample locations will have confirmation samples submitted for laboratory analysis of pH and will have paste prepared in the laboratory so that analysis can be completed within the holding time.

5.2.7 Equipment Decontamination Procedures

Documented decontamination will be performed for non-dedicated sampling equipment in contact with groundwater or surface water, and drilling equipment, tooling, and instruments in contact with subsurface materials, in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination* to prevent cross-contamination. Pumps dedicated to a specific well do not need to be decontaminated.

Decontamination activities will be performed away from surface water bodies and areas of potential impacts. Decontamination of non-disposable sampling equipment or instruments can be performed using water and Liquinox ® or other appropriate non-phosphatic detergent in 5-gallon buckets. Following decontamination, fluids will be disposed of in accordance with Section 5.2.8.

Decontamination of sampling equipment and instruments (i.e., water level meters, etc.) will be performed prior to use and between sampling locations. Decontamination activities will be documented in the logbook field notes. Additional information regarding equipment decontamination procedures is in the QAPP.

5.2.8 Waste Management

Investigation derived waste (IDW) generated during implementation of this Sampling and Analysis Plan may include, but is not limited to:

- CCR material Cuttings
- Purge Water
- Personal Protective Equipment
- Decontamination fluids
- General trash

IDW will be handled in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination,* the Plant-specific waste management plan, and local, state, and federal regulations. Transportation and disposal of IDW will be coordinated with TVA Plant personnel.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

The QAPP describes quality assurance (QA)/quality control (QC) requirements for the overall Investigation. The following sections provide details regarding QA/QC requirements specific to pore water and CCR material sampling and analysis.

6.1 OBJECTIVES

The Data Quality Objectives (DQOs) process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA and the Investigation Project Manager considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts for the Investigation.

Specific quantitative acceptance criteria for analytical precision and accuracy for the matrices included in this investigation are presented in the QAPP.

6.2 QUALITY CONTROL CHECKS

Five types of field QA/QC samples will be collected during sampling activities: field duplicate samples, matrix spike/matrix spike duplicate (MS/MSD) samples, equipment blanks, field blanks, and filter blanks. QA/QC samples will be collected in accordance with TVA TI ENV-TI-05.80.04, Field Sampling Quality Control. Criteria for the number and type of QA/QC samples to be collected for each analytical parameter are specified below. A complete description of the QA requirements is provided in the QAPP.

Field Duplicate Samples – One duplicate sample will be collected for every 20 samples or once per sampling event. Duplicates samples will be prepared as blind duplicates and will be collected in two sets of identical, laboratory-prepared sample bottles. The primary and duplicate samples will be labeled according to procedure in Section 6.2.1. Sample identifier information will not be used to identify the duplicated samples. Actual sample identifiers for duplicate samples will be noted in the field logbook. The duplicate sample will be analyzed for the same parameters as the primary sample.

MS/MSD Samples – A sufficient volume of sample will be collected for use as the MS/MSD. MS/MSD samples will be collected to allow matrix spike samples to be run to assess the effects of matrix on the accuracy and precision of the analyses. One MS/MSD sample will be analyzed for every 20 samples collected or once per sampling event. MS/MSD samples will be collected by filling bottles alternately by thirds in accordance with TVA TI ENV-TI-05.80.04, *Field Sampling Quality Control* into three sets of identical, laboratory-prepared sample bottles.

Additional sample volume intended for use as the MS/MSD must be identified in the comments field on the COC records and sample labels. The location of sample collection will be noted in the log book. The MS/MSD sample will be analyzed for the same analytes as the primary sample, with exception of parameters that are not amenable to MS/MSD. For parameters such as Total Suspended Solids and radium that are not amenable to the MS/MSD procedure, additional sample volume will be collected for laboratory duplicate analysis per the QAPP.

Equipment Blanks (Rinsate Blanks) – One equipment (rinsate) blank will be collected for every 20 samples or once per sampling event. The equipment blank will be collected at a sampling location by pouring laboratory-provided deionized water into or over the decontaminated sampling equipment, then into the appropriate sample containers. The time and location of collecting the equipment blank will be noted in the log book. The sample will be analyzed for the same analytes as the sample collected from the location where the equipment blank is prepared. If the tubing used to collect the filter blank is not certified clean tubing, then a tubing blank will be collected at a frequency of blank per lot.

Field Blanks - One field blank sample will be prepared per day using laboratory-supplied deionized water. The sample will be analyzed for the same analytes, with the exception of pH.

Filter Blanks – One filter blank will be collected during each day of the sampling activities when dissolved parameters are collected for analysis. The filter blank will be collected at a sampling location by passing laboratory-supplied deionized water through in-line filters used in the collection of dissolved metals, (or other analytes), then into the appropriate sample containers. The time and location of collecting the filter blank will be noted in the log book. The sample will be analyzed for the same analytes as the sample collected from the location where the filter blank is prepared. In addition, one filter blank will be collected per lot of filters used. The filter lot check is to be performed one per lot of filters used and scheduled in a manner to allow for laboratory to report data prior to investigative sample collection.

6.2.1 Sample Labels and Identification System

Sample IDs will be recorded on all sample container labels, custody records, and field sheets in accordance with TVA TIs ENV-TI-05.80.02, *Sample Labeling and Custody* and ENV-TI-05.80.03, *Field Record Keeping*. Each sample container will have a sample label affixed and secured with clear package tape as necessary to ensure the label is not removed. Information on sample labels will be recorded in waterproof, non-erasable ink. Specific information regarding sampling labeling and identification is included in the QAPP.

6.2.2 Chain-of-Custody

The possession and handling of individual samples must be traceable from the time of sample collection until the time the analytical laboratory reports the results of sample analyses to the appropriate parties. Field staff will be responsible for sample security and record keeping in the field.

The COC form documents the sample transfer from the field to the laboratory, identifies the contents of a shipment, provides requested analysis from the laboratory, and tracks custody transfers. Additional information regarding COC procedures is located in the QAPP.

6.3 DATA VALIDATION AND MANAGEMENT

As stated in the EIP, a QAPP has been developed such that environmental data are appropriately maintained and accessible to data end users. The field investigation will be performed in accordance with the QAPP. Laboratory analytical data will be subjected to data validation in accordance with the QAPP. The data validation levels and process will also be described in the QAPP.

7.0 SCHEDULE

Anticipated schedule activities and durations for the implementation of this SAP are summarized below. This schedule is preliminary and subject to change based on approval, field conditions, and weather conditions. For the overall EIP Implementation schedule, including anticipated dates, see the schedule provided in the EIP.

Table 7. Preliminary Schedule for CCR Material Characteristics SAP Activities

Project Schedule		
Task	**Duration**	**Notes**
CCR Material Characteristics SAP Submittal		Completed
Prepare for Field Activities	25 Days	Following EIP Approval
Conduct Field Activities	20 Days	Following Field Preparation
Laboratory Analysis	50 Days	Following Field Activities
Data Validation	30 Days	Following Lab Analysis

8.0 ASSUMPTIONS AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- Approved sampling methods and protocols may have to be substituted in the EIP based on changing field conditions.

9.0 REFERENCES

Tennessee Valley Authority (TVA). 2017a. “Planning Sampling Events.” Technical Instruction ENV-TI-05.80.01, Revision 0000 March 31.

Tennessee Valley Authority (TVA). 2017b. “Sample Labeling and Custody.” Technical Instruction ENV-TI-05.80.02, Revision 0001 March 31.

Tennessee Valley Authority (TVA). 2017c. “Field Record Keeping.” Technical Instruction ENV-TI-05.80.03, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017d. “Field Sampling Quality Control.” Technical Instruction ENV-TI-05.80.04, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017e. “Field Sampling Equipment Cleaning and Decontamination.” Technical Instruction ENV-TI-05.80.05, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017f. “Handling and Shipping of Samples.” Technical Instruction ENV-TI-05.80.06, Revision 0000 March 31.

Tennessee Valley Authority (TVA). 2017g. “Groundwater Sampling.” Technical Instruction ENV-TI-05.80.42, Revision 0001. March 31.

Tennessee Valley Authority (TVA). 2017h. “Groundwater Level and Well Depth Measurement.” Technical Instruction ENV-TI-05.80.44, Revision 0000. March 31

Tennessee Valley Authority (TVA). 2017i. “Field Measurement Using a Multi-Parameter Sonde.” Technical Instruction ENV-TI-05.80.46, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017j. “Soil and Sediment Sampling.” Technical Instruction ENV-TI-05.80.50, Revision 0000 September 29.

ATTACHMENT A
FIGURE

Figure No.
1

Title
Proposed Borings

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2018-11-13
Technical Review by KB on 2018-11-13

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

Legend

△	Proposed Cone Penetration Test
▣	Proposed Boring with Piezometer Vibrating Wire
○	Proposed Boring
✿	Proposed Boring with Temporary Well *(Screened Material)*
●	Existing Boring
〰	Historical Stream Alignment (Approximate)
┅	Watts Bar Nuclear Facility 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 ESRI Imagery
3. Additional boring in Chemical Pond may be utilized if Cone Penetration Test is inconclusive.
4. CPT borings on 5 feet spacing at historical stream alignment.

Stantec

TVA

U:\TVA-EIP\175566336\gis\mxds\WBF_Proposed_Borings.mxd Revised: 2018-11-13 By: TRink

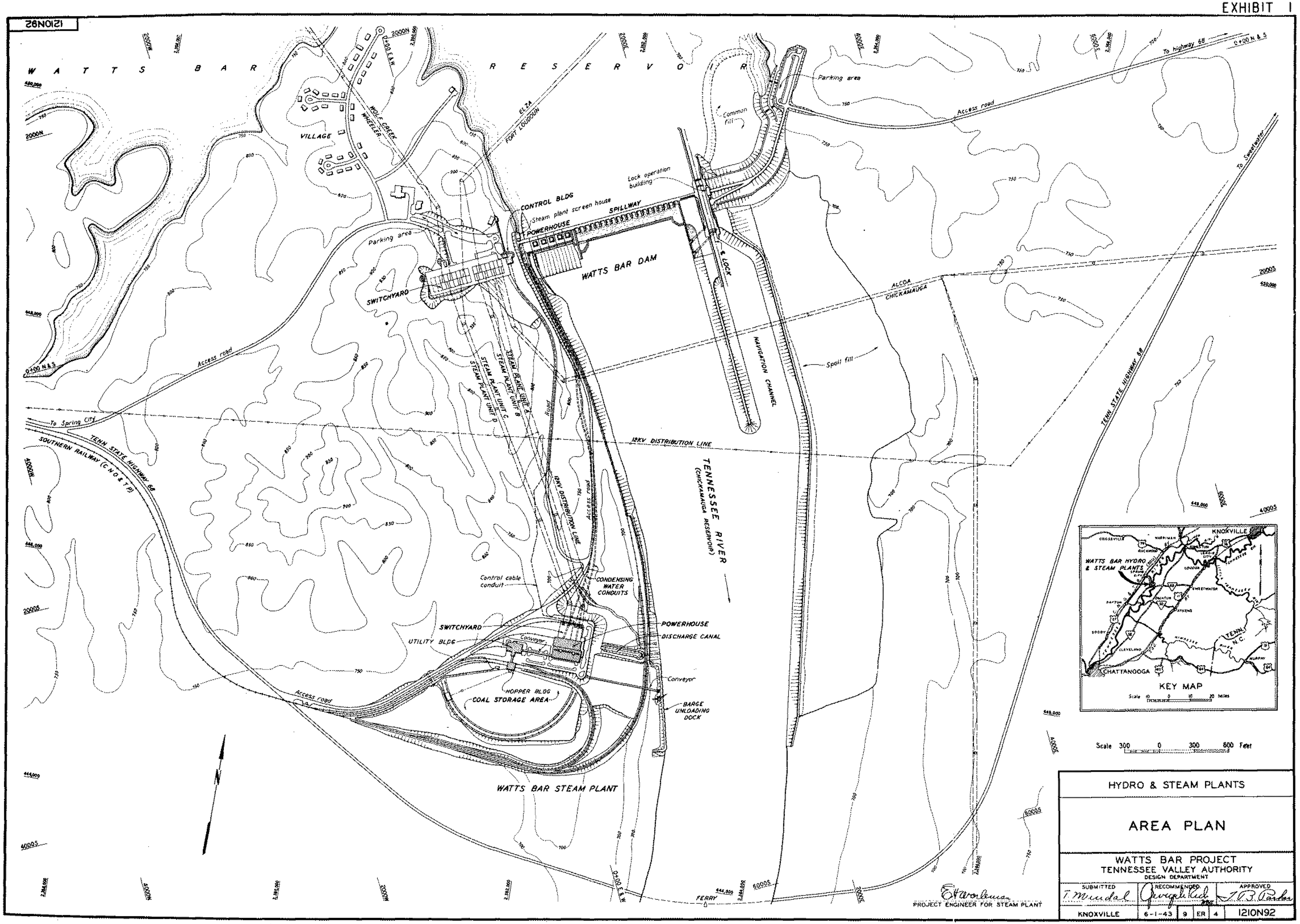
ATTACHMENT B
FIELD EQUIPMENT LIST

Field Equipment List
CCR Material Characteristics Investigation

Item Description
***Health and Safety Equipment (e.g. PPE, PFD, first aid kit)**
***Field Supplies/Consumables (e.g. data forms, labels, nitrile gloves)**
***Decontamination Equipment (e.g. non-phosphate detergent)**
***Sampling/Shipping Equipment (e.g. cooler, ice, jars, forms)**
Field Equipment[1]
GPS (sub-meter accuracy preferred)
Digital camera
Batteries
Water level indicator meter
Peristaltic pump
Tubing
Field pH Test Kits
Multi-parameter Sonde
***These items are detailed in associated planning documents to avoid redundancy.**
[1]Refer to the Exploratory Drilling SAP for drilling-specific field equipment

APPENDIX M
DRAWINGS

EXHIBIT 1



E.H. Workman
PROJECT ENGINEER FOR STEAM PLANT

HYDRO & STEAM PLANTS

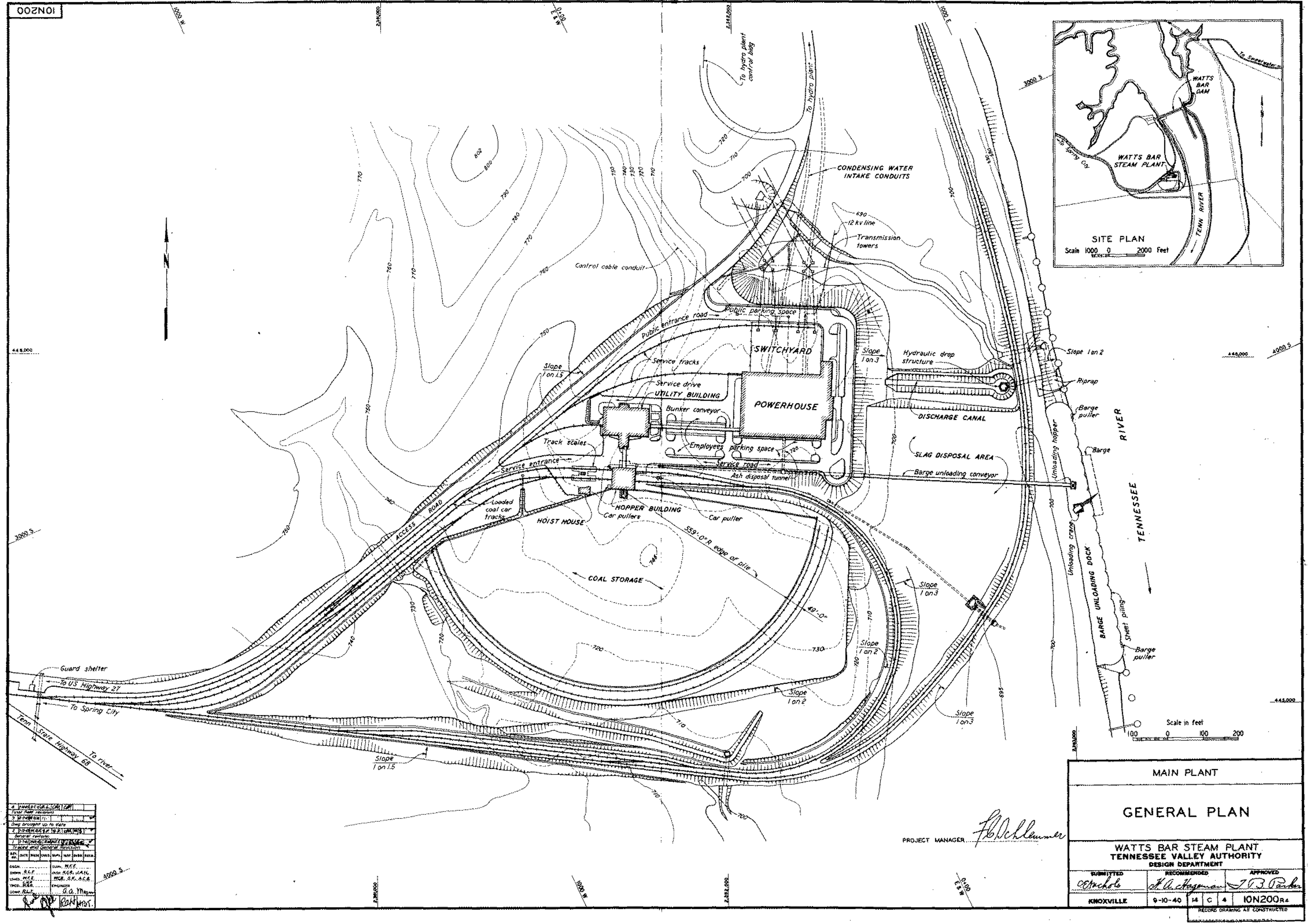
AREA PLAN

WATTS BAR PROJECT
TENNESSEE VALLEY AUTHORITY
DESIGN DEPARTMENT

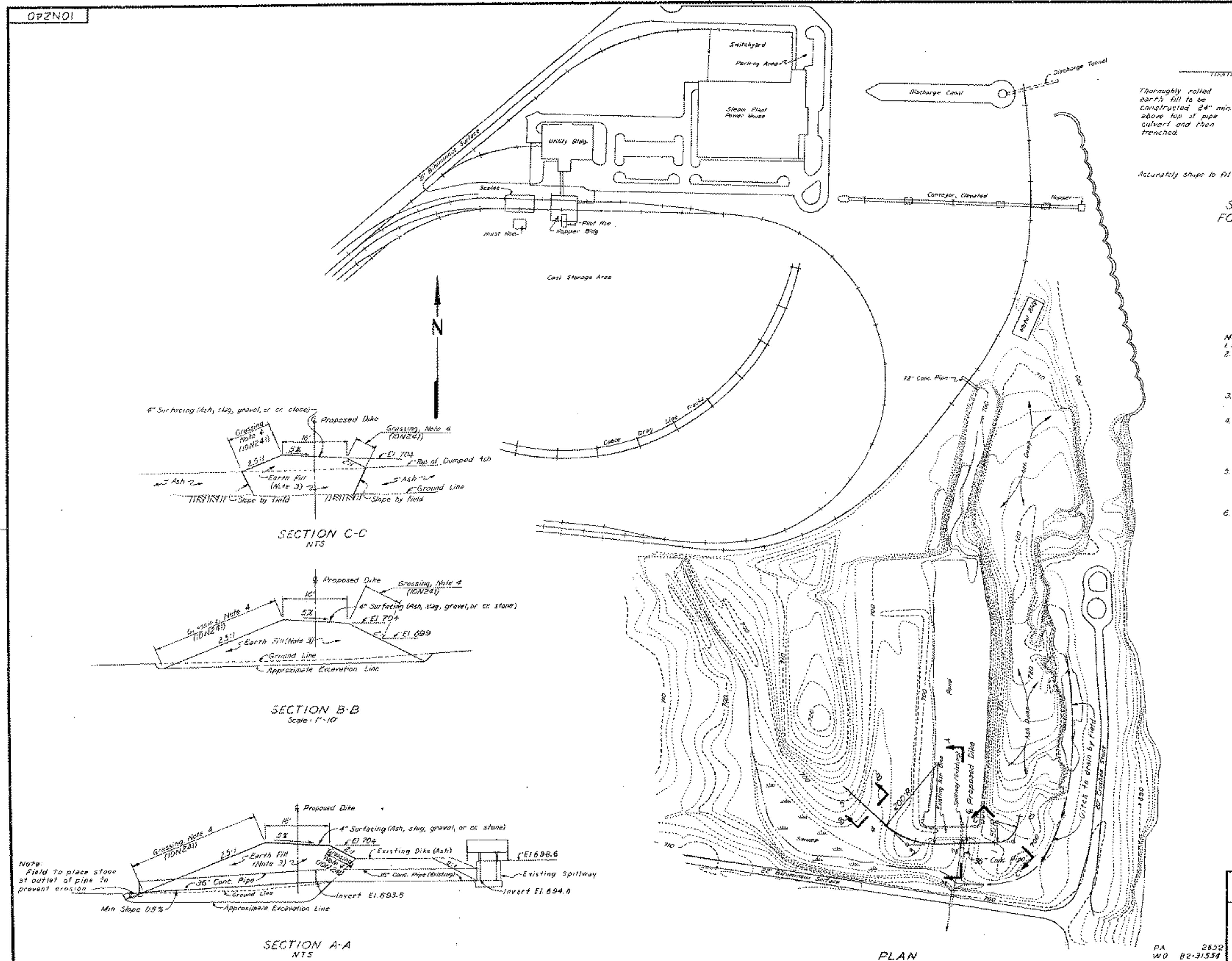
SUBMITTED	RECOMMENDED	APPROVED
T. Mundal	George Reid	T.B. Parker

KNOXVILLE	6-1-43	9	ER	4	1210N92

EXHIBIT 2


10N200
SITE PLAN
Scale 1000 0 2000 Feet
WATTS BAR DAM
WATTS BAR STEAM PLANT
TENN RIVER
To Sweetwater
To Spring City
3000 S
4900 S
4000 S
1000 W
1000 E
0+00 E & W
To hydro plant control bldg
To hydro plant
CONDENSING WATER INTAKE CONDUITS
12 kv line
Transmission towers
Control cable conduit
Public parking space
Public entrance road
SWITCHYARD
Service tracks
Service drive
UTILITY BUILDING
POWERHOUSE
Bunker conveyor
Employees parking space
Track scales
Service entrance
Service road
Ash disposal tunnel
Slope 1 on 1.5
Slope 1 on 3
Slope 1 on 2
Hydraulic drop structure
DISCHARGE CANAL
SLAG DISPOSAL AREA
Barge unloading conveyor
Riprap
Barge puller
Barge
Unloading hopper
Unloading crane
BARGE UNLOADING DOCK
Sheet piling
TENNESSEE RIVER
Loaded coal car tracks
HOIST HOUSE
HOPPER BUILDING
Car pullers
Car puller
559'-0"R edge of pile
49'-0"
COAL STORAGE
ACCESS ROAD
Guard shelter
To US Highway 27
To Spring City
Tenn State Highway 68
To river
Scale in feet
100 0 100 200
N
MAIN PLANT
GENERAL PLAN
WATTS BAR STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DESIGN DEPARTMENT
SUBMITTED
RECOMMENDED
APPROVED
C E Nichols
H. A. Hageman
T. B. Parker
KNOXVILLE
9-10-40
14
C
4
10N200R4
RECORD DRAWING AS CONSTRUCTED
PROJECT MANAGER F. C. Schlemmer
Final field revisions
Dwg brought up to date
General revision
Traced and General Revision
DATE
DSGN.
DRWN. R.L.F.
CHKD. W.F.E.
TRCD.
SUPV. W.F.E.
INSP. K.G.R., J.A.H.
W.C.R., S.K., A.C.B.
ENGINEER G. O. Meyer

10N240



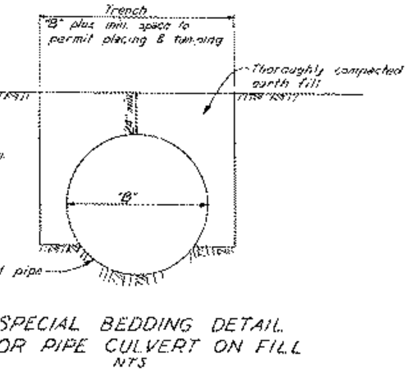
SECTION C-C
NTS

SECTION B-B
Scale: 1"=10'

Note:
Field to place stone at outlet of pipe to prevent erosion

SECTION A-A
NTS

PLAN



SPECIAL BEDDING DETAIL
FOR PIPE CULVERT ON FILL
NTS

NOTES:
1. All construction shall be in accordance with the T-1 Specifications.
2. The dike foundation shall have all weak surface soils removed to material that will easily bear the weight of loaded rubber tired earth hauling equipment. This will necessitate the draining of the swamp area on the downstream side of the existing dike.
3. The Fill shall consist of clean impervious soil, placed in 6-inch layers and compacted with sheepsfoot rollers as specified in Section 120.
4. Pipe backfill shall consist of clean impervious soil with no hard lumps or clods larger than 3 inches in diameter. Compaction shall be by hand held power compactors, to a minimum of 2 feet above the top of the pipe. Compaction shall be as specified in Section 125.
5. All earth borrow shall be in accordance with Section 123 and shall come from inside the disposal area and below El 700 if possible. If it is necessary to borrow above El 700 these disturbed areas shall be seeded in accordance with Section 180, type 5 mixture.
6. When connecting the end of the dike to earth care is to be used to insure a stable and impervious connection. When connecting the end of the dike to the dumped ash construct the connection as shown on Section C-C.

Scale: 1"=100'
Except as noted

PA 2652
WO 82-31554

COMPANION DRAWING: 10N241, 10N242

MAIN PLANT

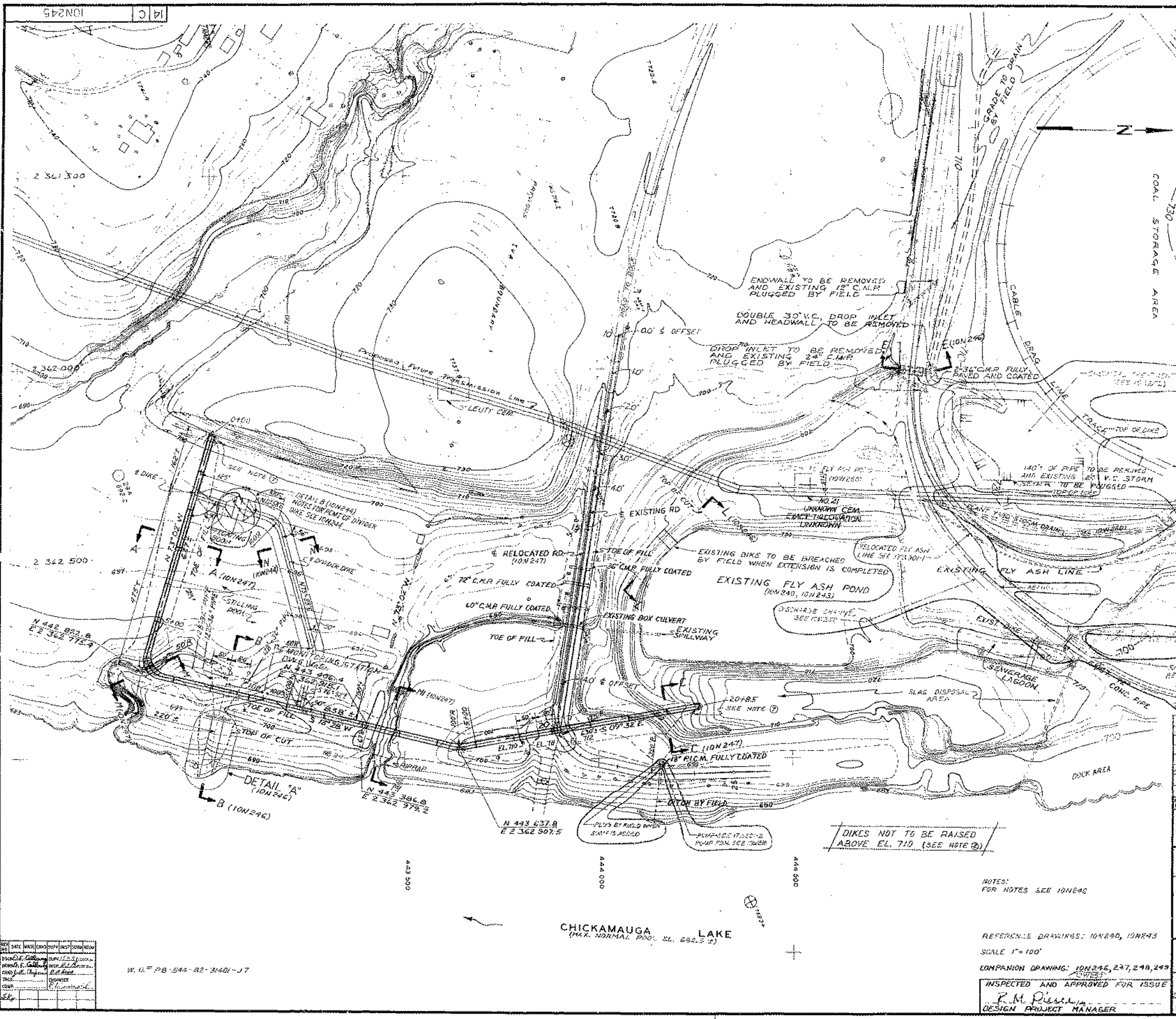
PLAN & SECTIONS
FLY ASH DISPOSAL AREA

WATTS BAR STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED
JM Johnst	W N Calvert	F.P. Long

KNOXVILLE	12-17-69	14	C	4	10N240 R0

RECORD DRAWING AS CONSTRUCTED



NOTES:
FOR NOTES SEE 10N248

REFERENCE DRAWINGS: 10N240, 10N243

SCALE 1" = 100'

COMPANION DRAWING: 10N246, 247, 248, 249

INSPECTED AND APPROVED FOR ISSUE
R. M. Pierce
DESIGN PROJECT MANAGER

REV NO.	ECN NO.	DATE	DSGN	DRWN	CHKD	SUPV	ENGR	INSP	INTFC	RECM	APPR
4		6-23-77									
ADD DISCHARGE CHAN., BOTTOM ASH DISPOSAL AREA; R.R. 30[illegible]											
3		10-19-76									
ADD DIVIDER DIKE; R.4, 3376											
2											
ADD PLANT 10 STORM DR., REM. PIPE SECT. D-D, & REM. PROP. FLY ASH LINE											
1		11-18-75									
REMOVE HOLD SEC. E-E											

DSGN D. E. Galloway
DRWN
CHKD
SUPV
INSP
ENGINEER

MAIN PLANT

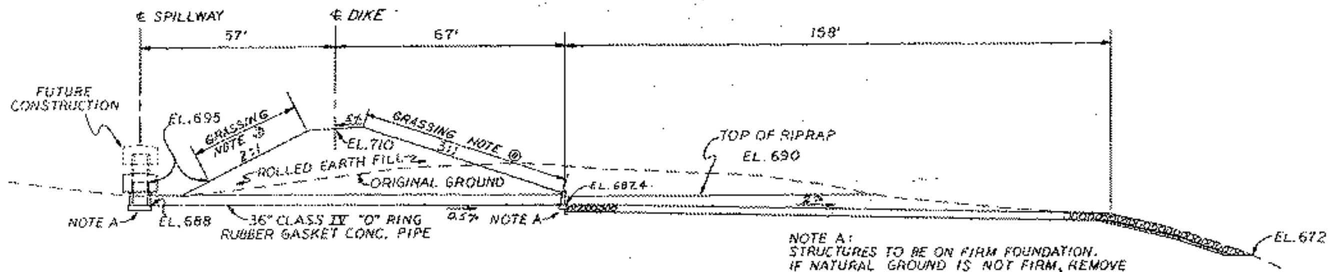
FLY ASH DISPOSAL AREA EXTENSION - PLAN

WATTS BAR STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED

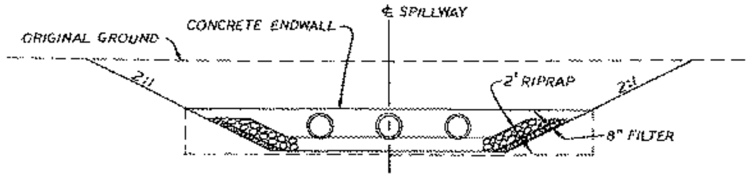
KNOXVILLE 10/24/75 | 14 | C | 10N245 R4

RECORD DRAWING AS CONSTRUCTED



NOTE A:
STRUCTURES TO BE ON FIRM FOUNDATION. IF NATURAL GROUND IS NOT FIRM, REMOVE TO DEPTH OF 4' AND REPLACE WITH COMPACTED FILL.

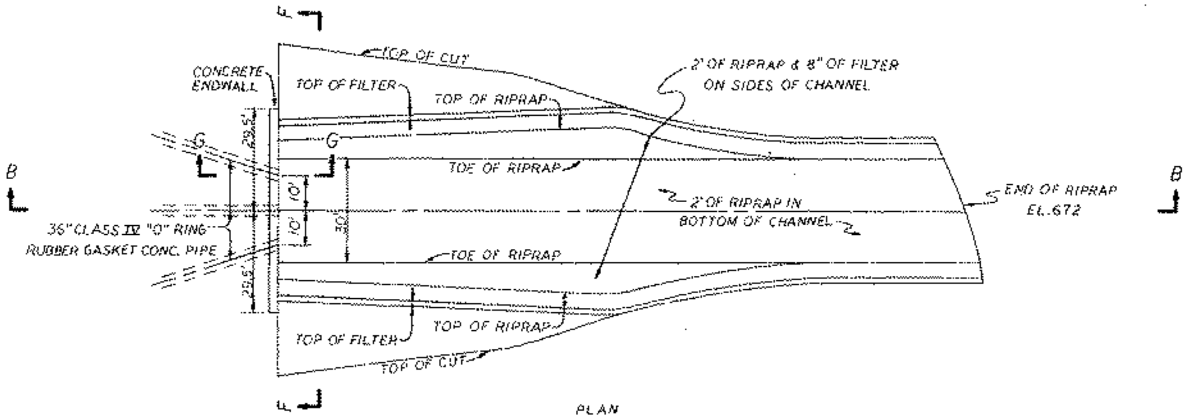
SECTION B-B
SCALE 1" = 20'



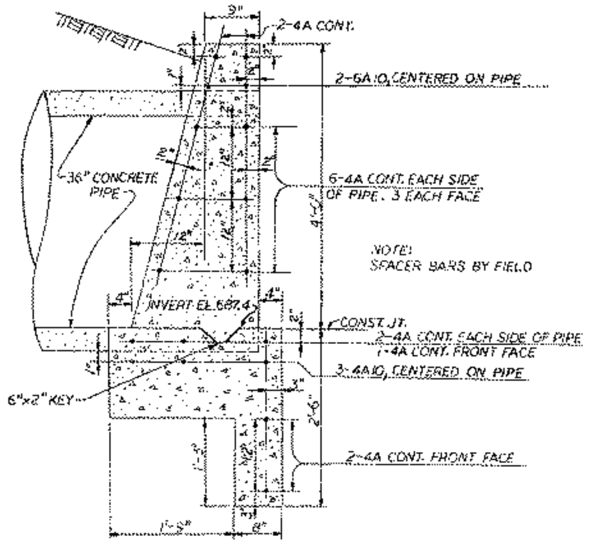
SECTION F-F
SCALE 1" = 10'

SUMMARY OF QUANTITIES

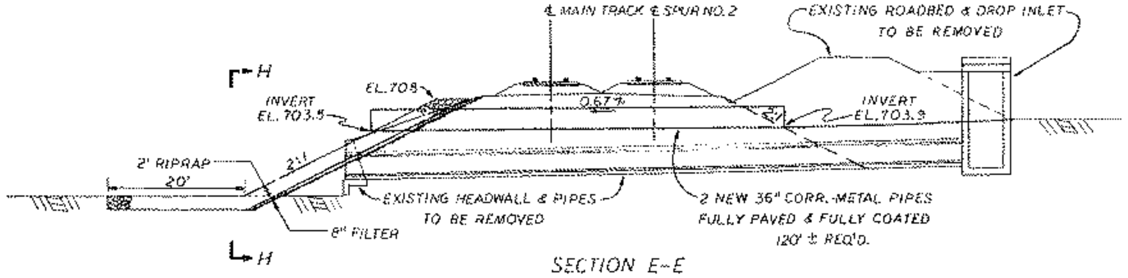
ITEM NO.	DESCRIPTION	QUANTITY
101	CLEARING & GRUBBING	24 AC
110	REMOVAL OF PIPES & DROP INLET	L.S.
120	CHANNEL EXCAVATION	3500 CY
123	EARTH BORROW	63900 CY
129	STRUCTURAL EXCAVATION	1,130 CY
180	GRASSING	23,660 SY
210	SURFACING (4" CRUSHED STONE)	830 TONS
401	CLASS A CONCRETE (ENDWALL)	18 C.Y.
418	REINFORCING STEEL (ENDWALL)	610 LBS
660	18"-12 GAGE FULLY COATED P.I.C.M.P.	48 L.F.
660	36"-12 GAGE FULLY COATED C.M.P.	50 L.F.
660	60"-12 GAGE FULLY COATED C.M.P.	28 L.F.
660	72"-12 GAGE FULLY COATED C.M.P.	124 L.F.
662	36"-12 GA. FULLY PAVED & COATED CMP	120 L.F.
830	RIPRAP	1000 C.Y.
836	FILTER	320 TONS
FOR BILL OF MATERIALS FOR SPILLWAYS SEE DWG. 10N248		



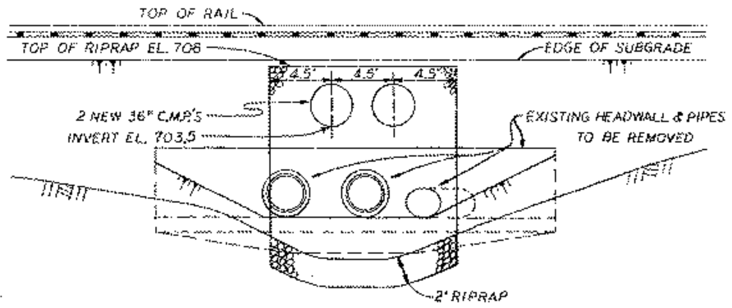
PLAN
DETAIL "A"
SCALE 1" = 20'



SECTION G-G
SCALE 1" = 1'



SECTION E-E
SCALE 1" = 10'



SECTION H-H
SCALE 1" = 5'

NOTES:

① SOILS EXPLORATION AND TEST RESULTS ARE IN A MEMORANDUM REPORT FROM GENE FARMER TO R.G. DOMER DATED JULY 16, 1973. BASED ON TEST RESULTS IN THE REPORT, WITH DIKE TOP EL. 710 THE MINIMUM STABILITY ANALYSIS SAFETY FACTORS ARE AS FOLLOWS:

EXTERIOR SLOPE, END OF CONSTRUCTION, S.F. = 2.2
OPERATING CONDITION, S.F. = 1.8
INTERIOR SLOPE, END OF CONSTRUCTION, S.F. = 2.0

② THE RAISING OF THE FLY ASH DISPOSAL AREA EXTENSION DIKES SHALL NOT BE DONE WITHOUT PRIOR APPROVAL FROM THE DIVISION OF ENGINEERING DESIGN.

③ DIKE CONSTRUCTION SHALL BE IN ACCORDANCE WITH ALL APPLICABLE PORTIONS OF GENERAL CONSTRUCTION SPECIFICATION NO. G-9 FOR ROLLED EARTHFILL FOR DAMS AND POWER PLANTS. FILL COMPACTION SHALL BE AT LEAST 95 PERCENT OF MAXIMUM STANDARD DENSITY AND FILL MOISTURE CONTENT NOT MORE THAN 3 PERCENT ABOVE OPTIMUM, AS DETERMINED BY THE CENTRAL SOILS LABORATORY.

④ ALL OTHER CONSTRUCTION SHALL BE IN ACCORDANCE WITH APPLICABLE PORTIONS OF HIGHWAY SPECIFICATION T-1.

⑤ THERE SHALL BE NO CLEARING OR GRUBBING ABOVE EL. 710.

⑥ EARTH FILL FOR THE DIKE CONSTRUCTION SHALL CONSIST OF MATERIAL EXCAVATED FROM INSIDE THE FLY ASH DISPOSAL AREA EXTENSION AND SOUTH OF THE EXISTING ROAD THAT CROSSES THE EXTENSION AREA. CUT SLOPES FOR BORROW MATERIAL ADJACENT TO THE DIKE SHALL NOT BE EXCAVATED STEEPER THAN 3:1, AND TOP OF CUT SHALL BE A MINIMUM OF 25 FEET FROM THE TOE OF ANY SLOPE. EXCAVATION FOR FILL SHALL NOT EXTEND BELOW EL. 686.

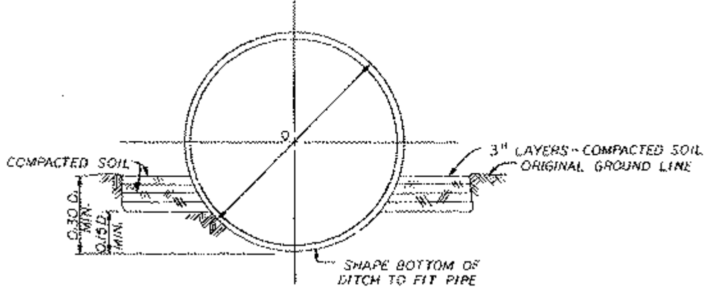
⑦ WHEN CONNECTING THE END OF THE NEW DIKE TO THE OLD DIKE, EXTREME CARE SHALL BE USED TO INSURE AN IMPERVIOUS AND STABLE CONNECTION. THE EXISTING SURFACE SHALL BE STRIPPED OF ALL VEGETATION AND SCARIFIED TO A MINIMUM DEPTH OF 6 INCHES AND COMPACTED SO AS TO FORM A BOND WITH THE NEW FILL.

⑧ RIPRAP SHALL BE PLACED AT LOCATIONS SHOWN ON DRAWINGS. THE STONE SHALL CONSIST OF SOUND DURABLE STONE PER SECTION 830 OF T-1 SPECIFICATION. THE RIPRAP SHALL BE A MINIMUM OF 2' THICK WITH AT LEAST 50 PERCENT BY WEIGHT BEING 200 LBS. OR MORE, AND WITH THE MAXIMUM WEIGHT TWO TIMES THE 50 PERCENT WEIGHT AND NOT MORE THAN 5 PERCENT PASSING THE 1" SIEVE.

⑨ THE FILTER BLANKET UNDER THE RIPRAP SHALL BE 8" THICK AND IN ACCORDANCE WITH SECTION 836 OF THE T-1 SPECIFICATIONS.

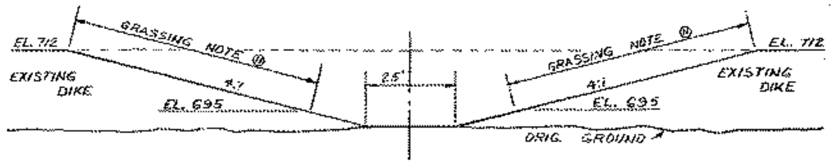
⑩ SURFACING ON TOP OF THE DIKE SHALL CONSIST OF CRUSHED STONE 4" THICK PLACED OVER THE FULL WIDTH OF THE DIKE IN ACCORDANCE WITH SECTION 210 OF THE T-1 SPECIFICATION.

⑪ ALL CUT AND FILL SLOPES AND OTHER DISTURBED AREAS SHALL BE SEEDED WITH TYPE 7 MIXTURE, FERTILIZED, AND MULCHED IN ACCORDANCE WITH SECTIONS 180 AND 182 OF THE T-1 SPECIFICATIONS.



DETAIL - CLASS "B" BEDDING
NOT TO SCALE

W.O. # PS-544-82-31401-07



SECTION L-L
SCALE 1" = 20'
DIKE BREACH

SCALE AS NOTED

COMPANION DRAWINGS: 10N245, 247, 248, 249

INSPECTED AND APPROVED FOR ISSUE
R.M. Pierce
DESIGN PROJECT MANAGER

REVISE QUANTITIES DELETE NOTE 2 ...
1 | 3-19-73 | REMOVE HOLD & REVISE SECS. E-E, H-H, & QUANTITIES.

DSGN J.R. Chapman
DRWN J.R. Chapman
CKD
SUPV J.R.H. Stivers
INSP
ENGINEER

MAIN PLANT

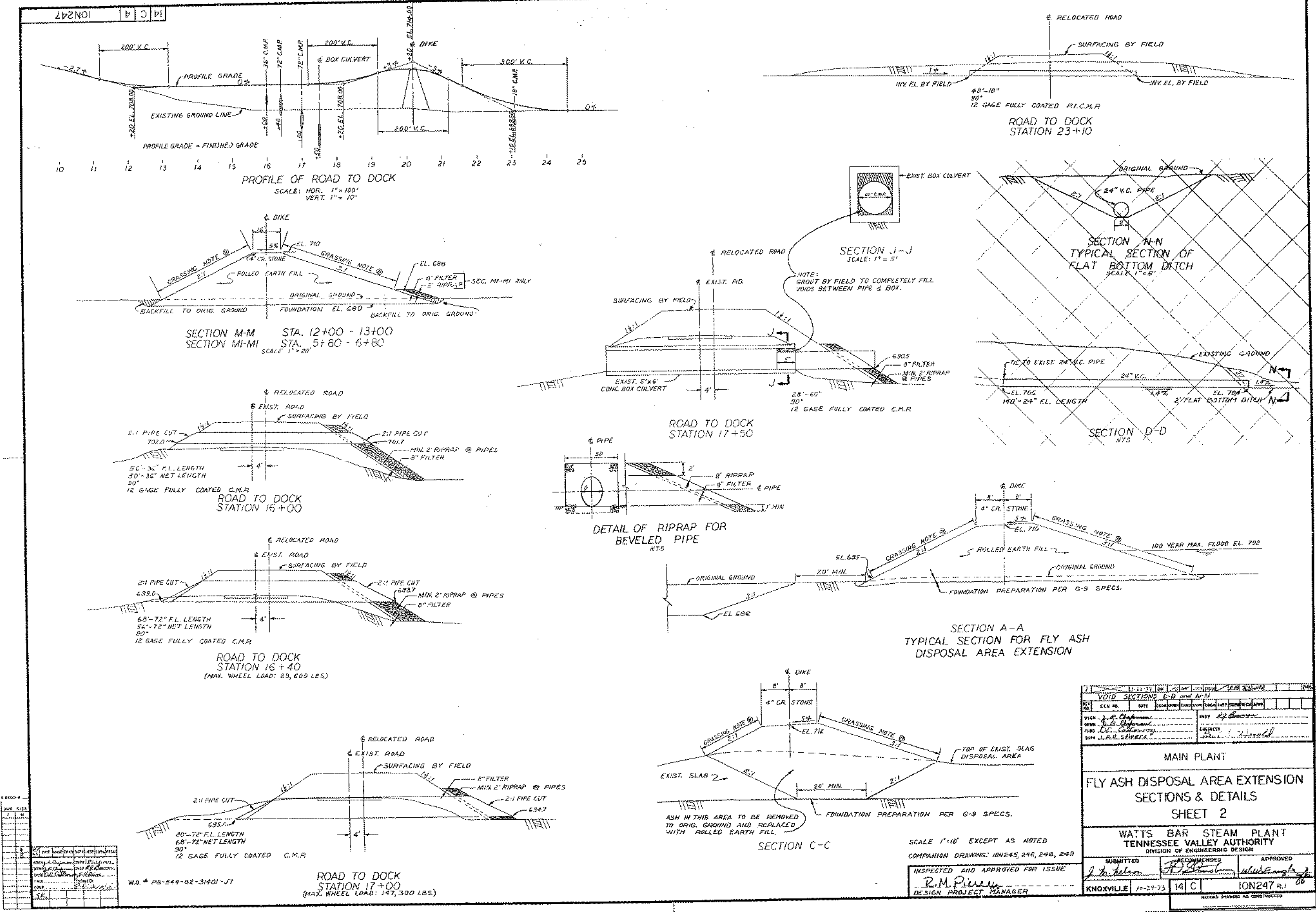
FLY ASH DISPOSAL AREA EXTENSION
SECTIONS & DETAILS
SHEET 1

WATTS BAR STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED | RECOMMENDED | APPROVED

KNOXVILLE | 10-29-73 | 14 | C | 10N246 R2

RECORD DRAWING AS CONSTRUCTED



SCALE 1"=10' EXCEPT AS NOTED

COMPANION DRAWINGS: 10N245, 246, 248, 249

W.O. # P8-544-82-31401-J7

INSPECTED AND APPROVED FOR ISSUE
R.M. Pierce
DESIGN PROJECT MANAGER

1 | 2-22-77 | VOID SECTIONS D-D and N-N

REV. NO. | ECN NO. | DATE | DSGN | DRWN | CHKD | SUPV | ENGR | INSP | SUBM | RCMD | APPD

DSGN J. R. Chapman
DRWN G. R. Chapman
CHKD D.C. Calloway
SUPV J.R.H. Stivers
INSP R.J. Brown
ENGINEER

MAIN PLANT

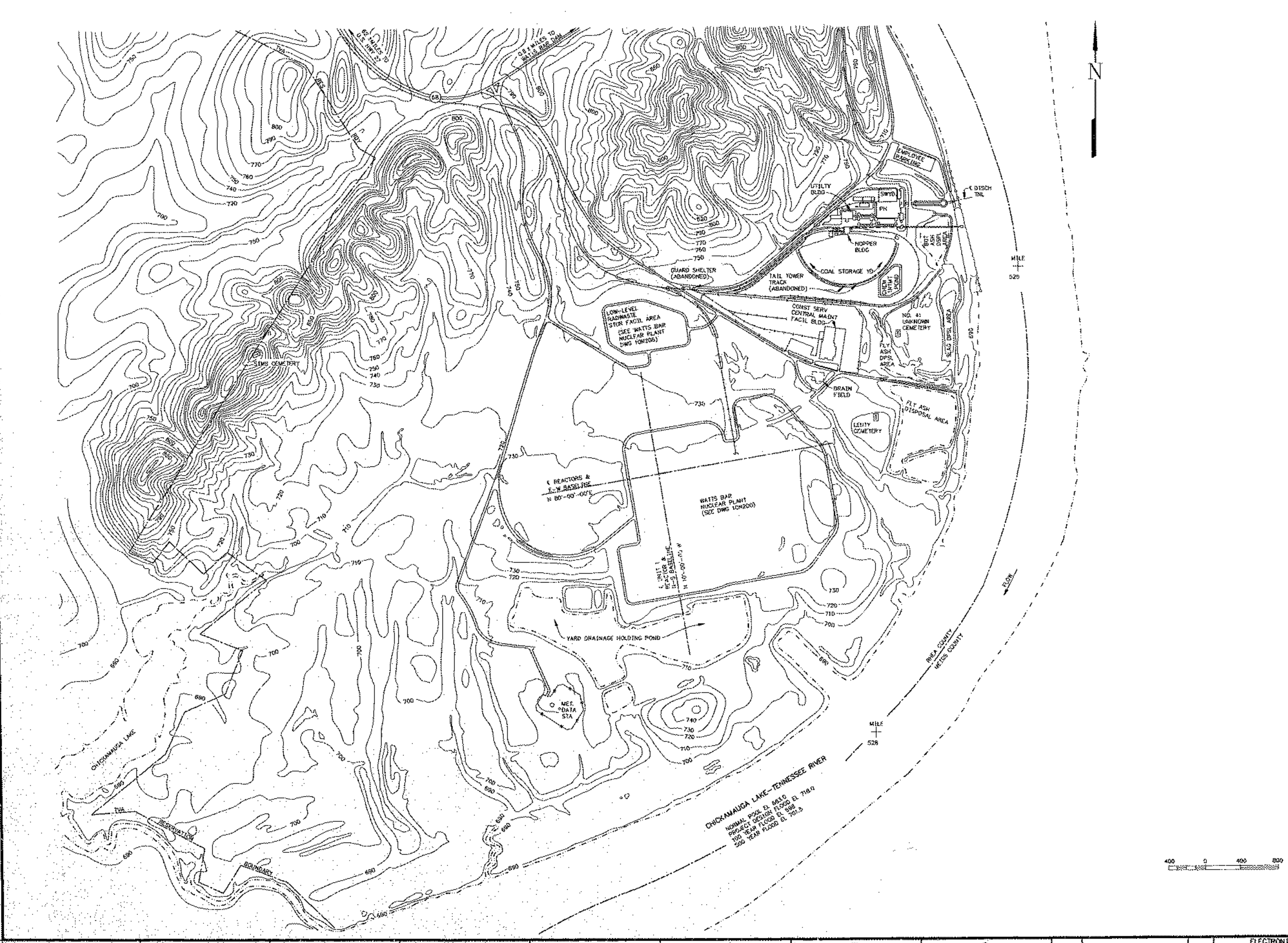
FLY ASH DISPOSAL AREA EXTENSION
SECTIONS & DETAILS
SHEET 2

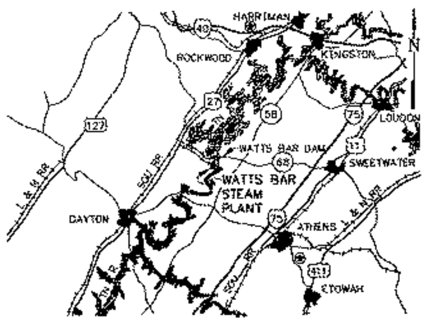
WATTS BAR STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED J. M. Nelson
RECOMMENDED
APPROVED

KNOXVILLE | 10-29-73 | 14 | C | 10N247 R1

RECORD DRAWING AS CONSTRUCTED





LOCALITY MAP

1"=10 MILE 0 10 20

NOTES:

1. TOPOGRAPHY TRACED FROM REDUCED KELSH PLOTTED FROM 1971 AND 1970 AERIAL PHOTOGRAPHS AND USGS-TVA 7.5 MINUTE QUADRANGLE, 110-SE AND 110-NE (DECATUR AND SPRING CITY, TN.) CONTOUR INTERVAL SHOWN IS 10 FT.
2. FOR COORDINATE LOCATION OF WATTS BAR STEAM PLANT SEE LOCATION OF STRUCTURES DWG 10N202.
3. FOR TEMPORARY AND PROPOSED FEATURES SEE WATTS BAR NUCLEAR PLANT PROPOSED FEATURES DWG 10N209-01.

R 9	2/21/96	RWA	JCH	RWA	SWA	VWD	REJ		
REDRAWN TO CAD FORMAT									
REV NO.	DATE							PROJECT ID	AS CONST

SCALE: 1"=400' EXCEPT AS NOTED

MAIN PLANT

GENERAL PLAN

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
	R.L.F.	W.F.E.	W.F.E.	HAH	RBP	

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R12 | DATE 9-10-40 | 14 | C | 10W200 | R 9

R1

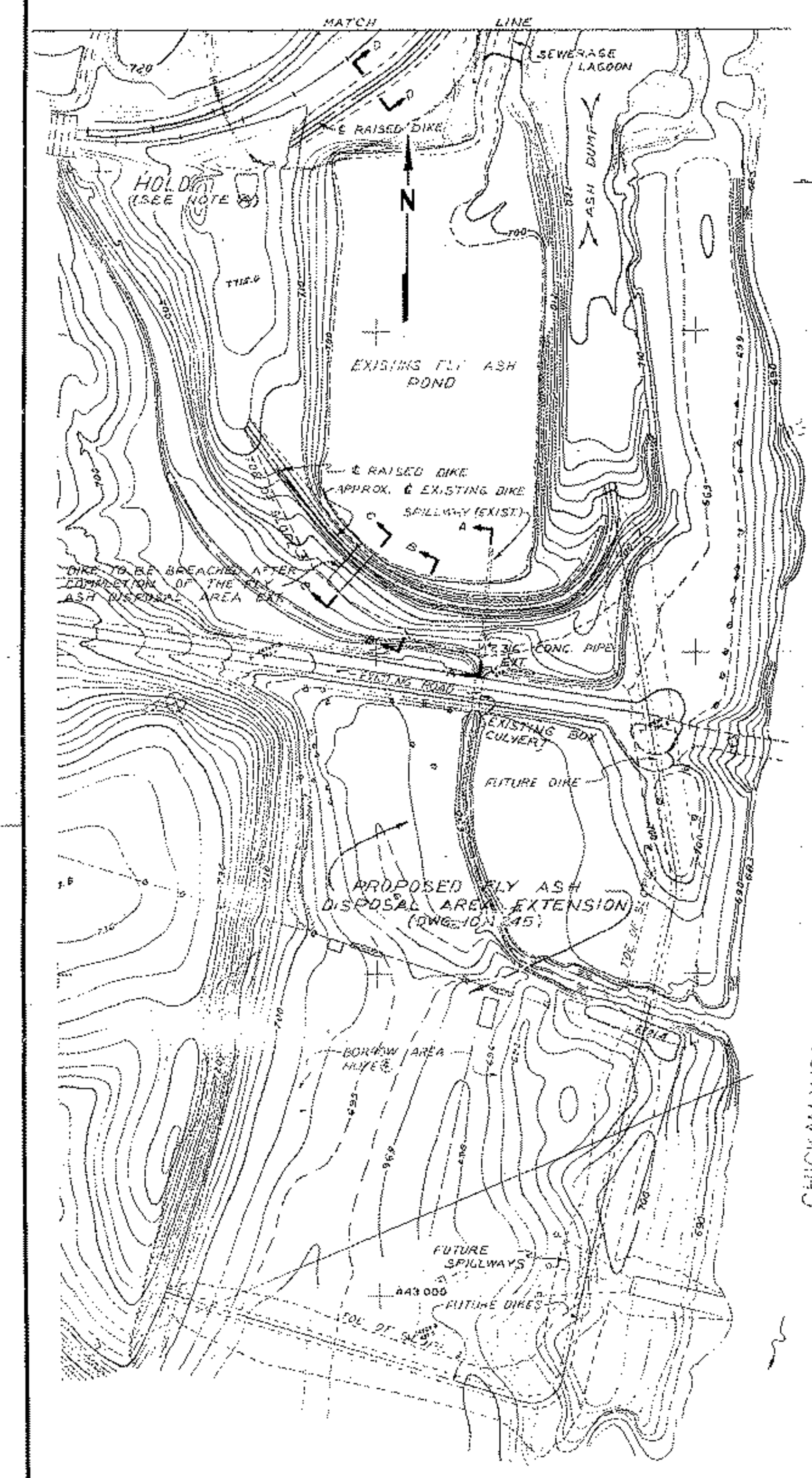
TASK COMPLETED BY | REV NO.

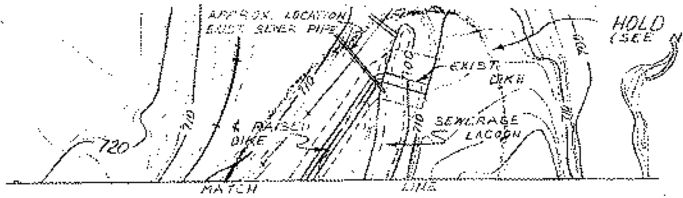
ELECTRONICALLY RESTORED DRAWING
THIS DRAWING HAS BEEN COMPLETELY REDRAWN AND SUPERSEDES :(10N200, R8)

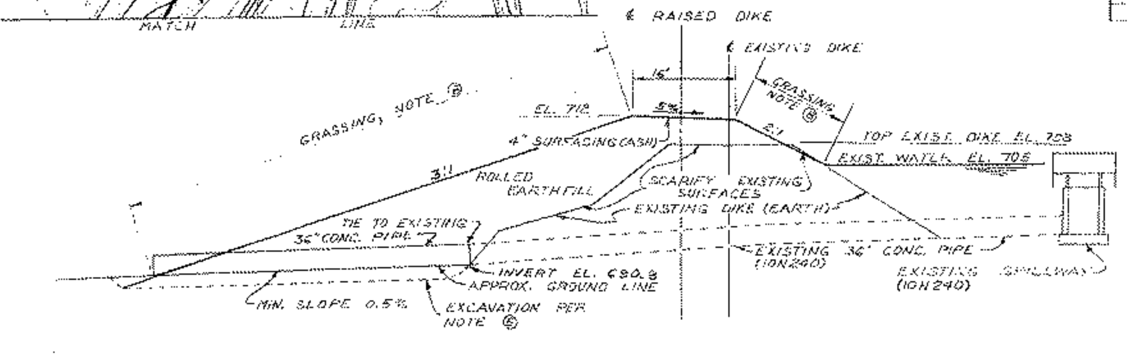
PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

10W200 | C | 14

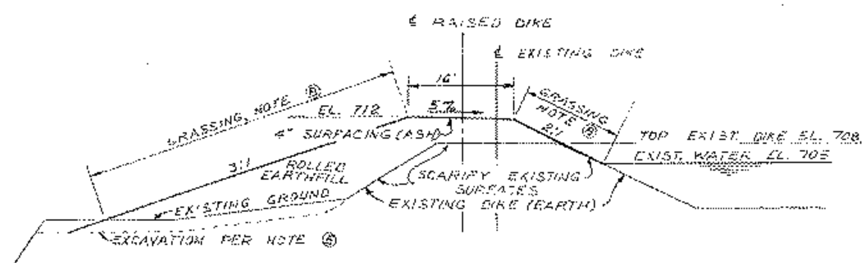






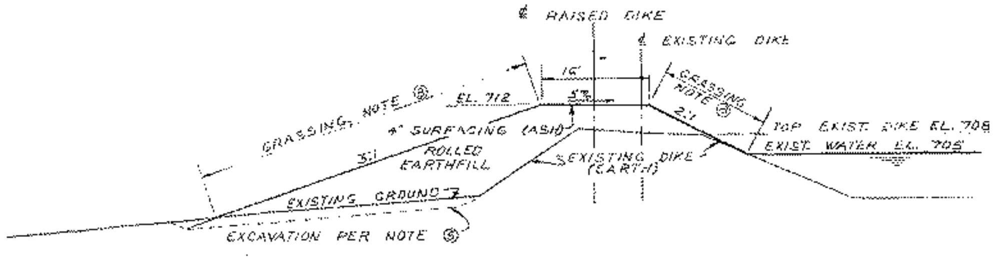
SECTION A-A

NTS



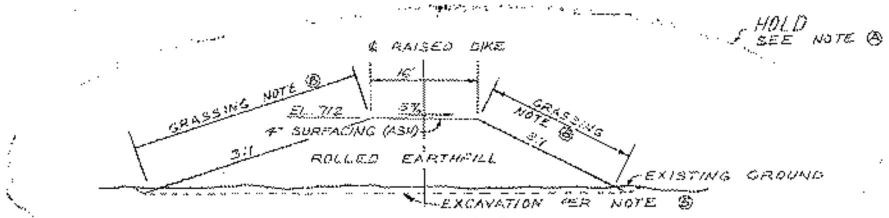
SECTION B-B

SCALE 1"=10'



SECTION C-C

1"=10'



SECTION D-D

NTS

SUMMARY OF QUANTITIES			
ITEM NO.	DESCRIPTION	QUANTITY	UNIT
101	CLEARING AND GRUBBING	1.3	ACRES
123	EARTH BORROW	11,000	C.Y.
180-182	SEEDING AND MULCHING	4,600	S.Y.
602	CLASS III O'RING CONC. PIPE	45	LIN. FT.
	ASH SURFACING (4")	220	TONS

NOTES:

① STABILITY ANALYSIS SAFETY FACTOR FOR THE EXTERIOR DIKE SLOPE WITH 3:1 SLOPE AND DIKE TOP RAISED TO EL. 712 IS A MINIMUM OF 1.5. SOILS EXPLORATION AND TESTING OF FOUNDATION AND BORROW FOR THE DIKE OF THE PROPOSED EXTENSION OF THE FLY ASH DISPOSAL AREA IS RECORDED IN MEMORANDUM REPORT GENE FARMER TO R. G. DOMER DATED JULY 18, 1973. DIKE RAISING SHOWN ON THIS DWG. WILL USE THE SAME BORROW FROM INSIDE THE PROPOSED AREA. THE STABILITY ANALYSIS SAFETY FACTOR IS THAT CALCULATED FOR THE EXTENSION DIKE WITH MAXIMUM HEIGHT AND POOREST FOUNDATION FOUND IN THE EXPLORATION.

② DIKE CONSTRUCTION SHALL BE IN ACCORDANCE WITH ALL APPLICABLE PORTIONS OF GENERAL CONSTRUCTION SPECIFICATION NO. G-9 FOR ROLLED EARTHFILL FOR DAMS AND POWER PLANTS. FILL COMPACTION SHALL BE AT LEAST 95% OF STANDARD MAXIMUM DENSITY AND FILL MOISTURE CONTENT SHALL NOT BE MORE THAN 3% ABOVE OPTIMUM, AS DETERMINED BY THE CENTRAL SOILS LABORATORY.

③ ALL OTHER CONSTRUCTION SHALL BE IN ACCORDANCE WITH HIGHWAY SPECIFICATIONS NO. T-1.

④ EARTHFILL FOR THE DIKE CONSTRUCTION SHALL CONSIST OF MATERIAL EXCAVATED FROM INSIDE THE PROPOSED FLY ASH DISPOSAL AREA EXTENSION AND SOUTH OF THE EXISTING ROAD THAT CROSSES THE EXTENSION AREA. CUT SLOPES FOR BORROW MATERIAL ADJACENT TO THE PROPOSED DIKES OF THE FLY ASH DISPOSAL AREA EXTENSION SHALL NOT BE EXCAVATED STEEPER THAN 3:1 AND TOP OF CUT SHALL BE A MINIMUM OF 20' FROM THE TOE OF ANY SLOPE.

⑤ DIKE FOUNDATION UNDER NEW FILL SHALL HAVE ALL WEAK SURFACE SOILS REMOVED TO A DEPTH THAT WILL SUPPORT HEAVY EARTHMOVING EQUIPMENT WITHOUT RUTTING OR HEAVING. CARE SHALL BE TAKEN TO PREVENT UNDERMINING THE EXISTING DIKE DURING THIS EXCAVATION.

⑥ EXISTING DIKE SURFACE, TO BE COVERED BY NEW FILL IS TO BE STRIPPED OF ALL VEGETATION AND ASH, SCARIFIED TO A MINIMUM DEPTH OF 4", AND COMPACTED SO AS TO FORM A BOND WITH THE NEW FILL.

⑦ SURFACING SHALL CONSIST OF 4" OF COMPACTED BOTTOM ASH PLACED OVER THE ENTIRE WIDTH OF THE TOP OF THE DIKE.

⑧ ALL CUT AND FILL SLOPES AND OTHER DISTURBED AREAS SHALL BE SEEDED WITH TYPE 7 MIXTURE, FERTILIZED, AND MULCHED IN ACCORDANCE WITH SECTIONS 180 AND 182 OF THE T-1 SPECIFICATIONS.

NOTE Ⓐ: DIKE PARALLEL TO RAILROAD (SECTION D-D) NOT TO BE CONSTRUCTED UNLESS DIRECTED BY DIVISION OF ENGINEERING DESIGN.

REFERENCE DWG. 10N240

SCALE 1"=100' EXCEPT AS NOTED

ACCT. NO. P8-761-82-175.3 (DESIGN)

INSPECTED AND APPROVED FOR ISSUE
R. M. Pierce
DESIGN PROJECT MANAGER

MAIN PLANT

FLY ASH DISPOSAL AREA –
GENERAL PLAN AND SECTIONS
FOR RAISING DIKE

WATTS BAR STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED
J. M. Nelson		W. W. Engle

KNOXVILLE 10-2-73 14 C 10W243 R0

RECORD DRAWING AS CONSTRUCTED

14 C 10W426-01

TENNESSEE VALLEY AUTHORITY
WATTS BAR FOSSIL PLANT
WORK PLAN FOR SLAG DISPOSAL AREA MAINTENANCE
TVA PROJECT NO. 729178

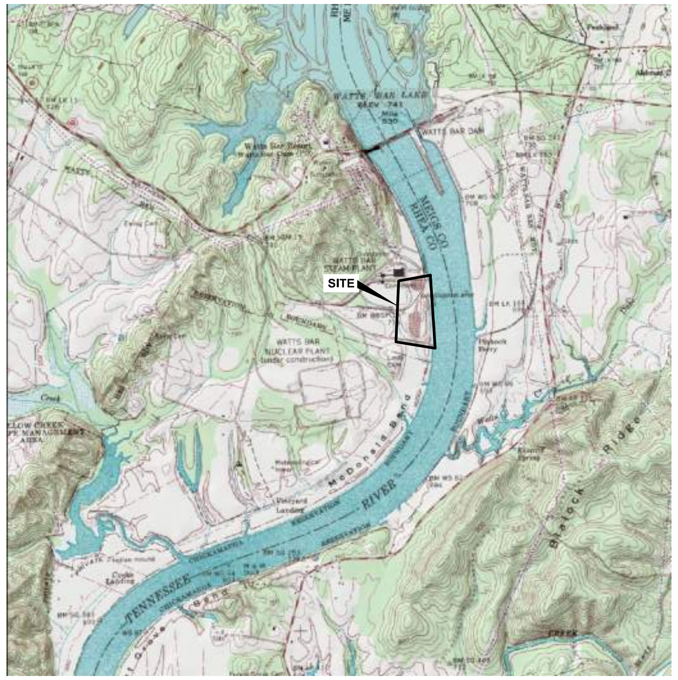
100% SUBMITTAL
ISSUED FOR CONSTRUCTION

2 WORKING DAYS
BEFORE YOU DIG
1-800-351-1111
TENNESSEE ONE CALL SYSTEM

SPRING CITY, RHEA COUNTY, TENNESSEE
MAY 8, 2015

PREPARED FOR:
TENNESSEE VALLEY AUTHORITY
1101 MARKET STREET
CHATTANOOGA, TN 37402-2801

PREPARED BY:
URS CORPORATION
1600 PERIMETER PARK DRIVE
SUITE 400
MORRISVILLE, NC 27560
PHONE: (919) 461-1100



SITE VICINITY MAP

0 2000 4000
SCALE IN FEET

N

DWG. NO.	DWG. DESCRIPTION
10W426-01	TITLE SHEET
10W426-02	GENERAL NOTES I
10W426-03	GENERAL NOTES II
10W426-04	MASTER LEGEND & ABBREVIATIONS
10W426-05	EXISTING SITE PLAN
10W426-06	EROSION AND SEDIMENT CONTROL PLAN
10W426-07	CAP MAINTENANCE/TOPSOIL PLAN
10W426-08	DITCH RELOCATION PLAN
10W426-09	OVERALL SITE GRADING PLAN
10W426-10	SEEP #1 REPAIR & PIPE ABANDONMENT PLAN
10W426-11	SEEP #1 REPAIR SECTIONS
10W426-12	PIPE ABANDONMENT DETAILS
10W426-13	GRADING DETAILS I
10W426-14	GRADING DETAILS II
10W426-15	GRADING DETAILS III
10W426-16	CULVERT DETAILS
10W426-17	EROSION AND SEDIMENT CONTROL DETAILS

FOR SUPPORTING DESIGN CALCULATIONS SEE:
FPGWBFDEGCDX0003002015000007

R #											
R 0	05/08/15	ANR	ASL	JJH	MRM	JDM	MST	JCK	729178		D
ISSUED FOR CONSTRUCTION											
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD

DISCIPLINE INTERFACE
1
2
3
4

MICHAEL MEULEMANS
No. 16952
5/8/15

SCALE: NONE EXCEPT AS NOTED

TITLE SHEET

WATTS BAR SLAG DISPOSAL AREA MAINTENANCE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
ANR	ASL	JJH	MRM	JDM	MST	JCK

URS

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 | DATE 05/08/15 | 14 | C | 10W426-01 | R 0

URS Corporation | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

Q:\Projects\31858011_TVAWattsBa\DWGs\Sheets\SlagPile\31858011 10W426-01 Title Sheet.dwg User:andrew_rodzianko May 08, 2015 - 9:05pm

1. PURPOSE

THE PURPOSE OF THIS WORK IS TO CONSTRUCT THE FOLLOWING MAINTENANCE IMPROVEMENTS:

1.1. ADD TOPSOIL TO THE SURFACE OF THE EXISTING SLAG DISPOSAL AND CHEMICAL POND CLOSURE AREAS AND RE-ESTABLISH VEGETATIVE COVER.

1.2. CONSTRUCT STORM WATER ENHANCEMENTS AND CONVEYANCE IMPROVEMENTS TO MANAGE THE 25-YR./24-HR. STORM, REDUCING THE POTENTIAL FOR DAMAGE TO OLD FERRY ROAD IN THE EVENT OF OVERTOPPING. SOME EROSION DAMAGE TO OLD FERRY ROAD DUE TO LARGE STORM EVENTS IS EXPECTED, AND MAY REQUIRE OCCASIONAL ROAD MAINTENANCE.

1.3. FILL THE NON-JURISDICTIONAL WETLANDS AND RELOCATE THE PERIMETER DITCH TO MINIMIZE SURFACE WATER INFILTRATION IN AREAS ADJACENT TO THE SLAG DISPOSAL AREA CLOSURE.

1.4. ELIMINATE SEEP #1 BY EXCAVATING AN INTERCEPTOR TRENCH ADJACENT TO THE SLAG DISPOSAL AREA CLOSURE.

1.5. ABANDON THE INACTIVE 30-INCH DIAMETER STORM DRAIN BENEATH THE SLAG DISPOSAL AREA.

2. DEFINITIONS

2.1. THE OWNER IS TENNESSEE VALLEY AUTHORITY (TVA).

2.2. THE ENGINEER IS URS CORPORATION (URS). URS HAS PREPARED THE PLANS AND NOTES HEREIN.

2.3. THE CONTRACTOR IS TVA OR THE ENTITY WITH WHOM TVA HAS AN AGREEMENT WITH TO PERFORM THE PROJECT CONSTRUCTION.

3. PERMITTING

3.1. PERMITTING REQUIREMENTS ASSOCIATED WITH THIS WORK MUST BE HANDLED BY TVA AND MUST BE MAINTAINED/VERIFIED BY THE TVA ENVIRONMENTAL GROUP.

4. DATUM AND TOPOGRAPHIC INFORMATION

4.1. THE EXISTING CONDITIONS, TOPOGRAPHIC AND SURVEY INFORMATION SHOWN ON THESE DRAWINGS WAS PROVIDED BY TVA AND IS BASED UPON AN AERIAL SURVEY CONDUCTED ON JULY 20, 2011 BY TUCK MAPPING SOLUTIONS, INC. IN ORDER TO IMPROVE THE ACCURACY OF THIS MAPPING, THIS INFORMATION WAS SUPPLEMENTED WITH SOUNDING DATA, AND SURVEY DATA COLLECTED AT VARIOUS INTERVALS TO DATE, FURNISHED BY TVA AND/OR THEIR OTHER CONSULTANTS AND CONTRACTORS, OR OBTAINED FROM DATA UTILIZED ON PREVIOUS TVA PROJECTS. THE EXISTING CONDITIONS SHOWN ON THESE DRAWINGS ARE BELIEVED TO REPRESENT THE BEST KNOWN DATA AVAILABLE. ALTHOUGH THIS INFORMATION HAS BEEN INCLUDED IN THE CONSTRUCTION PLANS BY URS CORP. (URS), THEY ARE NOT NECESSARILY THE WORK PRODUCT OF URS AND HAVE BEEN INCORPORATED IN RESPONSE TO CERTAIN ASSIGNED CONDITIONS. URS HAS NOT SURVEYED OR FIELD VERIFIED ANY OF THE EXISTING CONDITIONS INFORMATION AND CANNOT BE HELD RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF THIS DATA.

4.2. TOPOGRAPHIC MAPPING IS BASED UPON THE FOLLOWING DATUM AND PROJECTION:

HORIZONTAL PROJECTION: WBN/WBF PLANT LOCAL GROUND

VERTICAL DATUM: NGVD 29

UNITS: US SURVEY FEET

4.3. BENCHMARK LOCATIONS TO BE PROVIDED BY TVA SURVEYING & PROJECT SERVICES GROUP. IF BENCHMARKS ARE DISTURBED, THE CONTRACTOR SHALL COORDINATE WITH SURVEYING AND PROJECT SERVICE TO RE-ESTABLISH BENCHMARKS.

5. GENERAL SITEWORK REQUIREMENTS

5.1. ACCESS INTO THE WORK AREA FOR DELIVERY OF EQUIPMENT, MATERIALS AND WORKFORCE MUST BE REVIEWED DAILY BY THE CONTRACTOR, AND CONTROLLED AS NEEDED TO PREVENT ANY DAMAGE TO COMPONENTS OF THE EXISTING SLAG DISPOSAL AREA, CHEMICAL POND OR ASH POND CLOSURES. IF EQUIPMENT OR MATERIAL HAULING CAUSES DAMAGE, THE DAMAGE MUST BE IMMEDIATELY REPAIRED BY THE CONTRACTOR, AND THE METHODS FOR HAULING MUST BE ALTERED TO PREVENT FURTHER DAMAGE. THE CONTRACTOR SHALL NOT MAKE ANY UNPLANNED EXCAVATIONS WITHOUT THE APPROVAL OF THE OWNER AND THE ENGINEER. DURING CONSTRUCTION THE CONTRACTOR IS RESPONSIBLE FOR PRECAUTIONS REQUIRED TO PROTECT THE INTEGRITY OF THE CLOSURES SYSTEMS AND RELATED STORMWATER CONVEYANCE.

5.2. HEAVY EQUIPMENT USAGE OVER THE NUCLEAR INTAKE/DISCHARGE PIPES IS STRICTLY PROHIBITED. THE NUCLEAR INTAKE/DISCHARGE PIPES CORRIDOR SHALL BE CLEARLY DELINEATED ADJACENT TO THE PROPOSED WORK AREAS AND PROTECTED FROM EQUIPMENT ACCESS AT ALL TIMES.

5.3. THE SCOPE DESCRIBED HEREIN INVOLVES WORK IN THE VICINITY OF EXISTING OVERHEAD HIGH-VOLTAGE LINES AND MEDIUM VOLTAGE LINE (UNDERGROUND AND OVERHEAD). PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL COORDINATE WITH TVA REGARDING THE CONSTRAINTS, CLEARANCE REQUIREMENTS, AND RESTRICTIONS ASSOCIATED WITH WORK IN THE VICINITY OF THESE FEATURES.

5.4. THE CONTRACTOR SHALL TAKE EVERY PRECAUTION TO AVOID OIL EXCURSIONS DURING CONSTRUCTION. THE CONTRACTOR SHALL HAVE OIL CONTROL EQUIPMENT (ABSORBENT BOOMS, ETC) ON SITE AT ALL TIMES. IF OIL IS RELEASED OR OBSERVED DURING CONSTRUCTION, THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE OWNER AND DEPLOY OIL CONTROL EQUIPMENT. THE CONTRACTOR SHALL COORDINATE WITH THE ENGINEER AND THE OWNER ON OIL CLEANUP, AS NECESSARY.

5.5. THE CONTRACTOR SHALL INSTALL, MAINTAIN AND INSPECT SILT FENCES, WATTLES AND OTHER EROSION CONTROL FEATURES AS REQUIRED. EROSION CONTROL FEATURES MUST BE INSTALLED PRIOR TO BEGINNING ANY EARTHMOVING ACTIVITIES. EROSION PROTECTION MUST BE PER THE STORM WATER POLLUTION PREVENTION PLAN (SWPPP).

5.6. MAINTENANCE OF PERIMETER ACCESS ROAD SHALL BE COORDINATED WITH TVA.

5.7. THE OUTLET FOR STORMWATER RUNOFF FROM THE SLAG DISPOSAL AREA INCLUDES TWO DISCHARGES WITH TENNESSEE MULTI-SECTOR PERMITS (TMSPS); ONE TO THE SOUTH AT THE ASH POND SPILLWAY STRUCTURE, AND ONE TO THE NORTH, AT THE NORTH STORMWATER DETENTION POND. DURING CONSTRUCTION, THE PROPOSED IMPROVEMENTS MAY CAUSE CHANGES IN PERMITTED EFFLUENT CHARACTERISTICS. THE CONTRACTOR SHALL EXERCISE EVERY REASONABLE PRECAUTION AT ALL TIMES TO PREVENT WATER POLLUTION. THE OWNER WILL MONITOR WATER QUALITY AT THE DISCHARGE POINTS THROUGHOUT CONSTRUCTION. THE CONTRACTOR MAY NEED TO ADJUST CONSTRUCTION PRACTICES IF WATER QUALITY ISSUES ARISE. THE CONTRACTOR SHALL COORDINATE WITH THE OWNER REGARDING THE NEED FOR CHANGES IN CONSTRUCTION PRACTICES BASED ON WATER QUALITY OBSERVATIONS.

5.8. THE CONTRACTOR SHALL COORDINATE WITH THE OWNER TO DETERMINE THE LOCATION OF STAGING AREAS FOR EQUIPMENT OR MATERIAL STORAGE AND FOR OTHER CONSTRUCTION LAY DOWN ACTIVITY.

5.9. WHENEVER REFERENCE IS MADE TO TENNESSEE DEPARTMENT OF TRANSPORTATION (TDOT) STANDARD SPECIFICATIONS, AMERICAN CONCRETE INSTITUTE (ACI), AMERICAN WATER WORKS ASSOCIATION (AWWA), AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM) AND OTHER PUBLISHED STANDARDS OR SPECIFICATIONS, IT MUST MEAN THE LATEST VERSION IN ITS ENTIRETY.

5.10. THE CONTRACTOR SHALL SECURE THE LATEST EDITION OF TDOT STANDARD SPECIFICATIONS PRIOR TO PERFORMING WORK THAT IS PRESCRIBED HEREIN. COPIES MAY BE OBTAINED FROM

TENNESSEE DEPARTMENT OF TRANSPORTATION
CONSTRUCTION DIVISION
505 DEADERICK STREET, SUITE 700
NASHVILLE, TN 37243-0326
PHONE: 615-741-2414
WEB: WWW.TDOT.STATE.TN.US/CONSTRUCTION/2015_SPEC_BOOK/

5.11. HORIZONTAL AND VERTICAL SURVEY CONTROL POINTS FOR CONSTRUCTION STAKING MUST BE THE RESPONSIBILITY OF THE OWNER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL SURVEYING AND STAKING NECESSARY FOR LAYOUT AND CONSTRUCTION OF THE PROJECT.

5.12. ACCEPTABLE CONSTRUCTION TOLERANCES FROM PLAN DIMENSIONS, ELEVATIONS, AND GRADES SHALL BE AS SPECIFIED IN THE CQA PLAN.

5.13. THE CONTRACTOR SHALL MAKE NO DEVIATIONS FROM THE PLANS, ASSOCIATED SPECIFICATIONS, OR APPROVED SHOP DRAWINGS WITHOUT PRIOR APPROVAL FROM THE ENGINEER. THE CONTRACTOR SHALL KEEP A RECORD PLAN SET NOTING ALL DEVIATIONS IN LOCATION OR ELEVATION OF ANY INSTALLATION FROM THAT SHOWN ON THE PLANS, AND ANY DEVIATIONS IN INSTALLATIONS FROM APPROVED SHOP DRAWINGS. AT COMPLETION OF THE PROJECT A PLAN SET OF FINAL RECORD DRAWINGS SHALL BE PREPARED BY THE ENGINEER. THE CONTRACTOR SHALL COOPERATE FULLY AND ASSIST WITH PREPARATION OF THE FINAL RECORD DRAWINGS.

5.14. THE SLAG DISPOSAL AREA IS A PERMITTED CLOSED ASH DISPOSAL FACILITY. FINAL GRADES WITHIN THE CLOSURE LIMITS MUST NOT BE MODIFIED BY MORE THAN ONE (1) FOOT, PLUS OR MINUS, UNLESS APPROVED BY THE ENGINEER.

6. CLEARING AND GRUBBING

6.1. THIS WORK MUST BE DONE IN ACCORDANCE WITH THE LATEST EDITION OF THE TENNESSEE DEPARTMENT OF TRANSPORTATION'S STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION, SECTION 201, AND WITH THE ADDITIONAL NOTES PROVIDED HEREIN. PAYMENT FOR CLEARING AND GRUBBING WILL INCLUDE ALL LABOR, MATERIALS, EQUIPMENT, AND INCIDENTAL ITEMS NECESSARY TO COMPLETE THE WORK.

6.2. AREAS WHICH WILL BE EXCAVATED AND/OR FILLED SHALL BE CLEARED OF TREES. TREES, STUMPS, OR OTHER PROTRUDING OBSTRUCTIONS SHOULD BE CUT TO WITHIN 6 INCHES OF EXISTING GROUND, OR AS DIRECTED BY THE ENGINEER. CLEARED MATERIALS MAY REMAIN WITHIN DESIGNATED AREA OF PROPOSED FILL PLACEMENT. SALVAGEABLE MATERIALS, IF ANY, MUST BE CAREFULLY REMOVED AND PLACED IN STORAGE ON THE OWNER'S PROPERTY, AS DIRECTED BY THE ENGINEER.

6.3. WITH THE PROPOSED DITCH RELOCATION, EXCAVATED AREAS MUST BE CLEARED OF TREES, STUMPS, BRUSH, PROJECTING ROOTS, WEEDS, LOGS AND OTHER PROTRUDING OBSTRUCTIONS. THIS AREA MUST BE GRUBBED TO A DEPTH OF 6 INCHES TO REMOVE GRASS, ROOTS AND OTHER ORGANIC MATERIAL.

6.4. EXCEPT FOR STRIPPED TOPSOIL AND OTHER MATERIALS INDICATED TO BE STOCKPILED OR OTHERWISE REMAIN ON OWNER'S PROPERTY, CLEARED MATERIALS WILL BECOME THE CONTRACTOR'S PROPERTY AND MUST BE REMOVED FROM PROJECT SITE.

6.5. SUBMITTALS FOR THIS WORK MUST INCLUDE DOCUMENTATION OF EXISTING TREES/FORESTED AREAS TO BE CLEARED, ADJOINING CONSTRUCTION, AND EXISTING SITE IMPROVEMENTS THAT MAY BE AFFECTED BY CLEARING AND GRUBBING OPERATIONS. USE NOTATION ON PLANS, AND SUFFICIENTLY DETAILED PHOTOGRAPHS AS NECESSARY.

6.6. CLEARING AND GRUBBING OPERATIONS MUST NOT COMMENCE UNTIL NECESSARY EROSION AND SEDIMENTATION CONTROL MEASURES ARE IN PLACE.

7. EARTHWORK NOTES

7.1. ALL EXCAVATIONS MUST BE SLOPED, BENCHED, OR SHORED TO PERMIT SAFE WORKING CONDITIONS PER OSHA REQUIREMENTS FOR PROTECTIVE SYSTEMS (29 CFR 1926.652). ALL EXCAVATED MATERIALS MUST BE CONSIDERED OSHA TYPE C MATERIALS UNLESS OTHERWISE DETERMINED BY A COMPETENT PERSON.

7.2. ANY MISCELLANEOUS EXCAVATIONS GREATER THAN 4 FT IN DEPTH THAT WILL REMAIN OPEN FOR A PERIOD OF GREATER THAN 1 WEEK MUST BE SLOPED NO STEEPER THAN 2H:1V, UNLESS OTHERWISE ALLOWED BY THE ENGINEER.

7.3. THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING DRAINAGE WAYS, SUMP PITS AND PUMPS, OR OTHER METHODS AND PRACTICES TO KEEP EXCAVATIONS IN A DRAINED CONDITION AT ALL TIMES. SURFACES ABOVE EXCAVATIONS MUST BE GRADED OR PROTECTED SUCH THAT SURFACE RUNOFF IS DIRECTED AWAY FROM OPEN EXCAVATIONS.

7.4. ENGINEERED AND GENERAL FILL MATERIALS: UNLESS OTHERWISE INDICATED, SOIL MATERIALS TO BE PLACED AS FILL MUST CONSIST OF CLAY SOILS THAT EXHIBIT A CLASSIFICATION OF CL, CL-ML, OR CH IN ACCORDANCE WITH ASTM D-2487. IMPORTED CLAY FILL CLASSIFIED AS CH MUST HAVE A LIQUID LIMIT LESS THAN OR EQUAL TO 65, AND PLASTICITY INDEX LESS THAN OR EQUAL TO 40. THE MATERIAL MUST BE FREE OF FROZEN MATERIAL, ORGANIC MATTER, TOPSOIL, RUBBISH, DEBRIS, WASTE MATERIALS, AND ROCK PIECES GREATER THAN 3 INCHES (MAXIMUM DIMENSION) IN SIZE, AND MUST BE AT A MOISTURE CONTENT THAT IS SUITABLE FOR ACCEPTABLE COMPACTION, AS REQUIRED HEREIN. EXISTING CLAY SOILS REMOVED FROM THE EXCAVATIONS MAY BE REUSED AS FILL, TO THE EXTENT THAT THEY MEET THE REQUIREMENTS GIVEN HEREIN.

7.5. UTILIZE A BRIDGE LIFT OVER THE EXISTING SURFACE OF SOFT, WET AREAS ADJACENT TO THE EXISTING COVER SYSTEM TO SUPPORT CONSTRUCTION EQUIPMENT AND OVERLYING FILL PLACEMENT. THE BRIDGE LIFT MAY CONSIST OF GENERAL FILL OR OTHER MATERIALS SUFFICIENTLY DRY TO PERFORM AS A BRIDGE LIFT. THE BRIDGE LIFT THICKNESS SHOULD RANGE BETWEEN 3 AND 4 FT. PLACEMENT OF THE BRIDGE LIFT SHALL BE VISUALLY MONITORED BY THE ENGINEER.

IN THE EVENT EXISTING SURFACES ARE TOO SOFT TO SUPPORT THE BRIDGE LIFT, STABILIZE EXISTING MATERIALS BY SUFFICIENTLY ADDING AND MIXING CEMENT, FLY ASH, LIME AND/OR KILN DUST. PRIOR TO UNDERTAKING THE AFOREMENTIONED STABILIZATION WORK, THE CONTRACTOR SHALL DEVELOP AND SUBMIT A STABILIZATION PLAN FOR OWNER AND ENGINEER APPROVAL.

7.6. NEW FILL MATERIAL MUST NOT BE PLACED ON UNSUITABLE SUBGRADES (EXISTING SURFACES, EXCAVATED FOUNDATION SOILS, FROZEN SURFACES OR PREVIOUSLY PLACED FILL LAYERS). UNSUITABLE SUBGRADES, AS DETERMINED BY PROOF-ROLLING OR OBSERVATION BY THE ENGINEER, MUST BE REWORKED OR REPLACED TO THE SATISFACTION OF THE ENGINEER, PRIOR TO PLACEMENT OF ADDITIONAL FILL. THE CONTRACTOR SHALL KEEP SUBGRADE SOILS FREE FROM WATER OR UNACCEPTABLE MATERIALS AFTER FILL OPERATIONS HAVE STARTED.

7.7. PRIOR TO PLACING FILL AGAINST EXISTING EMBANKMENTS, OR TIE-INS TO THE EXISTING COVER SYSTEM, THE BOTTOM MUST BE BENCHED LEVEL TO PROVIDE A LEVEL SURFACE TO BEGIN THE FILLING ACTIVITIES. SLOPING SURFACES STEEPER THAN 5H:1V AGAINST WHICH FILL MATERIAL WILL BE PLACED MUST BE BENCHED TO ENHANCE BONDING OF THE FILL TO THE EXCAVATION FACE.

7.8. COMPACTION REQUIREMENTS:
- 7.8.1. ALL FILL MATERIALS MUST BE PLACED AND SPREAD IN LOOSE LIFTS THAT DO NOT EXCEED 8 INCHES IN THICKNESS (THICKNESS REQUIREMENTS DO NOT APPLY TO THE BRIDGE LIFT). EACH LIFT MUST BE THOROUGHLY COMPACTED AS FOLLOWS (COMPACTION DENSITIES ARE REFERENCED TO ASTM D-698):
  - 7.8.1.1. ENGINEERED FILL, 98% OF MAXIMUM DRY DENSITY AND MOISTURE CONTENT WITHIN A RANGE OF -2 TO +3 PERCENT OF THE OPTIMUM MOISTURE CONTENT;
  - 7.8.1.2. GENERAL FILL, 90% OF MAXIMUM DRY DENSITY AND MOISTURE CONTENT WITHIN A RANGE OF -2 TO +3 PERCENT OF THE OPTIMUM MOISTURE CONTENT;
  - 7.8.1.3. BRIDGE LIFT (TOP SURFACE), 85% OF MAXIMUM DRY DENSITY AND MOISTURE CONTENT WITHIN A RANGE OF -4 TO +1 PERCENT OF THE OPTIMUM MOISTURE CONTENT.
- 7.8.2. THE CONTRACTOR SHALL SUBMIT SAMPLES TO THE ENGINEER TO PERFORM PROCTOR TESTING IN ACCORDANCE WITH THE PROJECT CQA PLAN PRIOR TO BEGINNING ANY COMPACTION ACTIVITIES.
- 7.8.3. COMPACTION TESTS, BY THE ENGINEER, WILL BE PERFORMED ON EACH LIFT TO VERIFY THAT SPECIFIED LEVELS OF COMPACTION ARE ACHIEVED.
- 7.8.4. DO NOT PLACE OR COMPACT FILL IN A FROZEN CONDITION OR ON TOP OF FROZEN MATERIAL.

7.9. MATERIAL THAT IS PLACED ADJACENT TO AND LESS THAN 3 FEET ABOVE THE TOP OF CULVERT PIPES MUST BE COMPACTED USING LIGHTWEIGHT COMPACTORS. COMPACTION OF FILLS WITHIN 5 FT OF ANY STRUCTURE (WALLS, SLABS, ETC) MUST BE PERFORMED WITH LIGHTWEIGHT COMPACTION EQUIPMENT. LIGHTWEIGHT COMPACTION EQUIPMENT IS DEFINED HEREIN AS COMPACTION EQUIPMENT OPERATED BY HAND OR REMOTE CONTROL.

7.10. TOPSOIL: PROVIDE A NATURAL, FRIABLE, FERTILE, FINE SANDY LOAM POSSESSING THE CHARACTERISTICS OF REPRESENTATIVE TOPSOILS IN THE VICINITY THAT PRODUCES HEAVY GROWTHS OF VEGETATION. THE TOPSOIL SHALL BE FREE FROM SUBSOIL, NOXIOUS WEEDS, STONES LARGER THAN 1 INCH IN DIAMETER, LIME, CEMENT, ASHES, SLAG, AND OTHER DELETERIOUS MATTER. TOPSOIL SHALL BE WELL DRAINED IN ITS ORIGINAL POSITION AND FREE FROM TOXIC QUANTITIES OF ACID OR ALKALINE ELEMENTS.

7.11. EXISTING TOPSOIL, MEETING THE REQUIREMENTS GIVEN HEREIN, SHALL BE REMOVED AND STOCKPILED FOR REUSE.

7.12. PRIOR TO PLACING TOPSOIL, MOW CURRENTLY VEGETATED SURFACES TO THE LOWEST PRACTICAL LIMIT (MAXIMUM 3 INCHES HIGH) BY TYPICAL MOWING EQUIPMENT. ACCUMULATED CUT GRASS SHALL BE REMOVED OR RAKED FROM THE LIMITS OF CONSTRUCTION, IF NECESSARY.

7.13. PLACE A 5 TO 6-INCH LAYER OF TOPSOIL ON ALL AREAS REQUIRING SEEDING OR SOD. PLACE TOPSOIL WITH LOW GROUND PRESSURE EQUIPMENT TO MINIMIZE DAMAGE TO UNDERLYING COVER SYSTEM; AREAS OF TOPSOIL THAT BECOME COMPACT SHALL BE DISKED OR OTHERWISE LOOSENED/PREPARED TO FACILITATE SEEDING. UPON COMPLETION, TOPSOIL SURFACE SHALL BE UNIFORM AND SMOOTH, SHAPED WITHIN REASONABLY CLOSE CONFORMITY TO THE SPECIFIED LINES, GRADES, AND CROSS-SECTIONS.

7.14. PROOF ROLLING:
- 7.14.1. EXPOSE SUBGRADE THAT IS TO BE PROOF-ROLLED.
- 7.14.2. PROOF-ROLL EXPOSED SUBGRADE WITH A MINIMUM OF 3 OVERLAPPING PASSES IN THE PRESENCE OF THE ENGINEER. PROOF-ROLL WITH A FULLY LOADED HAUL TRUCK OR OTHER EQUIPMENT DEEMED APPROPRIATE BY THE ENGINEER.
- 7.14.3. IF SUBGRADE IS REJECTED BY THE ENGINEER, UNDERCUT TO DEPTH SHOWN ON DETAIL (OR AS DIRECTED BY THE ENGINEER) AND REPLACE WITH COMPACTED ENGINEERED FILL. RE-PROOF-ROLL THE SUBGRADE; IF THE ENGINEER VERIFIES COMPETENT SUBGRADE, CONSTRUCT THE SECTION AS DEPICTED. THE CONTRACTOR SHALL REPEAT PROCESS UNTIL COMPETENT SUBGRADE IS ACHIEVED.

7.15. STOCKPILING
- 7.15.1. THE CONTRACTOR MAY TEMPORARILY STOCKPILE MATERIALS WITHIN DESIGNATED AREAS OR OTHER AREAS APPROVED BY THE OWNER. PRIOR TO STOCKPILING, THE APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MUST BE IN PLACE. STOCKPILING ALONG SLOPE OR EMBANKMENT CRESTS WILL NOT BE ALLOWED.
- 7.15.2. THE CONTRACTOR SHALL USE EQUIPMENT AND METHODS AS NECESSARY TO MAINTAIN THE MOISTURE CONTENTS OF STOCKPILED MATERIALS (EXCLUDING TOPSOIL) AT OR NEAR THEIR OPTIMUM MOISTURE CONTENT.
- 7.15.3. STOCKPILES SHOULD BE PROPERLY SLOPED AND THE SURFACES SEALED BY THE CONTRACTOR AT THE END OF EACH WORKING DAY, OR DURING THE DAY IN THE EVENT OF HEAVY RAIN, TO THE SATISFACTION OF THE ENGINEER.
- 7.15.4. CARE SHALL BE EXERCISED IF STOCKPILING WITHIN SLAG DISPOSAL AREA LIMITS TO PROTECT EXISTING CLAY CAP.

8. AGGREGATE AND RIPRAP

8.1. AGGREGATE AND RIPRAP MATERIALS TO BE USED FOR CONSTRUCTION OF THE LINED DITCHES, INLET/OUTLET EROSION PROTECTION, BACKFILL, TEMPORARY AND PERMANENT ACCESS ROADS, ETC. SHALL CONSIST OF CRUSHED LIMESTONE AGGREGATES, CONFORMING TO THE TENNESSEE DEPARTMENT OF TRANSPORTATION'S STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION, SECTIONS 401 AND 709, AND THE ADDITIONAL NOTES PROVIDED HEREIN.

8.2. AGGREGATE GRADATION:
- 8.2.1. AASHTO NO. 57 COURSE AGGREGATE MEETING THE SIZE REQUIREMENTS OF TDOT SECTION 903.22.
- 8.2.2. TEMPORARY/PERMANENT ACCESS ROADS & 6-INCH CHOKE LAYER: TDOT TYPE A, GRADING D MINERAL AGGREGATE SURFACE COURSE AS INDICATED ON TABLE 903.05-2.

8.3. TDOT CLASS A-1 AND A-3 RIPRAP MUST BE PLACED BY MECHANICAL MEANS USING AN EXCAVATOR OR LOADER. THE MAXIMUM ALLOWABLE DROP HEIGHT FOR RIPRAP PLACEMENT IS 2 FEET (1 FT WHEN DROPPING DIRECTLY ONTO A GEOTEXTILE). THE ROCK MUST BE PLACED TO THE DEPTHS AND EXTENTS SHOWN IN THE DRAWINGS. THE SURFACE OF THE RIPRAP, UPON COMPLETION, MUST BE GRADED AS PRACTICABLE INTO FINAL POSITION TO ENSURE PROPER THICKNESS AND A UNIFORM SURFACE. LARGER ROCKS MUST BE UNIFORMLY DISTRIBUTED WITH THE SMALL ROCKS AND SPALLS FILLING THE VOIDS BETWEEN THE LARGER ROCKS.

9. STRUCTURAL GENERAL NOTES

9.1. IT IS SOLELY THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE ERECTION PROCEDURES AND SEQUENCES TO ENSURE THE SAFETY OF THE STRUCTURE, ITS COMPONENT PARTS, AND WORKERS AND EQUIPMENT DURING ERECTION. THIS INCLUDES, BUT IS NOT LIMITED TO, THE ADDITION OF WHATEVER TEMPORARY BRACING, GUYS OR TIE-DOWNS THAT MAY BE NECESSARY. SUCH MATERIAL MUST BE REMOVED AND MUST REMAIN THE PROPERTY OF THE CONTRACTOR AFTER COMPLETION OF THE PROJECT.

9.2. ALL DIMENSIONS AND ELEVATIONS SHOWN ON THE STRUCTURAL DRAWINGS MUST BE VERIFIED BY THE CONTRACTOR AND MUST CONFORM TO THOSE SHOWN ON THE CIVIL DRAWINGS. COORDINATE STRUCTURAL DRAWINGS WITH ALL OTHER DRAWINGS FOR CLEARANCES, ATTACHMENTS, ETC.

9.3. ANY CHANGES TO THE STRUCTURAL SYSTEMS MUST BE REDESIGNED BY A PROFESSIONAL ENGINEER AND MUST BE SUBMITTED TO THE ENGINEER FOR REVIEW AND APPROVAL. SUBMITTAL MUST BE ACKNOWLEDGED IN WRITING BEFORE BEGINNING CONSTRUCTION. IF CHANGES ARE MADE WITHOUT WRITTEN APPROVAL SUCH CHANGES WILL BE THE LEGAL AND FINANCIAL RESPONSIBILITY OF THE PARTY MAKING THE CHANGE.

9.4. STRUCTURAL DESIGN SHOWN ON THESE PLANS DOES NOT INCLUDE CONSTRUCTION LOADINGS. THE CONTRACTOR SHALL SUBMIT SURCHARGE LOAD INFORMATION TO THE ENGINEER FOR REVIEW, AT LEAST 14 WORKING DAYS PRIOR TO THE PLACEMENT OF THE SURCHARGE LOAD.

9.5. DETAIL, FABRICATE AND ERECT STRUCTURAL STEEL IN ACCORDANCE WITH THE LATEST AISC MANUAL OF STEEL CONSTRUCTION (ASD), AWS D1.1, EXCEPT AS EXPLICITLY MODIFIED HEREIN.

9.6. ALL STEEL EXPOSED TO THE EXTERIOR MUST BE HOT DIP GALVANIZED PER ASTM A123, UNLESS OTHERWISE NOTED.

9.7. ALL STEEL USED FOR CONSTRUCTION OF THE STEEL BULKHEAD SHALL CONFORM TO THE MATERIAL GRADES AS FOLLOWS:
- 9.7.1. HSS STRUCTURAL TUBES: ASTM A 500 GRADE B
- 9.7.2. STEEL BULKHEAD PLATE: ASTM A36
- 9.7.3. STEEL ANGLES: ASTM A36
- 9.7.4. STEEL EPOXY ANCHOR BOLTS: ASTM A36 THREADED ROD WITH HILTI HIT-HY 150 MAX-SD ADHESIVE

9.8. WELDING:
- 9.8.1. PREPARATION OF BASE METAL PRIOR TO WELDING MUST BE PERFORMED IN ACCORDANCE WITH AWS D1.1.
- 9.8.2. ALL WELDING MUST BE DONE BY THE SHIELDED METAL ARC WELDING (SMAW) PROCESS.
- 9.8.3. WELDING OPERATORS MUST BE QUALIFIED IN ACCORDANCE WITH AWS STANDARD QUALIFICATION PROCEDURES. CERTIFICATIONS SHOWING THAT WELDERS EMPLOYED IN THE WORK HAVE SATISFACTORILY PASSED AWS QUALIFICATION TEST WITHIN THE PREVIOUS 12 MONTHS MUST BE PROVIDED PRIOR TO BEGINNING SUCH WORK.
- 9.8.4. ALL WELDING ELECTRODES SHOULD CONFORM TO A WELD MATERIAL GRADE OF E70XX.
- 9.8.5. NO FIELD WELDING OF THE STEEL BULKHEAD WILL BE ALLOWED. ALL WELDING OF THE STEEL BULKHEAD MUST BE PERFORMED PRIOR TO ATTACHMENT OF THE NEOPRENE GASKET.

10. SUBMITTALS

REFER TO CQA PLAN FOR SUBMITTALS TABLE.

11. CONTROLLED LOW STRENGTH MATERIAL (CLSM)

11.1. CLSM/FLOWABLE FILL MEETING THE REQUIREMENTS HEREIN SHALL BE PLACED AT THE LOCATIONS AND DIMENSIONS DESCRIBED IN THIS WORK PLAN.

11.2. CLSM/FLOWABLE FILL MATERIAL SHALL BE A SELF-LEVELING AND SELF-COMPACTING, UNIFORM CEMENTIOUS MATERIAL MEETING THE REQUIREMENTS OF THE TDOT STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION, SECTION 204.06.B.

11.3. CONTRACTOR SHALL SUBMIT SOURCES AND A MIX DESIGN SHOWING PROPORTIONS OF CLSM INGREDIENTS PRIOR TO PLACEMENT. THE CONTRACTOR SHALL ALSO SUBMIT APPROPRIATE LABORATORY AND FIELD TEST DATA, DOCUMENTING COMPLIANCE TO THE SPECIFIED MATERIAL AND/OR PERFORMANCE PROPERTIES.

11.4. CLSM BEDDING SHALL EXTEND 8-INCHES BELOW THE PIPE, AND SHALL BE ALLOWED TO CURE 16 HOURS PRIOR TO DISTURBING OR SUBJECTING LOADS.

11.5. AFTER CLSM BEDDING HAS CURED, PIPES WILL BE ANCHORED TO THE FOUNDATION TO REDUCE UPLIFT FORCES ACTING ON THE PIPE BY THE REMAINDER OF THE CLSM BACKFILL.

11.6. THE REMAINDER OF THE TRENCH WILL BE BACKFILLED WITH CLSM/FLOWABLE FILL, AND SHALL BE ALLOWED TO CURE 16 HOURS PRIOR TO DISTURBING OR SUBJECTING LOADS.

11.7. FLOWABLE FILL MEETING THE REQUIREMENTS HEREIN MUST BE PLACED AT THE LOCATIONS AND DIMENSIONS DESCRIBED IN THESE PLANS. MUDMATS POURED FOR FOUNDATIONS WILL BE CONSIDERED FLOWABLE FILL.

12. PIPE ABANDONMENT – CLEANING AND INSPECTION

12.1. THE ABANDONED PIPES SHALL BE INSPECTED WITH A CLOSED-CIRCUIT TELEVISION (CCTV) CAMERA SURVEY PRIOR TO GROUTING ACTIVITIES. THE SURVEY SHALL DETERMINE THE OPEN EXTENTS, STRUCTURAL CONDITIONS, AND PRESENCE OF DEBRIS WITHIN THE PIPE. THE PIPES SHALL BE CLEANED AS DIRECTED BY THE OWNER AND ENGINEER. THE ENGINEER OR A REPRESENTATIVE OF THE ENGINEER SHALL BE PRESENT DURING THE CCTV SURVEY AND VIEW THE LIVE VIDEO FEED.

12.2. THE ENDWALL SHALL BE THOROUGHLY CLEANED EXTERNALLY TO ENSURE A GOOD SEAL WITH THE STEEL BULKHEAD PLATE. THE EFFECTIVENESS OF THE CLEANING SHALL BE VERIFIED BY THE ENGINEER. IT IS ANTICIPATED THAT CLEANING CAN BE PERFORMED USING A PRESSURE WASHER OR SCRUBBING.

13. GROUT FOR PIPE ABANDONMENT

13.1. AT LEAST 20 DAYS PRIOR TO THE START OF THE GROUTING OPERATION, THE CONTRACTOR SHALL SUBMIT A GROUTING PLAN TO THE ENGINEER FOR REVIEW. THE PLAN SHALL INCLUDE THE EQUIPMENT AND PROCEDURE/METHOD THAT THE CONTRACTOR PROPOSES FOR THE WORK. THE PLAN SHALL ALSO INCLUDE THE CONTRACTOR'S PROPOSED GROUT MIX DESIGN (MATERIALS, PROPORTIONS, ADMIXTURES, ETC.), INITIAL SET TIME FOR THE GROUT, MAXIMUM INJECTION PRESSURES, 24 HOUR AND 28 DAY MINIMUM COMPRESSIVE STRENGTH, AND PRESSURE GAUGE CERTIFICATION.

13.2. THE GROUT MIX SHALL BE DETERMINED BY THE CONTRACTOR. GROUT MAY BE COMPOSED OF PORTLAND CEMENT, FINE AGGREGATE (SAND), WATER, AND ADMIXTURES TO PROVIDE FLUIDITY, RETARD SETTING TIME, AND PREVENT SHRINKAGE. THE DESIGN OF THE GROUT MIXTURE SHALL BE BASED ON A WATER-CEMENT RATIO NECESSARY TO SECURE (1) A PLASTIC FLOWABLE MIXTURE SUITABLE FOR THE SPECIFIC CONDITION OF PLACEMENT, (2) PROVIDE LESS THAN ONE-HALF PERCENT SHRINKAGE, AND (3) RETARD THE SETTING TIME TO AT LEAST THE TIME REQUIRED BY THE CONTRACTOR TO COMPLETE FILLING OF THE PIPE IN A SINGLE UNINTERRUPTED OPERATION. ADDITIONALLY, THE GROUT MIXTURE SHALL BE DESIGNED SO THAT IT WILL PRODUCE A MINIMUM LABORATORY COMPRESSIVE STRENGTH OF 1000 PSI AT 28 DAYS. PRIOR TO BEGINNING WORK, THE GROUT MIX DESIGN SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL.

13.3. PORTLAND CEMENT SHALL MEET THE REQUIREMENTS OF ASTM C-150 TYPE I CEMENT. CEMENT SHALL BE PROPERLY STORED AND PROTECTED FROM WEATHER, DAMPNESS, OR OTHER DESTRUCTIVE AGENTS. ANY CEMENT WHICH IS DAMAGED WILL BE REJECTED AND NOT PERMITTED TO BE USED IN THE WORK. PORTLAND CEMENT SHALL BE SUBJECT TO SAMPLING AND TESTING IN ACCORDANCE WITH ASTM C-150.

13.4. SAND SHALL MEET THE REQUIREMENTS OF TDOT. IT SHALL BE UNIFORMLY GRADED AND 100% SHALL PASS THE NO. 8 SIEVE.

13.5. WATER FOR MIXING GROUT SHALL BE POTABLE WATER IN ACCORDANCE WITH ASTM C-94.

13.6. THE MATERIALS SHALL BE MIXED AND DELIVERED TO THE JOBSITE IN EQUIPMENT OF SUFFICIENT SIZE AND CAPACITY TO PROVIDE GROUT MATERIAL FOR EACH PIPE TO COMPLETELY FILL IN A SINGLE OPERATION. THE CONTRACTOR SHALL PROVIDE A STAND-BY GROUT PUMP, DEWATERING PUMP, AND HOSES FOR 100 PERCENT BACKUP CAPACITY TO ENSURE AN UNINTERRUPTED PIPE GROUTING OPERATION ONCE GROUT PLACEMENT BEGINS.

13.7. GROUT SHALL BE INJECTED THROUGH THE PRIMARY PORT, WHICH DISCHARGES INTO THE PIPE AT THE BULKHEAD. IN THIS MANNER GROUT WILL FILL THE LOWER END OF THE PIPE FIRST AND DISPLACE AIR/SEEPAGE WATER IN AN UPSTREAM DIRECTION. GROUT INJECTION SHALL BE TERMINATED WHEN THE GROUT FILLS THE OPEN EXTENTS OF PIPE TO BE ABANDONED, AS DETERMINED BY THE CCTV INSPECTION.

13.8. THE CONTRACTOR SHALL MONITOR THE SLOPES AROUND AND ABOVE THE PIPE AND BE ALERT FOR GROUND HEAVE. IF GROUND HEAVE IS NOTED, GROUT INJECTION SHALL BE HALTED.

13.9. THE CONTRACTOR SHALL RECORD THE GROUT TAKE FOR EACH PIPE AND REPORT RESULTS TO THE ENGINEER.

14. CAST-IN-PLACE CONCRETE (NON-STRUCTURAL)

14.1. CAST-IN-PLACE CONCRETE WORK MUST CONFORM TO THE AMERICAN CONCRETE INSTITUTE CODES AND STANDARDS. ACI 301-96 "STANDARD SPECIFICATIONS FOR STRUCTURAL CONCRETE" IS HEREBY MADE A PART OF THESE DRAWINGS. ALL CONCRETE CONSTRUCTION MUST CONFORM TO ACI 301-96, EXCEPT AS EXPLICITLY MODIFIED HEREIN.

14.2. ALL CONCRETE WORK MUST BE IN ACCORDANCE WITH ACI 318-11, "THE BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE".

14.3. ALL CONCRETE MUST HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI AT 28 DAYS.

14.4. ALL CONCRETE PERMANENTLY EXPOSED TO THE WEATHER MUST CONTAIN AN ADMIXTURE CONFORMING WITH ASTM C260. THE AMOUNT OF ENTRAINED AIR SHALL BE 2% TO 5%.

14.5. SLUMP OF CONCRETE AT THE POINT OF PLACEMENT MUST BE 4" +/- 1", UNLESS AN APPROVED PLASTICIZING AGENT IS ADDED AT THE PLANT. CONCRETE MIXES WITH PLASTICIZING AGENTS MUST HAVE SLUMP NOT EXCEEDING 8-INCHES AT THE POINT OF PLACEMENT.

14.6. REINFORCING STEEL MUST BE GRADE 60, CONFORMING TO ASTM A615, A616, OR A617. TACK WELDING OF THE REINFORCING WILL NOT BE PERMITTED.

14.7. CALCIUM CHLORIDE WILL NOT BE PERMITTED NOR WILL ANY ADMIXTURE CONTAINING CALCIUM CHLORIDE BE PERMITTED.

14.8. ALL CONCRETE MUST CONTAIN A WATER REDUCING ADMIXTURE CONFORMING TO ASTM C494, TYPE A, F OR G.

14.9. ALUMINUM PIPE MUST NOT BE USED WITH CONCRETE PUMPS.

14.10. CONCRETE MUST BE DISCHARGED AT THE SITE WITHIN 1-1/2 HOURS AFTER WATER HAS BEEN ADDED TO THE CEMENT AND AGGREGATES. ADDITION OF WATER TO THE MIX AT THE PROJECT SITE WILL NOT BE ALLOWED. ALL WATER MUST BE ADDED AT THE BATCH PLANT.

14.11. CONCRETE MUST BE PLACED IN A SINGLE POUR AND ALL REINFORCEMENT MUST BE CONTINUOUS, UNLESS OTHERWISE SHOWN IN THE PLANS.

14.12. EXPOSED EDGES MUST BE CHAMFERED 3/4 INCH UNLESS OTHERWISE NOTED. EXPOSED, FORMED SURFACES MUST RECEIVE A CLASS A ORDINARY SURFACE FINISH, UNLESS OTHERWISE SHOWN IN THESE PLANS. EXPOSED, UN-FORMED (HORIZONTAL) SURFACES MUST RECEIVE A FLOAT FINISH.

14.13. NO CONCRETE WILL BE PLACED UNTIL THE BEARING SURFACE/SUBGRADE HAS BEEN APPROVED BY THE ENGINEER. UNSUITABLE BEARING SURFACES MUST BE UNDERCUT AND REPLACED OR OTHERWISE IMPROVED TO THE SATISFACTION OF THE ENGINEER.

14.14. ALL CONCRETE AND/OR STEEL REINFORCEMENT MUST BE HANDLED AND STORED IN SUCH MANNER AS TO AVOID DAMAGE OR CORROSION. IF CORROSION OR DAMAGE IS OBSERVED, REPLACEMENT MATERIALS MAY BE REQUIRED.

14.15. CONCRETE FIELD QUALITY CONTROL:
- 14.15.1. THE ENGINEER WILL PERFORM CONCRETE TESTING, WHICH WILL INCLUDE PREPARATION OF TEST CONCRETE CYLINDERS, SLUMP TESTS, TESTS FOR AIR CONTENT, AND STRENGTH TESTS IN ACCORDANCE WITH ASTM C39.
- 14.15.2. MINIMUM OF FOUR CYLINDERS WILL BE TAKEN FOR EACH 50 CUBIC YARDS OF CONCRETE OR FRACTION THEREOF OR PER STRUCTURE FOR EACH STRENGTH AND TYPE OF CONCRETE BEING CAST THAT DAY. THE CONTRACTOR WILL ASSIST THE ENGINEER IN PREPARATION OF CONCRETE CYLINDERS AS APPROPRIATE.
- 14.15.3. NO CONCRETE WILL BE PLACED THAT DOES NOT MEET SLUMP OR AIR CONTENT REQUIREMENTS. ALL TESTS FOR AIR CONTENT MUST BE MADE BY THE PRESSURE METHOD. SLUMP TESTS WILL BE TAKEN AT EACH 20 CUBIC YARDS OF CONCRETE BEING PLACED.
- 14.15.4. SLUMP EXCEEDING THE SPECIFIED MAXIMUM, WHEN OCCURRING IN 2 CONSECUTIVE TESTS MADE ON DIFFERENT PORTIONS OF THE SAME SAMPLE, WILL BE CAUSE FOR REJECTION OF THAT TRUCKLOAD.
- 14.15.5. CONCRETE NOT MEETING THE REQUIREMENTS GIVEN HEREIN MUST BE REMOVED AND REPLACED.

14.16. CONCRETE PROTECTION (COVER) FOR REINFORCEMENT BARS WILL BE AS FOLLOWS (UNLESS SHOWN OTHERWISE ON THE DRAWINGS):
3 INCH CLEAR, SURFACES IN CONTACT WITH SOIL
2 INCHES, ALL OTHER SURFACES

FOR SUPPORTING DESIGN CALCULATIONS SEE:
FPGWBFDEGCDX0003002015000007

MICHAEL MEULEMANS
No. 16952
5/8/15

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DISCIPLINE INTERFACE
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SCALE: NONE EXCEPT AS NOTED

GENERAL NOTES I

WATTS BAR SLAG DISPOSAL AREA MAINTENANCE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
ANR	ASL	JJH	MRM	JDM	MST	JCK

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 | DATE 05/08/15 | 14 | C | 10W426-02 | R 0

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TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

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14.17. ALL REINFORCING STEEL DEVELOPMENT LENGTHS FOR LAP SPLICES AND ANCHORAGE MUST CONFORM TO THE FOLLOWING. WHERE THESE REQUIREMENTS CANNOT BE MET, PROVIDE A STANDARD HOOK SUITABLE TO APPLICATION.

TOP BARS

SIZE	LAP	ANCHORAGE
#4	20"	15"
#5	29"	22"
#6	39"	30"
#7	64"	49"
#8	80"	62"
#9	97"	75"

14.18. WHERE SPLICES ARE SPECIFIED OR REQUIRED DURING CONSTRUCTION, ALL CONTINUOUS VERTICAL OR HORIZONTAL BARS IN WALLS, FOUNDATIONS, AND SLABS MUST BE LAP-SPLICED BY WIRING TOGETHER IN CONTACT, UNLESS OTHERWISE SHOWN.

14.19. ALL REINFORCING DETAILS MUST CONFORM TO "DETAILS AND DETAILING OF REINFORCEMENT" ACI 315, UNLESS DETAILED OTHERWISE IN THE DRAWINGS.

14.20. SUBMIT REINFORCING/CONCRETE PLACEMENT SHOP DRAWINGS FOR REVIEW PRIOR TO CONSTRUCTION.

14.21. FOUNDATIONS AND SLABS MUST BE WITHIN 0.1 FT OF THE SPECIFIED ELEVATIONS. ALL OTHER TOLERANCES MUST BE IN ACCORDANCE WITH ACI 301 CHAPTERS 4 AND 11 CLASS A, RESPECTIVELY.

14.22. PROVIDE ADEQUATE BOLSTERS, HI-CHAIRS, SUPPORT BARS, ETC. TO MAINTAIN SPECIFIED CLEARANCES FOR THE ENTIRE LENGTH OF ALL REINFORCING BARS.

14.23. FORM WORK FOR ALL CONCRETE WHICH WILL BE EXPOSED MUST BE CONSTRUCTED FROM METAL OR PLYWOOD WHICH WILL PRODUCE AN ACCEPTABLY SMOOTH SURFACE.

14.24. ALLOW 12 HOURS TO ELAPSE BETWEEN ADJACENT CONCRETE POURS.

15. SOLID WALL HDPE PIPE (PERMANENT)

15.1. PE3608 PIPE AND FITTING MATERIAL COMPOUND:
- 15.1.1. PE3608 MATERIAL COMPOUND MUST CONFORM TO MATERIAL REQUIREMENTS SPECIFIED IN ASTM D3261 AS APPLICABLE FOR THE PIPE OR FITTING. PE3608 MATERIAL MUST MEET THE REQUIREMENTS OF ASTM D3350 AND MUST MEET OR EXCEED A CELL CLASSIFICATION OF 345464 PER ASTM D3350.
- 15.1.2. PE3608 MATERIAL COMPOUND MUST HAVE A HYDROSTATIC DESIGN STRESS (HDS) RATING FOR WATER AT 73°F (23°C) OF NOT LESS THAN 800 PSI THAT MUST BE DOCUMENTED IN THE NAME OF THE MATERIAL MANUFACTURER IN PPI TR-4.
- 15.1.3. PE3608 MATERIAL COMPOUND MUST HAVE A HYDROSTATIC DESIGN BASIS (HDB) RATING AT 140°F (60°C) OF NOT LESS THAN 800 PSI THAT MUST BE DOCUMENTED IN THE NAME OF THE MATERIAL MANUFACTURER IN PPI TR-4.
- 15.1.4. PE3608 PIPE AND FITTING MATERIAL COMPOUND IN PE3608 PIPE AND FITTINGS MUST CONTAIN COLOR AND ULTRAVIOLET (UV) STABILIZER MEETING THE REQUIREMENTS OF CODE C OR E PER ASTM D3350. CODE C MATERIAL MUST CONTAIN 2 TO 3 PERCENT CARBON BLACK TO PROVIDE INDEFINITE PROTECTION AGAINST UV DEGRADATION WHEN MATERIAL FROM THE PIPE IS TESTED IN ACCORDANCE WITH ASTM D1603 OR ASTM D4218. CODE E MATERIAL USED FOR COEXTRUDED OD COLOR STRIPES OR A COEXTRUDED ID COLOR LAYER MUST CONTAIN SUFFICIENT UV STABILIZER TO PROTECT THE PIPE AGAINST UV DEGRADATION FOR AT LEAST 24 MONTHS OF UNPROTECTED OUTDOOR EXPOSURE. COEXTRUDED COLOR PE COMPOUND MATERIAL MUST BE PE3608 PIPE MATERIAL COMPOUND, VARYING ONLY BY COLOR AND UV STABILIZER.

15.2. PE3608 PIPE AND BUTT FUSION FITTINGS MUST HAVE PLAIN ENDS FOR BUTT FUSION.

15.3. PE3608 PIPE:
- 15.3.1. NOMINAL STRAIGHT LENGTHS OF 3 INCH AND LARGER PIPE MUST BE 40 FT. OR 50 FT.
- 15.3.2. NOMINAL COIL LENGTHS OF 4-INCH AND SMALLER PIPE MUST BE 500 FT. LONGER OR SHORTER COILS SUCH AS 800 FT FOR 4-INCH PIPE, 1000 FT FOR 3-INCH PIPE, OR 2000 FT FOR 2 INCH OR SMALLER PIPE WILL BE ACCEPTABLE.
- 15.3.3. PIPE MUST BE BLACK. CO-EXTRUDED OD GREEN STRIPES WILL BE AN ACCEPTABLE OPTION. A CO-EXTRUDED LIGHT GREY OR LIGHT GREEN COLOR ID LAYER TO FACILITATE VIDEO ID INSPECTION WILL BE AN ACCEPTABLE OPTION.

15.4. PIPE MUST BE PERMANENTLY MARKED USING HEATED INDENT PRINTING IN ACCORDANCE WITH ASTM D3035 AS APPLICABLE FOR THE PIPE SIZE INCLUDING:
- 15.4.1. NOMINAL SIZE AND SIZING SYSTEM
- 15.4.2. MATERIAL DESIGNATION
- 15.4.3. IPS SDR 11
- 15.4.4. STANDARD DESIGNATION – THE STANDARD DESIGNATION MARKING ON THE PIPE WILL SERVE AS THE MANUFACTURER'S CERTIFICATION THAT THE PIPE HAS BEEN MANUFACTURED, SAMPLED AND TESTED AND HAS BEEN FOUND TO COMPLY WITH THE REQUIREMENTS OF THE STANDARD.
- 15.4.5. EXTRUSION PRODUCTION-RECORD CODE
- 15.4.6. MANUFACTURER'S TRADEMARK OR TRADE NAME

15.5. PE3608 FITTINGS:
- 15.5.1. PE3608 BUTT FUSION FITTINGS MUST BE MANUFACTURED FROM PE3608 MATERIAL COMPOUND IN ACCORDANCE WITH THIS SPECIFICATION.
- 15.5.2. PE3608 FITTINGS MUST COMPLY WITH ASTM D3261 FOR MOLDED BUTT FUSION FITTINGS, FLANGE ADAPTERS AND MJ ADAPTERS, OR MUST COMPLY WITH ASTM F2206 FOR FABRICATED BUTT FUSION FITTINGS
- 15.5.3. PE3608 FITTINGS MUST COMPLY WITH THE MARKING REQUIREMENTS OF ASTM D3261 FOR MOLDED BUTT FUSION FITTINGS, FLANGE ADAPTERS AND MJ ADAPTERS OR MUST COMPLY WITH THE MARKING REQUIREMENTS OF AWWA C906 OR ASTM F2206 FOR FABRICATED BUTT FUSION FITTINGS
- 15.5.4. PE3608 FITTINGS MUST HAVE PRESSURE CLASS RATINGS NOT LESS THAN THE PRESSURE CLASS RATING OF THE PIPE TO WHICH THEY ARE JOINED.

15.6. FUSION JOINTS:
- 15.6.1. UNLESS OTHERWISE SPECIFIED, PE3608 PIPE AND FITTINGS MUST BE ASSEMBLED IN THE FIELD WITH BUTT FUSION JOINTS. ASTM F2620 AND THE PIPE MANUFACTURER'S RECOMMENDED PROCEDURE MUST BE OBSERVED FOR BUTT FUSION JOINTS.
- 15.6.2. FIELD BUTT FUSION JOINTS MUST BE MADE BY FUSION TECHNICIANS THAT ARE QUALIFIED IN ACCORDANCE WITH THIS SPECIFICATION.
- 15.6.3. FIELD FUSION JOINTS MUST BE RECORDED AND DOCUMENTED IN ACCORDANCE WITH THIS SPECIFICATION.

15.7. HANDLING AND STORAGE OF HDPE PIPE:
- 15.7.1. ALL PIPING MUST BE BUNDLED OR PACKAGED FOR TRANSPORTATION BY COMMERCIAL CARRIER TO THE SITE.
- 15.7.2. BEFORE OFF-LOADING, THE PIPE MUST BE INSPECTED FOR DAMAGE. ANY PIPE DAMAGED IN SHIPMENT MUST BE ASSESSED AND EITHER ACCEPTED OR REJECTED AS DIRECTED BY THE OWNER OR THE ENGINEER, AND THE PIPE SUPPLIER MUST BE NOTIFIED OF REJECTED PIPE WITHIN 7 DAYS OF DELIVERY AT THE SITE. REJECTED PIPE MUST BE QUARANTINED FOR DISPOSITION. EACH PIPE SHIPMENT MUST BE CHECKED FOR QUANTITY AND PROPER PIPE SIZE, COLOR AND TYPE.
- 15.7.3. PIPE MUST BE OFF-LOADED AND HANDLED IN ACCORDANCE WITH THE PIPE MANUFACTURER'S INSTRUCTIONS.
- 15.7.4. PIPE LENGTHS SHOULD BE PLACED AND STORED ON LEVEL GROUND. PIPE SHOULD BE STORED AT THE JOB SITE IN THE UNIT PACKAGING PROVIDED BY THE MANUFACTURER. THE INTERIOR OF THE PIPE, AS WELL AS ALL END SURFACES, SHOULD BE KEPT FREE FROM DIRT AND FOREIGN MATTER.
- 15.7.5. PIPE MUST BE HANDLED AND SUPPORTED WITH THE USE OF WOVEN FIBER PIPE SLINGS OR APPROVED EQUAL. CARE MUST BE EXERCISED WHEN HANDLING THE PIPE TO NOT CUT, GOUGE, SCRATCH OR OTHERWISE ABRADE THE PIPING IN ANY WAY. USE OF HOOKS, CHAINS, WIRE ROPE OR ANY OTHER HANDLING DEVICE WHICH CREATES THE OPPORTUNITY TO DAMAGE THE SURFACE OF THE PIPE IS STRICTLY PROHIBITED.

15.8. THE STANDARD DIMENSION RATIO (SDR) RATING OF INDIVIDUAL HDPE PIPE AND FITTINGS MUST CONFORM TO SDR 11.

15.9. WELDING
- 15.9.1. FLANGE CONNECTIONS CONSIST OF AN HDPE FLANGE ADAPTER FUSED TO THE END OF THE HDPE PIPE AND A METAL BACK-UP RING WITH BOLTS TO MAKE THE CONNECTION.
- 15.9.2. STEEL PIPE WITH FLANGE SHALL BE PERFORMED BY A CERTIFIED WELDER (AWS AND/OR ASME). MEETING WELDING PROCEDURE SPECIFICATIONS (WPS) FOR FIELD WELDS. A MINIMUM 60 KSI BUTT WELD (FULL PENETRATION) SHALL BE PERFORMED ON THE FLANGES BEING ADDED TO THE STEEL PIPE. QUALITY CONTROL OF THE WELD SHALL BE PERFORMED BY NONDESTRUCTIVE EVALUATION (NDE) (I.E. X-RAY TESTING, MAGNETIC PARTICLE INSPECTION, ULTRA SONIC TEST, OR ANOTHER METHOD APPROVED BY THE ENGINEER AS EQUAL.

16. FOUNDATIONS

16.1. SUBGRADES MUST BE FREE OF SOFT, COMPRESSIBLE MATERIALS. SOILS NOT MEETING THESE REQUIREMENTS OR SUBGRADE SOILS THAT DETERIORATE PRIOR TO CONCRETE PLACEMENT MUST BE OVER-EXCAVATED TO COMPETENT SUBGRADE OR OTHERWISE IMPROVED AS DIRECTED BY THE ENGINEER. DO NOT PLACE REINFORCING STEEL OR CONCRETE UNTIL THE BEARING SURFACE HAS BEEN INSPECTED BY THE ENGINEER.

16.2. SHOULD OVER-EXCAVATION BEYOND PLANNED DIMENSIONS AND DEPTHS BE REQUIRED, BACKFILL OF OVER-EXCAVATION MUST BE WITH FLOWABLE FILL.

16.3. CARE MUST BE TAKEN TO NOT DISTURB SURFACES THAT ARE TO RECEIVE CONCRETE. EXCAVATION TO FINAL GRADE MUST NOT BE MADE UNTIL JUST PRIOR TO PLACING CONCRETE. SURFACE WATER MUST BE DIVERTED AROUND OPEN EXCAVATIONS, AND EXCAVATION MUST BE KEPT FREE OF STANDING WATER. IT MAY BE NECESSARY TO POUR A THIN MUD MAT AT THE BASE OF SOME EXCAVATIONS IN ORDER TO PROTECT BEARING SURFACES FROM SOFTENING DUE TO CONTACT BY WATER.

16.4. DO NOT PLACE CONCRETE IN EXCAVATIONS CONTAINING WATER OR FROZEN SOIL.

16.5. SETTLEMENT OR WASHING OUT THAT OCCURS IN GRADED OR BACKFILLED AREAS PRIOR TO ACCEPTANCE OF THE WORK MUST BE REPAIRED AND GRADES RE-ESTABLISHED TO THE REQUIRED ELEVATIONS AND SLOPES.

16.6. ALL EXCESS MATERIAL MUST BE REMOVED FROM THE SITE OR RE-USED, AS ALLOWED IN THESE PLANS.

17. DUST SUPPRESSION

17.1. THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING CONTROL OF FUGITIVE DUST ASSOCIATED WITH EARTHWORK ACTIVITIES IN ACCORDANCE WITH THE WBF AIR PERMIT (INFORMATION RELATIVE TO THIS PERMIT MAY BE PROVIDED BY TVA). DUST SUPPRESSION MAY BE ACCOMPLISHED USING THE FOLLOWING SUGGESTED MEANS:
- 17.1.1. STRATEGIC PLACEMENT OF CLAY FILL, IN THIN LIFTS, OR TOPSOIL OVER PROPORTIONALLY LARGE AREAS, WITH THE PLACEMENT OF SUCCESSIVE LIFTS OR LANDSCAPING WHEN THE MOISTURE OF THE EMPLACED MATERIALS HAS EVAPORATED AND CEASES TO CONTROL DUST EFFECTIVELY.
- 17.1.2. THE ADDITION OF WATER, LIGHTLY SPRAYED ONTO THE SURFACE, ESPECIALLY IN HIGH TRAFFIC AREAS.
- 17.1.3. APPROVED POLYMER-BASED EMULSIONS, USED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.

18. DEWATERING

18.1. DEWATERING REFERS TO THE REMOVAL OF ACCUMULATED WATER FROM PROJECT SITE AND SURROUNDING AREAS AND/OR THE PREVENTION OF FLOODING WITHIN WORK AREAS BY MANAGING SURFACE WATER AND/OR SUBSURFACE/GROUNDWATER FLOWS INTO WORK ZONES OR EXCAVATIONS.

18.2. DEWATERING ACTIVITIES WILL CONSIST OF MULTIPLE PUMPS, SUMPS, SUCTION AND DISCHARGE LINES, AND OTHER DEWATERING SYSTEM COMPONENTS NECESSARY TO CONVEY THE WATER AWAY FROM WORK AREAS. WATER DISCHARGED FROM DISTURBED AREAS SHALL BE HANDLED IN A MANNER WHICH WILL MEET THE DISCHARGE PERMIT REQUIREMENTS. UNDISTURBED LOW AREAS WITHIN THE LIMITS OF WORK MAY BE UTILIZED TO PROVIDE ADDITIONAL STORAGE AND RETENTION TIME. DISCHARGES MAY REQUIRE FILTRATION OR TREATMENT TO PREVENT THE RELEASE OF FINE ASH AND SOIL PARTICLES. DEWATERING ACTIVITIES SHALL ALSO COMPLY WITH EROSION AND SEDIMENT CONTROL REQUIREMENTS.

18.3. MAINTAIN DIVERSION BERMS, TEMPORARY DRAINAGE DITCHES, OR OTHER CONTROLS OUTSIDE THE WORK AREAS TO ADEQUATELY PROTECTED WORK AREAS FROM THE ACCUMULATION OF RAIN WATER AND STORM WATER RUN-ON. DO NOT ALLOW WATER TO ACCUMULATE IN AREAS OF FILL PLACEMENT OR EXCAVATIONS WHERE SUBBASES OR BEARING SURFACES COULD BE: SOFTENED, UNDERCUT, OR OTHERWISE DESTABILIZED.

18.4. ALL EXCAVATION, CONSTRUCTION AND BACKFILLING SHALL BE PERFORMED UNDER WORKABLE DRY CONDITIONS. THE CONTRACTOR SHALL EMPLOY ADDITIONAL DEVICES AS REQUIRED TO CONTROL GROUNDWATER OR WATER INFILTRATION INTO EXCAVATIONS AS NECESSARY TO ADEQUATELY COMPLETE THE WORK.

18.5. PLACEMENT OF THE BRIDGE LIFT SHOULD BE SEQUENCED TO "PUSH" STANDING WATER TO EXISTING SUMPS.

19. GEOSYNTHETICS

19.1. FURNISH GEOSYNTHETIC (GEOTEXTILES AND GEOMEMBRANE) IN ACCORDANCE WITH TENNESSEE DEPARTMENT OF TRANSPORTATION'S STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION, SECTION 740, AND THE ADDITIONAL NOTES PROVIDED HEREIN.
- 19.1.1. GEOMEMBRANE (40 MIL HDPE TEXTURED GEOMEMBRANE) FOR PLACEMENT WITHIN DITCH RELOCATION AND DRAINAGE ENHANCEMENTS. INSTALL IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.
- 19.1.2. GEOTEXTILE (MIRAFI PET70/70 HIGH-STRENGTH WOVEN POLYESTER, OR EQUAL) FOR PLACEMENT UNDER TEMPORARY AND PERMANENT PERIMETER ROADS. INSTALL IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.
- 19.1.3. GEOTEXTILE (MIRAFI S600 6 OZ./SY. NON-WOVEN POLYPROPYLENE, OR EQUAL) FOR USE AS SEPARATION FABRIC. INSTALL IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.
- 19.1.4. GEOTEXTILE (MIRAFI S1600 16 OZ./SY NON-WOVEN POLYPROPYLENE, OR EQUAL) FOR USE AS A CUSHION BETWEEN GEOMEMBRANE AND COARSE AGGREGATE. INSTALL IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.

20. SEEDING

20.1. SOURCES:
- 20.1.1. TENNESSEE EROSION AND SEDIMENT CONTROL HANDBOOK. AS PREPARED BY TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION (TDEC). DIVISION OF WATER POLLUTION CONTROL LATEST EDITION.
- 20.1.2. TENNESSEE DEPARTMENT OF TRANSPORTATION (TDOT) STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION. LATEST EDITION.

20.2. NOTES:
- 20.2.1. THE FOLLOWING SEEDING SCHEDULE SHALL BE USED UNLESS OTHERWISE NOTED.
- 20.2.2. NO SEEDING SHALL BE PERFORMED DURING WINDY WEATHER, OR WHEN THE GROUND SURFACE IS FROZEN , WET, OR OTHERWISE NONTILLABLE.
- 20.2.3. NO SEEDING SHALL BE PERFORMED DURING DECEMBER OR JANUARY UNLESS OTHERWISE PERMITTED.

20.3. TEMPORARY COVER FOR EROSION CONTROL
- 20.3.1. INITIAL PROTECTION: WHERE SEEDING IS TO BE DELAYED, USE DRY HAY OR DRY STRAW. APPLIED AT A RATE OF THREE (3) TONS PER ACRE.
- 20.3.2. SITE PREPARATION: UNIFORMLY INCORPORATE INTO SOIL FOR A DEPTH OF APPROXIMATELY 0.5 INCH. FERTILIZER OF GRADE 10-10-10 OR EQUIVALENT AT A RATE OF ONE-HALF (0.5) TONS PER ACRE PLUS AGRICULTURAL GRADE LIMESTONE AT A RATE OF NOT LESS THAN TWO (2) TONS PER ACRE.
- 20.3.3. SEEDING MIXTURES: WHEN A SEED GROUP IS USED, THE PERCENTAGES FORMING THE GROUP SHALL BE AS SET OUT BELOW, UNLESS OTHERWISE SPECIFIED. SEED SHALL BE SET AT A RATE OF 2.5 LBS PER 1,000 SF.

SEEDING DATES	GRASS SEED	PERCENTAGES
JAN 1 TO MAY 1	ITALIAN RYE	33
	KOREAN LESPEDEZA	33
	SUMMER OATS	34
MAY 1 TO JULY 15	SUDAN – SORGHUM	100
MAY 1 TO JULY 15	STARR MILLET	100
JULY 15 TO JAN 1	BALBOA RYE	67
	ITALIAN RYE	33

20.4. PERMANENT SLOPE HYDROSEEDING (FLEXTERRA) FOR STABILIZATION
- 20.4.1. SUBGRADE SHALL BE PREPARED IN THE FOLLOWING WAY:
- 20.4.2. AGRICULTURAL LIME OR PELLETIZED LIME SHALL BE ADDED DURING THE SLOPE PREPARATION STAGE AT THE RATE RECOMMENDED ACCORDING TO SOIL ANALYSIS. APPLY AGRICULTURAL LIME OR PELLET LIME AT A RATE OF 2000 LBS PER ACRE IF NO SOIL ANALYSIS HAS BEEN PERFORMED.
- 20.4.3. SLOPES SHALL BE TRACKED SO CLEATS ARE RUNNING PERPENDICULAR TO THE FLOW OF WATER DOWN THE HILL.

20.5. SEED MATERIALS SHALL INCLUDE:
- 20.5.1. SEED MIXTURE SHALL BE A MIXED SUSTAINABLE SLOPE SEED APPLIED AT THE FOLLOWING MINIMUM SUMMER HYDROSEEDING OR WINTER HYDROSEEDING LBS PER ACRE RATES, DEPENDING ON THE PERIOD OF YEAR:

SPRING/SUMMER HYDRO SEEDING MIX (APRIL-AUG):
150 POUNDS OF KENTUCKY 31 TALL FESCUE
50 POUNDS OF COMMON HULLED BERMUDA
50 POUNDS OF ANNUAL RYEGRASS

FALL/WINTER HYDRO SEEDING MIX (SEP-MAR):
200 POUNDS OF KENTUCKY 31 TALL FESCUE
50 POUNDS OF ANNUAL RYEGRASS

- 20.5.2. FLEXTERRA FLEXIBLE GROWTH MEDIUM-HIGH PERFORMANCE FIBER MULCH: APPLIED AT A MINIMUM RATE OF 3500 LBS/ACRE (80 LBS/1000 SQUARE FEET).
- 20.5.3. FERTILIZER: A BALANCED COMMERCIAL GRADE GRANULAR FERTILIZER OF 19-19-19 APPLIED AT A RATE OF 250 LBS PER ACRE (5.5 LBS/1000 SQUARE FEET).
- 20.5.4. SOIL AMENDMENTS: THE SOIL AMENDMENT NEUTRA LIME DRY SHOULD BE APPLIED AT A RATE RECOMMENDED BY THE ENGINEER BASED ON RESULTS OF SOIL ANALYSIS COMPLETED ON THE TOPSOIL MATERIALS FOR EACH SEEDING AREA.
- 20.5.5. EQUIPMENT SHALL HAVE A BUILT IN MECHANICAL AGITATION SYSTEM AND OPERATING CAPACITY SUFFICIENT TO AGITATE, SUSPEND, AND HOMOGENEOUSLY MIX A SLURRY CONTAINING NOT LESS THAN 44 LBS OF ORGANIC MULCHING AMENDMENT PLUS FERTILIZER, CHEMICAL ADDITIVES, AND SOLIDS FOR EACH 150 GALLONS OF WATER.

20.6. FLEXTERRA SHALL BE INSTALLED IN THE FOLLOWING MANNER:
- 20.6.1. STRICTLY COMPLY WITH MANUFACTURER'S INSTALLATION INSTRUCTIONS AND RECOMMENDATIONS.
- 20.6.2. MIX THE SEED, SOIL AMENDMENTS, AND COMMERCIAL FERTILIZER WITH A SMALL AMOUNT OF THE FLEXIBLE GROWTH MEDIUM FOR VISUAL METERING AND APPLY ALONG THE AREAS TO BE VEGETATED BEING SURE TO APPLY SEED AND AMENDMENTS AT THE SPECIFIED RATES.
- 20.6.3. MIX AND APPLY THE FLEXIBLE GROWTH MEDIUM AT A RATE OF 50 LBS/150 GALLONS OF WATER OVER FRESHLY SEEDED AREAS. HYDROMULCH SHALL BE APPLIED IN MULTIPLE DIRECTIONS SO THAT SHADOWING DOES NOT OCCUR AND TO INSURE UNIFORMITY OF THE APPLICATIONS. CONFIRM THE LOADING RATES WITH EQUIPMENT MANUFACTURERS. DO NOT LEAVE SEEDED SURFACES UNPROTECTED, ESPECIALLY IF PRECIPITATION IS IMMINENT.
- 20.6.4. SPECIAL CARE SHALL BE TAKEN TO PREVENT ANY OF THE SLURRY FROM BEING SPRAYED ONTO ANY HARDSCAPE AREAS INCLUDING CONCRETE WALKS, FENCES, WALLS, BUILDINGS, ETC. REMOVE ALL SLURRY SPRAYED ONTO THESE SURFACES IMMEDIATELY.

20.7. FLEXTERRA MAINTENANCE PROGRAM:
- 20.7.1. FREQUENT LIGHT IRRIGATION WILL NEED TO BE APPLIED TO SEEDED AREAS IF NO NATURAL RAIN EVENTS HAVE OCCURRED WITHIN ONE WEEK OF HYDROSEEDING. WATER SHALL BE APPLIED LONG ENOUGH TO MOISTEN THE SOIL THOROUGHLY TO THE DEPTH OF THE SLURRY MULCH TAKING CARE NOT TO SUPER SATURATE OR WASH AWAY THE SLURRY AND SEED.
- 20.7.2. AFTER SEED GERMINATION HAS OCCURRED AND PLANTS ARE VISIBLE THE FREQUENCY OF IRRIGATION SHOULD BE CUT BACK WITH HEAVIER APPLICATION RATES STILL MAKING SURE NOT TO SUPER SATURATE OR WASH AWAY THE SLURRY AND SEED.
- 20.7.3. REPAIR ALL SEED WASHINGS AND EROSION.
- 20.7.4. FUTURE FERTILIZATION SHOULD OCCUR WHENEVER APPLICABLE AT THE RECOMMENDED RATE BASED ON SOIL ANALYSIS WITH A LOW NITROGEN FERTILIZER.

21. SEQUENCE OF CONSTRUCTION

- 21.1. ESTABLISH PERIMETER EROSION AND SEDIMENT CONTROLS. (SHEET 6).
- 21.2. CONSTRUCT HAUL ROADS ON SLAG DISPOSAL AREA CAP (SHEET 7).
- 21.3. PLACE TOPSOIL AND SEED/MULCH OVER THE SLAG DISPOSAL AREA CAP (SHEET 7) (CONCURRENT WITH ITEMS BELOW).
- 21.4. ESTABLISH SITE SUPPORT FACILITIES: SUMP/PUMP, DISCHARGE LINES, AND DISCHARGE PADS FOR CONSTRUCTION STORM WATER DIVERSION (SHEET 6).
- 21.5. CONSTRUCT DIVERSION BERM/HAUL ROAD ADJACENT TO PROPOSED DITCH RELOCATION (SHEET 8).
- 21.6. CONCURRENT WITH DIVERSION BERM CONSTRUCTION, INSTALL ASSOCIATED CULVERTS AND CATCH BASINS WITH BLIND FLANGE AT DOWNSTREAM ENDS. (SHEET 9)
- 21.7. EXCAVATE AND INSTALL RELOCATED DITCH LINING AND PROTECTION (SHEET 8; SECTIONS A, B, AND C, SHEET 13).
  - 21.7.1. REMOVE SUMP/PUMP FROM DOWNSTREAM END OF RELOCATED DITCH PRIOR TO COMPLETING DITCH LINING.
  - 21.7.2. UPON COMPLETION OF DITCH LINING, REMOVE BLIND FLANGE FROM CULVERTS DRAINING RUN-ON FROM BLUE LINE STREAM.
- 21.8. CONSTRUCT SEEP #1 REPAIR (SHEETS 10 & 11)
  - 21.8.1. COULD BE CONCURRENT WITH OTHER ACTIVITIES ABOVE.
  - 21.8.2. PLACE SPOIL WITHIN NON-JURISDICTIONAL WETLANDS OR SLOUGH.
- 21.9. GENERALLY WORKING NORTH TO SOUTH, PERFORM GRADING/DRAINAGE WORK IN DESIGNATED AREAS WEST OF SLAG DISPOSAL AREA: CHEM POND, PLATEAU AREA, AND SLOUGH AREAS (SHEET 9; SECTIONS D, E, AND F, SHEET 14).
  - 21.9.1. INSTALL BRIDGE LIFT, WHERE APPROPRIATE.
  - 21.9.2. PERFORM ROUGH GRADING OF SUBGRADE TO RECEIVE CLAY COVER.
  - 21.9.3. CONSTRUCT CLAY COVER, WHERE APPROPRIATE.
  - 21.9.4. PLACE TOPSOIL, SEED, AND MULCH.
  - 21.9.5. PLACE DRAINAGE ENHANCEMENT DITCH LININGS.
  - 21.9.6. UPON COMPLETION OF THE AREAS WEST OF SLAG DISPOSAL AREA, REMOVE BLIND FLANGE TO OPEN DRAINAGE TO THE RELOCATED DITCH.
- 21.10. NON-JURISDICTIONAL WETLANDS (SHEET 9; SECTION C SHEET 13).
  - 21.10.1. CONSTRUCT BRIDGE LIFT FILL.
  - 21.10.2. CONSTRUCT CLAY COVER.
  - 21.10.3. PLACE TOPSOIL, SEED, AND MULCH.
  - 21.10.4. PLACE DRAINAGE ENHANCEMENT DITCH LININGS.
  - 21.10.5. UPON COMPLETION OF NON-JURISDICTIONAL WETLANDS, REMOVE BLIND FLANGE TO OPEN DRAINAGE TO THE RELOCATED DITCH.
- 21.11. INSTALL DRAINAGE ENHANCEMENT DITCH LININGS ON SLAG DISPOSAL AREA (SHEET 9; SHEET 15).
- 21.12. INSTALL CONCRETE EMERGENCY OVERFLOW SECTION ON PLANT ROAD (SHEET 8).
- 21.13. PERFORM STORM PIPE ABANDONMENT (SHEET 12).
  - 21.13.1. COULD BE CONCURRENT WITH OTHER ACTIVITIES ABOVE.
  - 21.13.2. EMPTY VACUUM TRUCK CONTENTS IN BORROW AREA SEDIMENT BASIN.
- 21.14. DEMOBILIZE.
- 21.15. UPON ESTABLISHMENT OF VEGETATION, REMOVE PERIMETER EROSION AND SEDIMENT CONTROLS.

22. QUANTITIES

ITEM	QUANTITY	UNIT
CLAY	43,100	CUBIC YARDS
TOPSOIL	28,800	CUBIC YARDS
TDOT CLASS A-1 RIPRAP	2,450	CUBIC YARDS
TDOT CLASS A-3 RIPRAP	740	CUBIC YARDS
AASHTO NO. 57 STONE AGGREGATE	2,940	CUBIC YARDS
TDOT MINERAL AGGREGATE TYPE A, GRADING D	1,900	CUBIC YARDS
16 OZ/SY NONWOVEN GEOTEXTILE	5,550	SQUARE YARDS
6 OZ/SY NONWOVEN GEOTEXTILE	185	SQUARE YARDS
WOVEN GEOTEXTILE	2,150	SQUARE YARDS
40 MIL HDPE TEXTURED GEOMEMBRANE	11,690	SQUARE YARDS
TURF REINFORCEMENT MAT	720	SQUARE YARDS
SEEDING	35.1	ACRES
FILTER LOG / SILT FENCE	10,700	LINEAR FEET
CONSTRUCTION ENTRANCE	4	EACH
SUMP	3	EACH
PUMP PAD	2	EACH
CCTV AND CLEANING OF 30 INCH STORM PIPE	150	LINEAR FEET
BULKHEAD FOR PIPE ABANDONMENT	1	EACH
GROUT FOR PIPE ABANDONMENT	150	LINEAR FEET
CLSM	340	CUBIC YARDS
CATCH BASIN	1	EACH
HEADWALL	1	EACH
SOLID WALL SDR-11 HDPE CULVERTS:		
8-INCH ID	100	LINEAR FEET
12-INCH ID	300	LINEAR FEET
16-INCH ID	250	LINEAR FEET
24-INCH ID	150	LINEAR FEET
BLUE LINE STREAM DIVERSION AND STORMWATER/GROUNDWATER MANAGEMENT	1	LUMP SUM

FOR SUPPORTING DESIGN CALCULATIONS SEE:
FPGWBFDEGCDX0003002015000007

MICHAEL MEULEMANS
No. 16952
5/8/15

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R #											
R 0	05/08/15	ANR	ASL	JJH	MRM	JDM	MST	JCK	729178		D
ISSUED FOR CONSTRUCTION											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: NONE EXCEPT AS NOTED

GENERAL NOTES II

WATTS BAR SLAG DISPOSAL AREA MAINTENANCE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
ANR	ASL	JJH	MRM	JDM	MST	JCK

URS

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 | DATE 05/08/15 | 14 | C | 10W426-03 | R 0

URS Corporation	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

Q:\Projects\31858011_TVAWattsBa\DWGs\Sheets\SlagPile\31858011 10W426-03 General Notes II.dwg User:andrew_rodzianko May 08, 2015 - 9:05pm

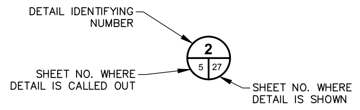
LEGEND

PROPOSED	EXISTING	DESCRIPTION
—— 630 ——	– – – 630 – – –	MAJOR CONTOUR INTERVAL
—— 629 ——	- - - 629 - - -	MINOR CONTOUR INTERVAL
∿∿∿∿∿	∿∿∿∿∿	SITE VEGETATION BOUNDARY
N/A	— x — x — x —	FENCE
N/A	— OE — OE — OE —	OVERHEAD ELECTRIC LINE
N/A	— UE — UE — UE —	UNDERGROUND ELECTRIC LINE
☼	☼	LIGHT POLE
▽	▽	FIRE HYDRANT
ø	ø	UTILITY POLE
———	— — — —	PIPES/CULVERTS
— LOD — LOD —	N/A	LIMITS OF DISTURBANCE
— LG — LG — LG —	N/A	LIMITS OF GRADING
—— — ——	—— — ——	CENTER LINE OF ROAD
N/A	—— – – ——	ASSUMED LIMITS OF EXISTING CAP
–··–··–··–	–·–·–·–	EDGE OF WATER
— SF — SF — SF — SF — SF —	N/A	FILTER LOG OR SILT FENCE, AS APPLICABLE
—— FM —— FM ——	N/A	PUMP SUCTION/DISCHARGE LINE
N/A	▒	NUCLEAR INTAKE/DISCHARGE CORRIDOR
◄∿	◁∿	GRADING/DRAINAGE FLOW PATH
✿	✿	TREE
▇	▒	ROADWAY EXTENTS (PAVED)
▇	▒	ROADWAY EXTENTS (UNPAVED)
▩	▩	RIP–RAP
N/A	↓ ↓ ↓	WETLANDS DELINEATED BY TVA
▨	N/A	LIMITS OF TOPSOIL/SEEDING
N/A	◉	BENCHMARK
▭	▭	BUILDINGS, STRUCTURES
◻	◻	DRAINAGE BASIN/INLET STRUCTURE

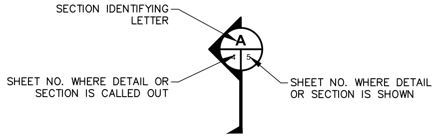
LEGEND (SECTION/PROFILE VIEW)

PROPOSED	EXISTING	DESCRIPTION
———	— — — — — —	EXISTING OR FINISHED GRADE
━━━	N/A	40 MIL HDPE GEOMEMBRANE
▩	N/A	CUT
▨	N/A	FILL – COMPACTED CLAY
▩	N/A	RIPRAP/AGGREGATE
░	N/A	SAND
▒	N/A	CONCRETE
░	N/A	TOPSOIL
▦	N/A	STRAW WATTLE
▦	N/A	NONWOVEN GEOTEXTILE
▼	▽	WATER LEVEL

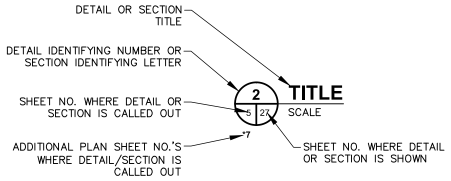
DETAILING & SECTION IDENTIFICATION NOMENCLATURE



DETAIL REFERENCE ON SHEET WHERE DETAIL IS CALLED OUT



SECTION REFERENCE ON SHEET WHERE SECTION IS CALLED OUT



DETAIL OR SECTION, NUMBER OR LETTER & TITLE ON SHEET WHERE DETAIL OR SECTION IS SHOWN

ABBREVIATIONS

CURTAILMENT/ACRONYM	DESCRIPTION
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
@	AT
C/L	CENTER LINE
CPP	CORRUGATED PLASTIC PIPE
DIA	DIAMETER
EL, ELEV	ELEVATION
EOP	EDGE OF PAVEMENT
GDL	GEOCOMPOSITE DRAINAGE LAYER
GMB	GEOMEMBRANE
GN	GEONET
GTX	GEOTEXTILE
HORIZ	HORIZONTAL
ID	INNER DIAMETER
INV	INVERT
LF	LINEAL FEET
MAX	MAXIMUM
MIN	MINIMUM
N/A	NOT APPLICABLE
NTS	NOT TO SCALE
NO.	NUMBER
OC	ON CENTER
OD	OUTER DIAMETER
STA	STATION OR STATIONING
TBD	TO BE DETERMINED
TNDOT	TENNESSEE DEPARTMENT OF TRANSPORTATION
TDEC	TENNESSEE DEPARTMENT OF ENVIRONMENT & CONSERVATION
TYP	TYPICAL
TVA	TENNESSEE VALLEY AUTHORITY
VERT	VERTICAL
WBF	WATTS BAR FOSSIL PLANT
WWF	WELDED WIRE FABRIC
WP	WORK PLAN

FOR SUPPORTING DESIGN CALCULATIONS SEE:
FPGWBFDEGCDX0003002015000007

R #												
R 0	05/08/15	ANR	ASL	JJH	MRM	JDM	MST	JCK	729178		D	
ISSUED FOR CONSTRUCTION												
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD	

DISCIPLINE INTERFACE
1
2
3
4

MICHAEL MEULEMANS
No. 16952
5/8/15

SCALE: NONE EXCEPT AS NOTED

MASTER LEGEND & ABBREVIATIONS

WATTS BAR SLAG DISPOSAL AREA MAINTENANCE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
ANR	ASL	JJH	MRM	JDM	MST	JCK

URS

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

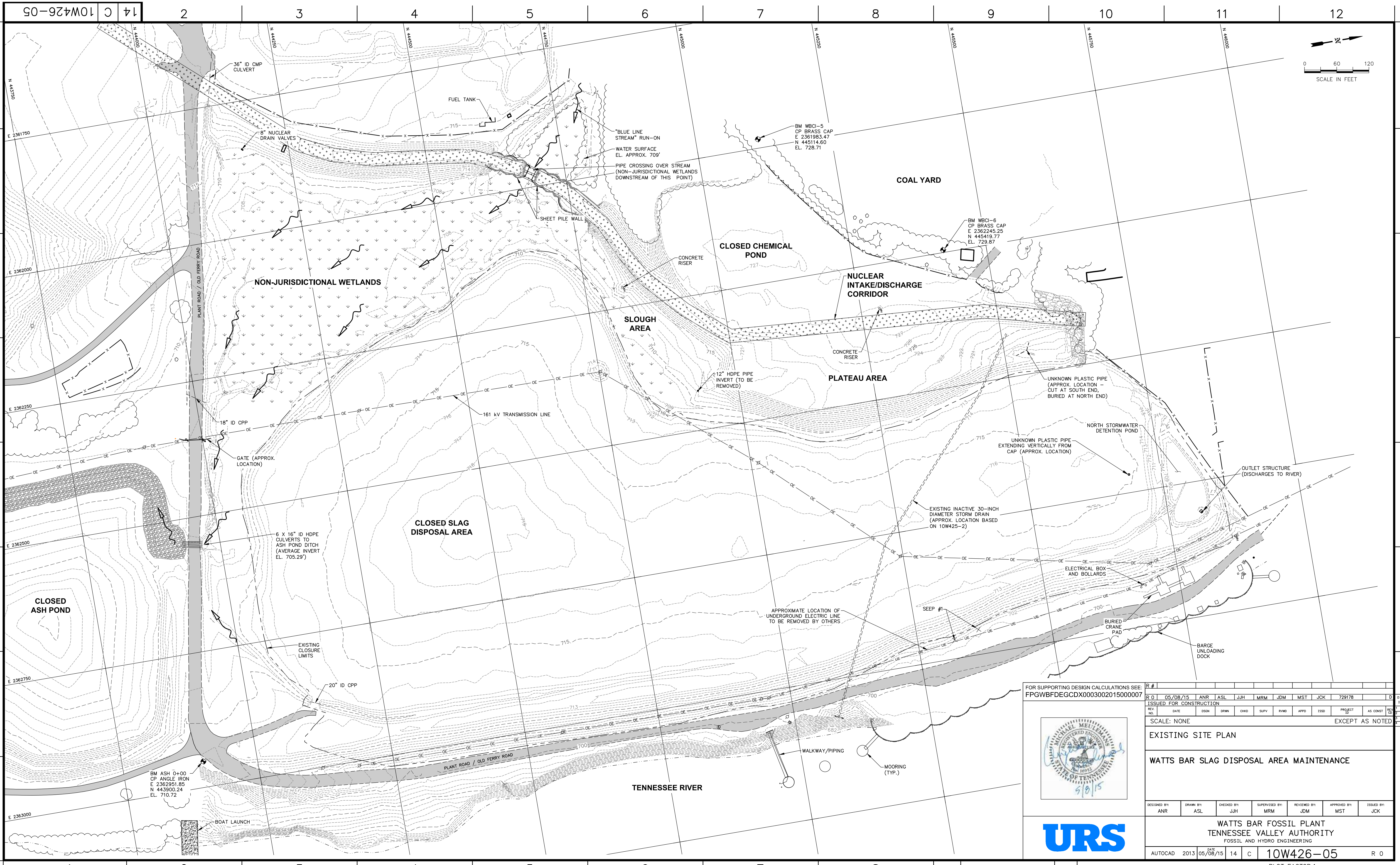
AUTOCAD 2013 | DATE 05/08/15 | 14 | C | 10W426–04 | R 0

URS Corporation | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

Q:\Projects\31858011_TVAWattsBa\DWGs\Sheets\SlagPile\31858011 10W426–04 Master Legend.dwg User:andrew_rodzianko May 08, 2015 – 9:05pm



Q:\Projects\31858011_TVAWattsBa\DWGs\Sheets\SlagPile\31858011 10W426-05 Existing Site Plan.dwg User:andrew_rodzianko May 08, 2015 - 9:06pm

FOR SUPPORTING DESIGN CALCULATIONS SEE:
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R #												
R 0	05/08/15	ANR	ASL	JJH	MRM	JDM	MST	JCK	729178		D	
ISSUED FOR CONSTRUCTION												
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD	

DISCIPLINE INTERFACE
1
2
3
4

MICHAEL MEULEMANS
No. 16952
5/8/15

SCALE: NONE EXCEPT AS NOTED

EXISTING SITE PLAN

WATTS BAR SLAG DISPOSAL AREA MAINTENANCE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
ANR	ASL	JJH	MRM	JDM	MST	JCK

URS

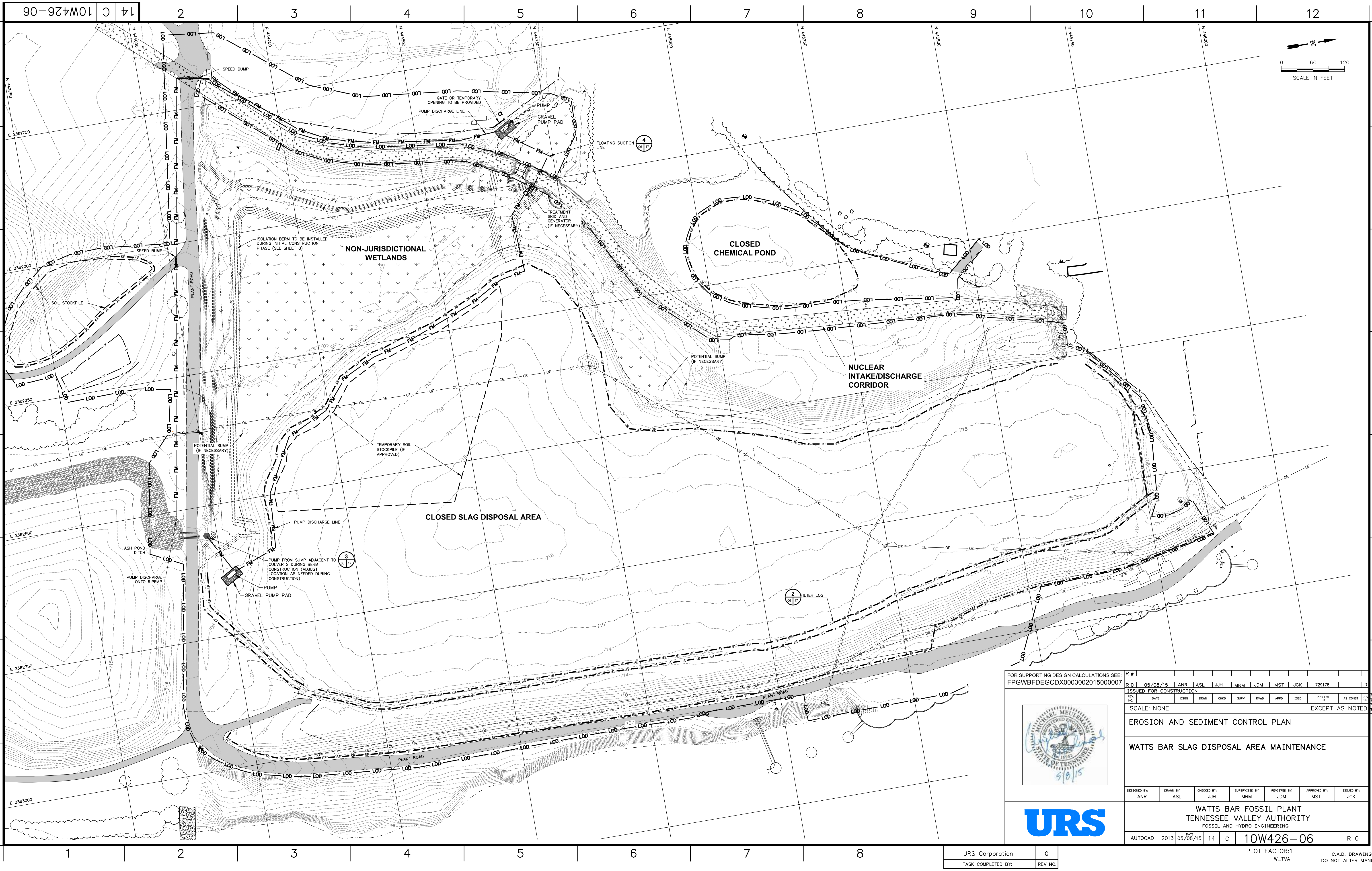
WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD	2013	DATE 05/08/15	14	C	10W426-05	R 0

URS Corporation	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



FOR SUPPORTING DESIGN CALCULATIONS SEE:
FPGWBFDEGCDX0003002015000007

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R #											
R 0	05/08/15	ANR	ASL	JJH	MRM	JDM	MST	JCK	729178		D
ISSUED FOR CONSTRUCTION											

DISCIPLINE INTERFACE
1
2
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4

MICHAEL MEULEMANS
No. 16952
5/8/15

SCALE: NONE EXCEPT AS NOTED

EROSION AND SEDIMENT CONTROL PLAN

WATTS BAR SLAG DISPOSAL AREA MAINTENANCE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
ANR	ASL	JJH	MRM	JDM	MST	JCK

URS

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

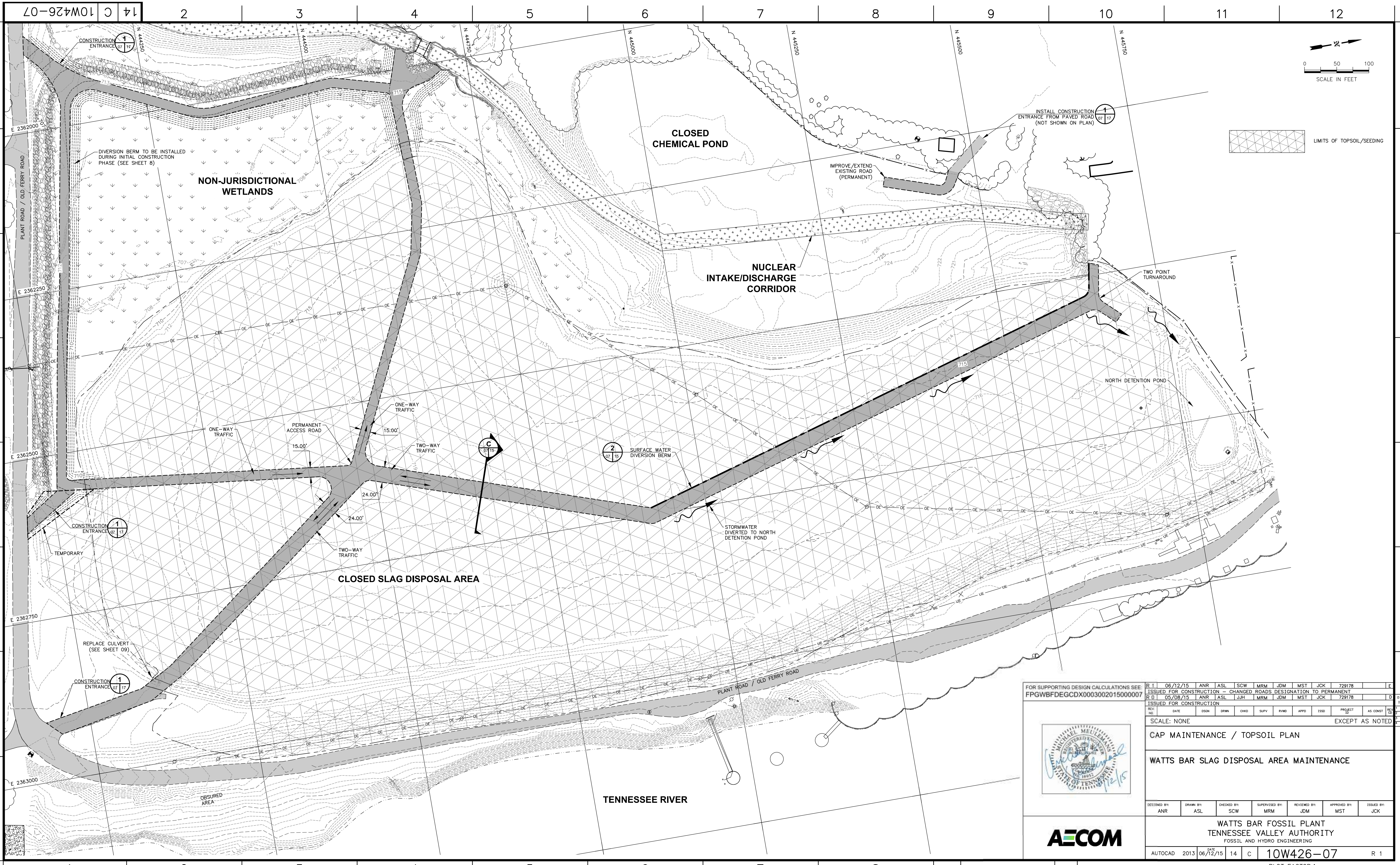
AUTOCAD 2013 | DATE 05/08/15 | 14 | C | 10W426-06 | R 0

URS Corporation	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

Q:\Projects\31858011_TVAWattsBa\DWGs\Sheets\SlagPile\31858011 10W426-06 Erosion and Sediment Control Plan.dwg User:andrew_rodzianko May 08, 2015 – 9:06pm



FOR SUPPORTING DESIGN CALCULATIONS SEE:
FPGWBFDEGCDX0003002015000007

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R 1	06/12/15	ANR	ASL	SCW	MRM	JDM	MST	JCK	729178		E
ISSUED FOR CONSTRUCTION – CHANGED ROADS DESIGNATION TO PERMANENT											
R 0	05/08/15	ANR	ASL	JJH	MRM	JDM	MST	JCK	729178		D
ISSUED FOR CONSTRUCTION											

DISCIPLINE INTERFACE
1
2
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4

SCALE: NONE EXCEPT AS NOTED

MICHAEL MEULEMANS
No. 16951
Michael Meulemans 6/12/15

CAP MAINTENANCE / TOPSOIL PLAN

WATTS BAR SLAG DISPOSAL AREA MAINTENANCE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
ANR	ASL	SCW	MRM	JDM	MST	JCK

AECOM

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

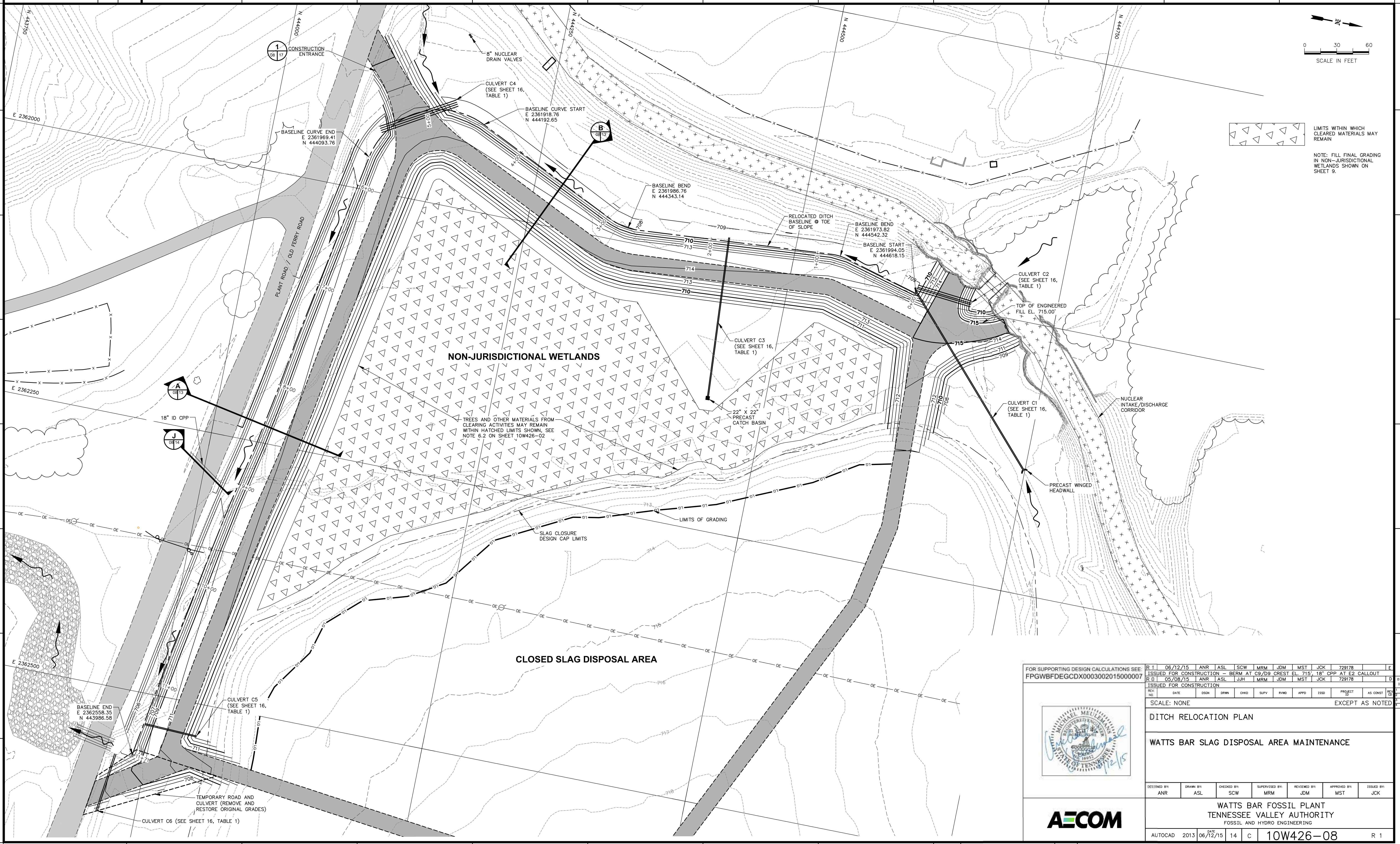
AUTOCAD 2013 DATE 06/12/15 14 C 10W426-07 R 1

AECOM	1
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

Q:\Projects\31858011_TVAWattsBa\DWGs\Sheets\SlagPile\31858011 10W426-07 Cap Maintenance Topsoil Plan.dwg User: andrew_rodzianko Jun 12, 2015 – 3:59pm



Q:\Projects\31858011_TVAWattsBa\DWGs\Sheets\SlagPile\31858011 10W426-08 Ditch Relocation Plan.dwg User: andrew_rodzianko Jun 12, 2015 - 4:03pm

FOR SUPPORTING DESIGN CALCULATIONS SEE:
FPGWBFDEGCDX0003002015000007

MICHAEL MEULEMANS
REGISTERED ENGINEER
No. 16952
Michael Meulemans 6/12/15

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R 1	06/12/15	ANR	ASL	SCW	MRM	JDM	MST	JCK	729178		E
ISSUED FOR CONSTRUCTION – BERM AT C9/D9 CREST EL. 715', 18" CPP AT E2 CALLOUT											
R 0	05/08/15	ANR	ASL	JJH	MRM	JDM	MST	JCK	729178		D
ISSUED FOR CONSTRUCTION											

DISCIPLINE INTERFACE
1
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SCALE: NONE EXCEPT AS NOTED

DITCH RELOCATION PLAN

WATTS BAR SLAG DISPOSAL AREA MAINTENANCE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
ANR	ASL	SCW	MRM	JDM	MST	JCK

AECOM

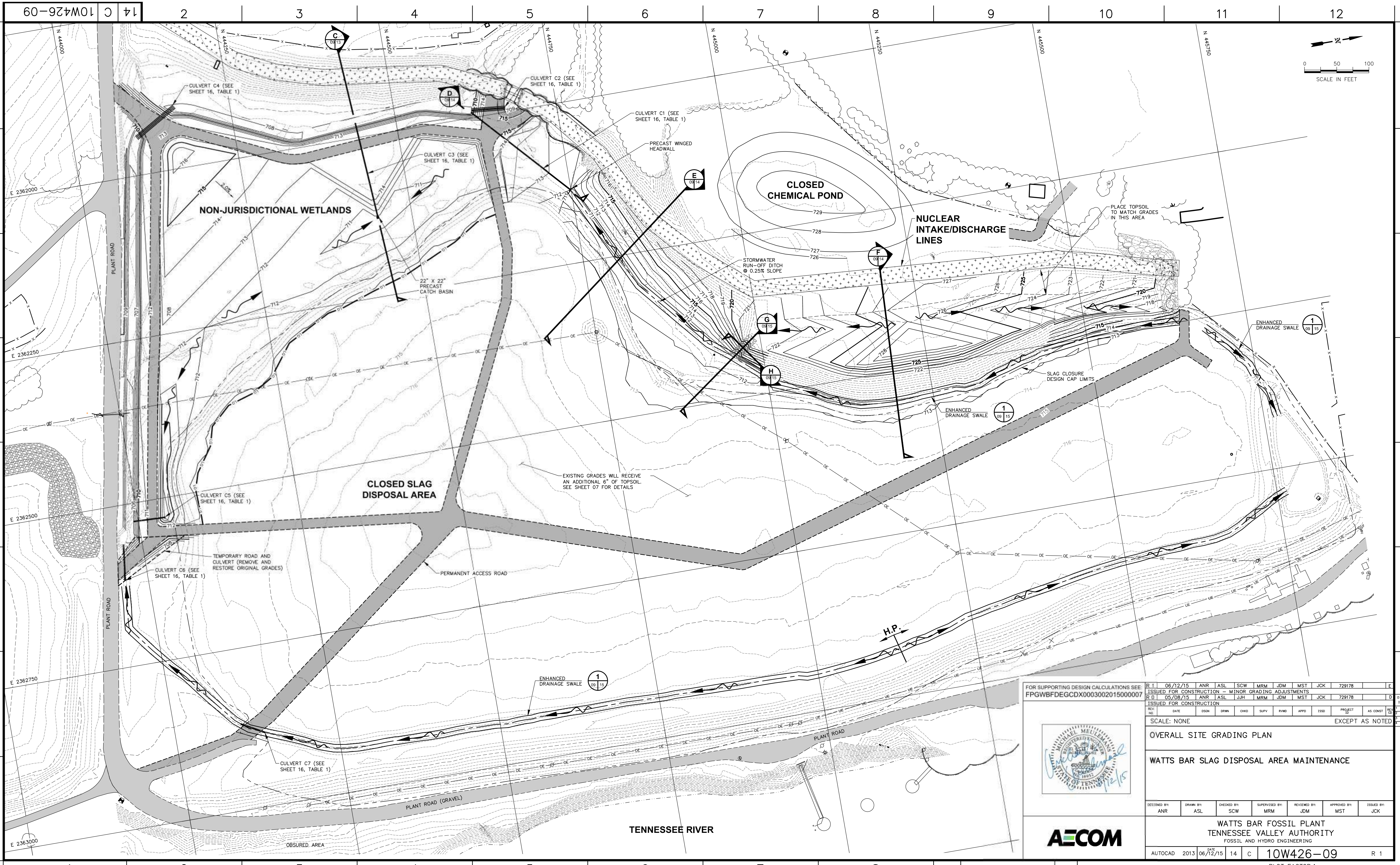
WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 DATE 06/12/15 14 C 10W426-08 R 1

AECOM	1
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



FOR SUPPORTING DESIGN CALCULATIONS SEE:
FPGWBFDEGCDX0003002015000007

MICHAEL MEULEMANS
No. 16952

Michael Meulemans
6/12/15

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R 1	06/12/15	ANR	ASL	SCW	MRM	JDM	MST	JCK	729178		E
ISSUED FOR CONSTRUCTION – MINOR GRADING ADJUSTMENTS											
R 0	05/08/15	ANR	ASL	JJH	MRM	JDM	MST	JCK	729178		D
ISSUED FOR CONSTRUCTION											

DISCIPLINE INTERFACE
1
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4

SCALE: NONE EXCEPT AS NOTED

OVERALL SITE GRADING PLAN

WATTS BAR SLAG DISPOSAL AREA MAINTENANCE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
ANR	ASL	SCW	MRM	JDM	MST	JCK

AECOM

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

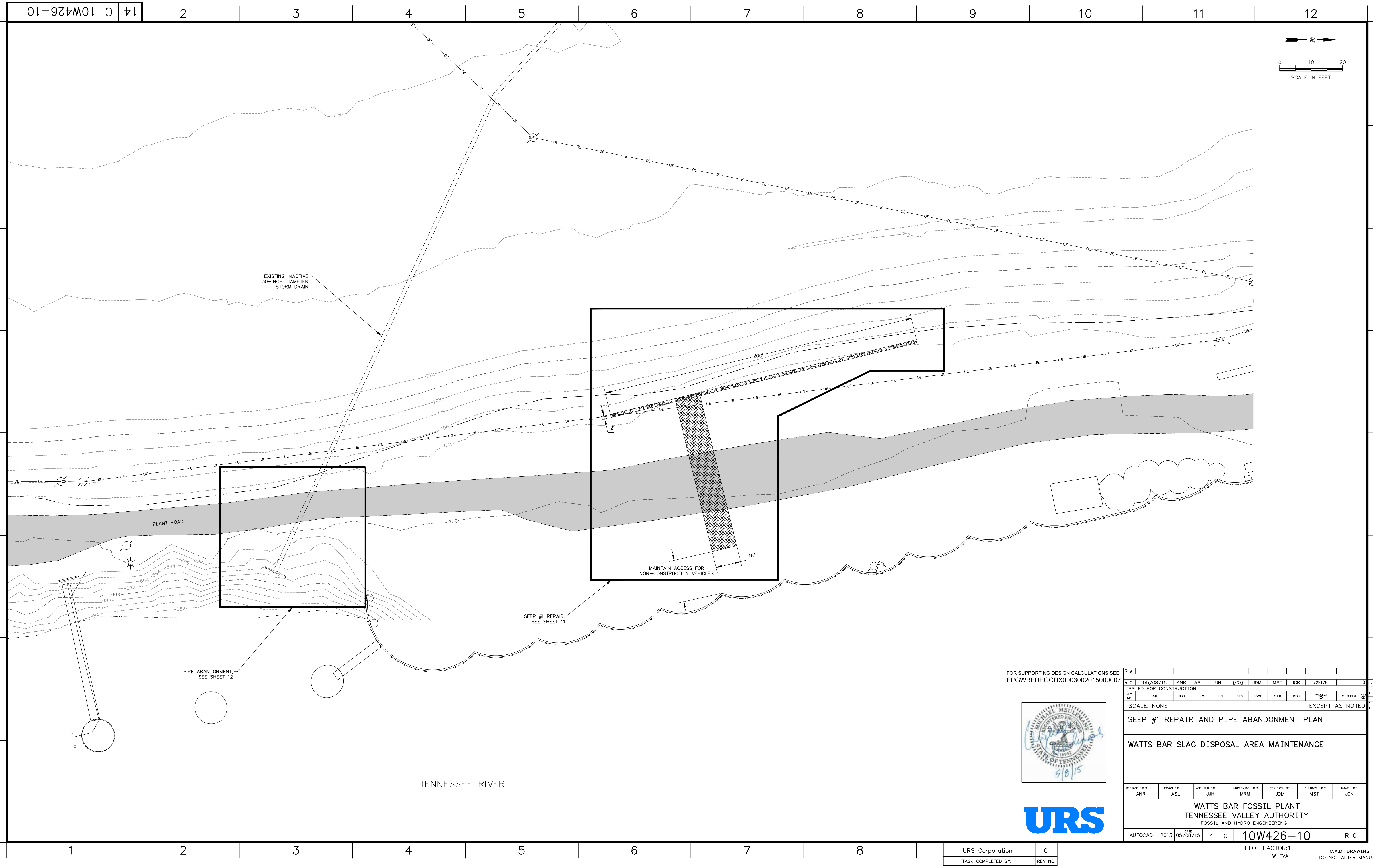
AUTOCAD 2013 | DATE 06/12/15 | 14 | C | 10W426-09 | R 1

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

AECOM	1
TASK COMPLETED BY:	REV NO.

O:\Projects\31858011_TVAWattsBa\DWGs\Sheets\SlagPile\31858011 10W426-09 Overall Site Grading Plan.dwg User:andrew_rodzianko Jun 12, 2015 - 4:08pm



Q:\Projects\31858011_TVAWattsBa\DWGs\Sheets\SlagPile\31858011 10W426-10 Seep #1 Repair & Pipe Abandonment Plan.dwg User: andrew_rodzianko May 08, 2015 - 9:07pm

FOR SUPPORTING DESIGN CALCULATIONS SEE:
FPGWBFDEGCDX0003002015000007

R #											
R 0	05/08/15	ANR	ASL	JJH	MRM	JDM	MST	JCK	729178		D
ISSUED FOR CONSTRUCTION											
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD

DISCIPLINE INTERFACE
1
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4

SCALE: NONE EXCEPT AS NOTED

SEEP #1 REPAIR AND PIPE ABANDONMENT PLAN

WATTS BAR SLAG DISPOSAL AREA MAINTENANCE

MICHAEL MEULEMANS No. 16952
5/8/15

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
ANR	ASL	JJH	MRM	JDM	MST	JCK

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

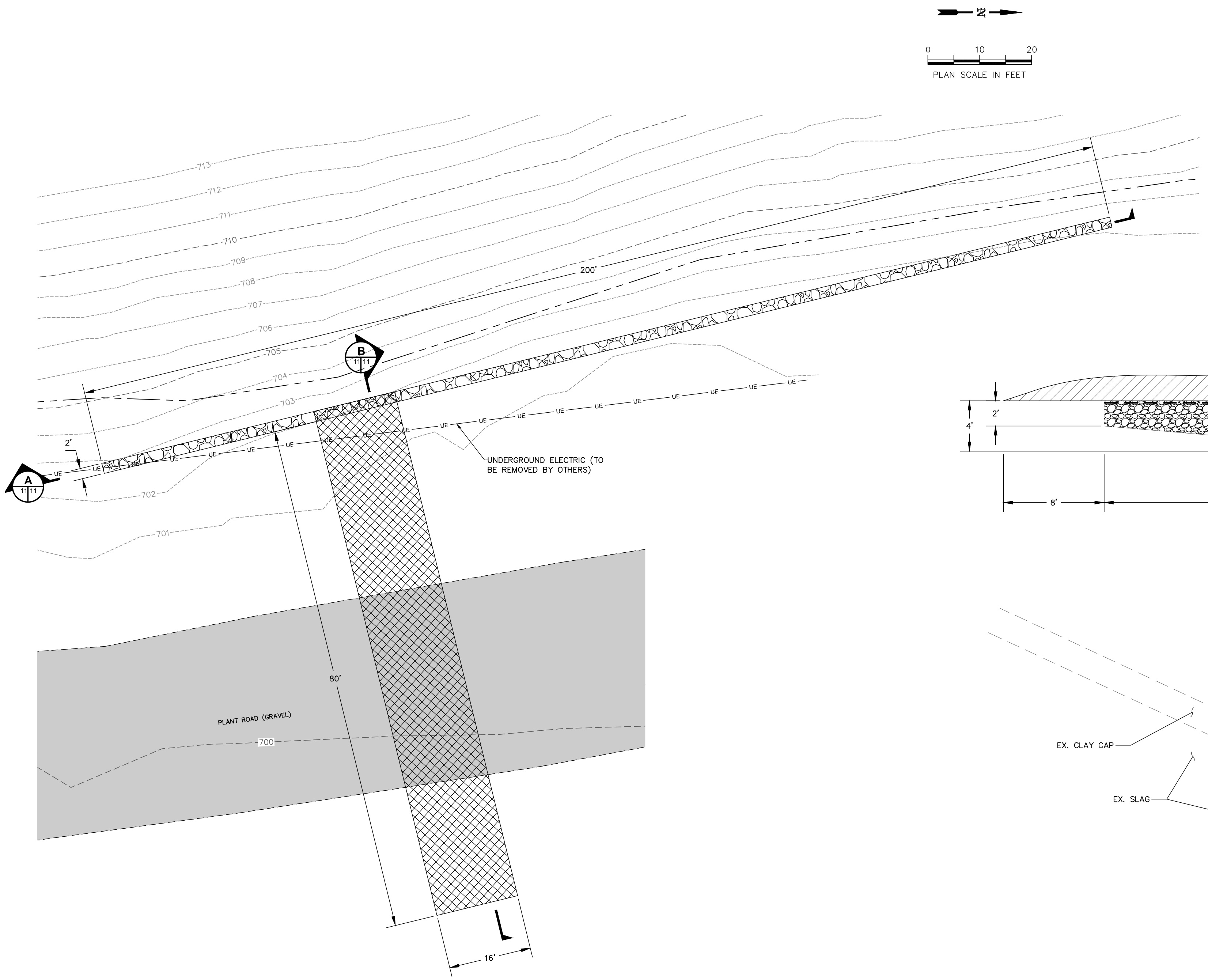
AUTOCAD 2013 DATE 05/08/15 14 C 10W426-10 R 0

URS Corporation 0
TASK COMPLETED BY: REV NO.

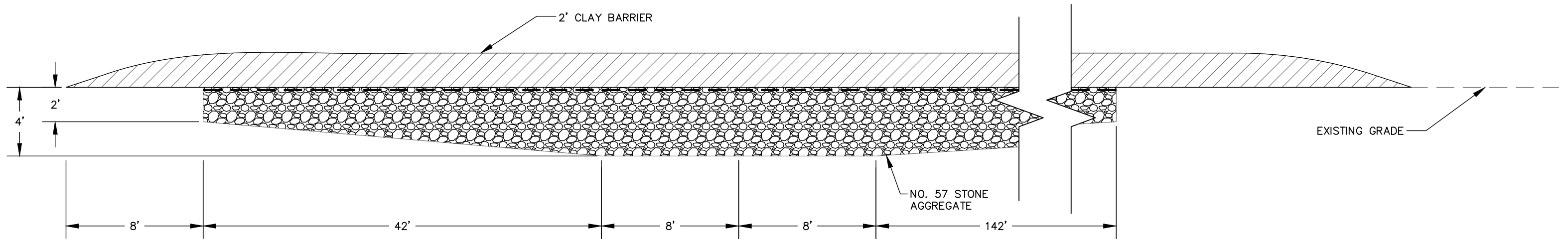
PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

14 C 10W426-11



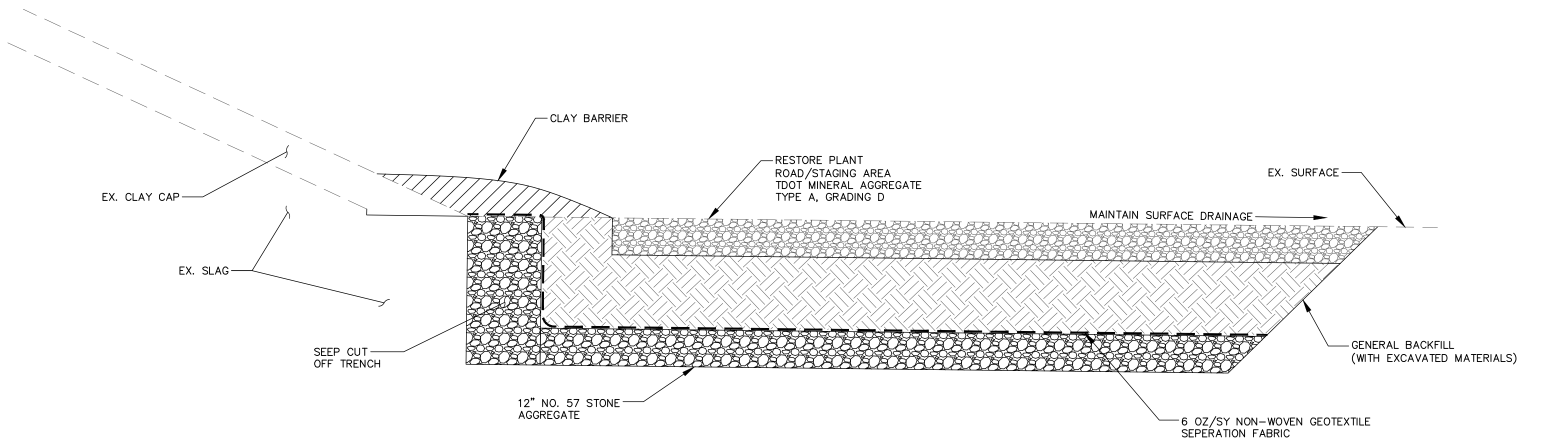
SEEP #1 REPAIR PLAN



SECTION A - SEEP #1 REPAIR

A 11 11

N.T.S.



SECTION B - SEEP #1 REPAIR

B 11 11

N.T.S.

FOR SUPPORTING DESIGN CALCULATIONS SEE:
FPGWBFDEGCDX0003002015000007

MICHAEL MEULEMANS
No. 16952
5/8/15

R #											
R 0	05/08/15	ANR	ASL	JJH	MRM	JDM	MST	JCK	729178		D
ISSUED FOR CONSTRUCTION											
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD

DISCIPLINE INTERFACE
1
2
3
4

SCALE: NONE EXCEPT AS NOTED

SEEP #1 REPAIR SECTIONS

WATTS BAR SLAG DISPOSAL AREA MAINTENANCE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
ANR	ASL	JJH	MRM	JDM	MST	JCK

URS

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

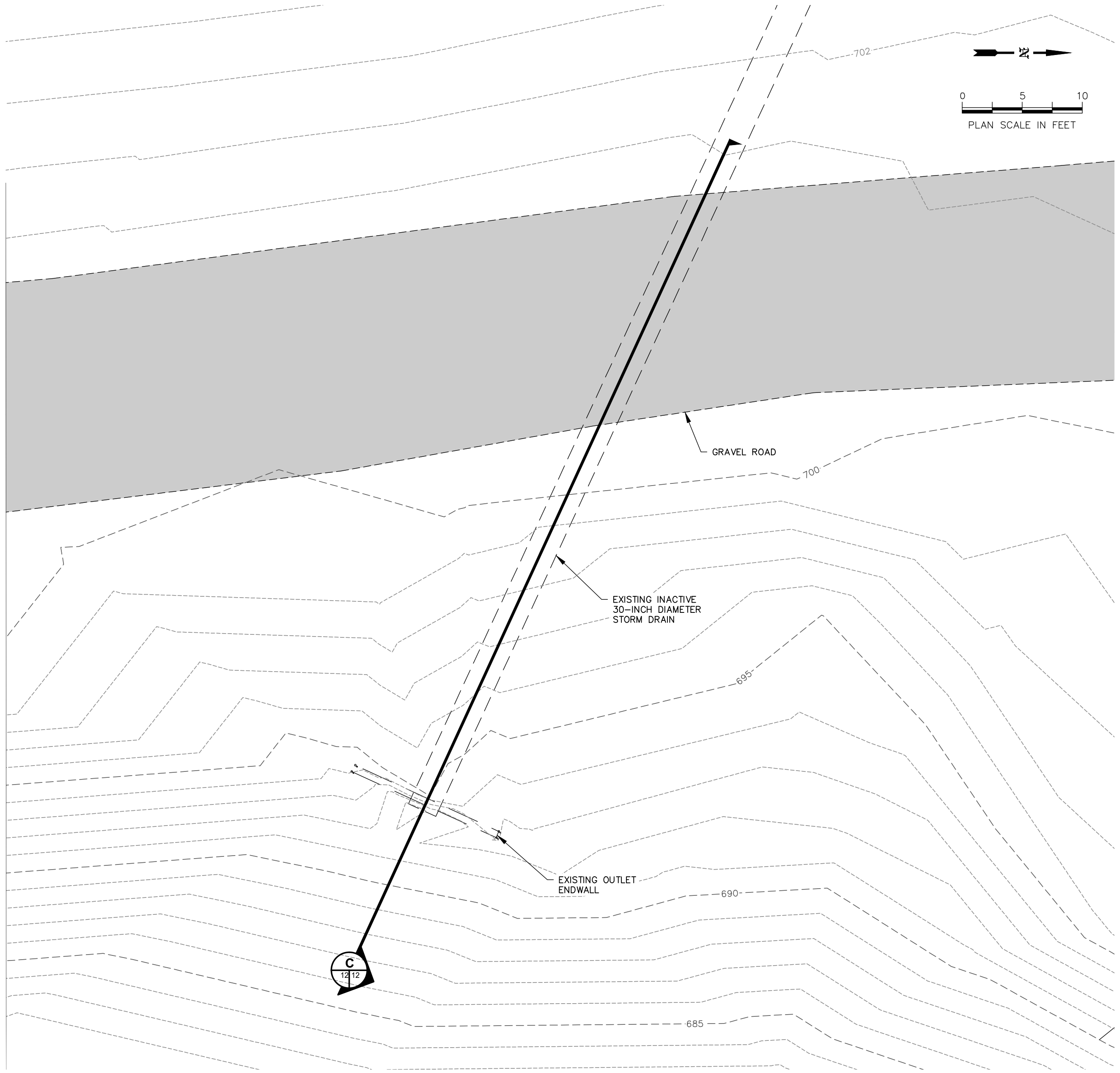
AUTOCAD 2013 DATE 05/08/15 14 C 10W426-11 R 0

URS Corporation 0
TASK COMPLETED BY: REV NO.

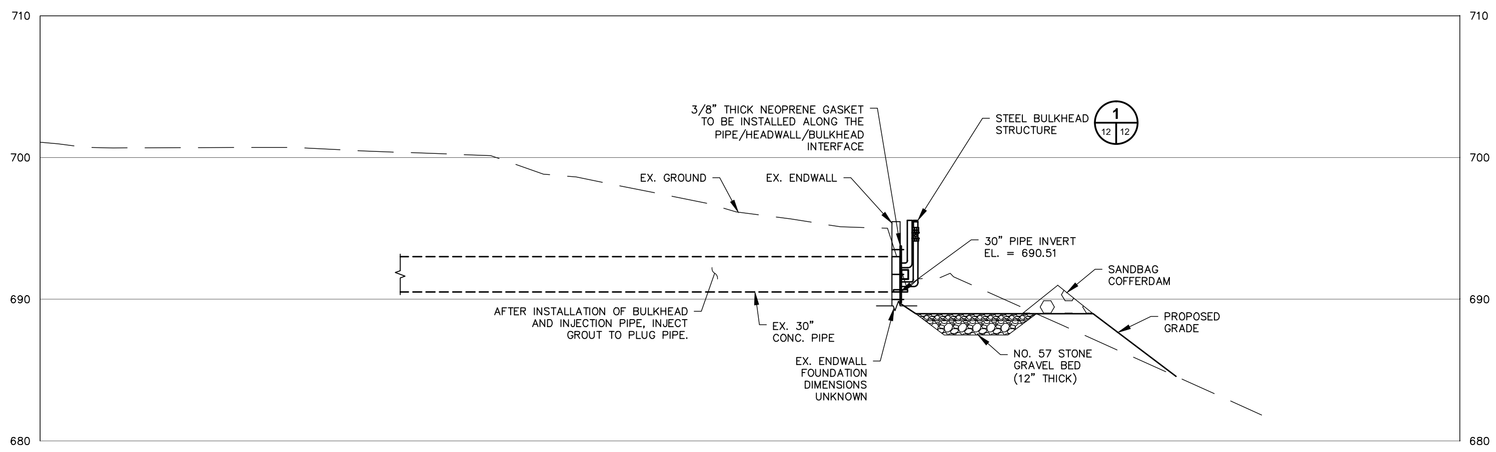
PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

Q:\Projects\31858011_TVAWattsBa\DWGs\Sheets\SlagPile\31858011 10W426-11 Seep #1 Repair Sections.dwg User:andrew_rodzionko May 08, 2015 - 9:08pm



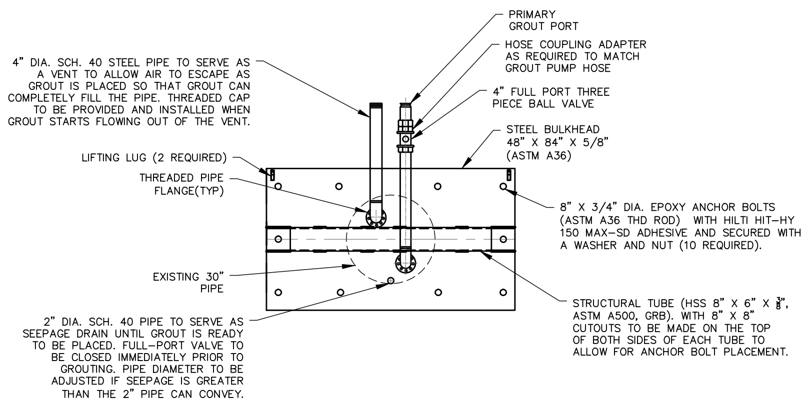
PIPE ABANDONMENT PLAN



C
12 | 12

SECTION C

N.T.S.



1
12 | 12

STEEL BULKHEAD STRUCTURE

N.T.S.

FOR SUPPORTING DESIGN CALCULATIONS SEE:
FPGWBFDEGCDX0003002015000007

MICHAEL MEULEMANS
REGISTERED ENGINEER
No. 16952
5/8/15

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R #											
R 0	05/08/15	ANR	ASL	JJH	MRM	JDM	MST	JCK	729178		D
ISSUED FOR CONSTRUCTION											

DISCIPLINE INTERFACE
1
2
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4

SCALE: NONE EXCEPT AS NOTED

PIPE ABANDONMENT DETAILS

WATTS BAR SLAG DISPOSAL AREA MAINTENANCE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
ANR	ASL	JJH	MRM	JDM	MST	JCK

URS

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013	DATE 05/08/15	14	C	10W426-12	R 0

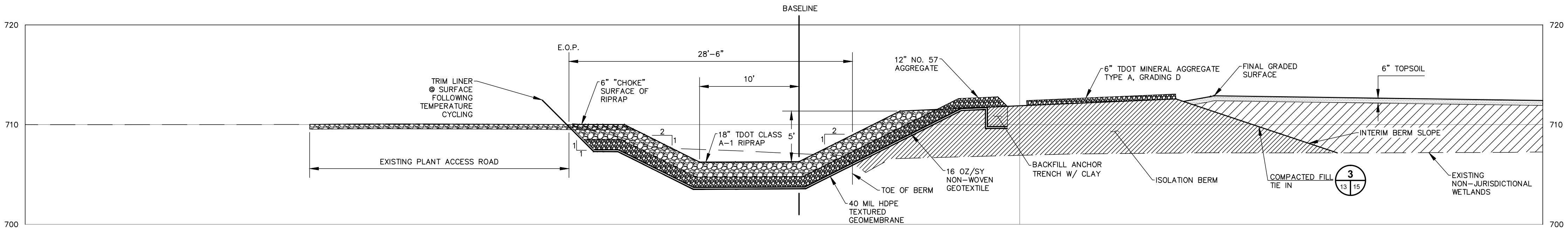
URS Corporation	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

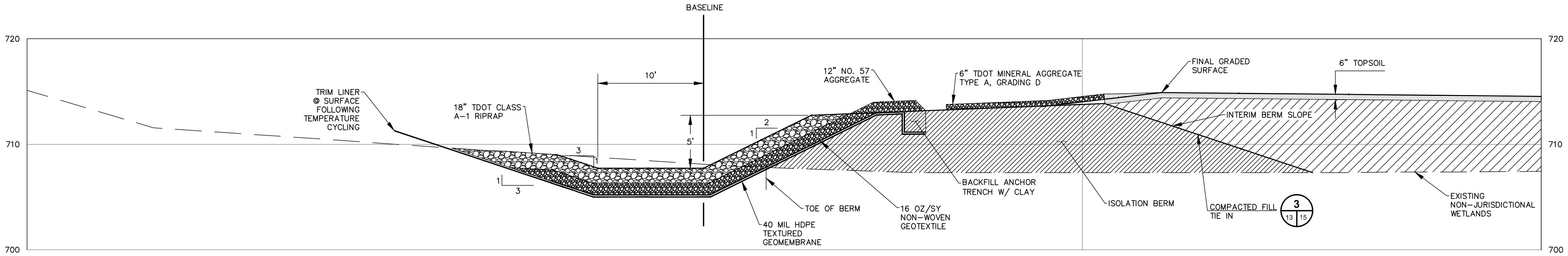
C.A.D. DRAWING
DO NOT ALTER MANUALLY

Q:\Projects\31858011_TVAWattsBa\DWGs\Sheets\SlagPile\31858011 10W426-12 Pipe Abandonment Details.dwg User:andrew_rodzianko May 08, 2015 - 9:08pm

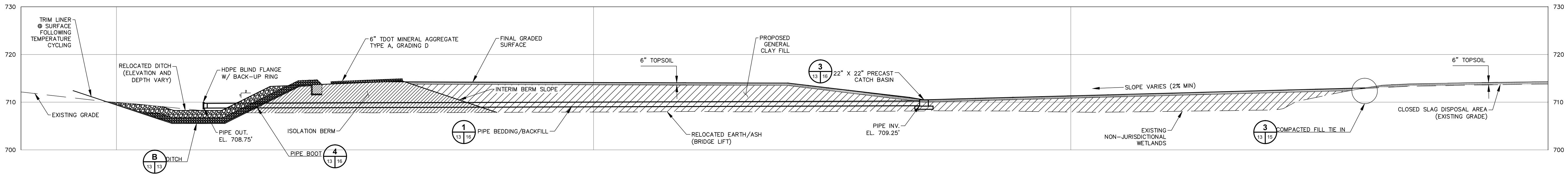
14 C 10W426-13



A 08 | 13 **TYPICAL SECTION**
N.T.S.



B 08 | 13 **TYPICAL SECTION**
N.T.S.



C 09 | 13 **TYPICAL SECTION**
N.T.S.

FOR SUPPORTING DESIGN CALCULATIONS SEE:
FPGWBFDEGCDX0003002015000007

R #											
R 0	05/08/15	ANR	ASL	JJH	MRM	JDM	MST	JCK	729178		D
ISSUED FOR CONSTRUCTION											
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD

DISCIPLINE INTERFACE
1
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4

SCALE: NONE EXCEPT AS NOTED

GRADING DETAILS I

WATTS BAR SLAG DISPOSAL AREA MAINTENANCE

MICHAEL MEULEMANS
No. 16952
5/8/15

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
ANR	ASL	JJH	MRM	JDM	MST	JCK

URS

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 | DATE 05/08/15 | 14 | C | 10W426-13 | R 0

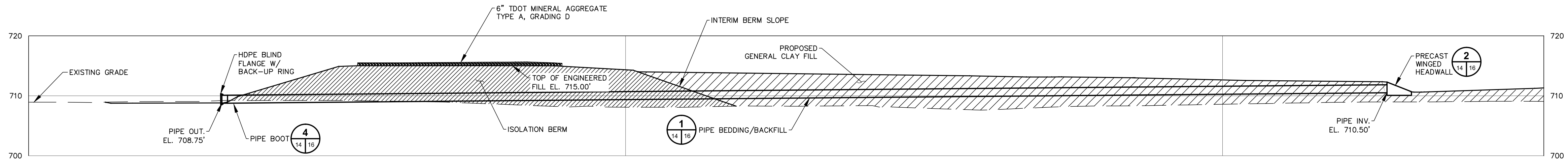
URS Corporation | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

Q:\Projects\31858011_TVAWattsBa\DWGs\Sheets\SlagPile\31858011 10W426-13 Grading Details I.dwg User: andrew_rodzianko May 08, 2015 - 9:08pm

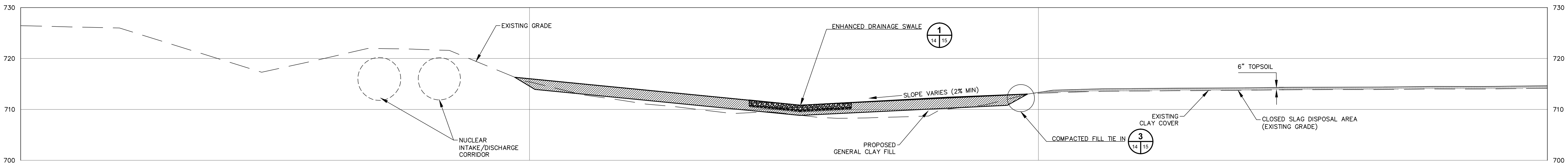
14 C 10W426-14



D 09 14

TYPICAL SECTION

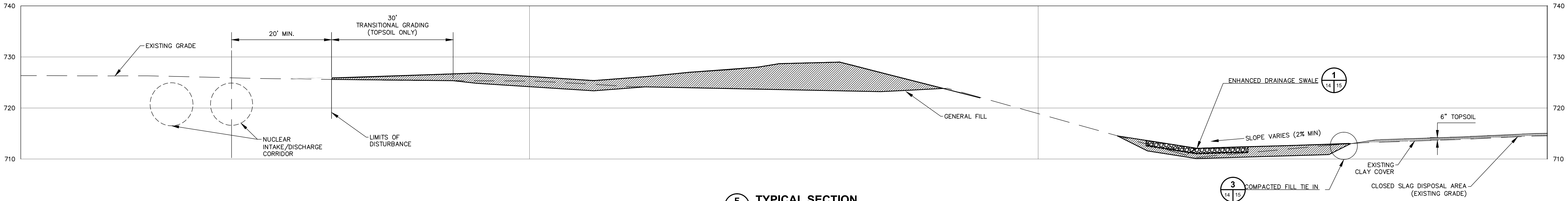
N.T.S.



E 09 14

TYPICAL SECTION

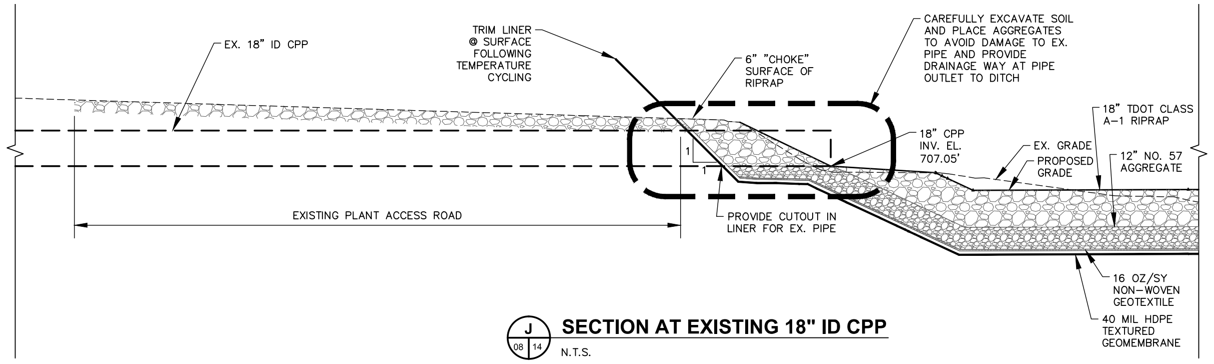
N.T.S.



F 09 14

TYPICAL SECTION

N.T.S.



J 08 14

SECTION AT EXISTING 18" ID CPP

N.T.S.

FOR SUPPORTING DESIGN CALCULATIONS SEE:
FPGWBFDEGCDX0003002015000007

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R 1	06/12/15	ANR	ASL	SCW	MRM	JDM	MST	JCK	729178		E
ISSUED FOR CONSTRUCTION – SCNS D,E,F UPDATED WITH GRADING CHANGES, ADDED SCN J											
R 0	05/08/15	ANR	ASL	JJH	MRM	JDM	MST	JCK	729178		D
ISSUED FOR CONSTRUCTION											

DISCIPLINE INTERFACE
1
2
3
4

MICHAEL MEULEMANS
6/12/15

SCALE: NONE EXCEPT AS NOTED

GRADING DETAILS II

WATTS BAR SLAG DISPOSAL AREA MAINTENANCE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
ANR	ASL	SCW	MRM	JDM	MST	JCK

AECOM

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

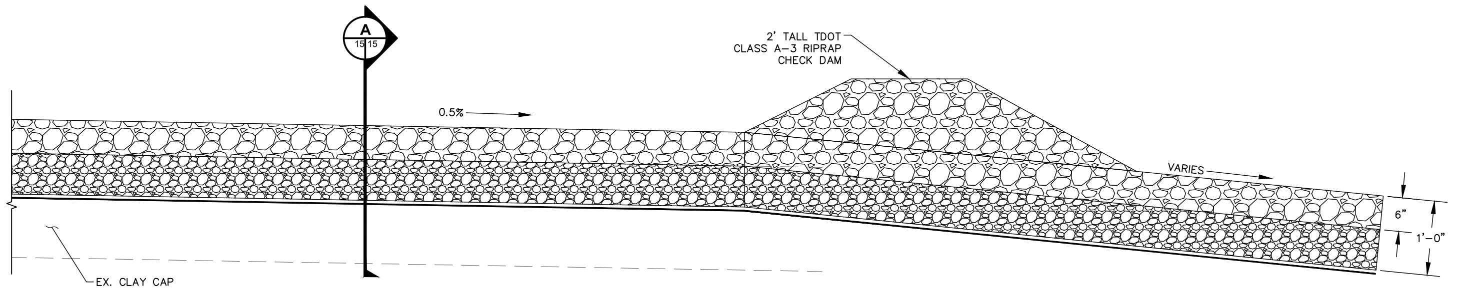
AUTOCAD 2013 DATE 06/12/15 14 C 10W426-14 R 1

AECOM	1
TASK COMPLETED BY:	REV NO.

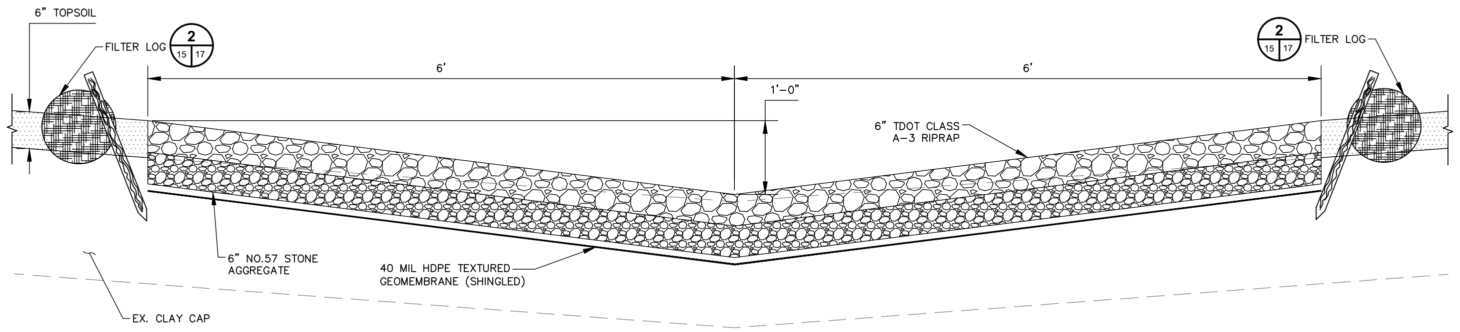
PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

O:\Projects\31858011_TVAWattsBa\DWGs\Sheets\SlagPile\31858011 10W426-14 Grading Details II.dwg User:andrew_rodzianko Jun 12, 2015 - 4:13pm

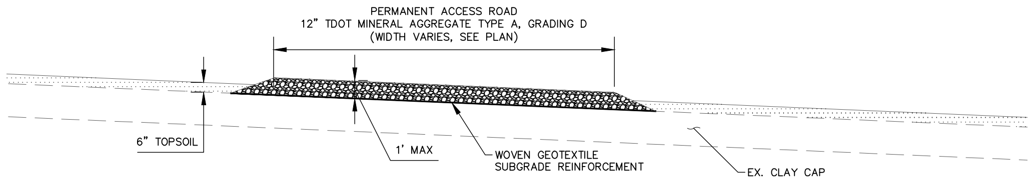


1 ENHANCED DRAINAGE SWALE
09 15
N.T.S.

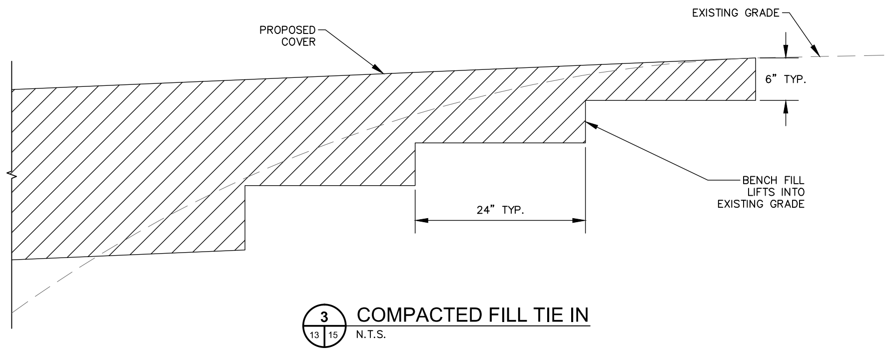


A SECTION A - ENHANCED DRAINAGE SWALE
15 15
N.T.S.

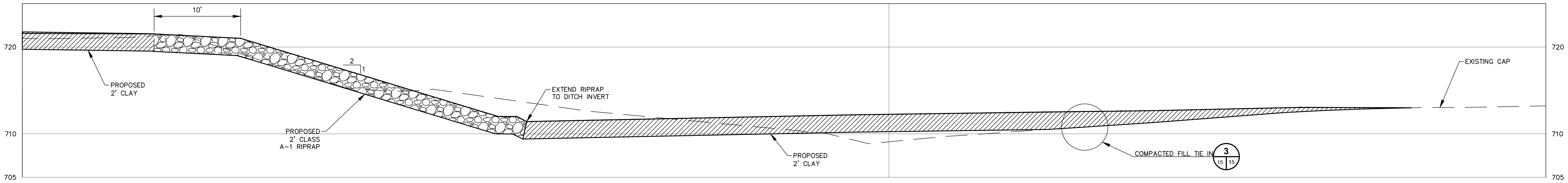
NOTE: CONTRACTOR TO USE CAUTION WHEN EXCAVATING IN CLAY CAP. EXCAVATION MUST NOT EXCEED ONE FOOT, UNLESS OTHERWISE APPROVED BY THE ENGINEER.



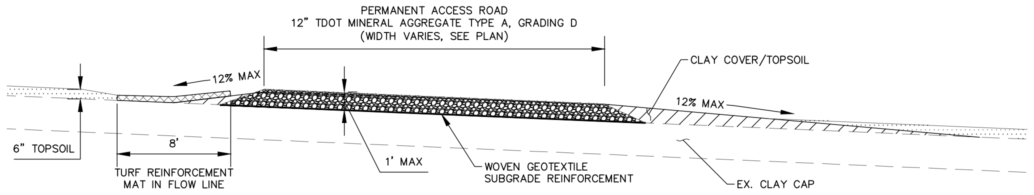
C PERMANENT ACCESS ROAD
07 15
N.T.S.



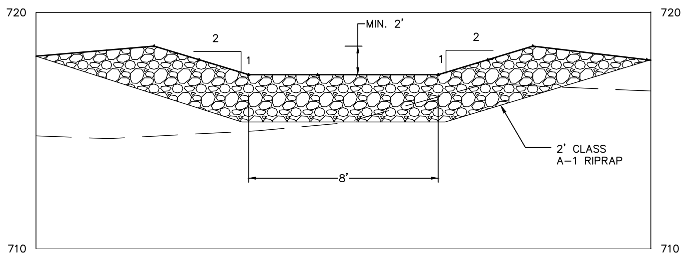
3 COMPACTED FILL TIE IN
13 15
*14
N.T.S.



G RIPRAP LETDOWN - SECTION G
09 15
N.T.S.



2 SURFACE WATER DIVERSION BERM
07 15
N.T.S.



H RIPRAP LETDOWN - SECTION H
09 15
N.T.S.

FOR SUPPORTING DESIGN CALCULATIONS SEE:
FPGWBFDEGCDX0003002015000007

MICHAEL MEULEMANS
REGISTERED ENGINEER
No. 16951
6/12/15

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R 1	06/12/15	ANR	ASL	SCW	MRM	JDM	MST	JCK	729178		E
ISSUED FOR CONSTRUCTION – ROAD DESIGNATION CHANGED TO PERMANENT, SCN G UPDATED											
R 0	05/08/15	ANR	ASL	JJH	MRM	JDM	MST	JCK	729178		D
ISSUED FOR CONSTRUCTION											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: NONE EXCEPT AS NOTED

GRADING DETAILS III

WATTS BAR SLAG DISPOSAL AREA MAINTENANCE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
ANR	ASL	SCW	MRM	JDM	MST	JCK

AECOM

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

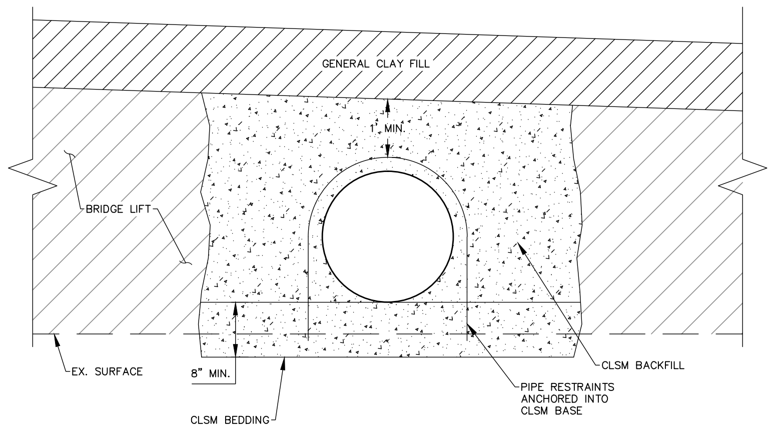
AUTOCAD 2013 DATE 06/12/15 14 C 10W426-15 R 1

AECOM	1
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

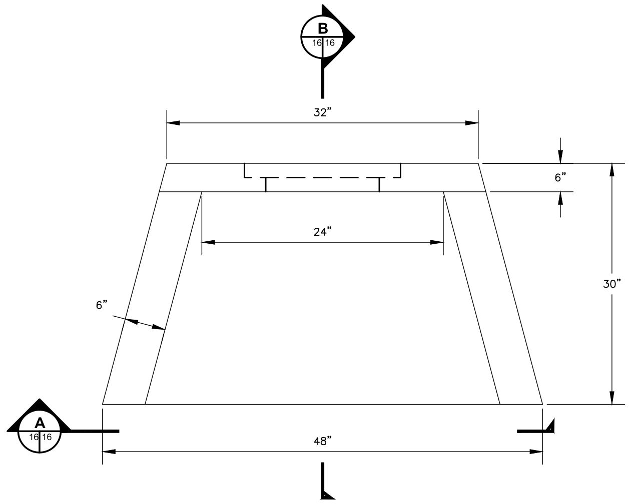
C.A.D. DRAWING
DO NOT ALTER MANUALLY

Q:\Projects\31858011_TVAWattsBa\DWGs\Sheets\SlagPile\31858011 10W426-15 Grading Details III.dwg User:andrew_rodzianko Jun 12, 2015 - 4:17pm

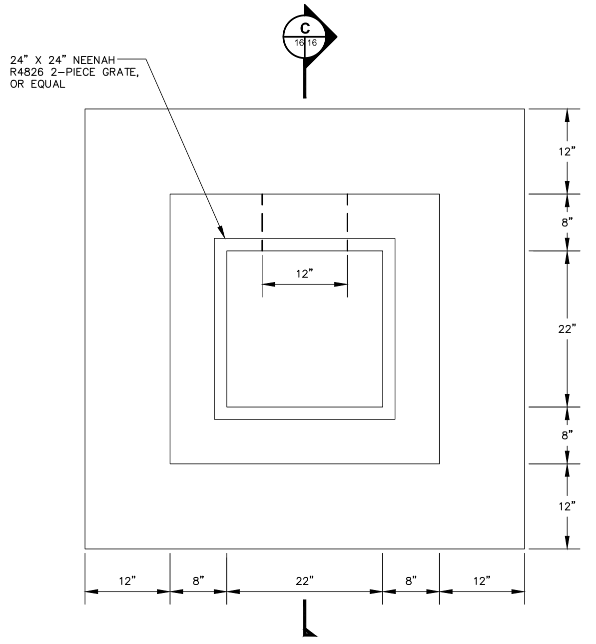


1 PIPE BEDDING/BACKFILL 13 16
N.T.S.

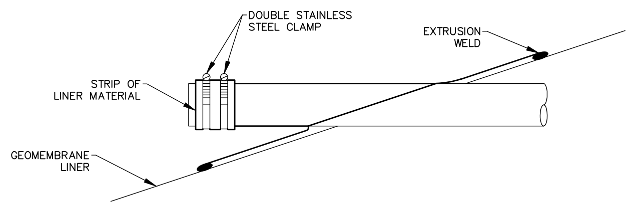
NOTE: THIS DETAIL IS TYPICAL FOR CULVERTS C1 THROUGH C5.



2 PRECAST WINGED HEADWALL 14 16
N.T.S.



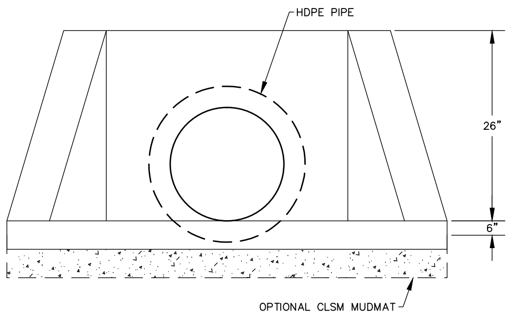
3 22" X 22" PRECAST CATCH BASIN 13 16
N.T.S.



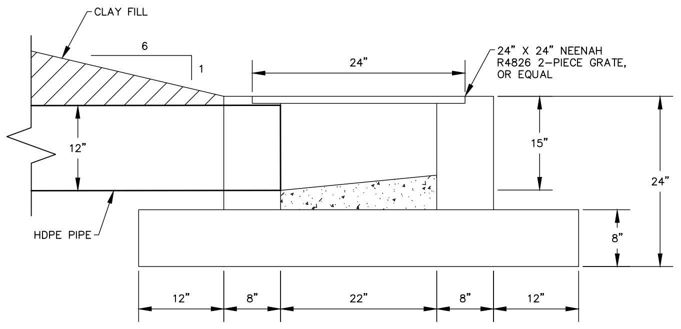
4 PIPE BOOT 13 16
N.T.S.

NOTES:

1. GEOTEXTILE AND STONE NOT SHOWN FOR CLARITY.
2. THIS DETAIL IS TYPICAL FOR ALL PIPE ENDS PENETRATING THROUGH DITCH LINER.



A SECTION A - PRECAST WINGED HEADWALL 16 16
N.T.S.



C SECTION C - 22" X 22" CATCH BASIN 16 16
N.T.S.

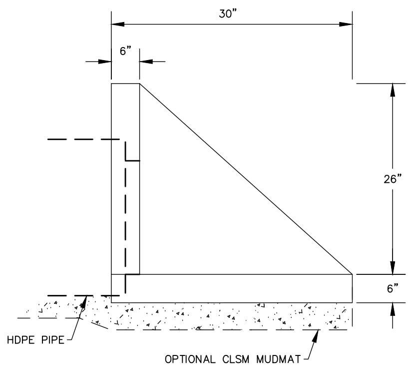
TABLE 1 - CULVERT INFORMATION (ALL HDPE)

CULVERT ID	INLET STRUCTURE	GRATE ELEVATION	NUMBER– INSIDE DIAMETER	INLET INVERT ELEVATION	INLET INVERT NORTHING	INLET INVERT EASTING	OUTLET INVERT ELEVATION	OUTLET INVERT NORTHING	OUTLET INVERT EASTING	LENGTH (FEET)	SLOPE (%)
C1	HEADWALL	N/A	1 – 16"	710.50'	444749	2362136	708.75'	444617	2361992	200	0.88
C2	N/A	N/A	2 – 24"	709.25'	444670	2361994	709.00'	444619	2361989	50	0.50
C3	CATCH BASIN	710.50'	1 – 12"	709.25'	444447	2362126	708.75'	444437	2361977	150	0.33
C4	N/A	N/A	2 – 24"	707.50'	444164	2361904	707.00'	444099	2361942	75	0.67
C5	N/A	N/A	1 – 12"	708.00'	444042	2362530	706.00'	443993	2362528	50	4.00
C6*	N/A	N/A	1 – 16"	706.60'	443964	2362616	706.00'	443971	2362561	50	1.20
C7**	N/A	N/A	2 – 12"	709.85'	444138	2362886	709.55'	444103	2362867	50	0.60

NOTES:

* C6 IS A TEMPORARY CULVERT.

** C7 BEDDING/BACKFILL SHALL CONSIST OF GRANULAR ENGINEERED FILL, 6-INCHES MINIMUM COVER ON ALL SIDES.



B SECTION B - PRECAST WINGED HEADWALL 16 16
N.T.S.

FOR SUPPORTING DESIGN CALCULATIONS SEE:
FPGWBFDEGCDX0003002015000007

MICHAEL MEULEMANS
No. 16951
6/12/15

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R 1	06/12/15	ANR	ASL	SCW	MRM	JDM	MST	JCK	729178		E
ISSUED FOR CONSTRUCTION – TABLE 1: C2 CHANGED TO 24" PIPES, ADDED LOCATION DATA											
R 0	05/08/15	ANR	ASL	JJH	MRM	JDM	MST	JCK	729178		D
ISSUED FOR CONSTRUCTION											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: NONE EXCEPT AS NOTED

CULVERT DETAILS

WATTS BAR SLAG DISPOSAL AREA MAINTENANCE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
ANR	ASL	SCW	MRM	JDM	MST	JCK

AECOM

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 DATE 06/12/15 14 C 10W426–16 R 1

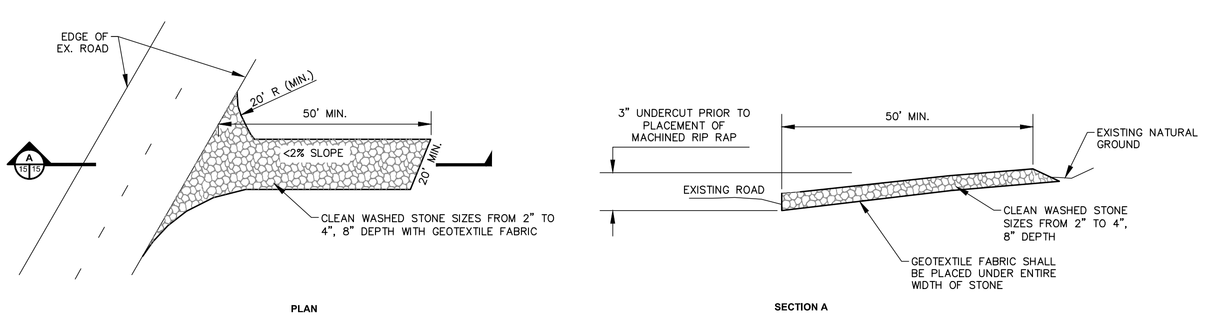
AECOM	1
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

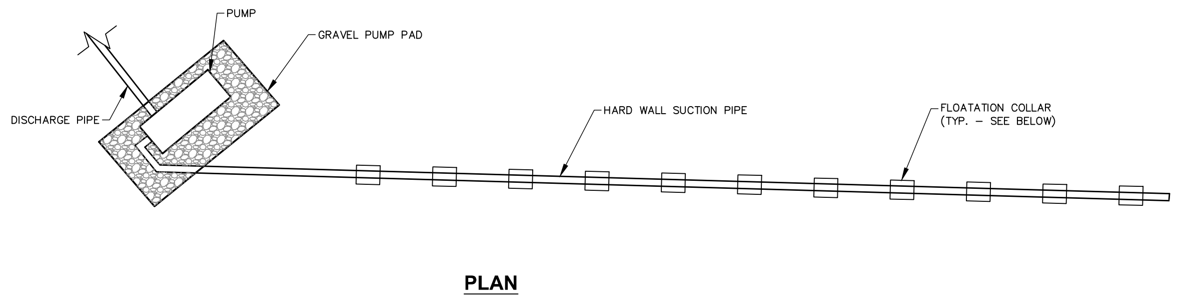
C.A.D. DRAWING
DO NOT ALTER MANUALLY

Q:\Projects\31858011_TVAWattsBa\DWGs\Sheets\SlagPile\31858011 10W426-16 Culvert Details.dwg User: andrew_rodzianko Jun 12, 2015 - 4:18pm

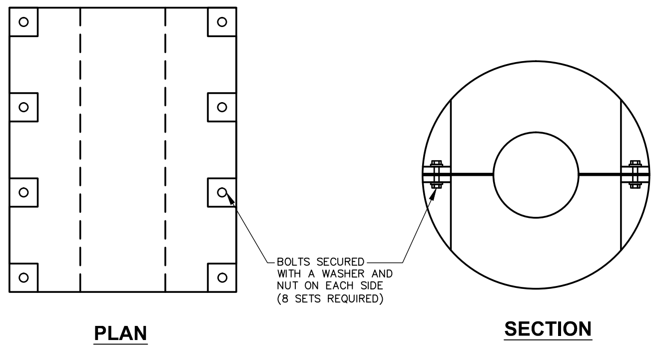
14 C 10W426-17



1 CONSTRUCTION ENTRANCE
07 17
N.T.S.
'08



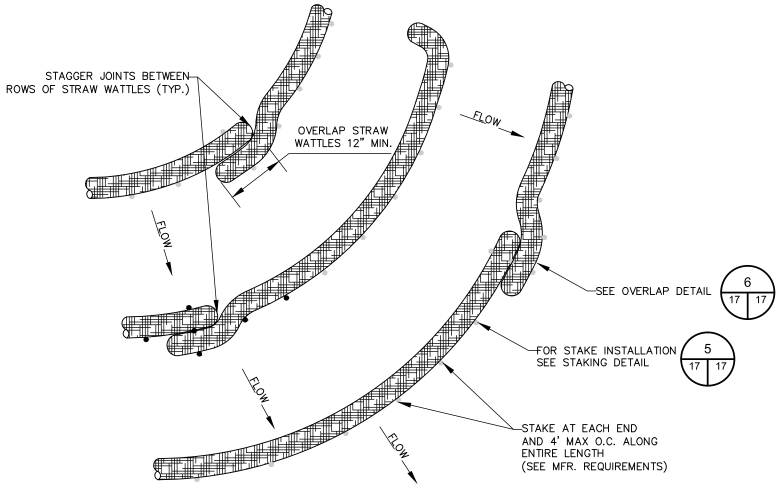
PLAN



FLOATATION COLLAR DETAIL

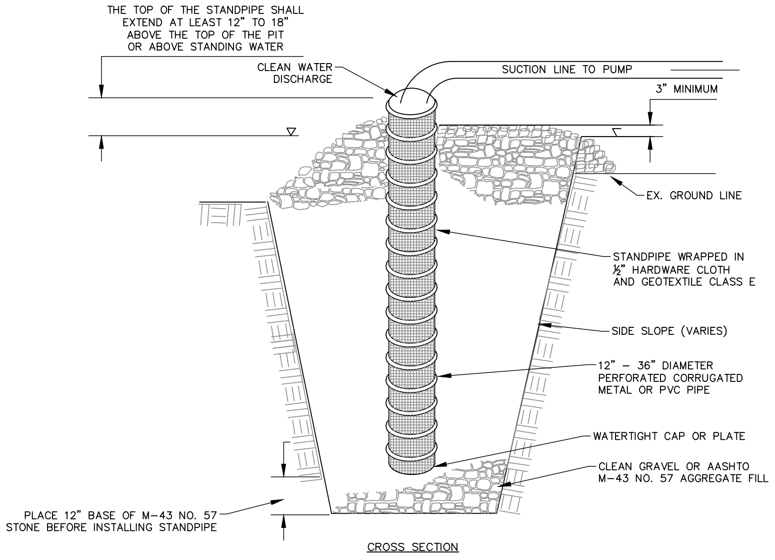
4 FLOATING SUCTION LINE
06 17
N.T.S.

NOTES:
1. FLOATATION COLLARS (NAUTILUS PART NUMBER 4441200F92602 OR EQUIVALENT) SHALL BE INSTALLED ON THE PUMP SUCTION LINES CONNECTED TO THE PUMP ACCORDING TO THE MANUFACTURERS SPECIFICATIONS (APPROXIMATELY 10 FEET FROM CENTER TO CENTER) AND TO ENSURE ADEQUATE SUSPENSION OF THE SUCTION LINES IN THE WATER.
2. APPROPRIATE FLOTATION COLLAR SIZES SHALL BE USED, DEPENDING ON THE SUCTION PIPE SIZE.
3. CONTRACTOR IS RESPONSIBLE FOR PROVIDING ALL NECESSARY PIPE BENDS, EXPANSIONS, CONNECTIONS, AND FLANGES IN ORDER TO DIRECT THE SUCTION AND DISCHARGE LINES TO THE APPROPRIATE INLET AND OUTLET LOCATIONS AS THEY ARE DEPICTED ON THIS WORK PLAN.
4. THE CONTRACTOR SHALL TAKE CARE TO USE BEST MANAGEMENT PRACTICES DURING CONSTRUCTION DEWATERING, INCLUDING, BUT NOT LIMITED TO, PREVENTING/CONTAINING FUEL SPILLS AND LIMITING SEDIMENT DISTURBANCE/INTAKE.

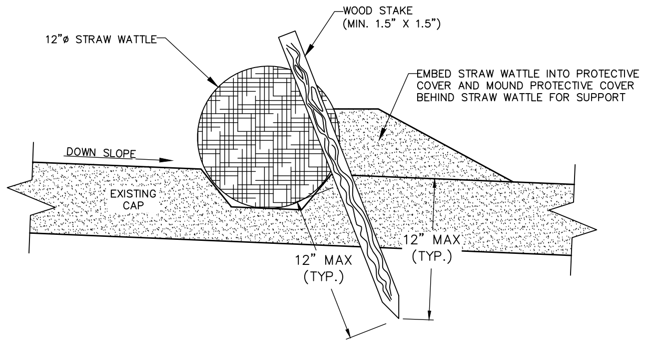


2 FILTER LOG
06 17
N.T.S.

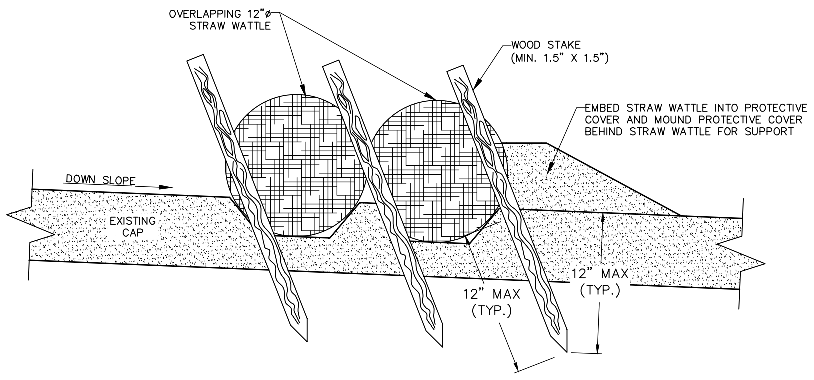
NOTE: FILTER LOG MUST BE INSTALLED IN LIEU OF SILT FENCE WITHIN SLAG DISPOSAL AREA CLOSURE LIMITS INDICATED ON THE PLANS. SILT FENCE MAY BE INSTALLED OUTSIDE CLOSURE LIMITS.



3 SUMP PIT
06 17
N.T.S.



5 STAKING DETAIL
17 17
N.T.S.



6 OVERLAP DETAIL
17 17
N.T.S.

FOR SUPPORTING DESIGN CALCULATIONS SEE:
FPGWBFDEGCDX0003002015000007

R #											
R 0	05/08/15	ANR	ASL	JJH	MRM	JDM	MST	JCK	729178		D
ISSUED FOR CONSTRUCTION											
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD

DISCIPLINE INTERFACE
1
2
3
4

SCALE: NONE EXCEPT AS NOTED

EROSION AND SEDIMENT CONTROL DETAILS

WATTS BAR SLAG DISPOSAL AREA MAINTENANCE

MICHAEL MEULEMANS
No. 16952
5/8/15

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
ANR	ASL	JJH	MRM	JDM	MST	JCK

URS

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD 2013 | DATE 05/08/15 | 14 | C | 10W426–17 | R 0

URS Corporation	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

Q:\Projects\31858011_TVAWattsBa\DWGs\Sheets\SlagPile\31858011 10W426-17 Erosion and Sediment Control Details.dwg User:andrew_rodzianko May 08, 2015 9:09pm

14 C 10W254-01

PLANS FOR CONSTRUCTION

ASH POND CLOSURE PROJECT
WORK PLAN 2 (WBF-10W254-WP-2)
WATTS BAR FOSSIL PLANT

SPRING CITY, RHEA COUNTY, TENNESSEE

PREPARED FOR

TENNESSEE VALLEY AUTHORITY

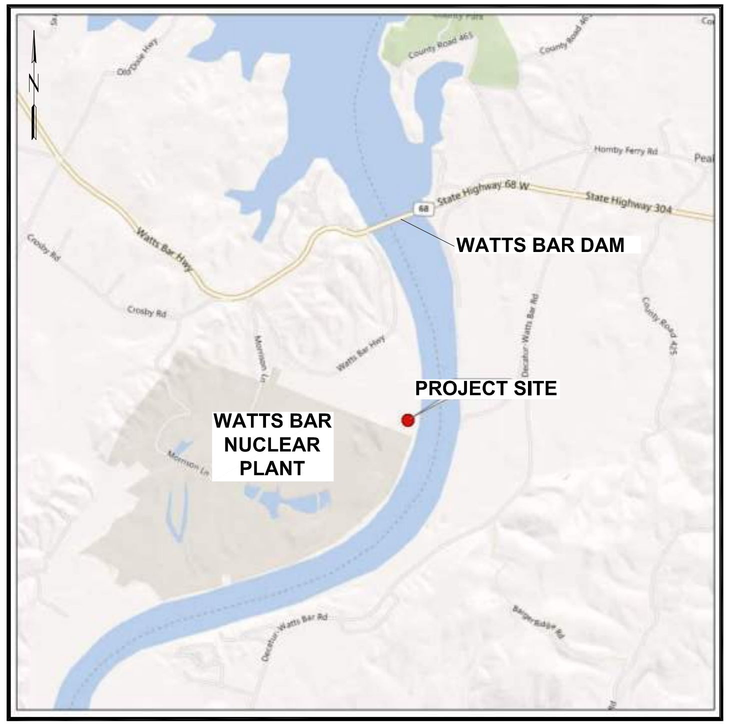
PREPARED BY

CDM Smith

CDM SMITH
1100 Marion Street
Suite 200
Knoxville, Tennessee
37921
Tel. 865.963.4300
Fax 865.963.4301
www.cdmsmith.com

INDEX OF SHEETS

10W254-01	COVER SHEET
10W254-02	GENERAL NOTES
10W254-03	EXISTING CONDITIONS PLAN
10W254-04	EXCAVATION PLAN
10W254-05	CONTAINMENT BERM PLAN
10W254-06	ASH GRADING PLAN
10W254-07	FINAL CAP GRADING PLAN
10W254-08	ASH EXCAVATION CROSS SECTIONS
10W254-09	ASH CLOSURE CROSS SECTIONS 1
10W254-10	ASH CLOSURE CROSS SECTIONS 2
10W254-11	EROSION AND SEDIMENTATION CONTROL PLAN
10W254-12	CIVIL DETAILS
10W254-13	CIVIL DETAILS
10W254-14	CIVIL DETAILS
10W254-15	FINAL CONDITIONS PLAN



VICINITY MAP
NOT TO SCALE

INDEX OF QUANTITIES

PLACEMENT AND COMPACTION OF ASH (SEE NOTE 1)	82,000 CY
40mil TEXTURED LLDPE	333,000 SF
PROTECTIVE COVER SOIL	18,000 CY
VEGETATIVE COVER SOIL	6,000 CY
CONTAINMENT BERM	15,000 CY
TDOT NO. 2 STONE	2,000 CY
TDOT CLASS A-1 RIPRAP	5,000 CY

R1

NOTES:

1. INCLUDES ASH EXCAVATED FROM THE POND PLUS MATERIAL PREVIOUSLY PLACED IN WINDROWS IN THE DRY ASH AREA ABOVE ELEVATION 706. DOES NOT INCLUDE EXISTING DRY ASH.

ISSUED FOR CONSTRUCTION

PLOT DATE: 05/14/2014 USER: BROKAW, MATTHEW J.
C:\CDMXM\BROKAWMJ\D1204666\WBF-10W254-01-SHT -REV 2.DWG

PROJECT REVISION HISTORY

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R2	05/14/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 2											
R1	05/06/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 1											
R0	04/17/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 0											
R B	10/29/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISON NO.B											
R A	6/28/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO.A											

DISCIPLINE INTERFACE
1
2
3
4

For Supporting Design Calculations See FPG-WBF-DEG-CDX0000002013000043

STEPHEN L. WHITESIDE
No. 108556
Stephen L. Whiteside
5/14/14

SCALE: NONE EXCEPT AS NOTED

YARD
–

ASH POND CLOSURE PROJECT
COVER SHEET
WORK PLAN 2 (WBF-10W254-WP-2)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
R.NAGEL	M.BROKAW	D.NEAMTU	S.WHITESIDE	J.MULLINS	M.TURNBOW	J.KAMMEYER

CDM Smith

CDM SMITH
1100 Marion Street
Suite 200
Knoxville, Tennessee
37921
Tel. 865.963.4300
Fax 865.963.4301
www.cdmsmith.com

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2013 | DATE 05/14/2014 | 14 | C | 10W254-01 | R 2

CDM SMITH	2
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

GENERAL PROVISIONS

1. THE CONTRACTOR SHALL CONFINE ALL SPECIFIC WORK ACTIVITIES TO THE AREA DEFINED BY THE PLANS OR APPROVED BY THE OWNER (TENNESSEE VALLEY AUTHORITY). ACCESS INTO THE WORK AREA FOR DELIVERY OF EQUIPMENT, MATERIALS AND WORKFORCE SHALL BE REVIEWED DAILY BY THE CONTRACTOR, AND CONTROLLED AS NEEDED TO PREVENT ANY DAMAGE TO AREAS OF THE SITE OUTSIDE THE WORK AREAS. IF EQUIPMENT OR MATERIAL HAULING CAUSES DAMAGE, THE DAMAGE SHALL BE IMMEDIATELY REPAIRED BY THE CONTRACTOR, AND THE METHODS FOR HAULING SHALL BE ALTERED TO PREVENT FURTHER DAMAGE. EXCEPT AS SHOWN ON THESE PLANS THE CONTRACTOR SHALL AVOID MAKING EXCAVATIONS WITHOUT THE APPROVAL OF THE OWNER OR THE ENGINEER (CDM SMITH).
2. THE CONTRACTOR SHALL COORDINATE WITH THE OWNER TO DETERMINE THE LOCATION AND AREA FOR EQUIPMENT OR MATERIAL STORAGE AND FOR OTHER CONSTRUCTION LAY DOWN ACTIVITY.
3. WHENEVER REFERENCE IS MADE TO TENNESSEE DEPARTMENT OF TRANSPORTATION (TDOT) STANDARD SPECIFICATIONS, AMERICAN CONCRETE INSTITUTE (ACI), AMERICAN WATER WORKS ASSOCIATION (AWWA), AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) AND OTHER PUBLISHED STANDARDS OR SPECIFICATIONS, IT SHALL MEAN THE LATEST VERSION IN ITS ENTIRETY.
4. THE TOPOGRAPHIC MAPPING PRESENTED ON THE DRAWINGS WAS PRODUCED BY TVA SURVEYING AND PROJECT SERVICES AND WAS PROVIDED TO CDM SMITH. THE LOCATION COORDINATES PRESENTED HEREIN ARE BASED ON THE TENNESSEE STATE PLANE COORDINATE SYSTEM OF 1927 (NAD27). VERTICAL DATUM IS NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29).
5. HORIZONTAL AND VERTICAL SURVEY CONTROL POINTS AND STAKING NECESSARY FOR LAYOUT AND CONSTRUCTION OF THE PROJECT INCLUDING BASELINES TO FACILITATE CONSTRUCTION SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
6. ACCEPTABLE CONSTRUCTION TOLERANCES FROM PLAN DIMENSIONS, ELEVATIONS, AND GRADES SHALL BE AS FOLLOWS:
   - EXCAVATIONS AND FINAL GRADES FOR EARTH SURFACES AND SLOPES: ± 0.25 FEET
   - RIPRAP: FINAL GRADE ± 0.5 FEET, THICKNESS ZERO TO +0.5 FEET
   - PIPES AND APPURTENANCES: ±0.10 FEET OF PLAN ELEVATION.
   - SEE SECTION 02200 FOR TOLERANCES FOR CAP SYSTEM MATERIALS.
7. NO DEVIATIONS FROM THE PLANS OR APPROVED SHOP DRAWINGS SHALL BE MADE WITHOUT PRIOR APPROVAL FROM THE ENGINEER. THE CONTRACTOR SHALL KEEP A RECORD OF ALL DEVIATIONS IN LOCATION OR ELEVATION OF ANY INSTALLATION FROM THAT SHOWN ON THE PLANS, AND ANY DEVIATIONS IN INSTALLATIONS FROM APPROVED SHOP DRAWINGS. AT COMPLETION OF THE PROJECT A PLAN SET OF FINAL RECORD DRAWINGS SHALL BE PREPARED BY THE ENGINEER TO ENSURE THAT THE OWNER HAS A PERMANENT RECORD OF THE PROJECT AS IT WAS CONSTRUCTED. THE CONTRACTOR SHALL COOPERATE FULLY AND ASSIST WITH PREPARATION OF THE FINAL RECORD DRAWINGS.
8. DIMENSIONS AND LIMITS OF WORK ARE SUBJECT TO FIELD ADJUSTMENT BY ENGINEER'S FIELD REPRESENTATIVE.
9. ALL ASH MATERIALS SHALL BE REMOVED FROM THE PONDS AND CAPPED IN THE CONTAINMENT AREA.
10. GRADING SHOWN ON EXCAVATION PLAN ASSUMES THAT REMOVAL TO EL. 690 WILL BE NECESSARY TO REMOVE ALL ASH MATERIAL.
11. SEE CQA DOCUMENT FOR PROPOSED METHOD TO VERIFY REMOVAL OF ALL VISIBLE ASH.
12. ASH CUT SHALL BE CONSIDERED ALL ASH EXCAVATED FROM THE PONDS AND DRY ASH AREA. VOLUME IS CALCULATED IN A LOOSE NATURAL STATE.
13. ASH FILL SHALL BE CONSIDERED DRIED AND COMPACTED ASH PLACED ON TOP OF THE DRY ASH AREA. VOLUME IS CALCULATED IN A COMPACTED STATE.
14. ASH WINDROWS FOR STACKING AND DRYING EXCAVATED ASH SHALL BE PLACED TO MAXIMUM HEIGHT OF 10 FEET, WITH 3H:1V SIDE SLOPES AND 20-FOOT TOE-TO-TOE SPACING. ASH WINDROWS SHALL BE AT LEAST 10 FEET AWAY FROM THE DIVERSION DITCH AND DRAINAGE DITCH AND AT LEAST 20 FEET FROM THE SOUTH SLOPE OF THE DRY ASH AREA. GROUND SURFACE BETWEEN WINDROWS SHALL BE SLOPED TO FACILITATE DRAINAGE AND DIRECT THE SURFACE WATER TO THE DRAINED NORTH POND SOUTH OF THE DRY ASH AREA. R1
15. ALL ASH STACKED IN THE DRY ASH AREA SHALL BE REMOVED TO ELEVATION 706 PRIOR TO STARTING ASH COMPACTION ACTIVITIES IN THE DRY ASH AREA.
16. THE DRAINAGE DITCH IN THE EAST SIDE OF THE DRY ASH AREA WILL BE TEMPORARILY LINED AND DISCHARGE INSIDE THE COFFER DAM TO THE NEW SPILLWAY BY TVA PRIOR TO CONSTRUCTION KICKOFF.

GENERAL NOTES

1. SEVERAL PROJECTS ARE PLANNED OR CURRENTLY UNDER CONSTRUCTION AT THE WBF SITE. THE ASH CLOSURE PROJECT MAY BE CONSTRUCTED CONCURRENTLY WITH THESE PROJECTS.
2. THE ASH POND BREACHING PROJECT IS ON-GOING AND EXISTING SITE CONDITIONS ARE SUBJECT TO CHANGE THROUGH THE COMPLETION OF THAT PROJECT.
3. IN ANY CIRCUMSTANCE WHEREIN THE SPECIFICATIONS CALL FOR A MATERIAL, METHOD, OR SEQUENCE DIFFERING FROM THESE DRAWINGS, THESE DRAWINGS SHALL TAKE PRECEDENT.
4. WATER FOR DUST CONTROL SHALL BE SOURCED FROM A FIRE HYDRANT AT THE WATTS BAR HYDRO WAREHOUSE AND LAYDOWN YARD.

CONSTRUCTION SEQUENCE

THE FOLLOWING CONSTRUCTION SEQUENCE WAS DEVELOPED TO SHOW ONE LOGICAL SEQUENCE OF CONSTRUCTION. PHASING AND SEQUENCE FOR THIS PROJECT SHALL BE COORDINATED WITH OTHER PROJECTS, AS REQUIRED. THE CONTRACTOR SHALL SUBMIT A DETAILED CONSTRUCTION SEQUENCE TO THE ENGINEER FOR REVIEW AND APPROVAL PRIOR TO CONSTRUCTION.

1. INSTALL AND MAINTAIN ALL EROSION AND SEDIMENTATION CONTROL DEVICES.
2. CONSTRUCT A SMALL TEMPORARY DIVERSION BERM ALONG THE SLOPE TO THE WEST OF THE CLOSURE AREA TO DIVERT RUNOFF FROM THE SLOPE SOUTH TO THE POND.
3. CONSTRUCT A TEMPORARY ACCESS ROAD TO THE WEST OF THE CLOSURE AREA AND CONNECTING WITH THE PROPOSED CONTAINMENT BERM ALIGNMENT.
4. CONSTRUCT A RAMP AT THE EAST AND WEST ENDS OF THE PROPOSED CONTAINMENT BERM ALIGNMENT.
5. REMOVE ASH IN THE POND AREA AT THE PROPOSED CONTAINMENT BERM LOCATION. R2
6. CONSTRUCT THE CONTAINMENT BERM TO ELEVATION 700 TO PROVIDE A 24-FOOT-WIDE CREST FOR VEHICLE ACCESS.
7. PLACE AND COMPACT DRY ASH IN THE AREA BETWEEN THE CONTAINMENT BERM AND DRY ASH AREA.
8. EXCAVATE AND CONSTRUCT THE PROPOSED DIVERSION DITCH AND LINE WITH PERMANENT LINER.
9. INSTALL TEMPORARY PIPES OR CULVERT IN THE TOP OF THE CONTAINMENT BERM TO CONVEY FLOW FROM THE DIVERSION DITCH TO THE POND.
10. DIVERT FLOW TO THE DIVERSION DITCH AND EXCAVATE ASH ON THE EAST SIDE.
11. CONSTRUCT THE DRAINAGE DITCH ON THE NORTH AND EAST SIDES.
12. EXCAVATE ASH FROM THE POND AND PLACE IN DESIGNATED AREAS IN THE DRY ASH AREA FOR DEWATERING.
13. PLACE AND COMPACT ASH IN THE CLOSURE AREA.
14. CONSTRUCT CAP SYSTEM.
15. DEMOLISH AND DISPOSE OF (3) STAND PIPES AND GROUT FULL (3) 36" RCP BARRELS. REMOVE COFFERDAM AND EXCAVATE MAIN BERM AS SHOWN ON 10W254-04.
16. CONSTRUCT RIPRAP PROTECTION IN DIVERSION DITCH AND DRAINAGE DITCH AND ON CONTAINMENT BERM.
17. CONSTRUCT NEW ASPHALT ROAD. R1
18. REMOVE EROSION AND SEDIMENTION CONTROL DEVICES AND RESTORE SITE.

PLOT DATE: 05/15/2014 USER: BROKAW, MATTHEW J.
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ISSSUED FOR CONSTRUCTION

PROJECT REVISION HISTORY

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R 2	05/14/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 2											
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REVISION NO. 1											
R 0	04/17/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 0											
R B	10/29/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISON NO.B											
R A	6/28/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO.A											

DISCIPLINE INTERFACE
1
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For Supporting Design Calculations See FPG-WBF-DEG-CDX0000002013000043

STEPHEN L. WHITESIDE
No. 108556
Stephen L. Whiteside
5/14/14

SCALE: NONE EXCEPT AS NOTED

YARD
—

ASH POND CLOSURE PROJECT
GENERAL NOTES AND SPECIFICATIONS
WORK PLAN 2 (WBF-10W254-WP-2)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
R.NAGEL	M.BROKAW	D.NEAMTU	S.WHITESIDE	J.MULLINS	M.TURNBOW	J.KAMMEYER

CDM Smith

CDM SMITH
1100 Marion Street
Suite 200
Knoxville, Tennessee
37921
Tel 865.963.4300
Fax 865.963.4301
www.cdmsmith.com

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2013	DATE 05/14/2014	14	C	10W254-02	R 2

CDM SMITH	2
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
W_TVA

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GROUNDWATER READINGS:

WELL DESIGNATION	RANGE OF GROUND WATER READINGS	DATE OF READINGS
B-1 (SEE NOTE 3)	EL. 687 TO EL. 690	11/2011,01/2012,06/2012
B-3	EL. 682 TO EL. 685	01/2012,06/2012
B-103	EL. 683 TO EL. 684	06/2012
B-107	EL. 682 TO EL. 684	06/2012
B-110	EL. 700	06/2012
B-202	EL. 688 TO EL. 690	04/2013

NOTES:

1. ALL GROUND WATER READINGS MEASURED AT LEAST 24 HOURS AFTER DRILLING WAS COMPLETED.
2. GROUNDWATER READINGS ARE PROVIDED FOR INFOMATION ONLY.
3. WELL OUTSIDE OF SHEET VIEW, TO THE NORTH.

LEGEND:

✦ B-201	CDM SMITH PHASE III BORING LOCATION (2013)
✦ B-101	CDM SMITH PHASE II BORING LOCATION (2012)
✦ B-2	CDM SMITH PHASE I BORING LOCATION (2011/2012)
● HA-1	CDM SMITH PHASE II HAND AUGER LOCATION (2012)
● HA-208-2	CDM SMITH PHASE III HAND AUGER LOCATION (2013)
⊕ B-103	EXISTING GROUNDWATER MONITORING WELL

NOTES:

1. SURVEY PERFORMED BY TVA WINTER OF 2011, SPRING OF 2012, AND WINTER OF 2013. HORIZONTAL DATUM IS US STATE PLANE 1927. VERTICAL DATUM IS NGVD 29.
2. SUMMER POOL (APRIL-SEPTEMBER) ELEVATION OF LAKE CHICKAMAUGA IS 682. WINTER POOL (OCTOBER-MARCH) ELEVATION OF LAKE CHICKAMAUGA IS 675.
3. ALL CDM SMITH BORING AND HAND AUGER LOCATIONS (PHASE I, PHASE II, AND PHASE III) ARE BASED UPON COORDINATES OBTAINED FROM HAND-HELD GPS UNIT AND SHOULD BE CONSIDERED APPROXIMATE.
4. ARCHEOLOGICAL SITE COORDINATES WERE PROVIDED BY TVA ARCHAEOLOGIST AND ARE INCLUDED IN THE CULTURAL COMPLIANCE SECTION OF THE CATEGORICAL EXCLUSION CHECKLIST (CEC) FOR THIS PROJECT.
5. EXISTING CONDITIONS SHOWN ON THIS PLAN MAY NOT BE THE CURRENT SITE CONDITIONS. CONDITIONS ON SITE ARE CONTINUOUSLY UNDERGOING CHANGE. THIS PLAN REPRESENTS THE EXISTING CONDITIONS ANTICIPATED AT THE START OF THIS CLOSURE PROJECT.
6. ALL ASH STACKED IN THE DRY ASH AREA SHALL BE REMOVED TO ELEVATION 706 PRIOR TO STARTING ASH COMPACTION ACTIVITIES IN THE DRY ASH AREA.
7. THE DRAINAGE DITCH IN THE EAST SIDE OF THE DRY ASH AREA WILL BE TEMPORARILY LINED AND DISCHARGE WILL BE DIRECTED INSIDE THE EXISTING COFFERDAM TO THE NEW SPILLWAY BY TVA PRIOR TO CONSTRUCTION KICKOFF. R1 R2

ARCHEOLOGICAL SITE NOTES:

1. EXTENTS OF ARCHEOLOGICAL SITE ARE NOT SPECIFIED, BUT ARE KNOWN TO BE IN THE AREA EAST OF THE ACCESS ROAD AND WEST OF LAKE CHICKAMAUGA.
2. THERE SHALL BE NO DISTURBANCE IN THIS AREA AND CONTRACTOR IS TO STAY OUT OF THE ENTIRE AREA EAST OF THE ACCESS ROAD WITH THE EXCEPTION OF THE CONSTRUCTION TO BE DONE IN THE EXISTING RIPRAP OUTLET AREA.
3. IF HEAVY EQUIPMENT IS TO BE USED ON TOP OF THE BANK (SUCH AS TRACKHOES OR DUMP TRUCKS CARRYING ROCK), THEN THE EQUIPMENT MUST BE USED WHEN THE GROUND IS DRY AND FIRM, OR MUST BE LOW GROUND PRESSURE EQUIPMENT, OR MUST BE USED WITH WETLAND MATS TO MINIMIZE COMPACTION AND RUTTING.

PLOT DATE: 05/14/2014 USER: BROKAW, MATTHEW J.
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PROJECT REVISION HISTORY

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R 2	05/14/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
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R 0	04/17/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
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R B	10/29/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISON NO.B											
R A	6/28/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO.A											

DISCIPLINE INTERFACE
1
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For Supporting Design Calculations See
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STEPHEN L. WHITESIDE
No. 106556
Stephen L. Whiteside
5/14/14

SCALE: 1"=50' EXCEPT AS NOTED

YARD
—

ASH POND CLOSURE PROJECT
EXISTING CONDITIONS PLAN
WORK PLAN 2 (WBF-10W254-WP-2)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
R.NAGEL	M.BROKAW	D.NEAMTU	S.WHITESIDE	J.MULLINS	M.TURNBOW	J.KAMMEYER

CDM Smith

CDM SMITH
1100 Marion Street
Suite 200
Knoxville, Tennessee
37921
Tel 865.963.4300
Fax 865.963.4301
www.cdmsmith.com

WATTS BAR FOSSIL PLANT
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FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2013	DATE 05/14/2014	14	C	10W254-03	R 2

CDM SMITH	2
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
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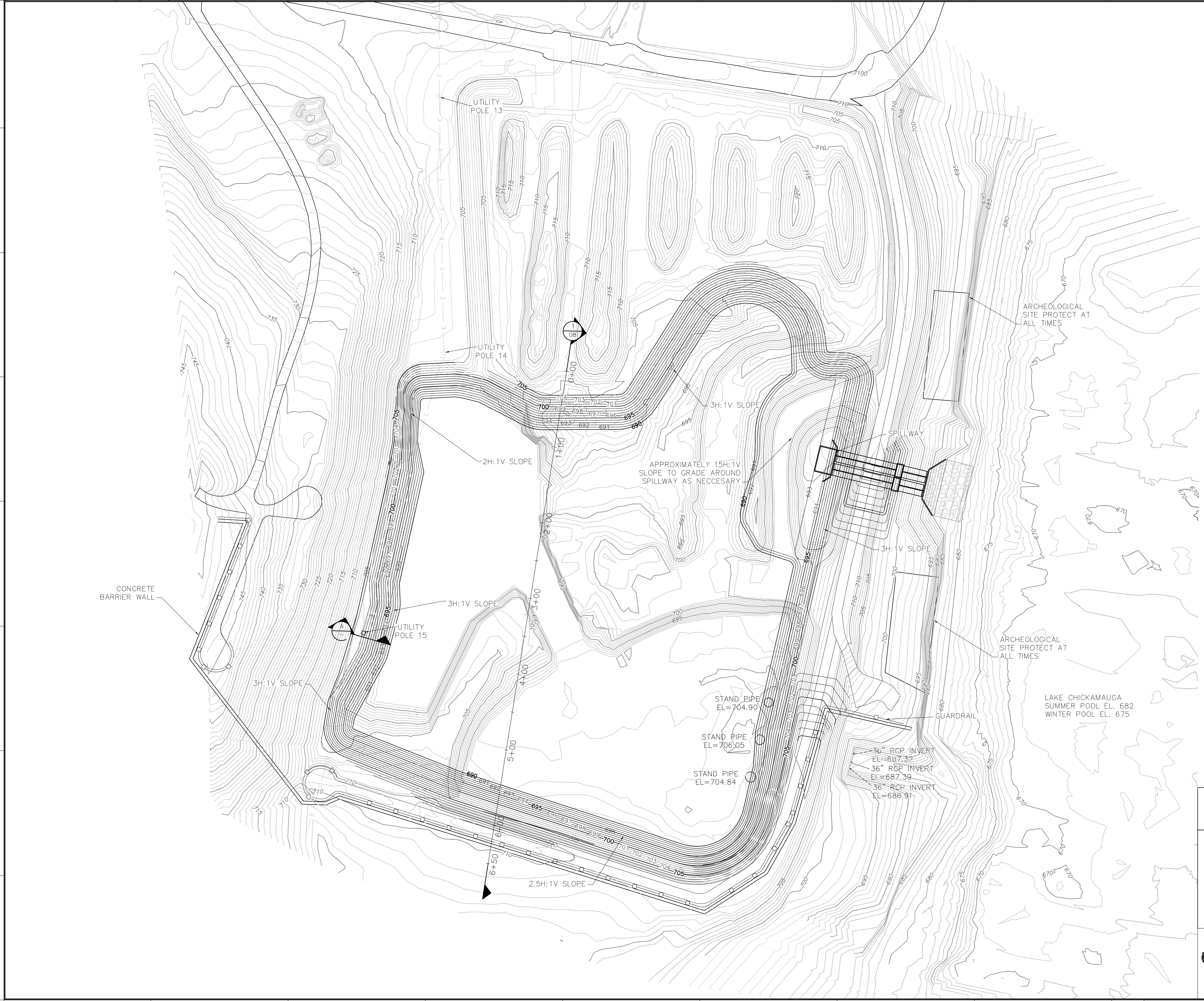
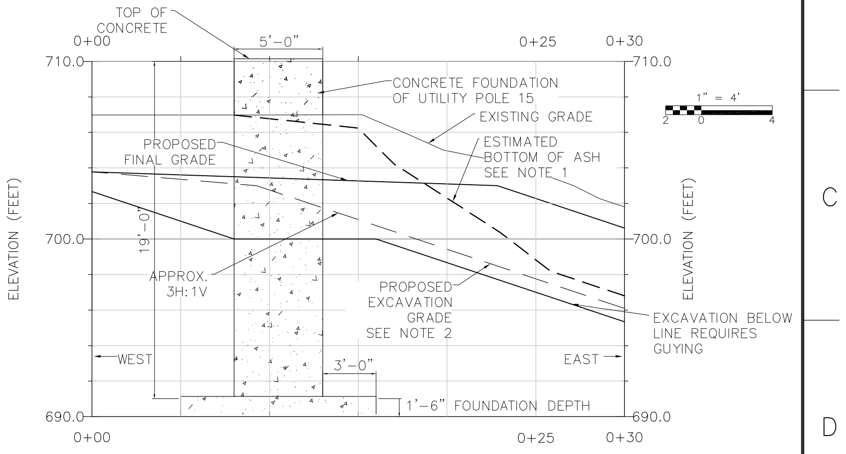


NOTES:

1. PROPOSED GRADES WITHIN THE POND SHOWN REPRESENT THE ESTIMATED BOTTOM OF WET ASH.
2. GRADING SHOWN ON EXCAVATION PLAN ASSUMES THAT REMOVAL TO EL. 690 WILL BE NECESSARY TO REMOVE ALL ASH MATERIAL.
3. SEE SHEET 02 FOR REQUIREMENTS ON DETERMINING COMPLETION OF ASH REMOVAL.



NOTES:

1. ESTIMATED BOTTOM OF ASH IS BASED ON FROM ASH TEST PIT DEPTHS PERFORMED ON OCT. 25, 2013.
2. GRADING SHOWN FOR EXCAVATION IS ESTIMATED. ACTUAL EXCAVATION GRADES WITHIN THE POND WILL VARY AS REQUIRED TO REMOVE ASH MATERIALS TO TOP OF ACCEPTABLE NATIVE SOILS.

ASH EXCAVATION AT UTILITY POLE 15
WEST-EAST PROFILE (0+00 – 0+30)

SECTION A
–

PLOT DATE: 05/06/2014 USER: BROKAW, MATTHEW J.
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PROJECT REVISION HISTORY

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
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REVISON NO.B											
R A	6/28/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO.A											

DISCIPLINE INTERFACE
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STEPHEN L. WHITESIDE
No. 108556
Stephen L. Whiteside
5/14/14

SCALE: 1"=50' EXCEPT AS NOTED

YARD
–

ASH POND CLOSURE PROJECT
EXCAVATION PLAN
WORK PLAN 2 (WBF-10W254-WP-2)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
R.NAGEL	M.BROKAW	D.NEAMTU	S.WHITESIDE	J.MULLINS	M.TURNBOW	J.KAMMEYER

CDM Smith

CDM SMITH
1100 Marion Street
Suite 200
Knoxville, Tennessee
37921
Tel: 865.963.4300
Fax 865.963.4301
www.cdmsmith.com

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FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2013	DATE 05/14/2014	14	C	10W254-04	R 2

CDM SMITH	2
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
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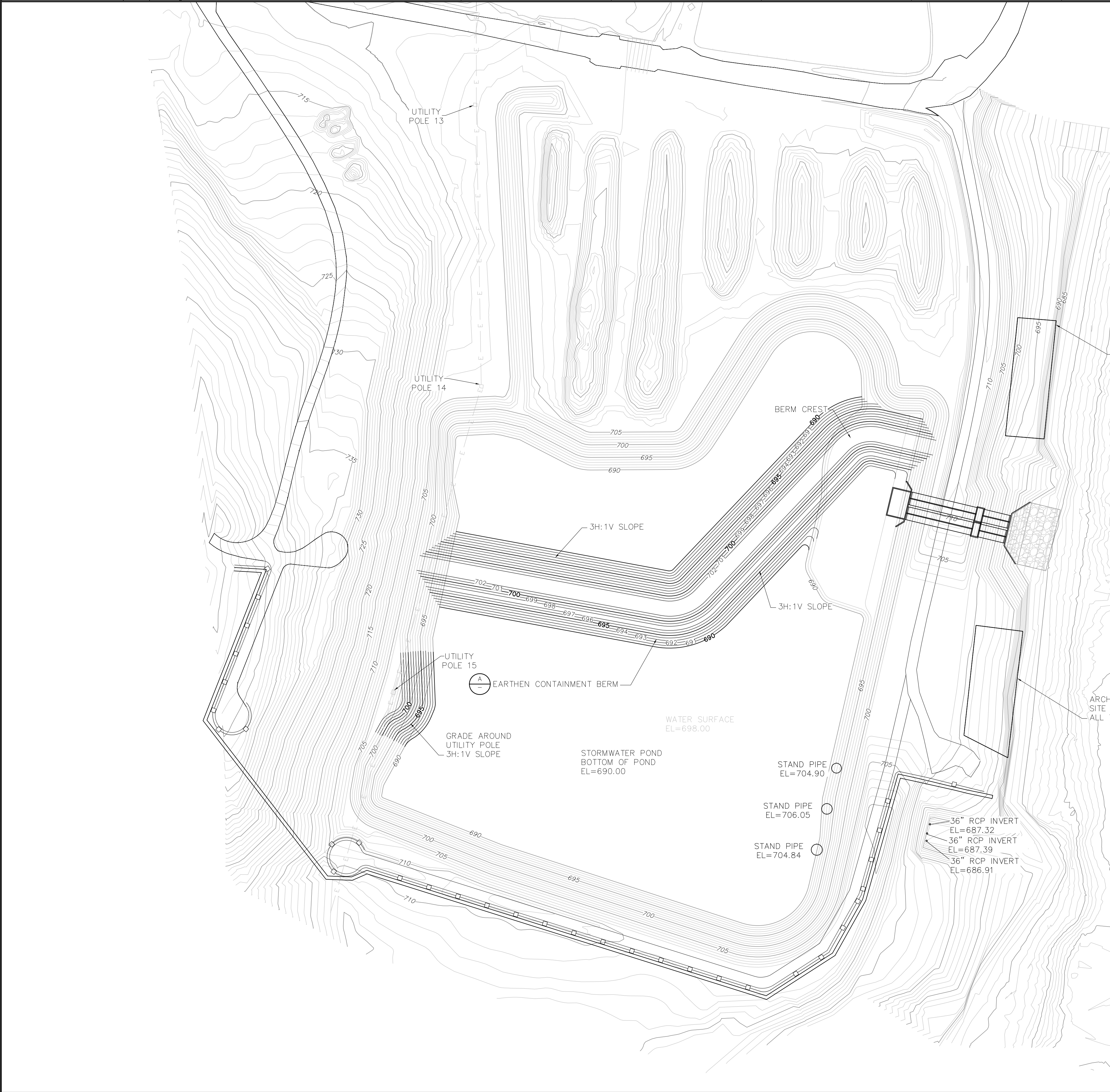

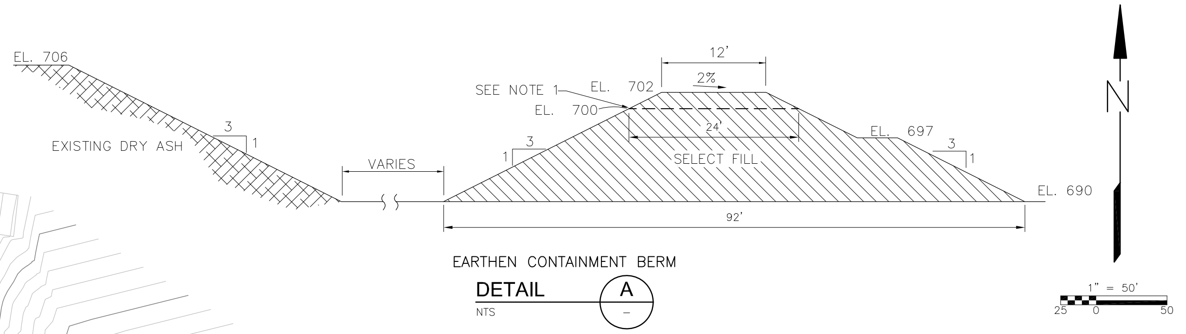

EARTHEN CONTAINMENT BERM

DETAIL A
NTS

NOTES:

1. DURING CONSTRUCTION ELEVATION SHALL REMAIN AT 700 TO ALLOW FOR CONSTRUCTION ACCESS ALONG THE TOP OF BERM. AFTER CONSTRUCTION ACCESS NEEDS ARE FINISHED, THE TOP 6 INCHES OF THE BERM SHALL BE REWORKED AND BROUGHT UP TO ELEVATION 702 PER SPECIFICATIONS.

2. CONTRACTOR SHALL PERFORM A SURVEY OF THE POND AREA ONCE EXCAVATION IS COMPLETE. IF WATER STORAGE IS DETERMINED TO BE GREATER THAN 50 ACRE/FT, FILL SHALL BE ADDED TO THE BOTTOM OF POND TO REDUCE WATER STORAGE.

PLOT DATE: 05/06/2014 USER: BROKAW, MATTHEW J.
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PROJECT REVISION HISTORY

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REVISION NO. 1											
R 0	04/17/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 0											
R B	10/29/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISON NO.B											
R A	6/28/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO.A											

DISCIPLINE INTERFACE
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For Supporting Design Calculations See FPG-WBF-DEG-CDX0000002013000043

STEPHEN L. WHITESIDE
No. 108556
Stephen L. Whiteside
5/14/14

SCALE: 1"=50' EXCEPT AS NOTED

YARD
—

ASH POND CLOSURE PROJECT
CONTAINMENT BERM PLAN
WORK PLAN 2 (WBF-10W254-WP-2)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
R.NAGEL	M.BROKAW	D.NEAMTU	S.WHITESIDE	J.MULLINS	M.TURNBOW	J.KAMMEYER

CDM Smith

CDM SMITH
1100 Marion Street
Suite 200
Knoxville, Tennessee
37921
Tel: 865.963.4300
Fax 865.963.4301
www.cdmsmith.com

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CDM SMITH	2
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
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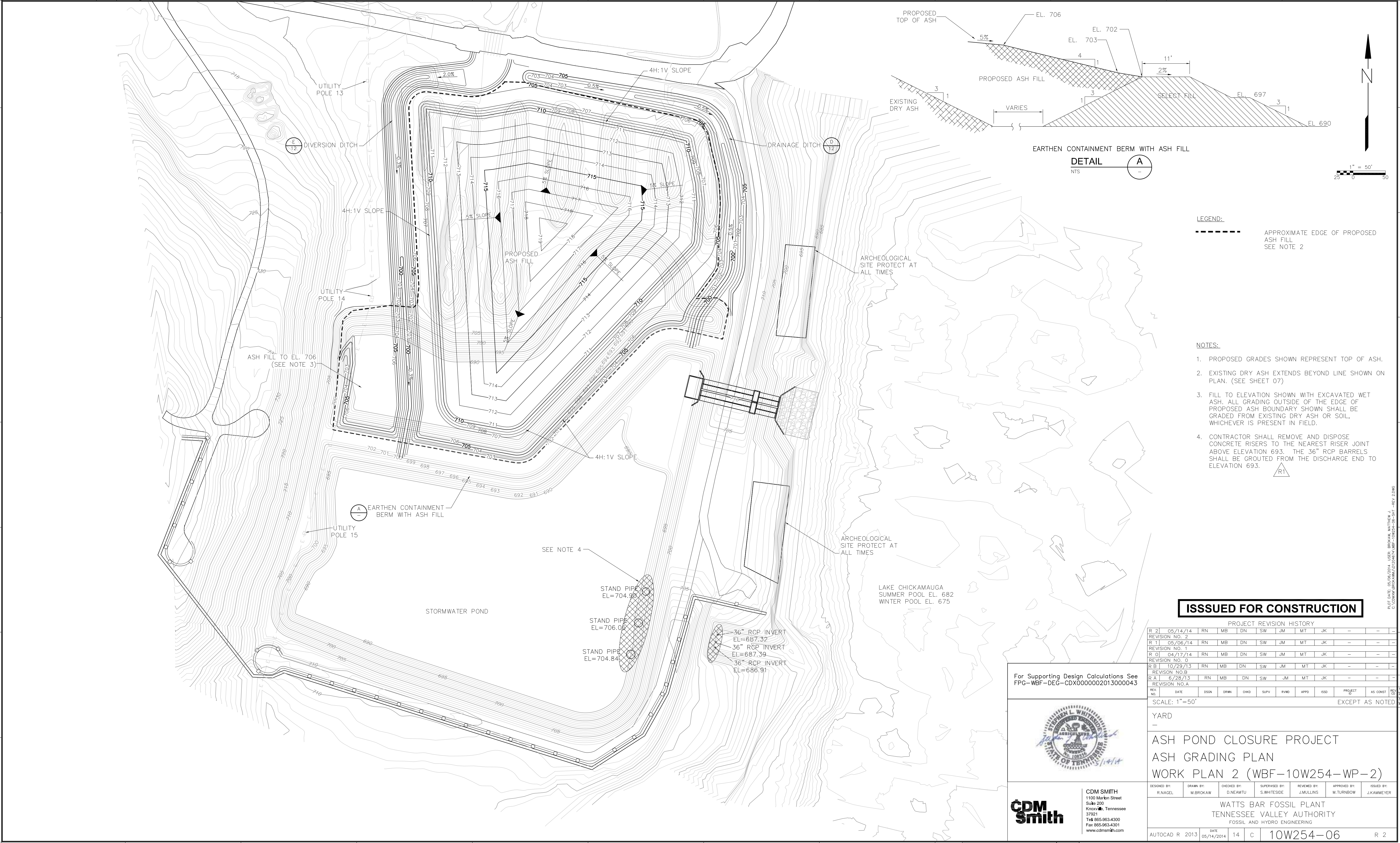

EARTHEN CONTAINMENT BERM WITH ASH FILL

DETAIL A
NTS

LEGEND:

- - - - APPROXIMATE EDGE OF PROPOSED ASH FILL SEE NOTE 2

NOTES:

1. PROPOSED GRADES SHOWN REPRESENT TOP OF ASH.
2. EXISTING DRY ASH EXTENDS BEYOND LINE SHOWN ON PLAN. (SEE SHEET 07)
3. FILL TO ELEVATION SHOWN WITH EXCAVATED WET ASH. ALL GRADING OUTSIDE OF THE EDGE OF PROPOSED ASH BOUNDARY SHOWN SHALL BE GRADED FROM EXISTING DRY ASH OR SOIL, WHICHEVER IS PRESENT IN FIELD.
4. CONTRACTOR SHALL REMOVE AND DISPOSE CONCRETE RISERS TO THE NEAREST RISER JOINT ABOVE ELEVATION 693. THE 36" RCP BARRELS SHALL BE GROUTED FROM THE DISCHARGE END TO ELEVATION 693. R1

PLOT DATE: 05/06/2014 USER: BROKAW, MATTHEW J.
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PROJECT REVISION HISTORY

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
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REVISION NO.A											

DISCIPLINE INTERFACE
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SCALE: 1"=50' EXCEPT AS NOTED

For Supporting Design Calculations See FPG-WBF-DEG-CDX000002013000043

STEPHEN L. WHITESIDE No. 108556
5/14/14

YARD
—

ASH POND CLOSURE PROJECT
ASH GRADING PLAN
WORK PLAN 2 (WBF-10W254-WP-2)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
R.NAGEL	M.BROKAW	D.NEAMTU	S.WHITESIDE	J.MULLINS	M.TURNBOW	J.KAMMEYER

CDM SMITH
1100 Marion Street
Suite 200
Knoxville, Tennessee
37921
Tel: 865.963.4300
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CDM SMITH	2
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
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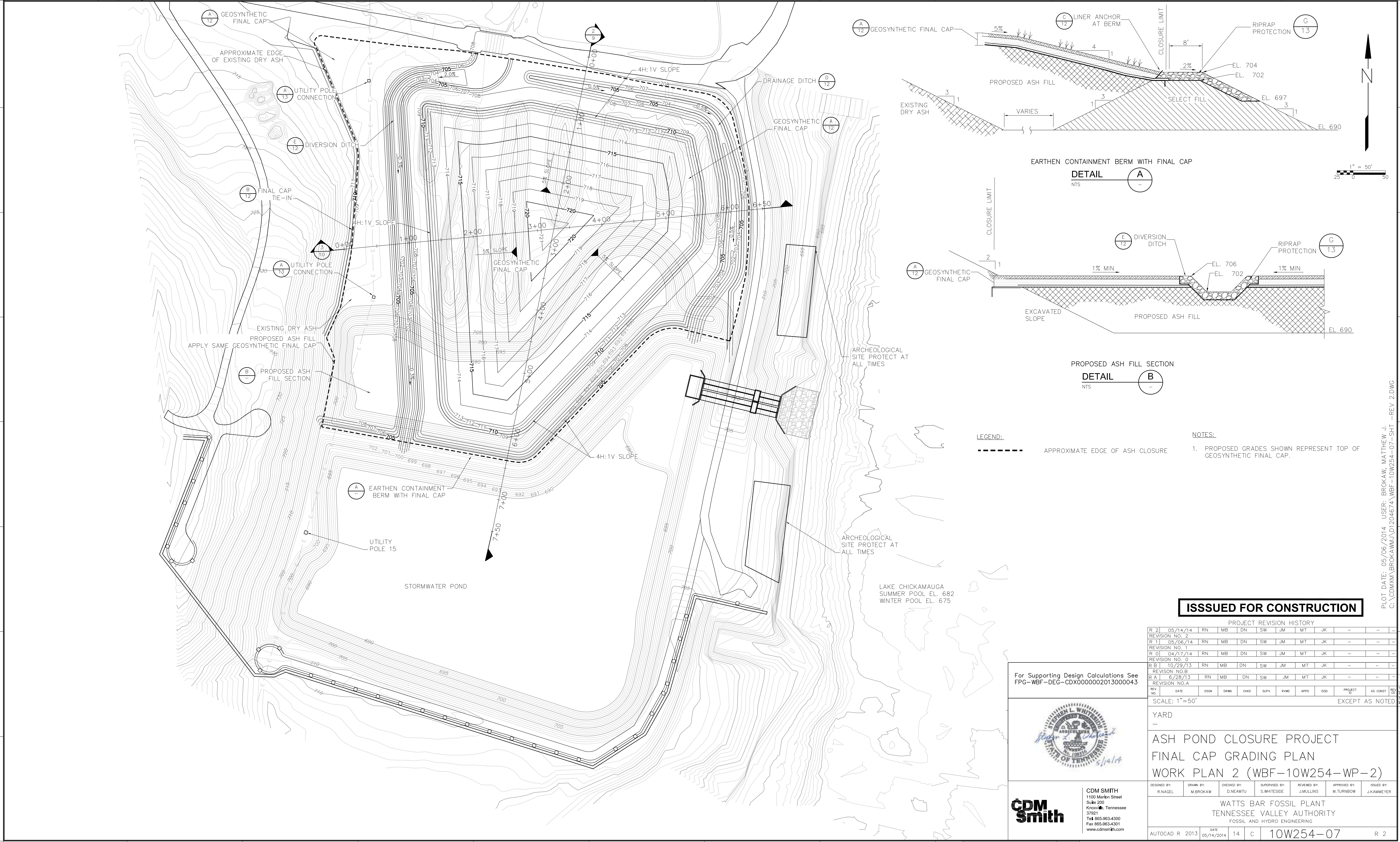

EARTHEN CONTAINMENT BERM WITH FINAL CAP

DETAIL A
NTS

PROPOSED ASH FILL SECTION

DETAIL B
NTS

LEGEND:

- - - - - - APPROXIMATE EDGE OF ASH CLOSURE

NOTES:

1. PROPOSED GRADES SHOWN REPRESENT TOP OF GEOSYNTHETIC FINAL CAP.

PLOT DATE: 05/06/2014 USER: BROKAW, MATTHEW J.
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PROJECT REVISION HISTORY

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R B	10/29/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISON NO.B											
R A	6/28/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO.A											

DISCIPLINE INTERFACE
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For Supporting Design Calculations See FPG-WBF-DEG-CDX0000002013000043

STEPHEN L. WHITESIDE
No. 108556
Stephen L. Whiteside
5/14/14

SCALE: 1"=50' EXCEPT AS NOTED

YARD
–

ASH POND CLOSURE PROJECT
FINAL CAP GRADING PLAN
WORK PLAN 2 (WBF-10W254-WP-2)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
R.NAGEL	M.BROKAW	D.NEAMTU	S.WHITESIDE	J.MULLINS	M.TURNBOW	J.KAMMEYER

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Knoxville, Tennessee
37921
Tel: 865.963.4300
Fax 865.963.4301
www.cdmsmith.com

WATTS BAR FOSSIL PLANT
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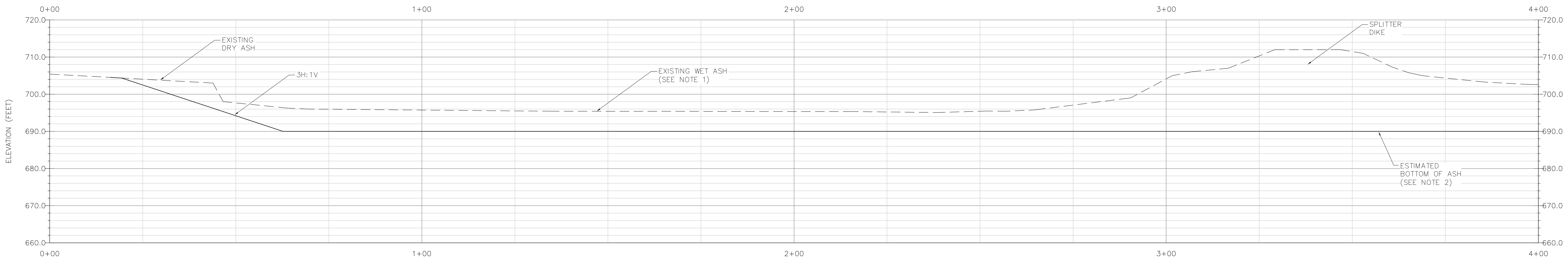
AUTOCAD R 2013 | DATE 05/14/2014 | 14 | C | 10W254-07 | R 2

CDM SMITH | 2
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

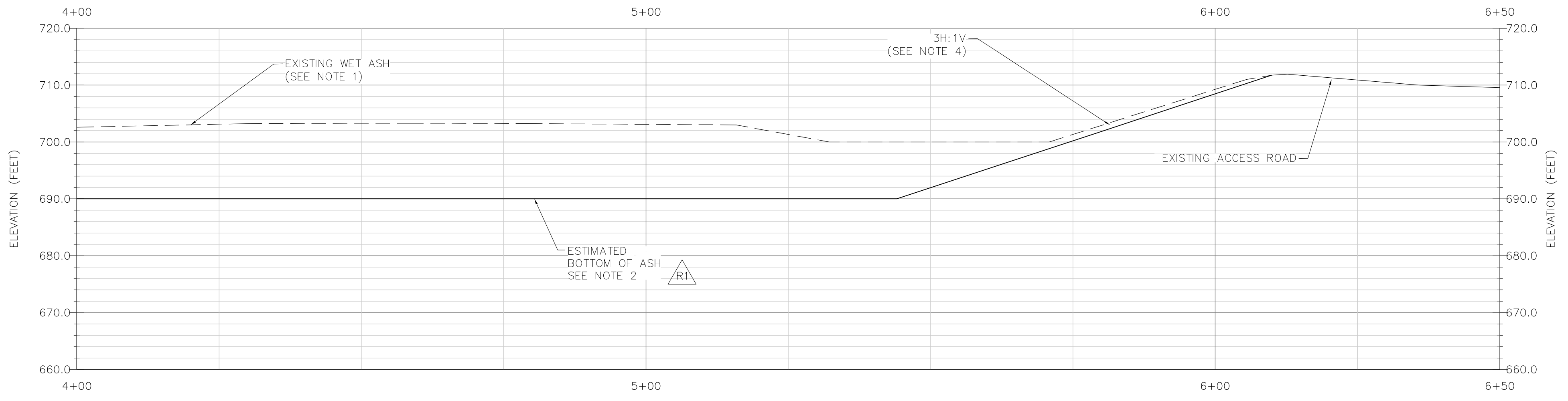


ASH EXCAVATION NORTH–SOUTH PROFILE (0+00 – 4+00)

SECTION 1 / 04

1" = 10'

5 0 10



ASH EXCAVATION NORTH–SOUTH PROFILE CONT. (4+00 – 6+50)

SECTION 1 / 04

1" = 10'

5 0 10

NOTES:

1. TOP OF WET ASH ELEVATIONS MAY BE DIFFERENT AT TIME OF CONSTRUCTION.
2. GRADING SHOWN ON EXCAVATION PLAN ASSUMES THAT REMOVAL TO EL. 690 WILL BE NECESSARY TO REMOVE ALL ASH MATERIALS. ACTUAL EXCAVATION GRADES WITHIN THE POND WILL VARY AND MAY BE ABOVE/BELOW EL. 690 AS REQUIRED TO REMOVE ASH MATERIALS TO TOP OF ACCEPTABLE NATIVE SOILS.
3. VISUAL INSPECTION SHALL BE USED TO DETERMINE THE LACK OF ASH AND IF THE AREA IS ACCEPTABLE PER SPECIFICATIONS ON SHEET 10W254-02.
4. CUT BACK TOPSOIL AND/OR ALL VISUALLY IDENTIFIED ASH TO SLOPE SHOWN.

PLOT DATE: 05/06/2014 USER: BROKAW, MATTHEW J.
C:\CDMXM\BROKAWMJ\D1204674\WBF-10W254-08-SHT -REV 2.DWG

ISSSUED FOR CONSTRUCTION

PROJECT REVISION HISTORY

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R 2	05/14/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 2											
R 1	05/06/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 1											
R 0	04/17/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 0											
R B	10/29/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISON NO.B											
R A	6/28/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO.A											

DISCIPLINE INTERFACE
1
2
3
4

For Supporting Design Calculations See FPG–WBF–DEG–CDX0000002013000043

SCALE: 1"=10' EXCEPT AS NOTED

YARD
–

ASH POND CLOSURE PROJECT
ASH EXCAVATION CROSS SECTIONS
WORK PLAN 2 (WBF–10W254–WP–2)

STEPHEN L. WHITESIDE
No. 108556
Stephen L. Whiteside
5/14/14

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
R.NAGEL	M.BROKAW	D.NEAMTU	S.WHITESIDE	J.MULLINS	M.TURNBOW	J.KAMMEYER

CDM SMITH
1100 Marion Street
Suite 200
Knoxville, Tennessee
37921
Tel: 865.963.4300
Fax 865.963.4301
www.cdmsmith.com

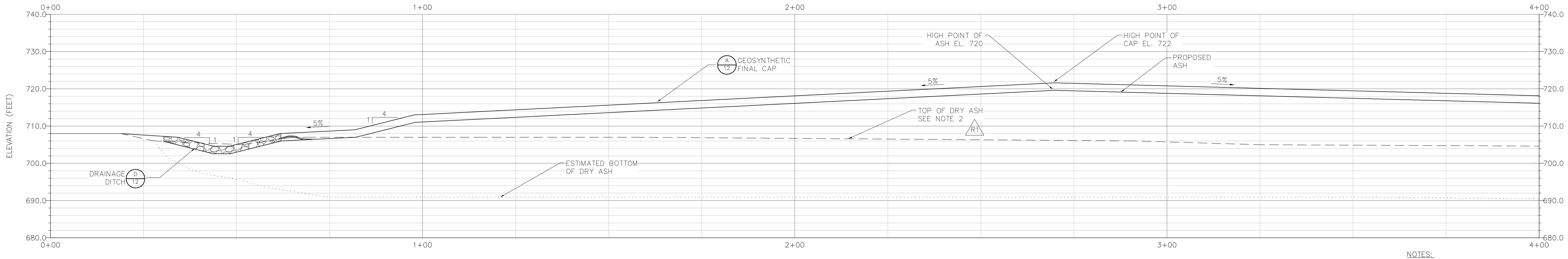
WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2013	DATE 05/14/2014	14	C	10W254–08	R 2

CDM SMITH	2
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



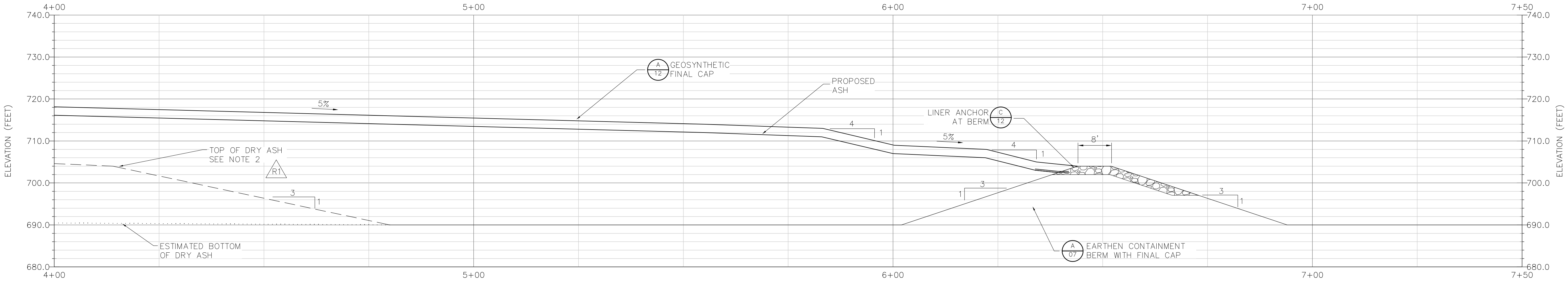
ASH CLOSURE NORTH–SOUTH PROFILE (0+00 – 4+00)

SECTION 2 07

1" = 10'

NOTES:

1. ALL SLOPES NOTED ARE THE HORIZONTAL TO VERTICAL RATIO OF THE SLOPE PERPENDICULAR TO THE EMBANKMENT CENTERLINE AND MAY NOT BE THE SAME AS THE SLOPE ALONG THE CROSS–SECTIONAL CUT.
2. ALL ASH STACKED IN THE DRY ASH AREA SHALL BE REMOVED TO ELEVATION 706 PRIOR TO STARTING ASH COMPACTION ACTIVITIES IN THE DRY ASH AREA. R1



ASH CLOSURE NORTH–SOUTH PROFILE CONT. (4+00 – 7+50)

SECTION 2 07

1" = 10'

PLOT DATE: 05/06/2014 USER: BROKAW, MATTHEW J.
C:\CDMXM\BROKAWMJ\D1204674\WBF-10W254-09-SHT -REV 2.DWG

ISSSUED FOR CONSTRUCTION

PROJECT REVISION HISTORY

R 2	05/14/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 2											
R 1	05/06/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 1											
R 0	04/17/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 0											
R B	10/29/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISON NO.B											
R A	6/28/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO.A											
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1"=10' EXCEPT AS NOTED

For Supporting Design Calculations See FPG–WBF–DEG–CDX0000002013000043

STEPHEN L. WHITESIDE No. 108556
Stephen L. Whiteside
5/14/14

YARD
–

ASH POND CLOSURE PROJECT
ASH CLOSURE CROSS SECTIONS 1
WORK PLAN 2 (WBF–10W254–WP–2)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
R.NAGEL	M.BROKAW	D.NEAMTU	S.WHITESIDE	J.MULLINS	M.TURNBOW	J.KAMMEYER

CDM Smith

CDM SMITH
1100 Marion Street
Suite 200
Knoxville, Tennessee
37921
Tel. 865.963.4300
Fax 865.963.4301
www.cdmsmith.com

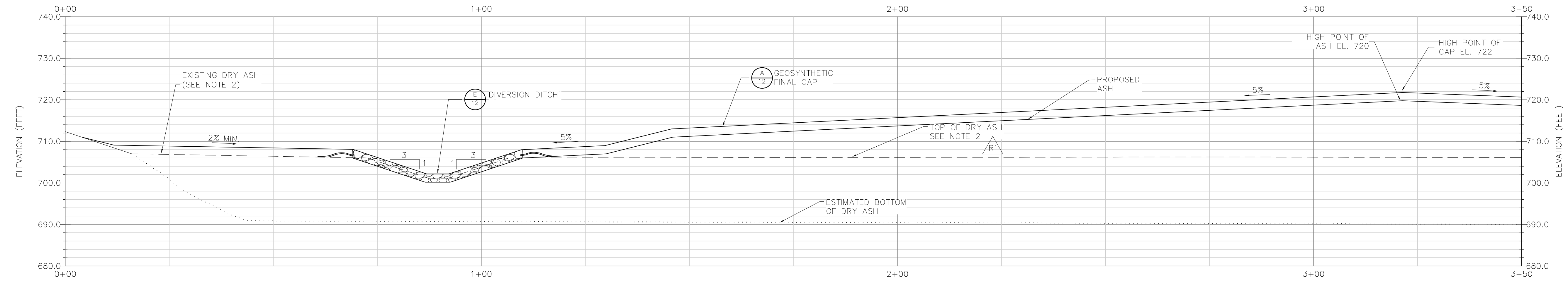
WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2013 | DATE 05/14/2014 | 14 | C | 10W254–09 | R 2

CDM SMITH | 2
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



ASH CLOSURE EAST–WEST PROFILE (0+00 – 3+00)

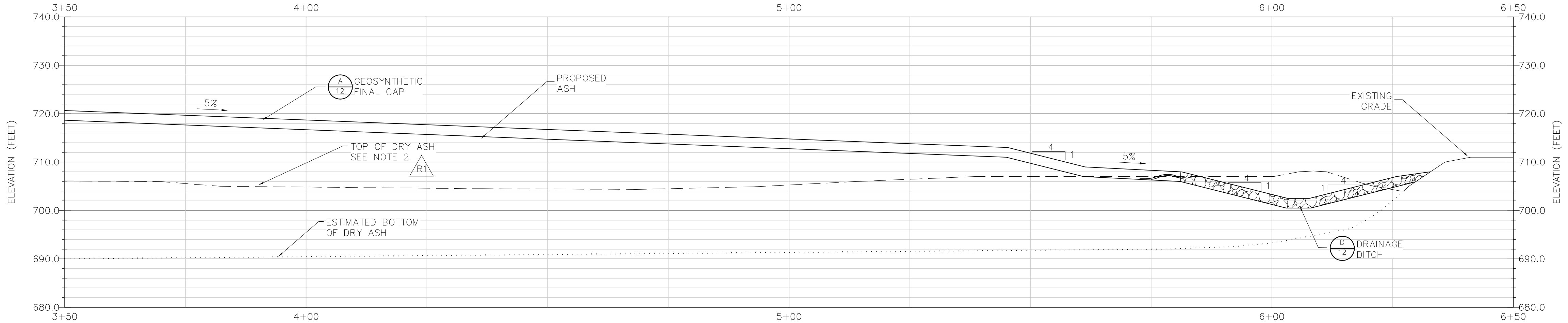
SECTION 3/07

1" = 10'

5 0 10

NOTES:

1. ALL SLOPES NOTED ARE THE HORIZONTAL TO VERTICAL RATIO OF THE SLOPE PERPENDICULAR TO THE EMBANKMENT CENTERLINE AND MAY NOT BE THE SAME AS THE SLOPE ALONG THE CROSS–SECTIONAL CUT.
2. EXISTING DRY ASH EXTENDS TO ESTIMATED BOUNDARY SHOWN ON SHEET 8. CONTINUE GEOSYNTHETIC FINAL CAP TO 3' BEYOND EDGE OF DRY ASH AND TIE INTO EXISTING GRADE PER DETAIL B ON SHEET 12. R1
3. ALL ASH STACKED IN THE DRY ASH AREA SHALL BE REMOVED TO ELEVATION 706 PRIOR TO STARTING ASH COMPACTION ACTIVITIES IN THE DRY ASH AREA.



ASH CLOSURE EAST–WEST PROFILE CONT. (3+00 – 6+00)

SECTION 3/07

1" = 10'

5 0 10

PLOT DATE: 05/06/2014 USER: BROKAW, MATTHEW J.
C:\CDMXM\BROKAWMJ\D1204674\WBF–10W254–10–SHT –REV 2.DWG

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PROJECT REVISION HISTORY

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R 2	05/14/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 2											
R 1	05/06/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 1											
R 0	04/17/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 0											
R B	10/29/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISON NO.B											
R A	6/28/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO.A											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1"=10' EXCEPT AS NOTED

YARD
–

For Supporting Design Calculations See FPG–WBF–DEG–CDX0000002013000043

STEPHEN L. WHITESIDE
No. 108336
Stephen L. Whiteside
5/14/14

ASH POND CLOSURE PROJECT
ASH CLOSURE CROSS SECTIONS 2
WORK PLAN 2 (WBF–10W254–WP–2)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
R.NAGEL	M.BROKAW	D.NEAMTU	S.WHITESIDE	J.MULLINS	M.TURNBOW	J.KAMMEYER

CDM Smith

CDM SMITH
1100 Marion Street
Suite 200
Knoxville, Tennessee
37921
Tel 865.963.4300
Fax 865.963.4301
www.cdmsmith.com

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2013	DATE 05/14/2014	14	C	10W254–10	R 2

CDM SMITH	2
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

14 C 10W254–10

14 | C | 10W254-11

LEGEND:

— LOD —	LIMITS OF DISTURBANCE
▨	STONE CHECK DAMS
▨	CONSTRUCTION ENTRANCE
— TC —	TURBIDITY CURTAIN
▨	STRAW WATTLE
— — —	JUTE CURTAIN

N

1" = 50'
25 0 50

NOTES:

1. GEOSYNTHETIC FINAL CAP, EXPOSED POND EMBANKMENTS TO ELEVATION 697, AND OTHER DISTURBED AREAS SHALL BE SODDED PER SPECIFICATIONS. R1
2. THE PERIMETER AND INTERIOR EMBANKMENTS OF THE POND AND THE DRY ASH AREA SLOPES SHALL BE MONITORED THROUGHOUT CONSTRUCTION FOR INSTABILITY. IF INSTABILITY IS OBSERVED, THE CONTRACTOR SHALL HALT ALL ACTIVITIES AND NOTIFY THE CQA TEAM.
3. ALL EXPOSED AREAS AND SLOPES SHALL BE MAINTAINED AND CORRECTIVE ACTIONS MADE UNTIL PLACEMENT OF SOD.
4. IT IS THE CONTRACTOR'S RESPONSIBILITY TO MAINTAIN A SECURE AND PROTECTED SITE EXTENDING TO THE LIMITS OF DISTURBANCE. CONTROL MEASURES INCLUDE, BUT ARE NOT LIMITED TO, INSTALLING ORANGE SAFETY FENCING AND POSTING 'DO NOT ENTER' SIGNS AND SHALL BE APPROVED BY THE OWNER.
5. WATER FOR DUST CONTROL SHALL BE SOURCED FROM A FIRE HYDRANT AT THE WATTS BAR HYDRO WAREHOUSE AND LAYDOWN YARD.

PLOT DATE: 05/06/2014 USER: BROKAW, MATTHEW J.
C:\CDMXM\BROKAWMJ\D1204674\WBF-10W254-11-SHT -REV 2.DWG

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PROJECT REVISION HISTORY

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R 2	05/14/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 2											
R 1	05/06/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 1											
R 0	04/17/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 0											
R B	10/29/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISON NO. B											
R A	6/28/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. A											

DISCIPLINE INTERFACE
1
2
3
4

For Supporting Design Calculations See FPG-WBF-DEG-CDX0000002013000043

SCALE: 1"=50' EXCEPT AS NOTED

YARD
—

ASH POND CLOSURE PROJECT
EROSION AND SEDIMENTATION CONTROL PLAN
WORK PLAN 2 (WBF-10W254-WP-2)

No. 108556
Stephen L. Whiteside 5/14/14

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
R.NAGEL	M. BROKAW	D.NEAMTU	S.WHITESIDE	J.MULLINS	M.TURNBOW	J.KAMMEYER

CDM SMITH
1100 Marion Street
Suite 200
Knoxville, Tennessee
37921
Tel: 865.963.4300
Fax 865.963.4301
www.cdmsmith.com

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2013	DATE 05/14/2014	14	C	10W254-11	R 2

CDM SMITH	2
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
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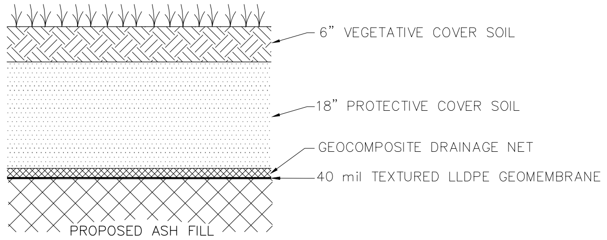


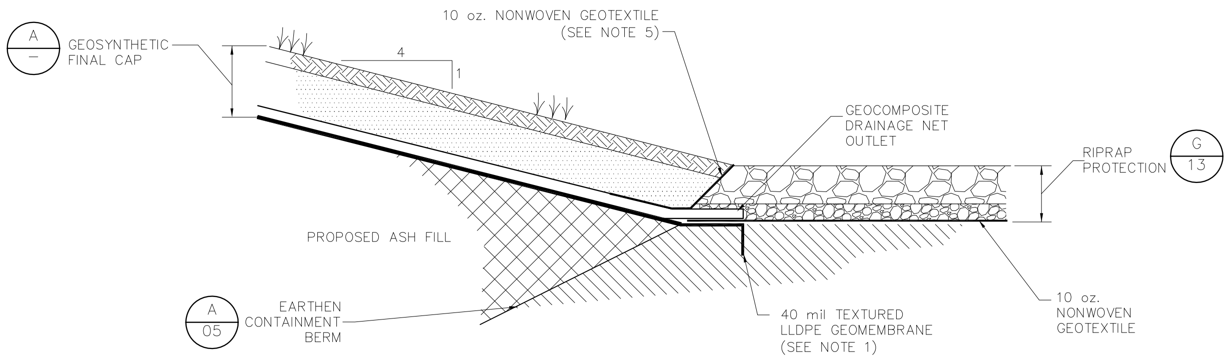
NOTES:

R1
1. FOLLOWING THICKNESS VERIFICATION AND PLACEMENT OF PROPOSED ASH FILL, PLACE FINAL CAP GEOSYNTHETICS AND SOILS.
2. GEOSYNTHETIC FINAL CAP, EXPOSED POND EMBANKMENTS, AND OTHER DISTURBED AREAS SHALL BE SODDED PER SPECIFICATIONS.
3. PROPOSED ASH FILL SHOWN IN DETAIL IS INTERCHANGEABLE WITH EXISTING DRY ASH.

GEOSYNTHETIC FINAL CAP

DETAIL A / 07

NTS



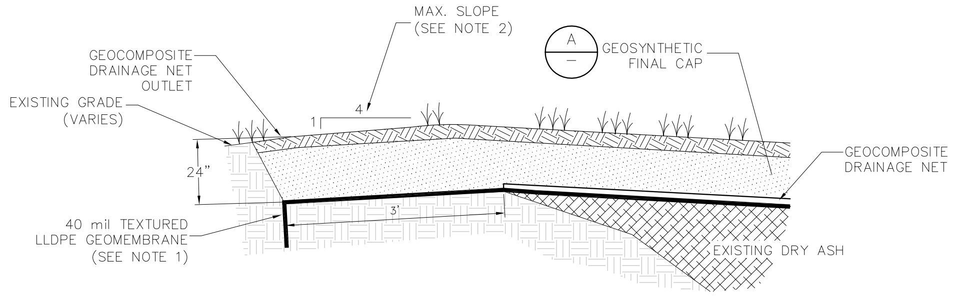
LINER ANCHOR AT BERM

DETAIL C / 07

NTS

NOTES:

1. INSTALL GEOMEMBRANE AND KEY 12" INTO COMPACTED SOIL AS SHOWN.



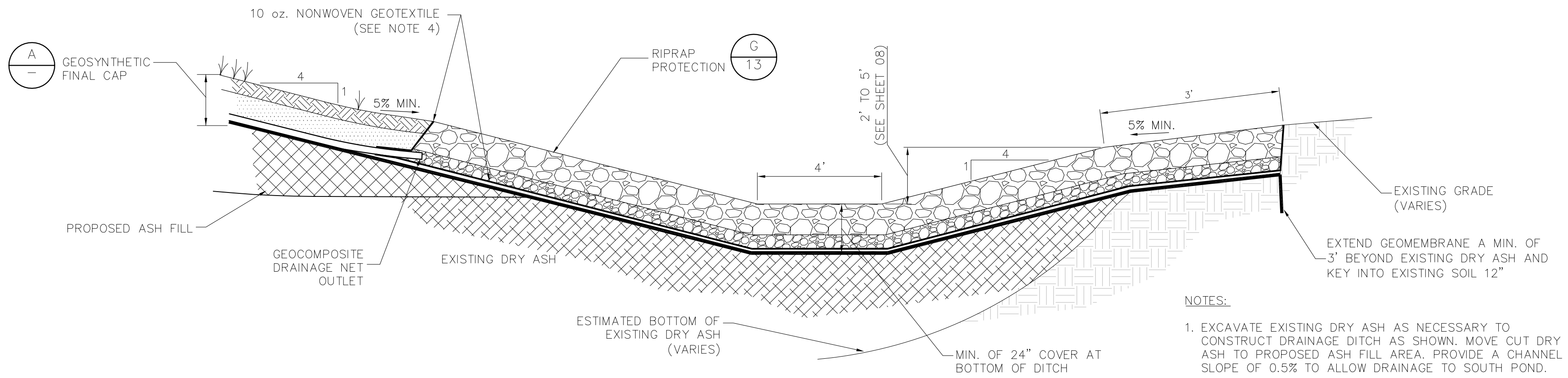
NOTES:

1. EXTEND GEOMEMBRANE AT LEAST 3' PAST EDGE OF ASH SHOWN IN PLAN, OR EDGE OF ASH DISCOVERED IN FIELD BY VISUAL INSPECTION, AND KEY DOWN 12". CONDITIONS MAY VARY.
2. GRADE SOIL CAP TO TIE-IN TO EXISTING GRADE PAST THE KEYED GEOMEMBRANE. SLOPE SHALL BE NO STEEPER THAN 4H:1V, RISING OR FALLING.

FINAL CAP TIE-IN

DETAIL B / 07

NTS



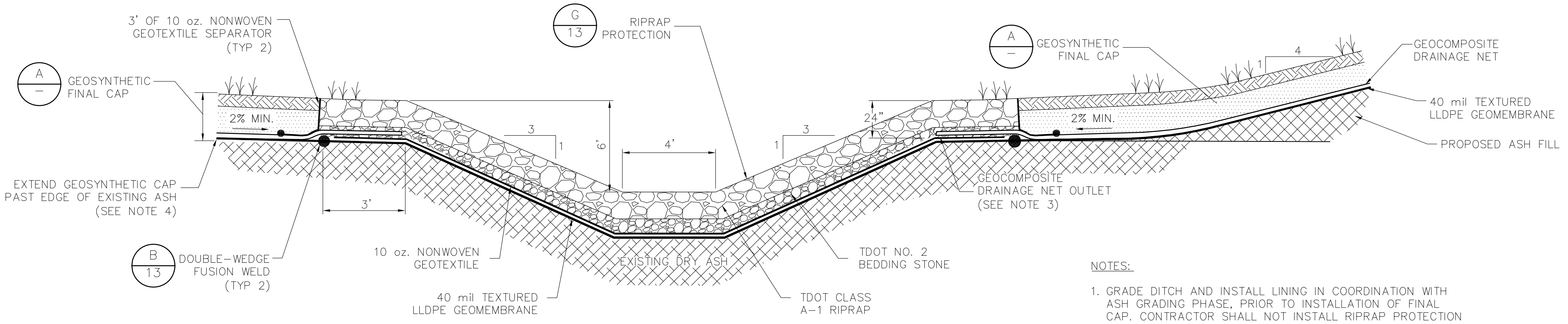
NOTES:

1. EXCAVATE EXISTING DRY ASH AS NECESSARY TO CONSTRUCT DRAINAGE DITCH AS SHOWN. MOVE CUT DRY ASH TO PROPOSED ASH FILL AREA. PROVIDE A CHANNEL SLOPE OF 0.5% TO ALLOW DRAINAGE TO SOUTH POND.

DRAINAGE DITCH

DETAIL D / 06

NTS



DIVERSION DITCH

DETAIL E / 06

NTS

NOTES:

1. GRADE DITCH AND INSTALL LINING IN COORDINATION WITH ASH GRADING PHASE, PRIOR TO INSTALLATION OF FINAL CAP. CONTRACTOR SHALL NOT INSTALL RIPRAP PROTECTION UNTIL PROPOSED ASH IS ENCLOSED BY GEOMEMBRANE.
2. PROVIDE A CHANNEL SLOPE OF 0.3%-2%, AS SHOWN ON SHEET 07, TO ALLOW DRAINAGE TO SOUTH POND.
3. EXTEND 10 oz. NONWOVEN GEOTEXTILE IN BETWEEN GEOMEMBRANE AND DRAINAGE NET APPROXIMATELY 3'. OUTLET GEOCOMPOSITE DRAINAGE NET INTO RIPRAP PROTECTION.
4. APPLY GEOSYNTHETIC FINAL CAP TO ENTIRE DRY ASH AREA AND TIE IN TO EXISTING GRADE PER DETAIL B.

ISSSUED FOR CONSTRUCTION

For Supporting Design Calculations See FPG-WBF-DEG-CDX0000002013000043

STEPHEN L. WHITESIDE
No. 108556
Stephen L. Whiteside
5/14/14

CDM Smith

CDM SMITH
1100 Marion Street
Suite 200
Knoxville, Tennessee
37921
Tel. 865.963.4300
Fax 865.963.4301
www.cdmsmith.com

PROJECT REVISION HISTORY

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R 2	05/14/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 2											
R 1	05/06/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 1											
R 0	04/17/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 0											
R B	10/29/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. B											
R B	06/28/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. A											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: NONE EXCEPT AS NOTED

YARD
—

ASH POND CLOSURE PROJECT
CIVIL DETAILS
WORK PLAN 2 (WBF-10W254-WP-2)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
R. NAGEL	M.BROKAW	D.NEAMTU	S.WHITESIDE	J.MULLINS	M.TURNBOW	J.KAMMEYER

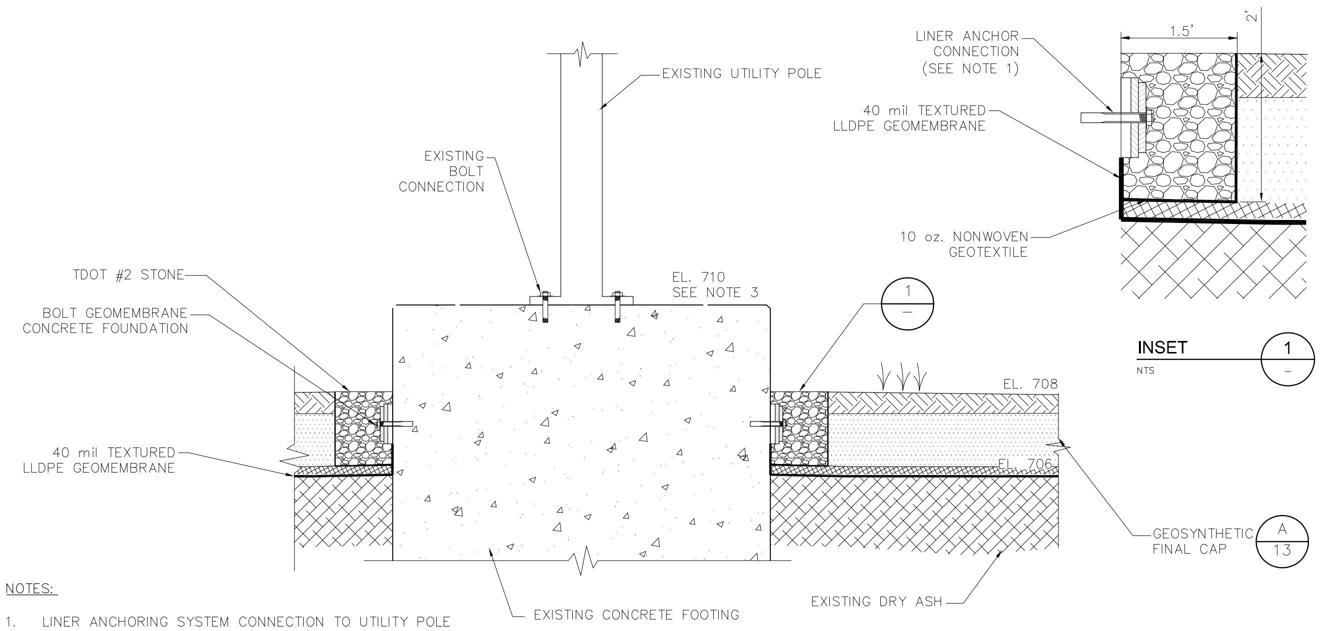
WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R2013	DATE 05/14/2014	14	C	10W254-12	R 2

CDM SMITH	2
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



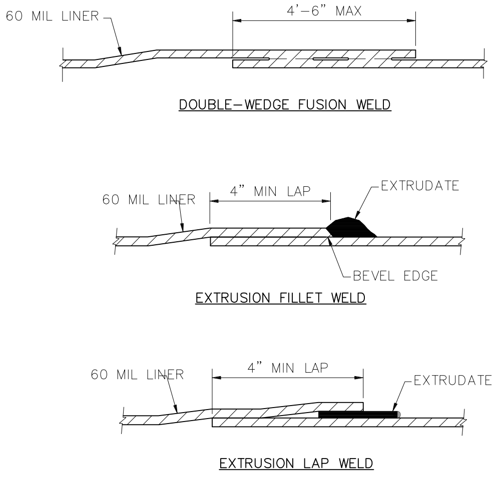
PROFILE

INSET 1
NTS

NOTES:

1. LINER ANCHORING SYSTEM CONNECTION TO UTILITY POLE SHALL BE DESIGNED BY MANUFACTURER. MANUFACTURER SHALL SUBMIT SHOP DRAWINGS TO ENGINEER FOR APPROVAL PRIOR TO CONSTRUCTION.
2. DESIGN MUST PROVIDE DRAINAGE FLOW AROUND UTILITY POLE WITHOUT EXPOSING ANY EXISTING DRY ASH. VISUAL INSPECTION OF COMPLETE GEOSYNTHETIC FINAL CAP IN AREA SHOWN ON PLAN SHALL BE THE JOINT RESPONSIBILITY OF THE ENGINEER AND OWNER.
3. ELEVATION PROVIDED BY TVA. CONTRACTOR IS TO FIELD VERIFY AND ADJUST ACCORDINGLY.

UTILITY POLE CONNECTION
DETAIL A 05
NTS

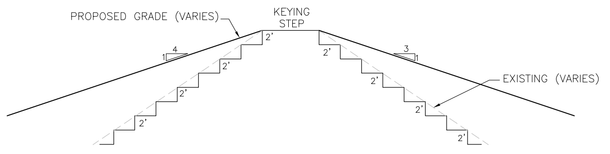


DOUBLE–WEDGE FUSION WELD

EXTRUSION FILLET WELD

EXTRUSION LAP WELD

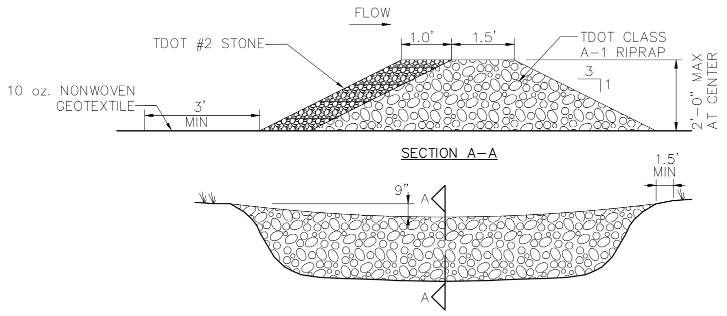
WELDS
DETAIL B 12
NTS



NOTES:

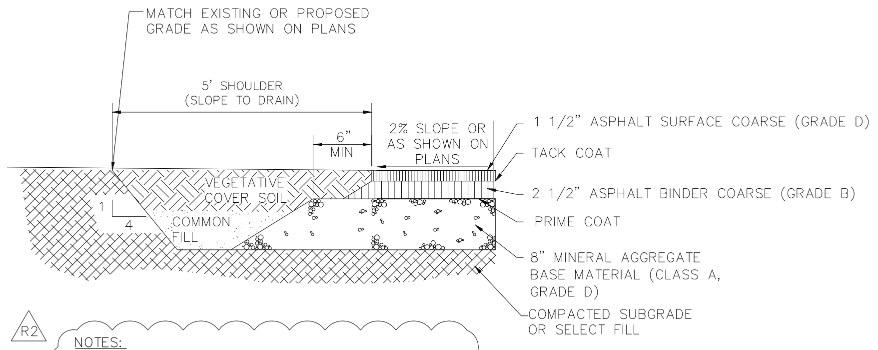
1. REMOVE TOP SOIL AND VEGETATION FROM SLOPES.
2. CUT EXISTING SLOPE WITH 2' VERTICAL STEPS.
3. BACKFILL TO PROPOSED SLOPE USING 8" THICK (LOOSE THICKNESS) VERTICAL LIFTS.
4. OVERFILL NEW SLOPES AND CUT GRADES BACK TO FINAL GRADE TO ENSURE PROPER COMPACTION AT FACE OF SLOPE.

BENCHING
DETAIL C –
NTS



SECTION A–A

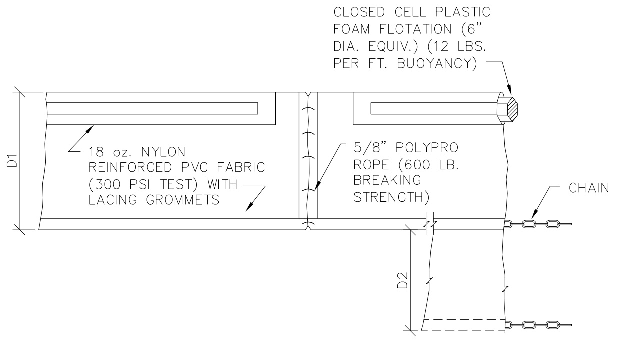
STONE CHECK DAM
DETAIL F 11
NTS



R2 NOTES:

1. PAVEMENT MATERIALS AND INSTALLATION SHALL CONFORM TO TDOT STANDARDS–LATEST EDITION.
2. ASPHALT PAVING SHALL BE 12 FEET WIDE.

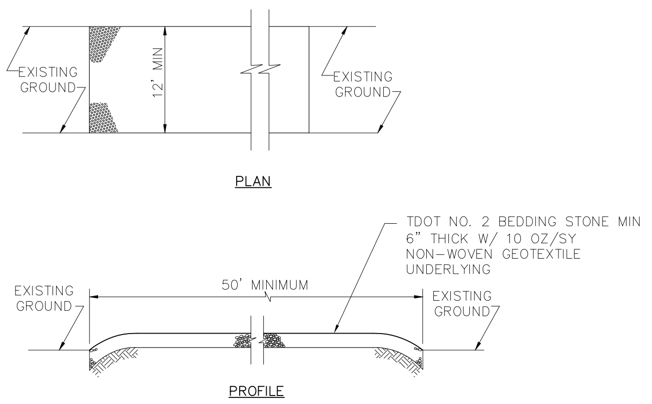
ASPHALT PAVING
DETAIL H –
NTS



NOTES:

1. D1 = 5' STD. (SINGLE PANEL FOR DEPTHS 5' OR LESS).
2. D2 = 5' STD. (ADDITIONAL PANEL FOR DEPTHS >5').
3. CURTAIN TO REACH BOTTOM UP TO DEPTHS OF 10'. TWO (2) PANELS TO BE USED FOR DEPTHS GREATER THAN 10'.
4. INSTALL IN ACCORDANCE WITH STANDARDS.

TURBIDITY CURTAIN
DETAIL D 11
NTS



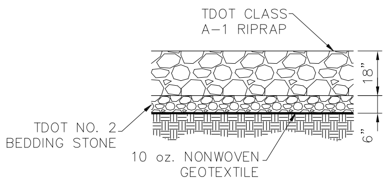
PLAN

PROFILE

NOTES:

1. PROVIDE APPROPRIATE TRANSITION BETWEEN TEMPORARY GRAVEL CONSTRUCTION ENTRANCE AND EXISTING ROAD.
2. THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHT–OF–WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE OR ADDING STONE TO THE LENGTH OF THE ENTRANCE.
3. REPAIR AND CLEAN OUT ANY MEASURES USED TO TRAP SEDIMENT.
4. ALL SEDIMENT SPILLED, DROPPED, WASHED, OR TRACKED ONTO PUBLIC RIGHT–OF–WAY MUST BE REMOVED IMMEDIATELY.

CONSTRUCTION ENTRANCE
DETAIL E 11
NTS



SECTION

RIPRAP PROTECTION
DETAIL G 05
NTS

GENERAL NOTES:

1. SEE GENERAL NOTES ON SHEET 02 OR C.Q.A. DOCUMENT FOR MATERIAL SPECIFICATIONS AND SUBMITTAL REQUIREMENTS.

ISSSUED FOR CONSTRUCTION

PROJECT REVISION HISTORY

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R 2	05/14/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 2											
R 1	05/06/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 1											
R 0	04/17/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 0											
R B	10/29/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. B											
R B	06/28/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. A											

DISCIPLINE INTERFACE
1
2
3
4

For Supporting Design Calculations See FPG–WBF–DEG–CDX000002013000043

5/14/14

SCALE: NONE EXCEPT AS NOTED

YARD
–

ASH POND CLOSURE PROJECT
CIVIL DETAILS
WORK PLAN 2 (WBF–10W254–WP–2)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
R.NAGEL	M.BROKAW	D.NEAMTU	S.WHITESIDE	J.MULLINS	M.TURNBOW	J.KAMMEYER

CDM SMITH
1100 Marion Street
Suite 200
Knoxville, Tennessee
37921
Tel 865.963.4300
Fax 865.963.4301
www.cdmsmith.com

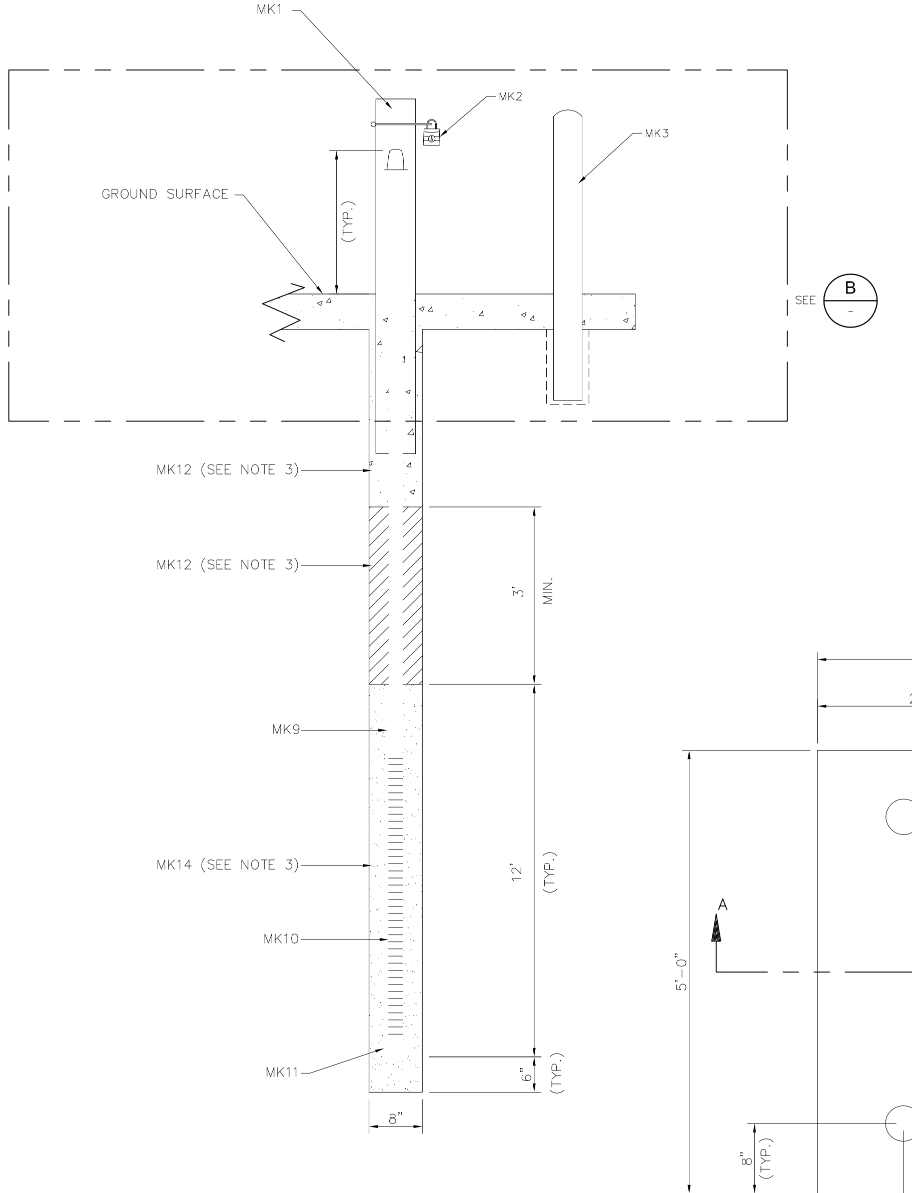
WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R2012 | DATE 05/14/2014 | 14 | C | 10W254–13 | R 2

CDM SMITH	2
TASK COMPLETED BY:	REV NO.

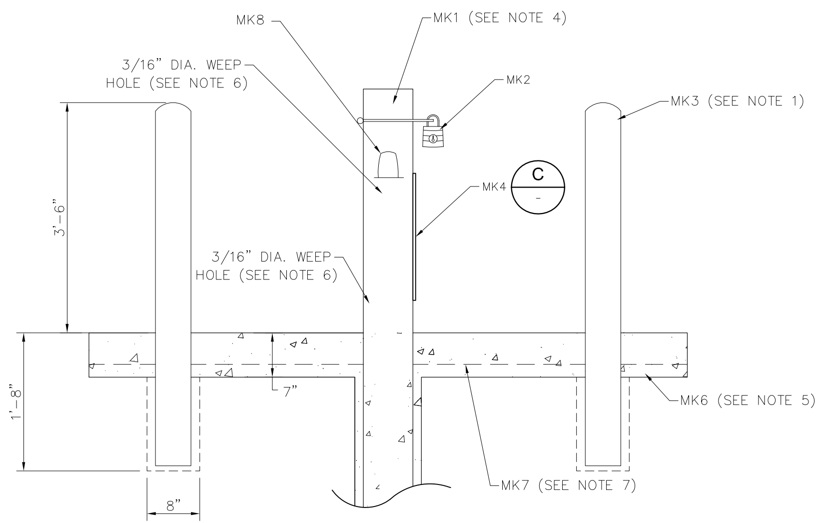
PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



MONITORING WELL

DETAIL A
NTS

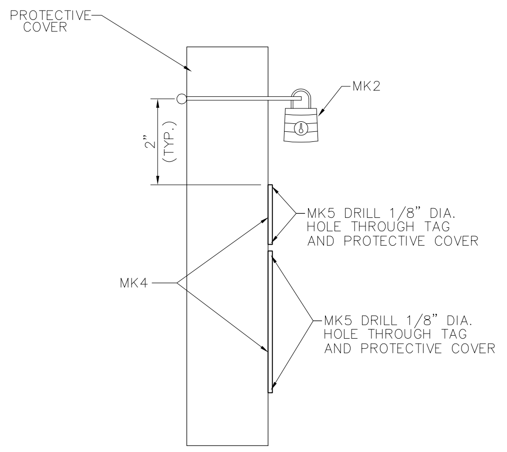


ENLARGED SECTION (A–A)

DETAIL B
NTS

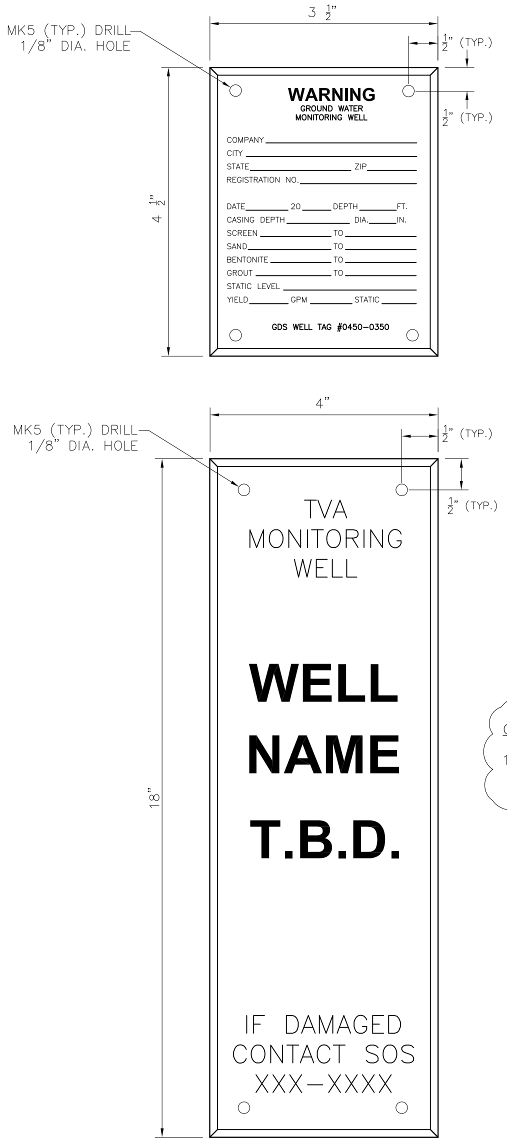
WELLHEAD NOTES:

1. PROTECTIVE BOLLARDS TO BE FILLED WITH 3000 PSI CONCRETE, AND CONE–TAPER THE TOP.
2. DRILL $\frac{3}{16}$" DIA. VENT HOLE 2" BELOW TOP OF THE PVC RISER.
3. NEW PROTECTIVE COVERS DO NOT REQUIRE PAINTING.
4. POSITION PROTECTIVE COVER WITH HINGE AT THE SAME ELEVATION AS TOP OF PVC RISER. FILL INSIDE OF PROTECTIVE COVER WITH CEMENT GROUT TO SAME LEVEL AS CONCRETE PAD.
5. SLOPE CONCRETE UPWARD TO PROTECTIVE COVER TO PREVENT PONDING WATER.
6. DRILL $\frac{3}{16}$" DIA. WEEP HOLE AT TOP OF GROUT INSIDE PROTECTIVE COVER.
7. PLACE WIRE MESH 2" MINIMUM FROM ALL CONCRETE EDGES.



WELL I.D. MOUNTING (B–B)

DETAIL C
NTS



WARNING
GROUND WATER MONITORING WELL

COMPANY ____________________
CITY ____________________
STATE ____________ ZIP ________
REGISTRATION NO. ____________
DATE ________ 20 ____ DEPTH ______ FT.
CASING DEPTH __________ DIA. ____ IN.
SCREEN __________ TO __________
SAND __________ TO __________
BENTONITE __________ TO __________
GROUT __________ TO __________
STATIC LEVEL ____________________
YIELD ______ GPM ______ STATIC ______

GDS WELL TAG #0450-0350

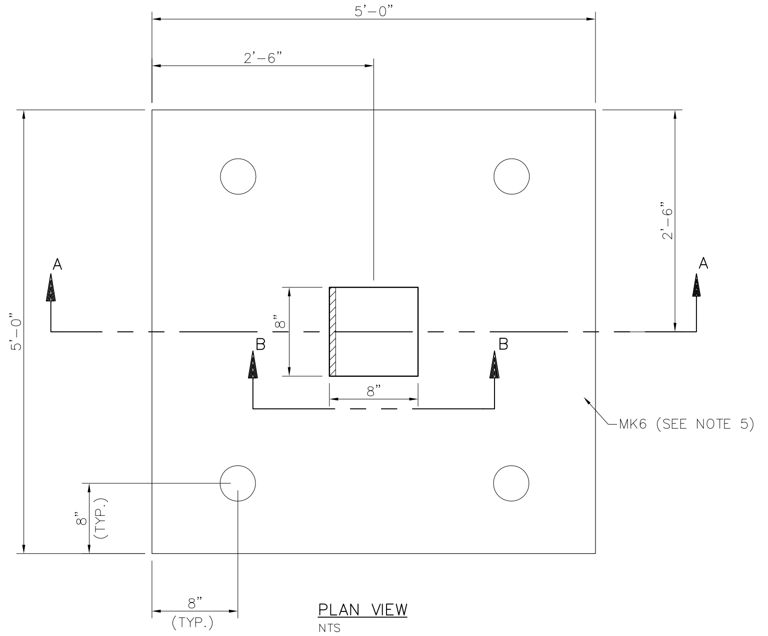
TVA MONITORING WELL

WELL NAME T.B.D.

IF DAMAGED CONTACT SOS XXX–XXXX

WELL I.D. TAGS (MK4)

DETAIL D
NTS



PLAN VIEW
NTS

MONITORING WELL NOTES:

1. BORING TO BE ADVANCED WITH HOLLOW STEM AUGERS THROUGH OVERBURDEN TO TARGET DEPTHS.
2. TARGET TIP ELEVATIONS TO BE DETERMINED FROM PRE–INSTALLATION EXPLORATORY BORINGS.
3. ANNULAR BACKFILL MATERIAL (SAND, BENTONITE, AND GROUT) TO BE TREMMIE–PLACED WITH SOUNDING MEASUREMENTS DURING AND AFTER CONSTRUCTION.

MARK NUMBERS AND MATERIAL LIST

MARK NO.	QUANTITY PER WELL	DESCRIPTION
1	1 EACH	GLOBAL SQUARE STEEL PROCOVER, GALVANIZED GDS SQ–PC 8"X8"X5" PROVIDED BY GLOBAL DRILLING SUPPLY, OR EQUIVALENT
2	1 EACH	BRASS MASTER LOCK, KEYED 0896
3	4 EACH	4" DIA. STEEL PIPE BOLLARD–PAINTED YELLOW, GDS GUARD PIPE 4"X5", PROVIDED BY GLOBAL DRILLING SUPPLY OR EQUIVALENT
4	1 EACH	WELL I.D. TAGS
5	8 EACH	DOME HEAD ALUMINUM RIVET #PASD403E, PROVIDED BY HANSON RIVET & SUPPLY CO. OR EQUIVALENT
6	AS REQ.	CONCRETE 3000 PSI
7	AS REQ.	$\frac{3}{16}$"X4"X4" WELDED WIRE. OVERLAPPED 4" AT JOINTS
8	1 EACH	2" SCH. 40 PVC SLIP CAP
9	AS REQ.	2" SCH. 40 PVC RISER. JSF 2"X10"–R "FLUSH THREAD", PROVIDED BY GLOBAL DRILLING SUPPLY OR EQUIVALENT
10	1 EACH	2" DIA. SCH. 40 PVC WELL SCREEN. JSF 2"X10'–010 "FLUSH THREAD" PROVIDED BY GLOBAL DRILLING SUPPLY OR EQUIVALENT
11	1 EACH	2" DIA. SCH. 40 PVC BOTTOM CAP. 2" FEM CAP "FLUSH THREAD" PROVIDED BY GLOBAL DRILLING SUPPLY OR EQUIVALENT
12	AS REQ.	GROUT–PORTLAND TYPE I OR II CEMENT WITH 5% BENTONITE BY WT.
13	AS REQ.	BENTONITE SEAL–PDS TR $\frac{30}{38}$ COATED PELLET PROVIDED BY GLOBAL DRILLING SUPPLY OR EQUIVALENT. PARTIALLY PRE–HYDRATE PRIOR
14	AS REQ.	FILTER SAND– GLOBAL NO. 7 (20X40MESH) PROVIDED BY GLOBAL DRILLING SUPPLY OR EQUIVALENT

GENERAL NOTE: R2

1. APPROXIMATE LOCATIONS SHOWN ON 10W254–15. FINAL LOCATIONS SHALL BE FLAGGED IN THE FIELD BY THE ENGINEER.

ISSSUED FOR CONSTRUCTION

PROJECT REVISION HISTORY

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R 2	05/14/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 2											
R 1	05/06/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 1											
R 0	04/17/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 0											
R B	10/29/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO.B											
R A	06/28/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. A											

DISCIPLINE INTERFACE
1
2
3
4

For Supporting Design Calculations See FPG–WBF–DEG–CDX0000002013000043

No. 108556
Stephen L. Whiteside
5/14/14

SCALE: NONE EXCEPT AS NOTED

YARD

ASH POND CLOSURE PROJECT
CIVIL DETAILS
WORK PLAN 2 (WBF–10W254–WP–2)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
R.NAGEL	M.BROKAW	D.NEAMTU	S.WHITESIDE	J.MULLINS	M.TURNBOW	J.KAMMEYER

CDM Smith

CDM SMITH
1100 Marion Street
Suite 200
Knoxville, Tennessee
37921
Tel. 865.963.4300
Fax 865.963.4301
www.cdmsmith.com

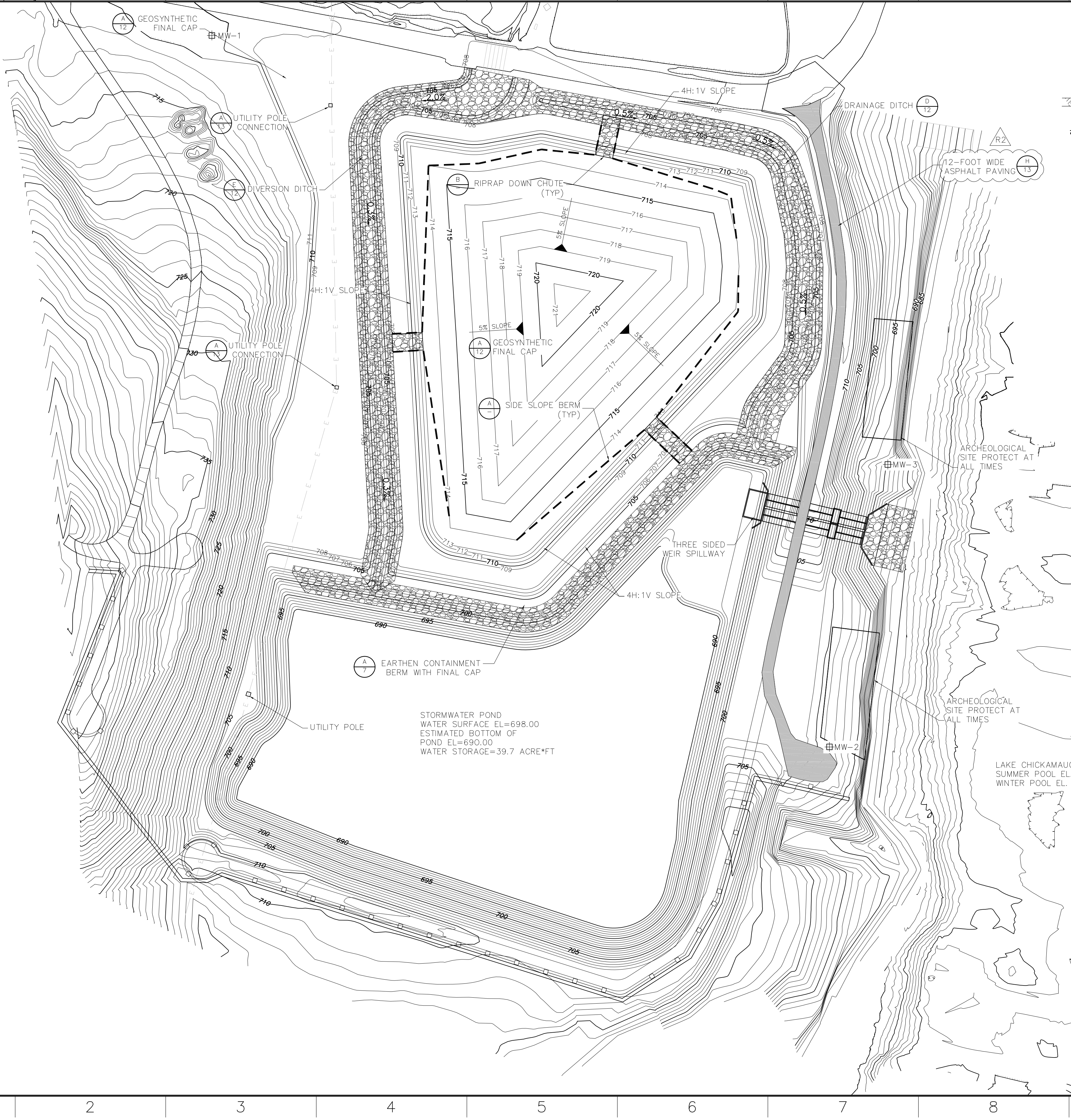
WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

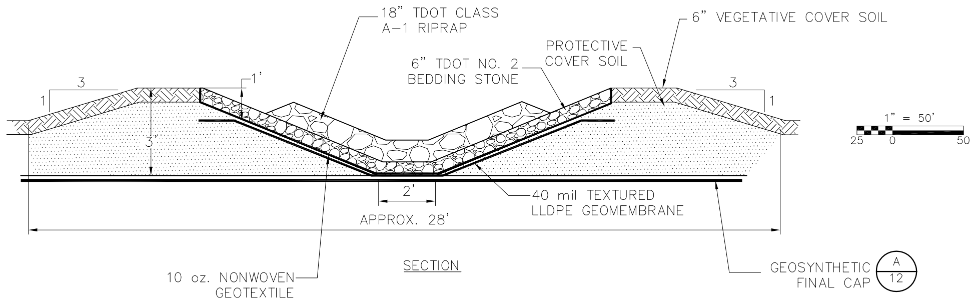
AUTOCAD R2013 | DATE 05/14/2014 | 14 | C | 10W254–14 | R 2

CDM SMITH	2
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
W_TVA

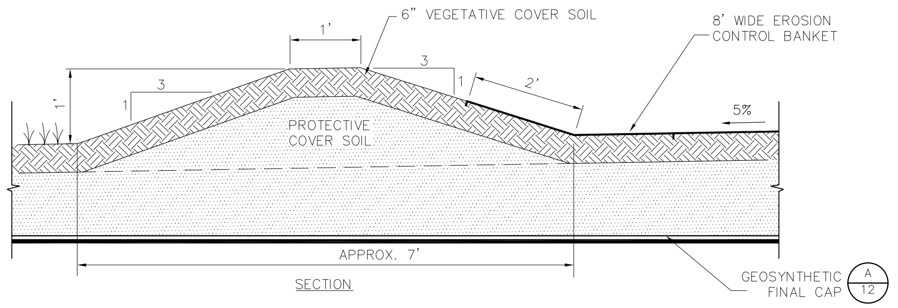
C.A.D. DRAWING
DO NOT ALTER MANUALLY





RIPRAP DOWN CHUTE

DETAIL B/–
NTS



SIDE SLOPE BERM

DETAIL A/–
NTS

LEGEND:

⌖ MW-3	GROUNDWATER MONITORING WELL

NOTES:

R2

1. CONTRACTOR SHALL PERFORM A SURVEY OF THE POND AREA ONCE EXCAVATION IS COMPLETE. IF WATER STORAGE IS DETERMINED TO BE GREATER THAN 50 ACRE/FT, FILL SHALL BE ADDED TO THE BOTTOM OF POND TO REDUCE WATER STORAGE.

ISSSUED FOR CONSTRUCTION

PLOT DATE: 05/15/2014 USER: BROKAW, MATTHEW J.
C:\CDMXM\BROKAWMJ\D1204674\WBF-10W254-15-SHT -REV 2.DWG

PROJECT REVISION HISTORY

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R 2	05/14/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 2											
R 1	05/06/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 1											
R 0	04/17/14	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO. 0											
R B	10/29/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISON NO.B											
R A	6/28/13	RN	MB	DN	SW	JM	MT	JK	–	–	–
REVISION NO.A											

DISCIPLINE INTERFACE
1
2
3
4

For Supporting Design Calculations See
FPG-WBF-DEG-CDX000002013000043

STEPHEN L. WHITESIDE
No. 106556
Stephen L. Whiteside
5/14/14

SCALE: 1"=50' EXCEPT AS NOTED

YARD
–

ASH POND CLOSURE PROJECT
FINAL CONDITIONS PLAN
WORK PLAN 2 (WBF-10W254-WP-2)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
R.NAGEL	M.BROKAW	D.NEAMTU	S.WHITESIDE	J.MULLINS	M.TURNBOW	J.KAMMEYER

CDM SMITH
1100 Marion Street
Suite 200
Knoxville, Tennessee
37921
Tel 865.963.4300
Fax 865.963.4301
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WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2013	DATE 05/14/2014	14	C	10W254-15	R 2

CDM SMITH	2
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

APPENDIX N
MATERIAL QUANTITY SAP

Material Quantity
Sampling and Analysis Plan
Watts Bar Fossil Plant

Revision 3

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

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

November 19, 2018

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	February 9, 2018
2	Addresses May 16, 2018 TDEC Review Comments and Issued for TDEC Review	July 6, 2018
3	Addresses Applicable Programmatic Revisions and Issued for TDEC Approval	November 19, 2018

TITLE AND REVIEW PAGE

Title of Plan: Material Quantity
Sampling and Analysis Plan
Watts Bar Fossil Plant
Tennessee Valley Authority
Spring City, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: November 19, 2018 Revision 3

All parties executing work as part of this Sampling and Analysis Plan sign below acknowledging they have reviewed, understand, and will abide by the requirements set forth herein.

TVA Investigation Project Manager — 11/19/18 Date

TVA Investigation Field Lead — 11/19/18 Date

Health, Safety, and Environmental (HSE) Manager — 11-19-18 Date

Investigation Project Manager — 2018-11-13 Date

Rock J. Vitale Digitally signed by Rock J. Vitale
DN: cn=Rock J. Vitale, o, ou, email=rvitale@envstd.com, c=US
Date: 2018.11.14 12:29:19 -05'00'

QA Oversight Manager — Date

K. Ryan R. Jones

Laboratory Project Manager — 2018-11-13 Date

Charles L. Head
TDEC Senior Advisor — Date

Robert Wilkinson
TDEC CCR Technical Manager — Date

Table of Contents

LIST OF TABLES

LIST OF ATTACHMENTS

1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 to the Tennessee Valley Authority (TVA), setting forth a process for the investigation, assessment, and remediation of any unacceptable risks at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference on April 27, 2016, at which time TVA briefed TDEC on its CCR management plans at Watts Bar Fossil Plant (WBF). On June 14, 2016, TDEC issued a follow-up letter which provided specific questions and tasks for TVA to address in this EIP. On June 22, 2017, TDEC issued a second follow-up letter to TVA regarding the TDEC Order and EIP submittal dates. On November 15, 2016, TVA submitted WBF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

In response to TDEC's comments, TVA has developed this Material Quantity Sampling and Analysis Plan (SAP) to answer TDEC's information requests regarding three-dimensional models, CCR material quantity, groundwater elevations, saturation levels, and subsurface conditions with respect to the Slag Disposal Area and Ash Pond Area (Study Area Units) at the WBF Plant (Plant).

2.0 OBJECTIVES

The objectives of this Material Quantity SAP are to describe the methods TVA will use to answer TDEC's information requests regarding CCR unit geometry, CCR material quantity, groundwater elevations, saturation levels, and subsurface conditions with respect to the Study Area. Activities described in this SAP will be completed to:

- Estimate the volume of CCR below and above groundwater
- Estimate the volume of CCR below and above the piezometric level of saturation
- Develop three-dimensional models of the subsurface from ground surface to bedrock and CCR volume estimates for each CCR unit
- Produce drawings specified in TDEC's information requests from the three-dimensional model

3.0 HEALTH AND SAFETY

This work will be conducted under an approved Plant-specific Health and Safety Plan (HASP). This HASP will be in accordance with TVA Safety policies and procedures. Each worker will be responsible for reviewing and following the HASP. Personnel conducting field activities will have completed required training, understand safety procedures, and be qualified to conduct the field work described in this SAP. The HASP will include a job safety analysis (JSA) for each task described in this SAP and provide control methods to protect personnel. Personal protective equipment (PPE) requirements and safety, security, health, and environmental procedures are defined in the HASP. In addition, authorized field personnel will attend TVA required safety training and Plant orientation.

The Field Team Leader will conduct safety briefings each day prior to beginning work and at mid-shift or after lunch breaks and document these meetings to include the names of those in attendance and items discussed. TVA-specific protocols will be followed, including the completion of 2-Minute Rule cards. The JSAs will be updated if conditions change.

4.0 APPROACH

4.1 EXPLORATORY BORINGS

4.1.1 Proposed TDEC Order Borings

In order to address TDEC's information requests regarding CCR material quantity, water levels, CCR material characteristics, and subsurface materials, subsurface characterization will be supplemented by performing CPTs and installing multi-purpose borings at locations shown on Figure 1 in Attachment A. These additional borings will provide supplemental data relative to CCR thickness, water levels, foundation soil type and thickness, and top of bedrock elevations for the interior of the CCR units. A total of 13 borings with both vibrating wire and temporary well installations and 41 CPTs are proposed. Details regarding proposed drilling, sampling, and piezometric activities are provided in the Exploratory Drilling SAP. Table 1 provides a summary of CPTs and borings proposed in each CCR unit.

Table 1. Summary of Exploratory Drilling Proposed in each CCR Unit

CCR/Study Area Unit	Total No. of Proposed CPTs	Total No. of Proposed Borings	No. of Borings with Temporary Wells	No. of Borings with Vibrating Wire Piezometers	No. of Borings with Rock Coring
Slag Disposal Area	30	11	3	4	8
Chemical Pond*	1	0*	0	0	0
Drainage Improvements Area**	10	0**	0	0	0
Ash Pond Area	0	2	2	0	0
Total	**41**	**13**	**5**	**4**	**8**

*The Chemical Pond is not a CCR unit, but drilling is planned to confirm that the Chemical Pond does not contain CCR backfill. A supplemental boring may be added should the CPT data be inconclusive.

**The Drainage Improvements Area is not a CCR unit, but drilling is planned to determine if the Maintenance Area contains CCR material. Supplemental borings may be added should the CPT data be inconclusive.

4.1.2 Data Analysis

Data from the proposed multi-purpose borings will be compared to the existing boring data and pre-construction topographic information available for each CCR unit. If this evaluation indicates different results between information sources for the lower CCR surface elevations, additional borings may be warranted. TVA will communicate with TDEC and discuss / determine if additional data collection is needed to meet the objectives listed in Section 2.0.

4.1.3 Water Level Monitoring

Monthly water level monitoring will be conducted for six months to establish and monitor levels in each CCR unit. TVA proposes using manual readings from any viable open standpipe piezometers and automated readings from proposed automated vibrating wire transducer piezometers shown on Figure 1 to estimate saturation levels in CCR. Details regarding water level monitoring field activities are provided in the Groundwater Investigation SAP.

4.2 THREE-DIMENSIONAL MODELS

Three-dimensional models of the Study Area Units will be developed to depict subsurface conditions from the ground surface to bedrock using the data summarized below which includes data from the proposed exploratory borings discussed in Section 4.1.

1. Ground and conventional aerial survey data will be used with record drawings to model features such as a soil cap and riprap layers.

2. Record drawings provided in CDM Smith (2015) approximate the final grade and upper and lower CCR surfaces in the Ash Pond. Closure drawings prepared by TVA (2009) approximate the final grade and upper CCR surface in the Slag Disposal Area. Record drawings provided in AECOM (2016) for drainage improvements at the Slag Disposal Area also show the final grade. These drawings are provided in Attachment B.

3. Data from borings shown on Figures 1 and 2 will also be used to model the upper CCR surface.

4. Pre-construction topographic information from USGS Decatur Quadrangles dated 1935 and 1942, three TVA Drawings (10N240, 10W243, and 10N245) titled “Fly Ash Disposal Area,” and two TVA Drawings (10N200 and 1210N92) titled “General Plan” (Attachment B), and data from borings that penetrated the CCR surface shown in Figures 1 and 2 will be used to model the lower CCR surface.

5. CDM Smith (2012a and 2012b) reports provide stability sections and boring logs which depict the upper and lower CCR surfaces in the Ash Pond.

6. Data from borings shown on Figures 1 and 3 will be used to model the foundation soils underlying each site.

7. Data from borings that encountered top of bedrock shown on Figures 1 and 4 will be used to model the top of bedrock surface.

8. Estimated piezometric levels of saturation discussed in Section 4.1.3 will be incorporated into the models.

9. Groundwater levels estimated as part of the Investigation will be incorporated into the models.

The three-dimensional model will be generated using software capable of rendering three-dimensional surfaces and calculating volumes such as Autodesk's AutoCAD Civil 3D or ArcGIS. Environmental Visualization Software (EVS) may also be used to visualize the three-dimensional model of the CCR units.

4.3 DRAWINGS

After the three-dimensional models are finalized, they will be used to produce drawings of the Study Area Units showing the following:

- Subsurface material types, properties, elevations, and thickness from the ground surface to top of bedrock
- Final elevations of units
- Upper and lower CCR surfaces and CCR thickness for each facility
- Top of bedrock contours
- Estimated piezometric saturation levels, contours, and river stage
- Estimated groundwater elevations, contours, and river stage
- Plan view showing areas where CCR is saturated
- Estimated extent of foundation soils between CCR and bedrock and estimated groundwater elevation

4.4 VOLUMETRIC ESTIMATES

The following volumetric estimates will be calculated for each Study Area Unit using three-dimensional modeling software such as Autodesk's AutoCAD Civil 3D or ArcGIS:

- Total volume of CCR
- Volume of CCR below estimated piezometric saturation levels
- Volume of CCR below estimated groundwater elevations
- Volume of CCR above estimated piezometric saturation levels
- Volume of CCR above estimated groundwater elevations

The combined total volume of CCR for all Study Area Units at the Plant will also be estimated. These volumetric estimates will be calculated using two methods to validate the model and results.

5.0 REPORTING AND DELIVERABLES

The EAR will document the field activities from the Investigation. This will include deviations from those procedures, results, and geological and hydrogeological interpretations. The results of the CCR material quantity assessment, including three-dimensional models of the facilities, drawings, and volumetric estimates, will also be incorporated into the EAR.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

The Plant-specific Quality Assurance Project Plan (QAPP) describes quality assurance (QA)/quality control (QC) requirements for the overall Investigation. The following sections provide details regarding QA/QC requirements specific to this Material Quantity SAP.

6.1 OBJECTIVES

The Data Quality Objectives (DQOs) process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA and the Investigation Project Manager considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts for the Investigation.

Specific quantitative acceptance criteria for analytical precision and accuracy for the matrices included in this investigation are presented in the QAPP.

6.2 QUALITY CONTROL CHECKS

The accuracy of the material quantity analysis procedures must be maintained throughout the investigation. Field and office personnel will be responsible for performing checks to confirm that the SAP has been followed. This consists of the completion of applicable field forms and documentation of field and office activities.

6.3 DATA VALIDATION AND MANAGEMENT

As stated in the EIP, a QAPP has been developed such that environmental data are appropriately maintained and accessible to data end users. The field investigation will be performed in accordance with the QAPP.

7.0 SCHEDULE

Anticipated schedule activities and durations for the implementation of this SAP are summarized below. This schedule is preliminary and subject to change based on approval, field conditions, and weather conditions. For the overall EIP Implementation schedule, including anticipated dates, see the schedule provided in the EIP.

Table 2. Preliminary Schedule for Material Quantity SAP Activities

Project Schedule		
Task	**Duration**	**Notes**
Material Quantity SAP Submittal	-	Completed
Develop models	60 Days	Following EIP Approval
Supplement models with data from proposed TDEC Order multi-purpose borings	30 Days	Following Field Activities
Use model to develop drawings and complete volumetric estimates	90 Days	Following Modeling Activities
Reporting and deliverables	60 Days	Following Analysis Activities

8.0 ASSUMPTIONS AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- Inaccuracies in historical data may cause uncertainty in the material quantity analysis. Uncertainty in the material quantity analysis will be evaluated and taken into consideration when determining if sufficient data has been gathered to complete the analysis.

9.0 REFERENCES

AECOM (2015). "Slag Disposal Area Maintenance." TVA Drawing Series, 10W426. Rev 1.

CDM Smith (2012a). "Report – Revision No. 1, Existing Conditions Stability Analyses, Ash Pond Area at Watts Bar Fossil Plant." Prepared for Tennessee Valley Authority. April 30.

CDM Smith (2012b). "Geotechnical Design Memorandum, Watts Bar Fossil Plant Coal Combustion Products Closure Project, Phase 2 – Ash/Stilling Pond Breaching Project." Internal memorandum. August 17.

CDM Smith (2015). "Ash Pond Closure Project". TVA Drawing Series 10W254-01 to 10W254-15. Rev. 2.

Tennessee Valley Authority (TVA). (1940). "General Plan". TVA Record Drawing No. 10N200 Rev .4.

Tennessee Valley Authority (TVA). (1969). "Plan and Sections Fly Ash Disposal Area". TVA Record Drawing No. 10N240 Rev. 0.

Tennessee Valley Authority (TVA). (1973). "Fly Ash Disposal Area". TVA Record Drawing No. 10W243 Rev. 0.

Tennessee Valley Authority (TVA). (1977). "Fly Ash Disposal Area". TVA Record Drawing No. 10N245 Rev. 4.

Tennessee Valley Authority (TVA). (1977). "Bottom Ash Disposal Area". TVA Record Drawing No. 10W251 Rev. 0.

Tennessee Valley Authority (TVA). (1977). "Chemical Treatment Pond". TVA Record Drawing No. 10W252 Rev. 0.

Tennessee Valley Authority (TVA). (1979). "Fly Ash Disposal Area Extension Sections and Details." Sheet 1. TVA Record Drawing No. 10N246 Rev. 2.

Tennessee Valley Authority (TVA). (1979). "Fly Ash Disposal Area Extension Sections and Details." Sheet 2. TVA Record Drawing No. 10N247 Rev. 1.

Tennessee Valley Authority (TVA). (2009). "Watts Bar Slag Processing and Pond Area Closure." Drawing Series 10W425.

United States Geological Survey (USGS). (1935). "USGS Topographic Map of the Decatur Quadrangle."

United States Geological Survey (USGS). (1942). "USGS Topographic Map of the Decatur Quadrangle."

ATTACHMENT A
FIGURES

Figure No.
1

Title
Proposed Borings

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2018-11-13
Technical Review by KB on 2018-11-13

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

Legend

- △ Proposed Cone Penetration Test
- ◻ Proposed Boring with Piezometer Vibrating Wire
- ○ Proposed Boring
- ⬠ Proposed Boring with Temporary Well *(Screened Material)*
- ● Existing Boring
- ∿ Historical Stream Alignment (Approximate)
- ┅ Watts Bar Nuclear Facility 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 ESRI Imagery
3. Additional boring in Chemical Pond may be utilized if Cone Penetration Test is inconclusive.
4. CPT borings on 5 feet spacing at historical stream alignment.

U:\TVA-EIP\175566336\gis\mxds\WBF_Proposed_Borings.mxd Revised: 2018-11-13 By: TRink

Figure No.
2

Title
Existing CCR Thickness Boring Data

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LMB on 2018-02-07
Technical Review by TG on 2018-02-07

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

Legend

●	Boring with CCR Thickness Data
▬	Watts Bar Nuclear Facility 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 ESRI Imagery

Stantec

TVA

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Figure No.

3

Title

Uppermost Foundation Soil Data

Client/Project

Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location

Spring City, Tennessee

175566336

Prepared by LMB on 2018-02-07
Technical Review by TG on 2018-02-07

0 150 300 450 600 Feet

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

Legend

●	Clay
●	Clayey Sand
●	Silt
▬	Watts Bar Nuclear Facility 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 ESRI Imagery

Stantec

TVA

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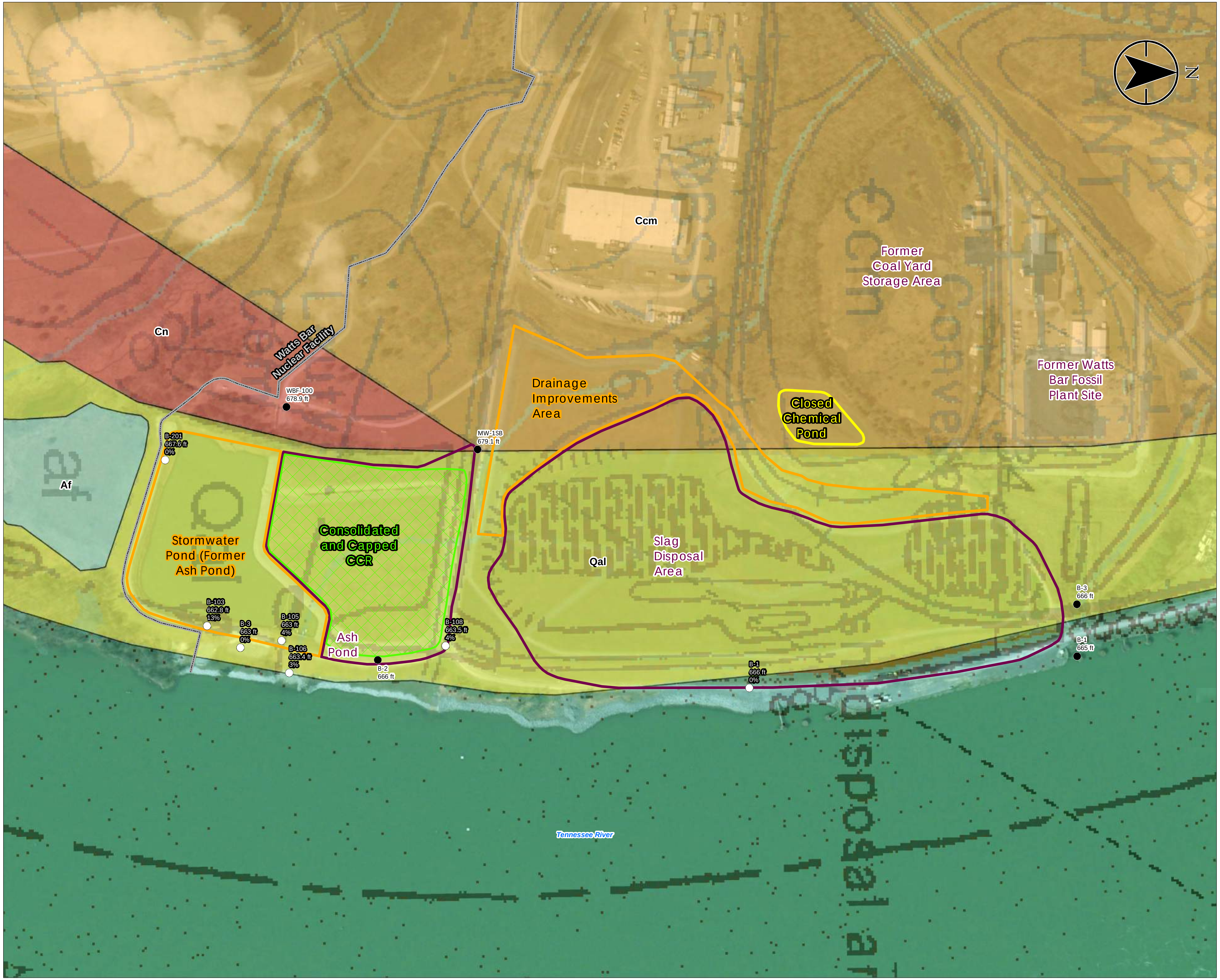

Figure No.
4

Title

Existing Top of Rock Elevation Boring Data

Client/Project

Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LMB on 2018-02-07
Technical Review by TG on 2018-02-07

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

Legend

- ● Borings without Rock Core Data [ID & TOR Elevation]
- ○ Borings with Rock Core Data [ID, TOR Elevation, RQD]
- Watts Bar Nuclear Facility Boundary
- CCR Unit Area (Approximate)
- Closed Chemical Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)
- Af - Artificial Fill
- Qal - Surficial Deposits
- Ccm - Conasauga Middle Group
- Cn - Nolichucky Shale

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by ESRI Imagery
3. Geologic Map: USGS TVA, Decatur Quadrangle, 1973

Stantec

TVA

U:\TVA-EIP\175566336\gis\mxds\WBF_TOR_Elevation.mxd Revised: 2018-02-07 By: mbough

APPENDIX O
EVALUATION OF EXISTING GEOTECHNICAL DATA

Evaluation of Existing Geotechnical Data Watts Bar Fossil Plant

Revision 3

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

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

November 19, 2018

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	February 9, 2018
2	Addresses May 16, 2018 TDEC Review Comments and Issued for TDEC Review	July 6, 2018
3	Issued for TDEC Approval	November 19, 2018

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LIST OF ATTACHMENTS

1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at Watts Bar Fossil Plant (WBF) on April 27, 2016, at which time TVA briefed TDEC on its Coal Combustion Residual (CCR) management plans at WBF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On June 14, 2016, TDEC issued a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 22, 2017, TDEC issued a second follow-up letter to TVA regarding the TDEC Order and EIP submittal dates. On November 15, 2016, TVA submitted WBF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

2.0 OBJECTIVES AND EVALUATION CRITERIA

Through the various information requests, as well as TDEC comments on the EIP, a need has been identified for an evaluation of existing geotechnical data. This document has been prepared to review the existing data and evaluate its adequacy with respect to responding to the various information requests.

Characterization of geotechnical parameters may differ from one evaluation to the next and can be due to multiple factors, such as:

1. Different loading cases (long-term static, short-term static, seismic, etc.) necessitate different strengths,
2. Spatial variation in subsurface conditions and analyses that consider different locations,
3. New information (field data, laboratory data, etc.) that allows updates to the characterization,
4. Changes in subsurface conditions due to the passage of time and/or geometric/operational changes at the site,
5. Evolution of the standard of practice and differences in professional engineering judgement with respect to geotechnical characterization and/or stability analyses,

Such differences are common within geotechnical engineering practice, particularly over a long period of time, with multiple studies performed by various professionals, and as additional data becomes available through various field and laboratory testing efforts. The relevancy of the above factors, with respect to the existing and upcoming analyses will be included as part of the response in the Environmental Assessment Report (EAR).

Evaluating the adequacy of existing data depends on both the type of data and its use. Existing geotechnical data will be used to support the following subjects addressed within the information requests:

1. Three-dimensional model (including CCR saturation) and volumetric estimates,
2. Stability of bedrock below fill areas,
3. Stability of the waste fill and side-slope berms,
4. CCR and soil shear strengths,
5. Potential for solution channeling, karst features, etc. in the shallow rock formations beneath the CCR units.

2.1 THREE-DIMENSIONAL MODEL (INCLUDING CCR SATURATION) AND VOLUMETRIC ESTIMATES

For evaluating the three-dimensional model and volumetric estimates, existing data to be considered (if available) includes:

1. Ground survey, aerial, and hydrographic surveys which including existing ground surface, upper CCR surface, and dike geometry data,
2. Instrumentation data and/or seepage models that include piezometric levels of saturation in CCR,
3. Borings that included the lower CCR surface, thickness of the clay foundation (or other materials) overlying bedrock, and top of bedrock elevations.
4. Electrical Resistivity Imaging (ERI) data that includes interpreted top of bedrock data.

For this subject, the basis for evaluating the adequacy of each type of data listed above are similar:

1. Suitability of methods used to perform topographic surveys, geotechnical borings, and geophysical surveys, as well as the associated documentation. Suitability is evaluated qualitatively, based on how well the methods obtain the necessary data and how the methods compare to the current standard of practice.
2. Spatial coverage of borings and geophysical surveys.
3. Potential for relevant changes in subsurface conditions since borings or surveys were performed.

2.2 STABILITY OF BEDROCK BELOW FILL AREAS

For evaluating the stability of bedrock below fill areas, existing data to be considered (if available) includes:

1. Geotechnical data from borings that included rock coring,
2. Geophysical surveys that included data below the top of bedrock,
3. Routine visual observations of CCR units, with respect to indicators of structural distress.
4. Geologic mapping and characterization of the site, including descriptions of the shallow rock formations.

For this subject, the basis for evaluating the adequacy of each type of data listed above are similar:

1. Spatial coverage of borings, geophysical surveys, and visual observations,
2. Suitability of methods used to perform rock coring, geophysical surveys, and visual observations, and of the associated documentation. Suitability is evaluated qualitatively, based on how well the methods obtain the necessary data and how the methods compare to the current standard of practice.
3. Potential for relevant changes in subsurface conditions since borings, surveys, or observations were performed.

2.3 STABILITY OF WASTE FILL AND SIDE-SLOPE BERMS

For evaluating stability of the waste fill and side-slope berms, existing data to be considered includes:

- Slope stability analyses of existing conditions,
- Slope stability analyses of future (i.e., permitted, "build-out", or closed) conditions.
- Structural stability assessments performed for CCR Rule compliance.

For this subject, the basis for evaluating the adequacy of each type of data listed above are similar:

1. Representative coverage with stability analysis cross sections,
2. Representative cross section geometry and subsurface characterization,
3. Representative material parameters and phreatic conditions,
4. Representative loads (static loads, seismic loads, etc.),
5. Appropriate stability analysis methods,
6. Potential for relevant changes in conditions since analyses were performed.

2.4 CCR AND SOIL SHEAR STRENGTHS

For evaluating CCR and soil shear strengths, existing data to be considered includes:

1. Shear strengths based on in-situ testing,
2. Shear strengths based on laboratory testing,
3. Shear strengths based on published values for similar materials.

For this subject, the basis for evaluating the adequacy of each type of data listed above are similar:

- Locations of in-situ tests and/or samples for each material,
- Suitability of methods used to perform in-situ testing, to collect samples, and to perform laboratory testing. Suitability is evaluated qualitatively, based on how well the methods obtain the necessary data and how the methods compare to the current standard of practice.
- Potential for relevant changes in subsurface conditions since in-situ testing and/or sampling were performed.

2.5 POTENTIAL FOR SOLUTION CHANNELING AND KARST FEATURES

For evaluating the potential for solution channeling in the shallow rock formations beneath the CCR units, existing data to be considered (if available) includes:

1. Geotechnical data from borings that included rock coring,
2. Geophysical surveys that included data at/below the top of bedrock,
3. Geologic mapping/characterization of the site, including descriptions of the shallow rock formations.

For this subject, the basis for evaluating the adequacy of each type of data listed above are similar:

1. Spatial coverage of borings, geophysical surveys, and geologic mapping,
2. Suitability of methods used to perform rock coring, geophysical surveys, and geologic mapping, and of the associated documentation,
3. Potential for relevant changes in subsurface conditions since borings, surveys, or mapping was performed.

3.0 EXISTING GEOTECHNICAL REPORTS

The following sections review and evaluate existing geotechnical reports with respect to the data necessary to support EIP information request responses. Each evaluation begins with a summary table of the key items, followed by additional details of each report.

3.1 FOX (1942)

Table 1. Summary of Evaluation for Fox (1942)

Reference:	Fox, P. P. 1942. "Watts Bar Steam Plant, Exploration and Geology of Foundation." Prepared for Tennessee Valley Authority, Water Control Planning Department, Geologic Division. April.
Purpose:	Site investigation for proposed steam plant to characterize subsurface conditions to aid in designing foundations
CCR Unit(s):	General area of WBF site
Spatial coverage:	Observations and mapping include the Watts Bar Fossil Steam Plant site along with auxiliary structures adjacent to future Slag Disposal Area.

Item	Yes/No	Remarks
Soil borings:	Yes	40 borings (3 near CCR units)
Rock coring:	No	
Other subsurface data:	Yes	31 test pits, 5 site-specific geologic sections, generalized bedrock stratigraphy for the area, and fracture orientation in Rutledge formation
Boring locations surveyed:	N/A	Mapped locations and elevations are provided
Data adequate to support three-dimensional model:	Yes	Geologic mapping can be correlated with top of bedrock elevations to evaluate trends
Geometry at time of document representative of 2017 conditions:	Yes	Structural geology and top of bedrock is the same as current
Piezometer installation:	No	
In-situ testing:	No	
Laboratory testing:	No	
Shear strength parameters:	No	
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Information is relevant to bedrock characterization
Other relevant analyses:	No	

3.1.1 Field Activities

In July 1940, three possible sites were selected around Watts Bar Dam. Two of the sites were excluded from consideration after this preliminary phase in which auger borings and/or topographical surveys were performed.

The third site was selected after a preliminary phase of auger borings. Additional auger borings, test pits, and wagon drill holes were performed following the preliminary phase of exploration. All phases of the foundation exploration accounted for a total of 40 soil borings and 31 test pits at the general steam plant site and adjacent auxiliary structures. The area of exploration extended from a series of three borings along the Tennessee River (Chickamauga Lake) for auxiliary structures to the general steam plant site footprint where the remaining borings and all the test pits were performed. The approximate locations for the three borings, which are near the CCR units, along the Tennessee River are provided in Figure 1 of Attachment A.

It was not documented whether the boring locations were surveyed upon the completion of drilling. Boring diagrams were provided that denoted the approximate location of each boring in relation to construction of the steam plant and the surrounding facilities.

Foundation excavations conducted in late August 1940 noted that the power shovel could excavate much of the soft shale bedrock without blasting and the approximate contact depth at which the brown, weathered shale turned to a dark bluish, unweathered shale.

3.1.2 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data is considered suitable for use in responding to the EIP information requests:

1. Top of rock surface and bedrock stratigraphy
    a. Geologic mapping can be correlated to rock cores and top of rock elevations.
    b. Geologic mapping methods meet current standard of practice.

3.2 MACTEC (2009)

Table 2. Summary of Evaluation for MACTEC (2009)

Reference:	MACTEC Engineering and Consulting, Inc. (MACTEC). 2009. "Quality Assurance/Quality Control, TVA Watts Bar Slag Area, Spring City, Tennessee, MACTEC Project 2043-09-1001." Prepared for Tennessee Valley Authority. June 11.	
Purpose:	Documentation of construction compliance for regrading of the CCR and capping of the unit in accordance to closure specifications	
CCR Unit(s):	Slag Disposal Area	
Spatial coverage:	Slag Disposal Area and Closed Chemical Pond	
Item	**Yes/No**	**Remarks**
Soil borings:	No	
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	No	
Data adequate to support three-dimensional model:	Yes	Data to support clay cap thickness (additional topsoil added per AECOM 2016)
Geometry at time of document representative of 2017 conditions:	Yes	Perimeter dike geometry is substantially the same as current.
Piezometer installation:	No	
In-situ testing:	Yes	Nuclear Density-Moisture testing and cap thickness verification
Laboratory testing:	Yes	One-point standard Proctor
Shear strength parameters:	No	
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	No	
Other relevant analyses:	No	

3.2.1 Field Activities

During clay cap construction by TVA Heavy Equipment Division (HED), a qualified inspector was on-site to observe the borrow material prior to and during placement, and to document moisture control and lift thicknesses during placement. After placement, the inspector performed density and moisture content testing with a nuclear density gauge (per ASTM standards), final cap thickness checks with a hand-auger, and collected soil samples for one-point standard Proctor tests. Daily field reports were provided detailing that the construction and inspection of the Slag Disposal Area closure was in accordance with the closure and post-closure plan.

3.2.2 Laboratory Testing

Prior to construction, Atterberg limits and standard Proctor tests were performed on bulk samples obtained from on-site borrow sources. The testing followed ASTM standards.

During construction, one-point standard Proctor tests were performed on representative samples of the placed clay cap material. The standards followed during this testing are not documented. However, this testing was used to determine if placed material was representative of standard Proctor tests prior to construction.

3.2.3 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data is considered suitable for use in responding to the EIP information requests:

1. Material descriptions and thicknesses are noted in field reports
    a. Field reports document approximate locations, material descriptions and thicknesses.
2. Laboratory testing of clay cap materials
    a. Borrow source sampling and testing followed relevant ASTM standards
    b. Field verification testing of placed material appeared to follow conventional procedures, but testing standards are not documented. Results can be used for comparison/context to other data, but should not be used directly for analyses.

3.3 CDM SMITH (2012A)

Table 3. Summary of Evaluation for CDM Smith (2012a)

Reference:	CDM Smith. 2012a. "Existing Conditions Stability Analyses" Revision 1. Prepared for Tennessee Valley Authority. April 30.	
Purpose:	Assessment of the static and seismic slope stability for the perimeter dike	
CCR Unit(s):	Slag Disposal Area and Ash Pond	
Spatial coverage:	Two cross-sections through the eastern perimeter dike of the Ash Pond	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	3 borings
Rock coring:	Yes	2 borings
Other subsurface data:	No	
Boring locations surveyed:	Yes	Surveyed by CDM Smith
Data adequate to support three-dimensional model:	Yes	Perimeter dike only
Geometry at time of document representative of 2017 conditions:	Yes	Perimeter dike only
Piezometer installation:	Yes	2 piezometers, screened in alluvium
In-situ testing:	Yes	SPT
Laboratory testing:	Yes	Testing followed ASTM standards
Shear strength parameters:	Yes	Static drained and undrained strength for alluvium, dike fill, and CCR
Static slope stability:	Yes	2 cross-sections
Seismic slope stability:	Yes	2 cross-sections
Information adequate to support stability evaluation:	Yes	Laboratory results can support material parameter derivation for soil, to support stability evaluation.
Other relevant analyses:	No	

3.3.1 Field Activities

A geotechnical drilling program was developed that consisted of three borings along the perimeter dike. Two of these soil borings included rock coring. The boring locations were surveyed using a handheld GPS unit by CDM Smith personnel after drilling was completed and are considered approximate (locations are shown in Figure 1).

The borings were drilled using hollow-stem augers powered by a truck-mounted CME-55 drilling rig. The encountered soils were sampled continuously for the first 10 feet and then on 5-foot centers thereafter by means of the standard penetration test conducted in accordance with ASTM D1586. Undisturbed (Shelby tube) samples were obtained at various intervals as directed by CDM Smith's field representative in accordance with ASTM D1587. Rock coring was performed using NQ-size wire-line coring equipment. Upon retrieval, the core was extracted and sequentially placed in a core storage box and labeled. An onsite representative logged the rock core upon retrieval for visual classification, core recovery, RQD, and other physical characteristics.

Upon completion of drilling, the borehole without instrumentation was grouted to the surface. At the two boreholes with instrumentation, a piezometer surrounded by a Filter Sand - DSI Well Gravel pack was installed with a bentonite seal above the sand followed by either soil or filter sand. Each piezometer received a one-foot (minimum) Portland cement surface seal. Piezometers were installed at two locations.

3.3.2 Laboratory Testing

Shelby tube and SPT samples were subjected to natural moisture content (D2216) tests. Select SPT soil samples were subjected to soil classification tests that included Atterberg limits (D4318) and sieve and hydrometer analyses (D422) tests. Undisturbed samples were subjected to CU triaxial compression with pore pressure measurements (D4767) and UU triaxial compression (D2850) tests.

3.3.3 Analysis

The primary emphasis of this study concerned the stability of the existing conditions of the Ash Pond. Slope stability was evaluated under static, steady state conditions and dynamic, earthquake loading conditions.

Data gathered from this geotechnical exploration along with typical/published values were used to estimate material parameters of the perimeter dike, foundation soils, and CCR at each cross section. The selection of the slope stability cross-sections was dependent upon the geometry of the exterior slopes, design plans, and the encountered subsurface conditions. Based on these criteria, two cross sections (Sections A-A' and B-B') were selected for seepage and slope stability analyses. The phreatic conditions were estimated using SEEP/W and compared to measurements from field piezometers.

The stability of the Ash Pond was evaluated using limit equilibrium methods as implemented in the SLOPE/W module. Analyses were completed for both undrained seismic (pseudostatic) and long-term static loading with steady-state seepage conditions. The drained and undrained shear strength parameters were derived using current laboratory data (i.e., consolidated-undrained triaxial tests and classification testing data), correlations to field data (i.e., standard penetration testing data, pocket penetrometer data) and typical/published literature values.

The stability analyses focused on global failures for the analyzed cross-sections. Global failures in this report are defined as "deep-seated failures that extend into the ash pond areas". The stability analysis results indicated factors of safety that equal or exceed the required minimum factor of safety for both static and seismic loading conditions.

3.3.4 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data is considered suitable for use in responding to the EIP information requests:

1. Material descriptions, thicknesses, and elevations from boring logs
    a. Locations were surveyed using handheld GPS unit and elevations were estimated from provided topographic survey.
    b. Boring logs document material descriptions and thicknesses.
    c. Phreatic conditions are more conservative than the existing, closed condition.
    d. Perimeter dike and foundation geometry are substantially the same as current.
2. Piezometers
    a. Installation methods meet current standard of practice.
    b. Locations were surveyed using handheld GPS unit and elevations were estimated from provided topographic survey.
3. CCR and Soil properties (including shear strengths)
    a. Sampling and testing followed relevant ASTM standards.
    b. Subsurface conditions are substantially the same as current.
4. Static and seismic slope stability analyses
    a. Allows for comparison of preliminary design versus closure design from later reports.
    b. Material parameters are representative of current.

3.4 CDM SMITH (2012B)

Table 4. Summary of Evaluation for CDM Smith (2012b)

Reference:	CDM Smith. 2012b. "Calculation Package Ash Pond Breaching Project Work Plan 1" Prepared for Tennessee Valley Authority. August 14.	
Purpose:	Assessment of the static and seismic slope stability for the new spillway structure through the perimeter dike	
CCR Unit(s):	Ash Pond	
Spatial coverage:	One-cross section at the proposed new spillway location	
Item	**Yes/No**	**Remarks**
Soil borings:	No	See CDM Smith (2012c)
Rock coring:	No	See CDM Smith (2012c)
Other subsurface data:	No	
Boring locations surveyed:	No	
Data adequate to support three-dimensional model:	No	
Geometry at time of document representative of 2017 conditions:	No	
Piezometer installation:	No	
In-situ testing:	No	
Laboratory testing:	No	
Shear strength parameters:	Yes	Static drained and undrained strength for alluvium, dike fill, and CCR
Static slope stability:	Yes	1 cross-section through proposed spillway
Seismic slope stability:	Yes	1 cross-section through proposed spillway
Information adequate to support stability evaluation:	No	
Other relevant analyses:	Yes	Hydraulic and hydrologic analysis of proposed spillway design, structural stability of proposed outlet structure

3.4.1 Analysis

The primary emphasis of this study concerned the slope stability analyses for the Ash Pond Breaching Project. These analyses were performed in support of the design of the new spillway structure at the Ash Pond. Slope stability was evaluated under static, steady state conditions and dynamic, earthquake loading conditions.

Boring information from CDM Smith (2012c) was used to establish subsurface geometry and material parameters of the dike material, foundation soils, and CCR at the evaluated cross section. The selection of the slope stability cross-section was based upon the location of the proposed spillway. The phreatic conditions were modeled based on the measurements from field piezometers and seepage modeling conducted in SEEP/W.

The stability analyses were performed using the Spencer method as implemented in SLOPE/W. The cross-section was analyzed with respect to deep-seated global stability. The drained and undrained shear strength parameters were derived from historical field and laboratory test data (standard penetration testing data and classification testing data) along with typical/published literature values. The results of the stability analyses indicated that the proposed spillway configuration of the analyzed cross-section met the minimum target factor of safety against slope failure for post-construction conditions.

3.4.2 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data is considered suitable for use in responding to the EIP information requests:

1. Static and seismic slope stability analyses
    a. Allows for comparison of preliminary design versus closure design from later reports.
    b. Material parameters are representative of current.

3.5 CDM SMITH (2012C)

Table 5. Summary of Evaluation for CDM Smith (2012c)

Reference:	CDM Smith. 2012c. "Geotechnical Design Memorandum, Watts Bar Fossil Plant Coal Combustion Products Closure Project, Phase 2 - Ash/Stilling Pond Breaching Project." Prepared for Tennessee Valley Authority. August 17.	
Purpose:	Evaluate the subsurface conditions for the design of the breach in the perimeter dike and future closure of the Ash Pond	
CCR Unit(s):	Ash Pond	
Spatial coverage:	Northern section of unit interior (dry ash area), splitter dike, and western perimeter dike	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	13 borings
Rock coring:	Yes	4 borings
Other subsurface data:	No	
Boring locations surveyed:	Yes	Surveyed by CDM Smith
Data adequate to support three-dimensional model:	No	
Geometry at time of document representative of 2017 conditions:	No	
Piezometer installation:	Yes	3 piezometers, screened in alluvium or CCR
In-situ testing:	Yes	SPT
Laboratory testing:	Yes	Testing followed ASTM standards
Shear strength parameters:	Yes	CU triaxial testing on undisturbed Shelby tube samples
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Laboratory results can support material parameter derivation for soil, to support stability evaluation.
Other relevant analyses:	No	

3.5.1 Field Activities

A geotechnical drilling program was developed that consisted of two phases. The first phase, performed in November 2011 and January 2012, is documented in Section 3.3. The second phase, performed in June 2012, consisted of ten borings, six of which included rock coring, and three hand auger borings. The boring locations were surveyed using a handheld GPS unit by CDM Smith personnel after drilling was completed and are considered approximate (locations are shown in Figure 1).

The ten borings were drilled using hollow-stem augers powered by a truck-mounted CME-55 drilling rig. The encountered soils were sampled continuously for the first 25 feet and then on 5-foot centers thereafter by means of the standard penetration test conducted in accordance with ASTM D1586. Shelby tube samples were obtained at various intervals as directed by CDM Smith's field representative in accordance with ASTM D1587. Rock coring was performed using NQ-size wire-line coring equipment. Upon retrieval, the core was extracted and sequentially placed in a core storage box and labeled. An onsite representative logged the rock core upon retrieval for visual classification, core recovery, RQD, and other physical characteristics.

Upon completion of drilling, the boreholes without instrumentation were grouted to the surface. At the three boreholes with instrumentation, a piezometer surrounded by a Filter Sand - DSI Well Gravel pack was installed with a bentonite seal above the sand followed by either soil or filter sand. Each piezometer received a one-foot (minimum) Portland cement surface seal. Piezometers were installed at three locations.

3.5.2 Laboratory Testing

Shelby tube and SPT samples were subjected to natural moisture content (D2216) tests. Select SPT soil samples were subjected to soil classification tests that included Atterberg limits (D4318), specific gravity (D854), and sieve and hydrometer analyses (D422) tests. Undisturbed samples were subjected to one-dimensional consolidation (D4186) and CU triaxial compression with pore pressure measurements (D4767) tests.

3.5.3 Analysis

After reviewing the existing information, the authors evaluated the following topics: foundation design bearing pressure and tolerable settlements, seismic site classification, the spillway's resistance to uplift, and lateral earth pressures.

3.5.4 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data is considered suitable for use in responding to the EIP information requests:

1. Material descriptions, thicknesses, and elevations from boring logs
    a. Locations were surveyed using handheld GPS unit and elevations were estimated from provided topographic survey.
    b. Boring logs document material descriptions and thicknesses.
    c. Phreatic conditions more conservative than the existing, closed condition.
    d. Foundation geometry is substantially the same as current.
2. Piezometers
    a. Installation methods meet current standard of practice.
    b. Locations were surveyed using handheld GPS unit and elevations were estimated from provided topographic survey.
    c. Instruments are adequate to provide current water level readings.
3. CCR and Soil properties
    a. Sampling and testing followed relevant ASTM standards.
    b. Subsurface conditions are substantially the same as current.

3.6 CDM SMITH (2013A)

Table 6. Summary of Evaluation for CDM Smith (2013a)

Reference:	CDM Smith. 2013a. "TVA Watts Bar CCP Closure - Final Design". Prepared for Tennessee Valley Authority. April.	
Purpose:	Support closure design for Ash Pond (boring logs only)	
CCR Unit(s):	Ash Pond	
Spatial coverage:	Northern portion of Ash Pond	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	6 borings
Rock coring:	Yes	1 borings
Other subsurface data:	No	
Boring locations surveyed:	Yes	Surveyed by CDM Smith
Data adequate to support three-dimensional model:	Yes	Data supports bottom surface modeling of CCR
Geometry at time of document representative of 2017 conditions:	No	Unit has since been reconfigured and closed. Bottom of CCR and foundation soil stratigraphy is substantially the same as current.
Piezometer installation:	Yes	One boring converted to an observation well.
In-situ testing:	Yes	SPT
Laboratory testing:	No	
Shear strength parameters:	No	
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	No	
Other relevant analyses:	No	

3.6.1 Field Activities

A subsurface exploration program consisted of five borings and one offset boring in the Ash Pond. The approximate locations are shown on the boring layout in Figure 1. The ground surface at each boring location was surveyed by CDM Smith using a handheld GPS unit. All six of the borings were drilled using hollow-stem augers powered by a CME-550 drilling rig. In the soil borings, continuous SPTs were typically performed in the CCR and dike fill material, whereas alluvial soils were sampled on 5-foot centers. Upon completion of drilling, borings were backfilled with grout, except one boring was converted to an observation well by installing a slotted PVC pipe.

3.6.2 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data is considered suitable for use in responding to the EIP information requests:

1. Material descriptions, thicknesses, and elevations from boring logs
    a. Boring locations and elevations were surveyed.
    b. Boring logs document material descriptions and thicknesses.
    c. Bottom of CCR and foundation geometry is substantially the same as current.

3.7 CDM SMITH (2013B)

Table 7. Summary of Evaluation for CDM Smith (2013b)

<table>
<tr><td>Reference:</td><td colspan="2">CDM Smith. 2013b. "Calculation Package WBF Ash Closure Project - Preliminary Slope Stability Analyses." Revision 2. Prepared for TVA. October 15.</td></tr>
<tr><td>Purpose:</td><td colspan="2">Preliminary assessment of the static and seismic slope stability for the Ash Pond Closure Project in support of design of the new ash fill placement</td></tr>
<tr><td>CCR Unit(s):</td><td colspan="2">Ash Pond</td></tr>
<tr><td>Spatial coverage:</td><td colspan="2">Two cross-sections within closure footprint</td></tr>
<tr><td></td><td colspan="2"></td></tr>
<tr><th>Item</th><th>Yes/No</th><th>Remarks</th></tr>
<tr><td>Soil borings:</td><td>No</td><td></td></tr>
<tr><td>Rock coring:</td><td>No</td><td></td></tr>
<tr><td>Other subsurface data:</td><td>No</td><td></td></tr>
<tr><td>Boring locations surveyed:</td><td>No</td><td></td></tr>
<tr><td>Data adequate to support three-dimensional model:</td><td>No</td><td></td></tr>
<tr><td>Geometry at time of document representative of 2017 conditions:</td><td>Yes</td><td>Closed conditions geometry and phreatic conditions are similar to or more conservative than current.</td></tr>
<tr><td>Piezometer installation:</td><td>No</td><td></td></tr>
<tr><td>In-situ testing:</td><td>No</td><td></td></tr>
<tr><td>Laboratory testing:</td><td>No</td><td></td></tr>
<tr><td>Shear strength parameters:</td><td>Yes</td><td>Part of a phased approach, refer to Sections 3.3, 3.5, and 3.6 for additional details</td></tr>
<tr><td>Static slope stability:</td><td>Yes</td><td>2 cross-sections for proposed closure geometry</td></tr>
<tr><td>Seismic slope stability:</td><td>Yes</td><td>2 cross-sections for proposed closure geometry</td></tr>
<tr><td>Information adequate to support stability evaluation:</td><td>Yes</td><td>Analyses are representative of static and pseudostatic stability of the closure perimeter dike.</td></tr>
<tr><td>Other relevant analyses:</td><td>No</td><td></td></tr>
</table>

3.7.1 Analysis

The primary emphasis of this study concerned the slope stability analyses for the Ash Pond Closure Project. Slope stability was evaluated under static, end of construction conditions; static, steady state conditions; and dynamic, earthquake loading conditions.

Historical boring information and data gathered from the previous phased geotechnical exploration (see Sections 3.3, 3.5, and 3.6) were used to establish subsurface geometry and material parameters of the dike material, foundation soils, and CCR at each cross-section. Two cross sections within the Ash Pond were evaluated.

The stability was evaluated using static limit equilibrium methods. Analyses were completed for end of construction, long term, and seismic conditions. The phreatic conditions were estimated using SEEP/W along with site-specific knowledge of pond and lake water elevations. Strength parameters were derived in earlier phases of the work as described in Sections 3.3, 3.5, and 3.6. The stability analyses considered deep seated global failures. The stability analysis results indicated factors of safety that equal or exceed the required minimum factor of safety for the evaluated loading conditions.

3.7.2 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data is considered suitable for use in responding to the EIP information requests:

1. Static and Seismic slope stability analyses
    a. Material parameters are representative of current.
    b. Surface and subsurface geometry is substantially the same as present.
    c. Pool elevations and phreatic conditions are similar or more conservative than current.
    d. Analysis methods meet current standard of practice.

3.8 CDM SMITH (2015A)

Table 8. Summary of Evaluation for CDM Smith (2015a)

Reference:	CDM Smith. 2015a. "Construction Record Documentation Report, Work Plan 1: Ash Pond Breaching Project, WBF-10W253-WP-1". Revision 0. Prepared for Tennessee Valley Authority. March 19.	
Purpose:	Documentation of construction compliance for spillway construction in accordance to project construction quality assurance plan	
CCR Unit(s):	Ash Pond	
Spatial coverage:	Ash Pond	
Item	**Yes/No**	**Remarks**
Soil borings:	No	
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	No	
Data adequate to support three-dimensional model:	Yes	Record drawings support perimeter dike geometry
Geometry at time of document representative of 2017 conditions:	Yes	Perimeter dike and foundation soil stratigraphy are substantially the same as current.
Piezometer installation:	No	
In-situ testing:	Yes	Nuclear density-moisture testing and proofroll
Laboratory testing:	Yes	Concrete compressive strength testing
Shear strength parameters:	No	
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	No	
Other relevant analyses:	No	

3.8.1 Field Activities

The scope of work for this project included construction monitoring by S&ME personnel for Work Plan 1: Ash Pond Breaching Project. The construction consisted of an earthen cofferdam, new concrete weir and box culvert spillway, new concrete barrier wall, perimeter access road, partial demucking of the ash pond, and drainage control. Construction was performed by TVA Civil Projects between August 27, 2012 and April 2, 2014.

During earthwork construction, a qualified inspector was on-site to observe excavations and placement of excavated wet ash into windrows, approve subgrade by observation of a proofroll, observe the borrow material prior to and during placement, and document moisture control and lift thicknesses during placement. After placement, the inspector performed density and moisture content testing with a nuclear density gauge (per ASTM standards).

Additionally, during concrete construction, a qualified inspector was onsite to observe flowable fill and concrete placement, perform slump and air entrainment testing prior to placement, obtain samples of the placed material for compressive strength or other testing, and observe pre-cast concrete structure installation. Upon substantial completion of concrete construction, the spillway and barrier wall were surveyed for as-built drawings as part of an overall site survey by TVA personnel.

Daily field reports were provided detailing that the construction and inspection of the Ash Pond Breaching project was in accordance with the work plan.

3.8.2 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data is considered suitable for use in responding to the EIP information requests:

1. Record drawings for Ash Pond Breaching Project
    a. Perimeter dike and foundation soil stratigraphy are substantially the same as current,
    b. Surveying methods are consistent with current standard of practice.
2. Material descriptions and thicknesses are noted in field reports
    a. Field reports document approximate locations, material descriptions and thicknesses.

3.9 CDM SMITH (2015B)

Table 9. Summary of Evaluation for CDM Smith (2015b)

Reference:	CDM Smith. 2015b. "Construction Record Documentation Report, Work Plan 2: Ash Pond Closure Project, WBF-10W254-WP-2". Revision 0. Prepared for Tennessee Valley Authority. March 19.	
Purpose:	Documentation of construction compliance for closure in accordance to project construction quality assurance plan	
CCR Unit(s):	Ash Pond	
Spatial coverage:	Ash Pond	
Item	**Yes/No**	**Remarks**
Soil borings:	No	
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	No	
Data adequate to support three-dimensional model:	Yes	Record drawings support closure geometry
Geometry at time of document representative of 2017 conditions:	Yes	Closure geometry is the same as current.
Piezometer installation:	No	
In-situ testing:	Yes	Nuclear density-moisture testing
Laboratory testing:	Yes	Laboratory testing of remolded borrow soil and ash samples followed ASTM standards
Shear strength parameters:	No	
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	No	
Other relevant analyses:	Yes	Field (destructive and non-destructive) testing of geomembrane seams

3.9.1 Field Activities

The scope of work for this project included construction monitoring for Work Plan 2: Ash Pond Closure Project. The construction consisted of dewatering of the existing Ash Pond, construction of a containment berm, demucking of the Ash Pond, relocation/stacking of excavated ash, construction of a diversion ditch, capping of the stacked ash with a geomembrane liner, and activation of the new spillway. Construction was performed by TVA Civil Projects between July 22, 2014 and February 28, 2015.

During construction, a qualified inspector was on-site to observe the borrow material prior to and during placement and to document moisture control and lift thicknesses during placement. After placement, the inspector performed density and moisture content testing with a nuclear density gauge (per ASTM standards).

The existing Ash Pond was dewatered using pumps. Dewatering rates were maintained to control turbidity of the discharge through the NPDES outfall. After dewatering of the existing Ash Pond, the contractor began demucking of the pond bottom to remove soft and unsuitable material. The excavated ash was stacked in north-south aligned windrows to dry and drain towards the south pond. A new containment berm was constructed with soil from the offsite borrow source to contain the excavated ash in the former “dry ash area”. Each lift of the containment berm was tested for proper compaction and moisture control.

Upon completion of the containment berm, the West Diversion Ditch was constructed to convey stormwater runoff away from the ash stack. In areas that required over excavation, No. 57 stone and geotextile was placed before backfilling with bottom ash. LLDPE geomembrane was placed along the bottom of the ditch in the improved areas.

TVA and CDM Smith utilized a phased verification process to confirm sufficient ash removal from the southern portion of the pond. The process for verifying ash removal consisted of visually screening for any potential areas of significant ash. Then, developing a surveyed grid system as areas were cleared. Finally, a template was placed at each grid point (176 total) and a second visual check was performed to check that each area within the template had less than 10% visual ash material. A photograph and GPS coordinates of the second visual check were obtained at each location.

The excavated ash from Phase 1 (section 3.10) and from Phase 2 were placed in 1-foot lifts within the former dry ash area within the perimeter dikes and containment berm. The ash fill was compacted to 90% of maximum dry unit weight at ± 2% optimum moisture content (per D698). These lifts were tested using a nuclear density gauge at a rate of 1 tests per lift per 10,000 square feet. Due to the less than expected ash material being obtained from excavation of the pond and splitter dike, the proposed contours for the closure slopes were revised. The side slopes of the closure area maintained the same 5% slope and the planned 4:1 side slopes were eliminated.

The closure cap design consisted of a geomembrane, geocomposite drainage layer, and 2-feet of cover soil. A 40-mil thick linear low-density polyethylene (LLDPE) geomembrane was installed overlying the compacted ash fill. Upon completion of the installation of the geomembrane, a geocomposite drainage net was installed. The 2-foot thick cover layer consists of 18-inches of cover soil overlain by 6-inches of topsoil. The installation was monitored and tested in accordance with design specifications.

Upon completion of the capping of the compacted ash fill, a portion of the containment dike was lowered to elevation 701 feet and the earthen cofferdam and spillway risers were removed. The spillway barrels were grouted full, and the new concrete spillway was activated.

The contractor performed multiple site surveys to verify the elevations of the various layers to confirm that appropriate cover was installed. As-built survey plans were submitted and included in the Record Drawings as documentation of these elevations and thicknesses. Daily field reports were provided detailing that the construction and inspection of the Ash Pond Closure project was in accordance with the work plan.

3.9.2 Laboratory Testing

Laboratory tests were performed in accordance with ASTM standard testing procedures, as noted below. Bulk samples were obtained from an offsite borrow source and from the ash fill. These samples were subjected to standard Proctor (D698), natural moisture content (D2216), Atterberg limits (D4318), and sieve and hydrometer analyses (D422) tests.

3.9.3 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data is considered suitable for use in responding to the EIP information requests:

1. Material descriptions, thicknesses, and elevations from construction surveys
   a. Locations and elevations were surveyed,
   b. Daily field logs and laboratory testing sheets document material descriptions and thicknesses,
   c. Perimeter dike and closure geometry is substantially the same as current.
2. Soil and geosynthetic liner properties
   a. Sampling and testing followed relevant standards.
   b. Subsurface conditions are substantially the same as current.

3.10 AECOM (2016)

Table 10. Summary of Evaluation for AECOM (2016)

Reference:	AECOM. 2016. "Slag Disposal Area Maintenance, TVA Project 901670, Construction Record Documentation Report, Watts Bar Fossil Plant." Revision 0. Prepared for Tennessee Valley Authority. January 18.
Purpose:	Documentation of construction compliance closure improvements in accordance to project construction quality assurance plan
CCR Unit(s):	Slag Disposal Area
Spatial coverage:	Slag Disposal Area, Closed Chemical Pond, and Non-regulated wetlands

Item	Yes/No	Remarks
Soil borings:	No	
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	No	
Data adequate to support three-dimensional model:	Yes	Record drawings support closure geometry
Geometry at time of document representative of 2017 conditions:	Yes	Closure geometry is substantially the same as current.
Piezometer installation:	No	
In-situ testing:	Yes	Nuclear density-moisture testing
Laboratory testing:	Yes	Laboratory testing of remolded borrow soil and ash samples followed ASTM standards
Shear strength parameters:	No	
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	No	
Other relevant analyses:	Yes	Field (destructive and non-destructive) testing of geomembrane seams

3.10.1 Field Activities

The scope of work for this project included construction monitoring for the Slag Disposal Area maintenance work. The construction consisted of re-establishing vegetative cover by adding topsoil to the surface of the existing slag disposal and chemical pond areas, improving drainage for the 25-year, 24-hour storm, filling of non-jurisdictional wetlands, relocating the perimeter ditch, excavating an interceptor trench for seep #1, and abandoning the inactive 30-inch diameter storm drain beneath the area. Construction was performed between June 16, 2015 and October 22, 2015. The following paragraphs are a summary of the monitored construction activities.

The seep repair was constructed to address seepage noted in the area. The repair consisted of excavating two to four feet of material then backfilling the area with No. 57 stone. The cut-off portion of the trench was backfilled the entire depth with No. 57 stone, whereas the conveyance portion was backfilled with 12 inches of No. 57 stone. The stone was covered with 6-ounce non-woven geotextile and capped with general backfill soil and imported clay to minimize infiltration.

The 30-inch storm drain pipe was inspected, cleaned, and then inspected again prior to pumping approximately 27 cubic yards of grout to seal off the pipe. Minimal seepage was noted at the bottom of the bulkhead after grouting.

Storm water enhancements including regrading of the non-jurisdictional wetlands, ditch relocation, and other drainage improvements were also performed. As part of the ditch relocation, the west and south ditches around the non-jurisdictional wetlands were constructed. The ditches were excavated, lined with a geomembrane and geotextile, backfilled with 12-inches of No. 57 stone, and then backfilled with an additional 18-inches of rip-rap. The wetlands were then regraded with imported clay fill. Additional drainage improvements constructed on site included swales, regrading of selected areas, and the construction of culverts. A qualified inspector was on-site to observe the borrow material prior to and during placement, and to document moisture control and lift thicknesses during placement. After placement, the inspector performed density and moisture content testing with a nuclear density gauge (per ASTM standards). The clay fill was compacted to 90% of maximum dry unit weight at 3% below to 2% above optimum moisture content (per D698). These lifts were tested using a nuclear density gauge at a rate of 1 tests per lift per acre.

Topsoil was added to the Chemical Pond and the Slag Disposal Area to promote vegetative growth. Prior to topsoil placement, additional imported clay fill was placed at the Closed Chemical Pond to improve the grade. Topsoil was spread with a dozer and then checked for thickness by a field representative. The topsoil was then hydroseeded to promote growth and watered as needed.

Upon the completion of construction activities, as-built survey plans were submitted and included in the Record Drawings as validation of these elevations and thicknesses. Daily field reports were provided detailing that the construction and inspection of the Slag Disposal Area Maintenance project was in accordance with the work plan.

3.10.2 Laboratory Testing

Laboratory tests were performed in accordance with ASTM standard testing procedures, as noted below. Bulk samples were obtained from an offsite borrow source and of the ash fill. These samples were subjected to standard Proctor tests (D698), natural moisture content (D2216), Atterberg limits (D4318), and grain size analyses (D2487) tests.

3.10.3 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data is considered suitable for use in responding to the EIP information requests:

1. Material descriptions, thicknesses, and elevations from construction surveys
    a. Locations and elevations were surveyed,
    b. Daily field logs and laboratory testing sheets document material descriptions and thicknesses,
    c. Perimeter dike and closure geometry is substantially the same as current.
2. Soil properties
    a. Sampling and testing followed relevant standards.
    b. Subsurface conditions are substantially the same as current.

3.11 STANTEC (2017)

Table 11. Summary of Evaluation for Stantec (2017)

Reference:	Stantec Consulting Services, Inc. (Stantec). 2017. “Geotechnical Field Services for Well Installations and Closures, Groundwater Monitoring Optimization - Phase 3, Watts Bar Fossil Plant, Harriman, Rhea County, Tennessee.” Prepared for Tennessee Valley Authority. March 3.	
Purpose:	Document groundwater monitoring well installations, re-developments, and abandonments, per the Groundwater Monitoring Optimization (GMO) for CCR units at WBF.	
CCR Unit(s):	Ash Pond	
Spatial coverage:	Perimeter of Ash Pond	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	2 borings
Rock coring:	No	
Other subsurface data:	Yes	Downhole video logging of existing wells
Boring locations surveyed:	Yes	Surveyed by Stantec after field work
Data adequate to support three-dimensional model:	Yes	Data support foundation soil thickness/stratigraphy, top of bedrock elevation, and bedrock stratigraphy
Geometry at time of document representative of 2017 conditions:	Yes	Unit geometry and phreatic conditions are similar.
Piezometer installation:	Yes	One new monitoring well installed
In-situ testing:	Yes	SPT
Laboratory testing:	No	Analytical (Chemical) testing of soil only
Shear strength parameters:	No	
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	No	
Other relevant analyses:	No	

3.11.1 Field Activities

Field activities included installation of one new monitoring well, the re-development of three existing monitoring wells, and the advancement of two soil borings. One boring was extended into bedrock. The work was performed by qualified Stantec drill crews using truck-mounted drill rigs under the direction of a licensed Tennessee driller (#949). The monitoring wells were installed using current industry and regulatory protocols to prevent introducing contaminants during the drilling and installation process. These procedures include the decontamination of the drilling equipment and tools before and after each well by washing with hot, potable water delivered under high pressure, using new well screen and riser that had been cleaned and sealed in plastic at the factory, and placing washed filter pack sand.

The new well (WBF-100) was installed using a truck mounted rotary drill rig equipped with hollow stem augers. The new well boring along with sample boring MW-1SB (adjacent to the existing well with the same identifier) were performed by advancing hollow-stem augers through the soil overburden. SPTs were performed at 2½-foot depth intervals through the soil overburden in WBF-100 only. The split-spoon samples were placed into glass jars with lids and transported to Stantec's Lexington, Kentucky laboratory. The subsurface materials were logged by a Stantec project geologist or engineer for material type, color, moisture content, consistency, and other notable composition characteristics.

The new well consisted of a four-inch diameter by ten-foot long Schedule 40 PVC pre-packed well screen (0.010-inch slots) and riser. The screen and riser consisted of flush-joint, threaded PVC pipe. A four-inch diameter Schedule 40 PVC bottom well plug measuring approximately three inches in length was threaded onto the bottom of the screen. The PVC riser extended above the ground surface and was capped with a temporary plug or slip cap. The annular space was backfilled with a sand filter pack (20/40 mesh – Global No. 7 sand) extending from the bottom of the borehole to an elevation corresponding to approximately two to three feet above the well screen. A minimum two-foot thick bentonite pellet seal was then placed on top of the sand filter pack. After the bentonite seal was sufficiently hydrated, the remaining annular space was backfilled with a bentonite grout.

Upon completion of the field work, the soil borings and well locations were surveyed onto the Tennessee state plane coordinate system by Stantec (approximate locations are shown in Figure 1).

3.11.2 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data is considered suitable for use in responding to the EIP information requests:

1. Material descriptions, thicknesses, and elevations from boring logs
    a. Boring locations and elevations were surveyed,
    b. Boring logs document material descriptions and thicknesses,
    c. Perimeter dike and foundation geometry is substantially the same as current.
2. Monitoring Wells
    a. Installation methods meet current standard of practice,
    b. Locations and elevations were surveyed,
    c. Instruments are adequate to provide current water level readings.

4.0 ASSUMPTIONS AND LIMITATIONS

In preparing this document, assumptions are as follows:

- The summaries presented herein cannot fully communicate the information contained in each document. Refer to the individual reference documents for additional context and detail.

5.0 REFERENCES

References are provided in the summary table for each document discussed herein.

ATTACHMENT A
FIGURE

Figure No.
1

Title
Existing Borings

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LT on 2018-02-07
Technical Review by TG on 2018-02-07

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

Legend

● Existing Boring
--- Watts Bar Nuclear Facility 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 ESRI Imagery

U:\TVA-EIP\175566336\gis\mxds\WBF_Existing_Borings.mxd Revised: 2018-02-07 By: mbough

APPENDIX P
STABILITY SAP

Stability
Sampling and Analysis Plan
Watts Bar Fossil Plant

Revision 3

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

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

November 19, 2018

STABILITY
SAMPLING AND ANALYSIS PLAN
WATTS BAR FOSSIL PLANT

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	February 9, 2018
2	Addresses May 16, 2018 TDEC Review Comments and Issued for TDEC Review	July 6, 2018
3	Issued for TDEC Approval	November 19, 2018

STABILITY
SAMPLING AND ANALYSIS PLAN
WATTS BAR FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Stability
Sampling and Analysis Plan
Watts Bar Fossil Plant
Tennessee Valley Authority
Spring City, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: November 19, 2018

Revision 3

All parties executing work as part of this Sampling and Analysis Plan sign below acknowledging they have reviewed, understand, and will abide by the requirements set forth herein.

TVA Investigation Project Manager — 11/19/18 Date

TVA Investigation Field Lead — 11/19/18 Date

Health, Safety, and Environmental (HSE) Manager — 11-19-18 Date

Investigation Project Manager — 2018-11-13 Date

Rock J. Vitale Digitally signed by Rock J. Vitale DN: cn=Rock J. Vitale, o, ou, email=rvitale@envstd.com, c=US Date: 2018.11.14 12:30:08 -05'00'

QA Oversight Manager — Date

K. Ryan R. Jones

Laboratory Project Manager — 2018-11-13 Date

Charles L Head
TDEC Senior Advisor — Date

Robert Wilkinson
TDEC CCR Technical Manager — Date

Stantec

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LIST OF TABLES

LIST OF ATTACHMENTS

1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at Watts Bar Fossil Plant (WBF) on April 27, 2016, at which time TVA briefed TDEC on its Coal Combustion Residual (CCR) management plans at WBF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On June 14, 2016, TDEC issued a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 22, 2017, TDEC issued a second follow-up letter to TVA regarding the TDEC Order and EIP submittal dates. On November 15, 2016, TVA submitted WBF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

Through the various information requests, as well as TDEC comments, a need for several stability analyses at WBF (the Plant) has been identified. This Stability Sampling and Analysis Plan (SAP) has been prepared to outline the proposed analyses and the methods to be employed during the Investigation.

2.0 OBJECTIVES

The purpose of this Stability SAP is to outline the methods that will be used to execute the following activities:

- Develop slope stability models (including material parameters) and perform slope stability analyses for selected CCR units.
- Document the analyses in the EAR.

3.0 HEALTH AND SAFETY

Implementation of this SAP does not include field work. A Health and Safety Plan (HASP) is not required.

4.0 PLANT-SPECIFIC STABILITY ANALYSIS PLAN

The proposed stability analyses were selected to aid in addressing data gaps and supplementing existing data, as necessary to address information requests of the TDEC Multi-site Order for WBF. Rationale for individual analyses are discussed below.

Table 1 provides the stability analyses (i.e., load cases) proposed for each CCR unit. In cases where new analyses are not proposed, existing analyses adequately address the load case(s) for the unit. For more information on these existing analyses, refer to summaries of existing geotechnical data provided as an appendix to the EIP.

Table 1. Stability Analyses Proposed for each CCR Unit

	Static Cases		Seismic Cases		
CCR Unit and Condition	**Long-Term, Global**	**Long-Term, Veneer[2]**	**Pseudostatic[1], Global**	**Pseudostatic[1], Veneer[2]**	**Post-EQ[3], Global**
Slag Disposal Area (Closed Condition)	x	x	x	x	x
Ash Pond (Closed Condition)		x		x	x

[1] Pseudostatic, correlated to a tolerable displacement.
[2] Veneer stability is the slope stability of the final cover.
[3] Post-earthquake (Post-EQ) analysis includes a preceding liquefaction triggering assessment.

The rationale for the proposed analyses is as follows:

- The Slag Disposal Area lacks documented static and seismic slope stability analyses for the current, closed geometry.
- The Ash Pond lacks documented static veneer, seismic veneer, and post-earthquake slope stability analyses for the current, closed geometry.

Other load cases that are not proposed in Table 1 have existing analyses that are representative.

Refer to Figure 1 in Attachment A for a layout of proposed analysis cross section locations. The selected locations represent critical cross sections based on reviews of previous stability analysis results, subsurface stratigraphy, material properties, and structure geometry. For selection of analysis section(s) for post-earthquake stability, the location of potentially liquefiable materials is also considered. Proposed section locations may be adjusted based on the methodology in Section 5.1.

Loading conditions and results from the analyses will be documented within the EAR. For proposed stability analyses, recent water levels, including those measured per the EIP will be considered. When existing stability analyses are to be leveraged, recent water levels will be compared to the modeled levels to confirm that the analyses are still suitable.

5.0 TECHNICAL APPROACH

This section provides a framework for the procedures that will be used to perform the proposed slope stability analyses. Within this framework, industry standard engineering practices will be employed to execute the work. Individual engineering decisions cannot be prescribed, as they are dependent on the site conditions, available information, type of analysis, and other factors. Details of each analysis, including engineering judgments, will be documented in the EAR.

5.1 ANALYSIS FRAMEWORK

5.1.1 Load Cases

The load cases to be evaluated in the stability analyses are based on conventional practice and appropriate industry standards for landfills and surface impoundments, as applicable.

- Static, long-term (i.e., normal operation conditions) global stability
- Static, long-term veneer (i.e., final cover) stability
- Seismic, pseudostatic global stability
- Seismic, pseudostatic veneer stability
- Seismic, post-earthquake global stability (includes a preceding liquefaction triggering assessment)

5.1.2 Phased Assessment and Acceptance Criteria

The stability analyses will be performed using a phased assessment process. Initial phases employ available site information, simplified analysis methods, and more conservative acceptance criteria. If acceptable performance is demonstrated, the analyses for the particular load case(s) are complete. If not, the next phase may include collection of additional site information and/or more advanced analysis methods. Less conservative acceptance criteria may be utilized, commensurate with the improved site characterization. The process may continue through multiple phases, as outlined below. The use of a phased approach is consistent with industry standard engineering practices.

The load cases and acceptance criteria presented herein (Table 2) apply specifically for the TDEC Order. The same CCR units may also be subject to other requirements (which may be more or less stringent) for compliance with other regulations such as state permitting, CCR Rule, etc.

Phase 1 Assessment

- Use available geotechnical data (Standard Penetration Testing (SPT), Cone Penetration Testing (CPT), lab testing, etc.)
    - Where geotechnical data is insufficient, collect supplemental CPT data
- Compute static, long-term factor of safety (global, FS_{static} and veneer, $FS_{static\text{-}veneer}$ slope stability)
- For seismic load cases, use site-specific design earthquake loading
    - If not already available, TVA will perform site-specific seismic hazards assessment (Section 5.4.2)
- Complete liquefaction triggering assessment based on SPT and CPT data
- Compute pseudostatic factor of safety (global, FS_{pseudo} and veneer, $FS_{pseudo\text{-}veneer}$ slope stability)
    - Using Newmark displacement analyses, compute displacements for range of yield accelerations
    - Select pseudostatic coefficient equal to yield acceleration that gives displacement of 3 feet in the Newmark analysis
    - Assign strengths considering results of liquefaction assessment
    - Compute pseudostatic FS_{pseudo} and $FS_{pseudo\text{-}veneer}$
- Compute static, post-earthquake factor of safety (global slope stability)
    - Assign pseudostatic coefficient equal to zero (static case)
    - Assign strengths considering results of liquefaction assessment
    - Compute post-earthquake $FS_{post\text{-}EQ}$
- Performance is acceptable if the following criteria are met
    - $FS_{static} \geq 1.5$
    - $FS_{static\text{-}veneer} \geq 1.5$
    - $FS_{pseudo} \geq 1.0$
    - $FS_{pseudo\text{-}veneer} \geq 1.0$

  - $FS_{post\text{-}EQ} \geq 1.1$

- If any load cases do not meet criteria, go to Phase 2

- During the Phase 1 stability assessment, TVA will work with TDEC to define criteria for acceptable performance that would be utilized during a potential Phase 4 (the final phase) of the proposed phased stability assessment. The factors that contribute to defining acceptable performance will be site-specific and related to the consequences of the predicted deformations. As more site-specific information becomes available after Phase 1, TVA and TDEC may need to revisit the acceptable performance criteria in light of the additional information.

Phase 2 Assessment

- Perform additional site explorations in targeted areas
  - Critical areas to be identified by parametric analyses
  - SPT using mud rotary drilling (or other suitable drilling method)
  - Seismic CPT soundings (companion to SPT locations)
  - Lab testing tailored to analysis needs (including triaxial and/or direct shear strength testing, as applicable)
- Compute static factor of safety
  - Update Phase 1 analyses with new site data
- Complete liquefaction triggering assessment
  - Update Phase 1 analyses with new site data
- Compute pseudostatic factor of safety
  - Update Phase 1 analyses with new site data
- Compute post-earthquake factor of safety
  - Update Phase 1 analyses with new site data
- Performance is acceptable if the following criteria are met
  - $FS_{static} \geq 1.5$
  - $FS_{static\text{-}veneer} \geq 1.5$

  - $FS_{pseudo} \geq 1.0$
  - $FS_{pseudo\text{-}veneer} \geq 1.0$
  - $FS_{post\text{-}EQ} \geq 1.0$ (lower criteria based on improved site characterization)
- If any load cases do not meet criteria, go to Phase 3

Phase 3 Assessment

- Perform a nonlinear deformation analysis (FLAC, OpenSees, or other appropriate code) to estimate displacements
- Performance is acceptable if representative displacement ≤ 3 feet
- If representative displacement > 3 feet, go to Phase 4

Phase 4 Assessment

- Consider the consequences (impacts to human health and/or environment) of the predicted deformations
- As more site-specific information becomes available after Phase 1, TVA and TDEC may need to revisit the acceptable performance criteria in light of the additional information.

Note that the tolerable displacement is subject to adjustment based on site-specific features and consequences of specific failure modes.

Table 2. Summary of Load Cases and Acceptance Criteria

Load Case	Pool Levels	Incipient Motion	Analysis	Soil Strengths	Pore Pressures	Acceptance Criteria
Static, Long-Term, Global and Veneer	Impoundment (where applicable): Normal Operating Pool Adjacent Reservoir: Winter Pool	Inboard (Impoundments Only) and Outboard	Drained	Drained Static	Seepage for Modeled Pool Levels and/or Piezometer Data	FS ≥ 1.5
Pseudostatic, Global and Veneer	Impoundment (where applicable): Normal Operating Pool Adjacent Reservoir: Winter Pool	Inboard (Impoundments Only) and Outboard	Undrained Seismic	Undrained Seismic	Seepage for Modeled Pool Levels and/or Piezometer Data	FS ≥ 1.0 (Correlated to tolerable displacement of 3 feet[1])
Post-Earthquake, Global	Impoundment (where applicable): Normal Operating Pool Adjacent Reservoir: Winter Pool	Inboard (Impoundments Only) and Outboard	Undrained Static	Undrained Seismic; Residual Strengths in Liquefied Materials	Seepage for Modeled Pool Levels and/or Piezometer Data	FS ≥ 1.1 (Phase 1); FS ≥ 1.0 (Phase 2); Representative displacement ≤ 3 feet[1] (Phase 3)

[1] Tolerable displacement subject to adjustment based on site-specific features and consequences of specific failure modes.

5.1.3 Basis for Load Cases and Acceptance Criteria

There are no established closure design criteria for certain categories of CCR units that are not regulated under the CCR Rule. The US Environmental Protection Agency (EPA) excluded from regulation inactive CCR landfills, § 257.50(d), as well as CCR surface impoundments that no longer impound water and that are "capped or otherwise maintained," 80 Fed. Reg. at 21343. EPA explained in its preamble that these exclusions are due to the lower risk associated with such units. Section VI.A.5 (page 21342) of the preamble states:

> "As noted, EPA's risk assessment shows that the highest risks are associated with CCR surface impoundments due to the hydraulic head imposed by impounded water. Dewatered CCR surface impoundments will no longer be subjected to hydraulic head so the risk of releases, including the risk that the unit will leach into the groundwater, would be no greater than those from CCR landfills."

To establish the closure design criteria presented herein, relevant standards from the landfill and embankment dam industries were considered. The following industries or agencies were considered when selecting the appropriate load cases and acceptance criteria:

- State of Tennessee solid waste landfill design guidance (TDEC, date unknown)
- EPA municipal solid waste landfill (i.e., RCRA Subtitle D) design guidance (Richardson et al. 1995)
- EPA CCR Rule requirements
- US Army Corps of Engineers (USACE) embankment dam design guidance (Hynes-Griffin and Franklin 1984)
- TVA embankment dam design guidance (TVA 2016) - (Note that the analysis load cases and acceptance criteria are based upon and generally consistent with other industry standards, such as the dam safety criteria of the US Army Corps of Engineers and the Federal Energy Regulatory Commission.)

5.1.3.1 Static Loading

For static loading, the landfill and embankment dam practices are generally in agreement that long-term (i.e., normal operating condition) loading should be analyzed for global slope stability. For landfills with a final cover that may consist of relatively thin layer(s) of materials, the long-term veneer stability should also be analyzed. The reviewed guidance documents generally agree that a static, long-term factor of safety of 1.5 for both global and veneer slope stability is appropriate, and this criterion is applied herein.

Other common static load cases, such as end-of-construction loading, flood loading and sudden drawdown loading are not applicable to existing landfills or surface impoundments that no longer impound water.

5.1.3.2 Seismic Loading

For seismic loading, the landfill and embankment dam practices are less consistent on the load cases to consider and the associated acceptance criteria. However, there is general consensus that because earthquake loading is less probable than static loading, that lower factors of safety and some permanent displacement can be accepted.

In the case of landfills, the tolerable displacement is typically related to the potential damage to components (liners, leachate collection pipes, covers, etc.) and the ability to make repairs after the earthquake. In the case of embankment dams, the tolerable displacement is typically related to preventing uncontrolled loss of pool, potential damage to internal components (sand filters, drainage pipes, etc.), and ability to make repairs after the earthquake.

Seismic loading is commonly evaluated by considering two scenarios:

- Stability during shaking, either using pseudostatic slope stability analyses or simplified displacement analyses,

- Stability immediately after shaking, using static, post-earthquake stability analyses that consider liquefaction potential and associated reductions in shear strength.

5.1.3.2.1 Pseudostatic Stability

There is general consensus that seismic-induced displacements are key to judging acceptable performance during and after the earthquake. However, the most common difference between various design guidance is whether to perform pseudostatic analyses (which can infer tolerable displacement) or to perform simplified displacement analyses (which estimate displacements directly). Depending on how the pseudostatic seismic coefficient is derived (i.e., the degree of conservatism), the slope stability analysis may or may not be a good index of displacement.

TDEC guidance for solid waste landfills judges acceptable performance based on results of simplified displacement analyses (Newmark sliding block or similar analysis). TDEC does not have acceptance criteria based on a pseudostatic slope stability factor of safety. Two acceptance criteria were established to "…insure that the landfill liner, leachate collection system and landfill appurtenances will remain functional when subjected to earthquake induced forces." The acceptance criteria are as follows:

- "Leachate collection systems and waste cells shall be designed to function without collection pipes for solid waste fill embankments that are predicted to undergo more than six inches of deformation."

- "No landfill shall be acceptable if the predicted seismic induced deformations within the waste fill exceed one-half the thickness of the clay liner component of the liner system."

In many cases, inactive CCR landfills and/or CCR surface impoundments that no longer impound water do not include leachate collection systems or engineered bottom liners, and can tolerate greater seismic displacements. As such, the above acceptance criteria are considered overly conservative and not applicable.

In contrast, CCR Rule has acceptance criteria based on a pseudostatic slope stability factor of safety of 1.0. The means to derive an appropriate pseudostatic seismic coefficient are not defined in the CCR Rule. In order to perform CCR Rule demonstrations, TVA has developed a method whereby the coefficient is correlated to a site-specific tolerable displacement. As a result, a factor of safety of 1.0 equates to the tolerable displacement. A factor of safety less than 1.0 would imply displacements that exceed the tolerable value.

EPA guidance for solid waste landfills and USACE and TVA guidance for embankment dams employ phased approaches. A pseudostatic slope stability analysis is performed, and if acceptance criteria ($FS_{pseudo} \geq 1.0$ for EPA and USACE; 1.1 or 1.0 for TVA depending on how well the site is characterized) are met it is implied that displacements are tolerable. The analysis methods recommended by EPA and USACE are correlated to tolerable displacements of 12 inches and 1 meter, respectively. If acceptance criteria are not met, a simplified displacement analysis is then performed. The estimated displacements are compared against tolerable displacement that is based on site-specific features and/or consequences.

In most cases, inactive CCR landfills and/or CCR surface impoundments that no longer impound water do not include leachate collection systems or engineered bottom liners, and can tolerate greater seismic displacements. Therefore, for pseudostatic slope stability (global), an acceptable factor of safety of 1.0 ($FS_{pseudo} \geq 1.0$) which is correlated to a tolerable displacement of 3 feet will be employed. Based on a series of seismic displacement analyses for a variety of earthquakes and site conditions, Hynes-Griffin and Franklin (1984) conclude that if FS_{pseudo} is greater than or equal to one, that the slope deformations should be tolerable for an embankment dam (they define tolerable as displacements less than 1 meter, or about 3 feet). The tolerable displacement is subject to adjustment based on site-specific features and consequences of specific failure modes.

With respect to veneer (i.e., final cover) slope stability during an earthquake, there is consensus that more permanent displacement is tolerable because of the low probability of the earthquake and the ability to repair the final cover. For solid waste landfills, EPA still suggests an acceptable factor of safety of 1.0, but states:

> "For cover systems, where permanent seismic deformations may be observed in post-earthquake inspections and damage to components can be repaired, larger permanent deformations may be considered acceptable. In fact, some regulatory agencies consider seismic deformations of the landfill cover system primarily a maintenance problem."

Indeed, the TDEC guidance for solid waste landfills requires a factor of safety of 1.0 but acknowledges design flexibility for final cover displacements that occur due to the earthquake:

> "Presently, it is the opinion of the Solid Waste Division that this type of failure mechanism will generally not result in a catastrophic type of failure. Therefore, some flexibility will be given for the design of the stability of landfill cover systems."

Therefore, for pseudostatic slope stability (veneer), an acceptable factor of safety of 1.0 ($FS_{pseudo\text{-}veneer} \geq 1.0$) which is correlated to a tolerable displacement of 1 meter (approximately 3 feet) will be employed. The tolerable displacement is subject to adjustment based on site-specific features and consequences of specific failure modes.

5.1.3.2.2 Post-Earthquake Stability

In addition to permanent displacements that occur during shaking, further movement can occur immediately after shaking if shear strengths are significantly reduced due to liquefaction triggering.

Assigning appropriate post-earthquake strengths first requires a liquefaction triggering assessment for each material in the slope stability model. The results of the liquefaction triggering assessment will inform the derivation of post-earthquake strengths. The post-earthquake slope stability analysis is a static load case; there is no earthquake load applied.

The TDEC guidance for solid waste landfills includes a liquefaction triggering assessment, but does not stipulate a post-earthquake slope stability analysis. Instead, an effort is made to estimate liquefaction-induced damage at the ground surface.

The EPA guidance for solid waste landfills and the TVA guidance for embankment dams include a liquefaction triggering assessment followed by a post-earthquake slope stability analysis. In the EPA and TVA guidance, performance is considered acceptable if the factor of safety ($FS_{post\text{-}EQ}$) is 1.1 or greater. However, TVA guidance also allows an acceptable $FS_{post\text{-}EQ}$ of 1.0 "for embankments with well-defined subsurface and site condition information."

The CCR Rule requires a liquefaction triggering assessment followed by a post-earthquake slope stability analysis. The acceptance criterion is $FS_{post\text{-}EQ}$ of 1.2. Commentary within the Rule notes that a minimum factor of safety higher than 1.0 was selected because “liquefaction potential analysis and post-liquefaction residual strength analysis involves a larger degree of uncertainties…in assumptions and analysis…”.

Therefore, for post-earthquake slope stability (global), an acceptable factor of safety of 1.1 ($FS_{post\text{-}EQ} \geq 1.1$) will be employed. This applies when an ordinary amount/type of site information is available, and generally corresponds to a Phase 1 assessment as defined herein. If the site characterization is “well-defined” an acceptable factor of safety of 1.0 ($FS_{post\text{-}EQ} \geq 1.0$) will be employed. This generally corresponds to a Phase 2 assessment as defined herein.

If a Phase 3 assessment is necessary, including a nonlinear deformation analysis, the acceptance criteria is a representative displacement of 3 feet. The tolerable displacement is subject to adjustment based on site-specific features and consequences of specific failure modes.

5.2 CROSS SECTION DEVELOPMENT

Each analysis cross section will be selected to represent the critical cross section for slope stability failure. Cross sections previously evaluated will be reviewed and evaluated for use in the proposed analyses. If the previously used cross sections are not considered representative for the new analyses, new cross sections will be developed using available site-specific data (including data collected per the Exploratory Drilling SAP). The basis for analysis cross sections will be documented in the EAR.

5.3 MATERIAL PROPERTIES

Measurements of material properties are obtained from site-specific field and/or laboratory testing where available (including data collected per the Exploratory Drilling SAP). If parameters are not available, they will be derived for each material based on the available data, specific characteristics of the material, geologic setting, application of the parameter in the analysis, and professional judgment. If needed, standard engineering references such as Navy (NAVFAC), US Army Corps of Engineers (USACE), and US Bureau of Reclamation (USBR) publications will be used to develop material parameters. Material properties to be developed include but are not limited to the following parameters for use in the analyses:

- Unit Weights
- Drained Shear Strengths
- Undrained Shear Strengths
- Seismic Shear Strengths

- Post-Earthquake (Liquefied Strengths)
- Hydraulic Conductivity

Prior to the post-earthquake analysis, the materials will be evaluated for liquefaction potential using an industry standard, simplified stress-based approach (e.g., Boulanger and Idriss 2014). The liquefaction assessment may include site-specific ground response analyses. If a material is anticipated to liquefy, residual strengths will be estimated using available laboratory data, field data and/or published correlations.

Appropriate material properties will be applied, consistent with each load case (Table 2). A discussion of utilized parameters and their derivations will be included in the EAR.

5.4 LOADING

5.4.1 Pool Levels and Pore Water Pressures

For static, long-term and seismic load cases, the pool within an impoundment (where applicable) is the normal operating pool. The pool in the adjacent body of water (e.g., river or reservoir) is the normal operating pool (Summer or Winter Pool, whichever is more conservative) for the reservoir.

The slope stability analyses require pore water pressures for computing effective consolidation stresses, as defined for the load conditions. Pore water pressures can be estimated with finite element analyses (i.e., seepage models) or by assigning a piezometric line to the cross section. Either approach will be based, in part, on available site-specific piezometer data. The methodology utilized in the analyses will be documented in the EAR.

Consideration of both estimated pore water pressures and adjacent reservoir pool levels (where applicable) will generally encompass the phreatic conditions that will be experienced by the unit.

5.4.2 Seismic Loading

The design earthquake is an event with a 2 percent probability of exceedance in 50 years (i.e., return period of 2,475 years). This return period is similar to that of an event with a 10 percent probability of exceedance in 250 years (return period of 2,373 years). TVA seismic hazard models or appropriate US Geological Survey (USGS) seismic hazard mapping may be used to derive the appropriate seismic loading. Derivation of the seismic loads will be documented in the EAR.

5.5 SOFTWARE EMPLOYED IN ANALYSES

Slope stability will be evaluated using conventional, limit equilibrium methods as implemented in the GeoStudio SLOPE/W software or equivalent. With SLOPE/W, the distribution of pore water pressures within the earth mass may be mapped directly from the results of a SEEP/W analysis or piezometric line(s) can be input.

If ground response analyses become warranted, software such as Strata, QUAD4, or other appropriate code may be utilized.

If nonlinear deformation analyses become warranted, software such as FLAC, OpenSees, or other appropriate code may be utilized.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

The Quality Assurance Project Plan (QAPP) describes quality assurance (QA)/ quality control (QC) requirements for the overall Investigation. The following sections provide details regarding QA/QC requirements specific to stability analyses.

6.1 OBJECTIVES

The Data Quality Objectives (DQOs) process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA and the Investigation Project Manager considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts for the Investigation.

Specific quantitative acceptance criteria for analytical precision and accuracy for the matrices included in this investigation are presented in the QAPP.

6.2 QUALITY CONTROL CHECKS

The accuracy of the stability analysis processes must be maintained throughout the Investigation.

Office personnel will be responsible for performing checks to confirm that the SAP has been followed. This consists of the completion of applicable forms and documentation of activities.

6.3 DATA VALIDATION AND MANAGEMENT

As stated in the EIP, a QAPP has been developed such that data are appropriately maintained and accessible to data end users. The Investigation will be performed in accordance with the QAPP. Analyses will be subjected to data validation in accordance with the QAPP.

7.0 SCHEDULE

Anticipated schedule activities and durations for the implementation of this SAP are summarized below. This schedule is preliminary and subject to change based on approval. For the overall EIP Implementation schedule, including anticipated dates, see the schedule provided in the EIP.

Table 3. Preliminary Schedule for Stability SAP Activities

Project Schedule		
Task	**Duration**	**Notes**
Stability SAP Submittal		Completed
Conduct Stability Analyses	180 Days	Following EIP Approval
Documentation	60 Days	Following Analyses

8.0 ASSUMPTIONS AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- None.

9.0 REFERENCES

Boulanger, R.W. and Idriss, I.M. 2014. "CPT and SPT based liquefaction triggering procedures." Report No. UCD/CGM-14/01, Center for Geotechnical Modeling, Department of Civil and Environmental Engineering, University of California, Davis, CA.

Hynes-Griffin, M. E., and Franklin, A. G. 1984. "Rationalizing the seismic coefficient method." Miscellaneous Paper GL-84-13, July. US Army Engineer Waterways Experiment Station. Vicksburg, Mississippi, 37 pages.

Richardson, G. N., Kavazanjian, E., and Matasovi, N. 1995. "RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities." Report No. EPA/600/R-95/051. Prepared for United States Environmental Protection Agency. April.

Tennessee Division of Solid Waste Management (unknown date). "Earthquake Evaluation Guidance Document."

Tennessee Valley Authority (TVA). 2016. "Design and evaluation of new and existing river system dams." SRME-SPP-27.001, Rev. 0000, January 5 (effective date). Chattanooga, Tennessee.

United States Army Corps of Engineers (USACE). 2003. "Slope stability." EM 1110-2-1902, October, Washington D.C.

United States Environmental Protection Agency (EPA). 2015. "Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities." Federal Register, Vol. 80, No. 74, April 17.

ATTACHMENT A
FIGURE

CCR Unit and Condition	Static Cases		Seismic Cases		
	Long-Term, Global	Long-Term, Veneer[2]	Pseudostatic[1], Global	Pseudostatic[1], Veneer[2]	Post-EQ[3], Global
Slag Disposal Area 1 (Closed Condition)	SD	Typ.[4]	SD	Typ.	SD
Ash Pond (Closed Condition)	N/S, E/W	Typ.	N/S, E/W	Typ.	E/W

[1] Pseudostatic, correlated to a tolerable displacement.

[2] Veneer stability is the slope stability of the final cover.

[3] Post-earthquake (Post-EQ) analysis includes a preceding liquefaction triggering assessment.

[4] Typical design section is being analyzed as shown in closure design.

Blue cells are completed analyses. Yellow cells are proposed analyses.

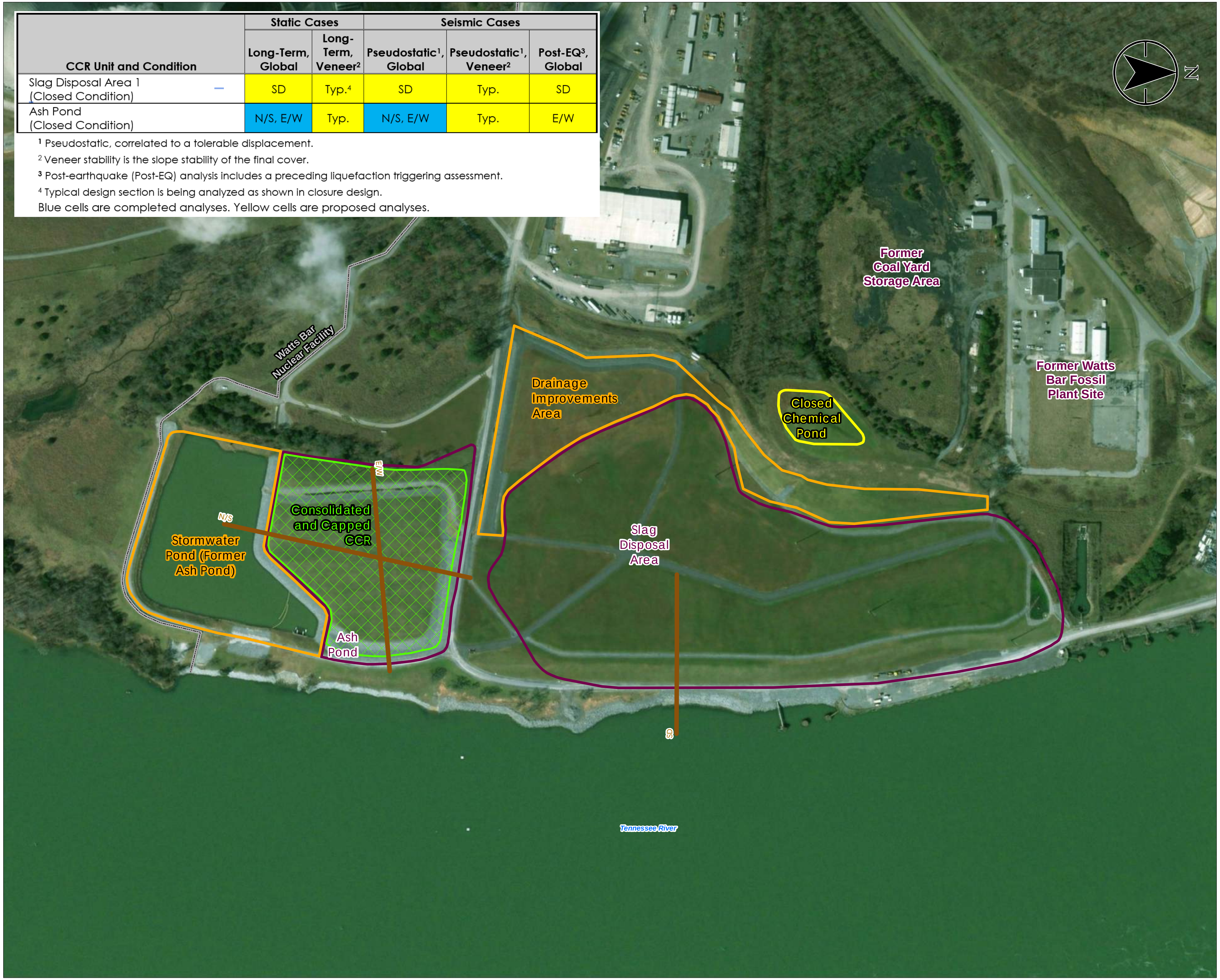

Figure No.
1

Title
Completed and Proposed Stability Analyses

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LMB on 2018-02-07
Technical Review by TG on 2018-02-07

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

Legend

▬	Cross Section
┅	Watts Bar Nuclear Facility 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 ESRI Imagery

U:\TVA-EIP\175566336\gis\mxds\WBF_Stability_Analysis.mxd Revised: 2018-02-07 By: mbough

APPENDIX Q
BENTHIC SAP

Benthic Sampling and Analysis Plan Watts Bar Fossil Plant

Revision 3

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

Stantec

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

November 19, 2018

BENTHIC
SAMPLING AND ANALYSIS PLAN
WATTS BAR FOSSIL PLANT

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	February 9, 2018
2	Addresses May 16, 2018 TDEC Review Comments and Issued for TDEC Review	July 6, 2018
3	Addresses Applicable Programmatic Revisions and Issued for TDEC Approval	November 19, 2018

TITLE AND REVIEW PAGE

Title of Plan: Benthic
Sampling and Analysis Plan
Watts Bar Fossil Plant
Tennessee Valley Authority
Spring City, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: November 19, 2018 Revision 3

All parties executing work as part of this Sampling and Analysis Plan sign below acknowledging they have reviewed, understand, and will abide by the requirements set forth herein.

TVA Investigation Project Manager — 11/19/18 Date

Tyler Baker
TVA Investigation Field Lead — 11-19-18 Date

Health, Safety, and Environmental (HSE) Manager — 11-19-18 Date

Investigation Project Manager — 2018-11-13 Date

Rock J. Vitale Digitally signed by Rock J. Vitale
DN: cn=Rock J. Vitale, o, ou,
email=rvitale@envstd.com, c=US
Date: 2018.11.14 12:30:32 -05'00'
QA Oversight Manager — Date

Andy Johnson for Gail Lage
Tod Noltemeyer Digitally signed by Tod Noltemeyer [illegible]
Laboratory Project Manager — 11/16/18 Date

Charles L. Head
TDEC Senior Advisor — Date

Robert Wilkinson
TDEC CCR Technical Manager — Date

Table of Contents

LIST OF TABLES

LIST OF ATTACHMENTS

1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at Watts Bar Fossil Plant (WBF) on April 27, 2016, at which time TVA briefed TDEC on its Coal Combustion Residual (CCR) management plans at WBF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On June 14, 2016, TDEC issued a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 22, 2017, TDEC issued a second follow-up letter to TVA regarding the TDEC Order and EIP submittal dates. On November 15, 2016, TVA submitted WBF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

TDEC's comments included requests for greater clarification in TVA's phased approach for evaluating whether CCR material has migrated from the WBF Plant (Plant) into surface streams on or adjacent to the Plant. Based on these requests, a Benthic Sampling and Analysis Plan (SAP) and associated sediment sampling locations have been developed.

This Benthic SAP has been prepared to describe TVA's phased approach for evaluating whether CCR material has migrated from the Plant into surface streams on or adjacent to the Plant. This Benthic SAP has also been prepared to assess potential impacts of CCR constituents on aquatic life as part of the biological studies at the Plant and to assist in providing a good overall view of conditions at the Plant. The results from implementation of this SAP will be evaluated and addressed in the Environmental Assessment Report (EAR).

2.0 OBJECTIVES

The objectives of this study are to characterize sediment chemistry, benthic macroinvertebrate (invertebrate) community composition, and benthic invertebrate bioaccumulation in surface streams on or adjacent to the Plant to determine if CCR material has migrated into those surface streams.

The initial approach is to collect sediment samples from identified transects in surface streams on or adjacent to the Plant. Samples will be analyzed for CCR parameters listed in 40 CFR Part 257, Appendices III and IV along with additional parameters required by the state groundwater monitoring program (copper, nickel, silver, vanadium, and zinc). These constituents, along with strontium, will be hereafter referred to as "CCR parameters." Additionally, samples will be analyzed for percent ash, to determine the presence or absence of CCR.

This Benthic SAP will provide the procedures necessary to collect sediment samples from the proposed sediment sampling transects discussed in Section 4.0. The sediment sampling transects will coincide with surface stream sampling locations provided in the Surface Stream SAP. Mayfly sampling locations will cover the same geographic areas as fish tissue sampling areas.

A phased approach to surface stream and sediment sampling has been proposed in the EIP. For Phase 1, all sediment samples will be analyzed by Polarized Light Microscopy (PLM) for percentage of ash and all sediment samples collected from 0 to 6 inches deep will be analyzed for the CCR parameters. All deeper sediment samples collected for the analysis of CCR parameters during Phase 1 will be held pending the results of the Phase 1 analyses. Should the percentage of ash in a Phase 1 sample exceed 20%, Phase 2 will consist of analysis of the held sediment sample(s) from the deeper strata collected from the location at which percentage of ash exceeded 20% for the CCR parameters. Depending on the location of the exceedance and collective results of the Phase 1 data, Phase 2 may include sediment sampling at additional locations in surface streams on or adjacent to the Plant. If Phase 2 is not required, no additional sediment samples will be taken or analyzed. Refer to Section 4.0 for additional Plant-specific details.

Quantitative benthic invertebrate samples will also be collected during Phase 1. The benthic invertebrate sediment samples will be collected along transects at the locations discussed in Section 4.0. The benthic invertebrate samples will be submitted for processing during which the specimens will be identified and enumerated to the lowest practical taxonomic level. The results of the quantitative sampling will be used to assess benthic community diversity.

The benthic invertebrate evaluation will also include collecting composite samples of mayfly nymphs and adults (*Hexagenia*) from random locations within the areas discussed in Section 4.0. Select mayfly nymph samples will have their digestive systems depurated prior to analysis. Composite adult mayfly samples will be opportunistically collected by direct removal from vegetation or other structures along the shoreline or by use of sweep nets.

Mayfly sampling locations will cover the same geographic areas as fish tissue sampling areas. The mayfly nymphs (collected for both depuration and non-depuration) and adult mayflies will be submitted for laboratory analysis of metals included in the CCR parameters list (excluding radium). The mayfly analytical results will be used in conjunction with sediment and fish tissue data to evaluate contaminant bioaccumulation.

The field activities associated with Phase 1 will include the following tasks:

- Verify proposed sampling locations using the global positioning system (GPS)
- Collect sediment samples from proposed sampling locations
- Collect benthic invertebrate samples from proposed sampling locations
- Collect adult mayfly, non-depurated mayfly nymph, and depurated mayfly nymph composite samples from proposed sampling locations
- Package and ship sediment samples to laboratory for analysis or for storage pending Phase 1 results
- Package and ship benthic invertebrate samples to laboratory for community evaluation
- Package and ship composite mayfly samples to laboratory for analysis

Should additional samples be needed as part of Phase 2 implementation, a new sampling map will be developed. Data collected during this investigation will be reported to TDEC in the EAR.

3.0 HEALTH AND SAFETY

This work will be conducted under an approved Plant-specific Health and Safety Plan (HASP). This HASP will be in accordance with TVA Safety policies and procedures. Each worker will be responsible for reviewing and following the HASP. Personnel conducting field activities will have completed required training, understand safety procedures, and be qualified to conduct the field work described in this SAP. The HASP will include a job safety analysis (JSA) for each task described in this SAP and provide control methods to protect personnel. Personal protective equipment (PPE) requirements and safety, security, health, and environmental procedures are defined in the HASP. In addition, authorized field personnel will attend TVA required safety training and Plant orientation.

The Field Team Leader will conduct safety briefings each day prior to beginning work and at mid-shift or after lunch breaks and document these meetings to include the names of those in attendance and items discussed. TVA-specific protocols will be followed, including the completion of 2-Minute Rule cards. The JSAs will be updated if conditions change.

4.0 SAMPLING LOCATIONS

4.1 SEDIMENT SAMPLING LOCATIONS

Seven sediment sample transects are planned for the Phase 1 investigation, with individual samples being collected perpendicular to flow from the right descending bank, the center of the channel, and the left descending bank at each transect. Right descending bank and left descending bank will be determined with a downstream-facing orientation. Background transects upstream of the Plant on the Tennessee River are proposed to provide baseline data for CCR parameter concentrations. Background transects were not proposed upstream of the Watts Bar Dam because conditions upstream of the dam are not representative of downstream locations. Phase 1 sediment sampling transects adjacent to the Plant in the Tennessee River were selected to evaluate areas where CCR could potentially have been released from the impoundment into the surface streams. Additional transects are proposed in the Tennessee River downstream from the Plant. See Table 1 below for a summary of transect locations and Figure 1 for proposed sediment sampling transects.

Water samples will also be taken at coincident sediment sampling locations as described in the Surface Stream Sampling and Analysis Plan. The number and/or location of the proposed sediment samples may be modified based on conditions encountered in the field, which may include local boat traffic and the Watts Bar Dam release schedule.

Table 1. Proposed Sediment Sample Location

Transect Location ID	Description
SED-TR01	Tennessee River Upstream of Plant (Background)
SED-TR02	Tennessee River Upstream of Plant (Background)
SED-TR03	Tennessee River adjacent to Former Slag Disposal Area/Historic Fly Ash Pond
SED-TR04	Tennessee River at Southern End of Former Slag Disposal Area/Historic Fly Ash Pond and Northern End of Former Ash Pond Area
SED-TR05	Tennessee River at Southern End of Former Ash Pond Area
SED-TR06	Tennessee River Downstream from Former CCR Units
SED-TR07	Tennessee River Downstream from Plant

4.2 BENTHIC INVERTEBRATE SAMPLING LOCATIONS

Quantitative benthic invertebrate sampling will also be conducted during Phase 1. The benthic invertebrate sediment samples will be collected along transects at the locations depicted on Figure 2. See Table 2 below for a summary of transect locations.

Benthic invertebrate sediment samples will be collected from five locations along each proposed transect. If it is not possible to collect samples due to conditions encountered in the field (e.g., large sediment grain size), locations may be adjusted based on the judgement of the field team.

Table 2. Proposed Benthic Invertebrate Transect Sample Locations

Transect ID	Description
MAC-TR01*	Tennessee River Upstream of Plant (Background)
MAC-TR02	Tennessee River Upstream of Plant (Background)
MAC-TR03	Tennessee River Upstream of Plant (Background)
MAC-TR04	Tennessee River adjacent to Former Slag Disposal Area/Historic Fly Ash Pond
MAC-TR05	Tennessee River at Southern End of Former Ash Pond Area
MAC-TR06*	Tennessee River Downstream from Former CCR Units
MAC-TR07	Tennessee River Downstream from Plant

*Historical benthic macroinvertebrate sampling location.

4.3 MAYFLY SAMPLING LOCATIONS

Mayfly sampling will also be conducted during Phase 1. Both nymph and adult mayflies (*Hexagenia*) will be collected. Composite mayfly nymph samples will be collected from submerged sediments at multiple random locations within the areas depicted on Figure 3. See Table 3 below for a summary of these locations. Adult mayflies will be opportunistically collected by direct removal from vegetation or other structures along the shoreline or by use of sweep nets. The timing of the sampling will need to be coordinated with local adult mayfly emergence.

Efforts will be made to collect mayfly adults/nymphs within the designated areas, however other species may need to be evaluated and/or other locations added if an insufficient number of mayfly adults/nymphs are encountered within the designated areas at the time the proposed sampling is conducted.

Table 3. Proposed Mayfly Sample Locations

Location ID	Description
TRU	Tennessee River Upstream from Site
TRA	Tennessee River Adjacent to Site
TRD	Tennessee River Downstream from Site

4.4 CORRESPONDING SAMPLING LOCATIONS

Several of the sediment, benthic invertebrate, and mayfly sample locations coincide with sample locations of other environmental SAPs. Table 4 summarizes the corresponding samples for the Surface Stream, Benthic, and Fish Tissue SAPs.

Table 4. WBF Environmental Corresponding Sample Locations Matrix

Surface Stream Sample Location	Corresponding Sediment Sample Location	Corresponding Benthic Sampling Location	Corresponding Mayfly Sampling Location	Corresponding Fish Tissue Sampling Location
NA	NA	MAC-TR01	TRU	TRU
NA	NA	MAC-TR02	NA	NA
STR-TR01	SED-TR01	NA	NA	NA
STR-TR02	SED-TR02	MAC-TR03	TRA	TRA
STR-TR03	SED-TR03	MAC-TR04		
STR-TR04	SED-TR04	NA		
STR-TR05	SED-TR05	MAC-TR05		
STR-TR06	SED-TR06	MAC-TR06		
STR-TR07	SED-TR07	MAC-TR07	NA	NA
NA	NA	NA	TRD	TRD

NA – Not Applicable

5.0 SAMPLE COLLECTION AND FIELD ACTIVITY PROCEDURES

This section provides details of procedures that will be used to collect samples, document field activities, and assist in providing scientifically defensible results.

Sample collection will adhere to TVA Technical Instruction (TI) documents. A project field book and/or field forms will be maintained by the Field Team Leader to record field measurements, analyses, and observations. Field activities will be documented according to TVA TI ENV-TI-05.80.03, *Field Record Keeping*.

5.1 PREPARATION FOR FIELD ACTIVITIES

As part of field mobilization activities, the field sampling team will:

- Complete required health and safety paperwork and confirm Field Sampling Personnel have completed required training
- Coordinate activities with the Laboratory Coordinator, including ordering sample containers and preservatives (if required), obtaining coolers and analyte-free deionized (DI) water, and notifying the Laboratory Coordinator of sampling and sample arrival dates
- Coordinate activities with subcontractors
- Obtain required field equipment, including health and safety equipment and sediment sampling devices
- Complete sample paperwork to the extent possible, including chain-of-custody (COC) forms and sample labels
- Obtain ice prior to sample collection for sample preservation
- Complete utility locates and obtain excavation permit for VibeCore^{TM} sample locations (An excavation permit is required prior to initiating any digging or boring at the Plant. A key component to the completion of the excavation permit is consensus on the sampling locations with pertinent TVA staff. Prior to initiating subsurface activities, subsurface utility clearance will be sought via the Plant engineering department and/or the TN 811 service. For locations within the Plant, engineering will provide primary utility clearance assurance in addition to TN 811 being notified. At sampling locations where underground obstructions or utilities are expected nearby, TVA or 3rd party underground locators will be engaged to clear sampling locations. For off-Plant sampling locations, utility avoidance assurance will be supplemented by the TN 811 service and the TVA or 3rd party underground locators.)

- Environmental Review (As required by the National Environmental Policy Act (NEPA), an environmental review must be completed to document and mitigate potential impact from the work described herein. The level of review required for this work is anticipated to be a categorical exclusion, which would be documented by TVA with a categorical exclusion checklist (CEC). A CEC has a number of signatories from TVA. It is understood that the environmental review is to be completed before implementation of the field work. Additionally, Plant staff will not issue an excavation permit ahead of the completed environmental review.)

5.2 SAMPLING METHODS AND PROTOCOL

Sampling and collection methods will be conducted in accordance with applicable TVA Technical Instructions, including:

- TI-05.80.02 *Sample Labeling and Custody*
- TI-05.80.03 *Field Record Keeping*
- TI-05.80.04 *Field Sampling Quality Control*
- TI-05.80.05 *Field Sampling Equipment Cleaning and Decontamination*
- TI-05.80.06 *Handling and Shipping of Samples*

5.2.1 Sampling Method

Samples should be located based on project work control documents using a survey grade GPS unit. Sample locations will be documented in the field logbook in accordance with TVA TI ENV-TI-05.80.03, *Field Record Keeping*. Three-point anchoring may be required to stabilize the vessel during sampling.

5.2.1.1 Sediment Sampling

Sediment sampling will be conducted at the transect locations discussed in Section 4.0, with individual samples being collected perpendicular to flow from the right descending bank, the center of the channel, and the left descending bank at each transect. Sediment samples at each location will be collected in accordance with TVA TI ENV-TI-08.80.50, *Soil and Sediment Sampling* using a VibeCore™ vibration-driven sediment sampler. Refer to the TVA Gallatin *Standard Operating Procedure for Sediment Sampling* document (TVA-GAF-SOP-02) for additional information and guidelines regarding the use of VibeCore™ samplers. Sediment samples collected for analysis of PLM and the CCR parameters are to be collected from downstream to upstream in surface streams on or adjacent to the Plant to prevent the disturbance of bottom sediments from impacting further downstream sample locations.

Upon arrival at a sample location where both sediment and surface water are being collected, the surface stream sample will be collected before the associated sediment sample if the sediment and surface stream sampling is conducted concurrently/during the same event. This will minimize the possibility of water sample contamination from disturbance of sediments.

At each location, the VibeCore™ sampler with a properly decontaminated acrylic core tube will be advanced the full six-foot length of the core tube or until refusal. Upon retrieval, the core will be photographed against a prepared board containing a graduated scale and location information. The core will be inspected, and distinct horizons will be identified based on color, texture, etc. The core length and depth of horizon changes will be recorded in the field notes (logbooks and/or field forms). A sediment sample will be collected from the upper six inches of the collected sediment core at each location after thoroughly homogenizing the material. For each distinct horizon identified below six inches, the sediment will be portioned and homogenized to create a representative sample. Field Sampling Personnel wearing powder-free nitrile gloves will homogenize the samples using decontaminated high density polyethylene (HDPE) containers and new disposable HDPE scoops. Field Sampling Personnel will first remove twigs, roots, leaves, rocks, and miscellaneous debris from the sample, then mix the sediment until the physical appearance is consistent over the entire sample. Once homogenized, an appropriate volume of sediment will be transferred into certified clean laboratory-supplied pre-labeled containers required for each analysis using the disposable HDPE scoops. Samples will not be collected for deeper sediment-free native soil samples if recovered. In the event sediment sample collection using a VibeCore™ sampler is not practical due to site conditions, attempts to collect sediment samples from the upper six inches using a Wildco™ Ponar Dredge or similar self-closing mechanical benthic sampling device may be conducted.

5.2.1.2 Benthic Community Sampling

Quantitative benthic invertebrate community sampling will be conducted using a Wildco™ Ponar Dredge or similar self-closing mechanical benthic sampling device in accordance with TVA Kingston *Standard Operating Procedure for Reservoir Benthic Macroinvertebrate Sampling* document (TVA-KIF-SOP-35). Adult and nymph mayfly samples will also be collected in accordance with TVA Kingston *Standard Operating Procedure for Mayfly Sampling* (TVA-KIF-SOP-29). Self-closing mechanical benthic sampling devices use a spring-loaded system that releases when the sampler impacts the bottom and the lowering cable or line becomes slack, causing the scoops to close.

A transect will be established perpendicular to the direction of flow at the quantitative benthic invertebrate sampling locations discussed in Section 4.0. Five grab samples will be collected along each transect from the upper approximate six inches of sediment at each location. Approximate water depth and proportions of substrate types recovered will be recorded for each sample.

Three attempts will be made to collect an adequate sample volume based on the judgement of the Field Sampling Personnel at each location. In the event an insufficient volume of sediment is recovered after three attempts, the failed attempts will be documented and no sample for quantitative benthic invertebrate analysis will be collected at that location. Benthic invertebrate sediment samples will be washed on a 500-micrometer screen using river water to remove finer material.

The remaining substrate will be photographed then transferred into individual sample containers along with the benthic organisms. The contents of each sample container will then be fixed with a 10% buffered formalin solution.

5.2.1.3 Mayfly Sampling

Adult and nymph mayfly samples will be collected in accordance with TVA Kingston *Standard Operating Procedure for Mayfly Sampling* (TVA-KIF-SOP-29). Mayfly nymphs will be collected from multiple random submerged locations within each area discussed in Section 4.0. The contents of the benthic sampling device from each mayfly nymph sampling location will be emptied onto a decontaminated stainless steel sieve fitted with 2 millimeter or less stainless steel, Nitex, or Teflon mesh/netting then rinsed with river water to remove fine sediment particles and expose the nymphs. The nymphs will then be removed from the sieve using decontaminated stainless steel, plastic, or Teflon-coated forceps and placed into a decontaminated or dedicated plastic container filled with surface water from the Plant to allow preliminary removal of substrate adhering to the organisms. Nymphs that appear damaged (i.e. severed head/abdomen) will be discarded. Undamaged nymphs collected from each area will be randomly sorted into composite samples, with a minimum of 50 to 75 nymphs from each area required for both depuration and non-depuration. Nymphs collected for analysis without depuration of their gut contents will then be transferred into individual sample containers and held at temperatures less than 6 degrees Celsius (^{0}C) pending transport to the laboratory. Nymphs collected for depuration prior to laboratory analysis must be kept alive and handling stress to the nymphs must be minimized. Nymphs collected for depuration will be transferred into individual sample containers filled with water from the sampling location and placed in a cooler containing ice pending transport to the off-site laboratory or on-site processing center. To help regulate the temperature of the water in the sample containers containing the nymphs collected for depuration, the sample containers will be prevented from making direct contact with the ice in the coolers.

Adult mayflies will be opportunistically collected by direct removal from vegetation or other structures along the shoreline or by use of sweep nets. A minimum of 50 to 75 adult mayflies will be collected from each area discussed in Section 4.0. The adult mayflies from each area will be transferred to composite sample containers and held at temperatures less than 6 ^{0}C pending transport to the laboratory.

Issues that could affect the quality of samples will be recorded in the log book along with the action(s) taken to resolve the issue. These could include observations such as insufficient sediment recovery, partial sediment recovery, or defective materials or equipment. The sediment, quantitative benthic invertebrate and mayfly sampling methods described above may have to be modified based on conditions encountered in the field.

5.2.2 Field Equipment Description, Testing/Inspection, Calibration and Maintenance

A list of anticipated equipment for the field activities described herein is provided as Attachment B. A final list of equipment will be prepared by the Field Team Leader, and approved by TVA, prior to mobilization. Field equipment will be inspected, tested, and calibrated (as applicable) prior to initiation of fieldwork by the Field Sampling Personnel and, if necessary, repairs will be made prior to equipment use. If equipment is not in the proper working condition, that piece of equipment will be repaired or taken out of service and replaced prior to use. Additional information regarding field equipment inspection and testing is included in the QAPP.

5.2.3 Field Documentation

Field documentation will be maintained in accordance with TVA TI ENV-05.80.03, *Field Record Keeping* and the QAPP. Field documentation associated with investigation activities will primarily be recorded in Plant-specific field forms, logbooks and/or on digital media (e.g., geographic information system (GIS)/GPS documentation). Additional information regarding field documentation is provided below and included in the QAPP and TVA TIs.

5.2.3.1 Daily Field Activities

Field observations and measurements will be recorded and maintained daily to chronologically document field activities, including sample collection and management. Field observations and measurements will be recorded in bound, waterproof, sequentially paginated field logbooks and/or on digital media and field forms.

Deviations from applicable work plans will be documented in the field logbook during sampling and data collection operations. The TVA Technical Lead and the QA Oversight Manager or designee will approve deviations before they occur.

5.2.3.2 Field Forms

Plant-specific field forms will be used to record field measurements and observations for specific tasks.

5.2.3.3 Chain-of-Custody Forms

For the environmental samples to be collected, chain-of-custody (COC) forms, shipping documents, and sample logs will be prepared and retained. Field Quality Control samples will be documented in both the field notes (logbooks and field forms) and on sample COC records. COC forms will be reviewed daily by the Field Team Leader and Field Oversight Coordinator for completeness and a quality control (QC) check of samples in each cooler compared to sample IDs on the corresponding COC form. The Investigation Project Manager will staff the project with a field sample manager during sample collection activities. Additional information regarding COC forms is included in Section 6.2.2 of this SAP, the QAPP, and TVA TIs.

5.2.3.4 Photographs

In addition to documentation of field activities as previously described, photographs of field activities will also be used to document the field investigation. A photo log will be developed, and each photo in the log will include the location, date taken, and a brief description of the photo content, including direction facing for orientation purposes.

5.2.4 Collection of Samples

Once each sample container is filled, the rim and threads will be cleaned by wiping with a clean paper towel, capped, and a signed and dated custody seal will be applied. Each sample container will be checked to ensure that it is sealed, labeled legibly, and externally clean. Each sample container will be individually wrapped with bubble wrap, secured using tape or rubber bands, and placed in a re-sealable plastic bag.

Sediment samples collected will be submitted for analysis of percentage of ash. Sediment samples collected from 0 to 6 inches deep will also be submitted for analysis of the CCR parameters. All deeper sediment samples collected for analysis of the CCR parameters will be held pending the results of the Phase 1 analyses.

Benthic invertebrate samples will be submitted for quantitative taxonomic analysis of community structure. Mayfly samples will be submitted for analysis of metals included in the CCR parameters list (excluding radium). Mayfly nymph samples must be processed in the off-site laboratory or on-site processing center within 24 hours of sample collection, and mayfly nymphs collected for depuration must be kept alive and handling stress to the nymphs must be minimized. Refer to TVA-KIF-SOP-29 for further details.

Samples will be separated as described above and shipped to the following:

- Sediment samples collected for percentage of ash analysis will be submitted to the RJ Lee Group in Monroeville, Pennsylvania.
- Sediment samples collected for analysis of the CCR parameters (including samples being held pending the results of the Phase 1 analyses) will be submitted to TestAmerica in Pittsburgh, Pennsylvania.
- Benthic invertebrate samples collected for quantitative analysis will be submitted to Pennington and Associates, Inc. in Cookeville, Tennessee.
- Mayfly samples collected for analysis of metals included in the CCR parameters list (excluding radium) will be submitted to Pace Analytical in Minneapolis, Minnesota.
- Mayfly samples designated for depuration prior to laboratory analysis will be submitted to Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tennessee or will be processed at an on-site location. Upon completion of the depuration process at ORNL or on-site the samples will be submitted to Pace Analytical in Minneapolis, Minnesota.

Coolers will be prepared for shipment in accordance with TVA TI ENV-TI-05.80.06 *Handling and Shipping of Samples* by taping the cooler drain shut and lining the bottom of the cooler with packing material or bubble wrap. Sample containers will be placed in the cooler in an upright position.

Small uniformly sized containers (such as 4-ounce or 8-ounce soil jars) will be stacked in an upright configuration and packing material will be placed between layers. Plastic containers will be placed between glass containers when possible. A temperature blank will be placed inside each cooler to measure sample temperature upon arrival at the laboratory. Samples will be held at temperatures less than 6 °C during shipment. The cooler will be filled with packing material to secure the containers during transport.

The original COC form will be placed in a re-sealable plastic bag taped to the inside lid of the cooler. A copy of the COC form will be retained with the field notes in the project files. A unique cooler ID number will be written on the COC form and the shipping label placed on the outside of the cooler. The total number of coolers required to ship the samples will be recorded on the COC form. If multiple coolers are required to ship samples contained on a single COC form, then the original copy will be placed in cooler 1 of X with copies (marked as such) placed in the additional coolers. Two signed and dated custody seals will be placed on alternate sides of the cooler lid. Packaging tape (i.e. strapping tape) will be wrapped around the cooler to secure the sample shipment.

Upon receipt of the samples, the analytical laboratory will open the cooler and will sign "received by laboratory" on each COC form. The laboratory will verify that the custody seals have not been previously broken and that the seal number corresponds with the number on the COC form. The laboratory will note the condition and temperature of the samples upon receipt and will identify discrepancies between the contents of the cooler and COC form. If there are discrepancies the Laboratory Project Manager will immediately call the Laboratory Coordinator and Field Team Leader to resolve the issue and note the resolution on the laboratory check-in sheet. The analytical laboratory will then forward the back copy of the COC form to the QA Oversight Manager and Investigation Project Manager.

5.2.5 Sample Analyses

All sediment samples will be submitted for analysis of percentage ash using PLM. The top six inches of each sediment sample will also be submitted for analysis of the CCR parameters. The CCR parameters are summarized in Tables 5 through 7. The quantitative benthic invertebrate samples will be submitted for processing during which the specimens will be identified and enumerated to the lowest practical taxonomic level. The total number of each taxa will be tallied and used to generate benthic invertebrate community metrics needed to quantify aspects of community structure. The mayfly samples will be submitted for analysis of metals included in the CCR parameters list (excluding radium). Select mayfly nymph samples will have their digestive systems depurated before analysis.

Table 8 provides the analytical laboratory methods, preservation requirements, sample containers and holding times for the PLM analysis, CCR parameters, benthic invertebrates, and mayflies. Additional sampling and laboratory-specific information is covered in more detail in the QAPP.

Table 5. 40 CFR Part 257 Appendix III Constituents

Appendix III Constituents
Boron
Calcium
Chloride*
Fluoride*
pH*
Sulfate*

*Not included in mayfly tissues analyses

Table 6. 40 CFR Part 257 Appendix IV Constituents

Appendix IV Constituents
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride*
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226 and 228 Combined

*Not included in mayfly tissues analyses

Table 7. TN Rule 0400-11-01-.04, Appendix 1 Inorganic Constituents

TDEC Appendix 1 Constituents*
Copper
Nickel
Silver
Vanadium
Zinc
Strontium **

* Constituents not listed in CCR Appendices III and IV

** Constituent not included in TDEC regulations but included in sampling program

Table 8. Analytical Methods, Preservation, Container(s) and Holding Times

Constituent	Analytical Method	Preservative(s)	Container(s)	Holding Time
Percent ash	PLM	NA	4 oz. glass jar	NA
Metals	SW-846 6020A	Cool to < 6° C	4 oz. glass jar	180 days
Mercury	SW-846 7471B	Cool to < 6° C	4 oz. glass jar	28 days
Radium 226	SW-846 901.1	Cool to < 6° C	One 16 oz. wide mouth glass jar to be used for both Ra 226 and 228 samples	180 days
Radium 228	SW-846 901.1	Cool to < 6° C	See Ra 226 above	180 days
Chloride	SW-846 9056A Modified	Cool to < 6° C	4 oz. glass jar	28 days
Fluoride	SW-846 9056A Modified	Cool to < 6° C	4 oz. glass jar	28 days
Sulfate	SW-846 9056A Modified	Cool to < 6° C	4 oz. glass jar	28 days
pH	SW-846 9045D	Cool to < 6° C	4 oz. glass jar	NA*
Benthic Invertebrates	NA	10% buffered formalin solution	16 oz./32 oz. glass jars	NA
Non-depurated Mayfly Nymphs	SW-846 6020A	Cool to < 6° C	4 oz. glass jar	24 hours**
Depurated Mayfly Nymphs	SW-846 6020A	Surface water, cool to < 6° C	32 oz. glass jar	24 hours**
Adult Mayflies	SW-846 6020A	Cool to < 6° C	32 oz. glass jar	24 hours**

* Holding time for sediment pH samples is 15 minutes following creation of sediment paste. Sediment samples submitted for laboratory analysis of pH will have paste prepared in the laboratory so that analysis can be completed within the holding time.

**Additional laboratory preparation required upon receipt.

5.2.6 Equipment Decontamination Procedures

Decontamination procedures will be conducted in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*. The following procedures will be used to maintain the overall objective of minimizing the potential for cross-contaminating samples and media during sampling activities. Sampling equipment will be cleaned before transport to the field. When appropriate or practical, disposable sampling equipment will be utilized in the field. However, non-dedicated and non-disposable equipment used for sampling is to be decontaminated prior to and after each use.

Equipment that comes into direct contact with sediment samples for laboratory analyses will undergo decontamination between each use that will include the following steps:

- Wash with non-phosphate detergent (e.g., LiquiNox™) and analyte-free DI water solution
- Rinse multiple times with analyte-free DI water
- Air drying

Equipment decontamination is not critical when sampling benthic invertebrates and mayflies. The Ponar Dredge and associated equipment will be rinsed with river water to ensure that all debris is removed from each between sampling locations.

Equipment will be placed in a clean trash bag or other separate container during transport to prevent cross-contamination. Equipment that is not fully decontaminated prior to leaving the Plant will be properly disposed or wrapped and stored to prevent contamination of other equipment until it can be properly decontaminated. Decontamination activities will be documented in the field book or on a field data sheet. Additional information regarding equipment decontamination procedures is located in the QAPP.

5.2.7 Waste Management

Investigation derived waste (IDW) generated during implementation of this Sampling and Analysis Plan may include, but is not limited to:

- Sediment and debris
- Personal Protective Equipment
- Decontamination fluids
- General trash

IDW will be handled in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination,* the Plant-specific waste management plan, and local, state, and federal regulations. Transportation and disposal of IDW will be coordinated with TVA Plant personnel.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

The QAPP describes quality assurance (QA)/QC requirements for the overall Investigation. The following sections provide details regarding QA/QC requirements specific to benthic sampling and analysis.

6.1 OBJECTIVES

The Data Quality Objectives (DQOs) process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA and the Investigation Project Manager considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts for the Investigation.

Specific quantitative acceptance criteria for analytical precision and accuracy for the matrices included in this investigation are presented in the QAPP.

6.2 QUALITY CONTROL CHECKS

Three types of field QA/QC samples will be collected during sampling activities: field duplicate samples, MS/MSD samples, and equipment blanks. QA/QC samples will be collected in accordance with TVA TI ENV-TI-05.80.04, *Field Sampling Quality Control*. Criteria for the number and type of QA/QC samples to be collected for each analytical parameter are specified below. A complete description of the QA requirements is provided in the QAPP.

Field Duplicate Samples – One duplicate sediment sample will be collected for every twenty sediment samples or once per sampling event. Duplicates samples will be prepared as blind duplicates and will be collected by splitting the homogenized sample volume into two sets of identical, laboratory-prepared sample bottles. One duplicate composite sample of mayflies per type (i.e. adult, depurated nymph, and non-depurated nymph) will be collected per sampling event. Duplicate samples will be prepared as blind duplicates and will be collected by dividing a composite sample into approximate equal numbers of whole individuals collected from one area.

For each duplicate sample collected of each type, one set of samples will be given the sample identifier indicative of the sample location, and the second set of sample bottles will be simply labeled as DUP1, DUP2, etc. followed by the collection date, as further defined below in Section 6.2.1. Sample identifier information will not be used to identify the duplicated samples. Actual sample identifiers for duplicate samples will be noted in the field logbook. The duplicate sample will be analyzed for the same parameters as the primary sample.

MS/MSD Samples – Matrix spike samples will be collected to assess the effects of matrix on the accuracy and precision of the analyses. One MS/MSD sediment sample will be collected for every twenty sediment samples collected. MS/MSD samples will be collected by splitting the homogenized sample volume into three sets of identical, laboratory-prepared sample bottles. Samples designated in the field to be processed as the MS/MSD, for which extra sample volume will be collected, must be identified as such (i.e., "MS/MSD") in the comments field on the COC records and sample labels. The sample locations will be noted in the log book. The MS/MSD sample will be analyzed for the same analytes as the primary sample, with exception of parameters that are not amenable to MS/MSD (e.g., pH, radium-226, radium-228).

Equipment Blanks (Rinsate Blanks) – One equipment (rinsate) blank will be collected during each day of the sediment sampling activities. The sediment sampling equipment blank will be collected at a sediment sampling location by pouring laboratory-provided DI water into or over the decontaminated sampling equipment, then into the appropriate sample containers. The locations of collecting the equipment blanks will be noted in the log book.

Field quality control samples are not germane to quantitative benthic invertebrate sampling. Quality control will be assessed by the laboratory by recounting and re-keying a subset of samples and comparing the results to the primary analysis.

6.2.1 Sample Labels and Identification System

Sample IDs will be recorded on all sample container labels, custody records, and field sheets in accordance with TVA TIs ENV-TI-05.80.02, *Sample Labeling and Custody* and ENV-TI-05.80.03, *Field Record Keeping*. Each sample container will have a sample label affixed and secured with clear package tape as necessary to ensure the label is not removed. Information on sample labels will be recorded in waterproof, non-erasable ink. Specific information regarding sampling labeling and identification is included in the QAPP.

6.2.2 Chain-of-Custody

The possession and handling of individual samples must be traceable from the time of sample collection until the time the analytical laboratory reports the results of sample analyses to the appropriate parties. Field staff will be responsible for sample security and record keeping in the field.

The COC form documents the sample transfer from the field to the laboratory, identifies the contents of a shipment, provides requested analysis from the laboratory, and tracks custody transfers. Phase 2 retained samples will be documented on a separate COC form from Phase 1 samples. Additional information regarding COC procedures is located in the QAPP.

6.3 DATA VALIDATION AND MANAGEMENT

As stated in the EIP, a QAPP has been developed such that environmental data are appropriately maintained and accessible to data end users. The field investigation will be performed in accordance with the QAPP. Laboratory analytical data will be subjected to data validation in accordance with the QAPP. The data validation levels and process will also be described in the QAPP.

PLM data will not be subjected to data validation due to the specialized training and equipment required to accurately visually quantitate ash. PLM data will be subjected to verification including a review of QC analyses and a reasonability assessment based on photomicrographs included in the data package.

7.0 SCHEDULE

Anticipated schedule activities and durations for the implementation of this SAP are summarized below. This schedule is preliminary and subject to change based on approval, field conditions, and weather conditions. For the overall EIP Implementation schedule, including anticipated dates, see the schedule provided in the EIP. The overall project schedule may be adjusted to reflect seasonal restrictions to when SAPs can be implemented. Approval of the final EIP will dictate the actual start and completion dates on the project timeline.

Table 9. Preliminary Schedule for Phase 1 Benthic SAP Activities

Project Schedule		
Task	**Duration**	**Notes**
Benthic SAP Submittal		Completed
Prepare for Field Activities	30 Days	Following EIP Approval
Conduct Field Activities	210 Days*	Following Field Preparation
Laboratory Analysis	90 Days	Following Field Activities
Data Validation	30 Days	Following Lab Analysis

*Mayfly nymph anticipated sampling in May/June, mayfly adult anticipated sampling in June/July (after adult mayflies begin emerging), sediment anticipated sampling in August, and benthic invertebrate community anticipated sampling in October/November.

8.0 ASSUMPTIONS AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- The number and/or location of the proposed samples described in this SAP may have to be modified based on conditions encountered in the field. Any deviations from this SAP will be documented in the EAR.
- The sediment, quantitative benthic invertebrate, and mayfly sampling methods described in this SAP may have to be modified based on conditions encountered in the field. Any deviations from this SAP will be documented in the EAR.
- The anticipated schedule in Section 7.0 assumes that approval to proceed is provided such that sampling can be scheduled and conducted during the appropriate time of year. If approval to proceed is received too late in the year, sampling will not proceed until the following year.

9.0 REFERENCES

Tennessee Valley Authority (TVA). 2013. "TVA Kingston Standard Operating Procedures – TVA-KIF-SOP-35 Standard Operating Procedure for Reservoir Benthic Macroinvertebrate Sampling, Rev 1." August.

Tennessee Valley Authority (TVA). 2015. "TVA Kingston Standard Operating Procedures – TVA-KIF-SOP-29 Standard Operating Procedure for Mayfly Sampling, Rev 2." March.

Tennessee Valley Authority (TVA). 2016. "TVA Gallatin Standard Operating Procedures – TVA-GAF-SOP-02 Standard Operating Procedure for Sediment Sampling, Rev 0." July.

Tennessee Valley Authority (TVA). 2017a. "Sample Labeling and Custody." Technical Instruction ENV-TI-05.80.02, Revision 0001 March 31.

Tennessee Valley Authority (TVA). 2017b. "Field Record Keeping." Technical Instruction ENV-TI-05.80.03, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017c. "Field Sampling Quality Control." Technical Instruction ENV-TI-05.80.04, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017d. "Field Sampling Equipment Cleaning and Decontamination." Technical Instruction ENV-TI-05.80.05, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017e. "Handling and Shipping of Samples." Technical Instruction ENV-TI-05.80.06, Revision 0000 March 31.

Tennessee Valley Authority (TVA). 2017f. "Soil and Sediment Sampling." Technical Instruction ENV-TI-05.80.50, Revision 0000 September 29.

ATTACHMENT A
FIGURES

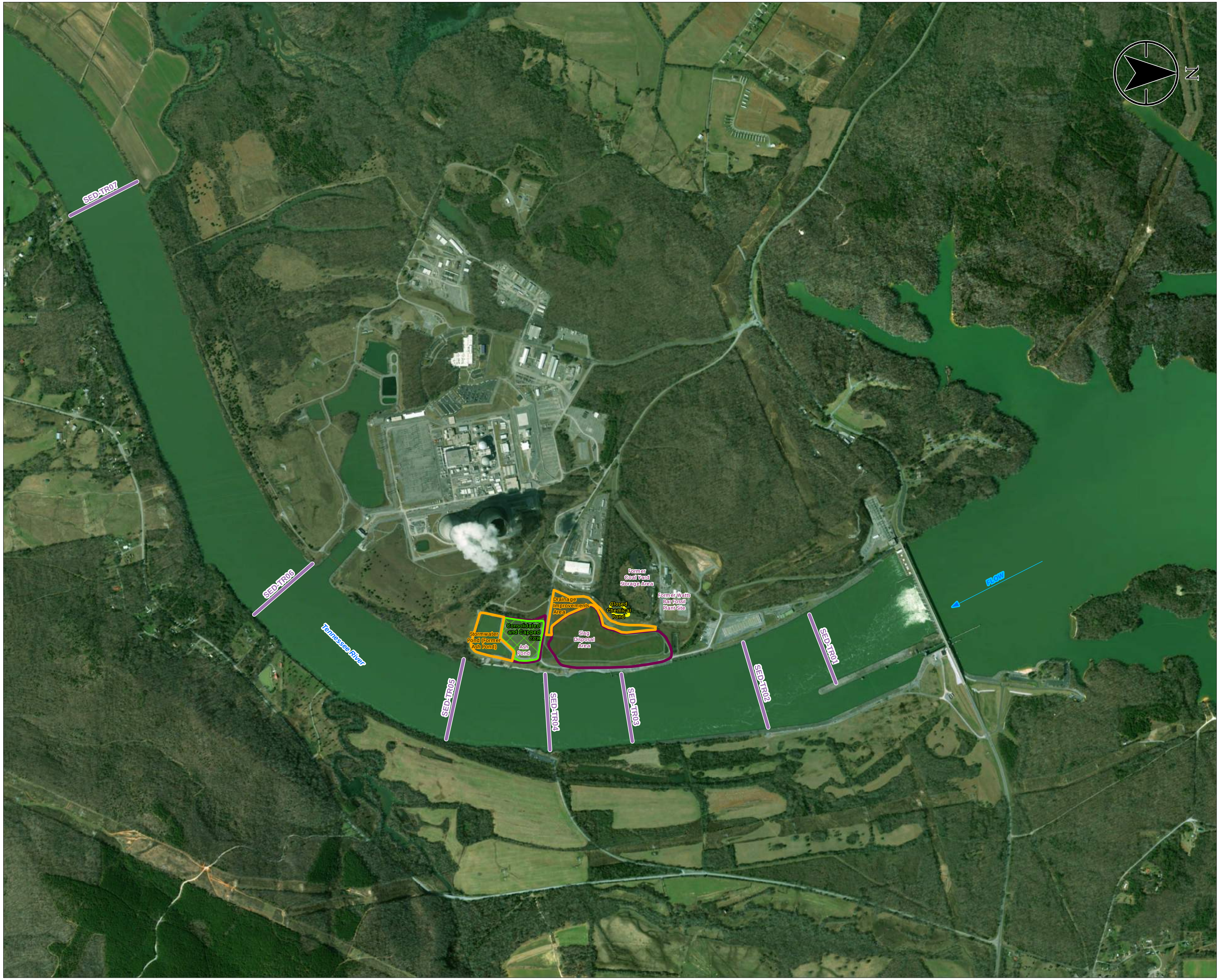

Figure No.
1

Title
Sediment Sampling

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2018-02-06
Technical Review by TG on 2018-02-06

0 700 1,400 2,100 2,800 Feet
1:8,400 (At original document size of 22x34)

Legend

━	Sediment Transect
▢	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 ESRI Imagery

Stantec TVA

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Figure No.
2

Title
Benthic Macroinvertebrates Sampling

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2018-02-06
Technical Review by TG on 2018-02-06

0 1,250 2,500 3,750 5,000 Feet
1:15,000 (At original document size of 22x34)

Legend

▬	Benthic Transect
▭	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 ESRI Imagery

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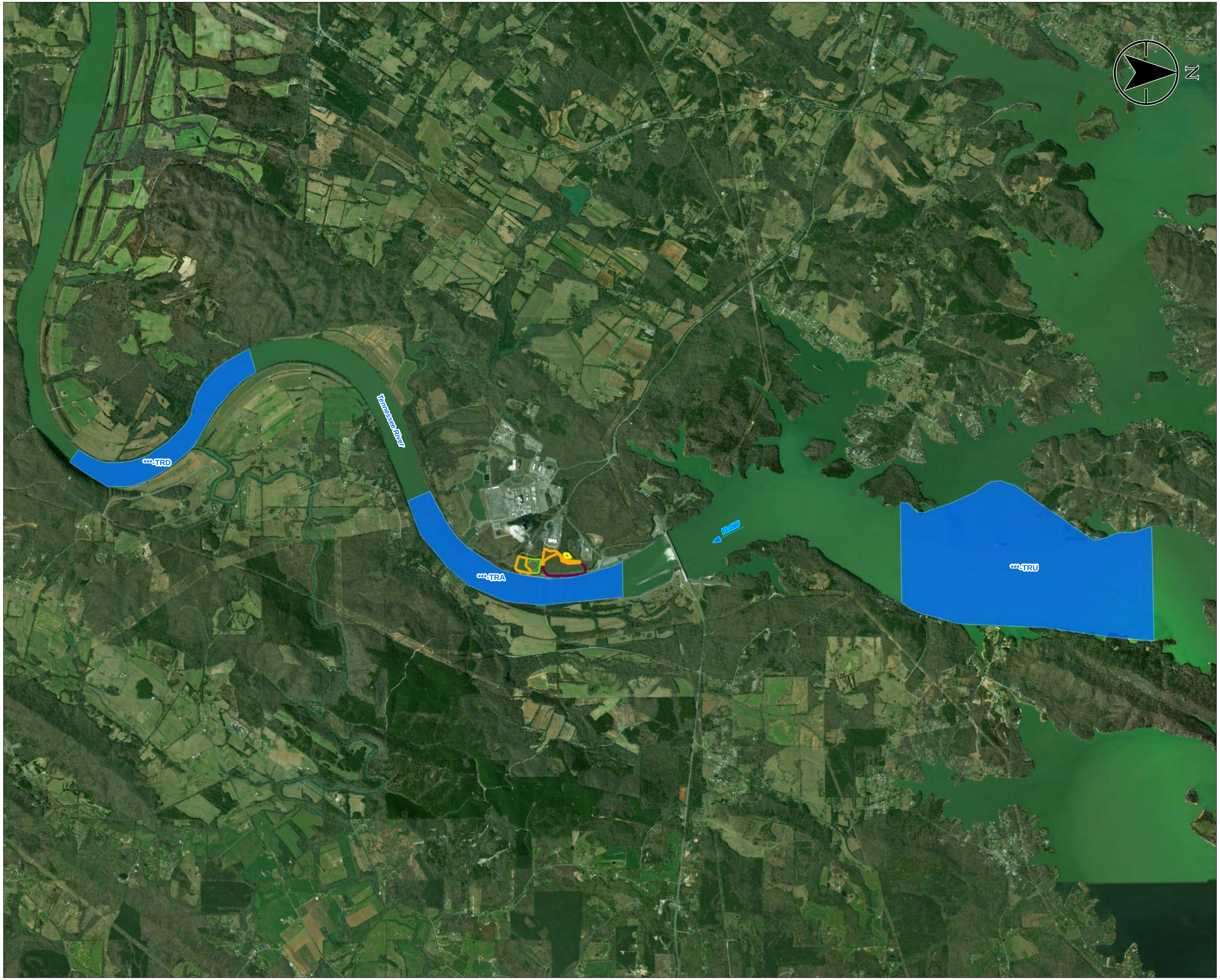

Figure No.
3

Title
Mayfly Sampling
Adult Mayflies, Purated Mayfly Nymphs, & Non-Purated Mayfly Nymphs

Client/Project

Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2018-02-06
Technical Review by TG on 2018-02-06

0 2,000 4,000 6,000 8,000 Feet

1:24,000 (At original document size of 22x34)

Legend

●	Mayfly Sample Location
☐	CCR Unit Area (Approximate)
☐	Closed Chemical Pond (Approximate)
☒	Consolidated and Capped CCR Area (Approximate)
☐	Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

Notes

1. *** Adult Mayflies, Purated Mayfly Numphs, and Non-Purated Mayfly Nymphs; sampled at each location, samples at each location will have a unique ID sample Biota Matrix Code (MFA, MFP, MFN respectively).
2. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
3. Imagery Provided by ESRI Imagery

Stantec

TVA

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ATTACHMENT B
FIELD EQUIPMENT LIST

Field Equipment List
Benthic Investigation

Item Description
***Health and Safety Equipment (e.g. PPE, PFD, first aid kit)**
***Field Supplies/Consumables (e.g. data forms, labels, nitrile gloves)**
***Decontamination Equipment (e.g. non-phosphate detergent)**
***Sampling/Shipping Equipment (e.g. cooler, ice, jars, forms)**
Field Equipment
GPS (sub-meter accuracy preferred)
Digital camera
Batteries
Submersible dissolved oxygen meter
500 micrometer screen
Decontaminated HDPE containers and new lab-certified HDPE scoops
Stainless steel sieve fitted with 2 millimeter or less stainless steel, Nitex, or Teflon mesh/netting
Stainless steel, plastic, or Teflon-coated forceps
Sweep nets
***These items are detailed in associated planning documents to avoid redundancy.**

APPENDIX R
HISTORICAL SEEPAGE SUMMARY

WBF Seepage History Summary

TVA has conducted annual dike inspections at WBF since 1967. These inspections have primarily focused on stability issues pertaining to seeps. The Watts Bar Fossil Plant ceased operations in 1982 and no coal combustion products (CCP) have been discharged from the plant since that time. Slag was reclaimed from the Slag Disposal Area until 2005, and closure of the Slag Disposal Area was completed in 2008. The facility is inactive.

The WBF Slag Disposal Area has historically been referred to as the Fly Ash Pond, the Active Fly Ash Pond, the Existing Fly Ash Pond, the Bottom Ash Disposal Area, and ultimately the Slag Disposal Area. The Slag Disposal Area consists of smaller cells within its unit boundary used during the various operating timelines of the Watts Bar Fossil Plant.

All historic seeps have been observed in the Slag Disposal Area. None have been observed in the adjacent Ash Pond. Seep A was observed in 1970; it was not observed afterward, according to legible inspection reports of 1973 through the present. Seep B was observed from 1993 to 2007; it's exact location was not identified. Seep C was observed from 1998 to 2001; it's exact location was not identified. Seep D was observed from 1999 to 2000; it's exact location was not identified. Seepage was observed adjacent to the river in 2004-2007; it's exact location was not identified.

In 2008, five seeps were observed along the river bank of the existing fly ash pond. Their locations were labeled as Seeps No. 1-5 on a WBF Fly Ash Disposal Area drawing. In 2013, red water seepage was observed on the exterior eastern slope of the slag disposal area and located on an aerial photo of the site; the locations on the aerial photo appear to coincide with Seeps Nos. 1-4 listed below from the 2008 inspection. In 2014, a TDEC NPDES Compliance Evaluation Inspection was conducted, and four seeps were observed between the Coal Slag Disposal Area and the Tennessee River, with Seep No. 4 identified as inactive. The exact location of the seeps was not identified.

A surface water drainage improvement project was completed in 2015. Improvements included the mitigation of three non-flowing seepage areas between the Slag Disposal Area and the Tennessee River, improvements to reduce infiltration through the cap, and drainage improvements to reduce ponded water around the perimeter of the Slag Disposal Area. A seep cut-off trench was installed to prevent seepage. The seepage areas were reportedly not flowing during or after the 2015 mitigation was completed. There are currently no active seeps at the site.

A map depicting historic seepage areas is shown on Figure 1. A summary of the seep history for CUF is provided in Table 1.

Table. 1 Historic Seepage Areas		
Seep No.	**CCR Unit**	**Description**
A	Slag Disposal Area (Historic Fly Ash Pond)	Seep observed in 1970. Photograph No. 8 was identified with the caption "seepage from original ash pond." The location is shown on a map attached to the inspection report. It was not observed thereafter, according to the legible inspection reports of 1973 through the present.
B (exact location unknown)	Slag Disposal Area (Historic/Abandoned Fly Ash Disposal Area/Pond)	Seep observed in 1993. Stormwater run-off and seepage from the external side of the abandoned fly ash disposal area and the slag disposal area flows through a ditch to a pumping station and is pumped into a channel to the fly ash disposal area. The exact location of the seep was not identified.
C (exact location unknown)	Bottom Ash Disposal Area	Seep observed in 1998 - 2001 in bottom ash disposal area. It was not observed thereafter according to later inspection reports. The exact location of the seep was not identified.
D (exact location unknown)	Slag Disposal Area (Active Fly Ash Disposal Area)	Seep observed in 1999 and 2000 in active fly ash disposal area. It was not observed thereafter according to later inspection reports. The exact location of the seep was not identified.
E (exact location unknown)	Active Ash Pond (Existing Fly Ash Pond)	Seepage observed through the ash pile dike adjacent to the river in 2004 -2007. The exact location of the seepage was not identified.
Seep No. 1	Slag Disposal Area (Historic Fly Ash Pond)	This seep was identified during the stability inspection of waste disposal areas in February 25, 2008. The seep was located at the toe of the bank, with an areal size is 20 ft wide x 60 ft length. Its coordinates were listed as N 444572.18, E 2363081.59. The location is shown on the map attached to the inspection report. The seepage area was reportedly not flowing during or after the 2015 mitigation was completed.
Seep No. 2	Slag Disposal Area (Historic Fly Ash Pond)	This seep was identified during the stability inspection of waste disposal areas in February 25, 2008. The seep was located at the toe of the bank, with an areal size is 10 ft wide x 20 ft length. Its coordinates were listed as N 444669.17, E 2363075.42. The location is shown on the map attached to the inspection report. The seepage area was reportedly not flowing during or after the 2015 mitigation was completed.

Table. 1 Historic Seepage Areas		
Seep No.	**CCR Unit**	**Description**
Seep No. 3	Slag Disposal Area (Historic Fly Ash Pond)	This seep was identified during the stability inspection of waste disposal areas in February 25, 2008. The seep was located at the toe of the bank, with an areal size is 5 ft wide x 5 ft length. Its coordinates were listed as N 444718.01, E 2363099.58. The location is shown on the map attached to the inspection report. The seepage area was reportedly not flowing during or after the 2015 mitigation was completed.
Seep No. 4	Slag Disposal Area (Historic Fly Ash Pond)	This seep was identified during the stability inspection of waste disposal areas in February 25, 2008. The seep was located at the toe of the bank, with an areal size is 8 ft wide x 5 ft length. Its coordinates were listed as N 444778.61, E 2363093.87. The location is shown on the map attached to the inspection report. This seep was listed as inactive in the 2014 compliance evaluation inspection.
Seep No. 5	Slag Disposal Area (Historic Fly Ash Pond)	This seep was identified during the stability inspection of waste disposal areas in February 25, 2008. The seep was located at the headwall at the pipe outlet. Its coordinates were listed as N 445081.54, E 2363060.36. The location is shown on the map attached to the inspection report. The seepage area was reportedly not flowing during or after the 2015 mitigation was completed.

References

TVA. “Watts Bar Fossil Plant – Annual Report on Waste Disposal Areas.” 1973 – 2008

Stantec (2013). “2013 Intermediate Inspection of CCP Facilities and Ponds, Watts Bar Fossil Plant.” May 23, 2013.

TDEC (2014). “Compliance Evaluation Inspection, TVA – Watts Bar Fossil Plant, NPDES Permit: TNR058427.” June 11, 2014.

Stantec (2016). “Slag Disposal Area Maintenance, TVA Project 901670, Construction Record Documentation Report (Rev. 0), Watts Bar Fossil Plant.” January 18, 2016.

APPENDIX S
SEEP SAP

Seep
Sampling and Analysis Plan
Watts Bar Fossil Plant

Revision 3

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

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

November 19, 2018

SEEP
SAMPLING AND ANALYSIS PLAN
WATTS BAR FOSSIL PLANT

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	February 9, 2018
2	Addresses May 16, 2018 TDEC Review Comments and Issued for TDEC Review	July 6, 2018
3	Addresses Applicable Programmatic Revisions and Issued for TDEC Approval	November 19, 2018

SEEP
SAMPLING AND ANALYSIS PLAN
WATTS BAR FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Seep
Sampling and Analysis Plan
Watts Bar Fossil Plant
Tennessee Valley Authority
Spring City, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: November 19, 2018

Revision 3

All parties executing work as part of this Sampling and Analysis Plan sign below acknowledging they have reviewed, understand, and will abide by the requirements set forth herein.

TVA Investigation Project Manager — 11/19/18 Date

TVA Investigation Field Lead — 11/19/18 Date

Health, Safety, and Environmental (HSE) Manager — 11-19-18 Date

Investigation Project Manager — 2018-11-13 Date

Rock J. Vitale Digitally signed by Rock J. Vitale DN: cn=Rock J. Vitale, o, ou, email=rvitale@envstd.com, c=US Date: 2018.11.14 12:30:59 -05'00'
QA Oversight Manager — Date

Laboratory Project Manager — 11-15-18 Date

Charles L. Head
TDEC Senior Advisor — Date

Robert Wilkinson
TDEC CCR Technical Manager — Date

Stantec

Table of Contents

LIST OF TABLES

LIST OF ATTACHMENTS

ATTACHMENT A	FIGURE
ATTACHMENT B	FIELD EQUIPMENT LIST

1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at Watts Bar Fossil Plant (WBF) on April 27, 2016, at which time TVA briefed TDEC on its Coal Combustion Residual (CCR) management plans at WBF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On June 14, 2016, TDEC issued a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 22, 2017, TDEC issued a second follow-up letter to TVA regarding the TDEC Order and EIP submittal dates. On November 15, 2016, TVA submitted WBF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

TVA has developed this Seep Sampling and Analysis Plan (SAP) to provide procedures and methods necessary to evaluate whether dissolved CCR material is present in the surface streams on or adjacent to the WBF Plant (Plant). This Seep SAP presents a phased approach and plan to sample water from seeps along surface impoundments and landfills at the WBF Plant (Plant).

2.0 OBJECTIVES

The objectives of this Seep SAP are to identify and characterize active seeps at the Plant for CCR constituents, and identify information that may explain and/or assess the potential movement of groundwater/pore water with dissolved CCR constituents into surface water streams on or adjacent to the Plant, through seepage.

This Seep SAP will provide the procedures necessary to identify and conduct the sampling and analysis of water from active seeps, along with soil samples from the same active seep area.

Proposed sampling locations are discussed in Section 4.0. Field activities will include the following tasks:

- Conduct a seep investigation to identify active seeps, if any, that could potentially discharge to adjacent surface water bodies
- Document the location of identified active seeps using a sub-meter global positioning system (GPS)
- Use the GPS data to identify seeps on the seep sampling location map
- Collect surface water samples from active seeps that are not captured and managed through a permitted unit
- Collect soil samples from active seeps that are not captured and managed through a permitted unit
- Package and deliver samples to the laboratory for analyses of CCR Parameters (described in Section 5.3)

3.0 HEALTH AND SAFETY

This work will be conducted under an approved Plant-specific Health and Safety Plan (HASP). This HASP will be in accordance with TVA Safety policies and procedures. Each worker will be responsible for reviewing and following the HASP. Personnel conducting field activities will have completed required training, understand safety procedures, and be qualified to conduct the field work described in this SAP. The HASP will include a job safety analysis (JSA) for each task described in this SAP and provide control methods to protect personnel. Personal protective equipment (PPE) requirements and safety, security, health, and environmental procedures are defined in the HASP. In addition, authorized field personnel will attend TVA required safety training and Plant orientation.

The Field Team Leader will conduct safety briefings each day prior to beginning work and at mid-shift or after lunch breaks and document these meetings to include the names of those in attendance and items discussed. TVA-specific protocols will be followed, including the completion of 2-Minute Rule cards. The JSAs will be updated if conditions change.

4.0 SAMPLING LOCATIONS

Figure 1 (Attachment A) illustrates the locations of historic seeps at the Plant. Sampling locations will be based on the identification of active seeps at the Slag Disposal Area and Ash Pond Area, with locations verified in the field using Global Positioning System (GPS). Water and soil samples will be taken at each active seep location. A list of the identified active seep(s) will be included in a Table 1, Proposed Seep Sampling Locations, and the completed Table 1 will be included in the EAR.

Table 1. Proposed Seep Sampling Locations

Sample Location ID	Description
e.g., SeS01	(To be determined)
e.g., SeS02	(To be determined)
e.g., SeW01	(To be determined)
e.g., SeW02	(To be determined)

SeS – Seep Soil; SeW – Seep Water

5.0 SAMPLE COLLECTION AND FIELD ACTIVITY PROCEDURES

This section provides details of procedures that will be used to prepare for field activities, collect samples, and assist in providing scientifically defensible results.

Seep water sample collection will adhere to TVA Environmental Technical Instruction (TI) documents. The seep water sampling will be conducted in accordance with TVA TI EMA-TI-05.80.40, *Surface Water Sampling*, which references other TIs that are applicable to various aspects of surface water sampling.

A project field book and field forms will be maintained by the Field Team Leader to record field measurements, analyses, and observations. Field activities will be planned in accordance with TVA TI ENV-TI-05.80.01 *Planning Sampling* Events and documented according to TVA TI ENV-TI-05.80.03, *Field Record Keeping*.

Both soil and water samples (provided flow is available), will be collected at each active seep location that is not captured and managed through a permitted unit. Soil samples will be collected provided the seep occurs from soils and not rock. Soil samples will be collected as a five-point composite from within the saturated soil area and will be conducted according to TVA TI ENV-TI-05.80.50, *Soil and Sediment Sampling*. If required for access to seeps, any removal of aggregate and riprap filters at repaired seep locations will be coordinated through TVA prior to sampling. Seep surface water samples will be collected provided flow is adequate to obtain sufficient sample volume. Due to anticipated high turbidity conditions of seep surface water samples, both field-filtered samples and unfiltered surface water samples will be collected. The purpose of field filtering is to obtain a sample that is representative of dissolved constituents in the seepage fluid; unfiltered seep surface water samples will be taken for comparative purposes.

Seep soil and seep water samples will be analyzed for the CCR Parameters listed in Section 5.3.5.

5.1 PREPARATION FOR FIELD ACTIVITIES

As part of field mobilization activities, the field sampling team will:

- Designate a Safety Officer
- Complete required health and safety paperwork and confirm field team members have completed required training
- Coordinate activities with the Laboratory Coordinator, including ordering sample bottles with contained preservatives (as required), obtaining coolers and analyte-free deionized water, if needed, and notifying the laboratory of sampling and sample arrival dates

- Obtain required calibrated field instruments, including health and safety equipment

- Perform environmental review prior to sampling – as required by the National Environmental Policy Act (NEPA), an environmental review must be completed to document and mitigate any potential impact of the work described herein. The level of review required for this work is anticipated to be a categorical exclusion, which would be documented by TVA with a categorical exclusion checklist (CEC). A CEC has a number of signatories from TVA.

- Complete sample paperwork to the extent possible, including chain-of-custody forms and sample labels in accordance with TVA TIs ENV-TI-05.80.02, *Sample Labeling and Custody* and ENV-TI-05.80.03, *Field Record Keeping.*

- Obtain decontamination materials, including scrub brushes, soap, solvents, buckets, and DI water, as indicated in TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*.

- Obtain ice prior to sample collection for sample preservation

5.2 SEEP INVESTIGATION

As outlined in the EIP, a one-time seep investigation will be conducted to identify active seeps that do not flow through a permitted National Pollutant Discharge Elimination System (NPDES) outfall, are not permitted as an NPDES outfall, and have the potential to discharge into the adjacent surface streams. Known locations of historic seeps, inspection reports, and any other related information will be utilized in the identification of active seeps. If active seeps in this area are discovered, their locations will be staked in the field and shown on a Seep Sampling Location(s) map.

In order to evaluate seeps not visible due to structural mitigation activities (e.g., rip rap), the following investigative protocol will be used:

1. Field testing shall be conducted at the point where water from a seep(s) most likely enters a stream. TVA shall use a boat to monitor the stream channel and surface water at the water's edge.

2. Field testing will be conducted for pH, temperature, dissolved oxygen and conductivity using a multiparameter Sonde.

3. If field testing indicates a significant difference between stream channel samples and samples adjacent to the stream bank, then TVA shall determine if there is a flow from the seep.

4. If the seep is covered with rock or other material, the material shall be removed to determine if there is flow from the seep. [Note: additional work order will be required to remove rip rap.]
5. If there is flow from the seep, then the seep shall be sampled and analyzed for the CCR parameters.

Should active seeps be discovered during the investigation, a seep sampling location map will be finalized, and seep sampling will be implemented in accordance with Section 5.3.

5.3 SAMPLING METHODS AND PROTOCOL

Samples will be analyzed for CCR constituents listed in 40 CFR Part 257, Appendices III and IV. However, five inorganic constituents listed in Appendix 1 of TN Rule 0400-11-01-.04 (i.e., TDEC regulations), and not included in the federal CCR Appendices III and IV, have been added to the list of CCR constituents for analyses to maintain continuity with other TDEC environmental programs. Those additional constituents include the following metals: copper, nickel, silver, vanadium, and zinc. The combined federal CCR Appendices III and IV constituents, and TDEC Appendix 1 inorganic constituents, will hereafter be referred to collectively as “CCR Parameters.”

Seep soil and surface water samples will be collected once and then submitted to the laboratory for the chemical analysis of the CCR Parameters. Various means and methods for collecting seepage water will be used based on the location and flow of the seep. Sampling and collection methods will be conducted in accordance with applicable TVA TIs, including:

- ENV-TI-05.80.01, Planning Sampling Events
- ENV-TI-05.80.02, Sample Labeling and Custody
- ENV-TI-05.80.03, Field Record Keeping
- ENV-TI-05.80.04, Field Sampling Quality Control
- ENV-TI-05.80.05, Field Sampling Equipment Cleaning and Decontamination
- ENV-TI-05.80.06, Handling and Shipping of Samples
- EMA-TI-05.80.40, Surface Water Sampling
- ENV-TI-05.80.46, Field Measurement Using a Multiparameter Sonde
- ENV-TI-05.80.50, *Soil and Sediment Sampling*

5.3.1 Field Equipment Description, Testing/Inspection, Calibration, and Maintenance

A list of anticipated equipment for the field activities described herein is provided as Attachment B. A final list of equipment will be prepared by the Field Team Leader, and approved by TVA, prior to mobilization. Field equipment will be inspected, tested, and calibrated (as applicable) prior to initiation of fieldwork by Field Sampling Personnel and, if necessary, repairs will be made prior to equipment use. If equipment is not in the proper working condition, that piece of equipment will be repaired or taken out of service and replaced prior to use. Additional information regarding field equipment inspection and testing is included in the Quality Assurance Project Plan (QAPP).

5.3.2 Field Documentation

Field documentation will be maintained in accordance with TVA TI *ENV-05.80.03, Field Record Keeping* and the QAPP. Field documentation associated with investigation activities will primarily be recorded in Plant-specific field forms, logbooks and/or on digital media (e.g., geographic information system (GIS)/GPS documentation). Additional information regarding field documentation is provided below and included in the QAPP and TVAs TIs.

5.3.2.1 Daily Field Activities

Field observations and measurements will be recorded and maintained daily to chronologically document field activities, including sample collection and management. Field observations and measurements will be recorded in bound, waterproof, sequentially paginated field logbooks and/or on digital media and field forms.

Deviations from applicable work plans will be documented in the field logbook during sampling and data collection operations. The TVA Technical Lead and the QA Oversight Manager or designee will approve deviations before they occur.

5.3.2.2 Field Forms

Plant-specific field forms will be used to record field measurements and observations for specific tasks.

5.3.2.3 Chain-of-Custody Forms

For the environmental samples to be collected, chain-of-custody (COC) forms, shipping documents, and sample logs will be prepared and retained. Field Quality Control samples will be documented in both the field notes (logbooks and field forms) and on sample COC records. COC forms will be reviewed daily by the Field Team Leader and Field Oversight Coordinator for completeness and a quality control (QC) check of samples in each cooler compared to sample IDs on the corresponding COC form.

The Investigation Project Manager will staff the project with a field sample manager during sample collection activities. Additional information regarding COC forms is included in Section 6.2.2 of this SAP, the QAPP, and TVA TIs.

5.3.2.4 Photographs

In addition to documentation of field activities as previously described, photographs of field activities will also be used to document the field investigation. A photo log will be developed, and each photo in the log will include the location, date taken, and a brief description of the photo content, including direction facing for orientation purposes.

5.3.3 Collection of Samples

5.3.3.1 Seep Soil Sample Collection

Seep soil samples will be collected from surface soils as a five-point composite from within the saturated soil area in accordance with TVA TI ENV-TI-05.80.50, *Soil and Sediment Sampling*. Five surface soils will be collected from discolored areas in the seep areas using a dedicated or decontaminated trowel (or similar tool) or disposal sampling scoop, and placed in a re-sealable dedicated plastic bag or decontaminated glass or plastic bowl for compositing. The collected sample will be homogenized until the physical appearance is consistent over the entire sample. After homogenization, a sample will be collected from the mixed soil and placed in the appropriate laboratory-supplied sampling container. Seep soil samples will be submitted to the laboratory for the chemical analysis of the CCR Parameters. Any free water issues will be addressed by the laboratory.

5.3.3.2 Seep Water Sample Collection

Seep water samples will be collected from active seep locations provided flow is adequate to obtain sufficient sample volume, as defined and required by the laboratory. A seep water sample will be collected by directly filling a properly decontaminated sampling device or clean, non-preserved laboratory container from the seep area, and transferring the seep surface water to an appropriate laboratory-supplied and preserved, sampling container for analysis of CCR Parameters listed in Section 5.3.5. Due to the expected high turbidity of seep surface water samples, a second sample of water from each location will be field filtered using a peristaltic pump and a new, certified clean 0.45-micron filter and placed in an appropriate laboratory-supplied and preserved, sampling container for analysis of dissolved constituents. The purpose of field filtering is to obtain a sample that is representative of the dissolved constituents in the seepage itself. In instances where a non-preserved laboratory supplied bottle is used as the transfer container, the transfer container will only be used at that seep location, properly disposed and will not be used for sampling at other seeps, unless properly decontaminated. A handheld calibrated pH meter will be used to collect pH data at each seep water sample location.

At locations where the surface water stream is not deep enough to directly fill the sampling device or transfer bottle, but a small area of "pooling" is occurring, a peristaltic pump with new, certified clean tubing or a pipette with a bulb may be viable collection options, if recharge is adequate. Collection options are dependent upon field conditions and every effort will be made to collect viable water samples from the seep locations. Filtered and unfiltered seep surface water samples will be submitted to the laboratory for the chemical analysis of CCR Parameters listed in Section 5.3.5.

5.3.4 Preservation and Handling

Sample containers will be labeled in accordance with TVA TI ENV-05.80.02, *Sample Labeling and Custody*. Once each sample container is filled, the rim and threads will be cleaned by wiping with a clean paper towel and capped, and a signed and dated custody seal will be applied. Each sample container will be checked to ensure that it is sealed, labeled legibly, and externally clean. Sample containers will be packaged in a manner to prevent breakage during shipment.

Coolers will be prepared for shipment in accordance with TVA TI ENV-TI-05.80.06, *Handling and Shipping of Samples* by taping the cooler drain shut and lining the bottom of the cooler with packing material or bubble wrap. Sample containers will be placed in the cooler in an upright position. Small uniformly sized containers will be stacked in an upright configuration, and packing material will be placed between layers. Plastic containers will be placed between glass containers when possible. A temperature blank will be placed inside each cooler to measure sample temperature upon arrival at the laboratory. Loose ice will be placed around and among the sample containers to cool the samples to less than 6 degrees Celsius (°C) during shipment. The cooler will be filled with additional packing material to secure the containers.

The original COC form will be placed in a re-sealable plastic bag taped to the inside lid of the cooler. A copy of the COC form will be retained with the field notes in the project files. A unique cooler ID number will be written on the COC form and the shipping label placed on the outside of the cooler. The total number of coolers required to ship the samples will be recorded on the COC form. If multiple coolers are required to ship samples contained on a single COC form, then the original copy will be placed in cooler 1 of X with copies (marked as such) placed in the additional coolers. Two signed and dated custody seals will be placed on alternate sides of the cooler lid. Packaging tape (i.e., strapping tape) will be wrapped around the cooler to secure the sample shipment.

Upon receipt of the samples, the analytical laboratory will open the cooler and will sign "received by laboratory" on each COC form. The laboratory will verify that the custody seals have not been previously broken and that the seal number corresponds with the number on the COC form. The laboratory will note the condition and temperature of the samples upon receipt and will identify discrepancies between the contents of the cooler and COC form. If there are discrepancies the Laboratory Project Manager will immediately call the Laboratory Coordinator and Field Team

Leader to resolve the issue and note the resolution on the laboratory check-in sheet. The analytical laboratory will then forward the back copy of the COC form to the QA Oversight Manager and Investigation Project Manager.

5.3.5 Sample Analyses

Samples will be submitted to the TVA-approved laboratory for analysis per the QAPP. Both soil and water samples will be analyzed for the CCR Parameters, while filtered and unfiltered water samples will also be evaluated for dissolved and total constituents, respectively. Tables 2, 3, and 4 summarize the listed constituents. Analytical methods, preservation, containers(s) and holding times are presented in Table 5. Additional sampling and laboratory-specific information is covered in more detail in the QAPP.

Table 2. 40 CFR Part 257, Appendix III Constituents

Appendix III Constituents
Boron
Calcium
Chloride
Fluoride
pH
Sulfate
Total Dissolved Solids (TDS)

* Add TSS for aqueous unfiltered sampling

Table 3. 40 CFR Part 257, Appendix IV Constituents

Appendix IV Constituents
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226 and 228 Combined

Table 4. TN Rule 0400-11-01-.04, Appendix 1 Inorganic Constituents

TDEC Appendix 1 Constituents*
Copper
Nickel
Silver
Vanadium
Zinc

* Constituents not listed in CCR Appendices III and IV

Table 5. Analytical Methods, Preservatives, Containers, and Holding Times

Parameter	Analytical Methods	Preservative(s)	Container(s)	Holding Times
Metals, dissolved	SW-846 6020A	HNO3 to pH < 2; & Cool to <6°C	250-mL HDPE	180 days
Metals, total	Liquid & Solid - SW-846 6020A	HNO3 to pH < 2 & Cool to <6°C; Cool to <6°C	250-mL HDPE; 4-oz glass (soil)	180 days
Mercury, dissolved	SW-846 7470A	HNO3 to pH < 2 & Cool to <6°C	250-mL HDPE	28 days
Mercury, total	Liquid - SW-846 7470A; Solid - SW-846 7471B	HNO3 to pH < 2 & Cool to <6°C; Cool to <6°C	250-mL HDPE; 4-oz glass (soil)	28 days
Radium 226	Liquid - SW-846 903.0; Solid - SW-846 901.1	HNO3 to pH < 2 & Cool to <6°C; Cool to <6°C	1 L glass or Plastic; One 16-oz wide mouth glass jar (soil) to be used for both Ra 226 and 228 samples	180 days
Radium 228	Liquid - SW-846 904.0; Solid - SW-846 901.1	HNO3 to pH < 2 & Cool to <6°C; Cool to <6°C	2 L glass or plastic; See Ra 226 above for soil	180 days
Chloride	Liquid - SW-846 9056A; Solid - SW-846 9056A Modified	Cool to <6°C; Cool to <6°C	250-mL HDPE; 4-oz glass (soil)	28 days
Fluoride	Liquid - SW-846 9056A;	Cool to <6°C; Cool to <6°C	250-mL HDPE; 4-oz glass (soil)	28 days

Table 5. Analytical Methods, Preservatives, Containers, and Holding Times

Parameter	Analytical Methods	Preservative(s)	Container(s)	Holding Times
	Solid - SW-846 9056A Modified			
Sulfate	Liquid - SW-846 9056A; Solid - SW-846 9056A Modified	Cool to <6°C; Cool to <6°C	125-mL HDPE; 4-oz glass (soil)	28 days
Total Dissolved Solids (TDS)	SM2540C	Cool to <6°C	250-mL HDPE	7 days
Total Suspended Solids (TSS)	SM2540C	Cool to <6°C	1 L HDPE	7 days
pH	Liquid - SW-846 9040C (field measurement); Solid - SW-846 9045D	NA	NA (liquids); 4-oz glass (soil)	NA*

*The pH of groundwater samples will be measured in the field. Holding time for soil pH samples is 15 minutes following creation of soil paste. Soil samples will be tested in the field using field pH test kits, 10% of the sample locations will have confirmation samples submitted for laboratory analysis of pH and will have paste prepared in the laboratory so that analysis can be completed within the holding time.

5.3.6 Equipment Decontamination Procedures

Documented decontamination will be performed for sampling equipment and instruments in contact with water or subsurface materials in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination* to prevent cross-contamination.

Following decontamination, fluids will be placed into a drum for storage, transportation, and ultimately disposal in accordance with Section 5.3.7. Decontamination activities will be performed away from surface water bodies and areas of potential impacts. Decontamination of non-disposable sampling equipment or instruments can be performed using water and Liquinox® or other appropriate non-phosphatic detergent in 5-gallon buckets.

Decontamination of sampling equipment and instruments (e.g., water level meters, etc.) will be performed prior to use and between sampling locations. Decontamination activities will be documented in the logbook field notes. Additional information regarding equipment decontamination procedures is in the QAPP.

5.3.7 Waste Management

Investigation derived waste (IDW) generated during implementation of this Sampling and Analysis Plan may include, but is not limited to:

- Personal Protective Equipment
- Decontamination fluids
- General trash

IDW will be handled in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination,* the Plant-specific waste management plan, and local, state, and federal regulations. Transportation and disposal of IDW will be coordinated with TVA Plant personnel.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

The QAPP describes quality assurance (QA)/quality control (QC) requirements for the overall Investigation. The following sections provide details regarding QA/QC requirements specific to pore water sampling and analysis.

6.1 OBJECTIVES

The Data Quality Objectives (DQOs) process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA and the Investigation Project Manager considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts for the Investigation.

Specific quantitative acceptance criteria for analytical precision and accuracy for the matrices included in this investigation are presented in the QAPP.

6.2 QUALITY CONTROL CHECKS

Five types of field QA/QC samples will be collected during sampling activities: field duplicate samples, matrix spike/matrix spike duplicate (MS/MSD) samples, equipment blanks, field blanks, and filter blanks. QA/QC samples will be collected in accordance with TVA TI ENV-TI-05.80.04, *Field Sampling Quality Control*. Criteria for the number and type of QA/QC samples to be collected for each analytical parameter are specified below. A complete description of the QA requirements is provided in the QAPP.

Field Duplicate Samples – One duplicate sample will be collected for every 20 samples or once per sampling event. Duplicates samples will be prepared as blind duplicates and will be collected in two sets of identical, laboratory-prepared sample bottles. The primary and duplicate samples will be labeled according to procedure in Section 6.2.1. Sample identifier information will not be used to identify the duplicated samples. Actual sample identifiers for duplicate samples will be noted in the field logbook. The duplicate sample will be analyzed for the same parameters as the primary sample.

MS/MSD Samples – A sufficient volume of sample will be collected for use as the MS/MSD. MS/MSD samples will be collected to allow matrix spike samples to be run to assess the effects of matrix on the accuracy and precision of the analyses. One MS/MSD sample will be analyzed for every 20 samples collected or once per sampling event. MS/MSD samples will be collected by filling bottles alternately by thirds in accordance with TVA TI ENV-TI-05.80.04, *Field Sampling Quality Control* into three sets of identical, laboratory-prepared sample bottles. Additional sample volume intended for use as the MS/MSD must be identified in the comments field on the COC records and sample labels. The location of sample collection will be noted in the log book. The MS/MSD sample will be analyzed for the same analytes as the primary sample, with exception of parameters that are not amenable to MS/MSD. For parameters such as Total Suspended Solids and radium that are not amenable to the MS/MSD procedure, additional sample volume will be collected for laboratory duplicate analysis per the QAPP.

Equipment Blanks (Rinsate Blanks) – One equipment (rinsate) blank will be collected for each sampling event. The equipment blank will be collected at a sampling location by pouring laboratory-provided deionized water into or over the decontaminated sampling equipment, then into the appropriate sample containers. The time and location of collecting the equipment blank will be noted in the log book. The sample will be analyzed for the same analytes as the sample collected from the location where the equipment blank is prepared. If the tubing used to collect the filter blank is not certified clean tubing, then a tubing blank will be collected at a frequency of blank per lot.

Field Blanks – One field blank sample will be prepared per day using laboratory-supplied deionized water. The sample will be analyzed for the same analytes, with the exception of pH.

Filter Blanks – One filter blank will be collected during each day of the sampling activities when dissolved parameters are collected for analysis. The filter blank will be collected at a sampling location by passing laboratory-supplied deionized water through in-line filters used in the collection of dissolved metals, (or other analytes), then into the appropriate sample containers. The time and location of collecting the filter blank will be noted in the log book. The sample will be analyzed for the same analytes as the sample collected from the location where the filter blank is prepared. In addition, one filter blank will be collected per lot of filters used. The filter lot check is to be performed one per lot of filters used and scheduled in a manner to allow for laboratory to report data prior to investigative sample collection.

6.2.1 Sample Labels and Identification System

Sample IDs will be recorded on all sample container labels, custody records, and field sheets in accordance with TVA TIs ENV-TI-05.80.02, *Sample Labeling and Custody* and ENV-TI-05.80.03, *Field Record Keeping*. Each sample container will have a sample label affixed and secured with clear package tape as necessary to ensure the label is not removed. Information on sample labels will be recorded in waterproof, non-erasable ink. Specific information regarding sampling labeling and identification is included in the QAPP.

6.2.2 Chain-of-Custody

The possession and handling of individual samples must be traceable from the time of sample collection until the time the analytical laboratory reports the results of sample analyses to the appropriate parties. Field staff will be responsible for sample security and record keeping in the field.

The COC form documents the sample transfer from the field to the laboratory, identifies the contents of a shipment, provides requested analysis from the laboratory, and tracks custody transfers. Additional information regarding COC procedures is located in the QAPP.

6.3 DATA VALIDATION AND MANAGEMENT

As stated in the EIP, a QAPP has been developed such that environmental data are appropriately maintained and accessible to data end users. The field investigation will be performed in accordance with the QAPP. Laboratory analytical data will be subjected to data validation in accordance with the QAPP. The data validation levels and process will also be described in the QAPP.

7.0 SCHEDULE

Anticipated schedule activities and durations for the implementation of this SAP are summarized below. This schedule is preliminary and subject to change based on approval, field conditions, and weather conditions. For the overall EIP Implementation schedule, including anticipated dates, see the schedule provided in the EIP.

Table 6. Preliminary Schedule for Seep SAP Activities

Project Schedule		
Task	**Duration**	**Notes**
Seep SAP Submittal		Completed
Prepare for Field Activities	25 Days	Following NTP
Conduct Field Activities – Seep Investigation	20 Days	Following Field Preparation
Conduct Field Activities – Implement Seep SAP (if required)	20 Days	Following Seep Investigation
Laboratory Analysis (if required)	50 Days	Following Field Activities
Data Validation (if required)	30 Days	Following Lab Analysis

8.0 ASSUMPTION AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- Approved sampling methods and protocols may have to be substituted in the EIP based on changing field conditions.

9.0 REFERENCES

Tennessee Valley Authority (TVA). 2017a. "Planning Sampling Events." Technical Instruction ENV-TI-05.80.01, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017b. "Sample Labeling and Custody." Technical Instruction ENV-TI-05.80.02, Revision 0001. March 31.

Tennessee Valley Authority (TVA). 2017c. "Field Record Keeping." Technical Instruction ENV-TI-05.80.03, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017d. "Field Sampling Quality Control." Technical Instruction ENV-TI-05.80.04, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017e. "Field Sampling Equipment Cleaning and Decontamination." Technical Instruction ENV-TI-05.80.05, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017f. "Handling and Shipping of Samples." Technical Instruction ENV-TI-05.80.06, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017g. "Surface Water Sampling." Technical Instruction EMA-TI-05.80.40, Revision 0000. May 4.

Tennessee Valley Authority (TVA). 2017h. "Field Measurement Using a Multi-Parameter Sonde." Technical Instruction ENV-TI-05.80.46, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017i. "Soil and Sediment Sampling." Technical Instruction ENV-TI-05.80.50, Revision 0000. September 29.

ATTACHMENT A
FIGURE

Figure No.
1

Title
Historic Seep Locations

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by LT on 2018-02-07
Technical Review by TG on 2018-02-07

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

Legend

●	Historic Seep
┄	Watts Bar Nuclear Facility 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 ESRI Imagery

U:\TVA-EIP\175566336\gis\mxds\WBF_Historic_Seeps.mxd Revised: 2018-02-07 By: mbough

ATTACHMENT B
FIELD EQUIPMENT LIST

Field Equipment List
Seep Investigation

Item Description
***Health and Safety Equipment (e.g. PPE, PFD, first aid kit)**
***Field Supplies/Consumables (e.g. data forms, labels, nitrile gloves)**
***Decontamination Equipment (e.g. non-phosphate detergent)**
***Sampling/Shipping Equipment (e.g. cooler, ice, jars, forms)**
Field Equipment
GPS (sub-meter accuracy preferred)
Digital camera
Batteries
Boat and paddles
Anchor
Two outboard gas tanks
Rope
Waders, muck boots, knee boots, etc.
pH and conductivity meters
Thermometer
***These items are detailed in associated planning documents to avoid redundancy.**
[1]Drilling rig equipment will be selected based on site conditions, selected by the Drilling Contractor, and approved by TVA.

APPENDIX T
SURFACE STREAM SAP

Surface Stream
Sampling and Analysis Plan
Watts Bar Fossil Plant

Revision 3

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

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

November 19, 2018

SURFACE STREAM
SAMPLING AND ANALYSIS PLAN
WATTS BAR FOSSIL PLANT

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	February 9, 2018
2	Addresses May 16, 2018 TDEC Review Comments and Issued for TDEC Review	July 6, 2018
3	Addresses Applicable Programmatic Revisions and Issued for TDEC Approval	November 19, 2018

SURFACE STREAM
SAMPLING AND ANALYSIS PLAN
WATTS BAR FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Surface Stream
Sampling and Analysis Plan
Watts Bar Fossil Plant
Tennessee Valley Authority
Spring City, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: November 19, 2018 Revision 3

All parties executing work as part of this Sampling and Analysis Plan sign below acknowledging they have reviewed, understand, and will abide by the requirements set forth herein.

TVA Investigation Project Manager — Date 11/19/18

Tyler Baker
TVA Investigation Field Lead — Date 11-19-18

Health, Safety, and Environmental (HSE) Manager — Date 11-19-18

Clark S Pennington
Investigation Project Manager — Date 2018-11-13

Rock J. Vitale Digitally signed by Rock J. Vitale DN: cn=Rock J. Vitale, o, ou, email=rvitale@envstd.com, c=US Date: 2018.11.14 12:31:25 -05'00'
QA Oversight Manager — Date

Laboratory Project Manager — Date 11-15-18

Charles L. Head
TDEC Senior Advisor — Date

Robert Wilkinson
TDEC CCR Technical Manager — Date

Stantec

Table of Contents

LIST OF TABLES

LIST OF ATTACHMENTS

ATTACHMENT A	**FIGURE**
ATTACHMENT B	**FIELD EQUIPMENT LIST**

1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at Watts Bar Fossil Plant (WBF) on April 27, 2016, at which time TVA briefed TDEC on its Coal Combustion Residual (CCR) management plans at WBF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On June 14, 2016, TDEC issued a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 22, 2017, TDEC issued a second follow-up letter to TVA regarding the TDEC Order and EIP submittal dates. On November 15, 2016, TVA submitted WBF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

TDEC's comments included a request for greater clarification on TVA's phased approach for evaluating whether dissolved CCR material has migrated to surface streams on or adjacent to the WBF Plant (Plant). TDEC also requested the submittal of a Surface Stream Sampling and Analysis Plan (SAP) and a map of surface stream sampling locations.

2.0 OBJECTIVES

The objective of this Surface Stream SAP is to characterize surface stream water quality on or adjacent to the Plant for CCR constituents, and identify information that may explain the potential transport of CCR constituents into those surface streams.

This Surface Stream SAP will provide the procedures necessary to conduct investigation activities associated with the sampling and analysis of water bodies bordering and in the vicinity of the Plant. Surface stream sampling is anticipated to be conducted concurrently with sediment sampling, as described in the Benthic SAP. Most sample locations will require both sediment and water sampling, but some locations will require one or the other. At locations that require both surface water and sediment sampling, the surface water sample will be collected first. To account for seasonal variations, two surface stream sampling events are proposed.

Surface stream samples will be collected from designated transects in the subject streams and analyzed for total and dissolved CCR constituents, as listed in Appendices III and IV of the CCR Rule, as well as TN Rule 0400-11-01-.04 Appendix 1.

Five inorganic constituents listed in Appendix 1 of TN Rule 0400-11-01-.04 (i.e., TDEC regulations), and not included in the federal CCR Appendices III and IV, have been added to the list of CCR constituents for analyses to maintain continuity with other TDEC environmental programs. Those additional constituents include the following metals: copper, nickel, silver, vanadium, and zinc. The combined federal CCR Appendices III and IV constituents, and TDEC Appendix 1 inorganic constituents, will hereafter be referred to collectively as "CCR Parameters."

Proposed surface stream sampling transects to be evaluated are discussed in Section 4.0. Field activities will include the following tasks:

- Verify proposed sampling locations using the global positioning system (GPS)
- Collect water quality parameters and surface water samples from proposed sampling transects
- Package and deliver surface stream samples to laboratory

3.0 HEALTH AND SAFETY

This work will be conducted under an approved Plant-specific Health and Safety Plan (HASP). This HASP will be in accordance with TVA Safety policies and procedures. Each worker will be responsible for reviewing and following the HASP. Personnel conducting field activities will have completed required training, understand safety procedures, and be qualified to conduct the field work described in this SAP. The HASP will include a job safety analysis (JSA) for each task described in this SAP and provide control methods to protect personnel. Personal protective equipment (PPE) requirements and safety, security, health, and environmental procedures are defined in the HASP. In addition, authorized field personnel will attend TVA required safety training and Plant orientation.

During planning and sampling activities, procedures to ensure safety will be incorporated according to the TVA Standard Programs and Processes (SPP) TVA-SPP-18.005, Plan Jobs Safely, which provides information on using job safety analyses (JSAs) and/or pre-job briefings (PJB).

The Field Team Leader will conduct safety briefings each day prior to beginning work and at mid-shift or after lunch breaks and document these meetings to include the names of those in attendance and items discussed. TVA-specific protocols will be followed, including the completion of 2-Minute Rule cards. The JSAs will be updated if conditions change.

4.0 SAMPLING LOCATIONS

A phased approach to surface stream sampling will be utilized. Phase 1 surface stream sampling locations in the Tennessee River illustrated on Figure 1 (Attachment A) were selected to evaluate whether ash processing at WBF has had or is having any adverse effects on water quality.

Seven surface stream sample locations are planned for the Phase 1 of this investigation (see Figure 1). Table 1 provides a summary of the proposed sampling locations. Sampling locations are proposed in the Tennessee River to evaluate water quality upstream of the CCR Units to serve as background samples, adjacent to the CCR Units, and downstream of the CCR Units. Samples will be analyzed for total and dissolved CCR Parameters and selected cations to calculate Total Hardness. The Surface Stream SAP for Phase 1 is written such that sediment and surface stream sampling would be conducted during the same sampling event. Sampling methodology and laboratory specific information is covered in more detail in the QAPP.

Phase 2 of surface stream sampling will be conducted if there is an exceedance of 20% ash content (based on PLM analysis) in one or more of the sediment samples collected in accordance with the Benthic SAP. Phase 2 will consist of collecting additional surface stream samples from the location(s) where greater than 20% ash occurs. Several surface stream sample transects at the location(s) with greater than 20% ash content may be necessary to delineate the extent of potential impacts. Should this second phase be implemented, a new sampling location map will be developed. Phase 2 sampling procedures will remain the same as those described in this SAP. Only the sampling locations will differ.

Table 1. Proposed Surface Stream Sample Locations

Sample Location ID	Description
STR-TR01	Tennessee River Upstream of WBF within Watts Bar Lake Reservoir - Background
STR-TR02	Tennessee River Upstream of WBF just downstream of the Watts Bar Lake Dam within the Chickamauga Lake Reservoir - Background
STR-TR03	Tennessee River just upstream of the Slag Disposal Area/Historic Fly Ash Pond.
STR-TR04	Tennessee River Downstream of the Slag Disposal Area/Historic Fly Ash Pond, Upstream of the Ash Pond Area
STR-TR05	Tennessee River just downstream of the Ash Pond Area
STR-TR06	Tennessee River Downstream of the CCR Units
STR-TR07	Tennessee River Downstream of WBF

Several of the surface stream sample locations coincide with sample locations of other environmental SAPs. Table 2 summarizes the corresponding sample locations for the surface stream, benthic, and fish tissue SAPs.

Table 2. WBF Environmental Corresponding Sample Locations Matrix

Surface Stream Sample Location	Corresponding Sediment Sample Location	Corresponding Benthic Sampling Location	Corresponding Mayfly Sampling Location	Corresponding Fish Tissue Sampling Location
NA	NA	MAC-TR01	TRU	TRU
NA	NA	MAC-TR02	NA	NA
STR-TR01	SED-TR01	NA	NA	NA
STR-TR02	SED-TR02	MAC-TR03	TRA	TRA
STR-TR03	SED-TR03	MAC-TR04		
STR-TR04	SED-TR04	NA		
STR-TR05	SED-TR05	MAC-TR05		
STR-TR06	SED-TR06	MAC-TR06		
STR-TR07	SED-TR07	MAC-TR07	NA	NA
NA	NA	NA	TRD	TRD

NA – Not Applicable

5.0 SAMPLE COLLECTION AND FIELD ACTIVITY PROCEDURES

This section provides details of procedures that will be used to collect samples, document field activities, and assist in providing scientifically defensible results.

Surface stream sample collection will adhere to TVA Environmental Technical Instruction (TI) documents. The surface stream sampling will be conducted in accordance with TVA TI EMA-TI-05.80.40 *Surface Water Sampling*, which references other TIs that are applicable to various aspects of surface stream sampling. A project field book and field forms will be maintained by the Field Team Leader to record field measurements, analyses, and observations. Field activities will be documented according to TVA TI ENV-TI-05.80.03, *Field Record Keeping*.

5.1 PREPARATION FOR FIELD ACTIVITIES

Preparation for field activities will be conducted in accordance with TVA TI ENV-TI-05.80.01, *Planning Sampling Events.* As part of field mobilization activities, the field sampling team will:

- Designate a Safety Officer
- Complete required health and safety paperwork and confirm field team members have completed required training
- Coordinate activities with the Laboratory Coordinator, including ordering sample bottles containing preservatives (if required), obtaining coolers and analyte-free, deionized water (DI), if needed, and notifying the Laboratory Coordinator of sampling and sample arrival dates
- Obtain required field instruments, including health and safety equipment, Hydrolab® DS5X (or similar) multiparameter sonde, handheld sonic water depth meter (if needed), and sampling equipment and accessories (i.e., peristaltic pump or Kemmerer depth sampler, as per EMA-TI-05.80.40 *Surface Water Sampling*)
- Complete sample paperwork to the extent possible, including chain-of-custody forms and sample labels in accordance with TVA TIs ENV-TI-05.80.02, *Sample Labeling and Custody* and ENV-TI-05.80.03, *Field Record Keeping*
- Determine current flow conditions of subject streams to assess whether conditions are appropriate to conduct sampling. Sampling will need to occur during seasonal mean flows as described in Section 5.2.4
- Coordinate arrangements for obtaining a boat or vessel for accessing sample locations

- Obtain ice prior to sample collection for sample preservation

- Obtain decontamination materials, including scrub brushes, soap, solvents, buckets, and DI water, as indicated in TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*

5.2 SAMPLING METHODS AND PROTOCOL

Sampling and collection methods will be conducted in accordance with applicable TVA TIs, including:

- ENV-TI-05.80.01, *Planning Sample Events*

- ENV-TI-05.80.02, *Sample Labeling and Custody*

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

- ENV-TI-05.80.04, *Field Sampling Quality Control*

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

- ENV-TI-05.80.06, *Handling and Shipping of Samples*

- EMA-TI-05.80.40, *Surface Water Sampling*

- ENV-TI-05.80.46, *Field Measurement Using A Multi-Parameter Sonde*

5.2.1 Field Analyses

A Hydrolab® DS5X (or similar) multiparameter sonde will be used to record a depth profile of conventional water quality parameters at each sample transect location in accordance with ENV-TI-05.80.46 Field Measurement Using A Multi-Parameter Sonde. If water depth is less than two meters, water quality parameters will be monitored at the surface and mid-depth of the water column. For depths greater than two meters, water quality parameters will be monitored within 1 meter of the stream bottom and in increments of one meter to the surface. If a thermocline, as determined by the procedure outlined in Section 5.2.1.1, is observed, the depth interval will be adjusted to better define. The instrument will undergo documented calibration daily. Instrument use and calibration will follow TVA TI ENV-TI-05.80.46, *Field Measurement Using A Multi-Parameter Sonde*. Conventional field parameters to be measured include:

- Temperature (°C)

- Dissolved Oxygen (milligrams per Liter; mg/L)

- Specific Conductivity (microSiemens per centimeter; µS/cm)
- Oxidation Reduction Potential (milliVolts; mV)
- pH (Standard Units)
- Turbidity (Nephelometric Turbidity Unit; NTU)

Water depth will be measured at each water sample location. Data will be recorded as described in TVA TI ENV-TI-05.80.03, *Field Record Keeping*.

5.2.2 Field Equipment Description, Testing/Inspection, Calibration, and Maintenance

A list of anticipated equipment for the field activities described herein is provided as Attachment B. A final list of equipment will be prepared by the Field Team Leader, and approved by TVA, prior to mobilization. Field equipment will be inspected by Field Sampling Personnel team members and, if necessary, repairs will be made prior to equipment use. If equipment is not in the proper working condition, that piece of equipment will be repaired or taken out of service and replaced prior to use. Additional information regarding field equipment inspection and testing is included in the QAPP.

5.2.3 Field Documentation

Field documentation will be maintained in accordance with TVA TI ENV-05.80.03, *Field Record Keeping* and the QAPP. Field documentation associated with investigation activities will primarily be recorded in Plant-specific field forms, logbooks and/or on digital media (e.g., geographic information system (GIS)/GPS documentation). Additional information regarding field documentation is provided below and included in the QAPP and TVAs TIs.

5.2.3.1 Daily Field Activities

Field observations and measurements will be recorded and maintained daily to chronologically document field activities, including sample collection and management. Field observations and measurements will be recorded in bound, waterproof, sequentially paginated field logbooks and/or on digital media and field forms.

Deviations from applicable work plans will be documented in the field logbook during sampling and data collection operations. The TVA Technical Lead and the QA Oversight Manager or designee will approve deviations before they occur.

5.2.3.2 Field Forms

Project-specific field forms will be used to record field measurements and observations for specific tasks.

5.2.3.3 Chain-of-Custody Forms

For the environmental samples to be collected, chain-of-custody (COC) forms, shipping documents, and sample logs will be prepared and retained. Field QC samples will be documented in both the field notes (logbooks and field forms) and on sample COC records. COCs will be reviewed daily by the Field Team Leader and Field Oversight Coordinator for completeness and a QC check of samples in each cooler compared to sample IDs on the corresponding COC. The Investigation Project Manager will staff the project with a field sample manager during sample collection activities. Additional information regarding COC forms is included in Section 6.2.2 of this SAP, the QAPP, and TVA TIs.

5.2.3.4 Photographs

In addition to documentation of field activities as previously described, photographs of field activities will also be used to document the field investigation. A photo log will be developed, and each photo in the log will include the location, date taken, and a brief description of the photo content, including direction facing for orientation purposes.

5.2.4 Collection of Samples

A Hydrolab® DS5X (or similar) will be used to collect water quality parameters along sample location transects. If thermal stratification is identified based on the Hydrolab® data, four water column samples will be collected at the stream thalweg (deepest point), right bank, and left bank along the sample transect for a total of 12 samples if stratification is observed throughout the transect. If no thermal stratification is identified, surface, mid-depth, and epibenthic samples will be collected at the thalweg, right bank, and left bank locations for the transect for a total of nine samples. The thalweg will be identified by passing the boat along the transect with depth finding equipment or measuring the water depth on intervals for smaller channels. Sampling procedures may be adjusted as described below to accommodate shallow and narrow sample locations.

Collection of surface stream samples will follow TVA TI EMA-TI-05.80.40 *Surface Water Sampling*. Sample collection will follow the procedures detailed below. Note that sampling methods may have to be substituted in some locations based on changing field conditions (obstructions, water depth, etc.). To account for seasonal variations, two sampling events are proposed (one during summer pool, one during winter pool). Flow during sampling events will be greater than the 25th percentile and less than the 75th percentile based on analysis of the mean daily flows of the Tennessee River at the nearest United States Geological Survey (USGS) gage.

- Upon arrival at a sample location where both sediment and surface water are being collected, the surface stream sample will be collected before the associated sediment sample if the sediment and surface stream sampling is conducted concurrently/during the same event. This will minimize the possibility of water sample contamination from disturbance of sediments.

- Surface stream samples are to be collected from downstream to upstream to prevent the disturbance of bottom sediments from impacting further downstream sample locations. In addition, sampling will be conducted upstream and away from the boat and motor.

- A sub-meter GPS unit will be used to navigate to sample locations. The depth of water will be determined, and water quality parameters will be measured in-situ with the Hydrolab® DS5X (or similar) multiparameter sonde.

- Presence of thermal stratification will be evaluated along sample transects at each site. This will determine the sampling procedure, as outlined below. The following method will be used to determine whether each sampling location is stratified or mixed (unstratified).

    1. Position and anchor the boat at the proper GPS coordinates.

    2. Use the boat's depth finder to determine the river depth at that location.

    3. Lower the calibrated Hydrolab® (or similar unit) to the bottom of the river, minimizing disturbance of bottom sediments.

    4. Collect field parameter readings for temperature at one-meter depth intervals. Readings will be collected over the entire column of water on whole meter increments, beginning a minimum of 0.5 meters above the bottom.

       Allow the Hydrolab® approximately 30 seconds to equilibrate at each depth increment, or until otherwise observed stable with Hydroplus GPS software. Allow Allow the field parameter readings to stabilize for 5-7 seconds before recording values.
    5. Record the temperature measured from each depth location.

    6. Evaluate the recorded data for evidence of stratification (specifically temperature).

A temperature change of greater than 1° C per meter indicates that there is a thermocline and that the location is stratified. A thermocline is defined as "a layer of water between the warmer, surface zone (epilimnion) and the colder, deep water zone (hypolimnion)". The thermocline will exhibit a more rapid decrease in temperature with depth when compared to the epilimnion and hypolimnion

Note: temperature changes with depth will also be observed in the epilimnion and hypolimnion, but not as rapid as in the thermocline. Thermal stratification may not be present at all sampling locations.

7. If a thermocline is present, bound the upper and lower reaches of the epilimnion and hypolimnion (in depth below the surface) for reference during sample collection, as described below.

- A peristaltic pump sampler or Kemmerer depth sampler (or approved other sampler) will be used to obtain samples. Pump tubing will be replaced upon completion of sampling at each site and prior to sampling at subsequent locations.

- Along each transect, samples will be collected vertically through the water column at thalweg, right bank, and left bank stations. "Left bank" and "right bank" will be determined with a downstream-facing orientation.

- Sampling at each site will be conducted as follows:

  If thermally stratified, four samples will be collected at each of three transect stations (thalweg, left bank, and right bank) at various depths: epibenthic (near bottom) sample 0.5 meters above the streambed, mid-hypolimnion sample midway between bottom of thermocline and streambed, mid-epilimnion sample midway between top of the thermocline and water surface, and near-surface sample collected at 0.5 meter depth. This sampling approach will yield a maximum of 12 total samples per transect, assuming stratification is homogenous throughout the transect.

  If not thermally stratified, collect surface, mid-depth, and epibenthic samples. This sampling approach will yield nine total samples per transect.

  For waterbodies that may not have adequate depth to collect multiple samples from the water column, the field sampling team may adjust the number of samples to accommodate. Similarly, if the width of the waterbody along a sampling transect is not sufficient to support the collection of multiple samples along the transect, the field sampling team may adjust the procedure accordingly. These determinations will be documented in the field logbook.

Specific sample collection procedures are included in EMA-TI-05.80.40 Surface Water Sampling. Samples will be collected for both total and dissolved inorganic analysis. The field team will filter dissolved fractions immediately following sample collection using a new, certified clean high-capacity inline 0.45-micron filter and following the quality assurance procedures for filter blanks. Each filter will be treated as single-use and will be replaced before collection at each sample location (Table 1).

- When filling sample bottles, care will be taken to minimize sample aeration (i.e., water will be directed down the inner walls of the sample bottle) and avoid overfilling and diluting preservatives. Each sample bottle will be capped before filling the next bottle.
- The sampling team will take care not to contaminate the samples. Nitrile gloves will be worn when collecting samples. A new pair of gloves will be used at each sample location.

5.2.5 Preservation and Handling

Samples will be collected in a transfer bottle that will then be poured into laboratory-provided sample containers.

Sample containers will be labeled in accordance with TVA TI ENV-05.80.02, *Sample Labeling and Custody*. Once each sample container is filled, the rim and threads will be cleaned by wiping with a clean paper towel and capped, and a signed and dated custody seal will be applied. Each sample container will be checked to ensure that it is sealed, labeled legibly, and externally clean. Sample containers will be packaged in a manner to prevent breakage during shipment.

Coolers will be prepared for shipment in accordance with TVA TI ENV-05.80.06, *Handling and Shipping of Samples* by taping the cooler drain shut and lining the bottom of the cooler with packing material or bubble wrap. Sample containers will be placed in the cooler in an upright single layer. Small uniformly sized containers will be stacked in an upright configuration and packing material will be placed between layers. Plastic containers will be placed between glass containers when possible. A temperature blank will be placed inside each cooler to measure sample temperature upon arrival at the laboratory. Loose ice will be placed around and among the sample containers to ensure that the samples remain at less than 6 degrees Celsius (°C) during shipment. The cooler will be filled with additional packing material to ensure the containers are secure.

The original COC will be placed in a re-sealable plastic bag taped to the inside lid of the cooler. A copy of the COC form will be retained with the field notes in the project files. A unique cooler ID number will be written on the COC and the shipping label placed on the outside of the cooler. The total number of coolers required to ship the samples will be recorded on the COC. If multiple coolers are required to ship samples contained on a single COC, the original copy will be placed in cooler 1 of X with copies (marked as such) placed in the additional coolers.

Two signed/dated custody seals will be placed on alternate sides of the cooler lid. Packaging tape (i.e., strapping tape) will be wrapped around the cooler to secure the sample shipment.

Upon receipt of the samples, the analytical laboratory will open the cooler and will sign "received by laboratory" on each COC form. The laboratory will verify that the custody seals have not been previously broken and that the seal number corresponds with the number on the COC. The laboratory will note the condition and temperature of the samples upon receipt and will identify discrepancies between the contents of the cooler and COC form.

If there are discrepancies, the laboratory project manager will immediately call the Laboratory Coordinator and Field Team Leader to resolve the issue and note the resolution on the laboratory check-in sheet. The analytical laboratory will then forward the back copy of the COC to the QA Oversight Manager and Investigation Project Manager.

5.2.6 Sample Analyses

Surface stream samples will be submitted to the TVA-approved laboratory for analysis. Surface stream samples will be analyzed by a lab for concentrations of the CCR Parameters summarized in Tables 2, 3, and 4. Total Hardness shall be calculated based on sample analyses and constituent results.

Table 3. 40 CFR Part 257 Appendix III Constituents

Appendix III Constituents
Boron
Calcium
Chloride
Fluoride
pH
Sulfate
Total Dissolved Solids (TDS)
Total Suspended Solids (TSS)

Table 4. 40 CFR Part 257 Appendix IV Constituents

Appendix IV Constituents
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226 and 228 Combined

Table 5. TN Rule 0400-11-01-.04, Appendix 1 Inorganic Constituents

TDEC Appendix 1 Constituents*
Copper
Nickel
Silver
Vanadium
Zinc

*Constituents not listed in CCR Rule Appendices III and IV

Table 6. Additional Cations to be Analyzed

Cations
Magnesium
Manganese
Iron

Surface stream data collected during this investigation will be reported to TDEC in an Environmental Assessment Report (EAR). Analytical methods, preservatives, containers, and holding times are summarized in Table 7.

Table 7. Analytical Methods, Preservation, Container(s) and Holding Times

Parameter	Analytical Methods	Preservative(s)	Container(s)	Holding Times
Metals, dissolved	SW-846 6020A	HNO3 to pH < 2 Cool to <6°C	250-mL HDPE	180 days
Metals, total	SW-846 6020A	HNO3 to pH < 2 Cool to <6°C	250-mL HDPE	180 days
Mercury, dissolved	SW-846 7470A	HNO3 to pH < 2 Cool to <6°C	250-mL HDPE	28 days
Mercury, total	SW-846 7470A	HNO3 to pH < 2 Cool to <6°C	250-mL HDPE	28 days
Radium 226	SW-846 903.0	HNO3 to pH < 2 Cool to <6°C	1 L glass or Plastic	180 days
Radium 228	SW-846 904.0	HNO3 to pH < 2 Cool to <6°C	2 L glass or plastic	180 days
Chloride	SW-846 9056A	Cool to <6°C	250-mL HDPE	28 days
Fluoride	SW-846 9056A	Cool to <6°C	250-mL HDPE	28 days
Sulfate	SW-846 9056A	Cool to <6°C	125-mL HDPE	28 days
Total Dissolved Solids (TDS)	SM2540C	Cool to <6°C	250-mL HDPE	7 days
Total Suspended Solids (TSS)	SM2540C	Cool to <6°C	1 L HDPE	7 days

5.2.7 Equipment Decontamination Procedures

The following procedures will be used to maintain the overall objective of minimizing the potential for cross-contaminating samples and media during sampling activities. Sampling equipment will be cleaned before transport to the field. When appropriate or practical, disposable sampling equipment will be utilized in the field. However, non-dedicated and non-disposable equipment used for sampling is to be decontaminated prior to and after each use in accordance with TVA TI ENV-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*.

Equipment that comes into direct contact with surface stream samples for laboratory analyses will undergo decontamination between each use that will include the following steps:

- Wash with non-phosphate detergent (i.e., LiquiNox™) and DI water solution
- Rinse multiple times with analyte-free, DI water
- Air drying

During site data collection, decontamination of water quality meters will be performed upon arriving at each new sampling location, using metals grade nitric acid for cleaning. Single-use equipment will be placed in a clean trash bag or other separate container during transport to prevent cross-contamination. Equipment that is not fully decontaminated prior to leaving the Plant will be properly disposed or wrapped and stored to prevent contamination of other equipment until it can be properly decontaminated. Decontamination activities will be documented in the field book or on a field data sheet. Additional information regarding equipment decontamination procedures is located in the QAPP.

5.2.8 Waste Management

Investigation derived waste (IDW) generated during implementation of this Sampling and Analysis Plan may include, but will not be limited to:

- Personal Protective Equipment
- Decontamination fluids
- General trash

IDW will be handled in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination,* the Plant-specific waste management plan, and local, state, and federal regulations. Transportation and disposal of IDW will be coordinated with TVA Plant personnel.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

The QAPP describes quality assurance (QA)/quality control (QC) requirements for the overall Investigation. The following sections provide details regarding QA/QC requirements specific to surface stream sampling and analysis.

6.1 OBJECTIVES

The Data Quality Objectives (DQOs) process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA and the Investigation Project Manager considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts for the Investigation.

Specific quantitative acceptance criteria for analytical precision and accuracy for the matrices included in this investigation are presented in the QAPP.

6.2 QUALITY CONTROL CHECKS

Five types of field QA/QC samples will be collected during sampling activities: field duplicate samples, matrix spike/matrix spike duplicate (MS/MSD) samples, equipment blanks, field blanks, and filter blanks. QA/QC samples will be collected in accordance with TVA TI ENV-TI-05.80.04, *Field Sampling Quality Control*. Criteria for the number and type of QA/QC samples to be collected for each analytical parameter are specified below.

Field Duplicate Samples – One duplicate sample will be collected for every 20 samples or once per sampling event. Duplicates samples will be prepared as blind duplicates and will be collected in two sets of identical, laboratory-prepared sample bottles. The primary and duplicate samples will be labeled according to procedure in Section 6.2.1. Sample identifier information will not be used to identify the duplicated samples. Actual sample identifiers for duplicate samples will be noted in the field logbook. The duplicate sample will be analyzed for the same parameters as the primary sample.

MS/MSD Samples – A sufficient volume of sample will be collected for use as the MS/MSD. MS/MSD samples will be collected to allow matrix spike samples to be run to assess the effects of matrix on the accuracy and precision of the analyses. One MS/MSD sample will be analyzed for every 20 samples collected or once per sampling event. MS/MSD samples will be collected filling bottles alternately by thirds in accordance with TVA TI ENV-TI-05.80.04, *Field Sampling Quality Control* into three sets of identical, laboratory-prepared sample bottles. Additional sample volume intended for use as the MS/MSD must be identified in the comments field on the COC records and sample labels. The location of sample collection will be noted in the log book. The MS/MSD sample will be analyzed for the same analytes as the primary sample, with exception of parameters that are not amenable to MS/MSD. For parameters such as Total Suspended Solids and radium that are not amenable to the MS/MSD procedure, additional sample volume will be collected for laboratory duplicate analysis per the QAPP.

Equipment Blanks (Rinsate Blanks) – One equipment (rinsate) blank will be collected for each sampling event. The equipment blank will be collected at a sampling location by pouring laboratory-provided deionized water into or over the decontaminated sampling equipment, then into the appropriate sample containers. The time and location of collecting the equipment blank will be noted in the log book. The sample will be analyzed for the same analytes as the sample collected from the location where the equipment blank is prepared. If the tubing used to collect the filter blank is not certified clean tubing, then a tubing blank will be collected at a frequency of blank per lot.

Field Blanks – One field blank sample will be prepared per day using laboratory-supplied deionized water.

Filter Blanks – One filter blank will be collected during each day of the sampling activities when dissolved parameters are collected for analysis. The filter blank will be collected at a sampling location by passing laboratory-supplied deionized water through in-line filters used in the collection of dissolved metals, (or other analytes), then into the appropriate sample containers. The time and location of collecting the filter blank will be noted in the log book. The sample will be analyzed for the same analytes as the sample collected from the location where the filter blank is prepared. In addition, one filter blank will be collected per lot of filters used. The filter lot check is to be performed one per lot of filters used and scheduled in a manner to allow for laboratory to report data prior to investigative sample collection.

6.2.1 Sample Labels and Identification System

Sample IDs will be recorded on all sample container labels, custody records, and field sheets in accordance with TVA TIs ENV-TI-05.80.02, *Sample Labeling and Custody* and ENV-TI-05.80.03, *Field Record Keeping*. Each sample container will have a sample label affixed and secured with clear package tape as necessary to ensure the label is not removed. Information on sample labels will be recorded in waterproof, non-erasable ink. Specific information regarding sampling labeling and identification is included in the QAPP.

6.2.2 Chain-of-Custody

The possession and handling of individual samples must be traceable from the time of sample collection until the time the analytical laboratory reports the results of sample analyses to the appropriate parties. Field staff will be responsible for sample security and record keeping in the field.

The COC form documents the sample transfer from the field to the laboratory, identifies the contents of a shipment, provides requested analysis from the laboratory, and tracks custody transfers. Additional information regarding COC procedures is located in the QAPP.

6.3 DATA VALIDATION AND MANAGEMENT

As stated in the EIP, a QAPP has been developed such that environmental data are appropriately maintained and accessible to data end users. The field investigation will be performed in accordance with the QAPP. Laboratory analytical data will be subjected to data validation in accordance with the QAPP. The data validation levels and process will also be described in the QAPP.

7.0 SCHEDULE

Anticipated schedule activities and durations for the implementation of this SAP are summarized below. This schedule is preliminary and subject to change based on approval, field conditions, and weather conditions. For the overall EIP Implementation schedule, including anticipated dates, see the schedule provided in the EIP. The overall project schedule may be adjusted to reflect seasonal restrictions to when SAPs can be implemented for sampling of fish tissue (April through October), fish ovary (April through June) and benthic/mayfly (June through August). Approval of the final EIP will dictate the actual start and completion dates on the project timeline.

Table 8. Preliminary Schedule for Surface Stream SAP Activities

Project Schedule		
Task	**Duration**	**Notes**
Surface Stream SAP Submittal		Completed
Prepare for Field Activities	30 Days	Following EIP Approval
Conduct Field Activities	15 Days	Following Field Preparation
Laboratory Analysis	50 Days	Following Field Activities
Data Validation	30 Days	Following Lab Analysis

8.0 ASSUMPTIONS AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- Sampling methods and field locations may be adjusted based on actual field conditions. Any adjustments will be reported in the EAR.
- The anticipated schedule in Section 7.0 assumes that approval to proceed is provided such that sampling can be scheduled and conducted during the appropriate time of the year. If approval to proceed is received too late in the year, sampling will not proceed until the following year.

9.0 REFERENCES

Tennessee Valley Authority (TVA). 2013. "Surface Water Sampling." Technical Instruction EMA-TI-05.80.40, Revision 0000. January 1.

Tennessee Valley Authority (TVA). 2016. "Planning Sampling Events." Technical Instruction ENV-TI-05.80.01, Revision 0000 May 5.

Tennessee Valley Authority (TVA). 2017a. "Sample Labeling and Custody." Technical Instruction ENV-TI-05.80.02, Revision 0001 March 31.

Tennessee Valley Authority (TVA). 2017b. "Field Record Keeping." Technical Instruction ENV-TI-05.80.03, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017c. "Field Sampling Quality Control." Technical Instruction ENV-TI-05.80.04, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017d. "Field Sampling Equipment Cleaning and Decontamination." Technical Instruction ENV-TI-05.80.05, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017e. "Handling and Shipping of Samples." Technical Instruction ENV-TI-05.80.06, Revision 0000 March 31.

Tennessee Valley Authority (TVA). 2017f. "Field Measurement Using a Multi-Parameter Sonde." Technical Instruction ENV-TI-05.80.46, Revision 0000. March 31.

ATTACHMENT A
FIGURE

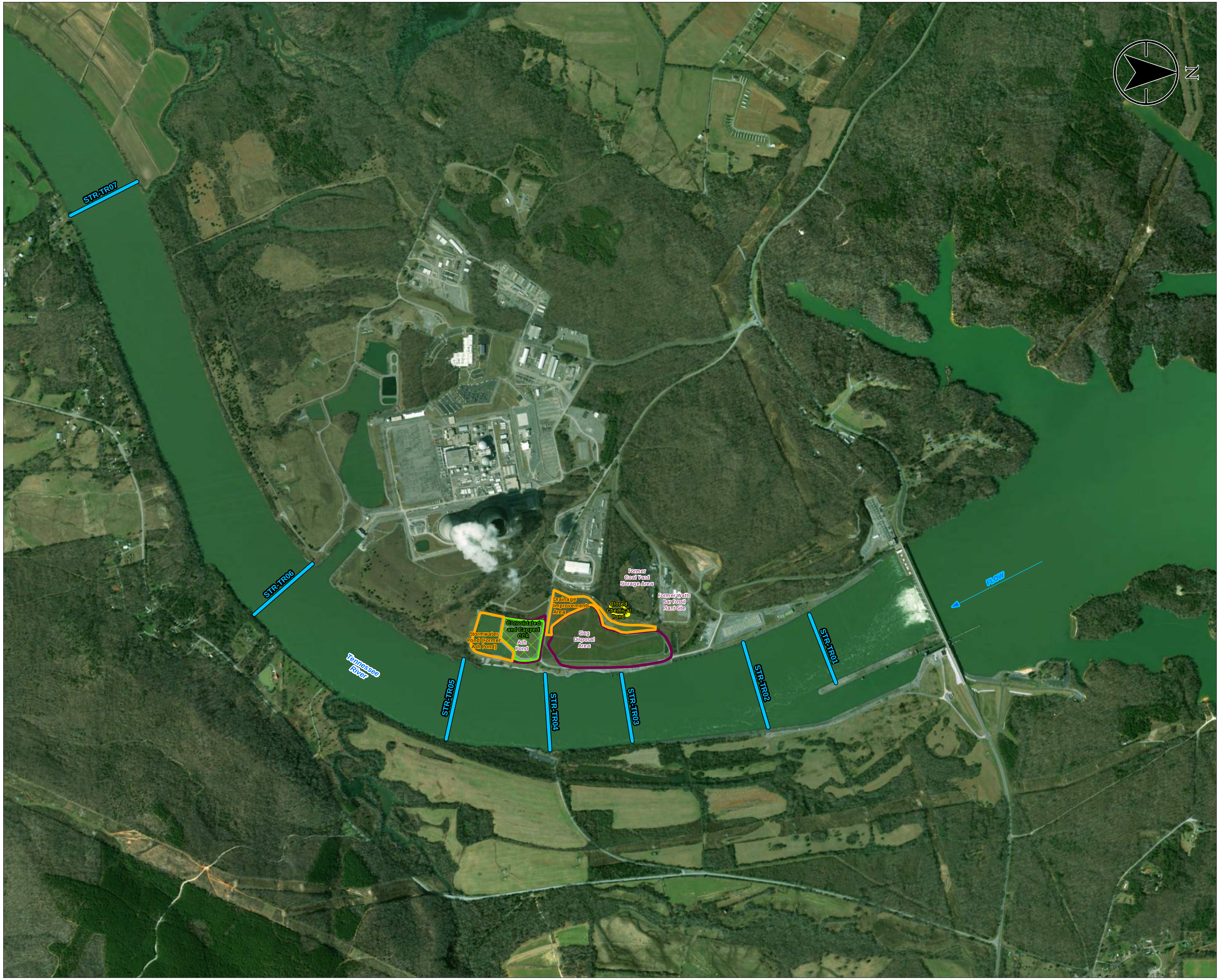

Figure No.
1

Title
Surface Stream Sampling

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2018-02-06
Technical Review by TG on 2018-02-06

0 700 1,400 2,100 2,800 Feet
1:8,400 (At original document size of 22x34)

Legend

▬	Stream Sample Transect
▢	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 ESRI Imagery

U:\TVA-EIP\175566336\gis\mxds\WBF_Surface_Stream.mxd Revised: 2018-02-06 By: mbough

ATTACHMENT B
FIELD ATTACHMENT LIST

Field Equipment List
Surface Stream Investigation

Item Description
***Health and Safety Equipment (e.g. PPE, PFD, first aid kit)**
***Field Supplies/Consumables (e.g. data forms, labels, nitrile gloves)**
***Decontamination Equipment (e.g. non-phosphate detergent)**
***Sampling/Shipping Equipment (e.g. cooler, ice, jars, forms)**
Field Equipment
GPS (sub-meter accuracy preferred)
Digital camera
Batteries
Waders, muck boots, knee boots, etc.
Peristaltic pump
Tubing
Hydrolab DS5X
Sonic depth meter
***These items are detailed in associated planning documents to avoid redundancy.**

APPENDIX U
FISH TISSUE SAP

Fish Tissue
Sampling and Analysis Plan
Watts Bar Fossil Plant

Revision 3

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

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

November 19, 2018

FISH TISSUE
SAMPLING AND ANALYSIS PLAN
WATTS BAR FOSSIL PLANT

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	February 9, 2018
2	Addresses May 16, 2018 TDEC Review Comments and Issued for TDEC Review	July 6, 2018
3	Addresses Applicable Programmatic Revisions and Issued for TDEC Approval	November 19, 2018

FISH TISSUE
SAMPLING AND ANALYSIS PLAN
WATTS BAR FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Fish Tissue
Sampling and Analysis Plan
Watts Bar Fossil Plant
Tennessee Valley Authority
Spring City, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: November 19, 2018 Revision 3

All parties executing work as part of this Sampling and Analysis Plan sign below acknowledging they have reviewed, understand, and will abide by the requirements set forth herein.

TVA Investigation Project Manager — Date 11/19/18

Tyler Baker
TVA Investigation Field Lead — Date 11-19-18

Health, Safety, and Environmental (HSE) Manager — Date 11-19-18

Investigation Project Manager — Date 2018-11-13

Rock J. Vitale Digitally signed by Rock J. Vitale
DN: cn=Rock J. Vitale, o, ou,
email=rvitale@envstd.com, c=US
Date: 2018.11.14 12:31:47 -05'00'
QA Oversight Manager — Date

Tod Noltemeyer Digitally signed by Tod Noltemeyer
DN: cn=Tod Noltemeyer, o, ou=Pace Analytical Services, Inc. - Green Bay,
email=tod.noltemeyer@pacelabs.com, c=US
Date: 2018.11.16 08:53:02 -06'00'
Laboratory Project Manager — Date

Charles L. Head
TDEC Senior Advisor — Date

Robert Wilkinson
TDEC CCR Technical Manager — Date

Stantec

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1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at Watts Bar Fossil Plant (WBF) on April 27, 2016, at which time TVA briefed TDEC on its Coal Combustion Residual (CCR) management plans at WBF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference. On June 14, 2016, TDEC issued a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 22, 2017, TDEC issued a second follow-up letter to TVA regarding the TDEC Order and EIP submittal dates. On November 15, 2016, TVA submitted WBF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

In response to TDEC's comments, this Fish Tissue Sampling and Analysis Plan (SAP) has been developed to evaluate whether fish in the immediate vicinity and downstream of WBF have higher concentrations of CCR-related constituents than fish from reference locations not adjacent to or downstream from the WBF Plant (Plant).

2.0 OBJECTIVES

The objective of this Fish Tissue SAP is to set forth the procedures to be followed to capture fish, remove tissue samples, and store and ship samples to a laboratory. Laboratory-generated results from the samples will be used to assess whether fish in the immediate vicinity and downstream of the Plant have higher tissue concentrations of CCR-related constituents than the same species of fish from reference locations not adjacent to or downstream of the Plant.

The fish tissue analytical results will be used in conjunction with sediment and mayfly data to evaluate contaminant bioaccumulation. Methods for collecting and analyzing sediment and mayfly tissues are described in other SAPs. This Fish Tissue SAP:

- Provides guidance on the use of boat-mounted electro-shocker and/or gill nets to capture target fish species
- Describes protocols for obtaining and processing fish tissue samples, and completing quality control activities, to ensure that data quality objectives are achieved
- Documents the analytical method/parameter list for sample analysis to be performed by TVA’s contracted laboratory
- Describes the data validation and management activities that will be performed on the fish tissue samples and resulting data

3.0 HEALTH AND SAFETY

This work will be conducted under an approved Plant-specific Health and Safety Plan (HASP). This HASP will be in accordance with TVA Safety policies and procedures. Each worker will be responsible for reviewing and following the HASP. Personnel conducting field activities will have completed required training, understand safety procedures, and be qualified to conduct the field work described in this SAP. The HASP will include a job safety analysis (JSA) for each task described in this SAP and provide control methods to protect personnel. Personal protective equipment (PPE) requirements and safety, security, health, and environmental procedures are defined in the HASP. In addition, authorized field personnel will attend TVA required safety training and Plant orientation.

The Field Team Leader will conduct safety briefings each day prior to beginning work and at mid-shift or after lunch breaks and document these meetings to include the names of those in attendance and items discussed. TVA-specific protocols will be followed, including the completion of 2-Minute Rule cards. The JSAs will be updated if conditions change.

4.0 SAMPLING LOCATIONS

Three reaches have been selected for the collection of fish and associated fish tissue as shown in Figure 1 (Attachment A) and Table 1. These three reaches are strategically located based on access, current hydrogeologic knowledge, and the greatest expectation of successfully capturing target fish species. The sites are located on the Tennessee River. The sampling reach TRA is located adjacent to WBF and is approximately two miles long. The downstream most sample site, TRD, is located approximately 2 miles downstream from the TRA sampling reach and is approximately 2 miles in length. The upstream site, TRU, is located approximately 2.5 miles upstream of the TRA sampling reach and is approximately 2 miles in length; it will act as a reference site. The sampling site locations may be modified based on conditions in the field at the time of the sampling activities. Table 1 lists each of the approximate fish collection locations proposed for the fish tissue sampling. Proposed sampling locations are shown on Figure 1.

The fish tissue sample locations coincide with sample locations for surface water, mayfly, benthic, and sediment sampling at the Plant. The corresponding sample locations are outlined in Table 2.

Table 1. Fish Collection Sampling Reaches Used for the Fish Tissue Sampling at WBF, Spring City, Tennessee.

Sampling Reach Name	Drainage	Approximate River/Creek Mile	Latitude	Longitude
TRD	Tennessee River	525.5 – 523.6	35.5718	-84.81000
			35.5503	-84.7964
TRA	Tennessee River	529.4 - 527.5	35.6151	-84.7789
			35.5910	-84.7903
TRU	Tennessee River	534.0 – 531.9	35.6775	-84.7817
			35.6478	-84.7775

Table 2. Corresponding Sample Locations at WBF, Spring City, Tennessee

Surface Stream Sample Location	Corresponding Sediment Sample Location	Corresponding Benthic Sampling Location	Corresponding Mayfly Sampling Location	Corresponding Fish Tissue Sampling Location
NA	NA	MAC-TR01	TRU	TRU
NA	NA	MAC-TR02	NA	NA
STR-TR01	SED-TR01	NA	NA	NA
STR-TR02	SED-TR02	MAC-TR03	TRA	TRA
STR-TR03	SED-TR03	MAC-TR04		
STR-TR04	SED-TR04	NA		
STR-TR05	SED-TR05	MAC-TR05		
STR-TR06	SED-TR06	MAC-TR06		
STR-TR07	SED-TR07	MAC-TR07	NA	NA
NA	NA	NA	TRD	TRD

NA – Not Applicable

5.0 SAMPLE COLLECTION AND FIELD ACTIVITY PROCEDURES

This section provides details of procedures that will be used to collect fish tissue samples and document field activities.

Fish tissue sample collection will be consistent with applicable TVA Technical Instruction (TI) and Standard Operating Procedure (SOP) documents. Quality Assurance/Quality Control (QA/QC) procedures and data quality objectives are included in Section 6.0 and the Plant-specific Quality Assurance Project Plan (QAPP). Related TVA methods used for sampling and/or any deviations from standard techniques listed in this SAP, the SOPs, or TI's will be documented in the field logbook. A project field logbook and field forms will be maintained by the Field Team Leader to record field data and observations including water quality data, electro-shocking and gill netting efforts, number and species of fish captured, and specific data for fish processed for laboratory testing. Field activities will be documented in accordance with Section 5.2.3.

5.1 PREPARATION FOR FIELD ACTIVITIES

As part of field mobilization activities, the field sampling team will:

- Designate a Safety Officer
- Complete required health and safety paperwork and confirm field team members have completed required training
- Coordinate activities with the Laboratory Coordinator, including ordering sample bottles, obtaining re-sealable sample bags, coolers, and high-purity deionized (DI) water, if needed, and notifying the Laboratory Coordinator of sampling and sample arrival dates
- Coordinate activities with Tennessee Wildlife Resources Agency (TWRA) as required by the Scientific Collection Permit
- Obtain the required field instruments and perform calibrations each day of sampling
- Obtain field equipment
- Discuss project objectives and potential hazards with project personnel
- Complete sample paperwork to the extent possible prior to deploying into the field, including chain-of-custody forms and sample labels

- Locate Sampling Reaches – Prior to starting sampling efforts each day, locate the sampling reaches using the Global Positioning System (GPS) and collect new coordinates if sampling reaches are modified due to field conditions

- Complete a field reconnaissance of proposed sampling locations to identify access locations

- Monitor weather, water levels, and water temperatures for safe and appropriate field sampling conditions and fish breeding seasons

5.2 SAMPLING METHODS AND PROTOCOL

Fish collection and associated fish tissue sampling will be completed following TVA TI's/SOPs to the extent practicable. Methods used for sampling and any deviations from the TVA TI's/SOPs will be documented in the field logbook. The TVA TI's/SOPs to be used during fish tissue sampling include but are not limited to the following:

- ENV-TI-05.80.02, *Sample Labeling and Custody*

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

- ENV-TI-05.80.04, *Field Sampling Quality Control*

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

- ENV-TI-05.80.06, *Handling and Shipping of Samples*

- KIF-SOP-31, *Fish Sampling with Gill Nets*

- KIF-SOP-33, *Fish Sampling Using Boat-Mounted Electroshocker*

The following sections describe fish collection and tissue sampling procedures.

5.2.1 Fish Collection

The fish sampling team will consist of personnel with expertise in fish sampling techniques and experience with the quality control requirements of the sampling protocols listed in Section 6.0. Prior to conducting fish sampling for tissue collection, appropriate Scientific Collection Permits will be obtained from TWRA. In addition, the survey will be coordinated with TWRA's Regional Office in accordance with TWRA's Scientific Collection Permits. Fish sampling will be completed on sampling reaches discussed in Section 4.0. Fish sampling will be conducted using a combination of boat-mounted electro-shocking (electro-fishing) and gill netting. The primary collection method will be electro-shocking; however, in the event that any species proves difficult to collect, gill nets will be used.

Electro-fishing will be performed beginning at the upstream end of each sampling reach and moving with the current to the downstream end of each sampling reach. As fish are shocked and begin to surface, Field Sampling Personnel will use dip nets to retrieve individuals with priority given to females of the target species.

In the event that some fish species (e.g. channel catfish) prove difficult to collect with boat electro-shocking equipment, gill nets will be used. Gill nets consist of a length of netting with a diameter large enough for a fish to pass partially through. There is a float line on top, and a lead line on the bottom, allowing the net to remain suspended in the water column. Gill nets will be set before dusk and retrieved just after sunrise the following morning. Fish visually observed to be decomposing will not be collected for sample analysis.

The fish captured will be observed for abnormalities, such as scoliosis, blind eye, parasites, fungus, or lesions. Fish collected for tissue samples will be weighed and measured. Collected fish will be stored in separate live wells or coolers of wet ice for each sampling reach until the sampling is completed each day.

In order to collect female fish with mature ovaries for tissue sampling, fish of each species will be collected during their respective spawning seasons which may necessitate multiple sampling events. Typically, these events will occur between April and June, corresponding with the spawning of each species targeted. Up to five electro-shocking passes and up to three gill net sampling events of a stream sampling reach will be performed during each sampling event, if necessary, to collect the appropriate number of fish of the desired size and fecundity for analysis.

Fish sampling techniques used and QA/QC procedures will follow TVA KIF-SOP-33, *Fish Sampling Using Boat-Mounted Electroshocker* and KIF-SOP-31, *Fish Sampling with Gill Nets*, to the extent practicable. The methods used for sampling, or the deviations made from them, will be documented in the field logbook.

5.2.2 Field Equipment Description, Testing/Inspection, Calibration, and Maintenance

A list of anticipated equipment for the field activities described herein is provided as Attachment B. A final list of equipment will be prepared by the Field Team Leader, and approved by TVA, prior to mobilization. Field equipment will be inspected, tested, and calibrated (as applicable) prior to initiation of fieldwork by Field Sampling Personnel and, if necessary, repairs will be made prior to equipment use. If equipment is not in the proper working condition, that piece of equipment will be repaired or taken out of service and replaced prior to use. Additional information regarding field equipment inspection and testing is included in the QAPP.

5.2.3 Field Documentation

Field documentation will be maintained in accordance with TVA TI ENV-05.80.03, *Field Record Keeping* and the QAPP. Field documentation associated with investigation activities will primarily be recorded in Plant-specific field forms, logbooks and/or on digital media (e.g., geographic information system (GIS)/GPS documentation). Additional information regarding field documentation is provided below and included in the QAPP and TVAs TIs.

5.2.3.1 Daily Field Activities

Field observations and measurements will be recorded and maintained daily to chronologically document field activities, including sample collection and management. Field observations and measurements will be recorded in bound, waterproof, sequentially paginated field logbooks and/or on digital media and field forms.

Deviations from applicable work plans will be documented in the field logbook during sampling and data collection operations. The TVA Technical Lead and the QA Oversight Manager or designee will approve deviations before they occur.

5.2.3.2 Field Forms

Plant-specific field forms will be used to record field measurements and observations for specific tasks.

5.2.3.3 Chain-of-Custody Forms

For the environmental samples to be collected, chain-of-custody (COC) forms, shipping documents, and sample logs will be prepared and retained. Field Quality Control samples will be documented in both the field notes (logbooks and field forms) and on sample COC records. COC forms will be reviewed daily by the Field Team Leader and Field Oversight Coordinator for completeness and a quality control (QC) check of samples in each cooler compared to sample IDs on the corresponding COC form. Additional information regarding COC forms is included in Section 6.2.2 of this SAP, the QAPP, and TVA TIs.

5.2.3.4 Photographs

In addition to documentation of field activities as previously described, photographs of field activities will also be used to document the field investigation. A photo log will be developed, and each photo in the log will include the location, date taken, and a brief description of the photo content, including direction facing for orientation purposes.

5.2.4 Collection of Samples

For purposes of tissue sampling, fish will be categorized into five distinct groups, representing specific trophic levels within the aquatic ecosystem. Each trophic level group will be represented by one specific species. The representative species for this SAP are consistent with TVA study protocols:

- Top Carnivores – largemouth bass (*Micropterus salmoides*)
- Invertivores – bluegill (*Lepomis macrochirus*)
- Bottom Feeding Invertivore – redear sunfish (*Lepomis microlophus*)
- Bottom Feeding Omnivore – channel catfish (*Ictalurus punctatus*)
- Planktivore (Forage Fish) –shad (*Dorosoma spp.*)

Except for shad, a minimum of six to eight individuals of each species will be collected from each sampling reach to obtain sufficient sample weight for analysis and to measure variability within the sampling reach. The six to eight individuals of each species will be processed into fillet, ovary, or liver tissues (as described below) and combined to form composite tissue samples for each species from each sampling reach. Whole fish composite samples of 10 – 20 shad will be obtained from each sampling reach and combined to form a composite sample from each reach. Female fish are preferred over males, so male fish will only be retained in the event that six to eight females of each species can't be captured in a sampling reach. Composite samples of six to eight individual fish of the same species are consistent with United States Environmental Protection Agency (EPA) guidance on fish tissue monitoring (EPA 2000) and recommendations for fish collection to compare to the fish tissue-based water quality standard for selenium (EPA 2016).

Whole fish will be transported from the field on wet ice to the TVA Chickamauga Power Service Center (PSC) in Chattanooga, Tennessee for processing. Alternatively, if a contractor completes the fish tissue sampling, fish tissues will be processed onsite, with TVA's permission. Fish tissue will be resected within 48 hours of sample collection and frozen. Fish tissue samples will be shipped overnight on dry ice to the analytical laboratory.

For the composite fish samples (all species except shad), the following tissue samples will be collected from each species and combined into four separate resealable bags from each sampling reach as follows:

- Fillets from the right sides of the fish
- Fillets from the left sides of the fish
- Ovaries from the right sides of female fish

- Ovaries from the left sides of female fish
- Livers

One set of fillets and ovaries (left or right side) from each species from each sampling reach will be submitted to the analytical laboratory and composited for analysis. The remaining tissues from each individual fish will be stored individually in resealable bags and frozen to -20°C at TVA's Chickamauga PSC for potential future analysis, as needed.

In the event that insufficient fillet or ovary tissue is obtained from one set of fillets or ovaries (left or right side), the additional set (opposite side) of fillet or ovary tissue will be added to the sample for compositing by the analytical laboratory. Any remaining composite tissue will be and held at the analytical laboratory for potential future analysis, as needed.

Due to smaller weight, fish livers tissue from each species from each sampling reach will be sent to the analytical laboratory for compositing and analysis. Any remaining composite liver tissue will be frozen and held at the analytical laboratory for potential future analysis, as needed.

In the event that any homogenized composite tissue (fillet, liver, or ovary) sample yields unexpected results, the frozen and stored fish tissue samples may be used to validate or contradict previous laboratory analysis. Long-term storage, up to one year if stored at or less than -20°C, and laboratory preparation of stored ovaries will follow protocol established by EPA (2016).

One co-located sample will be collected from each sampling reach and will consist of additional composite fillets, ovaries, and liver tissues of one of the target species, preferably different target species at each stream sampling reach, and submitted to the analytical laboratory for analysis. Duplicate samples are discussed in Section 6.2.

The fish used in a composite sample must meet the following criteria:

- Be of the same species
- Meet legal requirements of harvestable size or weight
- Consistent with EPA guidance (EPA 2000 and 2016), the fish will be of similar size so that the smallest individual in a composite is no less than 75% of the total length of the largest individual
- Individuals of the same species will be collected as close to the same time as possible. This assumes that a sampling team was unable to collect all fish needed to prepare the composite sample on the same day. If fish used in the same composite are collected on different days (no more than one week apart) individual fish will be kept on ice until all the fish to be included in the composite are available for delivery to the laboratory

- Six to eight individuals per composite (or 10-20 individuals for shad) are proposed for collection. However, individuals must be collected in sufficient numbers and of adequate size so that collectively, they will provide at least eight grams of material per sample (i.e. eight grams of fillet, eight grams of liver, and eight grams of ovaries) to allow analysis of the CCR Parameters

All fish collection, tissue sampling, processing, and shipment activities will be recorded in the field logbook and on field forms as specified by TVA-ENV-TI-05.80.02, *Sample Labeling and Custody*, and TVA-ENV-TI-05.80.03, *Field Record Keeping*.

5.2.5 Preservation and Handling

Once each composite fish tissue sample container is filled, a water proof sample label will be placed inside, the container will be sealed, the outside will be cleaned by wiping with a clean paper towel, a sample label will be attached to the outside of the container, and a signed and dated custody seal will be applied. Each sample container will be checked to ensure that it is sealed, labeled legibly, and externally clean. Sample containers will be packaged in a manner to prevent breakage during shipment.

Coolers will be prepared for shipment in accordance with TVA TI ENV-05.80.06, *Handling and Shipping of Samples by taping* the cooler drain shut and lining the bottom of the cooler with packing material or bubble wrap. Sample containers will be placed in the cooler in an upright position. Small uniformly sized containers will be stacked in an upright configuration and packing material will be placed between layers. Plastic containers will be placed between glass containers when possible.

Wet ice will be placed around and among the sample containers in the cooler during transportation to the processing laboratory. Dry ice will be placed among the sample containers in the cooler during shipment to the analytical laboratory. The cooler will be filled with additional packing material to secure the containers.

The original COC form will be placed in a re-sealable plastic bag taped to the inside lid of the cooler. A copy of the COC form will be retained with the field notes in the project files. A unique cooler ID number will be written on the COC form and the shipping label placed on the outside of the cooler. The total number of coolers required to ship the samples will be recorded on the COC form. If multiple coolers are required to ship samples contained on a single COC form, then the original copy will be placed in cooler 1 of X with copies (marked as such) placed in the additional coolers. Two signed and dated custody seals will be placed on alternate sides of the cooler lid. Packaging tape (i.e., strapping tape) will be wrapped around the cooler to secure the sample shipment.

Upon receipt of the samples, the analytical laboratory will open the cooler and will sign "received by laboratory" on each COC form. The laboratory will verify that the custody seals have not been previously broken and that the seal number corresponds with the number on the COC form. The laboratory will note the condition and temperature of the samples upon receipt and will identify discrepancies between the contents of the cooler and COC form. If there are discrepancies the Laboratory Project Manager will immediately call the Laboratory Coordinator and Field Team Leader to resolve the issue and note the resolution on the laboratory check-in sheet. The analytical laboratory will then forward the back copy of the COC form to the QA Oversight Manager and Investigation Project Manager.

5.2.6 Sample Analyses

Composite fish tissue samples will be submitted for laboratory analysis of the following constituents, hereafter referred to as “CCR Parameters”:

- Boron and calcium from 40 CFR Part 257 Appendix III
- 40 CFR Part 257 Appendix IV Constituents, excluding radium and fluoride
- Five inorganic constituents from Appendix 1 of TN Rule 0400-11-.04
- Strontium
- Percent moisture

The constituents listed in Appendix 1 of TN Rule 0400-11-01-.04 (i.e., TDEC regulations) were added to the list of CCR constituents for analyses to maintain continuity with other TDEC environmental programs. The fish tissue analysis will not include dissolved oxygen, chloride, fluoride, pH, sulfate, or total dissolved solids which are on the federal CCR Appendices III and IV constituents lists, because the constituents are not analyzed in animal tissues. The individual constituents of the CCR Parameters to be analyzed for the fish tissue study are listed in Tables 2 through 4.

Once received and custody has been established, the analytical laboratory will homogenize composite tissue samples using a series of dicing and mechanical blending procedures. The samples will be composited and homogenized on a species and sampling reach specific basis, resulting in a separate homogenate composite fillet, ovary, and liver tissue sample for each species at each sampling reach. These homogenized tissue samples will be analyzed for percent moisture and CCR Parameters outlined in Tables 2 through 4 below. Table 5 provides the analytical laboratory methods, sample size, preservation requirements, container size and holding times for the analysis.

Table 3. 40 CFR Part 257 Appendix III Constituents[1]

Appendix III Constituents
Boron
Calcium

Notes [1] Total dissolved solids, chloride, fluoride, pH, and sulfate are included in 40 CFR Part 257 Appendix III Constituents; however, are not included in the CCR Parameters for fish tissue sampling.

Table 4. 40 CFR Part 257 Appendix IV Constituents[1, 2]

Appendix IV Constituents
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium

Notes [1] Radium 226 and 228 Combined are included in 40 CFR Part 257 Appendix IV Constituents; however, are not included in the CCR Parameters for fish tissue sampling.

[2] Analysis of fluoride is not applicable to fish tissue samples.

Table 5. TN Rule 0400-11-01-.04, Appendix 1 Inorganic Constituents

TDEC Appendix 1 Constituents[1, 2]
Copper
Nickel
Silver
Vanadium
Zinc

Notes [1] Strontium will be analyzed as part of the CCR Parameters; however, is not included in the Appendices III or IV or TDEC Appendix I constituents.

Table 6. Specifications for TVA Fish Tissue Sample Collection Analysis

Matrix	Parameters	Analytical Methods	Sample Size [1]	Preservation Requirements (chemical, temperature, light protected)	Containers (number, size, and type)	Maximum Holding Time (preparation/analysis)
Fish Tissue	Constituents in Tables 2 – 4 (except mercury)	SW-846 6020A	5 g	Stored and shipped at 6°C Frozen to < - 10°C at laboratory Archived samples: Frozen to < - 20°C	Re-sealable plastic bags or laboratory supplied bottles	One Year
	Mercury	SW-846 7473	1 g			
	Percent Moisture	ASTM D2974 - 87	2 g			

Notes: [1] Sample size is a minimum.

5.2.7 Equipment Decontamination Procedures

Decontamination will be performed for fish tissue sampling and processing equipment in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination* to prevent cross-contamination. Processing equipment and tools in contact with fish tissues will be decontaminated prior to use, between samples, and between sampling reaches. Nitrile gloves used during preparation of fish tissue sampling, and any swabs, or other decontamination brushes and wash pans used will be disposed of as general trash. All general trash, including fish remains, will be containerized and disposed of in accordance with Section 5.2.8. Decontamination activities will be documented in the field logbook. Additional information regarding equipment decontamination procedures and QA/QC is located in the QAPP.

5.2.8 Waste Management

Investigation derived waste (IDW) generated during implementation of this Sampling and Analysis Plan may include, but is not limited to:

- Fish remains
- Personal Protective Equipment
- Decontamination fluids
- General trash

IDW will be handled in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination,* the Plant-specific waste management plan, and local, state, and federal regulations. Transportation and disposal of IDW will be coordinated with TVA Plant personnel.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

The QAPP describes quality assurance (QA)/quality control (QC) requirements for the overall Investigation. The following sections provide details regarding QA/QC requirements specific to fish tissue sampling and analysis.

6.1 OBJECTIVES

The Data Quality Objectives (DQOs) process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA and the Investigation Project Manager considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts for the Investigation.

Specific quantitative acceptance criteria for analytical precision and accuracy for the matrices included in this investigation are presented in the QAPP.

6.2 QUALITY CONTROL CHECKS

Two types of field QA/QC samples will be collected when collecting fish tissue samples in accordance with TVA TI ENV-TI-05.80.04, *Field Sampling Quality Control*. Criteria for the number and type of QA/QC samples to be collected for each analytical parameter are specified below.

Field Duplicate Samples – One co-located sample will be collected from each sampling reach and will consist of additional fillet, ovaries, and liver tissues of one of the target species, preferably different target species at each stream sampling reach, and submitted to the analytical laboratory for analysis. These samples will be prepared as blind duplicates. The co-located sample will be analyzed for the same parameters as the primary sample.

Equipment Blanks (Rinsate Blanks) – One equipment (rinsate) blank will be collected during each day of the fish tissue processing activities. The equipment blank will be collected by pouring laboratory-provided DI water into or over the decontaminated tissue processing equipment, then into the appropriate sample containers. The time and location of collecting the equipment blank will be noted in the field logbook. The sample will be analyzed for the same analytes as the fish tissue samples.

Homogenization blank samples from the analytical laboratory processing equipment will be obtained by running ice through the fish tissue blending apparatus into laboratory grade sample containers for analysis.

6.2.1 Sample Labels and Identification System

Sample IDs will be recorded on all sample container labels, custody records, and field sheets in accordance with TVA TIs ENV-TI-05.80.02, *Sample Labeling and Custody* and ENV-TI-05.80.03, *Field Record Keeping*. Each sample container will have a sample label affixed and secured with clear package tape as necessary to ensure the label is not removed. Information on sample labels will be recorded in waterproof, non-erasable ink. Specific information regarding sampling labeling and identification is included in the QAPP.

6.2.2 Chain-of-Custody

The possession and handling of individual samples must be traceable from the time of sample collection until the time the analytical laboratory reports the results of sample analyses to the appropriate parties. Field staff will be responsible for sample security and record keeping in the field.

The COC form documents the sample transfer from the field to the laboratory, identifies the contents of a shipment, provides requested analysis from the laboratory, and tracks custody transfers. Additional information regarding COC procedures is located in the QAPP.

6.3 DATA VALIDATION AND MANAGEMENT

As stated in the EIP, a QAPP has been developed such that environmental data are appropriately maintained and accessible to data end users. The field investigation will be performed in accordance with the QAPP. Laboratory analytical data will be subjected to data validation in accordance with the QAPP. The data validation levels and process will also be described in the QAPP.

7.0 SCHEDULE

Anticipated schedule activities and durations for the implementation of this SAP are summarized below. This schedule is preliminary and subject to change based on approval, field conditions, and weather conditions. For the overall EIP Implementation schedule, including anticipated dates, see the schedule provided in the EIP. The overall project schedule may be adjusted to reflect seasonal restrictions to when SAPs can be implemented for sampling of fish tissue (April through October), fish ovary (April through June) and benthic/mayfly (June through August). Approval of the final EIP will dictate the actual start and completion dates on the project timeline.

Table 7. Preliminary Schedule for Fish Tissue SAP Activities

Project Schedule		
Task	**Duration**	**Notes**
Fish Tissue SAP Submittal		Completed
Prepare for Field Activities	20 Days	Following EIP Approval
Conduct Field Activities	40 Days	Following Field Preparation
Laboratory Analysis	45 Days	Following Field Activities
Data Validation	30 Days	Following Lab Analysis

8.0 ASSUMPTIONS AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- The number and/or location of the proposed samples described in this SAP may have to be modified based on conditions encountered in the field. Any deviations from this SAP will be included in the EAR.

- The fish sampling methods and analysis described in this SAP may have to be modified based on conditions encountered in the field, number of target specimen captured, presence of ovaries in female fish, and ability to obtain required sample weight of tissues. Any deviations from this SAP will be discussed in the EAR.

- The anticipated schedule in Section 7.0 assumes that approval to proceed is provided such that sampling can be scheduled and conducted during the appropriate time of the year. If approval to proceed is received too late in the year, sampling will not proceed until the following year.

9.0 REFERENCES

Tennessee Valley Authority (TVA). "Standard Operating Procedure for: Management of Investigation-Derived Waste." Standard Operating Procedure TVA-KIF-SOP-12.

Tennessee Valley Authority (TVA). 2010a. "Standard Operating Procedure for: Fish sampling with Gill Nets." Standard Operating Procedure TVA-KIF-SOP-31. August.

Tennessee Valley Authority (TVA). 2010b. "Standard Operating Procedure for: Fish Sampling Using Boat-mounted Electroshocker." Standard Operating Procedure TVA-KIF-SOP-33. June.

Tennessee Valley Authority (TVA). 2017a. "Sample Labeling and Custody." Technical Instruction ENV-TI-05.80.02, Revision 0001 March 31.

Tennessee Valley Authority (TVA). 2017b. "Field Record Keeping." Technical Instruction ENV-TI-05.80.03, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017c. "Field Sampling Quality Control." Technical Instruction ENV-TI-05.80.04, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017d. "Field Sampling Equipment Cleaning and Decontamination." Technical Instruction ENV-TI-05.80.05, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017e. "Handling and Shipping of Samples." Technical Instruction ENV-TI-05.80.06, Revision 0000 March 31.

United States Environmental Protection Agency (EPA). 2000. "Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 2, Risk Assessment and Fish Consumption Limits, Third Edition." EPA 823/B-00/007. November.

United States Environmental Protection Agency (EPA). 2004. "National Functional Guidelines for Inorganic Data Review." October.

United States Environmental Protection Agency (EPA). 2016. "Aquatic Life Ambient Water Quality Criterion for Selenium (Freshwater)." https://www.epa.gov/sites/production/files/2015-10/documents/draft-aquatic-life-ambient-water-quality-criterion-for-selenium-freshwater-2015-factsheet.pdf. June.

United States Environmental Protection Agency (EPA). 2016. "Technical Support for Fish Tissue Monitoring for Implementation of EPA's 2016 Selenium Criterion (Draft), EPA 820/F-16/007." September.

United States Environmental Protection Agency (EPA) Region 4. 2001 "Environmental Investigations Standard Operating Procedures and Quality Assurance Manual." November.

United States Environmental Protection Agency (EPA) Region 4. 2011. "Data Validation Standard Operating Procedures for Contract Laboratory Program Routine Analytical Services, Revision 2.0." September.

ATTACHMENT A
FIGURE

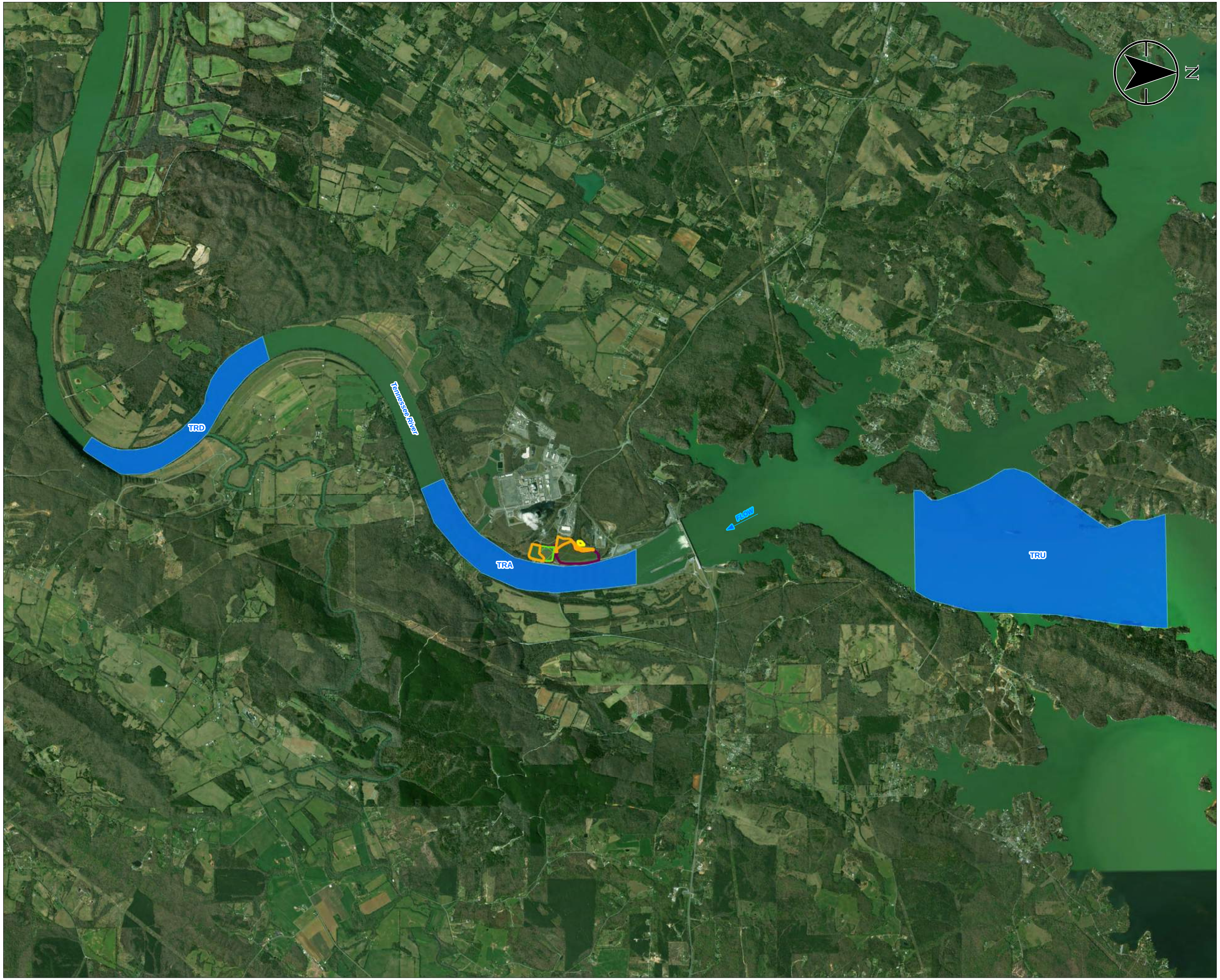

Figure No.
1

Title

Fish Sampling

Client/Project
Tennessee Valley Authority
Watts Bar Fossil Plant

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2018-02-06
Technical Review by TG on 2018-02-06

0 2,000 4,000 6,000 8,000
Feet
1:24,000 (At original document size of 22x34)

Legend

🟦	Fish Sample Location
▭	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 ESRI Imagery

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ATTACHMENT B
FIELD EQUIPMENT LIST

Field Equipment List
Fish Tissue Investigation

Item Description
***Health and Safety Equipment (e.g. PPE, PFD, first aid kit)**
***Field Supplies/Consumables (e.g. data forms, labels, nitrile gloves)**
***Decontamination Equipment (e.g. non-phosphate detergent)**
***Sampling/Shipping Equipment (e.g. cooler, ice, jars, forms)**
Field Equipment
GPS (sub-meter accuracy preferred)
Digital camera
Batteries
Boat and paddles
Depth finder
Anchor
Boat-mounted electro-shocker
Gasoline-powered generator
Control box (including isolation transformer)
“Dead-man” switch
Two outboard gas tanks
Positive and negative electrodes mounted on fiberglass poles
Gill nets (including spare nets)
Rope
Net hooks and net picks
Dragging hook for recovering lost nets
Marker floats (one per net)
Net anchors
Fiberglass fish club
Data logger
Galvanized net tubs
Live tank with water pump and aerator
Fillet knives
Fillet board
Knife sharpening equipment
900 mm measuring board
10 kg platform weighing scale
Scalers and spoons
Dip nets, long and short handled, insulated
Hand pails (approximately 13 liter)
5 gallon buckets
Waders, muck boots, knee boots, etc.
pH and conductivity meters
Thermometer
***These items are detailed in associated planning documents to avoid redundancy.**

APPENDIX V
PUBLIC COMMENTS